WILLIAMS CREEK WATERSHED

MASTER PLAN

Hamilton County, Indiana

Prepared for

Hamilton County Drainage Board
One Hamilton County Square
Noblesville, Indiana 46060

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EXECUTIVE SUMMARY

INTRODUCTION AND FOCUS OF THE STUDY

This report presents the results of the Christopher B. Burke Engineering, Ltd. (CBBEL) analysis of the Williams Creek Watershed. The Williams Creek Watershed upstream of the Hamilton/Marion County line encompasses about 16 square miles of drainage area in the southwest corner of Hamilton County. Portions of the City of Carmel and the City of Westfield are in the watershed.

The Williams Creek Watershed Master Plan was developed for long term use by the Cities and County for assistance with stormwater regulatory decisions, zoning decisions, and decisions relating to development in the watershed. Future development in the watershed should be reviewed with the Master Plan to ensure consistency and to properly evaluate potential impacts.

SUMMARY OF THE ISSUES

Meetings were held with residents of the watershed and with local agency officials to identify known stormwater (quantity and quality) concerns affecting the Williams Creek Watershed. Based on the results of the meetings, the extent of existing flooding problems in the watershed is limited to concerns about subdivision infrastructure issues, wet basements, flooding of a few roads, impacts from future development, and the impact of a private dam on flooding. Based on assessments completed as part of this study, there are also some existing water quality problems, and a few potential flooding issues for roads and buildings. Details regarding the analysis and findings are presented in the Master Plan report.

RECOMMENDATIONS

Based on the results of the detailed analysis of the watershed and the issues described above, the Master Plan components have been organized as study, regulatory, planning, education, or construction related recommendations and are noted below:

Study

1) Identify BMPs (structural and non-structural) for each site that had a low Qualitative Habitat Evaluation Index (QHEI) score (sites 4, 8, 9, & 10)

2) Confirm the condition of the macroinvertebrates at sites 4, 7, and 9

3) Conduct hydraulic studies to revise/identify floodplains on Spring Mill Run, Elliot Creek, Henley Creek, and Almond Ditch

4) Address the items from the Southwest Clay Township Annexation Master Drainage Plan, 2009 as details are made known and as jurisdiction will allow

5) Delineate the limits of the area inundated by the Base Flood Elevation (BFE) plus 2 feet flood elevations for use in regulatory functions

6) After about 10 more years of record at the Williams Creek stream gage or after a major rainfall event, revisit the hydrologic modeling to verify the model calibration or identify the existence of significant hydrologic changes in the watershed.

Regulatory/Incentives

1) Revise various City/County regulations to incorporate additional requirements or incentives such as:

    - Require wetland delineations by a qualified professional on any site prior to development
    - Establish a regulation prohibiting draining or diverting a water source from a delineated wetland
    - Require wetland mitigation at a higher ratio than the United States Army Corps of Engineers (USACE) and the Indiana Department of Environmental Management (IDEM)
    - Require additional monitoring and maintenance of wetland mitigation sites
    - Increase wetland buffer and setback requirements to filter pollutants
    - Update the Stormwater Management Ordinance and technical Standards to include removal requirements for nutrients, metals, and *E. coli*
    - Add a channel protection volume requirement to the Stormwater Management Ordinance and Technical Standards
    - Encourage the utilization of Low Impact Development (LID)/green approaches in meeting post-construction stormwater requirements including meeting channel protection volume regulations
    - Require developers of large areas of land, such as for subdivisions, to submit spatially referenced digital files of subbasins and flow directions and paths as part of final review process
    - For new construction, require lowest floor (including basement) to be 1 to 2 feet above the 1% annual chance flood elevation of nearby ponds that could impact a structure
    - Use the Master Plan floodplain delineation upstream of 131st Street for regulatory purposes
    - Require the proposed culvert replacements along 146th Street to include replacement of lost storage

2) Review development codes to determine how stormwater friendly they are

3) Integrate recommendations from the Central Indiana Green Infrastructure Plan into the Comprehensive Plans and development codes

4) Technically evaluate wetland mitigation plans for feasibility and probability of success

5) Make sure ordinances are enforced so that natural resources are protected and flood elevations are not increased by upstream land use changes

6) Consider adding non-regulated stream reaches to the regulated drain rolls so that a funding mechanism exists to maintain these reaches as well as Williams Creek itself

Maintenance

1) Establish/continue regular maintenance plan to keep the Williams Creek channel relatively free of debris. Conduct maintenance in a manner that minimizes disturbance and preserves the current vegetative corridor along the stream.

2) Until the culvert under Towne Road just south of 146th Street is replaced, locate the source of debris that blocks the culvert and develop plan for regular removal

3) Continue to maintain the USGS stream gage on Williams Creek at 96th Street

Education

1) Using County/City websites, post: Indiana Department of Natural Resources (IDNR) Construction in the Floodway jurisdictional limits, links and instructions to local sites for jurisdictional information, links and instructions to the Federal Emergency Management Agency (FEMA) Map Service Center web site for floodplain mapping and Flood Insurance Study (FIS) information, and brochures created to assist homeowners in addressing wet basement issues

2) Work with developers as they come in to discuss plans to: encourage inclusion of rain gardens, bioretention basins, increased flow paths, disconnected impervious areas, etc. in the green aesthetic requirements for the US 31 corridor, create site plans that avoid and minimize impacts to wetlands and streams, consider wetland mitigation only when impacts are unavoidable, and encourage pursuit of wetland mitigation in floodplains to increase flood protection

3) Use County/City websites and information dissemination avenues to encourage residents to: expand forested buffers along stream corridors (provide guidance so that it's done in a way that still allows the Surveyor's office access to the creek in some way if needed to remove debris), and, if home is near the BFE, pursue the benefits of flood insurance

4) Identify and create large scale wetland mitigation bank opportunities

5) Conduct a pond workshop to educate homeowner associations about the function, design, and good maintenance practices of stormwater ponds

Construction

1) Replace culverts at 106th Street west of Laurelwood Drive over Thomas Hussey Drain, 141st Street over Williams Creek, and Francis Court over Williams Creek with larger structures

2) Raise Spring Mill Road south of 106th Street, increase size of culverts under Spring Mill Road, raise private drive to act as a levee

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CHAPTER 1 INTRODUCTION

Williams Creek Watershed in Hamilton County Indiana has experienced tremendous growth over the recent past, and that growth is expected to continue. In an effort to render more effective opinions regarding environmental and flooding concerns due to urbanization, the Hamilton County Drainage Board, in partnership with the City of Carmel, retained Christopher B. Burke Engineering, Ltd. (CBBEL), to develop the Williams Creek Watershed Master Plan. This master plan can effectively assist these government entities by identifying and analyzing stormwater management concerns as this watershed continues to develop, and provide a recommended plan to manage those concerns so that new stormwater problems are not created and existing problems can be understood and addressed.

1.1 WATERSHED LOCATION

The Williams Creek Watershed upstream of the Hamilton/Marion County line encompasses about 16 square miles of drainage area in Hamilton County, the City of Carmel, and the City of Westfield. **Figure 1-1** highlights the location of the Williams Creek watershed.

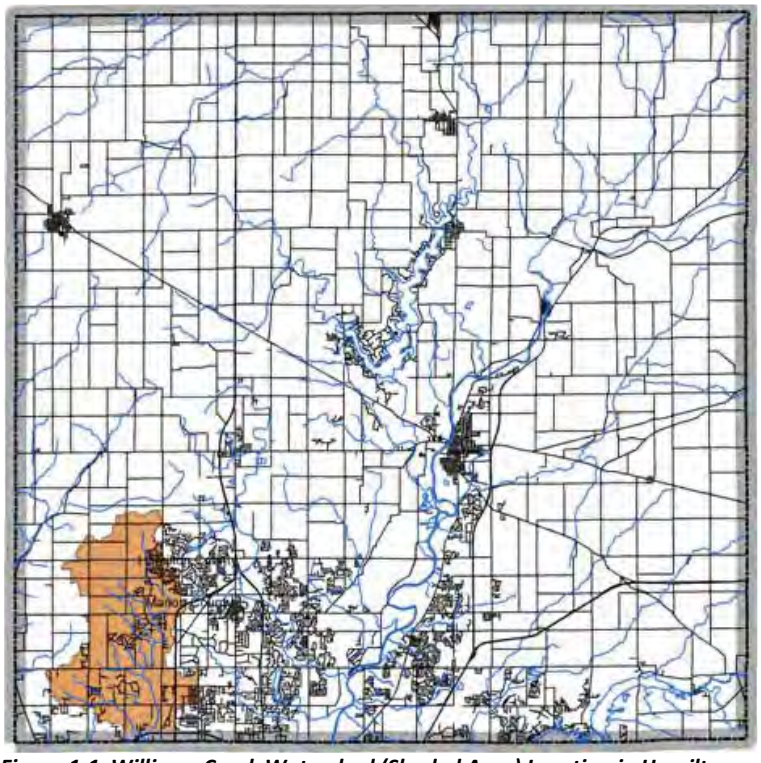


Figure 1-1 Williams Creek Watershed (Shaded Area) Location in Hamilton County

Williams Creek consists of both regulated drain and natural stream that wind through the eastern portion of the watershed. Several regulated and non-regulated tributary streams including Henley Creek, Almond Ditch, Elliot Creek, Ames Run, Will Creek, Clay Creek, Center Creek, Spring Mill Run, and Well Run drain into Williams Creek. Williams Creek drains into White River in Marion County, approximately five miles downstream of the Hamilton/Marion County line.

1.2 PURPOSE AND SCOPE

The primary purpose of this Master Plan is to identify and analyze stormwater management concerns as the watershed continues to develop and to provide a specific plan to manage stormwater. This Master Plan has been developed for long term use by the City and County for assistance with stormwater regulatory decisions, zoning decisions, and other decisions relating to development in the watershed as it affects the open drainage system. It is intended that this plan help guide proper stormwater management as development continues to occur within the watershed in order to preserve natural and beneficial functions of the natural drainage system and preserve and enhance stormwater quality.

The computer modeling of Williams Creek Watershed, developed as part of this Master Plan, can be revised in the future to understand the impacts of changes in the watershed that might arise other than those covered by this Master Plan. Proposed development/redevelopment in the watershed as defined in the Carmel, Westfield, and Hamilton County Stormwater Management ordinances and technical standards should be reviewed with the Master Plan to ensure consistency and to properly evaluate the potential impacts.

This Master Plan includes:

- Identification of existing conditions of the wetlands, floodplains, stream channels, runoff volumes, and water quality of the watershed,
- Identification of existing problems and potential future concerns associated with wetlands, floodplains, stream channels, runoff volumes, and water quality in the watershed,
- Evaluation of potential solutions to identified problems,
- Recommendation of a plan to address the problems,
- Implementation steps needed to carry out the recommendations

1.3 ORGANIZATION OF THIS DOCUMENT

This report is divided into several chapters with appendices of backup data. A brief summary of the contents of each chapter is presented below:

- **Chapter 1 : Introduction –** (this Chapter) – provides a brief background regarding the location of the watershed, purpose and scope of the Master Plan, and how it is organized.
- **Chapter 2 : Existing Conditions –** describes the current condition of the watershed and summarizes the extent and severity of surface water quantity and quality concerns based on information gathered from public input, local agency input, review of previous studies, data collection, and further analysis. This Chapter also includes an examination of impacts of land use and its changes over time, regulations, regulated drain projects or maintenance activities, and general activities in the watershed on wetlands, floodplains, stream channel morphology, and stormwater runoff quality and quantity.
- **Chapter 3 : Future Conditions –** describes the anticipated future land uses and regulations or projects. It also identifies the severity and extent of problems that could arise as a result.
- **Chapter 4 : Watershed Goals and Evaluation Criteria –** describes the goals for the watershed in terms of water quality improvement, flood reduction or prevention, etc. Also discusses the criteria used to evaluate potential solutions in order to meet the watershed goals.
- **Chapter 5 : Recommendations for Improvements and Addressing Concerns –** describes the alternatives investigated as solutions to the noted problems and provides information regarding each alternative's expected positive and negative results. A detailed explanation of findings is provided for those solutions that were promising. An explanation of the recommended alternative(s) is then provided. Estimated costs and potential funding sources are also discussed.
- **Chapter 6 : Implementation Plan –** provides a summary of conclusions of the study and a prioritized list of actions to be followed in order to implement the recommended plan components.
- **Chapter 7 : References –** lists information sources.

CHAPTER 2 EXISTING CONDITIONS

2.1 INTRODUCTION

Identifying effective solutions to stormwater problems depends on the thorough understanding of the existing stormwater conditions and concerns within the watershed. Due to the nature of a watershed, the resources, problems, concerns, and impacts of modifications occurring within a watershed are often times inter-related. Water that falls on the Williams Creek watershed absorbs into plants, evaporates, ponds and soaks into the ground, or runs off of roofs, roads, parking lots, driveways, and yards, and flows overland, down driveways and streets, through swales and storm pipes, to tributaries and then to Williams Creek and south into Marion County. The condition of all of the land within the watershed therefore affects the quality and quantity of the water that travels through the watershed.

Figure 2-1 Aerial View of Williams Creek Watershed

This chapter describes conditions in the Williams Creek Watershed as it exists today. Included are descriptions of the land use, wetlands, flood risk areas, channel morphology, and quality and quantity aspects of stormwater.

Regulations and existing studies and projects related to the water resources in the watershed are also described. This data has been gathered from available mapping, computer modeling for the watershed, water sampling and analysis, discussions of concerns with local officials and the public, and review of previous studies. The existing conditions in the watershed are described in the following sections:

2.2 Land Use
2.3 Wetlands
2.4 Stormwater Quality
2.5 Channel Morphology
2.6 General Flood Characteristics
2.7 Site Specific Flood Concerns
2.8 Regulations
2.9 Stormwater Related Projects
2.10 Summary of Concerns

2.2 LAND USE

Aerial photography from 1956 shows the vast majority of the area was farmland prior to development. Over the 50 plus years since then, population in the County has increased approximately 800%. As a result, almost the entire watershed is now developed. A conceptual development plan is under way for the last large open area located at the northern edge of the watershed. Once that area develops , only small pockets of undeveloped land will remain.

Aside from some commercial development along US 31, most of the watershed is estates or residential subdivisions. The estates are wooded and are located mainly in the southern part of the watershed. More than 50 subdivisions are located over the whole watershed. **Table 2-1** indicates the number of acres and the percentage of the land uses within the Williams Creek Watershed. The current land use map is provided in **Figure 2-2**.

Land Use	Acres	Percentage
Residential – Single Family	4,457.2	44%
Residential – Multi Family	40.7	< 1%
Commercial	466.6	5%
Agricultural	1,070.2	11%
Golf Course, Park	482.1	5%
Education	161.2	1%
Tax-Exempt (Non-Education)	142.0	1%
Vacant Land	2,993.2	30%
Right-of-Way	271.6	3%
Totals	**9,853**	**100%**

Table 2-1 General Land Use within the Williams Creek Watershed

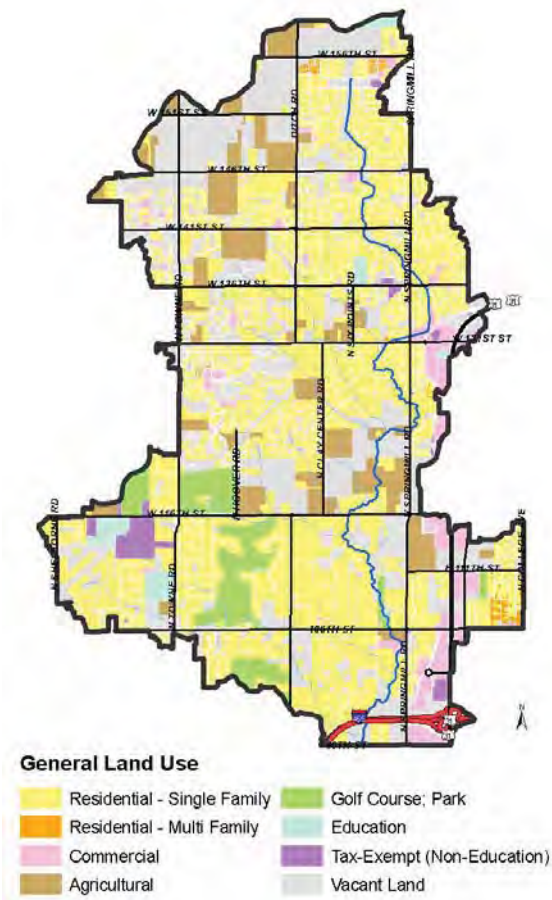


Figure 2-2 Current Land Use

Generally, as development and the amount of impervious surfaces within a watershed increase, water quality and general stream health is adversely impacted as increases in nutrient (phosphorus and nitrogen), sediment, bacteria, and pathogen-loading typically occur. Residential land use, the majority of land use in the Williams Creek Watershed, is typically a large source of pollutants such as wildlife and pet waste, lawn and yard clippings, fertilizers and pesticides, detergents, and debris which all cause water quality and stream habitat impacts.

Studies by the Center for Watershed Protection have shown how impervious surfaces (roof tops, driveways, streets, parking lots, etc.) reduce infiltration and increase both the volume and velocity of stormwater runoff. The study shows that when a watershed has less than 10% impervious surface, the negative impact to the stream is anticipated to be minimal. The percentage of impervious surface in the Williams Creek Watershed is approximately 17% so the impact is expected to be Moderate due to increased pollutant loads, toxic materials in the runoff, and elevated water temperatures. **Table 2-2**

summarizes some of the research completed by the Center for Watershed Protection.

Watershed Imperviousness	Stream Impact	Impact on Water Quality
0-10%	Minimal	Reduced macroinvertebrate diversity
10-15%	Low	Degraded habitat
15-25%	Moderate	Increased pollutant loads, toxic materials, and water temperatures
25-50%	High	Higher peak flows, impaired stream chemistry and biology
50%+	Severe	Severe changes in hydrology, hydraulics, morphology, and water quality; few natural habitat features remaining

Table 2-2 Impact of Imperviousness on Water Quality

2.3 WETLANDS

The Williams Creek Watershed is located in the Central Till Plain Natural Region of Indiana, a region that, in pre-settlement times, was dominated by poorly drained, hydric soils, flatwood forests, mesic forests, and seasonally wet depressions. The topography in this region is level to gently undulating and was heavily forested. Wetland communities predominated along river valleys.

The watershed is located in a rapidly developing area with only 10% - 25% of land use remaining cropland, pasture, or undeveloped floodplain. The natural hydrology of the entire county has been drastically altered by the construction of extensive tile systems and regulated ditches to quickly transport water away from agricultural fields. Further alteration has occurred as the area developed and brought extensive storm pipe systems and impervious surfaces.

With so few wetlands remaining, particularly in urban areas, it is important to recognize the type and quality of the existing wetland communities. Traditionally, wetland areas are classified based upon the Cowardin Classification System (see **Figure 2-3**).

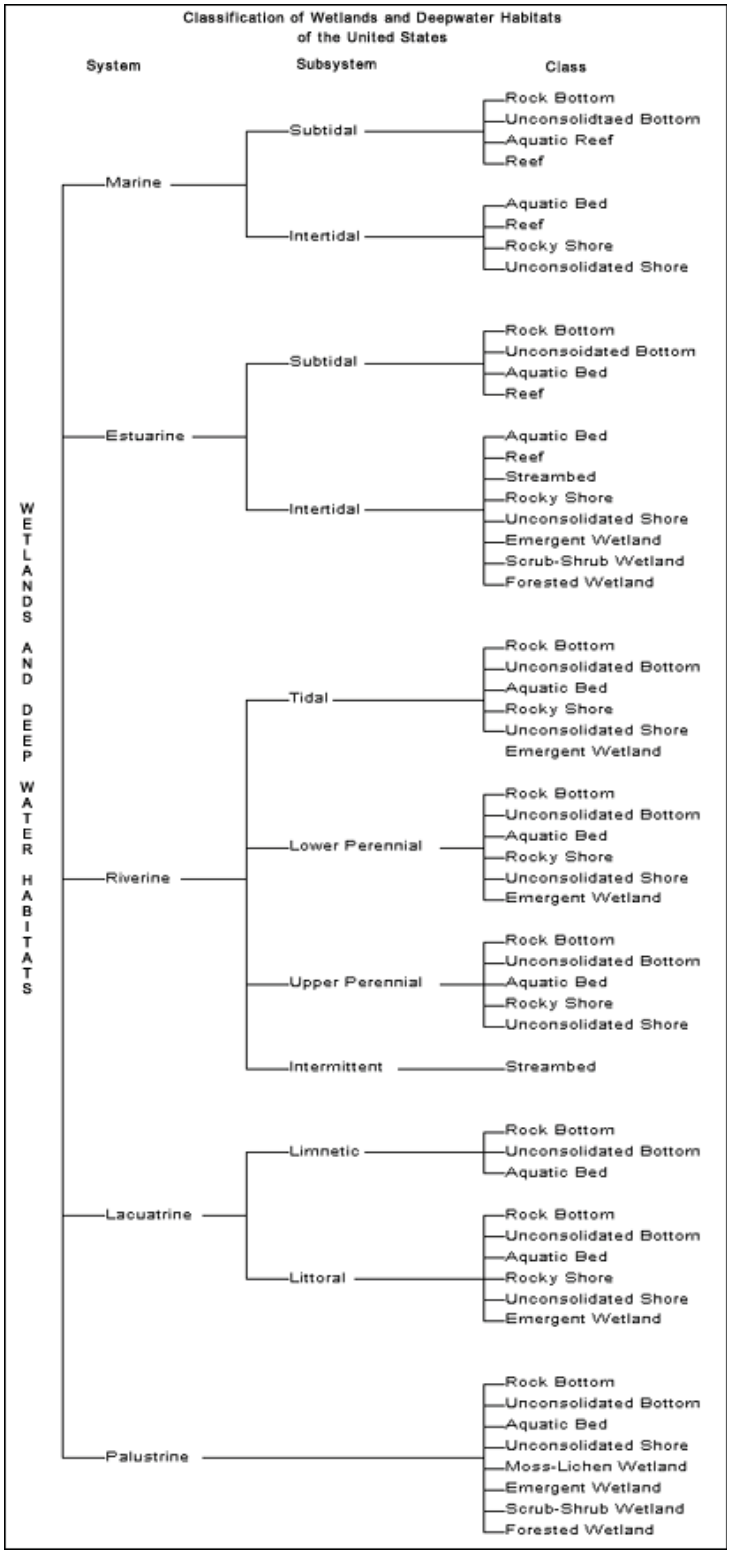


Figure 2-3 Cowardin Classification System

Several notable wetland areas within the Williams Creek Watershed were identified using 1992 National Wetland Inventory (NWI) data, 2007 aerial photography, soil maps, United States Geological Survey (USGS) topographic maps, and other available studies. No onsite wetland evaluations were conducted; however detailed field work would be beneficial to further determine the wetland community types and quality of the sites. Significant Wetland Sites are shown in **Figure 2-4**.

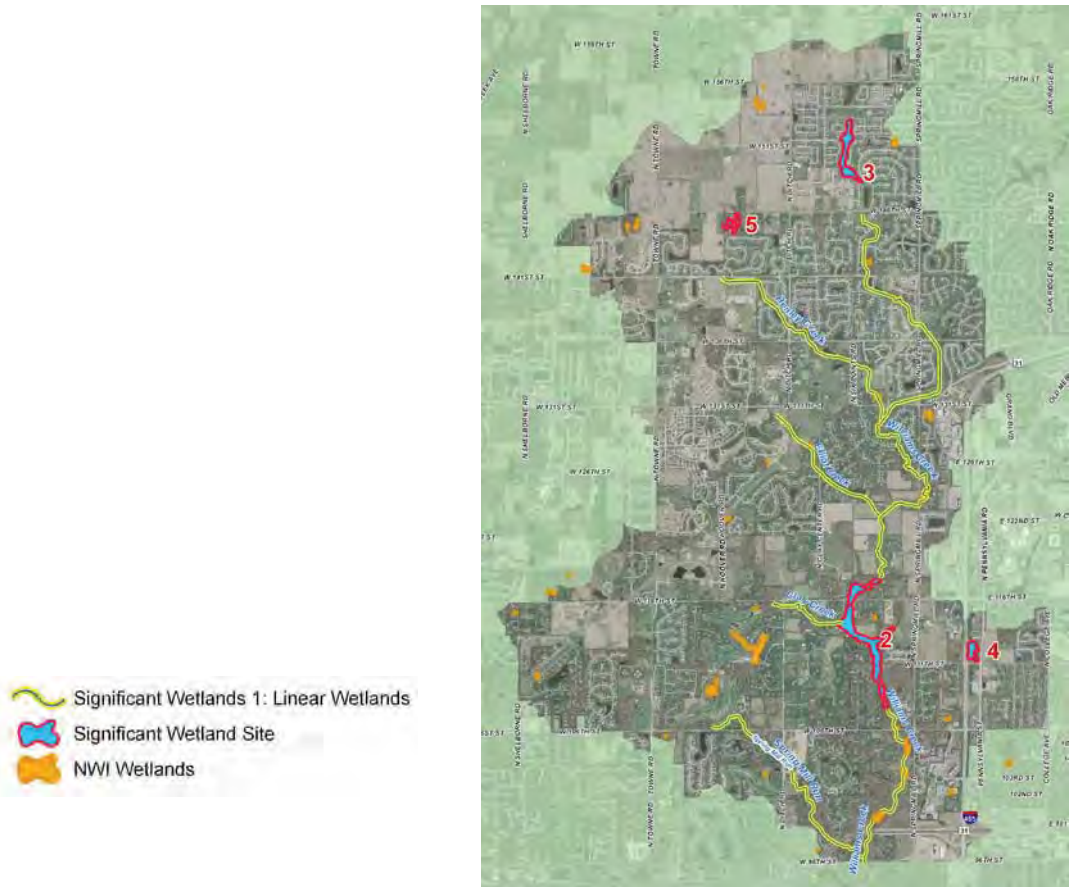


Figure 2-4 Significant Wetlands

Wetland Site 1: Multiple linear, forested wetlands were identified along Spring Mill Run, Williams Creek, Clay Creek, Elliot Creek, and Henley Creek. These wetlands are generally classified as Riverine, Lower Perennial, Unconsolidated Bottom, with Mud or Sand substrate (R2UB3(2)).

Wetland Site 2: A linear, Palustrine Forested (PFO) area was identified along Williams Creek between 106th Street and just north of 116th Street. This wetland encompasses both banks of the creek in this area and ranges from 150 feet to 400 feet wide. This wetland is dominated by Shoals Silt Loam (Sh), a partially hydric soil.

Wetland Site 3: A linear, Palustrine Forested Seasonally Flooded (PFOC) wetland is located along Williams Creek, between 146th Street and 151st Street. This wetland provides a buffer for the stream of approximately 50-feet on either bank, and is dominated by Sh soils.

Wetland Site 4: A PFOC is located northeast of the intersection of US 31 and 111th Street. This wetland is 5.5 acres in size and is mapped with hydric, Brookston soils (Br).

Wetland Site 5: A PFO wetland of 4.75 acres is located on the south side of 146th Street, between Towne Road and Ditch Road. This wetland is irregular in shape, and likely follows the outline of the mapped Br soils.

Wetlands located along stream corridors (Wetland Sites 1, 2, and 3) are particularly important because they provide crucial flood storage and they filter pollutants before they enter the stream channels.

The wetland sites above are listed in order of significance to the aquatic health of the watershed. Wetlands located along stream corridors (Wetland Sites 1, 2, and 3) are particularly important because they provide crucial flood storage and they filter pollutants before they enter the stream channels. When these wetlands are forested, they can filter a very high pollutant load due to the huge uptake capabilities of many tree and shrub floodplain species. Additionally, continuity of these floodplain wetlands is important for wildlife travel corridors. Wetland Sites 1, 2, and 3 have significant size and length and therefore are more valuable than smaller fragmented wetlands.

Wetland sites 4 and 5 are both forested. Forested wetlands have multiple vegetative layers; tree canopy, understory trees, shrubs and vines, and herbaceous plants, and are generally more diverse than emergent or scrub-shrub wetlands. Because of this, they can provide habitat to a wider range of species. Wetland Sites 4 and 5 are the largest sites. The greater the acreage of a wetland, the more habitat value, flood storage, and pollutant filtration it will provide. This is why larger wetland mitigation banks are preferred by the regulatory agencies over smaller, permittee-owned wetland mitigation at separate sites.

2.4 STORMWATER QUALITY

In 1999, the US Environmental Protection Agency (US EPA) issued regulations related to the National Pollutant Discharge Elimination System (NPDES) Storm Water Phase II program whereby discharges from small Municipal Separate Storm Sewer Systems (MS4s) in “urbanized areas” serving populations of less than 100,000 and stormwater discharges from construction activities that disturb more than 1 acre of land. These regulations are referred to as the NPDES Phase II Storm Water Program.

In the State of Indiana, the Indiana Department of Environmental Management (IDEM) is responsible for the development and oversight of the NPDES Phase II Program. The IDEM initiated the adoption of the Phase II Rules that were ultimately codified as 327 IAC 15-13 (Rule 13). Rule 13 requires designated MS4 entities to apply for permit coverage by submitting a Notice of Intent (NOI) and developing Storm Water Quality Master Plans (SWQMPs) through a phased submittal process. The SWQMP is the foundation of a MS4 entity's Stormwater Program. The IDEM's phased submittal requirements for the SWQMP include the following 3 components:

Part A: Initial Application
Part B: Baseline Characterizations Report
Part C: Program Implementation Plan

Part B of the SWQMP required communities to conduct an initial investigation of water quality within their communities. At a minimum Part B submittals were required to include the following information:

- An investigation and assessment of the impacts of existing land uses on stormwater runoff within the MS4 Area,
- An identification of sensitive areas within the MS4 Area,
- A review of known existing and available water quality monitoring data for the MS4 Area,
- An identification and assessment of structural and non-structural Best Management Practices (BMPs) within the MS4 Area, and
- An identification of priority areas for the implementation of BMPs.

"Ongoing data collection related to the SWQMP Part B: Base-line Characterization Report must be submitted to the Indiana Department of Environmental Management (IDEM) with the corresponding Annual Report."

As stated in Rule 13, "Ongoing data collection related to the SWQMP Part B: Baseline Characterization Report must be submitted to the Indiana Department of Environmental Management (IDEM) with the corresponding Annual Report." Rule 13 is not prescriptive in terms of how MS4s should go about completing ongoing characterizations, and a variety of characterization options, ranging from reviewing existing water quality data to collecting new biological, chemical, and physical data is generally considered acceptable. In past annual reports, Hamilton County, The City of Carmel, and the City of Westfield have typically reviewed IDEM's 303(d) List of Impaired Waters to determine if there have been changes to the list that may be associated with Stormwater Programs. However, the collection of biological, chemical, and physical water quality data within the Williams Creek Watershed provides MS4s in the watershed with useful baseline information that will serve as a tool in evaluating the long-term water quality impacts of their Stormwater Programs.

Biological, chemical, and physical water quality assessments were utilized to better characterize the overall ecological health of Williams Creek and its tributary streams. Assessments such as these assist water resource planners by serving as a baseline for comparing any future data collected. This is useful in establishing long-term trends in water quality; identifying water quality problems and potential sources of pollution; prioritizing water management decisions based on the positive or negative impacts to water quality; and educating watershed residents and stakeholders of the associations of their everyday activities and stream health.

In all, 10 sites in the Williams Creek Watershed were selected to be evaluated and are shown in **Figure 2-5**. These sites were selected based on available public access points and their general location within the watershed.

General descriptions of the 10 sites are:

1. ***Williams Creek at 96th St.***
2. ***Spring Mill at Interstate 465***
3. ***Spring Mill at 106th St.***
4. ***Williams Creek at 106th St.***
5. ***Williams Creek at 116th St.***
6. ***Williams Creek at Spring Mill Rd.***
7. ***Elliot Creek at Clay Center Rd.***
8. ***Almond Creek at 131st St.***
9. ***Williams Creek at 131st St.***
10. ***Williams Creek at 146th St.***

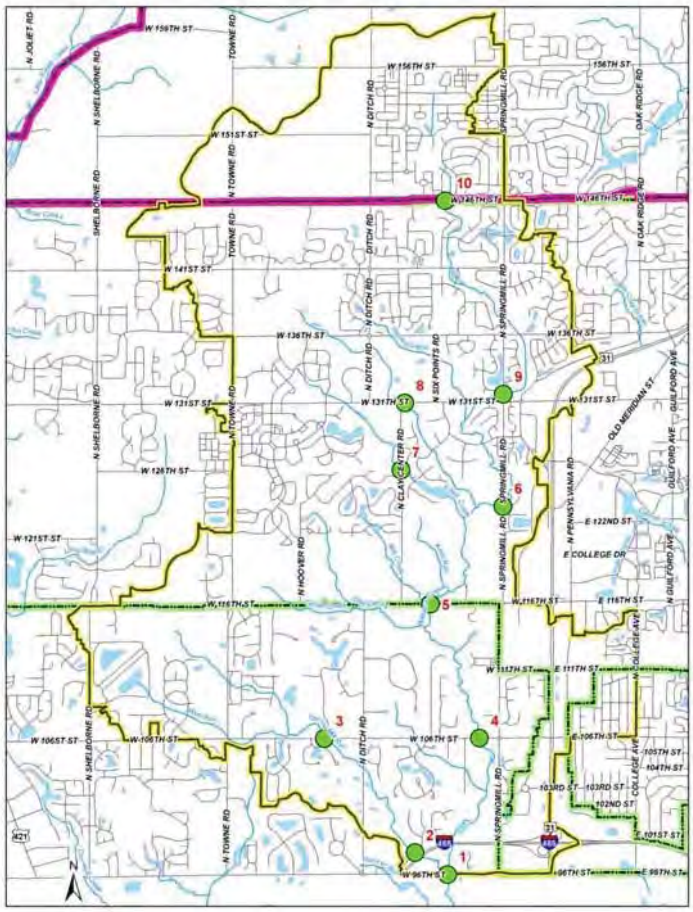


Figure 2-5 Sampling Sites in the Williams Creek Watershed

2.4.1 Biological Assessment

Biological assessments of Williams Creek and its tributary streams were completed by sampling the macroinvertebrate communities at each site in

October 2008 and April 2009. Macroinvertebrate communities are indicative of the overall health of an aquatic system, and provide a long term view of the water quality in a particular watershed or stream. Macroinvertebrate organisms serve as pollution indicators as some organisms (stoneflies, mayflies, and caddis flies) are considered to be "pollution sensitive" while others (midges, leeches, and worms) are considered more "pollution tolerant". As a stream becomes more polluted, various high quality pollution sensitive organisms will be less prevalent and lower quality pollution tolerant organisms will dominate the community.

Figure 2-6 Site #1 – Looking Upstream under the 96th Street Bridge

The Pollution Tolerance Index (PTI) is one method utilized to rapidly assess a stream's health as it relates to macroinvertebrate richness. This index, adapted from protocols developed for many monitoring programs throughout the United States, utilizes weighted values on 4 pollution Tolerance Groups (shown in **Table 2-3**), to determine an overall rating of the pollution tolerance of the stream being sampled. For example, the total number of taxa (not organisms) present in the sample for each Tolerance Group is recorded. This sum is then multiplied by the appropriate weighted value as shown in the table. The new values for each Tolerance Group are then added to determine the overall PTI for that sampling area. The PTI was utilized to assess the biological richness of the Williams Creek Watershed.

The Pollution Tolerance Index (PTI) is one method utilized to rapidly assess a stream's health as it relates to macroinvertebrate richness.

GROUP 1 Intolerant	GROUP 2 Moderately Intolerant	GROUP 3 Fairly Intolerant	GROUP 4 Very Intolerant
Weighted Value = 4	Weighted Value = 3	Weighted Value = 2	Weighted Value = 1
Stonefly	Damselfly	Midge	Left-Handed Snail
Mayfly	Dragonfly	Black Fly	Aquatic Worm
Caddis Fly	Sowbug	Planaria	Blood Midge
Dobsonfly	Scud	Leech	Rat-Tailed Maggot
Riffle Beetle	Crane Fly		
Water Penny	Clams/Mussels		
Right Handed Snail			

Table 2-3 Pollution Tolerance Groups and Representative Taxa

Caddis Fly Larva

A total sum of 58 is possible using these groups and weighted values. Streams with values of 23 or better are considered to be in "excellent" condition based on this metric while those with score of 10 or less are considered "poor". The ranges of scores and the associated ratings for the PTI are as follows:

- 23 and above – Excellent
- 17-22 – Good
- 11-16 – Fair
- 10 and below – Poor

During the October 2008 sampling event, few organisms, if any, were collected at many of the sampling locations in the study area, resulting in a

PTI rating of poor for each site. This may be a result of sampling in late fall during a period of prolonged cold temperatures, as many of the sites appeared to have adequate habitat for macroinvertebrates. In addition to available habitat, chemical water samples collected to date were typically within ranges appropriate for streams in central Indiana. Sampling riffles within several of the streams was also made difficult by the heightened water levels. These factors; date, temperature, and water level, are expected to be the basis for many of the extremely low PTI ratings for the October sampling event.

The April 2009 sampling event proved to be more productive as a greater number of families and a greater number of specimens were collected at each site. Based on these results, the best sites according to the PTI are Site #8- Almond Creek at 131st Street, and Site #10-Williams Creek at 146th Street, which both scored an "Excellent" rating of 26. The lowest PTI ratings were achieved at Site #4-Williams Creek at 106th Street with a PTI of 2 and Site #9-Williams Creek at 131st Street with a PTI of 5. **Figure 2-7** represents the PTI scores as follows: Red = Poor; Orange = Fair; Green = Good; Blue = Excellent. Raw data sheets for the macroinvertebrate sampling events are located in **Appendix 1**.

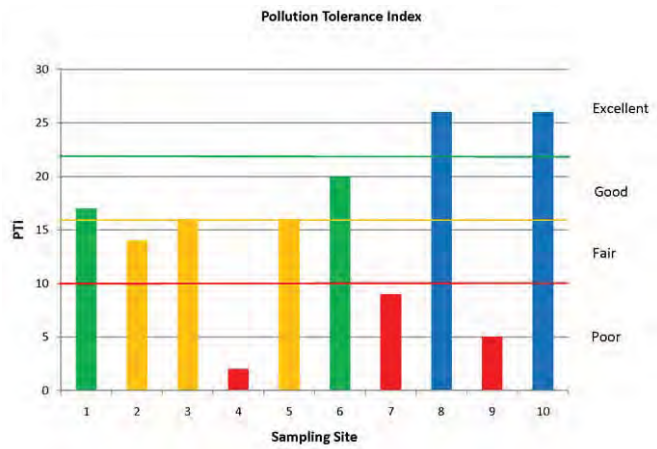


Figure 2-7 PTI Scores from Ten Sampling Sites

2.4.2 Chemical Assessment

Parameters sampled at each site included pH, temperature, dissolved oxygen, conductivity, turbidity, nitrate/nitrite, organic nitrogen, ammonia, total and dissolved phosphorus, and *E. coli*. Samples were collected once per month in September and October 2008 and April through August 2009. To ensure the integrity of the sampling protocol, duplicate samples and analyses were performed at site #7 during each sampling event. **Table 2-4** provides the target concentrations for the parameters sampled as recommended by the Indiana State Water Quality Standards, the IDEM Total Daily Maximum Load (TMDL) Reports, the Ohio Environmental Protection Agency (OEPA), and the US EPA.

Parameter	Target	Reference
Ammonia	0.0 – 0.21 mg/L *	Indiana Administrative Code
Conductivity	*NA*	*NA*
Dissolved Oxygen	Min: 4.0 mg/L Max: 12.0 mg/L	Indiana Administrative Code
Dissolved Phosphorus	*NA*	*NA*
E. coli	Max: 235 CFU/100 mL in a single sample	Indiana Administrative Code
Nitrate-Nitrite	Max: 10 mg/L in drinking water	Indiana Administrative Code
Organic Nitrogen	*NA*	*NA*
Total Phosphorus	Max: 0.3 mg/L	IDEM draft TMDL target
	Max: 0.08 mg/L	Ohio EPA recommendation to protect aquatic biotic integrity in warm water habitats
Turbidity	Max: 10.4 NTU	US EPA recommendation

Table 2-4 Target and Reference Information for Chemical Sampling

It is important to note that chemical sampling results provide a "snapshot" of the water quality at the precise time of sample collection. Chemical composition of the water column or water body can change quickly with changes in temperature, precipitation, adjacent land disturbances, and changes in velocities and flow within the stream. These results, however, are an integral component in better understanding sources and impacts of pollution within the watershed. Long term trends can be analyzed to provide comparisons between water quality at the sampling locations and land use changes, stream maintenance, precipitation, seasonality, etc. within the watershed. Raw water quality data is available in **Appendix 2**.

Nutrients

Figure 2-8 Algal Growth at Site #9

Nutrients such as nitrogen and phosphorus, while essential to the growth of beneficial aquatic plants, can become detrimental to the water system by enhancing the growth of algae. Increases in algal growth can lead to eutrophication in lakes and ponds and can alter the balance of the stream ecosystem. Heightened levels of such nutrients may also lead to detrimental fluctuations of dissolved oxygen levels, decreased sunlight penetration, alterations in the fish and macroinvertebrate assemblages, and even fish kills. **Figure 2-8** shows excessive algal growth at Site #9-Williams Creek at 131st Street.

Field crews collected grab samples at each site on a monthly basis during the sampling period as described above. These samples were delivered to a local water quality laboratory and each sample was analyzed for ammonia, nitrate/nitrite, organic nitrogen, and total and dissolved phosphorus. Within the Williams Creek Watershed, the samples analyzed were all reported to be below the nutrient targets mentioned in **Table 2-4**. Ammonia levels were consistently below 0.9 mg/L and total phosphorus levels, when detectable, were below the IDEM TMDL target recommendation. **Figure 2-9** shows the

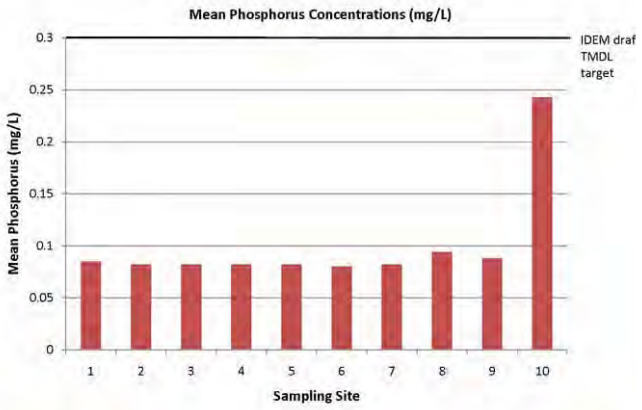


Figure 2-9 Mean Phosphorus Concentrations

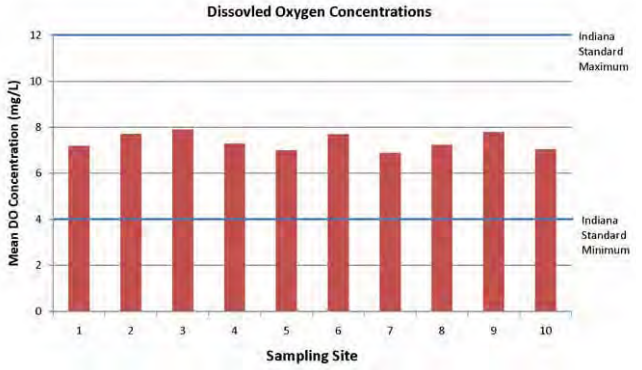


Figure 2-10 Mean Dissolved Oxygen Concentrations

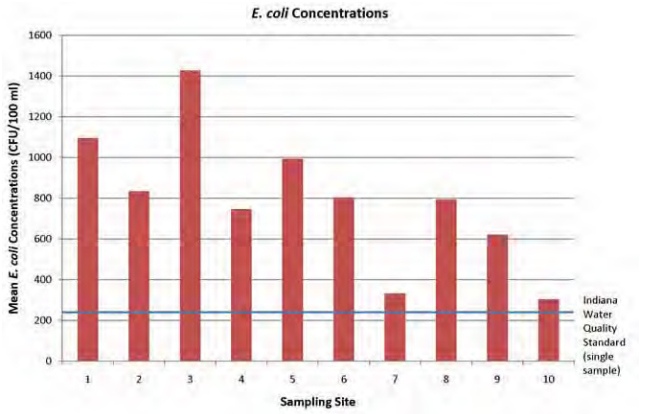


Figure 2-11 Mean E. coli Concentrations

mean phosphorus concentrations within the Williams Creek Watershed during the sampling period.

DO, Conductivity, pH, and Temperature

Field crews sampled dissolved oxygen, conductivity, pH, and temperature at each sampling location using hand held data collection devices. Temperature and pH levels were collected as these parameters are utilized to determine the appropriate levels of other important parameters such as dissolved oxygen (DO) concentrations, DO percentages, and total ammonia concentrations. Several literature sources suggest that conductivity levels below 800 µS (micro-Siemens) are indicative of background levels and suggest that when levels of 1,000 µS or greater are observed, investigations into sources of such pollution should be completed. Conductivity results at all locations never exceeded 800 µS and the majority of samples, were below 700 µS.

DO is necessary for the fish and aquatic macroinvertebrate populations to function properly and even to survive. As these levels may fluctuate significantly with diurnal cycles (daytime vs. nighttime), it is suggested that minimum levels should not drop below 4.0 mg/L and maximum levels of DO not exceed 12.0 mg/L. For the Williams Creek Watershed, the DO mean concentrations were consistently between 6.9 mg/L and 7.9 mg/L and no sites were identified as having concentrations below 4.0 mg/L or above 12.0 mg/L.

E. coli

These bacteria associated with the intestinal tract of warm blooded animals are widely used as an indicator of fecal pollution in water bodies. Among other sources, *E. coli* bacteria commonly enter streams from failing septic systems and pet and wildlife waste. As referenced in **Table 2-4**, water quality standards for *E. coli* have been established for Indiana at 235 CFU/100 mL for a single sample. These levels can be difficult to reach due to wildlife inputs and the high cost of sewer infrastructure and improvements.

During the chemical sampling events within the Williams Creek Watershed, the *E. coli* concentrations exceeded this standard in the majority (56%) of individual samples. Concentrations in excess of 2,420 CFU/100mL were observed at Site #3-Spring Mill Road at 106th Street. This site also has the highest mean concentration for *E. coli* at 1427 CFU/100 mL. With the exception of Site #7-Elliot Creek at Clay Center Road, all other mean concentrations were also above the single sample Indiana Water Quality Standard for *E. coli*.

Turbidity

Turbidity measures the "cloudiness" of the water. This cloudiness is due to the individual suspended solids (primarily clay and silt particles and/or algae) that are present within the water column. Many times, suspended solids such as soil particles are delivered to the stream via runoff from disturbed lands such as construction sites. Streambank erosion due to high velocities and volumes of water within the stream also is a source of these particles. During the sampling period, none of the NTU levels exceeded the US EPA recommendation of 10.4 NTU. Site #10-Williams Creek at 146th Street samples resulted in the highest mean concentration of 5.5 NTU while the majority of the other sites had mean concentrations between 2 and 3 NTU.

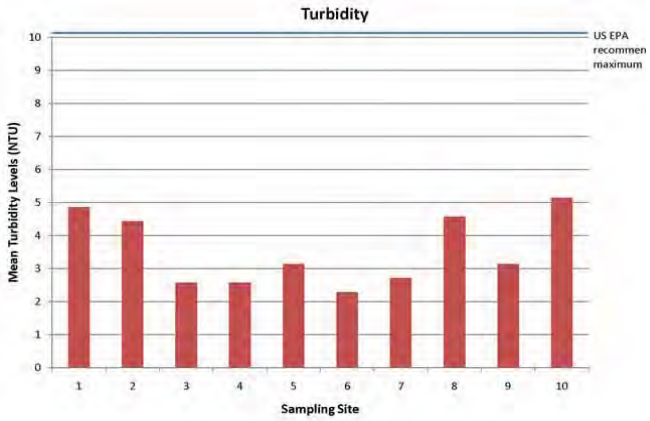


Figure 2-12 Mean Turbidity Levels

2.4.3 Physical Assessment

Physical characteristics regarding the general stream morphology of each site were collected and recorded. The width of the stream as well as the depth of the stream at regular intervals was measured. At the same time, any signs of significant erosion along the streambanks were noted. These assessments are beneficial when tracking changes in stream morphology and streambank stability over time. The Qualitative Habitat Evaluation Index (QHEI) was utilized to establish baseline data in regard to stream morphology as well as the evaluation of the in-stream characteristics and the correlation of those characteristics to the ability to support aquatic fauna.

The QHEI was developed by the OEPA to assist with relating stream habitat and the biological ability of a stream. The QHEI provides an overall quantitative metric that can generally correspond to the ability of a stream to support fish or other invertebrate communities. Individual metrics for substrate, instream cover, channel morphology, riparian and bank condition, pool and riffle quality, and gradient are summed to provide the total QHEI

score. It is important to note that QHEI score are indicative of the 200 foot stream reach segment that was assessed. Significant changes in any of the aforementioned metrics could be observed upstream or downstream of these areas.

This score, with a total possible score of 100 points has been correlated such that generally speaking, a stream segment with a score of 60 or more is conducive to the existence of warmwater fauna. In addition, scores ranging between 45 and 60 indicate areas where some modifications have been made and that the biology may or may not be supported in these streams. Scores under 45 are indicative of many man-made modifications or impacts and that the biological communities will generally not be supported in these waters. These scores can be utilized to compare changes in habitat at one site over time, or to compare different stream segments.

The Williams Creek QHEI assessments were completed in May of 2009 at each sampling location with the exception of Site #8. Due to an active construction project, access to this site was not available in May. The QHEI assessment for Site #8 was completed in August of 2009.

Figure 2-13 Recent Erosion at Site #10

At many of the sampling locations, the common factors having an effect on the overall QHEI score were substrate and channel morphology. The substrate of the stream is the compilation of silt, sand, gravel, cobble, or other material lining the channel bottom. The amount of substrate embeddedness is also estimated to better indicate the amount of sedimentation occurring within the stream. As an example of low scores in this metric, Site #9-Williams Creek at 131st Street received a score of 5 of 20 possible, largely due to the amount of silt and the amount of embeddedness of the substrate. Site #10-Williams Creek at 146th Street scored a 6 for similar reasons. Signs of significant streambank erosion were noted at Site #7-Elliot Creek at Clay Center Road, Site #8-Almond Creek at 131st Street (based on landowner conversations), and Site #10-Williams Creek at 146th Street, shown in **Figure 2-13**.

Within the QHEI evaluation, overall channel morphology accounted for a maximum possible 20 points for criteria such as:

- Sinuosity: the degree that the channel meanders
- Development: the development of the riffle/pool complexes
- Channelization: man-made channel modifications
- Stability: the stability of the stream channel substrate

Considering QHEI scores for the channel morphology portion, Site #2-Spring Mill Creek at I-465 and Site #6-Wililams Creek at Spring Mill Road each score a 16 of 20 with indications of moderate sinuosity, good stream development,

and no signs of recent channelization within the stream reach segment assessed.

The highest overall QHEI score (74.5) was observed at Site #7-Elliot Creek at Clay Center Road. Site #6-Williams Creek at Spring Mill Road also scored above a 70 with a score of 71.5. The lowest overall scores were observed at Site #9-Williams Creek at 131st Street (37) and Site #8-Almond Creek at 131st Street (38). While Site #8 achieved a low QHEI score, it should be noted that this site scored the highest PTI of all sites sampled. This is potentially due to the varied sampling dates as this site was sampled much later in the season than the others. Additionally, construction of a new bridge and street have occurred in this area and it is possible that the sediments noted during the QHEI assessment were recently deposited within this stream segment. **Figure 2-14** shows the QHEI scores for the Williams Creek sampling locations. Raw data sheets for the QHEI assessments are located in **Appendix 3**.

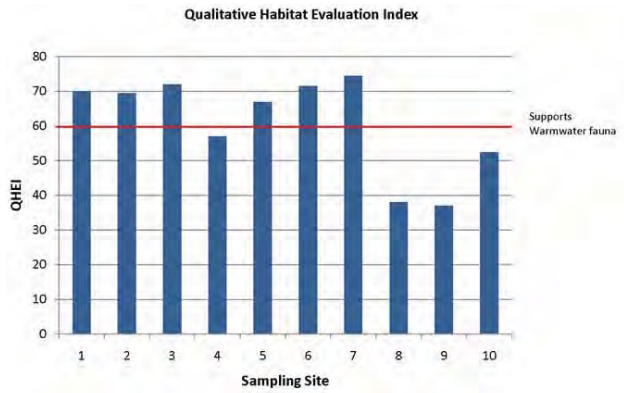


Figure 2-14 QHEI Scores for Sampling Points along Williams Creek

2.4.4 Water Quality Assessment Summary

To better understand the biological, chemical, and physical assessments discussed above and how they relate to each other, a prioritization matrix (shown in **Table 2-5**) was developed to provide a review of the individual metric scores, individual metric rankings, and a total score and rank. QHEI scores are those achieved through the assessment completed in May 2009 and the PTI scores are those resulting from the April/July 2009 assessment. *E. coli* was selected as an individual metric as over half of the single samples collected exceeded the Indiana Water Quality Standard. For all other chemical metrics, the samples collected were within the acceptable range based on the information provided in Table 2-5.

Site	QHEI		PTI		*E.coli*		Site Score	Overall Rank
	Score	Rank	Score	Rank	Score	Rank		
1	70	**4**	17	**3**	336.5	**3**	10	**2**
2	69.5	**5**	14	**5**	395.2	**5**	15	**4**
3	72	**2**	16	**4**	918.0	**10**	16	**5**
4	57	**7**	2	**8**	356.5	**4**	19	**7**
5	67	**6**	16	**4**	580.8	**9**	19	**7**
6	71.5	**3**	20	**2**	423.8	**6**	11	**3**
7	74.5	**1**	9	**6**	223.0	**1**	8	**1**
8	38	**9**	26	**1**	516.8	**8**	18	**6**
9	37	**10**	5	**7**	434.3	**7**	24	**8**
10	52.5	**8**	26	**1**	263.0	**2**	11	**3**

Table 2-5 Water Quality Assessment Summary

The shaded cells in Table 2-5 indicate those areas where observed scores were below ideal situations for each assessment. For example, as stated earlier, QHEI scores above 60 were indicative of areas that are most likely to support aquatic fauna. Therefore, the shaded boxes are those sites where the QHEI scores were below 60. Scores above 17 for the PTI are considered good indicating streams that support a range of macroinvertebrate populations and varied tolerances to pollution. Within the table the sites where PTI scores were below 17 are shaded. Similarly, *E. coli* mean concentrations that exceed the Indiana Water Quality Standard for a single grab sample (235 cfu/100 ml) are shaded. While these mean scores are not a single grab sample, it provides a baseline data set that can be valuable for comparing sites over a length of time. Single grab sample concentrations did range from acceptable to greatly exceeding the Indiana Water Quality Standard at individual sites and these ranges can be viewed in the raw data sheets in Appendix 2.

For the individual metrics a rank of 1 indicates the higher water quality and a score of 10 indicates potentially lower water quality. The numerical ranks were summed to determine the overall site score. To determine the overall site rank, the lowest overall site score received the highest rank (1) in terms of protection efforts. Conversely, the highest site rank (8) is prioritized for mitigation efforts to enhance the biological, chemical, and/or physical components of the stream system. **Figure 2-15** indicates the overall rank associated with the sampling sites within the Williams Creek Watershed along with each site's priority for mitigation efforts.

Figure 2-15 indicates the overall rank associated with the sampling sites within the Williams Creek Watershed.

Sampling Site Actions

- Mitigation
- Mitigation/Protection
- Protection
- Watershed_CBBEL
- Carmel Corporate Limits
- Westfield Corporate Limits

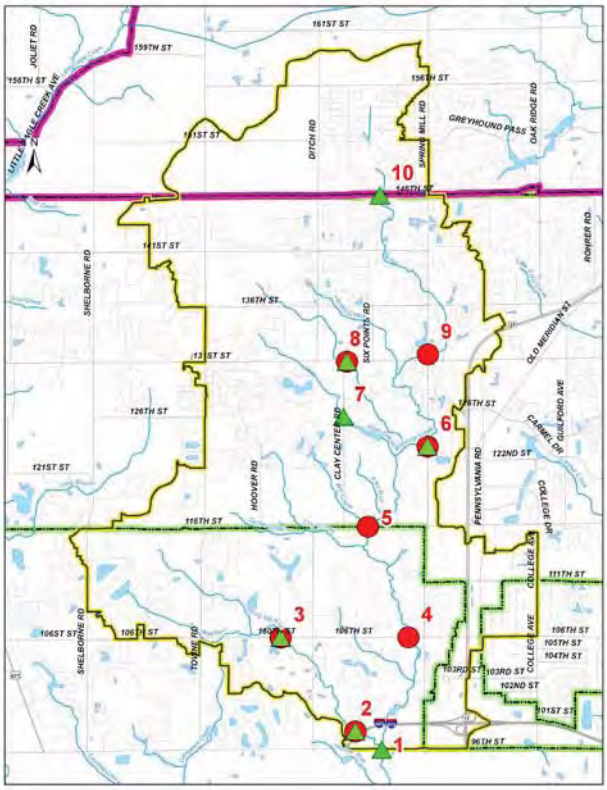


Figure 2-15 Sampling Site Priority for Mitigation Efforts

Macroinvertebrate sampling dates were adjusted to accommodate other aspects of this planning effort. Due to conditions discussed previously, the October macroinvertebrate results were not considered in the Water Quality Assessment Summary. As such, the PTI scores and rankings may not be an accurate representation of the Williams Creek Watershed. However, as no other macroinvertebrate data exists for this watershed, both sampling events provide insight to the conditions of the streams. Additional sampling in this area will result in a truer dataset of the macroinvertebrate health of the Williams Creek Watershed.

2.5 CHANNEL MORPHOLOGY

Overall channel morphology is a factor that influences water quality as described in the previous section. The factors that influence the channel morphology are the topic of this section. There is a strong relationship between stream channel stability and watershed changes. Streams are constantly evolving in response to natural and human-influenced changes in their watershed. These changes impact the physical, chemical, and biological processes of the stream corridor which may lead to degradation of water

quality, decreased water storage and conveyance capacity, loss of habitat for fish and wildlife, and decreased recreational and aesthetic value.

Stream channels develop their shape in response to the volume and rate of runoff that they receive from their contributing watersheds. Research has shown that in hydrologically stable watersheds, the streamflow responsible for most of the shaping of the channel (called the bankfull flow) occurs between every 1 to 2 years. When land is developed, the volume and rate of runoff from that land increases for these comparatively small flooding events that are not normally addressed by the detention practices and the stream channel will adapt by changing its shape. As the stream channel works to reach a new stable shape, excess erosion occurs.

Figure 2-16 Williams Creek DownstreamView

A graph comparing the bankfull (2-year) flood hydrograph from the 1957 and current land use models is shown in **Figure 2-17**. Note that not only has the development increased the 2-year (50% annual chance) frequency peak flow but it has nearly doubled the length of time that the discharge remains near bankfull. (Note: Because detention of the 2-year frequency storm is not required, no detention was modeled for those storms. Some detention may in reality be occurring that would not be reflected in this level of modeling.)

Not only has the development increased the 2- year (50% annual chance) frequency peak flow but it has nearly doubled the length of time that the discharge remains near bankfull.

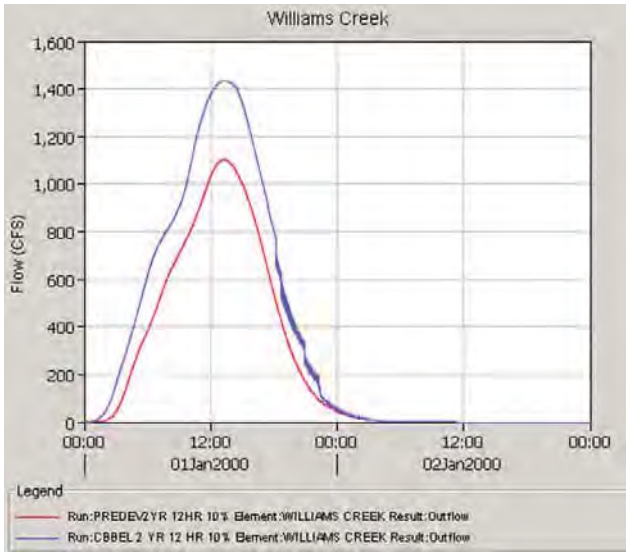


Figure 2-17 Comparison of Representative Hydrographs for 50% annual chance runoff

To provide a frame of reference, the rainfall associated with the flood graphed above is 2.5 inches in a 12 hour period. An example of a rainfall slightly larger than this order of magnitude was in June 2008 when 1.7 to 2.8 inches of rain fell over the watershed in 6 hours. The USGS gage at 96th Street recorded a peak discharge of 1,440 cfs for that storm. Hydraulic modeling shows some overbank flooding at that discharge.

Figure 2-18 Spring Mill Road Downstream of 141st Street

As shown in Figure 2-17, the channel-forming discharge in Williams Creek has increased as development has increased. This could explain the areas of channel bank erosion that were noted along the creek shown in the pictures.

Another factor influencing the channel bank erosion is manmade alteration of the stream channel. According to staff at the Surveyor's Office, some of the Williams Creek tributaries have been altered but they have shown little movement as a result of the development that has occurred in this watershed in the last 50 years. Much of this may be attributed to very good development and stormwater management ordinances as well as regular maintenance practices. For example, the County does not allow lot lines to extend right up to the channel banks, allowing a filter of sorts between the construction and the stream.

2.6 GENERAL FLOOD CHARACTERISTICS

The previous section described some of the impacts of watershed development on the stream channel. This section describes additional impacts in relation to the changes in the volume of runoff, the peak runoff, and the duration of flooding. This section also identifies the current floodplain for the stream.

To investigate stormwater runoff volumes and flows in response to various frequency rainfalls, a hydrologic model of the watershed was developed as part of this study. Details of the model are provided in **Appendix 4**. Digital copies of the modeling are provided in Appendix 5. Basically, the model takes information about the watershed in terms of runoff potential, how long it takes rainfall to reach certain points in the watershed, and the intensity and duration of rainfall, and calculates expected peak flows and volumes at specified locations within the watershed.

For this watershed, enough data was available to allow calibration of the model to the June 1957 flood as well as the September 2003 and June 2008 flood events. These calibration results provided information about the impact of watershed development on runoff volumes, peak flows, and duration of flooding.

2.6.1 Runoff Volume

Runoff volume created by any given rainfall episode is impacted by the land use. By using the calibration models, a comparison was made of runoff volumes between the 1% (100-year) annual chance – 12 hour rainfall episode occurring on the 1950s agricultural condition, and the present day developed condition. The graph in **Figure 2-19** shows there has been about a 10%

increase in the amount of the runoff from the watershed in response to the same amount of rainfall as a result of development.

There has been about a 10% increase in the amount of the rainfall that runs off the watershed now that it has been developed.

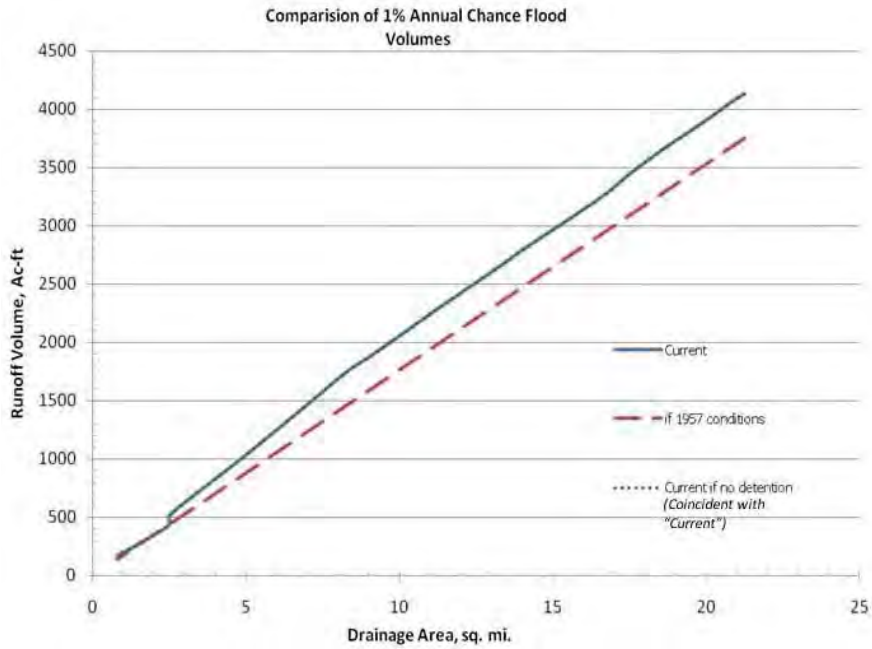


Figure 2-19 Comparison of 1% (100-year) Annual Chance Flood Volumes

The County and Cities have recognized the impacts development can have on runoff volumes and peak flows and have enacted regulations to address the issues. Stormwater regulations in Hamilton County have evolved over the years as the understanding of the implications of the regulations has grown. In particular, the County has tried to regulate release rates from development such that downstream peak discharges would not be increased by the changes in land use and any associated increases in runoff volume. As may be concluded from Figure 2-19, no effective regulation is yet in effect that would control the volume of runoff.

2.6.2 Peak Flows – Williams Creek

In 1984, the first detention requirements for the county were enacted. The criterion for stormwater discharge was that the 1% (100-year) annual chance post-development peak discharge be less than or equal to the 10% (10-year) annual chance pre-development peak discharge.

In 1999, the requirements were appended to further state that the 10% (10-year) annual chance post-development peak discharge must be less than or equal to the 50% (2-year) annual chance pre-development peak discharge.

In 2006, an allowable peak discharge per acre was developed to regulate the flood discharges from development. Presently, these standards state that the allowable post-developed peak discharge from a site shall be no greater than 0.1 cfs/acre for the 0-10 year return interval storms and 0.3 cfs/acre for the 11-100 year return interval storms. The standards allow for establishment of smaller (more restrictive) values if the results from site-specific studies warrant such a reduction. Carmel and Westfield have adopted the same standards.

The Hamilton County Surveyor has established more restrictive release rates in certain watersheds. Currently, the Williams Creek Watershed has no such more restrictive release rate requirement. In order to confirm whether lower release rates would be necessary in the Williams Creek Watershed, the cfs/Acre for each subwatershed calculated in the calibrated existing condition hydrologic model created for the watershed was compared to the current Allowable Release Rates. The current rates were found to be adequate. This means that the current Allowable Release Rates do indeed prevent developed condition 1% (100-year) and 10% (10-year) annual chance peak flood discharges from a development from being higher than the respective peak flow discharge was before development.

The current Allowable Release Rates do indeed prevent developed condition 1% and 10% annual chance peak flood discharges from a development from being higher than the respective peak flow discharge was before development.

The calibrated hydrologic model used to evaluate the allowable release rates was also used to evaluate the effect of development on the discharges along Williams Creek as the contribution from each subarea is combined. Three conclusions were drawn from the calibration model results. The first conclusion is that development that has preserved or created significant tree stands has offset at least a portion of the runoff potential increase. This was evidenced by the fact that the curve number (an indicator of runoff potential) for subareas with residential land use along with a dense cover of mature trees had to be lowered from a curve number representative of residential land use to a curve number closer to that of wooded areas to calibrate the model.

The second conclusion was that the percent of the area that is impervious and directly connected to the stormwater discharge system has a large affect on discharge peaks. In general, areas where development appeared to connect impervious areas directly to the stormwater system required a higher percent imperviousness value added in the model in order to achieve good calibration results.

The third conclusion has to do with the impact of detention practices in the watershed. The model was used to test the impact on expected peak discharges if the 1% (100-year) annual chance rainfall had occurred on the watershed in its:

- agricultural condition of the 1950s,
- existing condition, and
- existing condition had no detention been constructed.

These comparisons used generalized assumptions about detention volumes based on percentage of the area with runoff flowing to detention ponds and the detention requirements in place when the subdivision was assumed to have been developed. It does not model each individual detention basin.

A graphical comparison of the 1% (100-year) annual chance peak discharges for each of the noted conditions is shown below in **Figure 2-20**. (The "step" at the smaller discharges is due to the inclusion of Spring Mill Run and Clay Creek tributaries at their confluence with Williams Creek in addition to points along Williams Creek itself.)

Based on these results, it appears that development has increased the runoff potential of the land, but, the detention (release rate) requirements have been sufficient for the less frequent floods to generally prevent increased flows in Williams Creek.

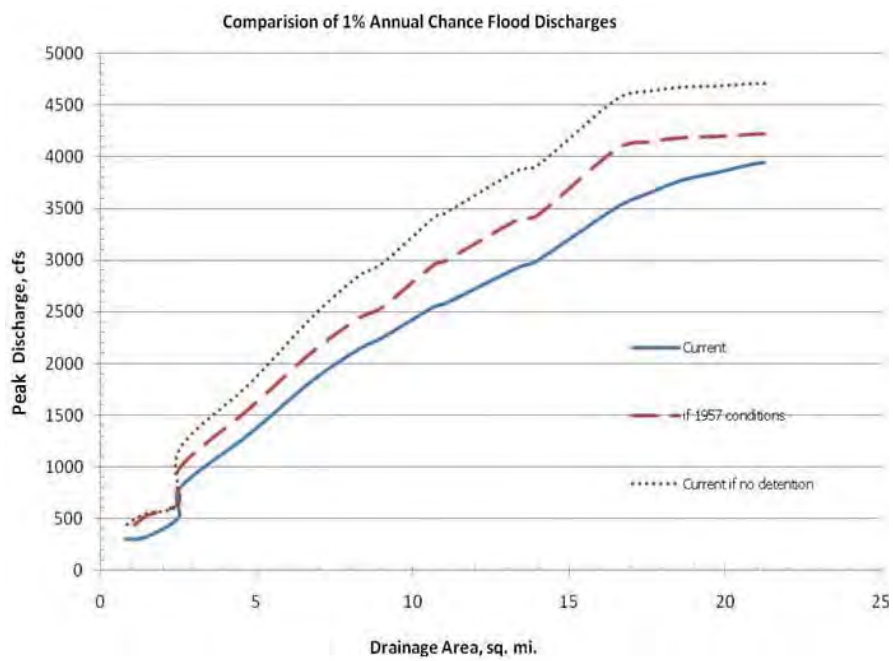


Figure 2-20 Comparison of 1% Annual Flood Discharges along Williams Creek

A comparison of the peak discharges for the 10% (10-year) and 50% (2-year) annual chance frequency rainfalls is shown in **Figure 2-21** and **Figure 2-22**. A discussion of the modeling assumptions made for these scenarios can be found in Appendix 4.

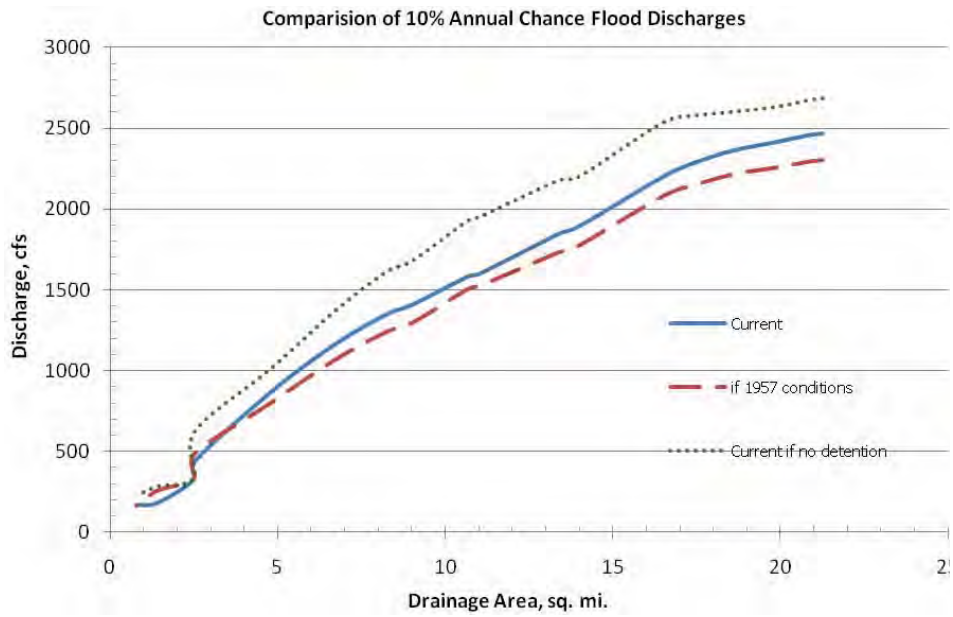


Figure 2-21 Comparison of 10% Annual Flood Discharges along Williams Creek

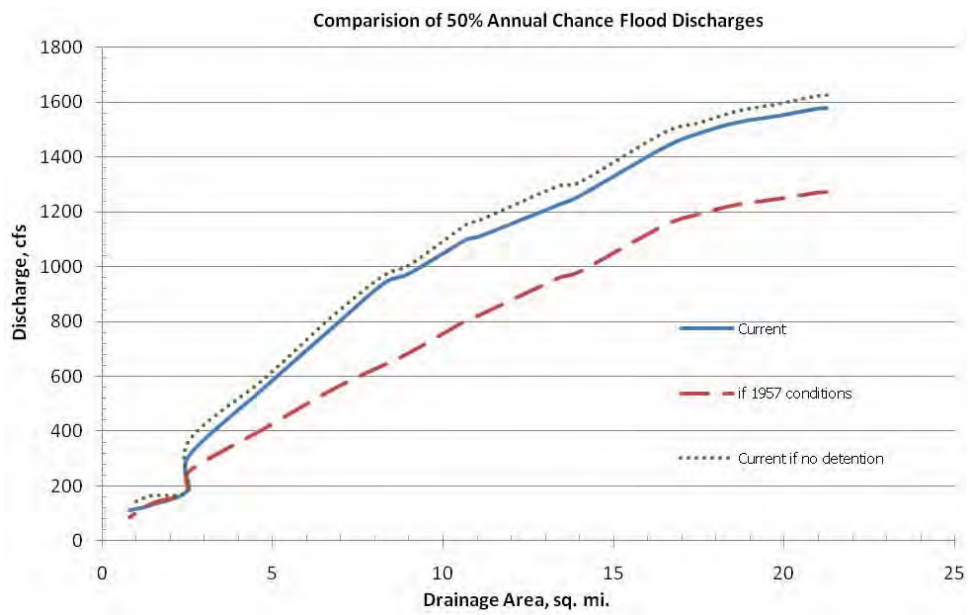


Figure 2-22 Comparison of 50% Annual Flood Discharges along Williams Creek

Based on these results, it appears that development has increased the runoff potential of the land, but, the detention (release rate) requirements have been sufficient for the less frequent, larger floods to generally prevent increased flows in Williams Creek. However, 10% (10-year) and 50% (2-year)

annual chance flood discharges have increased due to development and the historical lack of detention requirements for such frequency runoffs. In reality, a small amount of detention does probably occur for these more frequent floods but, since each detention facility was not individually modeled, the results provide a generalized comparison.

2.6.3 Peak Flows – OF Henley Drain & Williams Creek Watershed Upstream of 146th Street

The County Surveyor asked for further investigation of existing peak flows from the portion of the OF Henley and Williams Creek watersheds north of 146th Street where water has been seen ponding in the fields and on the north side of 146th Street. In other watershed plans in the County, Stony Creek in particular, a large number of depression areas within the watershed meant that the assumed values for current runoff rates were too high to use for regulating future development in that watershed. In that study, the depression areas were large enough to be easily located on the two foot contour interval mapping available at the time. Because of the visibility on the mapping, the depression storage areas could be more directly accounted for in the modeling. In contrast, the storage areas upstream of 146th Street are not deep enough to show up on the one foot contour interval mapping. They could therefore not be directly added to the modeling to compare with the current assumed runoff rates nor are they expected to have the degree of impact on current release rates that they did for the Stony Creek watershed.

Because 146th Street creates a lot of the ponding that has been seen in the fields to the north, the current rate of discharge under/over 146th Street was calculated based on information contained in the Culvert Design Report, West 146th Street Added Travel Lanes by Beam Longest & Neff dated July 2, 2009. This report was produced for portions of the design of the improvements to 146th Street and did not model the detention that currently occurs due to the restrictive culvert capacities under 146th Street. However, it did contain the present discharge that the existing pipes could pass before the road was overtopped. Copies of pertinent pages from the Culvert Design Report are included in **Appendix 6**.

For the two main culverts under 146th Street in the OF Henley Drain, the calculated culvert capacities, shown in **Table 2-6**, were approximately equal to about 0.1 cfs per Acre.

Station	DA, Ac.	Culvert Capacity Just Before Overtopping	Subwatershed Q_{10} (Huff)	Subwatershed Q_{100} (Huff)	Culvert Release Rate Just Before Overtopping	10-Year Runoff Rate
222+08 PR-A (OF Henley Drain)	150.6	16 cfs	58 cfs (for proposed condition 175.9 Ac.)	129 cfs	0.11 cfs/Ac.	0.32 cfs/Ac.
205+60 PR-A	119.2	11 cfs (based on use of data for other 18" culvert calculations at 2 ft depth	39 cfs	96 cfs	0.09 cfs/Ac.	0.33 cfs/Ac.

Table 2-6 Data for 146th Street Drainage Area Peak Flow Rates

Until 146th Street is overtopped, the downstream discharge is limited to about 0.1 cfs per Acre. Once the road is overtopped, little additional storage of the discharge occurs upstream of the road and therefore little further attenuation of discharges occurs and most of the flow continues downstream. Once the road is overtopped, and the full discharge is conveyed downstream, the runoff rate from the 10-year (10% annual chance) flood is approximately 0.3 cfs per Acre.

2.6.4 Flood Duration – Williams Creek

The presence of detention in the watershed as well as the changes in land use also affect the duration of flooding along Williams Creek. A hydrograph shows the flow versus time at a particular point along the stream **Figure 2-23** provides an example of the changes that development has created on the hydrograph.

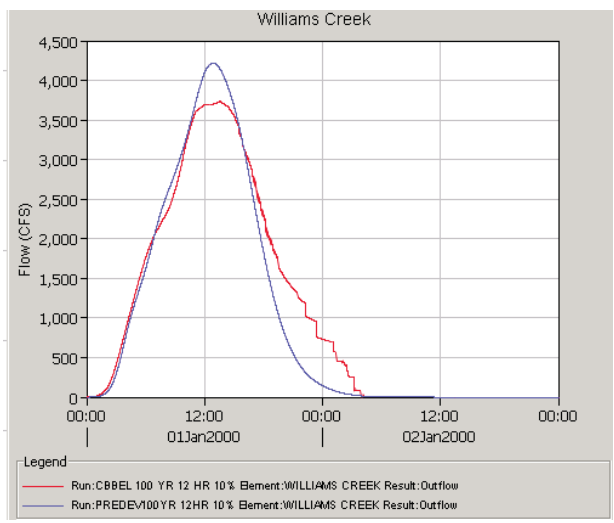


Figure 2-23 Comparison of 1% Annual Chance Hydrograph for Representative Location

The blue line is the result if the 1% (100-year) annual chance rainfall occurred on the 1957 agricultural land. The red line shows the shift that has occurred due to development. The comparison shows that although the peak flow was reduced by development, flows were maintained at given elevations for a longer period of time. For example, the length of time the

stream was at or above the elevation associated with the peak discharge from the June 2008 (approximately a 50% (2-year) annual chance rainfall), would have been about two hours less if the watershed were still completely agricultural. The recently installed USGS gage at 96th Street will provide data that will be of benefit in the future to show the extent to which this happens in the watershed, as well as to determine the relationships between discharge, stages and rainfall as time goes on.

2.6.5 Existing Floodplain Delineations

Each of the creeks, streams, regulated drains, and other water courses within the watershed has some degree of flood risk associated with it. Some of those risks are identified on the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) mapping and some are not. Flood risk areas within the watershed have been shown on the FEMA's Flood Insurance Rate Maps (FIRM) since the County joined the Flood Insurance Program in 1988. Some of the risk areas may also have been shown on the maps for Carmel or Westfield when they each joined the program in 1981. As of the writing of this report, the latest FEMA published version of floodplain mapping along Williams Creek and its tributaries is February 19, 2003. A sample of a portion of this mapping is provided in **Figure 2-24**.

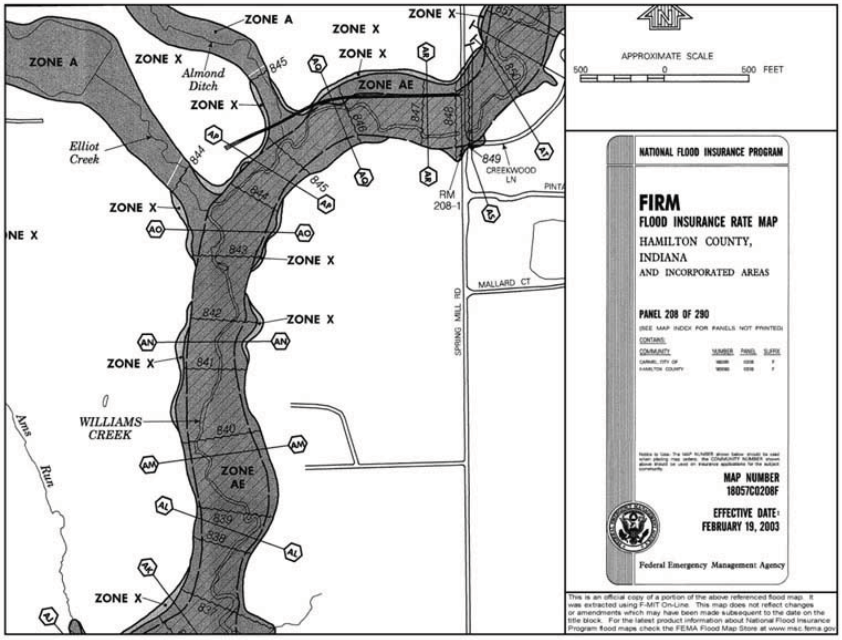


Figure 2-24 Portion of Hamilton County FIRM Panel 208

Streams with identified flood risks on the FIS mapping are Almond Ditch, Elliot Creek, and Will Creek with Approximate Zone A delineations and Spring Mill Run and Williams Creek with detailed Zone AE delineations (1% (100-

Streams with identified flood risks on the FIS mapping are Approximate Zone A delineations for Almond Ditch, Elliot Creek and Will Creek and detailed Zone AE Delineations for Spring Mill Run and Williams Creek.

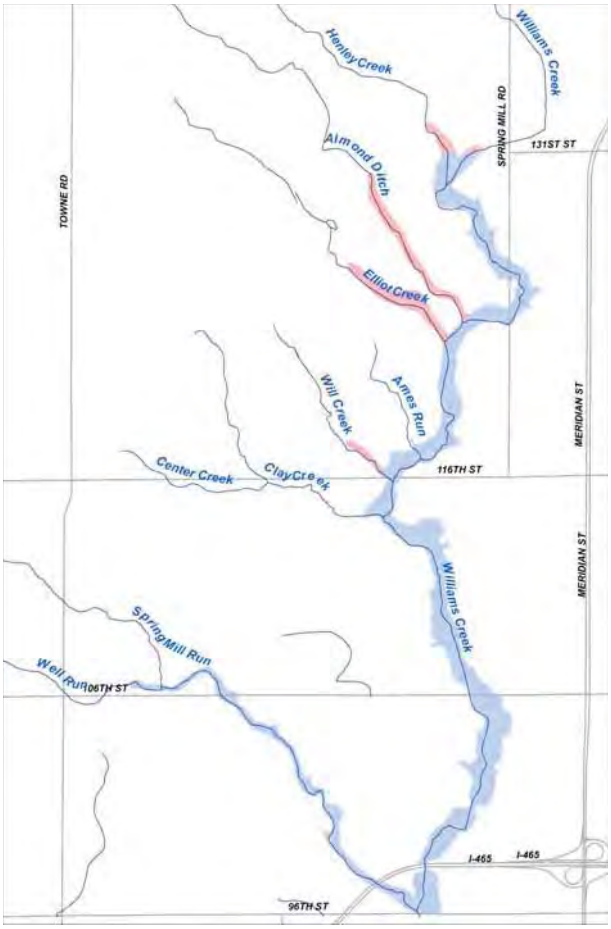


Figure 2-25 Effective FIS Zone AE (blue) and Zone A (pink) study reaches

year) annual chance floodplain delineation with floodway and Base Flood Elevation determinations). These studied reaches are shown in **Figure 2-25.**

2.6.6 Proposed Revised FIS Floodplain Delineations

Since the initial delineations, additional years of data regarding flood discharges have become available along with more detailed topographic information provided by Hamilton County Geographic Information Systems (GIS) using FEMA Standards. Some bridge structures over Williams Creek and the associated road approaches have also been replaced. The Department of Natural Resources (IDNR), Division of Water performed an updated study of the expected frequency discharges along Williams Creek. The study involved a hydrologic computer model that was used as the starting point for the calibrated hydrologic model created for the Master Plan. Their study showed lower discharge values than were used for the published FIS. The hydraulic model used in the Hamilton County FIS modeling of Williams Creek was not updated by IDNR to reflect the revised

discharges so the published FIS mapping does not yet reflect the lower discharges.

As part of this Master Plan, however, a new hydraulic model of Williams Creek using the lower discharges was created from the updated topography and new bridge data. The length of stream studied and floodplain delineated was also extended from 131st Street upstream to 151st Street. The revised IDNR Coordinated Discharges (which were within reasonable limits of the calibrated model done for this Master Plan) were used in this model to calculate updated flood elevations. A description of the modeling methodology and data used for these calculations is provided in **Appendix 6**. The revised 1% (100-year) annual chance floodplain along with the 0.2% (500-year) annual chance floodplain resulting from this updated modeling are provided in **Figure 2-26**. Larger copies of the mapping are provided as exhibits in Appendix 7.

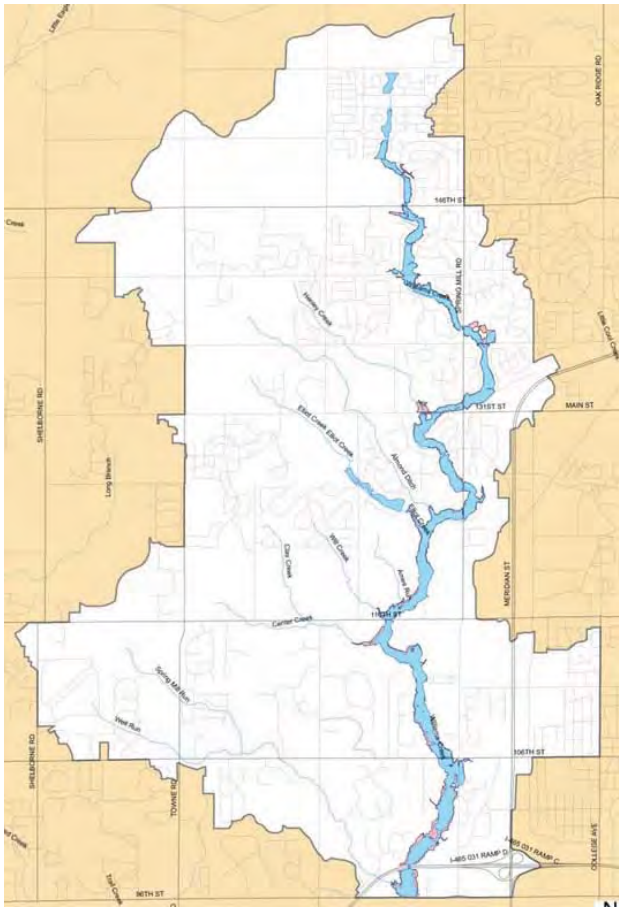


Figure 2-26 Proposed Floodplain Delineation

A comparison of the updated flood risk areas to the current effective maps show that overall, the updated Williams Creek delineation is narrower than

the current effective FIS mapping. There are, however, instances where the existing mapping is narrower than the new analysis, but it appears that this is mostly due to the differences in the detail of topographic data used for the mapping. The floodway is also generally narrower in the updated analysis, but some new areas are shown due to the floodway shifting either left or right along the stream.

Flood risks also exist along the tributaries to Williams Creek. A study of a portion of the Elliott Creek floodplain was done for another purpose and was approved by IDNR. It is included for reference here. (Only the delineation of Elliot Creek west of Clay Center Road has been approved by IDNR. The remaining portion downstream to the mouth is an approximate delineation.)

The updated flood risk mapping provided here cannot be used for regulatory or flood insurance purposes until it is approved by IDNR and incorporated into the Flood Insurance Study maps by FEMA. The portion of Williams Creek upstream of 131st Street is an exception. Because this study was a detailed study and the existing maps show only an approximate study or no study, the data provided here is considered "best available data" and can be used by the local jurisdictions for regulatory purposes. Once approved by IDNR, IDNR will use it for Construction in a Floodway Permit purposes as well.

2.7 SITE SPECIFIC FLOOD CONCERNS

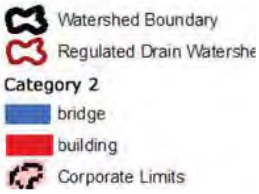
2008 aerial photography shows 6 buildings that appear to be located in or at the very edge of the 1% annual chance floodplain and 18 other homes that appear to be located in or at the very edge of the 0.2% chance floodplain.

Overlaying the floodplain delineations shown in Figure 2-26 on the 2008 aerial photography shows 6 buildings that appear to be located in or at the very edge of the 1% (100-year) annual chance floodplain and 18 other homes that appear to be located in or at the very edge of the 0.2% chance floodplain. One of the buildings in the 1% (100-year) annual chance floodplain is in the floodway but appears to be a large auxiliary building. Another 4 of the 6 structures are homes that are upstream of the published FIS floodplain limit. The last of the 6 structures in the 1% (100-year) annual chance floodplain is a home that was shown in the effective map floodplain but may have been elevated sufficiently. The approximate locations of these buildings are shown in **Figure 2-27**.

The locations of these buildings and the bridges are also shown in the larger scale map provided in Appendix 7, Exhibit 6.

Some roads are overtopped by the 1% annual chance flood on Williams Creek. These include 141st Street, portions of Spring Mill Road south of 106th Street, and Francis Court.

Figure 2-27 141st Street



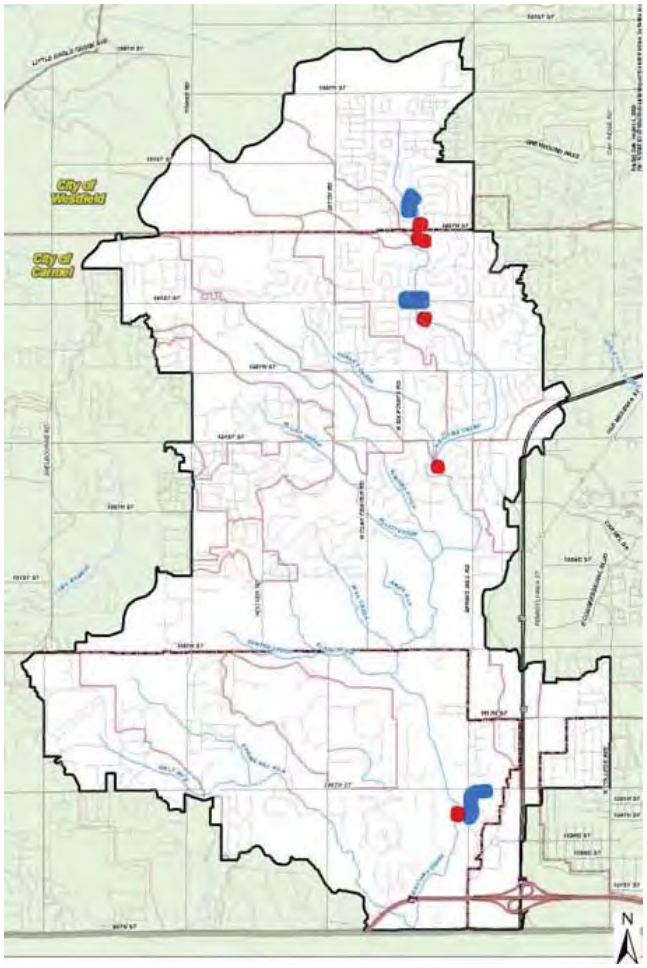


Figure 2-28 Buildings/Bridges Potentially Located in 1% Annual Chance Floodplain

Almost yearly, water flowing in the tributary from east of Spring Mill Road exceeds the capacity of the Spring Mill Road culverts south of 106th Street (two corrugated metal pipe arches with only about one and a half foot of opening depth). When this happens, water then flows south into the detention pond at Reserve at Spring Mill and then over Spring Mill Road back to Williams Creek just south of the dam on the Simon property as shown on the map in **Figure 2-29**.

Figure 2-29 Spring Mill Road south of 106th Street – Floodprone Area

Each of the historic storms modeled exceeded the 50 cfs capacity of the tributary culverts.

The culverts for conveying the tributary flow under the road have a capacity on the order of 50 cfs if they are unobstructed. Their configuration and size are such that they easily become blocked with debris which further reduces their capacity. Based on the hydrologic modeling for this study, it appears that the road has a high risk of being flooded more than once a year. Data from the hydrologic model is shown below in **Table 2-7**. This table shows that each of the historic storms modeled exceeds the 50 cfs capacity of the tributary culverts.

Event	Rainfall Depth, in.	Rainfall Duration, hrs.	Model Discharge, cfs
June 2008*	1.8	7	160
September 2003	7.1	20	510
June 1957	5.4	18	450

Table 2-7 Rainfall Events and Tributary Discharges
** - approximately a 1-year rainfall*

Hydraulic modeling revealed a second source of potential flooding of Spring Mill Road - Williams Creek itself.

Hydraulic modeling revealed a second source of potential flooding of Spring Mill Road - Williams Creek itself. **Figure 2-30** shows the profile of the 10% (10-year), 2% (50-year), and 1% (100-year) annual chance floods on Williams Creek compared to the profile of Spring Mill Road, south of 106th Street. This figure shows that even the 10% (10-year) annual chance flood on Williams Creek can currently cause flooding of Spring Mill Road.

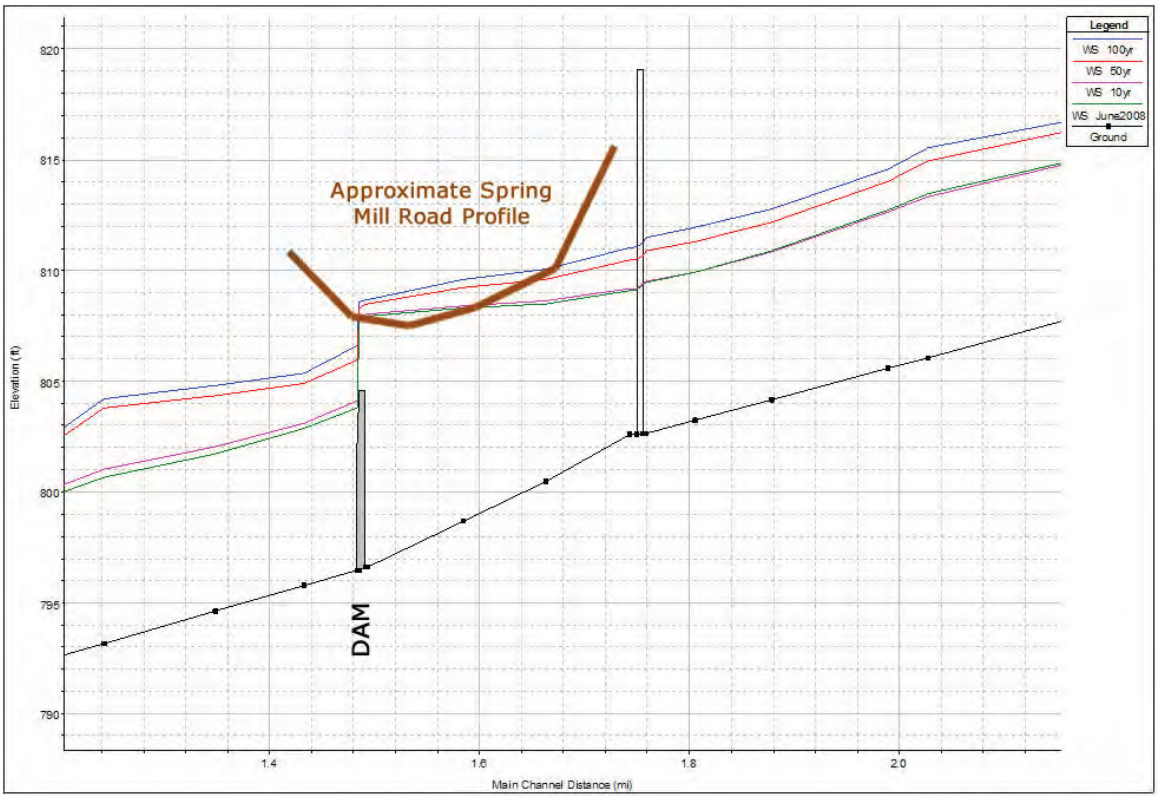


Figure 2-30 Comparison of Flood Elevations and Spring Mill Road Profile

The dam does have an impact on flood elevations between the dam and 106th Street.

In order to show the extent of the effect of the dam in Williams Creek in this area, the existing condition hydraulic model for Williams Creek was run and compared to a simulation run with the dam removed and the channel assumed restored to a configuration similar to that which currently exists just downstream. **Figure 2-31** provides a comparison of the water surface elevations for these two scenarios. This shows that the dam does have an impact on flood elevations between the dam and 106th Street. With the dam removed, the 1% (100-year) annual chance flood on Williams Creek would not be expected to flow over Spring Mill Road.

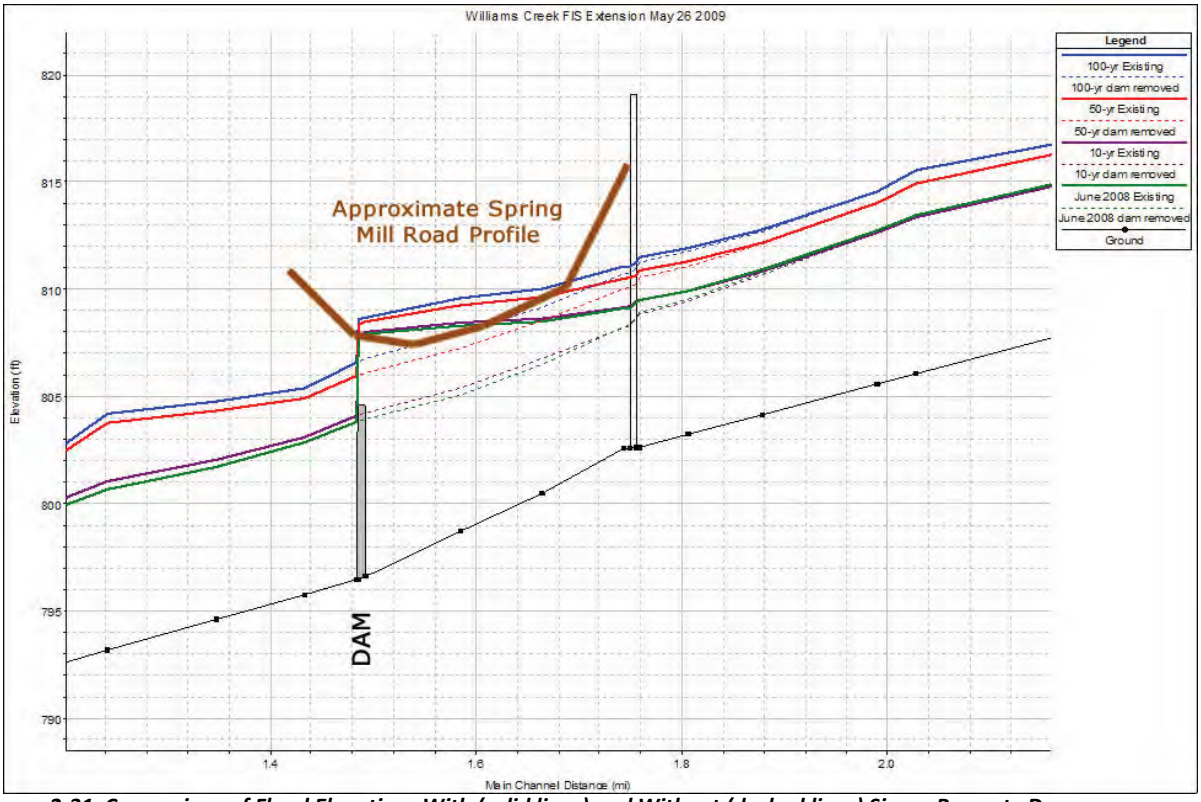


Figure 2-31 Comparison of Flood Elevations With (solid lines) and Without (dashed lines) Simon Property Dam

2.7.1 Thomas Hussey Drain and 106th Street

Another flooding concern area is the 106th Street crossing of Thomas Hussey Drain. The location is shown in **Figure 2-32**.

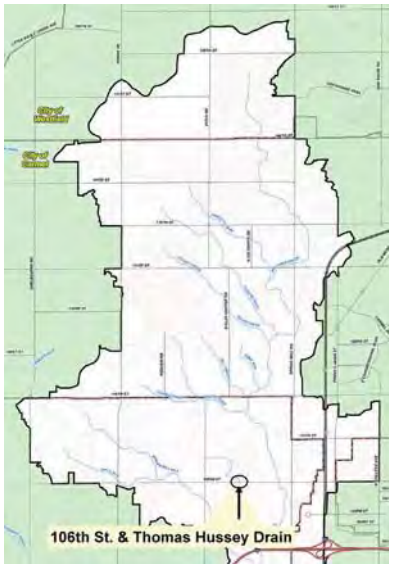


Figure 2-32 Location of Thomas Hussey Drain

In the September 2003 flood, water reportedly overtopped the road and put enough pressure on the brick wall constructed on the south side of the road so as to knock it over. The wall has been reconstructed but with four small openings along the base to relieve pressure. A short Hydrologic Engineering Center's Rive Analysis System (HEC-RAS) hydraulic model was created to evaluate flood risks at this location. This model is described in **Appendix 8**.

The culvert is not large enough to pass more than about 40% of the 1% annual chance discharge. The presence of the wall will therefore prevent water that flows over the road in the 1% annual chance flood from continuing downstream and will therefore increase upstream water surface elevations to some extent.

The model showed a culvert capacity of around 80 to 85 cfs before overtopping. Based on the HEC-Hydrologic Modeling System (HMS) model, this is approximately equivalent to a 10% (10-year) annual chance storm. The 1% (100-year) annual chance flood discharge from the HEC-HMS model adjusted to this location is about 225 cfs. Based on the HEC-HMS calibrated model results adjusted to the site, the 2003 storm produced about 270 cfs at this site. While the 2003 discharge at this site exceeded the 1% (100-year) annual chance discharge, the culvert is not large enough to pass more than about 40% of the 1% (100-year) annual chance discharge. The presence of the wall therefore prevents water that flows over the road in the 1% (100-year) annual chance flood from continuing downstream and therefore increases upstream water surface elevations to some extent. The presence of storage upstream of the culvert was not included in the model. Therefore, the amount of water surface increase was not quantified due to the wall. If storage volume upstream is encroached upon, the increase in water surface elevation will be even more.

2.7.2 Drainage Problems

A wide variety of drainage related problems were also identified in the course of this study. These problems arise from a wide range of situations such as:

- pavement subsidence
- detention ponds with insufficient capacity or outlet creating elevated water surfaces
- blockage of drainage paths and structures by landscaping, debris, or sedimentation
- failure of drainage structures
- lack of an outlet for low lying areas.

Some of these problems are already being addressed by the County or Carmel. Specific solutions for the remaining sites require a level of detail investigation that is beyond the scope of this study. Ideas for solutions or approaches to a solution will however be provided in **Chapter 5**.

2.7.3 Wet Basements

The public meeting conducted near the beginning of this study provided several general comments about basement flooding problems which people had heard about. Most of these were general comments about problems that had occurred somewhere within a subdivision. Specific information was generally not available. Wet basements can be caused by a variety of possible situations. Among these are:

- prolonged elevated water levels in detention ponds where the soil allows travel of water between the pond and basements
- landscaping or sump pump discharges that direct water towards a home's foundation
- breakage of old tiles during construction further down the tile line
- appearance of springs where they previously were not detected
- lack of foundation perimeter drains with adequate outlets.

These issues are beyond the level of investigation that is applicable to this study. Ideas for solutions or approaches to solutions will however be provided as possible in Chapter 5.

2.8 REGULATIONS

2.8.1 General Description of Regulatory Jurisdictions within the Watershed

Hamilton County, the City of Carmel, and the City of Westfield are the local governmental entities with jurisdictions within the watershed.

Hamilton County and the Cities of Carmel and Westfield are the local governmental entities with jurisdictions within the watershed. Current jurisdictional limits in the watershed are shown in **Figure 2-33**. Carmel is in the process of annexing the area in the watershed south of 116th Street. After annexation, the area north of 146th Street will be in Westfield and the portion south of 146th Street (except for the Home Place Area, located north of 106th Street and east of US 31) will be under Carmel jurisdiction. Regulated drains within the watershed will remain under the jurisdiction of the Hamilton County Surveyor. In addition, the IDNR, USACE, US EPA, and IDEM also have stormwater related requirements that will also need to be met.

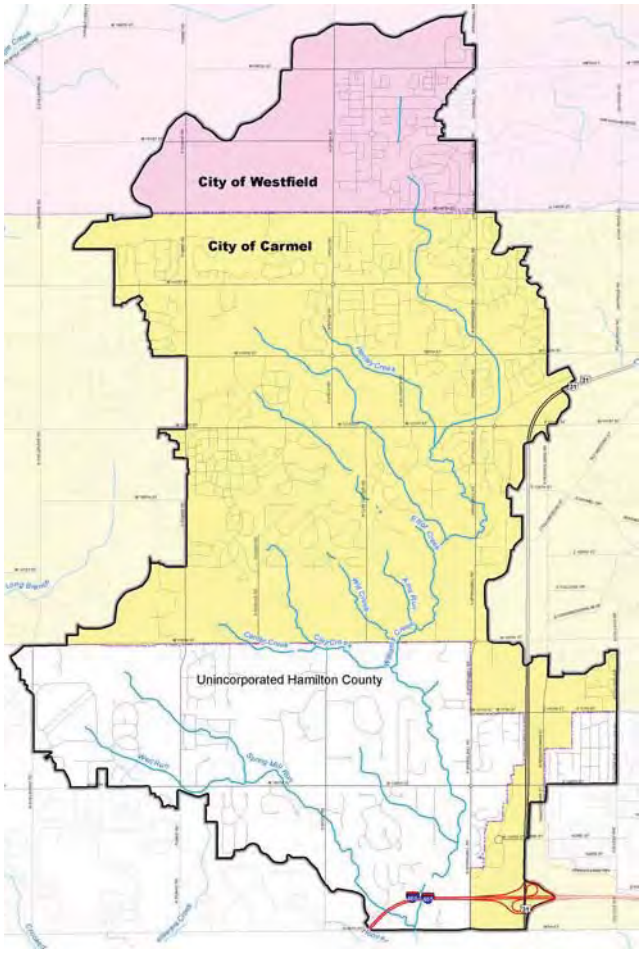


Figure 2-33 Current (2010) Corporate Limits in the Williams Creek Watershed.

2.8.2 Regulated Drains

For the regulated drains within the county, the County Surveyor's office has certain responsibilities and authority. These apply to the Williams Creek Watershed regulated drain as well as to the watersheds of some of the tributaries that have been established as legal drains as well. A map of the additional regulated drains and regulated subdivisions within the Williams Creek regulated drain watershed are shown in **Figure 2-34.**

The most up to date information on the location of regulated drains is available on the Hamilton County website Map Room

http://www.hamiltoncounty.in.gov/gis/start.html

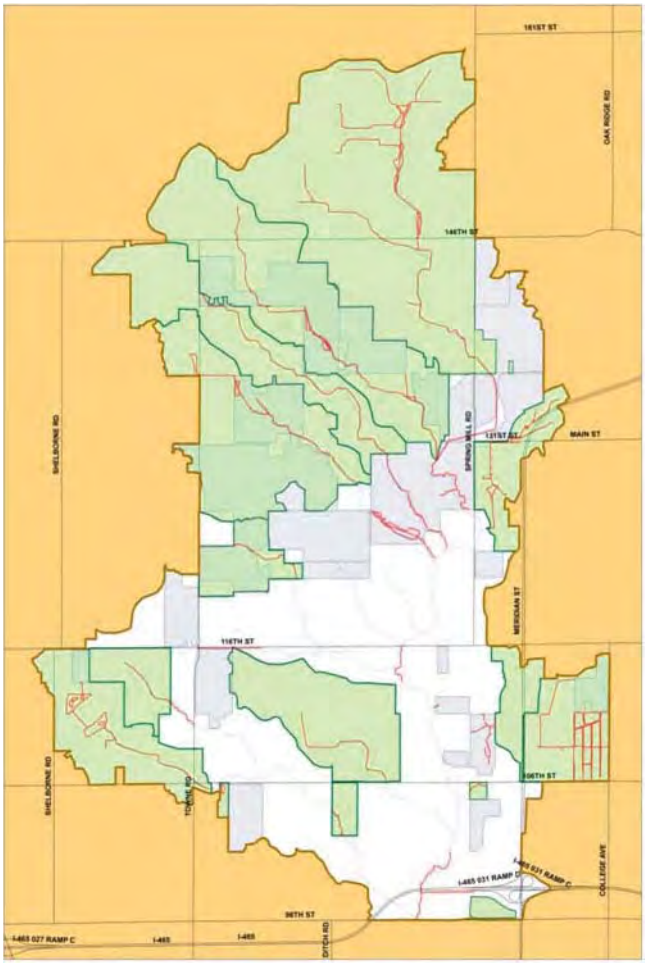


Figure 2-34 Regulated Drains, Watersheds, and Subdivisions

Following is a summary of the responsibilities of the County Surveyor for regulated drains:

The Hamilton County Drainage Board has the authority, per Indiana Code, to establish, construct, reconstruct, and maintain regulated drains within Hamilton County.

- The Hamilton County Drainage Board has the authority, per Indiana Code, to establish, construct, reconstruct, and maintain regulated drains within Hamilton County.
- The Hamilton County Drainage Board evaluates all proposed connections to regulated drains within the county. Any and all connections to regulated drains must be approved by the Drainage Board.
- Anyone wishing to directly or indirectly connect to a regulated drain in Hamilton County must file a formal application with the Drainage Board and pay appropriate fees.
- If the regulated drain does not have adequate capacity to accommodate the proposed connection, the petitioner must make provisions to reconstruct, upgrade, or otherwise improve the drain

or limit the discharge to an acceptable amount prior to discharging to the regulated drain.

- If the landowner benefited by a permitted connection to a regulated drain fails to maintain the drainage facilities (pipes, detention ponds, swales, etc.) connecting to a regulated drain, it is lawfully presumed that the failure is a request by the landowner for the drainage facilities to become a regulated drain pursuant to Indiana Code. The Drainage Board may then impose a maintenance or reconstruction assessment on all real estate benefited by the issuance of the particular outlet permit.
- A single owner or all owners affected by a private or mutual drain may petition the Hamilton County Drainage Board to assume jurisdiction over the drain per Indiana Code (36-9-27-18). The Board will then defer to the County Surveyor to determine whether or not the drain meets the standards of design and construction as defined by Indiana Code. If it does meet the standards, the Board shall grant the request. Otherwise, the request will be denied.
- In unincorporated Hamilton County, any subdivision over five (5) lots or five (5) acres will be required to dedicate a regulated drain.

Property owners within each regulated drain watershed can be required to pay an assessment. The collected funds from these assessments are then used by the County Surveyor's Office to prevent future problems or to take care of existing problems along the drain. Landowners can petition to have old infrastructure replaced or to do activities to maintain the current infrastructure. Regulated drains are viewed as utilities that are in place with the main purpose of providing drainage and are therefore regulated and maintained accordingly. The most up to date information on the location of regulated drains is available from the Hamilton County website Map Room. (*http://www.hamiltoncounty.in.gov/gis/start.html*)

2.8.3 Carmel Regulations

Project development in Carmel is subject to the City's stormwater ordinance and stormwater technical standards. Carmel's drainage code places some limits on what concerns the City can participate in addressing. Drainage problems caused by the following are typically not remedied by the City:

- Improvements placed in the easement or rights-of-way
- Lack of maintenance of the easements of rights-of-way
- Alteration of the grade of the easements or rights-of-way,
- Lack of maintenance of the property,
- Debris, lawn waste or garbage being placed in the easement or right-of-way,

- Grading or other improvements on the property that are outside of the easements or rights-of-way
- Groundwater levels

The City will pursue appropriate enforcement of violations of City Code. Issues arising from conditions or circumstances not related to these are considered a private matter not requiring City involvement. Carmel code also encourages discharges from sump pumps, and roof, perimeter, or foundation drains to be directed to rear yard swales or directly connected to storm sewers. Carmel does have jurisdiction over public storm sewer facilities and drainage issues on City property.

2.8.4 Westfield Regulations

Besides the Westfield Stormwater Ordinance and Technical Standards that impact drainage related issues in Westfield, the City has also adopted an Encroachment Specification Ordinance which affects proposed construction within the City's rights-of-way. The ordinance also establishes minimum standards for the construction of all improvements for which the City will be responsible. The City is responsible for maintaining all streets and structures accepted within the City rights-of-way.

2.8.5 Indiana Department of Natural Resources (IDNR) Jurisdiction

In most cases, the IDNR jurisdiction is limited to the floodway portion of the stream reaches with a drainage area greater than one square mile.

The IDNR jurisdiction is limited to the floodway portion of the stream reaches with a drainage area greater than one square mile and dams that exceed 20 feet in height or impound a volume of more than 100 acre-feet of water. To assist in alerting residents and the governmental entities to the reaches where the requirement exists, a map of the one square mile drainage area jurisdiction limits was created and approved by IDNR. That map is shown in **Figure 2-35.**

Upstream Limits of IDNR Jurisdiction

1) Williams Creek: upstream face of Francis Court
2) Henley Creek: upstream face of Magic Stallion Drive
3) Almond Ditch: 1,160 feet upstream of Brighton Avenue/ 1,200 feet downstream of 131st Street
4) Elliot Creek: 120 feet downstream of extension of Ditch Road
5) Ames Run: confluence with Williams Creek
6) Will Creek: confluence with Williams Creek
7) Clay Creek: a point on the stream 1,150 feet due east of Hoover Road and 1,560 feet due north of 116th Street
8) Center Creek: confluence with Clay Creek
9) Well Run: confluence with Spring Mill Run
10) Spring Mill Run: confluence with Well Run
11) Unnamed tributary of Williams Creek: confluence with Williams Creek
12) Unnamed tributary of Williams Creek: confluence with Williams Creek

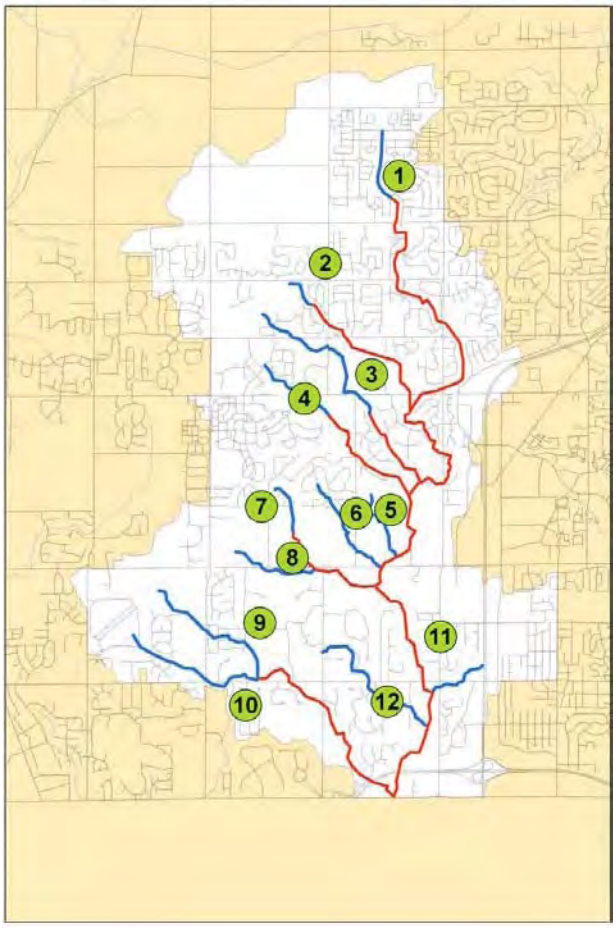


Figure 2-35 IDNR Jurisdiction limits – Red reaches are under IDNR jurisdiction

2.8.6 Summary

With multiple jurisdictions in the watershed that deal with stormwater related issues, it can become confusing as to who has authority for what problems. **Table 2-8** was developed to provide a summary of jurisdictions within the watershed. In some cases, an entity has regulatory but not maintenance responsibilities or vice versa so these are noted separately in the table. More specific information regarding regulatory and maintenance responsibilities and procedures can be found in the Carmel Drainage Ordinance (City Code 6-222), Carmel policy documents, Westfield Drainage Ordinance, and the Hamilton County Surveyor Drainage Code.

	JURISDICTION (M=Maintenance, R=Regulatory						
Drainage System Component	**Land-owner**	**H.O.A.**	**City**	**County Highway**	**County Surveyor**	**State Highway**	**Other**
rear/side yard drainage swales	M	R	R		R		
sump pump	M		R		R		
downspouts	M		R		R		
storm pipe inlets			M*, R		M**, R		
storm pipes			M*, R		M**, R		
Storm pipe outfalls			M*, R		M**, R		
pond berm & emergency spillway		M	R		M**, R		
pond principal outlet		M	R		M**, R		
swale, <6 cfs	M		R		R, **		
swale, > 6 cfs	M		M,R		M**, R		
swale, road ROW	M		R				
ditch, stream – 1%AC floodplain	M		R		R		IDNR***
regulated drain, incl. easement & 1%AC floodplain					M(of drain & access),R		IDNR***
culverts (for drainage under roads)			M,R		M,R		
bridges/culverts for stream/ditch			M,R		M,R		IDNR***
tile (regulated drain)					M,R		
tile (non-regulated drain)	M		R		R		
SR 31						M,R	
main N/S & E/W streets drainage			M,R				
subdivision streets drainage			M,R				
private streets drainage		M	R				
I-465						M,R	
Wetland or below stream Ordinary High Water Mark							USACE, IDEM

Table 2-8 Summary of jurisdictional responsibilities in the Williams Creek Watershed

**Unless a private system or regulated subdivision (most commercial properties and some subdivisions)*

***applies if is part of regulated drain*

**** applies if drainage area of stream at point of interest is greater than one square mile*

2.9 STORMWATER RELATED PROJECTS

Projects being planned:

- ***146th Street***
- ***Towne Road***
- ***Bridlebourne Subdivision***
- ***Larkspur Subdivision***

Past projects within the watershed have included basic maintenance of stormwater facilities and the replacement of several bridges over Williams Creek. Currently planned projects within the watershed are improvements along 146th Street, between Towne Road and Spring Mill Road, including the replacement of the 146th Street culvert over Williams Creek. It is currently anticipated that the structure will be replaced with a 10 ft X 6 ft or 12 ft X 6 ft box culvert in the year 2012.

Towne Road improvements have been designed between 131st and 146th Streets. These improvements include changes to drainage structures under the road.

As part of the annexation agreement for the part of the watershed south of 116th Street, a drainage study titled Southwest Clay Township Annexation Master Drainage Plan was completed in July 2009. This study notes various drainage related concerns in subdivisions in the watershed. Various actions were recommended as a result. These concerns are included in the summary of concern areas noted on the map in Section 2.10 of this Chapter. Recommended actions are noted in Chapter 5.

Bridlebourne subdivision is one of the concerns discussed in the Southwest Clay Township Annexation Master Drainage Plan. Plans have been completed by StructurePoint for the Drainage Board to help reduce the flooding in that subdivision by lowering the pond outlet (thus increasing the storage capacity of the ponds) and increasing the size of the outlet from Larkspur subdivision detention pond to drain that pond faster. Those involved in these plans expect that the changes will alleviate flooding problems in the Bridlebourne as well as Larkspur subdivisions.

2.10 SUMMARY OF CONCERNS

As noted in the previous sections, various areas of concern in the watershed have been identified. The locations of these areas are summarized in **Figure 2-36**. **Table 2-9** then follows, identifying these areas of concern in more detail. All concerns that were identified have been shown on the table and map, but not all of these concerns are within the scope of the issues this Master Plan is designed to address. Examples of concerns which are beyond the Master Plan scope are improper sump discharges, sedimentation of or breaking of non-regulated drain tile, springs that surface in new locations, etc. These issues are not typically the responsibility of the City or County. The extent to which each area of concern is being addressed in this Master Plan is noted in the table.

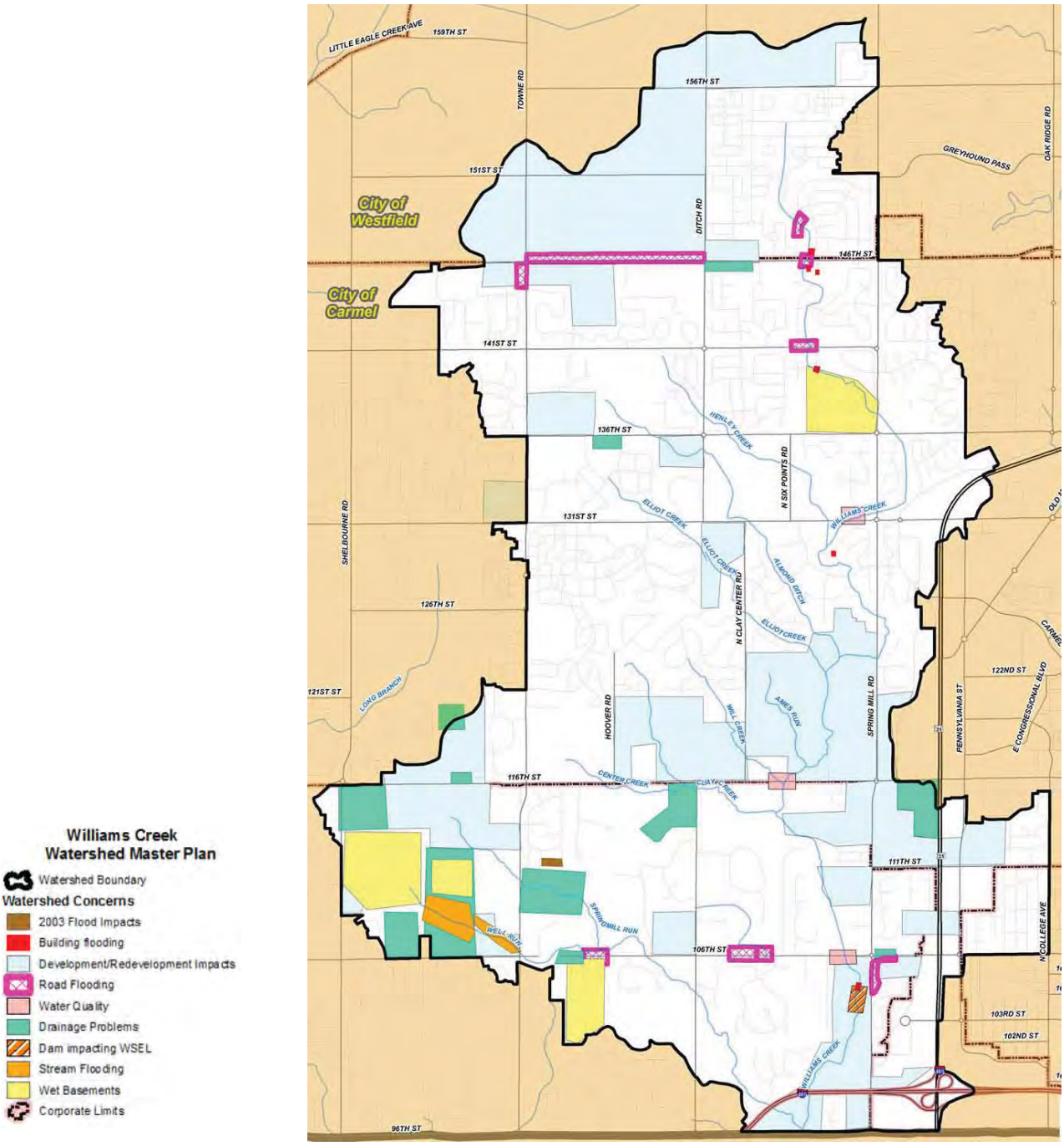


Figure 2-36 Areas of concern in the Williams Creek Watershed

Table 2-9 Areas of Concern in the Williams Creek Watershed

Location Description	Community	Regulated Drain	Description of Concern	Source of Concern Identification	Type of Concern	Preliminary Solution Ideas	Method of Addressing Concern
scattered locations throughout watershed	Carmel, Westfield, County	–	Undeveloped areas - make sure development won't increase flooding. Address replacement of existing storage.	Surveyor's Office	Prevent D/S problems resulting from future development	establish appropriate release rates, encourage practices that keep rainfallon-site	Master Plan
Bridlebourne	County/Carmel*	John Osborn	street ponding due to pavement subgrade failure, drainage/flood problems due to elevated water surface in ponds	Surveyor's Office, public mtg, SWCTAMDP**	drainage problems	Draft plan to lower normal pool of the northern pond and some modifications to the outlet of the southern pond is under review.	Plan under review by Surveyor's Office
Crooked Stick Estates	County/Carmel	–	roadside ditch ponding from sedimentation, blockage of drainage path due to landscaping, rear yard swale ponding, reports of drainage structure failures at various locations, (identified as priority concern in SWCTAMDP)	SWCTAMDP	drainage problems	restore surface drainage systems, public education regarding rear yard swales and confining ponding to raingardens, public education about property owner preservation of drainage paths	Being addressed by Carmel/County, general ideas presented in Master Plan
Crooked Stick West	County/Carmel	–	clogged/aging culverts, ponding on approach to Towne Rd across Firestone Lane (safety issue), (identified as priority concern in SWCTAMDP)	public mtg, SWCTAMDP	drainage problems	intercept water getting to road, restore surface drainage systems in easements	Being addressed by Carmel/County, general ideas presented in Master Plan
Kings Mill	County/Carmel	John Osborn	homes built in upstream subdivision's overflow path for storms greater than the 100-year, some clogging of drainage structures causes yard flooding	Surveyor's Office, SWCTAMDP	drainage problems	create additional bypass for upstream offsite flows that are in excess of present drainage system capacity, create opportunities to hold more runoff upstream, public education on keeping debris from drainage structures	Being addressed by Carmel/County, general ideas presented in Master Plan
Larkspur	County/Carmel	John Osborn	inadequate outlet from detention pond,(identified as priority concern in SWCTAMDP)	public mtg, SWCTAMDP	drainage problems	lowering of normal pool of the north pond in Bridlebourne is expected to address this issue	Plan under review by Surveyor's Office
North of 106th St, East of Springmill Rd	County/Carmel	–	poor drainage	public mtg	drainage problems	reduce amount of runoff reaching this location, provide outlet, accept the ponding	To be addressed by Carmel/County as details are made known and as jurisdiction allows
North side of 106th St, north of Windemere	County/Carmel	–	drainage problems	public mtg	drainage problems	may need to reestablish or provide maintenance for roadside drainage swales	To be addressed by Carmel/County as details are made known and as jurisdiction allows
SE corner of Ditch Rd & 146th St	Carmel	–	complaint that drainage to a constructed wetland has been cut off with Ditch Road project	Carmel	drainage problems	restablish intended drainage path	To be addressed by Carmel/County as details are made known and as jurisdiction allows
south of 136th St, midway between Towne Rd & Ditch Rd	Carmel	Thomas Stultz &Anson Almond	standing water that may not have an outlet	Carmel	drainage problems	confine ponding to bio-retention area, create outlet, let water pond as is	Can be addressed by legal drain procedures if needed
SW corner of 116th & US31	County/Carmel	–	poor drainage	Carmel	drainage problems	reduce amount of runoff reaching this location, confine standing water to bio-retention area, provide outlet	To be addressed by Carmel/County as details are made known and as jurisdiction allows
Walnut Creek Woods	County/Carmel	John Osborn	aging storm sewers	SWCTAMDP	drainage problems	verify that detention facility has sufficient capacity and drainage issues are due to blockage of outlet or downstream capacity or insufficient detention capacity, replace damaged drainage infrastucture, reduce runoff to the system	To be addressed by Carmel/County as details are made known and as jurisdiction allows
West Park	Carmel	–	poor drainage for trails, standing water north of 116th St.	public mtg/Carmel	drainage problems	regrade drainage or relocate trails, provide outlet or let water stand, reduce runoff that can reach trails	To be addressed by Carmel as needed
Windemere	County/Carmel	–	homes have flooded due to poor drainage or high pond levels	public mtg/SWCTAMDP	drainage problems	increase pipe capacity, grate capacity, outlet capacity, revise pipe inverts, floodproofing, revise landscaping to eliminate blockage	To be addressed by Carmel/County as details are made known and as jurisdiction allows, general ideas presented in Master Plan
various	County/Carmel	various	street flooding or standing water in roadside ditches	SWCTAMDP	[illegible]	reduce flow to ponding locations on streets, regrade street shoulders to allow outlet for ponded water, clean out sediment in ditches, increase ditch slopes, replace drive culverts	To be addressed by Carmel/County as details are made known and as jurisdiction allows
106th St, west of Laurelwood Dr.	County Highway	Thomas Hussey	possible obstruction of flow due to walls	Surveyor's Office	[illegible]	Reduce quantity of water reaching site, enlarge pipe capacity, enlarge openings in wall	Master Plan
141st St. & Williams Ck	County Highway	Williams Ck	overtops at 10-yr	CBBEL hydraulic modeling	[illegible]	enlarge pipe capacity, reduce quantitiy of water reaching site	Master Plan
146th St. between Towne Rd. & Ditch Rd.	County Highway	O.F. Henley	Road often flooded	CBBEL staff	[illegible]	encourage defined storage areas for runoff that would not impact road, reduce runoff to amount that can be handled by road culvert,establish release rate that does not exceed downstream system's capacity, divert runoff to constructed wetland at SE corner of 146th and Ditch	road improvements are under design, general ideas presented in Master Plan
Francis Ct & Williams Ck	Westfield	Williams Ck	overtops between 10 and 50-yr	CBBEL hydraulic modeling	[illegible]	Reduce quantity of water reaching site, enlarge pipe capacity,...	Master Plan

Location Description	Community	Regulated Drain	Description of Concern	Source of Concern Identification	Type of Concern	Preliminary Solution Ideas	Method of Addressing Concern
Springmill Rd south of 106th St	County/Carmel	-	Flooding issues	Surveyor's Office	[illegible]	reduce runoff rates, enlarge culvert capacity, upstream detention area, construct levee to prevent flow to subdivision pond, construct bypass channel from uupstream of Springmill Rd to tributary downstream of Simon Dam, enlarge Reserves at Springmill subdivision pond	Master Plan
Towne Rd just south of 146th St	Carmel	O.F. Henley	Road sometimes floods due to blocked culvert	Carmel	[illegible]	roadway improvements have been designed, develop plan for regular removal of debris	Being addressed by Carmel/County, general ideas presented in Master Plan
between Kings Mill & Towne Rd	County/Carmel	John Osborn	stream flooding	public mtg	stream flooding	note whether problems lessen after upstream Bridlebourne Drainage Modification project is constructed then if needed, investigate enlarge channel/pipe capacity, reduce flow from upstream....	To be addressed by Carmel/County as details are made known and as jurisdiction allows
Kings Mill	County/Carmel	John Osborn	flooding issues	public mtg	stream flooding	note whether problems lessen after upstream Bridlebourne Drainage Modification project is constructed then if needed, investigate enlarge channel/pipe capacity, reduce flow from upstream,...	To be addressed by Carmel/County as details are made known and as jurisdiction allows
Simon Property	County/Carmel	Williams Ck	does dam impact flood elevations?	Surveyor's Office	impacts from dam?	remove dam in way that does not negatively impact downstream, provide protection for roads, etc that are impacted by the dam's effect on water surface elevations	Master Plan
5 buildings	County/Carmel/Westfield	Williams Ck	in or very close to 100 year floodplain	CBBEL hydraulic modeling	[illegible]	compare Lowest Adjacent Grade to BFE, floodproofing, purchase flood insurance	Master Plan
Williams Ck at 106th St	County/Carmel	Williams Ck	2nd lowest water quality score	Physical, Chemical & Biological Sampling	Water Quality		Master Plan
Williams Ck at 116th St	Carmel	Williams Ck	3rd lowest water quality score	Physical, Chemical & Biological Sampling	Water Quality		Master Plan
Williams Ck at 131st St	Carmel	Williams Ck	lowest water quality score	Physical, Chemical & Biological Sampling	Water Quality		Master Plan
106th St and Windemere pond outlet	County/Carmel	-	possible obstruction of flow due to walls	Surveyor's Office	wet basements	improve outlet capacity, remove obstruction by walls & landscaping, individuals contract with local basement waterproofing company for assistance	To be addressed by Carmel/County as details are made known and as jurisdiction allows, general ideas presented in Master Plan
Bridlebourne	County/Carmel	John Osborn	several wet basements	Surveyor's Office, public mtg	wet basements	solution to drainage problems may solve wet basement problems, individuals contract with local basement waterproofing company for assistance	To be addressed by Carmel/County as details are made known and as jurisdiction allows, general ideas presented in Master Plan
Buckhorn	Carmel	-	several wet basements, drains slowly	public mtg	wet basements	individuals contract with local basement waterproofing company for assistance	To be addressed by Carmel/County as details are made known and as jurisdiction allows, general ideas presented in Master Plan
Crooked Stick West	County/Carmel	-	several wet basements	public mtg	wet basements	may be addressed by SWCTAMDP, individuals contract with local basement waterproofing company for assistance	To be addressed by Carmel/County as details are made known and as jurisdiction allows, general ideas presented in Master Plan
Kings Mill	County/Carmel	John Osborn	several wet basements	public mtg	wet basements	individuals contract with local basement waterproofing company for assistance	To be addressed by Carmel/County as details are made known and as jurisdiction allows, general ideas presented in Master Plan
Windemere	County/Carmel	-	several wet basements	public mtg, SWCTAMDP	wet basements	removing portion of wall may have improved the situation, redesign emergency spillway, restore surface drainage swales that have not been properly maintained or have been filled in	To be addressed by Carmel/County as details are made known and as jurisdiction allows, general ideas presented in Master Plan
Sutton Place	County/Carmel	-	2003 pond broke levee & flooded southern properties	public mtg	2003 flood broke [illegible]	has been repaired by Hamilton County	Already taken care of

* County/Carmel identifies areas that are currently in the County but proposed for annexation to Carmel

** Southwest Clay Township Annexation Master Drainage Plan, July 20, 2009

CHAPTER 3 FUTURE CONDITIONS

3.1 INTRODUCTION

Identifying effective solutions to stormwater problems depends on a thorough understanding of not only the existing stormwater conditions but also the future stormwater conditions and associated concerns. As land use, regulations, and activities in the watershed change, so potentially do the impacts on stormwater quantity and quality. Chapter 2 described current conditions and impacts from changes that have already occurred. This chapter describes expected changes from conditions that are expected to occur in the future. Included are descriptions of the land use, wetlands, flood risk areas, channel morphology, and quality and quantity aspects of stormwater. This data has been gathered from available mapping, computer modeling for the watershed, discussions of expected future land use with local officials, and review of studies regarding expected future conditions. The future conditions and concerns in the watershed are described in the following sections:

3.2 Land Use
3.3 Wetlands
3.4 Stormwater Quality
3.5 Channel Morphology
3.6 General Flood Characteristics
3.7 Site Specific Flood Concerns
3.8 Regulations
3.9 Stormwater Related Projects
3.10 Summary of Concerns

3.2 LAND USE

An additional 25% of the watershed is expected to develop in the future.

Based on conversations with staff from the City of Carmel Engineering Department and the Hamilton County Surveyor's Office, as well as review of the individual Comprehensive Plans and Zoning maps for the area, the expected future use of land in the watershed was identified. Areas at the upper edge of the watershed in Westfield have already been the subject of discussion and even preliminary design for development. In general, it is expected that areas along US 31 will continue to develop/redevelop as commercial uses. Chapter 5 of the Carmel Comprehensive Plan indicates that Carmel is encouraging very low density housing west of Spring Mill Road (1-1.3 development units per acre). Along US 31, high intensity office use (greater than 5 development units per acre) is being encouraged. The Comprehensive Plan also calls for enhancement of the corridor aesthetics by

creating large lawns, consistent landscapes, and using green architecture. These features could be used to serve the aesthetics goal as well as improve water quality if rain gardens, bio retention basins, extended flow paths and such were incorporated into the designs. This would be a good example of accomplishing two goals with one task if both goals are encouraged as developers work in the area.

Carmel does not expect the many estate lots within the watershed to redevelop into other uses. A map of the areas where land use is expected to change from current conditions is provided in **Figure 3-1.**

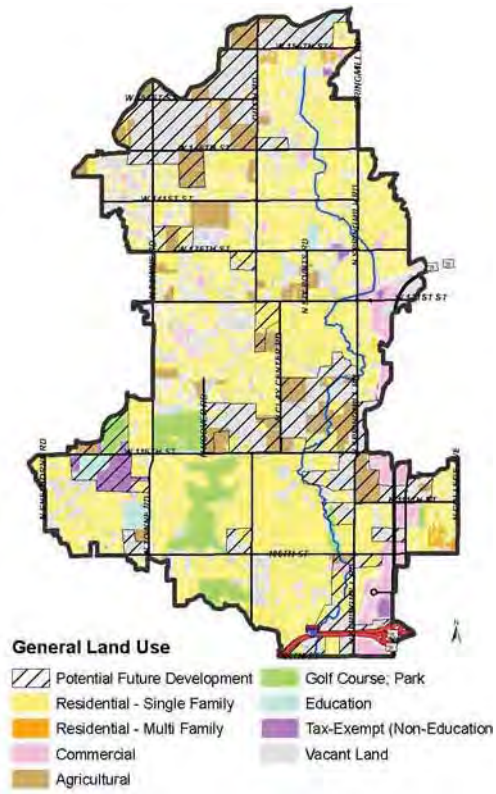


Figure 3-1 Areas Identified as Potential Future Development

The percentage of impervious surface in the Williams Creek Watershed is approximately 17% under existing conditions. If the additional 25% of the watershed as shown in Figure 3-1 develops as expected, there is the potential, (based on studies by the Center for Watershed Protection), for an additional 9% of the watershed to become impervious. According to Table 2-2, Williams Creek Watershed would then be on the low end of the high impact category for water quality.

3.3 WETLANDS

The wetland sites discussed in Chapter 2 (existing conditions) are in predominantly built-out residential areas of the Williams Creek Watershed. Because of this, it is unlikely that the neighboring land use, encroachment into these wetlands, or quality/quantity of stormwater runoff to these areas will change dramatically from today's conditions. Even though unlikely that changes will occur, protection of these wetlands is still needed.

Additional wetlands not identified on the NWI mapping may also exist in developed or un-developed areas because often the NWI predates the development of newer wetland areas. Additionally, the NWI serves only as a large scale guide, therefore it is important to require wetland delineations on any site prior to development.

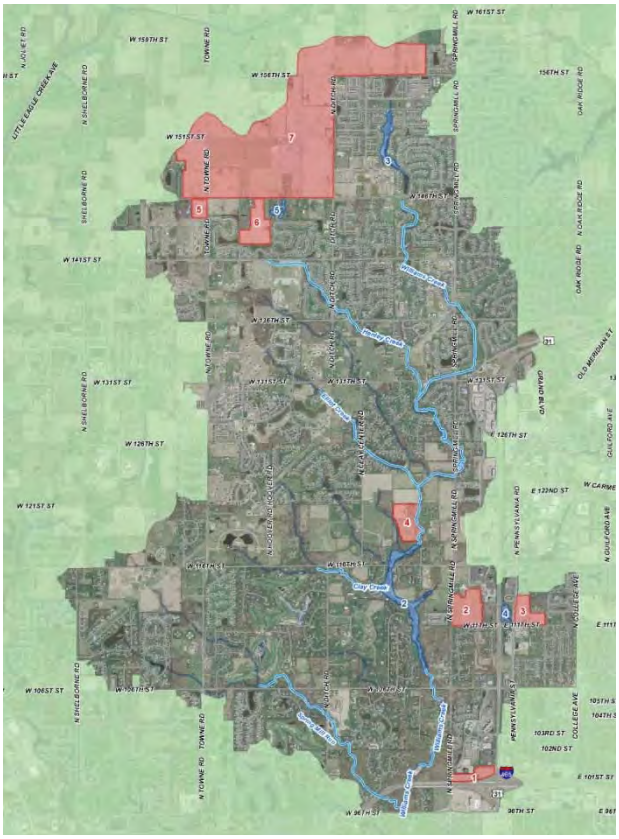
Efforts to preserve wetlands are important because wetland mitigation will not replace the habitat, value, and function of these existing sites for ten to twenty years to come.

Mature wetlands, particularly forested riparian sites, take many years to develop. Forested wetlands provide a higher flood storage capacity than emergent sites, and also contain a larger diversity of plant and animal species. When forested wetlands are located along stream corridors, they are of particular importance because they provide travel corridors for wildlife through otherwise heavily developed areas. Buffering stream corridors and wetland areas with undeveloped native upland areas and/or additional wetland habitat is important to prevent pollutants from disrupting these areas and to provide transition areas for wildlife.

Efforts to preserve these limited resources are important because wetland mitigation will not replace the habitat, value, and function of these existing sites for ten to twenty years to come, even if the mitigation is constructed properly. Mitigation ratios required by IDEM and the USACE have been used to make up for the lack of success of many wetland mitigation sites. The goal of this is to ensure that there is "no net loss" of wetland acreage. Even the required wetland acreage replacement ratios often don't succeed with this. In addition, there is currently no regulation prohibiting draining or altering the hydrology of existing wetlands. This results in indirect "impacts" to wetland sites decreasing their value and function.

It has been shown through years of research that larger (50 acres plus), third party controlled, wetland sites provide more benefit to wildlife and have a higher probability of being successful than isolated wetland mitigation sites interspersed throughout urban areas.

It has been shown through years of research that larger (50 acres plus), third party controlled, wetland sites provide more benefit to wildlife and have a higher probability of being successful than isolated wetland mitigation sites interspersed throughout urban areas. It is very difficult for wildlife, particularly reptiles and amphibians to inhabit sites that are surrounded by development and not connected to other natural areas. Potential large scale wetland mitigation sites within the Williams Creek watershed have therefore been identified as shown in **Figure 3-2**.



Significant Wetlands 1: Linear Wetland
Significant Wetland Site
Potential Wetland Mitigation Site
NWI Wetlands

Figure 3-2 Significant Wetlands and Potential Mitigation Sites
Source: Based on USFWS National Wetlands Inventory, 1992 and 2007 Aerial Photography

3.4 STORMWATER QUALITY

As the Williams Creek Watershed continues to become more developed, and as re-development in this area occurs, it is important to consider the relationship between land use and the overall health and condition of local waterways. In many cases, development and redevelopment activities may have detrimental effects on stream systems due to reduction in riparian corridor, increased amounts of sediment and other pollutants that may be carried with stormwater, and the overall volume of water that may reach the streams due to increases in impervious area.

Figure 3-3 shows many areas within the Williams Creek Watershed that are highlighted for potential future development. Eight of the 10 sampling sites are within, in proximity to, or immediately downstream of these areas. As discussed in Chapter 2, this Master Plan prioritizes 2 sites for protection (Site 1 and Site 7); 4 sites for mitigation/protection (Site 2, Site 3, Site 6 and Site 8); and 2 sites for mitigation (Site 4 and Site 5).

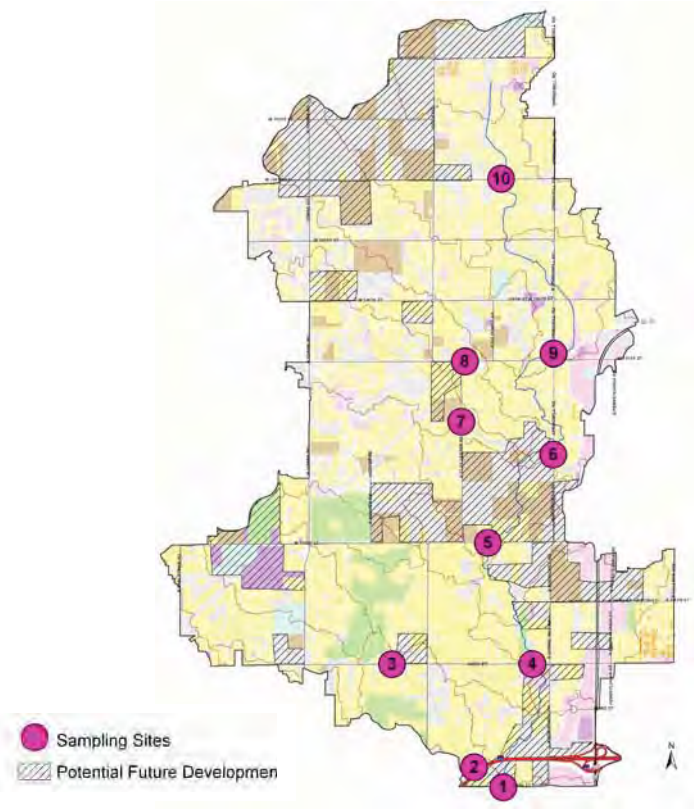


Figure 3-3 Potential Future Development

Enhancements to existing land uses, development (or redevelopment) of these areas, and enforcement of IDEM's Rules 5 and 13 creates an opportunity to protect and improve local water quality as well as the wildlife and aquatic habitat.

It is anticipated that current regulations such as IDEM's Rules 5 and 13 will continue to be enforced. However, if these rules, designed to protect water quality of receiving streams, are not enforced, the impacts may be greater than anticipated, have longer lasting effects, and may require more intense mitigation efforts to correct. The current Stormwater Management Ordinance for the City of Carmel, City of Westfield, and Hamilton County requires post-construction BMPs to remove 80% Total Suspended Solids (TSS) from stormwater runoff. It is assumed that other pollutants of concern will be captured to some extent with TSS which may not necessarily be the case.

Enhancements to existing land uses, development (or redevelopment) of these areas, and enforcement of IDEM's Rules 5 and 13 creates an opportunity to protect and improve local water quality as well as the wildlife

and aquatic habitat. Specific recommendations are discussed in **Chapter 5** of this Stormwater Master Plan.

3.5 CHANNEL MORPHOLOGY

As the Williams Creek Watershed continues to develop, increases in the bankfull discharge are expected to occur.

A graph comparing the bankfull (2-year) flood hydrograph from the current land use and future condition models is shown in **Figure 3-4**. These results indicate conditions if only current ordinance requirements are enforced. As the Williams Creek Watershed continues to develop, increases in the bankfull discharge are expected to occur as illustrated in Figure 3-4. The stream channel and corridor will respond accordingly in an effort to maintain channel stability. Measures must be taken to minimize the impact of such development on stream bank erosion and water quality. Through the use of appropriate BMPs, the volume and rate of runoff for channel-forming flows will be reduced in an attempt to minimize increased stream bank erosion in the receiving streams and channels.

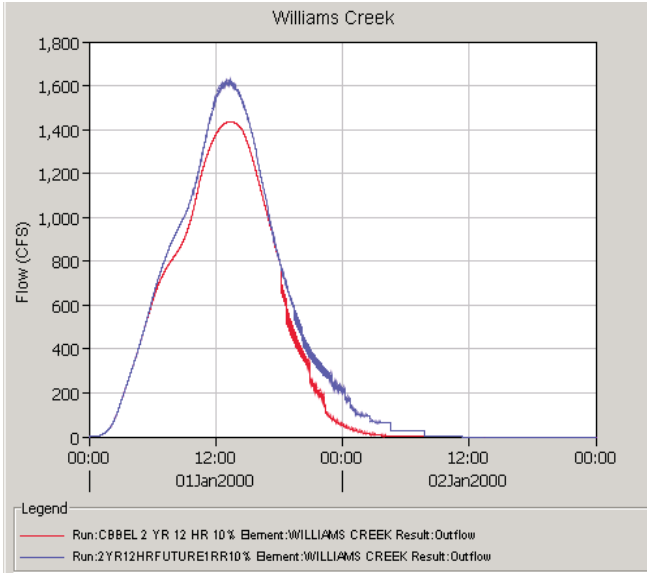


Figure 3-4 Flood Hydrograph (2-Year) for Current and Future Land Use

The following table illustrates the potential effects of major land use activities to stream channels and stream corridors.

Table 3-1 Impact of Land Disturbance Activity on the Stream Channel

⇩Potential Effects ⇩	DISTURBANCE ACTIVITY (X=Activity has potential for direct impact O=Activity has potential for indirect impact)										
	Vegetative Clearing	Channelization	Streambank Armoring	Streambank Disturbance	Soil Exposure or Compaction	Hard Surfacing	Roads & Railroads	Utility Crossings	Land Grading	Woody Debris Removal	Piped Discharge
Homogenization of landscape elements	X	X	O	O	O	O	O	O	X	O	O
Point source pollution	O	O	O	O	O	X	X	X	O	O	X
Nonpoint source pollution	X	X	O	X	O	X	X	X	X	X	X
Dense compacted soil	X	O	X	O	X	X	X	X	X	O	O
Increased upland surface runoff	X	O	O	O	X	X	X	O	X	O	O
Increased sheet flow with surface erosion rill and gully flow	X	O	O	O	X	X	X	O	X	O	O
Increased levels of fine sediment and contaminants in stream corridor	X	X	O	X	X	X	X	X	X	X	X
Increased soil salinity	O	O	O	O	O	X	X	O	O	O	O
Increased peak flood elevation	X	X	O	O	X	X	X	O	O	O	X
Increased flood energy	X	X	X	X	X	X	X	O	O	X	X
Decreased infiltration of surface runoff	X	O	X	O	X	X	X	O	X	O	X
Decreased interflow and subsurface flow	X	X	X	O	X	O	O	O	X	O	X
Reduced groundwater recharge and aquifer volume	X	O	O	O	X	X	X	O	O	X	X
Increased depth to groundwater	X	X	O	O	X	X	X	O	X	O	O
Decreased groundwater inflow to stream	X	X	X	O	X	X	X	O	X	O	X
Increased flow velocities	X	X	X	X	X	X	X	O	X	X	X
Reduced stream meander	O	X	X	X	O	X	O	O	X	X	X
Increased or decreased stream stability	X	X	X	X	X	X	X	X	X	X	X
Increased stream migration	X	O	O	X	X	X	X	O	O	X	X
Channel widening and downcutting	X	X	X	X	O	X	X	O	O	X	X
Increased stream gradient and reduced energy dissipation	O	X	X	X	O	O	O	O	O	X	X
Increased or decreased flow frequency	X	O	O	O	X	X	X	O	X	O	X
Reduced flow duration	X	X	X	X	X	X	X	O	O	X	X
Decreased capacity of floodplain and upland to accumulate, store, and filter materials and energy	X	O	O	O	X	X	X	O	X	X	X
Increased levels of sediment and contaminants reaching stream	X	X	X	X	O	X	X	X	X	X	X
Decreased capacity of stream to accumulate and store or filter materials and energy	O	X	X	X	O	O	O	O	O	X	X
Reduced stream capacity to assimilate nutrient/pesticides	X	X	X	X	X	X	O	O	O	X	X
Confined stream channel with little opportunity for habitat development	O	X	X	X	O	O	O	O	O	O	O

Source: USDA-NRCS, 1988

Other man-made changes to the erosion patterns of the channel are not expected to occur based on the development that has occurred in this watershed in the last 50 years. Much of this may be attributed to very good development and stormwater management ordinances as well as regular maintenance practices. For example, the County does not allow lot lines to extend right up to the channel banks, thus allowing a filter of sorts between construction and the stream.

3.6 GENERAL FLOOD CHARACTERISTICS

The previous section described some of the impacts of watershed development on the stream channel. This section describes additional potential for impacts from expected development in relation to the changes in the volume of runoff, the peak runoff, the duration of flooding, and extent of flooding. As for the existing condition, the future condition was analyzed using the hydrologic model described in Appendix 4. As noted in the problem definition map and shown in Figure 3-3, future expected development was added to the existing condition model to create the future condition model. Developed conditions were modeled based on assuming that the 1% annual chance flood runoff on a given subbasin would be equal to the percent of the subbasin that is expected to develop, contributing 0.3 cfs per acre (based on regulations), and the rest of the subbasin is unchanged from the existing condition. The curve number (land use) and percent imperviousness for a subarea with development were changed by developed land values being applied to the percent of land that was identified as having development potential.

Every 10-15 years or after a major rainfall event (2% annual chance or larger), the hydrologic model could be revisited to evaluate whether conditions have changed in the watershed and the conclusions reached are still valid.

3.6.1 Runoff Volume

There has been about a 10% increase in the amount of the rainfall that runs off the watershed now that it has been developed. An additional 10% increase is expected as the remainder of the watershed develops.

Runoff volume created by any given rainfall episode is impacted by the land use. By using the future conditions model, a comparison was made of runoff volumes for the 1% (100-year) annual chance – 12 hour rainfall episode occurring on the present day developed condition and the expected future condition. The graph in **Figure 3-5** shows there could be about a 10% increase in the amount of the runoff from the expected developed condition watershed in response to the same amount of rainfall on the existing condition. The runoff volume results from the 1957 agricultural condition are also included for a perspective of the total expected change from predevelopment to full developed conditions.

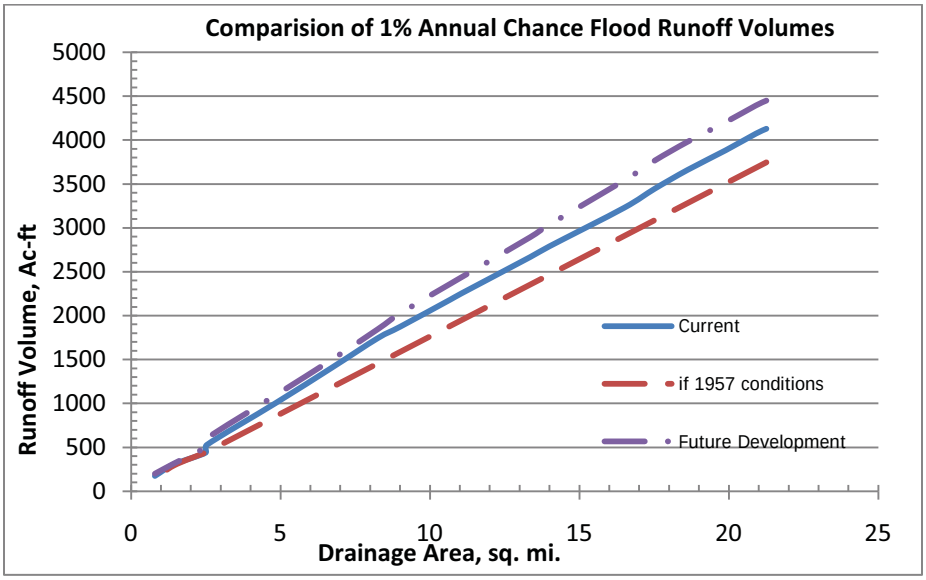


Figure 3-5 Comparison of 1% (100-year) Annual Chance Flood Runoff Volumes

As shown in Figure 3-5, the volume of runoff increases with development. The County and Cities have recognized the impacts development can have on runoff volumes to the extent that increased runoff volume causes increased peak discharges along with the increased volume. Communities have tried to address the peak discharge aspect by requiring the delay and attenuation of the runoff hydrograph. (Expected impacts of development on the peak flows in the watershed are described in following sections.) As seen in Figure 3-5, attenuating the hydrograph does not address the increased runoff volume that still must flow through the streams, potentially causing increases in peak discharges at some location downstream. Increases in runoff volume itself due to development need to be addressed.

3.6.2 Peak Flows – Williams Creek

Current release rates generally appear to be adequate to prevent increases in the peak 1% and 10 % annual chance flows in Williams Creek.

Since 2006, an allowable peak discharge per developed acre has been used to regulate the flood discharges from development. Presently, in the Williams Creek watershed, these standards state that the allowable post-developed peak discharge from a site shall be no greater than 0.1 cfs/acre for the 0-10 year return interval storms and 0.3 cfs/acre for the 11-100 year return interval storms. These standards are expected to continue to be enforced so were applied to future expected development areas in the modeling in the same way as used for existing development. The model details are described in Appendix 4.

A graphical comparison of the 1% (100-year) annual chance discharges for the 1957 agricultural conditions, existing conditions, and expected developed conditions is shown in **Figure 3-6**. (The "step" at the smaller discharges is due to the inclusion of Spring Mill Run and Clay Creek

tributaries at their confluence with Williams Creek in addition to points along Williams Creek itself.)

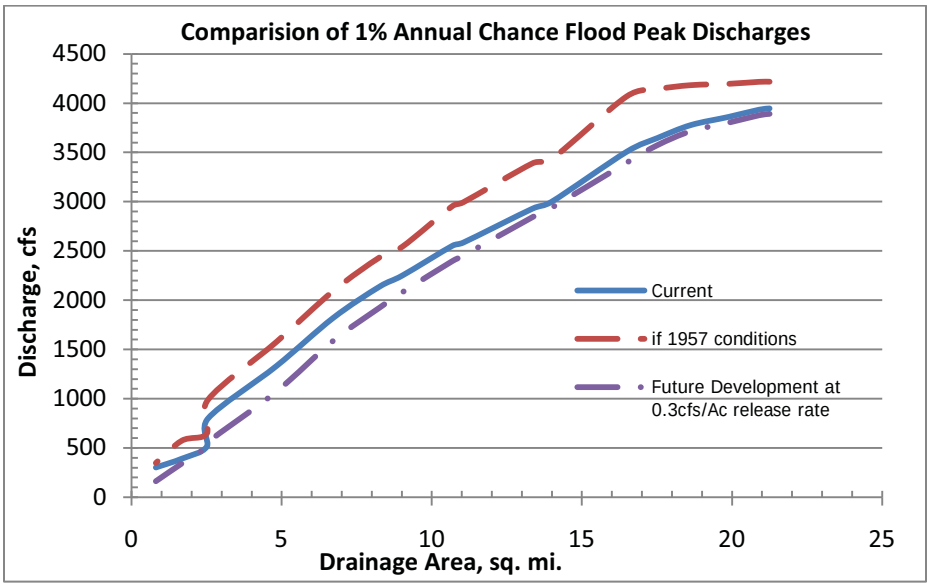


Figure 3-6 Comparison of 1% Annual Flood Discharges along Williams Creek

Comparisons of the discharges for the 10% (10-year) and 50% (2-year) annual chance frequency rainfalls are shown in **Figure 3-7** and **Figure 3-8**.

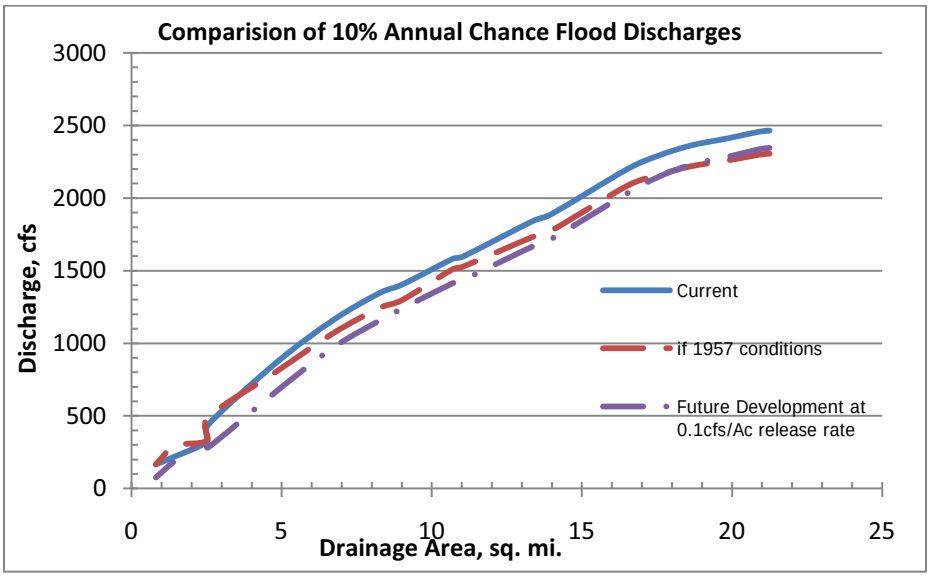


Figure 3-7 Comparison of 10% Annual Flood Discharges along Williams Creek

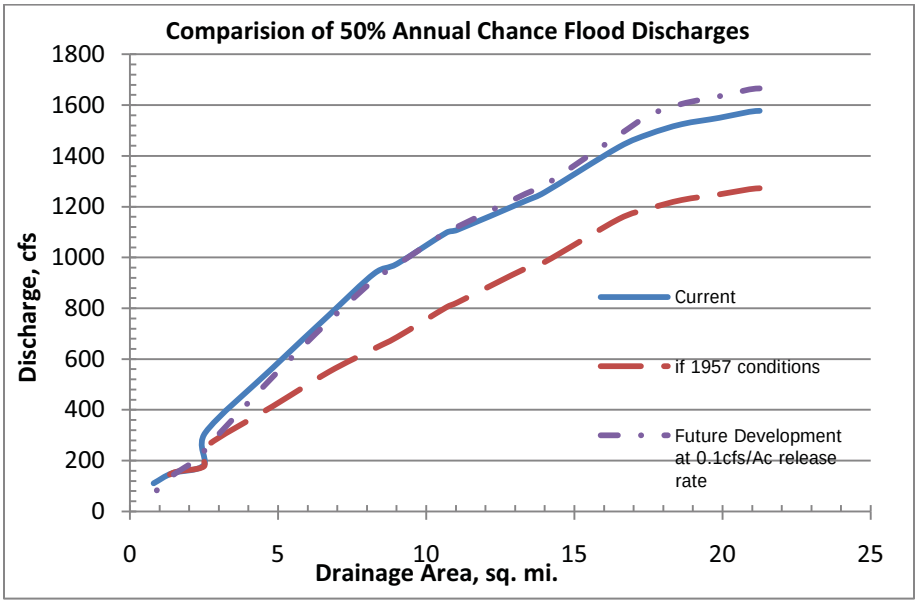


Figure 3-8 Comparison of 50% Annual Discharges along Williams Creek

Based on these results, it appears that future development will continue to increase the runoff potential of the land, but, the detention (release rate) requirements should be sufficient to generally prevent increased flows in Williams Creek. Figure 3-8 shows some increase in the 50% annual chance flood downstream of Hamilton County. Actual detention basins were not modeled; therefore, this increase may be attributed to the generalized assumptions made for the modeling.

3.6.3 Peak Flows – OF Henley Drain & Williams Creek Watershed Upstream of 146th Street

Under existing conditions, portions of the OF Henley Drain and Williams Creek watersheds are subject to ponding in the fields north of 146th Street. Because of Indiana Department of Transportation (INDOT) road design requirements, the proposed new culverts under 146th Street have a much larger capacity than the exiting culverts. While this eliminates road overflow for all but extreme floods, it does increase the more frequent discharges downstream because it eliminates the opportunity for storage of water that presently occurs up to the point that the road overtops. These increased discharges will be reduced back to the existing rates, or lower, once the upstream area is developed and detention is added to meet the default allowable release rates. In the meantime, increased flows can be expected downstream of 146th Street.

3.6.4 Flood Duration – Williams Creek

The presence of detention in the watershed as well as the changes in land use also affect the duration of flooding along Williams Creek. A hydrograph shows the flow versus time at a particular point along the stream. **Figure 3-9** provides an example of the changes that future development is expected to create on the hydrograph. The red line is the flow versus time if the 1% (100-year) annual chance rainfall occurred on the 1957 agricultural land. The blue line shows the shift that has occurred due to already existing development. The sky blue line shows the expected shift due to future development. The comparison shows that although the peak flow is expected to be reduced slightly (due to restrictive release rates) by future development, flows will be maintained at given elevations for longer periods of time. For example, the length of time the stream was at or above the elevation associated with the peak discharge from the June 2008 (approximately a 50% (2-year) annual chance rainfall), is expected to increase another two hours over the two hour increase that existing development has already caused. The recently installed USGS gage at 96th Street will provide data that will be of benefit in the future to show the extent to which this happens in the watershed, as well as to determine the relationships between discharge, stages and rainfall as time goes on.

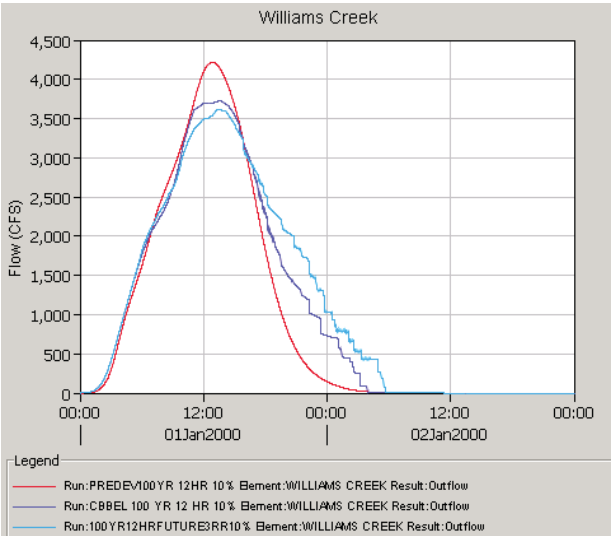


Figure 3-9 Comparison of 1% Annual Chance Hydrograph for Representative Location Under 1957 (red), Current (indigo), and Future (sky blue) Conditions.

3.6.5 Future Floodplain Delineations

Each of the creeks, streams, regulated drains, and other water courses within the watershed has some degree of flood risk associated with it. Regulations are in place to protect future buildings from being constructed below the 1% annual chance flood elevation. Most of the identified area has already been developed around so little additional development is expected near or in those areas. There is still room for development along some of the tributaries where the flood risk has not been identified. Carmel, Westfield, and Hamilton County ordinances require that the flood risk along unstudied streams be determined before permits are granted. If these ordinances continue to be enforced, future structures should continue to be placed above the 1% annual chance flood risk areas.

Steep floodplain limits have prevented construction of buildings near the 1% annual chance flood base flood eleveation (BFE) in the lower half of the watershed but structures are generally closer to the BFE limits in the upper

Approximately 85 buildings are located on ground within 2 feet above the 0.2% (500-year) annual chance flood levels.

portion of the watershed as shown by **Figure 3-10**. This figure shows how close structures are to the 1% annual chance base flood elevation (BFE), the 0.2% annual chance flood, and the 0.2% annual chance flood plus 2 feet. These results are based on the flood elevations compared to the Hamilton County 1 foot contour interval mapping elevations. Actual first floor elevations should be higher unless basements were constructed. Most of this reach does not currently have a BFE established in the FIS.

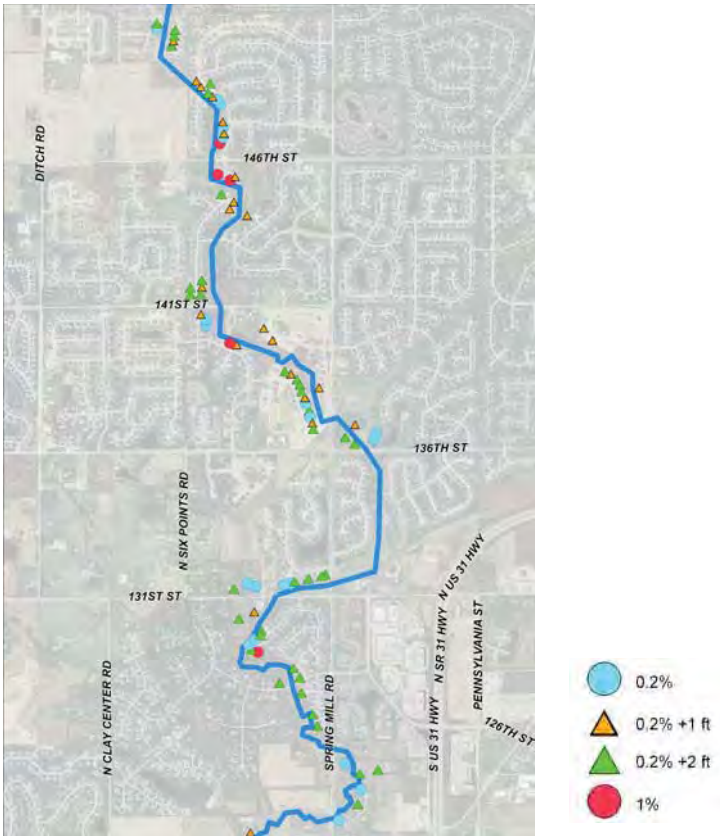


Figure 3-10 Structures Susceptible to Increases in Flood Elevations

To determine the sensitivity to channel maintenance (or a lack thereof) on floodprone status, the hydraulic model of Williams Creek was run with a channel roughness coefficient of 0.09 representing very overgrown channel banks and growth or debris within the channel itself. Resulting 10% and 1% annual chance flood elevations were increased by up to 2 feet (in the lower portion of the watershed). Generally, increases were around 1 foot.

The number of structures and the difference from the 1% and 0.2% annual chance flood elevations determined in this Master Plan are shown graphically in **Figure 3-11**. This data provides a general idea of the susceptibility of structures along Williams Creek to increased flood elevations.

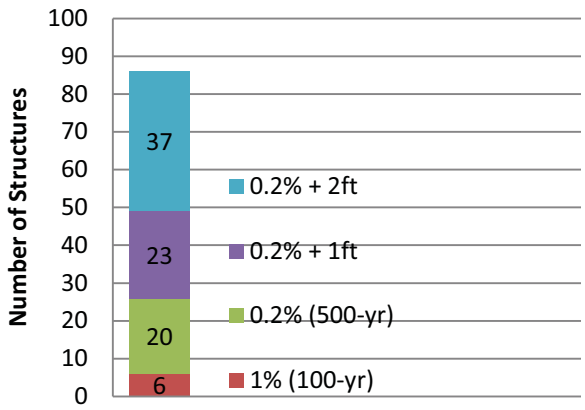


Figure 3-11 Number of Structures Susceptible to Various Increases in Flood Elevations

3.7 SITE SPECIFIC FLOOD CONCERNS

Several site specific existing concerns were described in Chapter 2. The impact of anticipated future conditions on those concerns is described in this chapter. The site specific concerns as shown on **Figure 3-12** included: potential flooding of 6 buildings, and road overtopping at 141st Street and Francis Court from Williams Creek, 106th Street from Thomas Hussey Drain, and Spring Mill Road south of 106th Street.

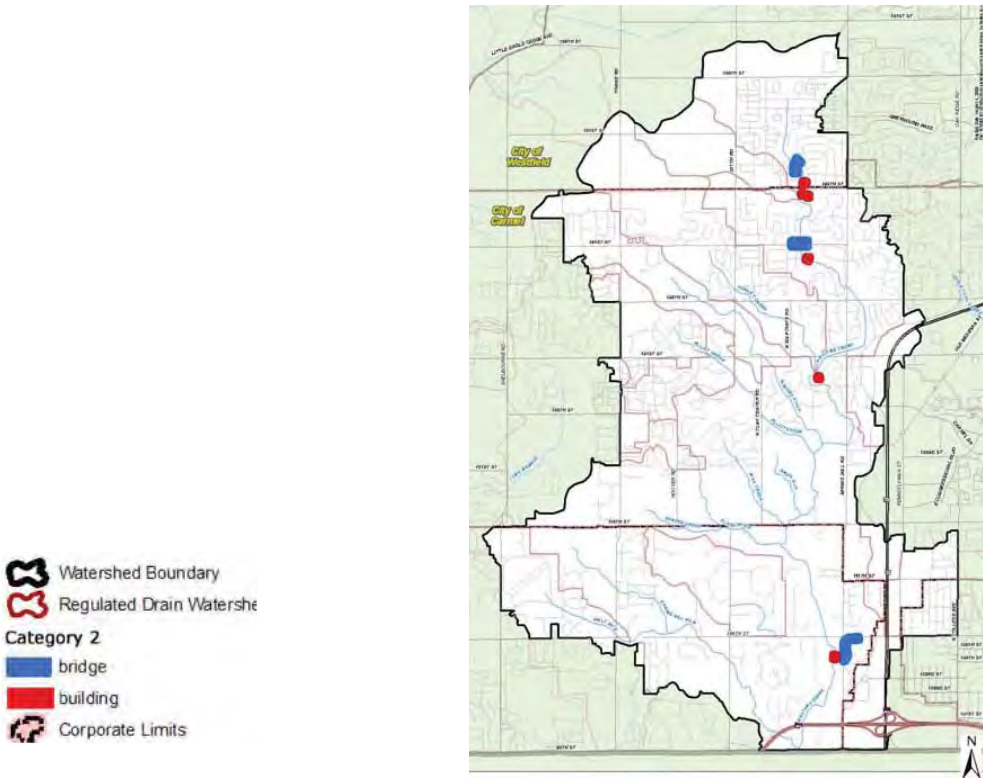


Figure 3-12 Buildings/Bridges Potentially Located in 1% Annual Chance Floodplain

Additional development that is assumed to occur in the watershed was modeled and the results were shown in Section 3.6. Based on those results, the 6 structures currently in the floodplain would have negligibly lower flood risks. Overtopping of 141st Street would continue for the 1% annual chance flood. Overtopping of Francis Court during the 1% annual chance flood may be eliminated with the anticipated development and associated detention upstream. This is based on generalized assumptions for the upstream development. Therefore, actual results may not be as much of a decrease as the models calculated. A slight increase in discharge (with almost no increase in water surface elevations) is expected at 106th Street and Thomas Hussey Drain. If the flood storage area upstream were to be reduced by development, flooding would be expected to increase. Current ordinances, if enforced, should prevent such increases. Flooding of Spring Mill Road would not change significantly with the addition of the detention required by the ordinance in the undeveloped portions of its watershed.

Future land use conditions in the watershed do not eliminate the site-specific flood concerns identified in Chapter 2.

3.8 REGULATIONS

3.8.1 General Description of Regulatory Jurisdictions within the Watershed

Hamilton County and the Cities of Carmel and Westfield are the current local governmental entities with jurisdictions within the watershed. Future jurisdictional limits in the watershed are shown in **Figure 3-13**. Carmel is in the process of annexing the area in the watershed south of 116th Street. After annexation, the area north of 146th Street will be in Westfield and the portion south of 146th Street (except for the Home Place Area, located north of 106th Street and east of US 31) will be under Carmel jurisdiction. Regulated drains within the watershed will remain under the jurisdiction of the Hamilton County Surveyor. In addition, the IDNR, USACE, EPA, and IDEM also have stormwater related requirements that the communities and county are responsible for seeing are met.

Hamilton County, the City of Carmel, and the City of Westfield are the local governmental entities with jurisdictions within the watershed.

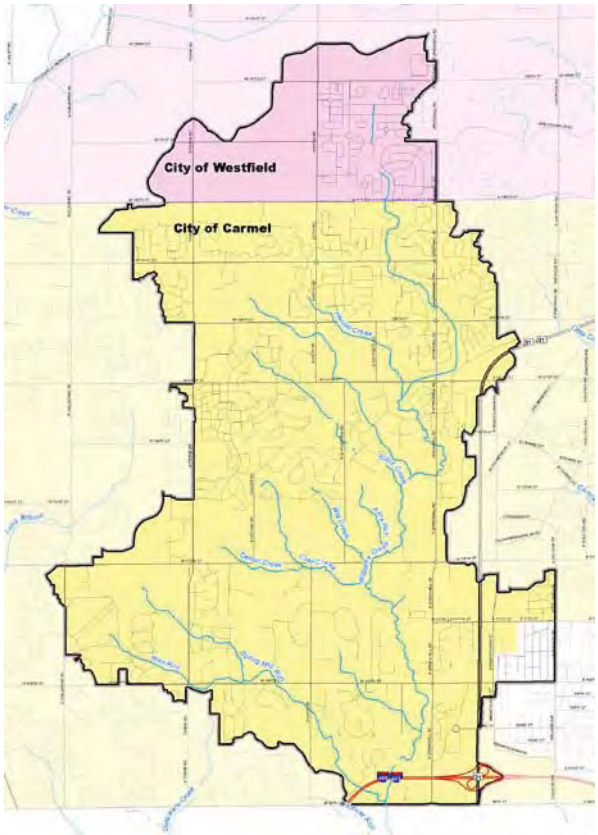


Figure 3-13 Future Corporate Limits in the Williams Creek Watershed

3.9 STORMWATER RELATED PROJECTS

Future projects within the watershed are expected to include regular maintenance of stormwater facilities. Road projects that are currently planned within the watershed include the replacement of the 146th Street culvert over Williams Creek. It is currently anticipated that the structure will be replaced with a 10 ft X 6 ft or 12 ft X 6 ft box culvert in the year 2012. This structure is larger than the existing and should not increase upstream water surface elevations. The anticipated new structure is slightly larger so may increase downstream discharges slightly.

Towne Road improvements have been designed between 131st and 146th Streets. These improvements include changes to drainage structures under the road to relieve upstream flooding and road overflow. Enlarging these structures may cause increased discharges downstream for certain frequency storms if the detention currently occurring upstream of the road is not replaced.

As part of the annexation agreement for the part of the watershed south of 116th Street, a drainage study titled Southwest Clay Township Annexation

Master Drainage Plan was completed in July 2009. This study notes various drainage related concerns in subdivisions in the watershed. These actions are expected to be completed as funds allow.

3.10 SUMMARY OF CONCERNS

As noted in the previous sections, various concerns related to the future condition of the watershed have been identified beyond those noted for existing conditions. These concerns are listed below:

- Wetland preservation and enhancement
- Stormwater quality improvement
- Increased bankfull discharges and subsequent erosion
- Increases in runoff volume
- 146th Street and Towne Road drainage improvements potential to increase downstream discharges on certain frequency storms unless storage is replaced
- Susceptibility to flooding of several structures in the upper half of the watershed if channel capacity is reduced or rainfalls larger than the 1% annual chance storm would occur.

Recommendations to address these stormwater concerns will be discussed in Chapter 5 of this Master Plan.

CHAPTER 4 WATERSHED GOALS AND EVALUATION CRITERIA

In order to address stormwater related issues in the watershed, goals and the preferred level of service to the public had to be determined. While complete protection of the watershed is a good goal, the cost to achieve it in every area is not always a wise use of available resources. A practical level of protection therefore needed to be determined so that the activities with the most value would become the focus of this plan. To accomplish this, meetings were held with staff from the City of Carmel Engineering Department and the Hamilton County Surveyor's Office. Based on the level of protection that the communities selected as practical to provide to the public, the following criteria should be met by any recommended actions:

4.1 WATERSHED GOALS

1) Reduce Flooding and drainage problems
2) Improve water quality of stormwater runoff
3) Protect, enhance, and restore natural systems for stormwater conveyance and storage.

4.2 EVALUATION CRITERIA

Based on the nature and extent of existing and future stormwater conditions and concerns presented in Chapters 2 and 3, the following set of technical, environmental, and economic criteria were developed to aid in the formulation and screening of potential alternatives.

4.2.1 Technical Criteria:

- Create at least one lane width that is open for road and bridge traffic during a 1% annual chance (100-year) storm
- Provide for at least 2 foot of freeboard for the lowest adjacent grade during the 1% annual chance (100-year) flood for residential and commercial structures
- Prevent development/redevelopment from having an adverse impact on upstream or downstream flood levels
- Address drainage concerns by identification of the cause, clarification of the public or private responsible party, and requirement of that party to solve in a manner that does not cause additional drainage problems on adjacent, upstream, or downstream properties.
- Prevent an increase in runoff from development/redevelopment sites

- Eliminate wet basements if the cause is something that is under the City or County jurisdiction
- Contradict no codes/policies unless a related revision is recommended

4.2.2 Economic Criteria:

- Select fundable options or those which require no funding
- Reduce economic damages resulting from flood events

4.2.3 Environmental Criteria

- Create no significant and/or permanent negative impacts on the environment, recreational opportunities, and /or fish and wildlife resources
- Maintain or enhance wetland aquatic and terrestrial species based on USFWS/IDEM classification systems (a wetlands classification system used by the U.S. Fish and Wildlife Service to map and inventory wetlands)
- Enhance the natural and beneficial function of floodplains, channel connectivity to the floodplain, pond-riffle-pond sequence, and natural sinuosity based on such methods as the Rosgen stream classification system (a widely-used method for classifying streams on the basis of channel morphology, or form, used to aid the understanding of stream condition and potential behavior under the influence of different types of changes)
- Meet ordinance requirements
- Limit the loss of wetland aquatic/terrestrial species
- Enhance water quality to the point of having a QHEI score of at least 60 when possible. (The qualitative habitat evaluation index (QHEI) represents a measure of the physical and biological conditions of a particular stream site. This comprehensive assessment is critical for evaluating the disturbance and land use practices in the watershed.)

4.2.4 Institutional Criteria

- The recommended improvement plan must be acceptable to Hamilton County, City of Carmel, and City of Westfield officials as well as the affected residents of these communities and incorporated areas.
- The recommended improvement plan must be permittable under existing federal, state, and local permit programs.

CHAPTER 5 RECOMMENDATIONS FOR IMPROVEMENT & ADDRESSING CONCERNS

This Chapter lists recommendations for addressing concerns identified in Chapters 2 and 3 of this Master Plan. The recommendations have been grouped by the section of the previous chapters in which the concern was identified. Each issue, concern, or opportunity is briefly restated and followed by a list of potential alternatives for addressing the issue (if different than the recommended action(s)), an evaluation of the potential alternatives (if applicable), a list of the recommended action(s), and an estimate of the associated costs (if applicable). The cost estimates provided are conceptual level only. A list summarizing all of the recommended improvements is provided at the end of this chapter. **Chapter 6** of this Master Plan will focus on implementation aspects of the identified recommendations.

5.1 LAND USE

1) Land use practices can influence the overall health of local waterways. Changes in land use may result in increased imperviousness and stormwater runoff as well as loss of valuable open space along streams needed to filter and store stormwater. Because of this relationship, the Center for Watershed Protection Stormwater Management Manual recognizes land use planning as the first BMP to reduce stormwater issues.

   Recommended Actions:

   - Review development codes to determine how stormwater friendly they are. The EPA, Center for Watershed Protection, and the Upper White River Watershed Alliance have each developed similar tools to allow an in-depth review of the standards, ordinances, and codes that shape how development occurs.
   - The Central Indiana Land Trust (CILTI) has developed maps of key working lands and natural landscapes critical to the maintenance and enhancement of green infrastructure network in Central Indiana. This includes hubs, cores, and corridors of forests, wetlands, and aquatic systems. This plan could be used to help guide how and where future development or redevelopment occurs. It is recommended that the recommendations from the Central Indiana Green Infrastructure Project be integrated into the Comprehensive Plans and development Ordinances.
   - Encourage the utilization of Low Impact Development (LID)/green approaches in meeting post-construction stormwater requirements

Estimated Cost: $9,500 ($2,000 for staff or a consultant to review development ordinances and fill out the Code and Ordinance Worksheet, $2,500 for staff or a consultant to review the Green Infrastructure Project and incorporate it into the Comprehensive Plans, and $5,000 for staff or a consultant to incorporate concepts into development ordinances)

2) Carmel's Comprehensive Plan for the US 31 corridor is encouraging large lawn areas to improve aesthetics. This creates an opportunity to use the area for aesthetic and water quality benefits.

Recommended Action(s):

- In the early stages of Carmel's process of working with developers along US 31, Carmel should encourage the developers to include rain gardens, bioretention basins, increased flow paths, disconnected impervious areas, etc. to reduce stormwater runoff to streams and improve water quality as they meet their aesthetic goals. A system will also need to be established to make sure long term maintenance of these components is carried out.

Estimated Cost: this activity would be part of existing review programs, cost for construction would be the developer's responsibility.

5.2 WETLANDS

1) Not all wetlands are delineated on the NWI mapping. The NWI is a large scale guide and may predate the development of newer wetlands.

Recommended Action(s):

- Require wetland delineations by a qualified professional on any site prior to development.

Estimated Cost: $2,000 - $8,000 (cost born by developer)

2) Often the focus of developers is on how to execute the preferred site plan rather than working with the existing aquatic resources at a site.

Recommended Action(s):

- Work with a developer to encourage creation of proposed site plans that minimize disturbance of wetland areas, provide 50-foot minimum buffers around wetlands, and preserve the wetland hydrology source (overland flow, groundwater, seasonal flooding, etc.)
- Consider mitigation only when impacts are unavoidable.

Estimated Cost: $500 staff time per development

3) The USACE and IDEM do not regulate alteration of the hydrology in wetlands by draining. Currently these agencies only regulate the placement of fill. This allows the hydrologic function of a wetland to be modified and could cause a previously determined wetland area to become non-wetland.

Recommended Action(s):

- Establish a regulation prohibiting draining or diverting a water source from a delineated wetland.

Estimated Cost: $5,000 for staff time or assistance from a consultant to develop ordinance language

4) Wetland mitigation is often un-successful and does not replace the wetland values and functions that were lost.

Recommended Action(s):

- Require mitigation at a higher ratio than the USACE and IDEM in order to ensure that the acreage, value, and functions of an impacted wetland are replaced.
- Technically evaluate mitigation plans for feasibility and probability of success.
- Require additional monitoring and maintenance beyond the five years required by the USACE and IDEM to show that a wetland mitigation site will be successful long-term.

Estimated Cost: $1,000 per site to technically evaluate mitigation plans, $5000 to update requirements, and provide training for staff

5) Mature wetlands, particularly forested riparian sites, take many years to develop. Forested wetlands provide a higher flood storage capacity than emergent sites, and also contain a larger diversity of plant and animal species. When forested wetlands are located along stream corridors, they are of particular importance because they provide travel corridors for wildlife through otherwise heavily developed areas. Buffering stream corridors and wetland areas with undeveloped native upland areas and/or additional wetland habitat is important to prevent pollutants from disrupting these areas and to provide transition areas for wildlife.

Recommended Action(s):

- Require a higher mitigation ratio for forested wetlands to discourage avoidable impacts.

- As wetland mitigation sites are selected, encourage pursuit of wetland mitigation in floodplains to increase flood protection.
- Expand forested buffers along stream corridors to protect existing wetlands from pollutants and to provide travel corridors for wildlife.

Estimated Cost: $5,000 for staff or a consultant to develop ordinance language increasing local mitigation ratios

6) Existing wetland sites, particularly within developed areas, are becoming inadvertently impacted due to runoff and pollutants.

Recommended Action(s):

- Increase wetland buffer and setback requirements to filter pollutants before they can enter a delineated wetland area.

Estimated Cost: $5,000 to develop ordinance language in-house or with assistance from consultant

7) It has been shown through years of research that larger (50 acres plus), third party controlled, wetland sites provide more benefit to wildlife and have a higher probability of being successful than isolated wetland mitigation sites interspersed throughout urban areas. It is very difficult for wildlife, particularly reptiles and amphibians to inhabit sites that are surrounded by development and not connected to other natural areas.

Recommended Action(s):

- Identify large scale wetlands mitigation bank opportunities within the Williams Creek Watershed and establish a mechanism to use the selected sites.

Estimated Cost: Preliminary locations have been identified in Chapter 3. Additional cost would be $5,000 to identify opportunities and establish a mechanism for use of those sites

5.3 STORMWATER QUALITY

1) Stream corridor habitat/physical evaluations conducted during the development of this Master Plan identified several sites that had QHEI scores less than 60. These include Site 4, Site 8, Site 9, and Site 10

Recommended Action(s):

- Identify BMPs (structural and non-structural) for each site that had a low QHEI score

Estimated Cost: $2000 staff time or consultant to identify BMPs

2) Macroinvertebrates are good indicators of the overall health of the stream. Biological sampling conducted during the development of this Master Plan identified sites that had PTI scores below 10 (between poor and fair). These include Site 4, Site 7, and Site 9.

   Recommended Action(s):

   - Conduct additional macroinvertebrate sampling to determine a more representative sample and confirm the condition of the macro-invertebrates and thus the stream health
   - If sampling results continue to show poor scores, initiate a study of causes for the poor scores, such as lack of stream canopy, chemicals in the water, lack of habitat requirements, etc.

   Estimated Cost: $400 per site per macro-invertebrate collection and identification and $2,000 for study of the causes of poor scores if needed

3) The Williams Creek Watershed has numerous small stormwater ponds that are managed by local homeowners associations. Depending on the design and maintenance practices, these ponds may not be functioning as well as they could to improve local water quality.

   Recommended Action(s):

   - Conduct a pond workshop to educate homeowners associations about the function, design, and maintenance practices of stormwater ponds.

   Estimated Cost: $5000 staff time or consultant to prepare for and facilitate pond workshop; cost of materials distributed at workshop could be covered by registration fee from attendees.

4) Current Stormwater Management Ordinance and Technical Standards requires post-construction BMPs to remove 80% TSS from stormwater runoff but does not target other pollutants of concern such as nutrients (nitrogen and phosphorus), metals, and *E. coli.*

   Recommended Action(s):

   - Update the Stormwater Management Ordinance and Technical Standards to include removal requirements for nutrients, metals, and *E. coli*.

   Estimated Cost: $2,500 each for Carmel, Westfield, and Hamilton County to draft such additional language for local adoption and implementation

5.4 STREAM MORPHOLOGY

1) Modeling shows that development in the watershed will increase the channel forming discharge and therefore contribute to additional erosion of the stream banks.

   Recommended Action(s):

   - Add a channel protection volume requirement to the Stormwater Management Ordinance and Technical Standards. Channel protection is typically achieved by matching the post-construction runoff volume and rate to the pre-settlement condition for all runoff events up to the bankfull flow. However, due to difficulties in determining the pre-settlement conditions, the net control of runoff resulting from a 1-year, 24-hour storm in proposed conditions can be established as the standard for channel protection. The bankfull flow in most Indiana streams correlate with 1.5- to 2-year flood event flow.

   Estimated Cost: $2,500 each for Carmel, Westfield, and Hamilton County to draft such additional language for local adoption and implementation

2) Some erosion of the stream banks was observed along Williams Creek. These do not presently appear to cause problems. Solution ideas are offered for use in the future should these or other areas become an issue.

   Potential Recommended Action(s) if needed in the future:

   - enhance stream bank with deep-rooted, mesic prairie vegetation (both sides – mow for access) and with native trees and shrubs (one side – no access)
   - incorporate 2-stage ditch design for flood control and water quality benefit
   - use grade control to maintain channel slope
   - vegetative buffer (natives) to trap and filter pollutants carried by stormwater
   - maintain established setbacks (including outbuildings, walls, etc.)
   - Promote the use of LID BMPs to intercept stormwater at the source, filter, temporarily store, and slowly release runoff to receiving streams reducing streambank erosion.

   Estimated Cost: $15,000 each for Carmel, Westfield, and Hamilton County to identify appropriate LID BMP practices, and draft language for local adoption and implementation

5.5 GENERAL FLOOD CHARACTERISTICS

1) Six structures identified as potentially located in the 1% annual chance floodplain

   Recommended Action(s):

   - Encourage homeowners to obtain information regarding the lowest adjacent grade for their house. If it is near the BFE, homeowners should seriously consider purchasing flood insurance.
   - Make sure ordinances are enforced so that flood elevations are not increased by upstream land use changes.
   - Every 10 years or after a significant flooding event, revisit hydrologic modeling in relation to the additional years of stream gage record to verify that flood levels are not increasing for given rainfalls.

   Estimated Cost: no additional cost to the community

2) Increased water surface elevations if the Williams Creek channel is not maintained in its present condition (free of debris in the channel, trees on channel banks with small amounts of underbrush, brush doesn't cross the channel)

   Potential Solutions:

   a) Establish/continue regular maintenance plan
   b) Clear one side of the channel to reduce resistance to flow and to allow access to the channel for removal of debris. (This alternative would be detrimental to the water quality goals of the watershed.)
   c) Use revised floodplain elevations developed as part of this Master Plan to enforce requirements for 2 feet of freeboard for the lowest adjacent grade (including walkout basements) of any structure in the floodplain or in the "BFE plus 2 feet floodplain".

   Recommended Action(s):

   - Establish/continue regular maintenance plan to keep channel free of debris
   - Use revised floodplain elevations developed as part of this Master Plan to enforce requirements for 2 feet of freeboard for the lowest adjacent grade (including walkout basements) of any structure in the floodplain or in the "BFE plus 2 feet floodplain". Delineate the limits of the area inundated by the BFE plus 2 feet flood elevations for use in regulatory functions.

Estimated Cost: cost of the maintenance is included in the watershed assessment fees. Cost to generate the "BFE plus 2 feet inundation area" map is estimated at less than $1,000.

3) New floodplain delineations show revised flood risk areas

Recommended Action(s):

- Communities should begin immediately to use the floodplain delineation upstream of 131st Street (where no detailed FIS study exists) for regulatory purposes.
- Submit the entire study of Williams Creek to IDNR and FEMA for inclusion in the next FIS revision (IDNR is reviewing the study and has already obtained FEMA money to include the study in the next FIS revision. Contract details are currently being finalized.)

Estimated Cost: no additional cost to the community

4) Detailed flood risks are not identified on Clay Creek, Henley Creek, Almond Ditch, Elliott Creek, or Spring Mill Run

Recommended Action(s):

- Propose the addition of Spring Mill Run and Almond Ditch to the Williams Creek coordinated discharge curve for regulatory purposes based on data in Appendix 4
- Conduct additional analysis of the parameters in the IDNR HEC-HMS model for Elliot Creek and Henley Ditch to confirm or revise the discharges calculated
- Make a proposal for coordinated discharges on Elliot Creek and Henley Creek to use for regulatory purposes.
- Conduct hydraulic studies to identify floodplains/floodway on all four streams, then use as best available data for local regulatory functions

Estimated Cost: The determination of the Clay Creek floodplain and floodway is underway. The cost of the study to determine the floodplains and floodway for the remaining stream reaches under IDNR jurisdiction (approximately 5 miles) is estimated at $30,000 - $36,000, depending whether all the streams are studied at once or separately.

5.6 SITE SPECIFIC FLOOD CONCERNS

1) 106th Street west of Laurelwood Drive is overtopped in the 1% annual chance flood. A wall constructed on the downstream side increases flood stages.

Potential Solutions:

a) Require removal of the wall or replacement of portions of the wall with materials that allow flood waters and debris to flow through sufficient area so as to prevent water surface elevation increases
b) Replace the culvert with a larger structure that would prevent road overflow in the 1% annual chance flood
c) Investigate opportunities for holding more water in portions of the watershed upstream of 106th Street

Recommended Action(s):

- Replace the culvert with a larger structure that would prevent road overflow in the 1% annual chance flood. This alternative would meet the evaluation criteria of having a travel lane open during the 1% annual chance flood

Estimated Cost: approximately $70,000

2) 141st Street at Williams Creek is overtopped by the 10% annual chance flood

Potential Solutions:

a) Replace the culverts with a larger structure
b) Raise the road
c) Create detention areas upstream

Recommended Action(s):

- Replace the culverts with a larger structure. This is the cheaper alternative and meets the criteria for providing a flood free travel lane during the 1% annual chance flood event

Estimated Cost: approximately $70,000

3) 146th Street between Towne Road and Ditch Road often floods.

Potential Solutions:

a) Make sure downstream owners are protected from potential increases in the 10% annual chance flood which may be increased once culverts under the road are improved and before upstream detention is provided with future developments
b) Require the culvert replacements to include replacement of lost storage. (perhaps could then be paid back by developments in lieu of site detention)
c) Create planned storage areas upstream of the road that would prevent impacts to the road from storage at the road culverts and over the road.

d) Divert runoff to constructed wetland at southeast corner of 146th and Ditch Road

Recommended Action(s):

- Require the culvert replacements to include replacement of lost storage. This option prevents negative impacts downstream
- If culvert replacements cannot include replacement of lost storage then make sure that downstream owners are protected from potential increases in the 10% annual chance flood which may be increased once culverts under the road are improved and before upstream detention is provided with future developments.

Estimated Cost: approximately $1,000 for staff time to coordinate the recommended actions

4) Francis Court is overtopped between the 10 and 50-year floods

Potential Solutions:

a) Replace the culverts with a larger structure
b) Raise the road
c) Create detention areas upstream

Recommended Action(s):

- Replace the culverts with a larger structure. This is the cheaper alternative and meets the criteria for providing a flood free travel lane during the 1% annual chance flood event

Estimated Cost: approximately $70,000

5) Spring Mill Road south of 106th Street floods almost yearly

Potential Solutions: (a detailed description of solutions and their evaluation is provided in **Appendix 9**)

a) Raise Spring Mill Road
b) Investigate opportunities for holding more water in portions of the watershed upstream of 106th Street (in-line or off-line detention basins, underground storage, increase size of existing ponds)
c) Replace culverts with larger structure
d) Construct bypass channel/culvert for the tributary flow

Recommended Action(s) (a detailed description is provided in Appendix 8):

- raise Spring Mill Road
- increase size of culverts under Spring Mill Road

- raise private drive to act as a levee

Estimated Cost: $575,000

6) Towne Road just south of 146th Street sometimes floods due to a blocked culvert

Recommended Action(s):

- Develop plan for regular removal of debris
- Locate and control source of debris that blocks the culvert
- Wait to see if planned improvements to the road eliminate the problem

Estimated Cost: already included in existing program activities

7) Private property dam on Williams Creek south of 106th Street increases flooding upstream which impacts Spring Mill Road

Potential Solutions:

a) Remove the dam and restore the area to channel shape consistent with downstream reaches
b) Raise Spring Mill Road above the 1% annual chance flood elevation

Recommended Action(s) (a detailed description is provided in Appendix 9):

- Raise Spring Mill Road above the 1% annual chance flood elevation since the dam is not the only cause of flooding on Spring Mill Road

Estimated Cost: included in other alternatives

5.7 REGULATIONS

1) Permit requirements are a key tool for improving water quality and controlling stormwater runoff in the watershed. Watershed residents need to be aware of the permit requirements and jurisdictional limits.

Recommended Action(s):

- post IDNR Construction in the Floodway jurisdictional limits on the county and city websites
- include links and instructions to local sites or FEMA Map Service Center web site for floodplain mapping

Estimated Cost: included in existing programs

5.8 MISCELLANEOUS STORMWATER RELATED PROJECTS

These concerns are to be addressed by Carmel/County as details are made known and as jurisdiction will allow. General ideas for solutions are presented here.

1) Crooked Stick Estates area experiences roadside ditch ponding from sedimentation, blockage of drainage path due to landscaping, rear yard swale ponding, and reports of drainage structure failures at various locations

   Potential Solutions:

   a) restore surface drainage systems
   b) educate public regarding the function of rear yard swales and landscaping impacts on drainage
   c) investigate the possibility of confining ponding to rain gardens/bioretention areas
   d) educate property owners regarding preservation of drainage paths

2) Crooked Stick West subdivision has clogged/aging culverts and experiences ponding on the street approach to Towne Road across Firestone Lane causing safety issues

   Potential Solutions:

   a) Investigate ways to prevent water from getting to the street approach to Towne Road (such as berms to redirect water, rain gardens to absorb rainfall, etc.
   b) Restore surface drainage systems in easements

3) Kings Mill subdivision has residences built in the upstream subdivision's overflow path for storms greater than the 1% annual chance flood. There is also some clogging of drainage structures which causes yard flooding.

   Potential Solutions:

   a) Create a new bypass for the overflow from the upstream subdivision
   b) Find and create opportunities upstream of the subdivision to hold more runoff
   c) Educate the public about keeping debris from drainage structures

4) Wet basement issues in Bridlebourne, Buckhorn, Crooked Stick West, Kings Mill, and Windemere subdivisions (or subdivisions developed in the future)

   Potential Solutions:

   a) Make sure all drainage infrastructure can operate as designed. This includes removing landscaping or structural features from drainage

swales, promoting the drainage of water away from residences, and making sure emergency spillways on ponds can function properly

b) Homeowners contacting local basement waterproofing companies for assistance

c) For future development, require lowest floor (including basement) to be 1-2 feet above the 1% annual chance flood elevation on nearby ponds that could affect the structure by flow through the ground or overland flow if there is a potential for the emergency overflow to become blocked (by debris or by landscaping)

5) Solutions for subdivision drainage problems require an understanding of what yards and streets were designed to drain along what paths, and to what points. Design plans are not always easy to obtain when problems develop years after the design is completed.

Potential Solutions:

a) Require developers to submit spatially referenced digital files of subbasins and flow directions and paths as part of the final approval process. The community/County should then archive these in a manner that they can access them in the future when if a problem develops.

5.9 SUMMARY OF RECOMMENDATIONS

Recommendations for the concerns identified in this Master Plan are listed below in **Table 5-1**. These recommendations were selected based on the evaluation criteria described in Chapter 4. More detailed actions needed to implement these recommendations are described in **Chapter 6**.

Table 5-1 Master Plan Recommendations

	Recommendation	Action to be taken by:	Cost paid by*:	Estimated Cost**	Master Plan Related Section
Study	Identify BMPs (structural and non-structural) for each site that had a low QHEI score (#4, 8, 9, & 10)	Westfield, Carmel, & County		$2,000	Stormwater Quality
	Confirm the condition of the macro-invertebrates at sites 4, 7, & 9. If continued sampling results show poor scores, initiate a study of causes	Carmel, & County		$400 per site, plus $2,000	Stormwater Quality
	Conduct hydraulic studies to revise/identify floodplains on Spring Mill Run, Elliot Ck, Henley Ck, and Almond D, then use as best available data for local regulatory functions	Carmel, & County		$28,000 - $34,000	General Flood Characteristics
	Address the items from the Southwest Clay Township Annexation Master Drainage Plan, 2009 as details are made known and as jurisdiction will allow	Carmel & County			Regulations
	Delineate the limits of the area inundated by the BFE plus 2 feet flood elevations for use in regulatory functions	Westfield, Carmel, & County		$1,000	General Flood Characteristics
Regulatory (Requirements or Incentives)	After major flooding or an additional 10 years of record for the stream gage at 96th Street, check for watershed changes or need to recalibrate hydrologic modeling	County		$1,000 - $5,000	General Flood Characteristics
	Review development codes to determine how stormwater friendly they are	Westfield, Carmel, & County		$2,000	Land Use
	Integrate recommendations from the Central Indiana Green Infrastructure Project into the Comprehensive Plans and development codes	Westfield, Carmel, & County		$7,500	Land Use
	Require wetland delineations by a qualified professional on any site prior to development	Westfield, Carmel, & County	developer	$2,000 - $8,000	Wetlands
	Establish a regulation prohibiting draining or diverting a water source from a delineated wetland	Westfield, Carmel, & County		$5,000	Wetlands
	Require mitigation at a higher ratio than the USACE and IDEM	Westfield, Carmel, & County		$5,000	Wetlands
	Technically evaluate mitigation plans for feasibility and probability of success	Westfield, Carmel, & County		$1,000 per site	Wetlands
	Require additional monitoring and maintenance of wetland mitigation sites	Westfield, Carmel, & County		$5,000	Wetlands
	Increase wetland buffer and setback requirements to filter pollutants	Westfield, Carmel, & County		$5,000	Wetlands
	Update the Stormwater Management Ordinance and Technical Standards to include removal requirements for nutrients, metals, and E.coli	Westfield, Carmel, & County		$2,500	Stormwater Quality
	Add a channel protection volume requirement to the Stormwater Management Ordinance and Technical Standards	Westfield, Carmel, & County		$2,500	Stream Morphology
	Encourage the utilization of LID/green approaches in meeting post-construction stormwater requirements	Westfield, Carmel, & County		$2,500	Land Use
	Make sure ordinances are enforced so that flood elevations are not increased by upstream land use changes	Westfield, Carmel, & County			General Flood Characteristics
	Use the floodplain delineation upstream of 131st Street for regulatory purposes	Westfield, Carmel, & County			General Flood Characteristics
	Propose the use of the discharges described in Appendix 4 for regulatory purposes along the Williams Creek tributaries	Carmel, & County			General Flood Characteristics
	Require the culvert replacements along 146th Street to include replacement of lost storage	Westfield & County		$1,000	Site Specific Flood Concerns
	Require lowest floor of structures to be 1-2 feet above the 1% annual chance flood elevation of nearby ponds	Westfield, Carmel, & County		$1,000	Miscellaneous Stormwater Related Projects
	Encourage developers along US 31 to include rain gardens, bioretention basins, increased flow paths, disconnected impervious areas, etc in the green aesthetic requirements for the corridor	Carmel			Land Use
	Require developers to submit spatially referenced digital files of subbasins and flow directions and paths as part of the final approval process	Westfield, Carmel, & County			Miscellaneous Stormwater Related Projects
	Work with a developer to encourage creation of proposed site plans that minimize disturbance of wetland areas, provide 50-foot minimum buffers around wetlands, and preserve the wetland hydrology source (overland flow, groundwater, seasonal flooding, etc.)	Westfield, Carmel, & County		$500	Wetlands
	Consider wetland mitigation only when impacts are unavoidable	Westfield, Carmel, & County			Wetlands
	Encourage pursuit of wetland mitigation in floodplains to increase flood protection	Westfield, Carmel, & County		$5,000	Wetlands
	Expand forested buffers along stream corridors	Westfield, Carmel, & County		$5,000	Wetlands
Maintenance	Establish/continue regular maintenance plan to keep the Williams Creek channel relatively free of debris	County			General Flood Characteristics
	Continue to fund the USGS Stream Gage at 96th Street	County		$6,000/yr	General Flood Characteristics
	Develop plan for regular removal of debris from the culvert under Towne Road just south of 146th Street or locate and control source of debris that blocks the culvert	Carmel			Site Specific Flood Concerns
Education	Post IDNR Construction in the Floodway jurisdictional limits on the county and city websites	Westfield, Carmel, & County			Regulations
	Identify and create large scale wetlands mitigation bank opportunities	Westfield, Carmel, & County		$5,000	Wetlands
	Work with the SWCD to conduct a pond workshop to educate homeowners associations about the function, design, and maintenance practices of stormwater ponds	Westfield, Carmel, & County		$5,000	Stormwater Quality
	Encourage homeowners shown by 1' contour mapping to be close to the BFE to obtain information regarding the lowest adjacent grade for their house, then purchase flood insurance if close	Westfield, Carmel, & County	homeowners		General Flood Characteristics
	Include links and instructions to local sites or FEMA Map Service Center web site for floodplain mapping	Westfield, Carmel, & County			Regulations
Construction	Replace the culvert at 106th Street west of Laurelwood Drive with a larger structure	County		$70,000	Site Specific Flood Concerns
	Replace the 141st Street culverts for Williams Creek with a larger structure	County		$70,000	Site Specific Flood Concerns
	Replace the Francis Court culverts with a larger structure	County		$70,000	Site Specific Flood Concerns
	Raise Spring Mill Road south of 106th Street, increase size of culverts under Spring Mill Road, raise private drive to act as levee	County		$575,000	Site Specific Flood Concerns

* Entry provided if different from the entity responsible for the noted action.

** Costs are for each item separately. Considerable cost savings are possible if appropriate actions are combined.

CHAPTER 6 IMPLEMENTATION PLAN

This chapter takes the recommendations identified in this Master Plan and summarized in Chapter 5 and breaks them down into steps that are needed to implement the recommendations. The recommendations have been grouped into the 5 categories noted in the summary sheet in Chapter 5: study, regulatory, planning, education, and construction. Where possible, specific steps to accomplish the recommendations have been provided.

6.1 STUDY

1) Identify BMPs (structural and non-structural) for each site that had a low QHEI score (sites #4, 8, 9, & 10)

    a) Review QHEI Field Sheets and identify metric that received the lowest scores
    b) Walk upstream/downstream to determine magnitude and extent of the problem.
    c) Depending on metric, magnitude, and extent of problem, identify appropriate structural and/or non-structural BMPs

2) Confirm the condition of the macr invertebrates at sites 4, 7, and 9

    a) Resample sites with low PTI scores
    b) Compare results with macro-invertebrates collected during the development of this Master Plan and QHEI scores for the same sites
    c) Walk upstream/downstream to determine source of physical or chemical stressor
    d) Identify structural and/or non-structural BMPs

3) Conduct hydraulic studies to revise/identify floodplains on Spring Mill Run, Elliot Creek, Henley Creek, and Almond Ditch

    a) Submit request to IDNR to include Spring Mill Run and Almond Ditch on the coordinated discharge curve for Williams Creek. Backup information to submit with this request is found in Appendix 4.
    b) Determine proposed coordinated discharges for use on Elliot Creek and Henley Creek based on an additional analysis to confirm or revise the parameters used by IDNR in the HEC-HMS model.
    c) Select consultant to create the models for these streams from the mouth to the limit of the IDNR jurisdiction as provided in this Master Plan. Include FIS profiles and mapping of the 1% and 0.2% annual chance floodplains, floodway, and BFE.
    d) Submit appropriate documentation of the models to IDNR for approval and inclusion in future FIS revisions

e) Use the approved IDNR mapping and BFE for local regulatory purposes as best available data until published in the FIS. (exception - Spring Mill Run already has floodplain/floodway identified in the FIS so that portion must be used for regulatory purposes until the FIS is revised)

4) Address the items from the 2009 Southwest Clay Township Annexation Master Drainage Plan as details are made known and as jurisdiction will allow

   a) Determine the appropriate jurisdiction to address each identified problem
   b) Gather available data
   c) Determine course of action to address each issue. This may include the decision to wait until additional information on the problem can be found.

5) Delineate the limits of the area inundated by the BFE plus 2 feet flood elevations for use in regulatory functions

   a) Identify whether this delineation is to be done using in house GIS capabilities or outside assistance
   b) Add 2 feet to the BFE determined in this Master Plan and delineate the associated inundation limits
   c) Once additional tributaries are studied, perform the same process on them
   d) Provide the inundation mapping to regulatory personnel for use in reviewing proposed construction elevations to make sure structures outside the 1% annual chance floodplain aren't lower than the BFE plus 2-foot freeboard requirement

6.2 REGULATORY/INCENTIVES

1) Revise various City/County regulations to incorporate additional requirements or incentives

   a) Select which of the following recommended revisions to local requirements will be implemented:

      - Require wetland delineations by a qualified professional on any site prior to development
      - Establish a regulation prohibiting draining or diverting a water source from a delineated wetland
      - Require wetland mitigation at a higher ratio than the USACE and IDEM

- Require additional monitoring and maintenance of wetland mitigation sites
- Increase wetland buffer and setback requirements to filter pollutants
- Update the Stormwater Management Ordinance and technical Standards to include removal requirements for nutrients, metals, and E. coli
- Add a channel protection volume requirement to the Stormwater Management Ordinance and Technical Standards
- Encourage the utilization of LID/green approaches in meeting post-construction stormwater requirements, including meeting channel protection volume requirements
- Use the floodplain delineation upstream of 131st Street for regulatory purposes
- Require the culvert replacements along 146th Street to include replacement of lost storage

b) Determine which regulations (ordinances, standards, policies,…) need to be revised to incorporate the selected requirements or incentives
c) Conduct research and create required language for additions to the appropriate regulations
d) Adopt and implement the selected language additions/revisions

2) Review development codes to determine how stormwater friendly they are.

a) Research and select the most appropriate development code review worksheet
b) Complete worksheet referencing appropriate ordinances and standards
c) Based on worksheet results, identify and prioritize areas for improvement
d) Add language to specific ordinances and standards
e) Adopt and implement new requirements

3) Integrate recommendations from the Central Indiana Green Infrastructure Plan into the Comprehensive Plans and development codes

a) Review the CILTI Green Infrastructure Plan
b) Using GIS create an overlay zone of the Green Infrastructure Network and Conservation and Managed Land Data
c) Integrate the Implementation Goals from the Green Infrastructure Plan into the Comprehensive Plan
d) Measure implantation success using the Indicators identified for each goal in the Plan

4) Technically evaluate wetland mitigation plans for feasibility and probability of success

    a) Determine whether this can be accomplished using in house resources or will require assistance from other professionals
    b) Revise review processes to include this step

5) Make sure ordinances are enforced so that natural resources are protected and flood elevations are not increased by upstream land use changes

    a) Periodically review approved development for compliance with the applicable regulations

6) Consider adding non-regulated stream reaches to the regulated drain rolls so that a funding mechanism exists to maintain these reaches as well as Williams Creek itself

6.3 MAINTENANCE

1) Establish/continue regular maintenance plan to keep the Williams Creek channel relatively free of debris. Conduct maintenance in a manner that minimizes disturbance and preserves the current vegetative corridor along the stream.
2) Until the culvert under Towne Road just south of 146th Street is replaced, locate the source of debris that blocks the culvert and develop plan for regular removal
3) Continue to maintain the USGS stream gage on Williams Creek at 96th Street

6.4 EDUCATION

1) Using City/County websites, post:

    a) IDNR Construction in the Floodway jurisdictional limits as approved in this Master Plan
    b) Include links and instructions to local sites for jurisdictional information
    c) Include links and instructions to the FEMA Map Service Center web site for floodplain mapping and FIS information
    d) Create brochures to assist homeowners in addressing wet basement issues

2) Work with developers as they come in to discuss plans to:

    a) Along US 31, encourage inclusion of rain gardens, bioretention basins, increased flow paths, disconnected impervious areas, etc. in the green aesthetic requirements for the corridor

b) Encourage creation of proposed site plans that avoid and minimize impacts to wetlands and streams
c) Consider wetland mitigation only when impacts are unavoidable
d) Encourage pursuit of wetland mitigation in floodplains to increase flood protection

3) Use City/County websites and information dissemination avenues to encourage residents to:

a) Expand forested buffers along stream corridors (provide guidance so that it's done in a way that still allows the Surveyor's office access to the creek in some way if needed to remove problematic debris
b) If shown by topographic mapping to be close to the BFE, obtain information regarding the lowest adjacent grade for their structure, and then explain the benefits of obtaining flood insurance based on the findings

4) Identify and create large scale wetland mitigation bank opportunities

5) Conduct a pond workshop to educate homeowners associations about the function, design, and maintenance practices of stormwater ponds

6.5 CONSTRUCTION

1) Replace culvert at 106th Street west of Laurelwood Drive over Thomas Hussey Drain, 141st Street over Williams Creek, and Francis Court over Williams Creek with larger structures

a) Use the 1% annual chance flood discharges from this study for design of structures that will allow the 1% annual chance flood to pass through the structure without overtopping the road
b) Obtain IDNR Construction in a Floodway approval
c) Obtain the required permits
d) Construct in a manner that minimizes disturbance to the stream bed

2) Raise Spring Mill Road south of 106th Street, increase size of culverts under Spring Mill road, raise private drive to act as a levee

a) Design the necessary road, culvert, and private drive improvements as generally outlined in this Master Plan
b) Obtain 404 and 401 permits as required. (IDNR construction in a Floodway permit is not required.)
c) Construct in a manner that minimizes disturbance to the stream bed or vegetation along the road

CHAPTER 7 REFERENCES

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APPENDIX 1

Macroinvertebrate Raw Data Sheets

POLLUTION TOLERANCE INDEX (PTI) SAMPLING SHEET

Date: 4/24/09 **Project #:** 07-0760 **Site #:** 1

Method Used: Kick Seine **Habitat:** Riffle

PTI Rating	
>= 23	Excellent
17-22	Good
11-16	Fair
<=10	Poor

Group 1:Intolerant		Group 2:Moderately Tolerant		Group 3:Fairly Tolerant		Group 4:Tolerant	
Stonefly Nymph		Damselfly Nymph	X	Midges		Left-handed Snail	
Mayfly Nymph		Dragonfly Nymph		Black Fly Larvae	X	Aquatic Worms	
Caddis Fly Larvae	X	Sow bug		Planaria		Blood Midges	X
Dobson Fly Larvae		Scud		Leech		Rat tailed Maggot	
Riffle Beetle	X	Crane Fly Larvae	X				
Water Penny		Clams/Mussels					
Right-handed Snail							
Total # Taxa	2	Total # Taxa	2	Total # Taxa	1	Total # Taxa	1
Group Weight	4	Group Weight	3	Group Weight	2	Group Weight	1
Group Score	8	Group Score	6	Group Score	2	Group Score	1
						PTI Rating	**17**

POLLUTION TOLERANCE INDEX (PTI) SAMPLING SHEET

Date: 4/24/09 **Project #:** 07-0760 **Site #:** 2

Method Used: Kick Seine **Habitat:** Riffle

Group 1:Intolerant		Group 2:Moderately Tolerant		Group 3:Fairly Tolerant		Group 4:Tolerant	
Stonefly Nymph		Damselfly Nymph		Midges		Left-handed Snail	
Mayfly Nymph		Dragonfly Nymph		Black Fly Larvae	X	Aquatic Worms	
Caddis Fly Larvae	X	Sow bug		Planaria		Blood Midges	X
Dobson Fly Larvae		Scud		Leech		Rat tailed Maggot	
Riffle Beetle	X	Crane Fly Larvae	X				
Water Penny		Clams/Mussels					
Right-handed Snail							
Total # Taxa	2	Total # Taxa	1	Total # Taxa	1	Total # Taxa	1
Group Weight	4	Group Weight	3	Group Weight	2	Group Weight	1
Group Score	8	Group Score	3	Group Score	2	Group Score	1
						PTI Rating	**14**

POLLUTION TOLERANCE INDEX (PTI) SAMPLING SHEET

Date: 4/24/09 **Project #:** 07-0760 **Site #:** 3

Method Used: Kick Seine **Habitat:** Riffle

Group 1:Intolerant		Group 2:Moderately Tolerant		Group 3:Fairly Tolerant		Group 4:Tolerant	
Stonefly Nymph		Damselfly Nymph	X	Midges		Left-handed Snail	X
Mayfly Nymph		Dragonfly Nymph		Black Fly Larvae	X	Aquatic Worms	
Caddis Fly Larvae	X	Sow bug		Planaria		Blood Midges	X
Dobson Fly Larvae		Scud		Leech	X	Rat tailed Maggot	
Riffle Beetle		Crane Fly Larvae	X				
Water Penny		Clams/Mussels					
Right-handed Snail							
Total # Taxa	1	Total # Taxa	2	Total # Taxa	2	Total # Taxa	2
Group Weight	4	Group Weight	3	Group Weight	2	Group Weight	1
Group Score	4	Group Score	6	Group Score	4	Group Score	2
						PTI Rating	**16**

POLLUTION TOLERANCE INDEX (PTI) SAMPLING SHEET

Date: 4/24/09 **Project #:** 07-0760 **Site #:** 4

Method Used: Kick Seine **Habitat:** Riffle

Group 1:Intolerant		Group 2:Moderately Tolerant		Group 3:Fairly Tolerant		Group 4:Tolerant	
Stonefly Nymph		Damselfly Nymph		Midges		Left-handed Snail	
Mayfly Nymph		Dragonfly Nymph		Black Fly Larvae		Aquatic Worms	X
Caddis Fly Larvae		Sow bug		Planaria		Blood Midges	X
Dobson Fly Larvae		Scud		Leech		Rat tailed Maggot	
Riffle Beetle		Crane Fly Larvae					
Water Penny		Clams/Mussels					
Right-handed Snail							
Total # Taxa	0	Total # Taxa	0	Total # Taxa	0	Total # Taxa	2
Group Weight	4	Group Weight	3	Group Weight	2	Group Weight	1
Group Score	0	Group Score	0	Group Score	0	Group Score	2
						PTI Rating	**2**

POLLUTION TOLERANCE INDEX (PTI) SAMPLING SHEET

Date: 4/24/09 **Project #:** 07-0760 **Site #:** 5

Method Used: Kick Seine **Habitat:** Riffle

Group 1:Intolerant		Group 2:Moderately Tolerant		Group 3:Fairly Tolerant		Group 4:Tolerant	
Stonefly Nymph		Damselfly Nymph	X	Midges		Left-handed Snail	
Mayfly Nymph		Dragonfly Nymph		Black Fly Larvae	X	Aquatic Worms	
Caddis Fly Larvae	X	Sow bug		Planaria		Blood Midges	X
Dobson Fly Larvae		Scud		Leech		Rat tailed Maggot	
Riffle Beetle	X	Crane Fly Larvae	X				
Water Penny		Clams/Mussels					
Right-handed Snail							
Total # Taxa	2	Total # Taxa	2	Total # Taxa	1	Total # Taxa	1
Group Weight	4	Group Weight	3	Group Weight	2	Group Weight	1
Group Score	8	Group Score	6	Group Score	2	Group Score	1
						PTI Rating	**17**

POLLUTION TOLERANCE INDEX (PTI) SAMPLING SHEET

Date: 4/24/09 **Project #:** 07-0760 **Site #:** 6

Method Used: Kick Seine **Habitat:** Riffle

Group 1:Intolerant		Group 2:Moderately Tolerant		Group 3:Fairly Tolerant		Group 4:Tolerant	
Stonefly Nymph		Damselfly Nymph	X	Midges		Left-handed Snail	
Mayfly Nymph		Dragonfly Nymph	X	Black Fly Larvae	X	Aquatic Worms	
Caddis Fly Larvae	X	Sow bug		Planaria		Blood Midges	X
Dobson Fly Larvae		Scud		Leech		Rat tailed Maggot	
Riffle Beetle	X	Crane Fly Larvae	X				
Water Penny		Clams/Mussels					
Right-handed Snail							
Total # Taxa	2	Total # Taxa	3	Total # Taxa	1	Total # Taxa	1
Group Weight	4	Group Weight	3	Group Weight	2	Group Weight	1
Group Score	8	Group Score	9	Group Score	2	Group Score	1
						PTI Rating	**20**

POLLUTION TOLERANCE INDEX (PTI) SAMPLING SHEET

Date: 4/24/09 **Project #:** 07-0760 **Site #:** 7

Method Used: Kick Seine **Habitat:** Riffle

Group 1:Intolerant		Group 2:Moderately Tolerant		Group 3:Fairly Tolerant		Group 4:Tolerant	
Stonefly Nymph		Damselfly Nymph	X	Midges		Left-handed Snail	
Mayfly Nymph		Dragonfly Nymph		Black Fly Larvae		Aquatic Worms	X
Caddis Fly Larvae	X	Sow bug		Planaria		Blood Midges	X
Dobson Fly Larvae		Scud		Leech		Rat tailed Maggot	
Riffle Beetle		Crane Fly Larvae					
Water Penny		Clams/Mussels					
Right-handed Snail							
Total # Taxa	1	Total # Taxa	1	Total # Taxa	0	Total # Taxa	2
Group Weight	4	Group Weight	3	Group Weight	2	Group Weight	1
Group Score	4	Group Score	3	Group Score	0	Group Score	2
						PTI Rating	**9**

POLLUTION TOLERANCE INDEX (PTI) SAMPLING SHEET

Date: 4/24/09 **Project #:** 07-0760 **Site #:** 8

Method Used: Kick Seine **Habitat:** Riffle

Group 1:Intolerant		Group 2:Moderately Tolerant		Group 3:Fairly Tolerant		Group 4:Tolerant	
Stonefly Nymph		Damselfly Nymph		Midges		Left-handed Snail	X
Mayfly Nymph	X	Dragonfly Nymph		Black Fly Larvae	X	Aquatic Worms	
Caddis Fly Larvae	X	Sow bug	X	Planaria		Blood Midges	X
Dobson Fly Larvae		Scud		Leech		Rat tailed Maggot	
Riffle Beetle	X	Crane Fly Larvae	X				
Water Penny		Clams/Mussels					
Right-handed Snail	X						
Total # Taxa	4	Total # Taxa	2	Total # Taxa	1	Total # Taxa	2
Group Weight	4	Group Weight	3	Group Weight	2	Group Weight	1
Group Score	16	Group Score	6	Group Score	2	Group Score	2
						PTI Rating	**26**

POLLUTION TOLERANCE INDEX (PTI) SAMPLING SHEET

Date: 4/24/09 **Project #:** 07-0760 **Site #:** 9

Method Used: Kick Seine **Habitat:** Riffle

Group 1:Intolerant		Group 2:Moderately Tolerant		Group 3:Fairly Tolerant		Group 4:Tolerant	
Stonefly Nymph		Damselfly Nymph	X	Midges		Left-handed Snail	X
Mayfly Nymph		Dragonfly Nymph		Black Fly Larvae		Aquatic Worms	
Caddis Fly Larvae		Sow bug		Planaria		Blood Midges	X
Dobson Fly Larvae		Scud		Leech		Rat tailed Maggot	
Riffle Beetle		Crane Fly Larvae					
Water Penny		Clams/Mussels					
Right-handed Snail							
Total # Taxa	0	Total # Taxa	1	Total # Taxa	0	Total # Taxa	2
Group Weight	4	Group Weight	3	Group Weight	2	Group Weight	1
Group Score	0	Group Score	3	Group Score	0	Group Score	2
						PTI Rating	**5**

POLLUTION TOLERANCE INDEX (PTI) SAMPLING SHEET

Date: 4/24/09 **Project #:** 07-0760 **Site #:** 10

Method Used: Kick Seine **Habitat:** Riffle

Group 1:Intolerant		Group 2:Moderately Tolerant		Group 3:Fairly Tolerant		Group 4:Tolerant	
Stonefly Nymph		Damselfly Nymph		Midges		Left-handed Snail	X
Mayfly Nymph	X	Dragonfly Nymph		Black Fly Larvae	X	Aquatic Worms	X
Caddis Fly Larvae		Sow bug		Planaria		Blood Midges	X
Dobson Fly Larvae	X	Scud		Leech	X	Rat tailed Maggot	
Riffle Beetle	X	Crane Fly Larvae	X				
Water Penny		Clams/Mussels					
Right-handed Snail	X						
Total # Taxa	4	Total # Taxa	1	Total # Taxa	2	Total # Taxa	3
Group Weight	4	Group Weight	3	Group Weight	2	Group Weight	1
Group Score	16	Group Score	3	Group Score	4	Group Score	3
						PTI Rating	**26**

APPENDIX 2

Water Quality Raw Data Sheets

Williams Creek Chemical Water Quality Monitoring Results

Site: 1 Williams Creek at 96th Street

Date	Nitrate-Nitrite	Organic Nitrogen	Ammonia	Total Phosphorus	Dissolved Phosphorus	Turbidity	*E. coli*	Dissolved Oxygen	Dissolved Oxygen	Temp	pH	Conductivity
	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	MPN/100mL	mg/L	%	C		us
9/30/2008	< DL	0.348		< DL	< DL	2	238	5.2	56.5	17.2	7.8	686
10/20/2008	< DL	0.607		< DL	< DL	2	365	7.5	69	11.2	7.9	662
4/22/2009	0.664	0.548	0.204	< DL	< DL	3	308	11.5	99	8.7	8.5	464
5/28/2009	0.484	0.923	0.207	0.082	< DL	4	480	6.56	75.3	20.3	8	675
6/25/2009	0.539	0.683	0.13	0.073	< DL	4	118	5.78	72.5	23.5	8.01	625
7/23/2009	0.286	0.93	0.17	0.056	< DL	4	510	6.55	69.9	18.8	8.1	638
8/12/2009	0.462	0.934	0.166	0.131	< DL	15	5654	6.44	74.3	21.4	7.95	473
Mean Concentration	0.348	0.710	0.175	0.0489	< DL	4.857	1096.143	7.076	73.786	17.300	8.037	603.286
Median	0.462	0.683	0.17	0.056	< DL	4	365	6.55	72.5	18.8	8	638

Site: 2 Spring Mill at Interstate 465

Date	Nitrate-Nitrite	Organic Nitrogen	Ammonia	Total Phosphorus	Dissolved Phosphorus	Turbidity	*E. coli*	Dissolved Oxygen	Dissolved Oxygen	Temp	pH	Conductivity
	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	MPN/100mL	mg/L	%	C		us
9/30/2008	0.115	0.372		< DL	< DL	0	517	6.27	63.3	15.8	8.05	615
10/20/2008	< DL	0.487		< DL	< DL	1	921	7.9	73	9.5	8.15	687
4/22/2009	0.395	0.647	0.185	< DL	< DL	3	82	11.5	98.6	8.5	8.4	413
5/28/2009	0.351	0.81	0.16	0.068	< DL	5	432	6.96	77.6	20.1	7.9	579
6/25/2009	0.402	0.598	0.16	0.073	< DL	5	172	6.16	72.5	23.7	7.98	551
7/23/2009	0.299	0.511	0.158	< DL	< DL	3	247	7.52	83.2	18.5	8.1	646
8/12/2009	0.503	0.958	0.152	0.126	0.063	14	3466	6.87	77.9	20.8	8	362.2
Mean Concentration	0.295	0.626	0.163	0.089	0.063	4.429	833.857	7.597	78.014	16.7	8.083	550.457
Median	0.351	0.598	0.16	0.073	0.063	3	432	6.96	77.6	18.5	8.05	579

Site: 3 Spring Mill at 106th Street

Date	Nitrate-Nitrite	Organic Nitrogen	Ammonia	Total Phosphorus	Dissolved Phosphorus	Turbidity	*E. coli*	Dissolved Oxygen	Dissolved Oxygen	Temp	pH	Conductivity
	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	MPN/100mL	mg/L	%	C		us
9/30/2008	0.535	0.66		< DL	< DL	1	1203	5.96	60.7	16	8.03	728
10/20/2008	0.216	0.463		< DL	< DL	2	2420	8.5	80	8.5		761
4/22/2009	0.483	0.547	0.199	< DL	< DL	2	54	13.1	110	9.6	8.3	414.8
5/28/2009	0.547	1	0.16	0.061	< DL	2	1019	6.46	71.7	19.5	7.84	520
6/25/2009	0.38	0.608	0.118	0.068	< DL	4	122	7.11	87.5	24.5	7.98	542
7/23/2009	0.339	0.683	0.13	0.06	< DL	3	690	6.26	71.5	19.1	8.06	586
8/12/2009	0.309	0.78	0.123	0.079	< DL	4	4480	6.15	72.5	21.1	8.02	470
Mean Concentration	0.401	0.677	0.146	0.067	< DL	2.571	1426.857	7.6486	79.129	16.9	8.038	574.543
Median	0.38	0.66	0.13	0.065	< DL	2	1019	6.46	72.5	19.1	8.025	542

Site: 4 Williams Creek at 106th Street

Date	Nitrate-Nitrite	Organic Nitrogen	Ammonia	Total Phosphorus	Dissolved Phosphorus	Turbidity	*E. coli*	Dissolved Oxygen	Dissolved Oxygen	Temp	pH	Conductivity
	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	MPN/100mL	mg/L	%	C		us
9/30/2008	0.156	0.635		< DL	< DL	2	579	5.82	60.5	16.6	7.82	645
10/20/2008	< DL	0.601		< DL	< DL	0	488	7.12	75	10	8.08	608
4/22/2009	0.77	0.596	0.16	< DL	< DL	3	219	12.1	108	8.6	8.3	433.2
5/28/2009	0.544	0.978	0.132	0.07	< DL	2	364	6.21	68.4	20.2	8.1	595
6/25/2009	0.616	0.586	0.113	0.067	< DL	3	125	5.99	71	24	7.99	568
7/23/2009	0.379	0.613	0.111	0.053	< DL	1	364	6.5	72.1	18.7	8.1	647
8/12/2009	0.314	0.895	0.145	0.089	0.062	7	3080	6.32	73.2	21.6	8.04	467
Mean Concentration	0.463	0.701	0.132	0.069	0.062	2.571	745.571	7.151	75.457	17.1	8.061	566.171
Median	0.462	0.613	0.132	0.069	0.062	2	364	6.32	72.1	18.7	8.08	595

Site: 5 Williams Creek at 116th Street

Date	Nitrate-Nitrite	Organic Nitrogen	Ammonia	Total Phosphorus	Dissolved Phosphorus	Turbidity	*E. coli*	Dissolved Oxygen	Dissolved Oxygen	Temp	pH	Conductivity
	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	MPN/100mL	mg/L	%	C		us
9/30/2008	< DL	0.481		< DL	< DL	1	185	5	52.6	16.8	7.97	671
10/20/2008	< DL	0.643		< DL	< DL	0	214	6.8	65	10.3	8.17	603
4/22/2009	0.909	0.632	0.101	< DL	< DL	3	411	12	109	9	8.38	437
5/28/2009	0.55	0.864	0.176	0.077	< DL	3	1246	6.05	65	20.4	7.86	594
6/25/2009	0.69	0.569	0.145	0.063	< DL	4	199	5.86	71.3	24.5	7.93	565
7/23/2009	0.336	0.716	0.134	0.053	< DL	2	1230	6.25	69.1	19	8	620
8/12/2009	0.234	1.29	0.111	0.102	< DL	9	3466	6.04	71.1	22.7	8.15	485
Mean Concentration	0.544	0.742	0.133	0.074	< DL	3.143	993	6.857	71.871	17.529	8.0657	567.857
Median	0.55	0.643	0.134	0.07	< DL	3	411	6.05	69.1	19	8	594

Site: 6 Williams Creek at Spring Mill

Date	Nitrate-Nitrite	Organic Nitrogen	Ammonia	Total Phosphorus	Dissolved Phosphorus	Turbidity	*E. coli*	Dissolved Oxygen	Dissolved Oxygen	Temp	pH	Conductivity
	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	MPN/100mL	mg/L	%	C		us
9/30/2008	0.673	0.603		< DL	< DL	0	461	5.6	57	16.5	8.04	764
10/20/2008	0.1	0.496		< DL	< DL	0	179	8.1	68	11.5	8.12	705
4/22/2009	1.22	0.585	0.123	< DL	< DL	4	119	13.8	124	9.3	8.3	459
5/28/2009	0.624	0.913	0.177	0.068	< DL	3	933	5.83	63.9	20.1	7.9	563
6/25/2009	0.858	0.631	< DL	0.063	< DL	3	225	6.22	75	24.3	7.98	586
7/23/2009	0.484	0.954	0.116	< DL	< DL	2	626	6.58	71.4	19.1	8.05	667
8/12/2009	0.473	0.878	0.152	0.073	< DL	4	3080	5.89	67.6	21.1	8	559
Mean Concentration	0.633	0.723	0.142	0.068	< DL	2.286	803.286	7.431	75.271	17.414	8.056	614.714
Median	0.624	0.631	0.138	0.068	< DL	3	461	6.22	68	19.1	8.04	586

Site: 7 Elliot Creek at Clay Center

Date	Nitrate-Nitrite	Organic Nitrogen	Ammonia	Total Phosphorus	Dissolved Phosphorus	Turbidity	*E. coli*	Dissolved Oxygen	Dissolved Oxygen	Temp	pH	Conductivity
	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	MPN/100mL	mg/L	%	C		us
9/30/2008	0.141	0.526		< DL	< DL	1	238	5.54	58.2	17.5	7.98	220
10/20/2008	< DL	0.62		< DL	< DL	1	27	6.33	61.7	12.7	8.15	551
4/22/2009	0.115	0.787	< DL	< DL	< DL	4	20	12.1	115	11.5	8.4	445.9
5/28/2009	< DL	1.03	0.122	0.08	< DL	3	464	5.79	68.3	22.6	7.95	555
6/25/2009	0.124	0.567	0.127	0.06	< DL	3	147	5.33	68.4	28.1	7.95	518
7/23/2009	< DL	0.833	0.102	0.051	< DL	1	442	6.26	71.2	21.5	8.1	504
8/12/2009	< DL	0.988	0.122	0.077	< DL	6	992	6.34	76.5	24.7	8.1	482
Mean Concentration	0.127	0.764	0.118	0.067	< DL	2.714	332.857	6.813	74.186	19.8	8.09	467.986
Median	0.124	0.787	0.122	0.0685	< DL	3	238	6.26	68.4	21.5	8.1	504

Site: 8 Almond Creek at 131st Street

Date	Nitrate-Nitrite	Organic Nitrogen	Ammonia	Total Phosphorus	Dissolved Phosphorus	Turbidity	*E. coli*	Dissolved Oxygen	Dissolved Oxygen	Temp	pH	Conductivity
	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	MPN/100mL	mg/L	%	C		us
9/30/2008	< DL	0.717		0.111	< DL	7	11	3.16	35	19.6	7.66	
10/20/2008	< DL	0.612		< DL	< DL	2	387	8.02	80	10.6	8.08	245
4/22/2009	0.338	0.571	< DL	< DL	< DL	3	173	15.2	135	9.4	8.4	414.3
5/28/2009	0.36	0.922	0.178	0.092	0.053	5	771	5.9	64.7	19.5	7.89	457
6/25/2009	0.39	0.697	0.14	0.08	< DL	4	210	3.81	53.1	25	7.78	488
7/23/2009	0.155	0.758	0.111	0.08	< DL	5	1549	7.37	78.9	18.8	8	442.9
8/12/2009	0.121	0.969	0.111	0.101	< DL	6	2452	6.18	71.7	21.5	7.92	501
Mean Concentration	0.273	0.7494	0.135	0.093	0.053	4.571	793.286	7.091	74.057	17.771	7.961	424.7
Median	0.338	0.717	0.1255	0.092	0.053	5	387	6.18	71.7	19.5	7.92	449.95

Site: 9 Williams Creek at 131st Street

Date	Nitrate-Nitrite	Organic Nitrogen	Ammonia	Total Phosphorus	Dissolved Phosphorus	Turbidity	*E. coli*	Dissolved Oxygen	Dissolved Oxygen	Temp	pH	Conductivity
	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	MPN/100mL	mg/L	%	C		us
9/30/2008	0.236	0.706		< DL	< DL	2	579	6.08	63	17	8	359
10/20/2008	< DL	0.576		< DL	< DL	1	79	8.4	73.3	13.7	8.12	681
4/22/2009	1.11	0.672	< DL	< DL	< DL	4	66	13	116	9.7	8.4	418.3
5/28/2009	0.504	0.986	0.124	0.094	< DL	4	1191	6.07	67	20.3	7.88	486
6/25/2009	0.884	0.65	0.12	0.075	< DL	4	173	6.63	80.7	25.5	7.88	571
7/23/2009	0.389	0.803	0.139	0.06	< DL	3	518	6.57	72.7	19.3	8.1	604
8/12/2009	0.43	0.882	0.178	0.077	0.06	4	1741	6.36	70.7	20.5	7.91	449.8
Mean Concentration	0.592	0.754	0.140	0.077	0.06	3.143	621	7.587	77.629	18	8.041	509.871
Median	0.467	0.706	0.132	0.076	0.06	4	518	6.57	72.7	19.3	8	486

Site: 10 Williams Creek at 146th Street

Date	Nitrate-Nitrite	Organic Nitrogen	Ammonia	Total Phosphorus	Dissolved Phosphorus	Turbidity	*E. coli*	Dissolved Oxygen	Dissolved Oxygen	Temp	pH	Conductivity
	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	MPN/100mL	mg/L	%	C		us
9/30/2008	< DL	1.12		0.115	< DL	6	548	5.94	66.1	20.3	7.91	463
10/20/2008	< DL	1.59		0.154	< DL	6	613	6.1	64	16.1	8.05	503
4/22/2009	1.68	0.969	0.111	< DL	< DL	8	78	11.2	105	11.1	8.5	295
5/28/2009	0.276	1.23	0.197	0.085	< DL	4	121	6.45	75	23.2	8.19	397.6
6/25/2009	0.341	1.39	0.189	0.9	< DL	4	20	6.02	90.1	30	8.02	432.4
7/23/2009	< DL	1.2	0.174	0.106	< DL	5	198	6.6	76.2	21.6	7.88	414.2
8/12/2009	0.137	0.935	0.145	0.067	< DL	3	550	5.56	66.5	23.5	7.75	471.4
Mean Concentration	0.609	1.205	0.163	0.238	< DL	5.143	304	6.839	77.557	20.829	8.043	425.229
Median	0.309	1.2	0.174	0.111	< DL	5	198	6.1	75	21.6	8.02	432.4

APPENDIX 3
QHEI Raw Data Sheets

QHEI scores

Williams Creek

Site	QHEI Parameters						
	Substrate (20)	Instream Cover (20)	Channel Morphology (20)	Bank Erosion & Riparian Zone (10)	Pool/Glide & Riffle/Run Quality (20)	Gradient (10)	TOTAL (100)
Williams Creek @ 96th	16	10	14	9.5	10.5	10	70
Spring Mill @ I465	13	15	16	9.5	8	8	69.5
Spring Mill @ 106th	16	20	13	6	13	4	72
Williams Creek @106th	5	14	9	10	11	8	57
Williams Creek @ 116th	13	13	14	7	10	10	67
Williams Creek @ Spring Mill	13	17	16	7.5	10	8	71.5
Elliot Creek @ Clay Center	12.5	18	13	8	13	10	74.5
Almond Creek @ 131st	8	7	8	5	2	8	38
Williams Creek @ 131st	5	9	6	5	6	6	37
Williams Creek @ 146th	6	14	10	5.5	9	8	52.5

OhioEPA Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 70

Stream & Location: WC 1 **RM:** ___ **Date:** 5/15/09

Scorers Full Name & Affiliation: ___

River Code: __-__-__ **STORET #:** ___ **Lat./Long.:** (NAD 83 - decimal °) __.____ /8 __.____ Office verified location ☐

1] SUBSTRATE
Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☑ COBBLE [8]			☐☐ MUCK [2]		
☐☑ GRAVEL [7]			☐☐ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☐ LIMESTONE [1]	☐ HEAVY [-2]
☑ TILLS [1]	☐ MODERATE [-1]
☐ WETLANDS [0]	☑ NORMAL [0]
☐ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	☐ EXTENSIVE [-2]
☐ RIP/RAP [0]	☐ MODERATE [-1]
☐ LACUSTURINE [0]	☑ NORMAL [0]
☐ SHALE [-1]	☐ NONE [1]
☐ COAL FINES [-2]	

SILT

EMBEDDEDNESS

Comments

Substrate 16 Maximum 20

2] INSTREAM COVER
Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2 UNDERCUT BANKS [1]	1 POOLS > 70cm [2]	0 OXBOWS, BACKWATERS [1]	
1 OVERHANGING VEGETATION [1]	1 ROOTWADS [1]	1 AQUATIC MACROPHYTES [1]	
2 SHALLOWS (IN SLOW WATER) [1]	0 BOULDERS [1]	1 LOGS OR WOODY DEBRIS [1]	
0 ROOTMATS [1]			

AMOUNT
Check ONE (Or 2 & average)
☐ EXTENSIVE >75% [11]
☐ MODERATE 25-75% [7]
☑ SPARSE 5-<25% [3]
☐ NEARLY ABSENT <5% [1]

Comments

Cover Maximum 20: 10

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☑ NONE [6]	☑ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☑ LOW [2]	☑ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel Maximum 20: 14

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)

downstream

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	
☑☑ NONE / LITTLE [3]	☑☐ WIDE > 50m [4]	☑☑ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☑ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☐☐ NONE [0]	☐☐ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian Maximum 10: 9.5

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH (Check ONE (ONLY!))
☐ > 1m [6]
☐ 0.7-<1m [4]
☑ 0.4-<0.7m [2]
☐ 0.2-<0.4m [1]
☐ < 0.2m [0]

CHANNEL WIDTH (Check ONE (Or 2 & average))
☑ POOL WIDTH > RIFFLE WIDTH [2]
☐ POOL WIDTH = RIFFLE WIDTH [1]
☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY (Check ALL that apply)
☐ TORRENTIAL [-1] ☐ SLOW [1]
☐ VERY FAST [1] ☐ INTERSTITIAL [-1]
☑ FAST [1] ☐ INTERMITTENT [-2]
☐ MODERATE [1] ☐ EDDIES [1]
Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current Maximum 12: 5

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☑ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☑ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☑ MAXIMUM < 50cm [1]	☑ MOD. STABLE (e.g., Large Gravel) [1]	☑ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run Maximum 8: 5.5

6] GRADIENT
(10 ft/mi) ☐ VERY LOW - LOW [2-4] ☑ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (mi²)

%POOL: 35 %GLIDE: ~~10~~ 15
%RUN: 25 %RIFFLE: ~~40~~ 15

Gradient Maximum 10: 10

60

EPA 4520 06/16/06

OhioEPA Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 69.5

Stream & Location: WC2 — 465 bridge RM: ___.___ Date: 5/15/~~06~~ 09

Scorers Full Name & Affiliation:

River Code: ___-___-___ STORET #: ___ Lat./Long.: (NAD 83 - decimal °) ___.___ /8___.___ Office verified location ☐

1] SUBSTRATE
Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☒ COBBLE [8]			☐☐ MUCK [2]		
☐☐ GRAVEL [7]			☐☐ SILT [2]		
☒☐ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN: ☐ LIMESTONE [1] ☒ TILLS [1] ☐ WETLANDS [0] ☐ HARDPAN [0] ☐ SANDSTONE [0] ☐ RIP/RAP [0] ☐ LACUSTURINE [0] ☐ SHALE [-1] ☐ COAL FINES [-2]

QUALITY: ☐ HEAVY [-2] ☒ MODERATE [-1] ☐ NORMAL [0] ☐ FREE [1]

SILT — EMBEDDEDNESS: ☐ EXTENSIVE [-2] ☒ MODERATE [-1] ☐ NORMAL [0] ☐ NONE [1]

Comments

Substrate: 13 (Maximum 20)

2] INSTREAM COVER
Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

- 2 UNDERCUT BANKS [1]
- 2 OVERHANGING VEGETATION [1]
- ___ SHALLOWS (IN SLOW WATER) [1]
- 1 ROOTMATS [1]
- 3 POOLS > 70cm [2]
- 2 ROOTWADS [1]
- 0 BOULDERS [1]
- 1 OXBOWS, BACKWATERS [1]
- 1 AQUATIC MACROPHYTES [1]
- 2 LOGS OR WOODY DEBRIS [1]

AMOUNT — Check ONE (Or 2 & average): ☐ EXTENSIVE >75% [11] ☒ MODERATE 25-75% [7] ☐ SPARSE 5-<25% [3] ☐ NEARLY ABSENT <5% [1]

Comments

Cover: 15 (Maximum 20)

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☒ NONE [6]	☐ HIGH [3]
☒ MODERATE [3]	☒ GOOD [5]	☐ RECOVERED [4]	☒ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments: unless bridge

Channel: 16 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)
River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☒☒ NONE / LITTLE [3]	☒☐ WIDE > 50m [4]	☒☒ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☒ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☐☐ NONE [0]	☐☐ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 9.5 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH — Check ONE (ONLY!): ☐ > 1m [6] ☒ 0.7-<1m [4] ☒ 0.4-<0.7m [2] ☐ 0.2-<0.4m [1] ☐ < 0.2m [0]

CHANNEL WIDTH — Check ONE (Or 2 & average): ☐ POOL WIDTH > RIFFLE WIDTH [2] ☐ POOL WIDTH = RIFFLE WIDTH [1] ☒ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY — Check ALL that apply: ☐ TORRENTIAL [-1] ☐ VERY FAST [1] ☐ FAST [1] ☒ MODERATE [1] ☐ SLOW [1] ☐ INTERSTITIAL [-1] ☐ INTERMITTENT [-2] ☐ EDDIES [1]
Indicate for reach - pools and riffles.

Recreation Potential: Primary Contact / Secondary Contact (circle one and comment on back)

Comments

Pool / Current: 3 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☒ BEST AREAS > 10cm [2]	☒ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☒ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☒ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run: 5 (Maximum 8)

61.5

6] GRADIENT
(25 ft/mi) ☐ VERY LOW - LOW [2-4] ☒ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (___ mi²)

%POOL: 40 %GLIDE: 30 %RUN: 20 %RIFFLE: 10

Gradient: 8 (Maximum 10)

EPA 4520 06/16/06

OhioEPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 72

Stream & Location: WC3 **RM:** ___ **Date:** 5/15/~~08~~ 09

Scorers Full Name & Affiliation: _____

River Code: __-__-__ **STORET #:** _____ **Lat./Long.:** (NAD 83 - decimal °) __.____ /8 __.____ Office verified location ☐

1] SUBSTRATE
Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☑ COBBLE [8]			☐☐ MUCK [2]		
☑☐ GRAVEL [7]			☐☐ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN: ☐ LIMESTONE [1] ☑ TILLS [1] ☐ WETLANDS [0] ☐ HARDPAN [0] ☐ SANDSTONE [0] ☐ RIP/RAP [0] ☐ LACUSTURINE [0] ☐ SHALE [-1] ☐ COAL FINES [-2]

QUALITY: SILT: ☐ HEAVY [-2] ☐ MODERATE [-1] ☑ NORMAL [0] ☐ FREE [1]; EMBEDDEDNESS: ☐ EXTENSIVE [-2] ☐ MODERATE [-1] ☑ NORMAL [0] ☐ NONE [1]

Comments

Substrate: 16 (Maximum 20)

2] INSTREAM COVER
Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2	UNDERCUT BANKS [1]	0	POOLS > 70cm [2]	1	OXBOWS, BACKWATERS [1]
2.5	OVERHANGING VEGETATION [1]	1.5	ROOTWADS [1]	3	AQUATIC MACROPHYTES [1]
2	SHALLOWS (IN SLOW WATER) [1]	1	BOULDERS [1]	1	LOGS OR WOODY DEBRIS [1]
2	ROOTMATS [1]				

AMOUNT Check ONE (Or 2 & average): ☑ EXTENSIVE >75% [11] ☐ MODERATE 25-75% [7] ☐ SPARSE 5-<25% [3] ☐ NEARLY ABSENT <5% [1]

Comments

Cover: 20 (Maximum 20)

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY: ☐ HIGH [4] ☑ MODERATE [3] ☐ LOW [2] ☐ NONE [1]

DEVELOPMENT: ☐ EXCELLENT [7] ☑ GOOD [5] ☐ FAIR [3] ☐ POOR [1]

CHANNELIZATION: ☐ NONE [6] ☐ RECOVERED [4] ☑ RECOVERING [3] ☐ RECENT OR NO RECOVERY [1] grasses

STABILITY: ☐ HIGH [3] ☑ MODERATE [2] ☐ LOW [1]

Rip rap?

Comments

Channel: 13 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R): ☑☐ NONE / LITTLE [3] ☐☐ MODERATE [2] ☐☑ HEAVY / SEVERE [1]

RIPARIAN WIDTH (L R): ☐☐ WIDE > 50m [4] ☑☐ MODERATE 10-50m [3] ☐☐ NARROW 5-10m [2] ☐☐ VERY NARROW < 5m [1] ☐☐ NONE [0]

FLOOD PLAIN QUALITY (L R): ☑☑ FOREST, SWAMP [3] ☐☐ SHRUB OR OLD FIELD [2] ☑☐ RESIDENTIAL, PARK, NEW FIELD [1] ☐☐ FENCED PASTURE [1] ☐☐ OPEN PASTURE, ROWCROP [0]

☐☐ CONSERVATION TILLAGE [1] ☐☐ URBAN OR INDUSTRIAL [0] ☐☐ MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 6 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!): ☐ > 1m [6] ☐ 0.7-<1m [4] ☑ 0.4-<0.7m [2] ☐ 0.2-<0.4m [1] ☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average): ☑ POOL WIDTH > RIFFLE WIDTH [2] ☐ POOL WIDTH = RIFFLE WIDTH [1] ☐ POOL WIDTH > RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply: ☐ TORRENTIAL [-1] ☐ SLOW [1] ☐ VERY FAST [1] ☐ INTERSTITIAL [-1] ☐ FAST [1] ☐ INTERMITTENT [-2] ☑ MODERATE [1] ☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential: Primary Contact / Secondary Contact (circle one and comment on back)

Comments

Pool / Current: 5 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH: ☑ BEST AREAS > 10cm [2] ☐ BEST AREAS 5-10cm [1] ☐ BEST AREAS < 5cm [metric=0]

RUN DEPTH: ☑ MAXIMUM > 50cm [2] ☐ MAXIMUM < 50cm [1]

RIFFLE / RUN SUBSTRATE: ☑ STABLE (e.g., Cobble, Boulder) [2] ☐ MOD. STABLE (e.g., Large Gravel) [1] ☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS: ☑ NONE [2] ☐ LOW [1] ☐ MODERATE [0] ☐ EXTENSIVE [-1]

Comments

Riffle / Run: 8 (Maximum 8)

6] GRADIENT
(44 ft/mi) ☐ VERY LOW - LOW [2-4] ☐ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (mi²)

%POOL: 20 %GLIDE: 20 %RUN: 30 %RIFFLE: 30

Gradient: 4 (Maximum 10)

exceeds very high = 4

nature sanctuary

OhioEPA Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 57

Stream & Location: WC 4 106 W of Springmill **RM:** ___ **Date:** 5/15/~~06~~ 09

Scorers Full Name & Affiliation:

River Code: __-__-__ **STORET #:** **Lat./Long.:** (NAD 83 - decimal °) __.____ /8__.____ Office verified location ☐

1] SUBSTRATE
Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☐☐ MUCK [2]		
☐☐ GRAVEL [7]			☒☐ SILT [2]		
☐☒ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Comments

Check ONE (Or 2 & average)

ORIGIN: ☐ LIMESTONE [1] ☐ TILLS [1] ☐ WETLANDS [0] ☐ HARDPAN [0] ☐ SANDSTONE [0] ☐ RIP/RAP [0] ☐ LACUSTURINE [0] ☐ SHALE [-1] ☐ COAL FINES [-2]

QUALITY: ☐ HEAVY [-2] ☒ MODERATE [-1] ☐ NORMAL [0] ☐ FREE [1]

SILT

EMBEDDEDNESS: ☐ EXTENSIVE [-2] ☒ MODERATE [-1] ☐ NORMAL [0] ☐ NONE [1]

Substrate **5** Maximum 20

2] INSTREAM COVER
Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

- 2 UNDERCUT BANKS [1]
- 0 OVERHANGING VEGETATION [1]
- 0 SHALLOWS (IN SLOW WATER) [1]
- 0 ROOTMATS [1]
- 3 POOLS > 70cm [2]
- 2 ROOTWADS [1]
- 0 BOULDERS [1]
- 0 OXBOWS, BACKWATERS [1]
- 1 AQUATIC MACROPHYTES [1]
- 2 LOGS OR WOODY DEBRIS [1]

AMOUNT Check ONE (Or 2 & average)
☐ EXTENSIVE >75% [11]
☒ MODERATE 25-75% [7]
☐ SPARSE 5-<25% [3]
☐ NEARLY ABSENT <5% [1]

Comments

Cover **14** Maximum 20

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☒ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☒ LOW [2]	☐ FAIR [3]	☒ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☒ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel **9** Maximum 20

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)
River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☒☒ NONE / LITTLE [3]	☒☒ WIDE > 50m [4]	☒☒ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☐☐ NONE [0]	☐☐ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian **10** Maximum 10

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!)
☒ > 1m [6]
☐ 0.7-<1m [4]
☐ 0.4-<0.7m [2]
☐ 0.2-<0.4m [1]
☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average)
☐ POOL WIDTH > RIFFLE WIDTH [2]
☒ POOL WIDTH = RIFFLE WIDTH [1]
☐ POOL WIDTH > RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply
☐ TORRENTIAL [-1] ☒ SLOW [1]
☐ VERY FAST [1] ☐ INTERSTITIAL [-1]
☐ FAST [1] ☐ INTERMITTENT [-2]
☐ MODERATE [1] ☐ EDDIES [1]
Indicate reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current **8** Maximum 12

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☒ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☒ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☒ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☒ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run **3** Maximum 8

6] GRADIENT (7.1 ft/mi)
DRAINAGE AREA (mi²)

☐ VERY LOW - LOW [2-4]
☒ MODERATE [6-10]
☐ HIGH - VERY HIGH [10-6]

%POOL: 30 %GLIDE: 50
%RUN: 10 %RIFFLE: 10

Gradient **8** Maximum 10

EPA 4520 06/16/06

OhioEPA Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 67

Stream & Location: #5 1143 W 116th RM: ___ Date: 5/15/2009

Scorers Full Name & Affiliation: ____

River Code: __-__-__ STORET #: ____ Lat./Long.: (NAD 83 - decimal °) __.____ /8 __.____ Office verified location ☐

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☐☐ MUCK [2]		
☐☐ GRAVEL [7]			☐☐ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☐ LIMESTONE [1]	☐ HEAVY [-2]
☑ TILLS [1]	☑ MODERATE [-1]
☐ WETLANDS [0]	☐ NORMAL [0]
☐ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	☐ EXTENSIVE [-2]
☐ RIP/RAP [0]	☑ MODERATE [-1]
☐ LACUSTURINE [0]	☐ NORMAL [0]
☐ SHALE [-1]	☐ NONE [1]
☐ COAL FINES [-2]	

SILT

EMBEDDEDNESS

Comments

Substrate: 13 (Maximum 20)

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2 UNDERCUT BANKS [1]	2 POOLS > 70cm [2]	0 OXBOWS, BACKWATERS [1]	
1 OVERHANGING VEGETATION [1]	2 ROOTWADS [1]	1 AQUATIC MACROPHYTES [1]	
1 SHALLOWS (IN SLOW WATER) [1]	2 BOULDERS [1]	1 LOGS OR WOODY DEBRIS [1]	
1 ROOTMATS [1]			

AMOUNT — Check ONE (Or 2 & average)
☐ EXTENSIVE >75% [11]
☐ MODERATE 25-75% [7]
☑ SPARSE 5-<25% [3]
☐ NEARLY ABSENT <5% [1]

Comments

Cover: 13 (Maximum 20)

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☑ NONE [6]	☐ HIGH [3]
☑ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☑ MODERATE [2]
☐ LOW [2]	☑ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel: 14 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	
☑ ☐ NONE / LITTLE [3]	☐ ☐ WIDE > 50m [4]	☑ ☐ FOREST, SWAMP [3]	☐ ☐ CONSERVATION TILLAGE [1]
☐ ☑ MODERATE [2]	☑ ☐ MODERATE 10-50m [3]	☐ ☐ SHRUB OR OLD FIELD [2]	☐ ☐ URBAN OR INDUSTRIAL [0]
☐ ☐ HEAVY / SEVERE [1]	☐ ☑ NARROW 5-10m [2]	☐ ☑ RESIDENTIAL, PARK, NEW FIELD [1]	☐ ☐ MINING / CONSTRUCTION [0]
	☐ ☐ VERY NARROW < 5m [1]	☐ ☐ FENCED PASTURE [1]	
	☐ ☐ NONE [0]	☐ ☐ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 7 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH (Check ONE (ONLY!))	CHANNEL WIDTH (Check ONE (Or 2 & average))	CURRENT VELOCITY (Check ALL that apply)	
☐ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1]	☐ SLOW [1]
☑ 0.7-<1m [4]	☑ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1]	☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH > RIFFLE WIDTH [0]	☐ FAST [1]	☐ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☑ MODERATE [1]	☐ EDDIES [1]
☐ < 0.2m [0]		Indicate for reach - pools and riffles.	

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current: 6 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☑ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☑ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☑ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☑ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run: 4 (Maximum 8)

6] GRADIENT (7.7 ft/mi) ☐ VERY LOW - LOW [2-4] ☑ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (mi²)

%POOL: 25 %GLIDE: 25 %RUN: 25 %RIFFLE: 25

Gradient: 10 (Maximum 10)

EPA 4520 06/16/06

OhioEPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 71.5

Stream & Location: #10 RM: ___ Date: 5/15/09

Scorers Full Name & Affiliation: ___

River Code: __-__-__ STORET #: ___ Lat./Long.: (NAD 83 - decimal °) __.____ /8__.____ Office verified location ☐

1] SUBSTRATE
Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☐☐ MUCK [2]		
☐☐ GRAVEL [7]			☐☐ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN: ☐ LIMESTONE [1] ☑ TILLS [1] ☐ WETLANDS [0] ☐ HARDPAN [0] ☐ SANDSTONE [0] ☐ RIP/RAP [0] ☐ LACUSTURINE [0] ☐ SHALE [-1] ☐ COAL FINES [-2]

QUALITY — SILT: ☐ HEAVY [-2] ☐ MODERATE [-1] ☑ NORMAL [0] ☐ FREE [1]

EMBEDDEDNESS: ☐ EXTENSIVE [-2] ☑ MODERATE [-1] ☐ NORMAL [0] ☐ NONE [1]

Comments

Substrate: 13 (Maximum 20)

2] INSTREAM COVER
Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep/ fast water, or deep, well-defined, functional pools.

3 UNDERCUT BANKS [1]	1 POOLS > 70cm [2]	0 OXBOWS, BACKWATERS [1]	
2 OVERHANGING VEGETATION [1]	2 ROOTWADS [1]	1 AQUATIC MACROPHYTES [1]	
2 SHALLOWS (IN SLOW WATER) [1]	2 BOULDERS [1]	1.5 LOGS OR WOODY DEBRIS [1]	
2 ROOTMATS [1]			

AMOUNT — Check ONE (Or 2 & average): ☐ EXTENSIVE >75% [11] ☑ MODERATE 25-75% [7] ☐ SPARSE 5-<25% [3] ☐ NEARLY ABSENT <5% [1]

Comments

Cover: 17 (Maximum 20)

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☑ NONE [6]	☐ HIGH [3]
☑ MODERATE [3]	☑ GOOD [5]	☐ RECOVERED [4]	☑ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel: 16 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☑☑ NONE / LITTLE [3]	☐☐ WIDE > 50m [4]	☑☑ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☑ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☑☐ NARROW 5-10m [2]	☑☑ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☐☐ NONE [0]	☐☐ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 7.5 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH — Check ONE (ONLY!): ☐ > 1m [6] ☑ 0.7-<1m [4] ☐ 0.4-<0.7m [2] ☐ 0.2-<0.4m [1] ☐ < 0.2m [0]

CHANNEL WIDTH — Check ONE (Or 2 & average): ☐ POOL WIDTH > RIFFLE WIDTH [2] ☐ POOL WIDTH = RIFFLE WIDTH [1] ☑ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY — Check ALL that apply: ☐ TORRENTIAL [-1] ☐ VERY FAST [1] ☐ FAST [1] ☑ MODERATE [1] ☐ SLOW [1] ☐ INTERSTITIAL [-1] ☐ INTERMITTENT [-2] ☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential: Primary Contact / Secondary Contact (circle one and comment on back)

Comments

Pool / Current: 5 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☑ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☑ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☑ MOD. STABLE (e.g., Large Gravel) [1]	☑ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run: 5 (Maximum 8)

6] GRADIENT (18.2 ft/mi) ☐ VERY LOW - LOW [2-4] ☐ MODERATE [6-10] ☑ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (mi²)

%POOL: ___ %GLIDE: ___ %RUN: ___ %RIFFLE: ___

Gradient: 8 (Maximum 10)

OhioEPA Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 74.5

Stream & Location: 7 RM: ___ Date: 5/15/09

River Code: __-__-__ STORET #: _____ Lat./Long.: (NAD 83 - decimal °) __.____ /8 __.____ Office verified location ☐

Scorers Full Name & Affiliation: _____

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☐☐ MUCK [2]		
☐☐ GRAVEL [7]			☐☐ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Comments

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☐ LIMESTONE [1]	☐ HEAVY [-2]
☑ TILLS [1]	☑ MODERATE [-1]
☐ WETLANDS [0]	☐ NORMAL [0]
☐ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	☐ EXTENSIVE [-2]
☐ RIP/RAP [0]	☐ MODERATE [-1]
☐ LACUSTURINE [0]	☐ NORMAL [0]
☐ SHALE [-1]	☐ NONE [1]
☐ COAL FINES [-2]	

SILT

EMBEDDEDNESS

Substrate 12.5 Maximum 20

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

2 UNDERCUT BANKS [1]	2 POOLS > 70cm [2]	1 OXBOWS, BACKWATERS [1]	AMOUNT (Check ONE (Or 2 & average))
3 OVERHANGING VEGETATION [1]	1 ROOTWADS [1]	2 AQUATIC MACROPHYTES [1]	☐ EXTENSIVE >75% [11]
2 SHALLOWS (IN SLOW WATER) [1]	1 BOULDERS [1]	2 LOGS OR WOODY DEBRIS [1]	☑ MODERATE 25-75% [7]
1 ROOTMATS [1]			☐ SPARSE 5-<25% [3]
			☐ NEARLY ABSENT <5% [1]

Comments

Cover 18 Maximum 20

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☑ MODERATE [3]	☑ GOOD [5]	☐ RECOVERED [4]	☑ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☑ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel 13 Maximum 20

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☐ ☑ NONE / LITTLE [3]	☐ ☑ WIDE > 50m [4]	☐ ☑ FOREST, SWAMP [3]	☐ ☐ CONSERVATION TILLAGE [1]
☑ ☐ MODERATE [2]	☑ ☐ MODERATE 10-50m [3]	☐ ☐ SHRUB OR OLD FIELD [2]	☐ ☐ URBAN OR INDUSTRIAL [0]
☐ ☐ HEAVY / SEVERE [1]	☐ ☐ NARROW 5-10m [2]	☑ ☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐ ☐ MINING / CONSTRUCTION [0]
	☐ ☐ VERY NARROW < 5m [1]	☐ ☐ FENCED PASTURE [1]	
	☐ ☐ NONE [0]	☐ ☐ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian 8 Maximum 10

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH (Check ONE (ONLY!))	CHANNEL WIDTH (Check ONE (Or 2 & average))	CURRENT VELOCITY (Check ALL that apply)	
☑ > 1m [6]	☑ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1]	☐ SLOW [1]
☐ 0.7-<1m [4]	☐ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1]	☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH > RIFFLE WIDTH [0]	☐ FAST [1]	☐ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☑ MODERATE [1]	☐ EDDIES [1]
☐ < 0.2m [0]			

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current 9 Maximum 12

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☑ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☑ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☑ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☑ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run 4 Maximum 8 58

6] GRADIENT (16.9 ft/mi) ☐ VERY LOW - LOW [2-4]

DRAINAGE AREA (mi²) ☒ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

%POOL: 25 %GLIDE: 35 %RUN: 25 %RIFFLE: 15

Gradient 10 Maximum 10

EPA 4520 06/16/06

OhioEPA Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 38

Stream & Location: Site #8 (Williams Creek MP) RM: ___ Date: 8/12/09

Scorers Full Name & Affiliation:

River Code: ___-___-___ STORET #: _____ Lat./Long.: (NAD 83 - decimal °) ___.___ /8 ___.___ Office verified location ☐

1] SUBSTRATE
Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR/SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☐☑ MUCK [2]		
☐☑ GRAVEL [7]			☐☐ SILT [2]		
☐☐ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☐ LIMESTONE [1]	☐ HEAVY [-2]
☑ TILLS [1]	☑ MODERATE [-1]
☐ WETLANDS [0]	☐ NORMAL [0]
☐ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	☐ EXTENSIVE [-2]
☐ RIP/RAP [0]	☑ MODERATE [-1]
☐ LACUSTURINE [0]	☐ NORMAL [0]
☐ SHALE [-1]	☐ NONE [1]
☐ COAL FINES [-2]	

SILT / EMBEDDEDNESS

Comments

Substrate: 8 (Maximum 20)

2] INSTREAM COVER
Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

___ UNDERCUT BANKS [1]	___ POOLS > 70cm [2]	___ OXBOWS, BACKWATERS [1]	
✓ OVERHANGING VEGETATION [1]	___ ROOTWADS [1]	✓ AQUATIC MACROPHYTES [1]	
✓ SHALLOWS (IN SLOW WATER) [1]	___ BOULDERS [1]	___ LOGS OR WOODY DEBRIS [1]	
✓ ROOTMATS [1]			

AMOUNT — Check ONE (Or 2 & average)
☐ EXTENSIVE >75% [11]
☐ MODERATE 25-75% [7]
☑ SPARSE 5-<25% [3]
☐ NEARLY ABSENT <5% [1]

Comments

Cover: 7 (Maximum 20)

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☑ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☑ RECOVERING [3]	☑ LOW [1]
☐ NONE [1]	☑ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel: 8 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)
River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☐☐ NONE / LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☐☐ NARROW 5-10m [2]	☑☑ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☐☐ FENCED PASTURE [1]	
	☐☐ NONE [0]	☐☐ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 5 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY
Check ONE (ONLY!)	Check ONE (Or 2 & average)	Check ALL that apply
☐ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1] ☐ SLOW [1]
☐ 0.7-<1m [4]	☐ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1] ☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☐ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1] ☐ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☐ MODERATE [1] ☐ EDDIES [1]
☐ < 0.2m [0]		Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current: 2 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run: 0 (Maximum 8)

6] GRADIENT (ft/mi)
DRAINAGE AREA (mi²)

☐ VERY LOW - LOW [2-4]
☐ MODERATE [6-10]
☐ HIGH - VERY HIGH [10-6]

%POOL: ( ) %GLIDE: ( )
%RUN: ( ) %RIFFLE: ( )

Gradient: 8 (Maximum 10)

OhioEPA Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 37

Stream & Location: #9 RM: ___ Date: 5/15/~~06~~ 09

River Code: ___-___-___ STORET #: ___ Scorers Full Name & Affiliation: ___

Lat./ Long.: (NAD 83 - decimal °) ___ . ___ /8 ___ . ___ Office verified location ☐

1] SUBSTRATE

Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☐ COBBLE [8]			☐☑ MUCK [2]		
☐☐ GRAVEL [7]			☐☐ SILT [2]		
☐☑ SAND [6]			☐☐ ARTIFICIAL [0]		
☐☐ BEDROCK [5]					

(Score natural substrates; Ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Comments

Check ONE (Or 2 & average)

ORIGIN
- ☐ LIMESTONE [1]
- ☑ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTURINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☑ HEAVY [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☑ EXTENSIVE [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate: 5 (Maximum 20)

2] INSTREAM COVER

Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

- 2 UNDERCUT BANKS [1]
- 1 OVERHANGING VEGETATION [1]
- 0 SHALLOWS (IN SLOW WATER) [1]
- 0 ROOTMATS [1]
- 2 POOLS > 70cm [2]
- 1 ROOTWADS [1]
- 0 BOULDERS [1]
- 0 OXBOWS, BACKWATERS [1]
- 1 AQUATIC MACROPHYTES [1]
- 0 LOGS OR WOODY DEBRIS [1]

AMOUNT Check ONE (Or 2 & average)
- ☐ EXTENSIVE >75% [11]
- ☐ MODERATE 25-75% [7]
- ☑ SPARSE 5-<25% [3]
- ☐ NEARLY ABSENT <5% [1]

Comments

Cover: 9 (Maximum 20)

3] CHANNEL MORPHOLOGY

Check ONE in each category (Or 2 & average)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☐ LOW [2]
- ☑ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☑ POOR [1]

CHANNELIZATION
- ☑ NONE [6]
- ☐ RECOVERED [4]
- ☑ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☐ MODERATE [2]
- ☑ LOW [1]

Comments

Channel: 6 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE

Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)
- ☑☑ NONE / LITTLE [3]
- ☐☐ MODERATE [2]
- ☐☐ HEAVY / SEVERE [1]

RIPARIAN WIDTH (L R)
- ☐☐ WIDE > 50m [4]
- ☐☐ MODERATE 10-50m [3]
- ☐☐ NARROW 5-10m [2]
- ☑☑ VERY NARROW < 5m [1]
- ☐☐ NONE [0]

FLOOD PLAIN QUALITY (L R)
- ☐☐ FOREST, SWAMP [3]
- ☐☐ SHRUB OR OLD FIELD [2]
- ☑☑ RESIDENTIAL, PARK, NEW FIELD [1]
- ☐☐ FENCED PASTURE [1]
- ☐☐ OPEN PASTURE, ROWCROP [0]
- ☐☐ CONSERVATION TILLAGE [1]
- ☐☐ URBAN OR INDUSTRIAL [0]
- ☐☐ MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian: 5 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!)
- ☐ > 1m [6]
- ☑ 0.7-<1m [4]
- ☐ 0.4-<0.7m [2]
- ☐ 0.2-<0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☑ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH > RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☑ FAST [1]
- ☐ MODERATE [1]
- ☐ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current: 6 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☒ NO RIFFLE [metric=0]

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5-10cm [1]
- ☑ BEST AREAS < 5cm [metric=0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ☑ MAXIMUM < 50cm [1]

RIFFLE / RUN SUBSTRATE
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☑ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE / RUN EMBEDDEDNESS
- ☐ NONE [2]
- ☐ LOW [1]
- ☐ MODERATE [0]
- ☑ EXTENSIVE [-1]

Comments

Riffle / Run: 0 (Maximum 8)

6] GRADIENT (10 ft/mi)

DRAINAGE AREA (mi²)

- ☐ VERY LOW - LOW [2-4]
- ☐ MODERATE [6-10]
- ☐ HIGH - VERY HIGH [10-6]

%POOL: ___ %GLIDE: ___ %RUN: ___ %RIFFLE: ___

Gradient: 6 (Maximum 10)

EPA 4520

06/16/06

OhioEPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 52.5

Stream & Location: 10 RM: ___ Date: 5/15/~~06~~ 09

Scorers Full Name & Affiliation:

River Code: __-__-__ STORET #: Lat./Long.: (NAD 83 - decimal °) __.__ /8 __.__ Office verified location ☐

all rip rap

1] SUBSTRATE
Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL	RIFFLE	OTHER TYPES	POOL	RIFFLE
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]			☐☐ DETRITUS [3]		
☐☑ COBBLE [8]			☐☐ MUCK [2]		
☐☐ GRAVEL [7]			☐☐ SILT [2]		
☐☐ SAND [6]			☐☑ ARTIFICIAL [0]		
☐☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN: ☐ LIMESTONE [1] ☐ TILLS [1] ☐ WETLANDS [0] ☐ HARDPAN [0] ☐ SANDSTONE [0] ☑ RIP/RAP [0] ☐ LACUSTURINE [0] ☐ SHALE [-1] ☐ COAL FINES [-2]

QUALITY — SILT: ☐ HEAVY [-2] ☑ MODERATE [-1] ☐ NORMAL [0] ☐ FREE [1]

EMBEDDEDNESS: ☐ EXTENSIVE [-2] ☑ MODERATE [-1] ☐ NORMAL [0] ☐ NONE [1]

Comments

Substrate: 16 (Maximum 20)

2] INSTREAM COVER
Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

0 UNDERCUT BANKS [1]	0 POOLS > 70cm [2]	0 OXBOWS, BACKWATERS [1]	
2 OVERHANGING VEGETATION [1]	1 ROOTWADS [1]	3 AQUATIC MACROPHYTES [1]	
1 SHALLOWS (IN SLOW WATER) [1]	2 BOULDERS [1]	1 LOGS OR WOODY DEBRIS [1]	
2 ROOTMATS [1]			

AMOUNT — Check ONE (Or 2 & average): ☐ EXTENSIVE >75% [11] ☑ MODERATE 25-75% [7] ☐ SPARSE 5-<25% [3] ☐ NEARLY ABSENT <5% [1]

Comments: b/n Lake + Culvert = bad

Cover: 14 (Maximum 20)

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☑ MODERATE [2]
☑ LOW [2]	☑ FAIR [3]	☑ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel: 10 (Maximum 20)

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☑☐ NONE / LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☑ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY / SEVERE [1]	☑☑ NARROW 5-10m [2]	☐☑ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING / CONSTRUCTION [0]
	☐☐ VERY NARROW < 5m [1]	☑☑ FENCED PASTURE [1]	
	☐☐ NONE [0]	☐☐ OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Comments: no floodplain

Riparian: 5.5 (Maximum 10)

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH — Check ONE (ONLY!): ☐ > 1m [6] ☐ 0.7-<1m [4] ☑ 0.4-<0.7m [2] ☐ 0.2-<0.4m [1] ☐ < 0.2m [0]

CHANNEL WIDTH — Check ONE (Or 2 & average): ☐ POOL WIDTH > RIFFLE WIDTH [2] ☑ POOL WIDTH = RIFFLE WIDTH [1] ☐ POOL WIDTH > RIFFLE WIDTH [0]

CURRENT VELOCITY — Check ALL that apply: ☐ TORRENTIAL [-1] ☐ VERY FAST [1] ☐ FAST [1] ☑ MODERATE [1] ☐ SLOW [1] ☐ INTERSTITIAL [-1] ☐ INTERMITTENT [-2] ☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential: Primary Contact / Secondary Contact (circle one and comment on back)

Comments

Pool / Current: 4 (Maximum 12)

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). ☐ NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☑ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☑ BEST AREAS 5-10cm [1]	☑ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☑ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run: 5 (Maximum 8)

6] GRADIENT (36 ft/mi)

DRAINAGE AREA (mi²) ☐ VERY LOW - LOW [2-4] ☐ MODERATE [6-10] ☑ HIGH - VERY HIGH [10-6]

%POOL: 100 %GLIDE: ( ) %RUN: 30 %RIFFLE: 100

Gradient: 8 (Maximum 10)

EPA 4520 06/16/06

APPENDIX 4

Williams Creek Hydrologic Analysis

WILLIAMS CREEK
HYDROLOGIC ANALYSIS

Hamilton County, Indiana

(Williams Creek Master Plan Appendix 4)

Prepared for

Hamilton County Drainage Board
One Hamilton County Square
Noblesville, Indiana 46060

June 2010

Prepared by

Christopher B. Burke Engineering, Ltd.
115 West Washington Street, Suite 1368 South
Indianapolis, Indiana 46204

CBBEL Project No. 07-0760

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1.0 INTRODUCTION

As part of the Williams Creek Master Plan in Hamilton County, Indiana, a hydrologic model of the watershed was needed to analyze existing and future conditions as well as to evaluate potential solutions to identified issues. Instead of creating a new model, the hydrologic model of the Williams Creek watershed in Hamilton and Marion Counties which was developed by IDNR along with the adjoining watershed of Crooked Creek was used as a starting point. The location of these watersheds is shown in **Figure A4-1**. The IDNR model was developed as a basis for new coordinated discharges that were used as part of the FIS restudy for the Marion County portion of the two streams. Additional revisions to the model for the purposes of the Williams Creek Watershed Master Plan are described in this report.

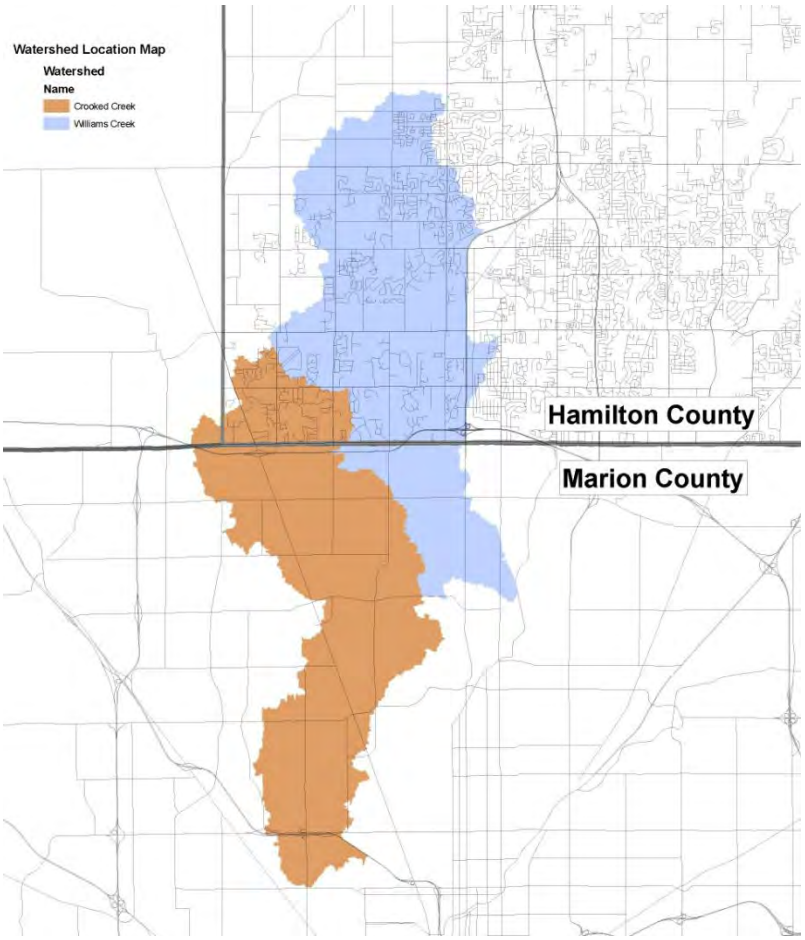


Figure A4-1: Watershed Location Map

2.0 EXISTING CONDITION ANALYSIS

2.1 INTRODUCTION

The hydrologic analysis performed to determine the discharges along Williams Creek was done using the U.S. Army Corps of Engineers HEC-HMS model (version 3.1). The analysis encompassed the Williams Creek and Crooked Creek watershed at their mouths in Marion County. Crooked Creek was included in the Williams Creek Master Plan modeling even though it is not in the Williams Creek watershed due to its proximity to Williams Creek and the existence of longer stream gage records for use in calibration. This approach maintained consistency with the IDNR approach. Because it was used as a basis for additional modeling for the Master Plan, a copy of the IDNR report explaining their model is included in **Appendix A4-1**. Key information from the IDNR report along with additional information incorporated for the purpose of the Williams Creek Master Plan are described below.

2.2 SUBBASIN PARAMETERS

The Clark unit hydrograph method was selected by IDNR as the basis of the rainfall-runoff generation for individual subbasins. This method requires the following major inputs for a given subbasin: basin area, Natural Resource Conservation Service (NRCS) curve number (CN), NRCS lag time, and a storage coefficient (R value). Other input parameters include the initial loss, percent imperviousness, and baseflow (if applicable). Of the optional parameters, only percent imperviousness was used for this model. The development of each of these parameters is explained below.

Subbasin Drainage Area

The subwatersheds used by IDNR in their study are shown below in **Figure A4-2** (Aerial photography is from 2003). Even though the delineations differ from those used in other parts of this Master Plan (such as the one square mile delineations), they were considered close enough for the purposes of the hydrologic modeling for the Master Plan. The areas used are listed with additional parameters from the IDNR model in **Table A4-1** at the end of this section.

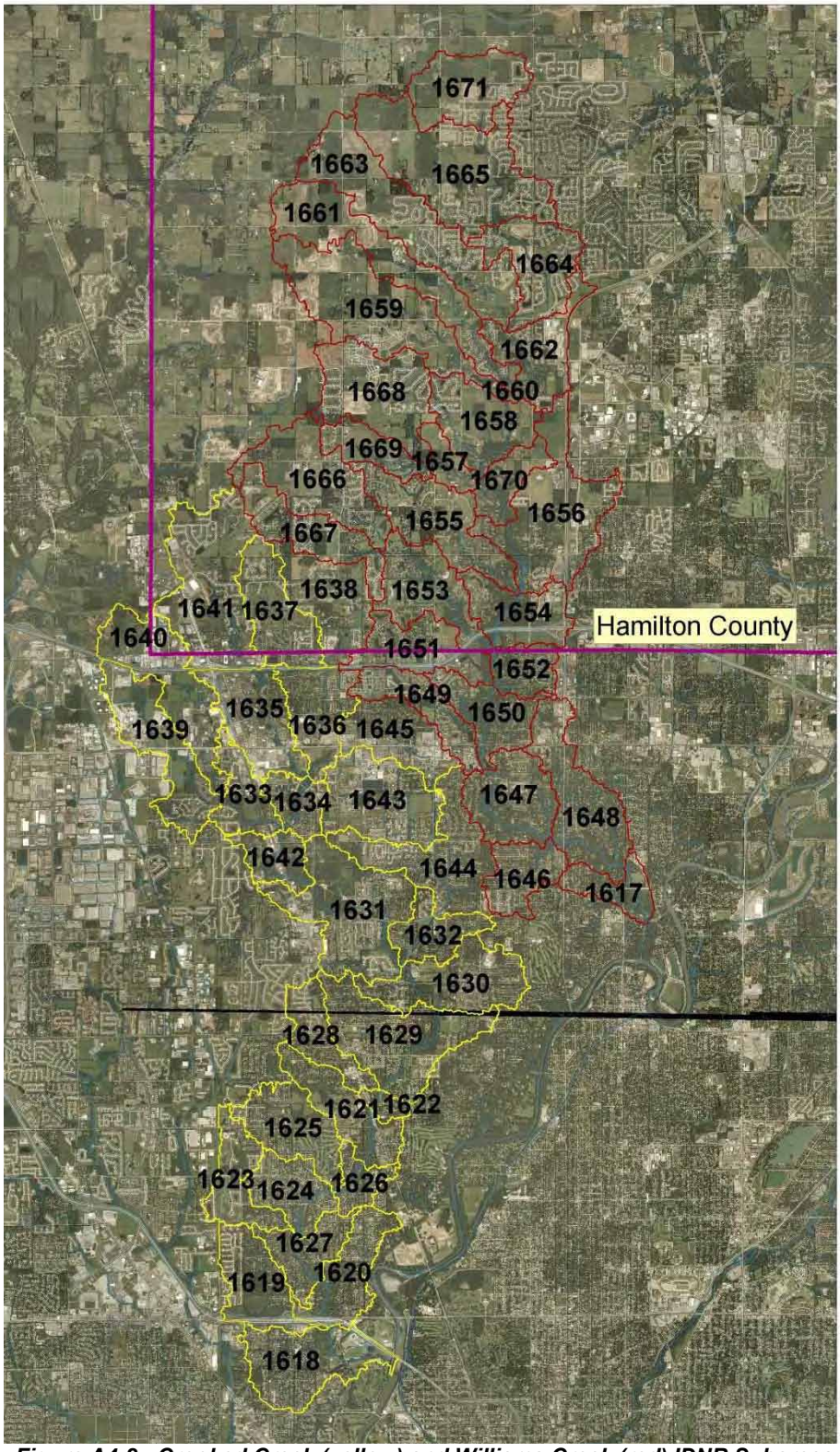


Figure A4-2: Crooked Creek (yellow) and Williams Creek (red) IDNR Subareas

Subbasin Curve Number

Curve numbers for the IDNR model were calculated based on the year 2000 land use data and soil types as described in their report. Curve numbers used in the IDNR study are listed in Table A4-1.

Subbasin Lag Time and Storage Coefficient

Lag time and Clarks method storage coefficient (R) were calibrated as described in the IDNR model description provided in Appendix A4-1 and shown below in Table A4-1.

Subbasin Percent Imperviousness

The IDNR model included values for percent imperviousness in some of the subbasins. These values are shown below in Table A4-1.

Table A4-1
IDNR Model Subbasin Parameters

basin	Drainage Area, sq. mi.	CN	Time of Concentration, hr	Storage Coefficient	% imperviousness
1617	0.350	71.1	2.152	1.38	7.2
1618	0.916	75.9	3.641	2.33	10.6
1619	0.668	79.1	2.605	1.67	6.2
1620	0.622	73.9	3.280	2.10	4.9
1621	0.643	77.5	3.001	1.92	15
1622	0.117	75.3	1.555	0.99	17.7
1623	0.540	79	3.449	2.20	4.9
1624	0.529	76.9	2.165	1.38	3.5
1625	0.716	77.9	3.394	2.17	11.4
1626	0.252	75	1.857	1.19	2.4
1627	0.484	75.8	2.394	1.53	4
1628	0.456	81.7	3.056	1.95	6.9
1629	1.195	77.6	3.024	1.93	6.4
1630	0.887	76.3	4.483	2.87	7.6
1631	1.326	77.9	2.898	1.85	8.4
1632	0.450	78.7	2.878	1.84	8.2
1633	0.458	78.9	3.014	1.93	6.1
1634	0.334	75.9	1.469	0.94	5.3
1635	0.796	86.3	1.419	0.91	5.9
1636	0.652	79	2.419	1.55	3.6

basin	Drainage Area, sq. mi.	CN	Time of Concentration, hr	Storage Coefficient	% imperviousness
1637	0.726	78.3	3.266	2.09	3.3
1638	0.803	77.1	2.862	1.83	0.6
1639	0.891	81.4	2.849	1.82	6.3
1640	1.009	83.2	4.411	2.82	4.4
1641	1.413	79.9	3.008	1.92	17.1
1642	0.363	75.2	1.813	1.16	5.7
1643	0.985	81.3	2.526	1.62	6.8
1644	1.055	78.9	2.488	1.59	5.4
1645	0.673	81.3	2.499	1.60	5.2
1646	0.484	77.6	2.552	1.63	5.7
1647	0.779	72.6	1.584	1.01	7.8
1648	1.017	73.8	2.834	1.81	6
1649	0.528	78.5	2.388	1.53	3
1650	0.582	73.2	1.895	1.21	3.5
1651	0.663	77	2.316	1.48	2
1652	0.352	74.5	2.086	1.33	2.2
1653	0.779	75.8	2.194	1.40	6.3
1654	0.644	76.6	2.079	1.33	4.8
1655	0.931	75.2	3.309	2.12	8.8
1656	1.366	77.8	3.233	2.07	5.7
1657	0.227	73.9	1.431	0.91	10.4
1658	0.767	78.1	2.450	1.57	3.9
1659	1.528	79.8	2.712	1.73	0.9
1660	0.014	72.2	0.691	0.44	0
1661	1.220	79.1	4.673	2.99	0.1
1662	0.672	78	4.236	2.71	0.2
1663	1.498	79.9	3.435	2.20	0
1664	0.777	79.7	2.074	1.33	0
1665	1.741	80.1	3.367	2.15	0
1666	1.025	78.2	4.541	2.90	4.6
1667	0.698	77.4	2.785	1.78	10.2
1668	1.052	80	3.847	2.46	2.5
1669	0.386	78.4	2.373	1.52	6.7
1670	0.370	77.5	2.051	1.31	12.7
1671	0.802	78.7	2.883	1.84	0

*Williams Creek basins in Hamilton County are shaded. (Subbasin 1651 is only partially in Hamilton County.)

2.3 ADDITIONAL INPUT PARAMETERS

Reach Routing

Reach routing parameters were based on reasonable velocities and measured reach lengths.

Rainfall Data

For the selected frequency rainfalls, the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency depth data was used with the 50% All Cases distribution of the 6-, 12-, and 24- hour duration storms. These rainfall depths are shown below in **Table A4-2**.

Table A4-2

Precipitation Depth Frequency Estimates (inches)

Storm Duration	Annual Chance	
	10%	1%
6 hr	3.10	4.88
12 hr	3.59	5.47
24 hr	4.12	6.01

2.4 CALIBRATION TO HISTORIC FLOODS

Since the IDNR study was completed, a USGS stream gage was installed at 96th Street, just downstream of Hamilton County. In June 2008, there was a rainfall of 1.7 - 2.5 inches across the watershed in 7 hours. This was approximately equal to a 50% annual chance (2-year) rainfall. This rainfall caused a peak flow of approximately 1,440 cfs at the gage (based on recorded gage height and a graph of previous gage heights versus discharge). In order to test the validity of the IDNR model for this more frequent level storm, the rainfall for this storm was input into the IDNR model. Results were significantly less than the gage value. Because of this, it was decided that further calibration of the IDNR model should be considered. The IDNR model also made some broad generalizations that did not lend themselves to evaluating scenarios in the watershed as needed for the Master Plan. These generalizations included use of the Clark R value to account for storage in the watershed and no accounting for detention ponds located throughout the basin.

For calibration purposes, the 1957 (approximately a 1% annual chance storm) and 2003 flood events from the IDNR study along with the June 2008 rainfall

(approximately a 50% annual chance storm) were used. The 1957 flood was used due to the existence of stream flow measurements on Crooked and Williams Creek for the event and the fact that little development had occurred in the watershed at the time. The 2003 flood was chosen due to the large rainfall depth. The 2008 flood calibration provided a smaller scale flood and made use of the Williams Creek gage data that was available. The observed discharges used for calibration are shown later in this section along with the model results.

The 1957 and 2003 rainfall data was unchanged from that used in the IDNR modeling. Rainfall depths for the 2008 storm were added based on the National Weather Service (NWS) grid data obtained from the Advanced Hydrologic Prediction Service web site. Depths varied from 1.7 to 2.5 inches across the Williams Creek basin. There was nothing to calibrate the Crooked Creek basin to for this storm so false depths were input for Crooked Creek basins in order to allow the Williams Creek basin values to be calculated. The rainfall distribution information for the 2008 storm was based on the Eagle Creek airport hourly rainfall data provided by the Indiana State Climatologist. A copy of the available rainfall data is included in **Appendix A4-2**.

As part of the additional calibration effort, two sets of curve numbers were recalculated from the IDNR study: 1957 (predevelopment) conditions and existing conditions. Based on an overview of the soils maps, it was determined that the soils were about 40% B soils and 60% C soils. This ratio was applied across all subbasins for simplicity.

A curve number of 80 for the 1957 conditions was used based on a land use of row crops for the entire Williams Creek watershed with some residential land use in the Crooked Creek watershed as noted on 1956 aerial photography.

For the purpose of Calibration of 2003 and 2008 flood events, curve numbers for the 2003 and 2008 conditions were assumed to be close enough to use the 2008 aerial photography to approximate land use. The associated calculation sheets are included in **Appendix A4-3.**

Percent impervious area from the IDNR model was used initially. Time of Concentration and the R values were also unchanged. Several avenues were then pursued in order to achieve a reasonable estimation of all three of the calibration floods. The best match that could be achieved by consistent methods that had a foundation in real life conditions was obtained by doing the following:

1) The percent imperviousness of each subbasin was determined by estimating the percent of the basin that was small or medium residential and commercial land uses, dividing that number in half and then reducing it by 5 (the latter two operations were to simulate the extent of pervious

areas within these developed areas). These values are compared to the IDNR values in **Table A4-3**.

2) For any subbasin that had a large percentage of what looked like mature woods on the aerial photography, curve numbers were reduced by 10 from the calculated value for that subbasin. This reduction put the curve number in those subbasins about the same as that for wooded areas. For Crooked Creek, the reduction in curve number was not appropriate for basins 1640, 1641, 1635, 1639, or 1643. For Williams Creek, the reduction was appropriate only in basins 1617, 1646, 1647, 1648, 1649, 1650, and 1652. An example of a subbasin adjusted in this manner is shown below in **Figure A4-3**.

Figure A4-3: Basin 1652, an Example of Land Use in Subareas with Curve Number Adjusted for Extensive Tree Cover

3) The changes noted in items 1 and 2 created a good calibration for the 1957 flood but were not enough to closely calibrate the 2003 and 2008 floods. For these calibration runs, detention was added as it was a factor that had changed as the watershed developed from farm land in 1957 to developed conditions in 2003. Based on a visual inspection of aerial photography, the percent of each subbasin that appears to use detention was used as the percent of the calculated flow for each subbasin to be diverted to an imaginary reservoir. Maximum outflow from this imaginary reservoir was set equal to the diverted percent of the calculated 10% annual chance (10-year) runoff for that subbasin (calculated using the critical duration for the 10% and 50% All Cases Atlas 14 rainfall distributions). The output of this diverted flow routed through the detention

basin approximation (imaginary reservoir) was then combined back with the undiverted portion of the runoff for the subbasin. These steps provided a generalized way to reduce the flow from the areas with detention to the approximate release rates required by ordinance.

The same approach but with a slightly different method of determining the diversion amount was used for subbasin 1654. This subbasins had substantial area that was identified by the Hamilton County Surveyor's Office as probably having been developed under the requirements of 0.3 cfs/Acre maximum release rate for the 1% annual chance flood and 0.1 cfs/Acre for the 10% annual chance flood. Outflow from the imaginary reservoir for each subbasin with this situation was limited to the associated regulatory release rate over the percent of the area so regulated. A copy of the calculations of the detention parameters is provided in **Appendix A4-4**.

A comparison of calibrated parameter values is provided in **Table A4-3**. It should be noted that the 1957 curve numbers listed are not accompanied by any impervious area. Curve numbers resulting from calibration of the 2003 and 2008 floods and labeled as the existing conditions are lower (even though they reflect a developed condition) only because the imperviousness is not included in the curve number but is separately reflected by the percent imperviousness. This method was used because use of a composite curve number could not achieve a reasonable calibration. A comparison of the model results and actual peak flows from the calibration described above is provided in **Table A4-4**.

Table A4-3
Comparison of Calibrated Input Parameters

	Curve Numbers				% imperviousness			
basin	IDNR	1957	CBBEL existing	CBBEL future	IDNR	1957	CBBEL existing	CBBEL future
1617	71.1	80*	64	64	7.2	0	30	30
1618	75.9	80*	65	65	10.6	0	35	35
1619	79.1	80*	68	68	6.2	0	35	35
1620	73.9	80*	65	65	4.9	0	30	30
1621	77.5	80*	63	63	15	0	25	25
1622	75.3	80*	64	64	17.7	0	30	30
1623	79	80*	63	63	4.9	0	20	20
1624	76.9	80*	73	73	3.5	0	35	35
1625	77.9	80*	63	63	11.4	0	20	20
1626	75	80*	64	64	2.4	0	30	30
1627	75.8	80*	65	65	4	0	35	35

	Curve Numbers				% imperviousness			
basin	IDNR	1957	CBBEL existing	CBBEL future	IDNR	1957	CBBEL existing	CBBEL future
1628	81.7	80*	78	78	6.9	0	50	50
1629	77.6	80*	67	67	6.4	0	45	45
1630	76.3	80*	65	65	7.6	0	35	35
1631	77.9	80*	66	66	8.4	0	30	30
1632	78.7	80*	66	66	8.2	0	35	35
1633	78.9	80	67	67	6.1	0	30	30
1634	75.9	80	68	68	5.3	0	35	35
1635	86.3	80	89	89	5.9	0	50	50
1636	79	80	65	65	3.6	0	35	35
1637	78.3	80	64	64	3.3	0	25	25
1638	77.1	80	61	61	0.6	0	20	20
1639	81.4	80	78	78	6.3	0	30	30
1640	83.2	80	79	79	4.4	0	25	25
1641	79.9	80	78	78	17.1	0	30	30
1642	75.2	80	64	64	5.7	0	20	20
1643	81.3	80*	81	81	6.8	0	40	40
1644	78.9	80*	67	67	5.4	0	40	40
1645	81.3	80*	85	85	5.2	0	50	50
1646	77.6	80*	67	67	5.7	0	45	45
1647	72.6	80*	66	66	7.8	0	30	30
1648	73.8	80*	68	68	6	0	40	40
1649	78.5	80	70	70	3	0	40	40
1650	73.2	80	68	68	3.5	0	45	45
1651	77	80	78	78	2	0	45	45
1652	74.5	80	67	77	2.2	0	45	45
1653	75.8	80	72	74	6.3	0	20	21
1654	76.6	80	76	82	4.8	0	25	36
1655	75.2	80	72	73	8.8	0	0	3
1656	77.8	80	79	84	5.7	0	32	39
1657	73.9	80	78	79	10.4	0	12	16
1658	78.1	80	77	84	3.9	0	10	45
1659	79.8	80	77	79	0.9	0	45	45
1660	72.2	80	73	88	0	0	0	45
1661	79.1	80	75	76	0.1	0	50	30
1662	78	80	79	87	0.2	0	25	45
1663	79.9	80	77	80	0	0	30	30

	Curve Numbers				% imperviousness			
basin	IDNR	1957	CBBEL existing	CBBEL future	IDNR	1957	CBBEL existing	CBBEL future
1664	79.7	80	77	77	0	0	45	45
1665	80.1	80	78	81	0	0	30	45
1666	78.2	80	78	83	4.6	0	25	45
1667	77.4	80	72	76	10.2	0	10	13
1668	80	80	75	80	2.5	0	40	45
1669	78.4	80	69	70	6.7	0	0	3
1670	77.5	80	76	80	12.7	0	25	20
1671	78.7	80	83	87	0	0	25	45

*these basins are downstream of the calibration points so do not necessarily reflect calibrated values. All are downstream of Hamilton County and therefore do not affect conclusions made in the Master Plan.

Williams Creek basins in Hamilton County are shaded. (Subbasin 1651 is only partially in Hamilton County.)

Table A4-4
Calibrated Discharges Compared to Measured Peak Discharges

Flood	Location (model junction)	Measured Peak Discharge, cfs	CBBEL Calibrated Model Peak Discharge, cfs	IDNR Model Peak Discharge, cfs
1957	Williams Ck (WC03)	4170	4227	4056
1957	Crooked Ck (CC10)	2160	2141	2190
2003	Crooked Ck (gage)	3397	3894	4257
2008	Williams Ck (gage, WC05D)	1440	1077 (+102 initial flow) = 1179	undetermined

A comparison of model results and observed hydrographs for the Crooked Creek gage in the 2003 flood and the Williams Creek gage in the June 2008 flood are shown in **Figures A4-4** and **A4-5** below. A graph is not provided for the 1957 flood since only a peak discharge measurement was available (shown in Table A4-4) instead of a gage hydrograph. A digital copy of the HEC-HMS calibration models is included in Appendix 5 of the Master Plan. Output is provided in **Appendix A4-5**.

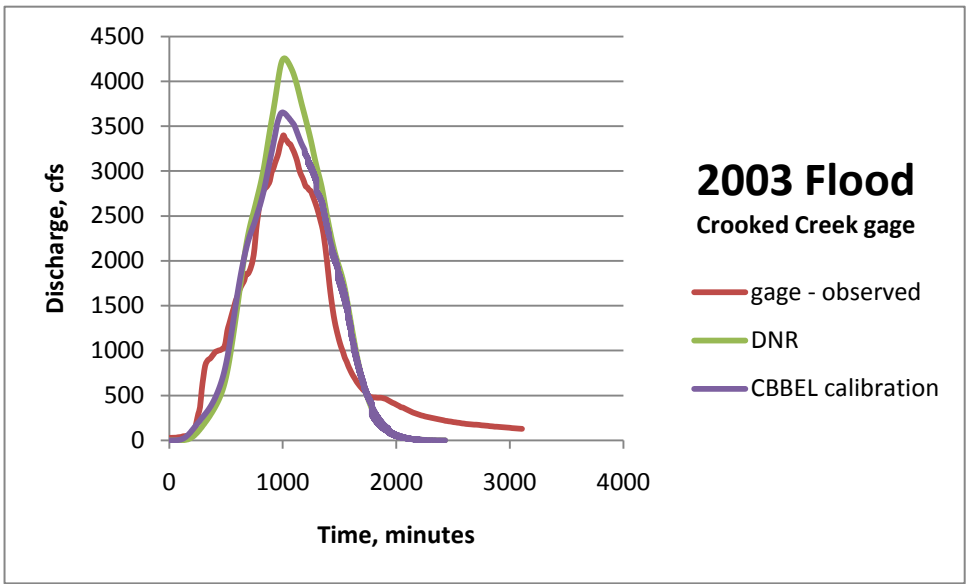


Figure A4-4: Comparison of Modeled and Actual Crooked Creek Gage Hydrograph from June 2003 Flood

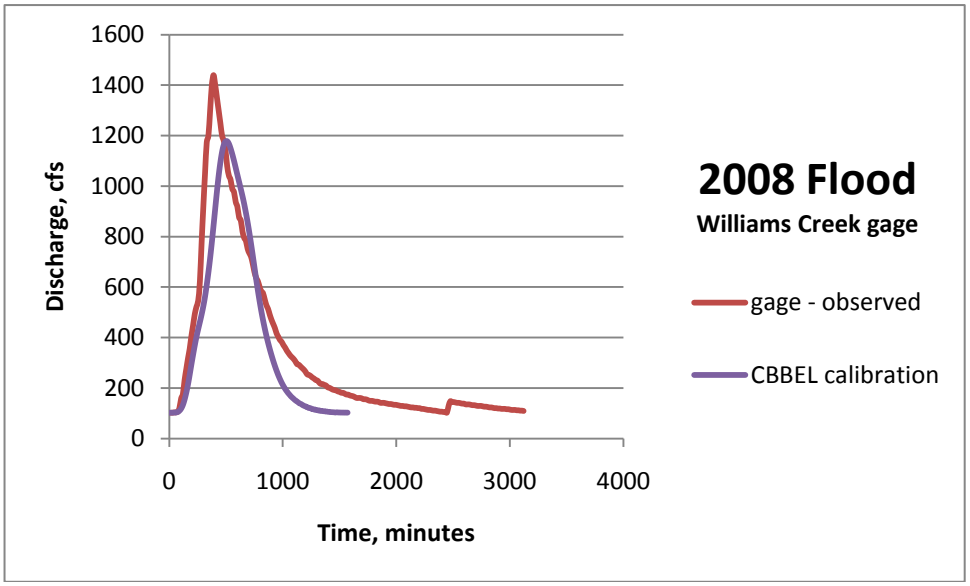


Figure A4-5: Comparison of Modeled and Actual Williams Creek Gage Hydrograph from June 2008 Flood

2.5 RESULTS

Once calibrated, the 2003/2008 calibration condition (existing conditions) basin model in HEC-HMS was run for the 1%, 10%, and 50% annual chance rainfalls (rainfall depths provided below in **Table A4-5**). Results for the 1% annual chance rainfall model were compared to the IDNR coordinated 1% annual chance discharges. IDNR had used the Atlas 14 50% All Cases distribution for the rainfall. CBBEL used the more severe 10% All Cases and SCS Type 2 distributions. Results are shown in Table **A4-6**. Only the locations directly on Williams Creek are noted.

The HEC-HMS model critical duration discharge at each location is highlighted. A copy of the calibrated existing condition models are provided in **Appendix A4-6**.

Table A4-5
Precipitation Depth Frequency Estimates (inches)
from NOAA Atlas 14

Storm Duration	Annual Chance		
	50%	10%	1%
6 hr	2.09	3.08	4.85
12 hr	2.46	3.56	5.47
24 hr	2.88	4.08	6.01

Table A4-6
Comparison of Coordinated Discharges and Modeled 1% Annual Chance Flood Discharges

		IDNR Coordinated Discharge, cfs	10% All Cases distributions			SCS Type 2
Location	DA, sq. mi.		6 hr, cfs	12 hr, cfs	24 hr, cfs	24 hr, cfs
WC01	20.9	3500	3374	3732	3935	3755
WC02	19.9	3500	3370	3720	3861	3703
WC03	18.6	3500	3355	3700	3778	3635
WC04	17.5	3480	3301	3633	3647	3531
WC05D	16.5	3470	3195	3509	3478	3390
WC05U	14	3200	2719	3000	2990	2896
WC06	13.4	3050	2663	2930	2886	2820
WC07	11.1	2550	2408	2586	2451	2490
WC08D	10.7	2480	2396	2553	2387	2454
WC08U	9	2150	2126	2251	2073	2162
WC09	8.3	2000	2048	2137	1921	2050
WC10	6.7	1690	1764	1820	1595	1757
WC11	4.8	1280	1318	1332	1154	1320
WC12	2.5	753	797	768	629	797
WC13	0.8	NA	301	282	222	304
Williams Creek	21.3	3510	3375	3780	3947	3769

IDNR coordinated discharges were generally within 10% of the highest of these values. When the higher values from the table above were placed in the Williams Creek hydraulic model, an elevation difference of 0.2 feet or less resulted. Based on these results, no change in the IDNR coordinated discharges for Williams Creek is proposed. A copy of the IDNR coordinated discharges is included in Appendix A4-1.

There are 5 tributaries to Williams Creek that have drainage areas greater than one square mile and will eventually need to be modeled to provide flood risk information. These are Spring Mill Run, Clay Creek, Elliot Creek, Almond Ditch, and Henley Ditch. In preparation for that, the discharges resulting from this model were evaluated for recommended coordinated discharge values on these streams. The 1% annual chance flood peak discharges resulting from the calibrated existing condition CBBEL model with detention removed as described for scenario 2 in Chapter 3.0 below (to agree with IDNR's policy of not directly including detention impacts) were plotted in comparison to the Williams Creek coordinated discharge curve. Results are shown in **Figure A4-6**.

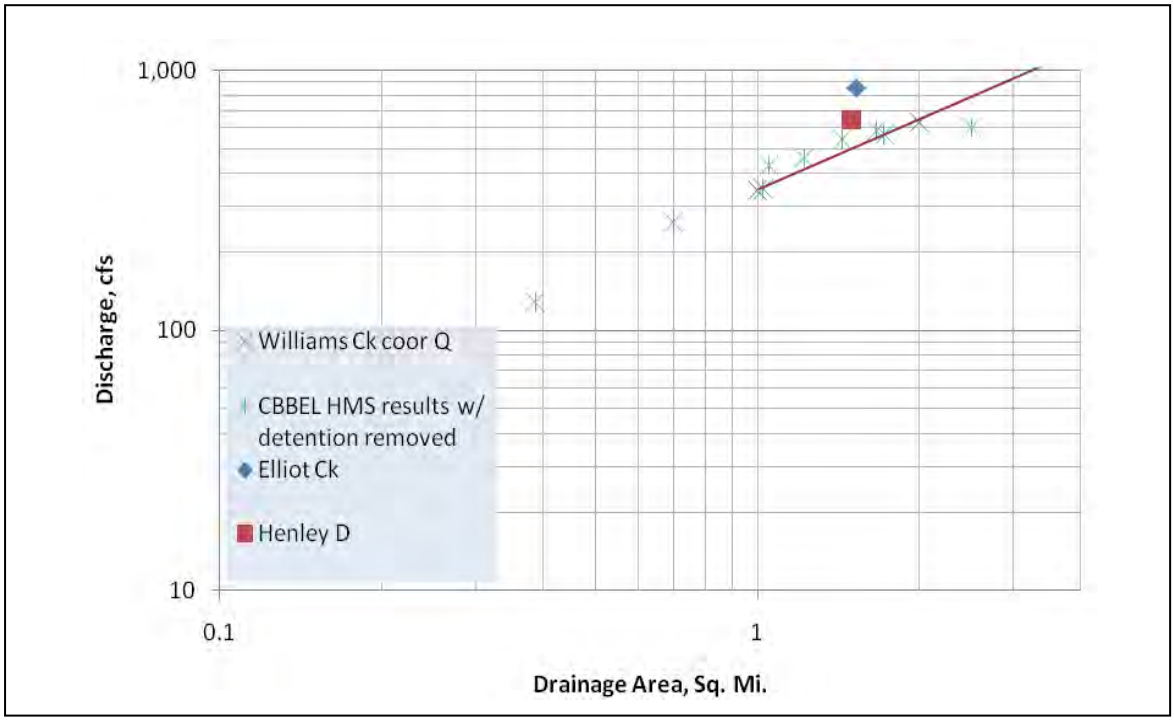


Figure A4-6: Comparison of Tributary HEC-HMS Results and the Williams Creek Coordinated Discharges

The HEC-HMS results for Spring Mill Run, Clay Creek, and Almond Ditch all are reasonably close to the Williams Creek coordinated discharge values. It is therefore recommended that these streams be added to the Williams Creek coordinated discharge curve. Elliot Creek and Henley Ditch peak discharges plotted significantly higher than the Williams Creek discharges. The reason for this is not apparent at

this time. Therefore, it is recommended that further evaluation of these basins be done before coordinated discharges for future Flood Insurance Study modeling on these streams are selected.

3.0 ADDITIONAL MODELS

For Master Plan purposes, three scenarios were created in addition to the calibrated existing conditions HEC-HMS model. The 50%, 10%, and 1% annual chance rainfall depths along with the 10% All-Cases Atlas 14 rainfall distribution were run for each of the following basin conditions:

1) 1957 (predevelopment),

2) current condition but with detention removed, and

3) full development of currently undeveloped areas where development is likely to occur soon, if release rates on the new development were limited to the current values of 0.3 cfs/Acre for the 1% annual chance flood and 0.1 cfs/Acre for the 10% annual chance flood.

The first model used the basin conditions from the 1957 calibrated model. The 1%, 10%, and 50% annual chance rainfalls with the 10% All Cases rainfall distribution were run on this basin. Results are discussed in Section 2.6 of the main section of the Master Plan. A digital copy of the model is included in Appendix 5 of the main report. Output is included in **Appendix A4-7**.

The second model was created by copying the current condition calibrated basin data then removing detention that was added in the form of diverts and reservoirs (as the current IDNR practice would require). Again, the 1%, 10%, and 50% annual chance rainfalls with the 10% All Cases rainfall distribution were run on this basin. This model provided a general idea of the impacts that the detention requirements have had on discharges in Williams Creek. Results are discussed in Section 2.6 of the main section of the Master Plan. A digital copy of the model is also included in Appendix 5 of the main report. Output is included in **Appendix A4-8.**

The third model was created to test the impacts on discharges if future development would occur in currently undeveloped areas with the release rate requirement of no more than 0.3 cfs/Acre for the 1% annual chance flood and 0.1 cfs/Acre for the 10% annual chance flood. The areas identified in the problem definition section of Chapter 2 of the Master Plan as areas of potential future development (shown in **Figure A4-7**) were converted to simulated developed conditions in the model by:

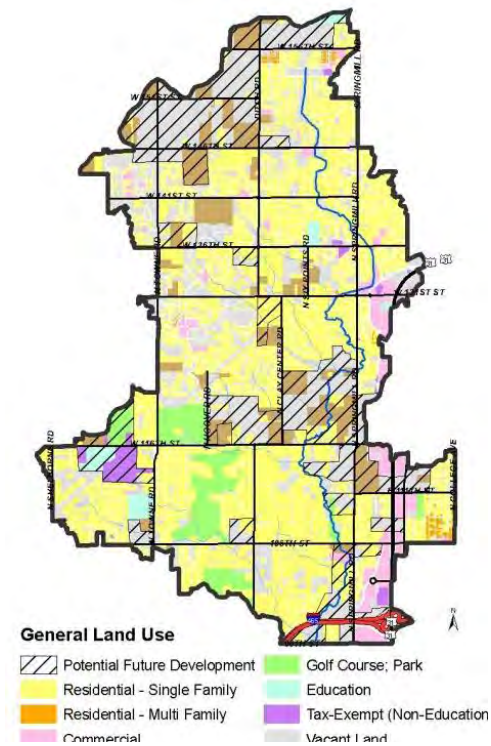


Figure A4-7: Potential Development Areas

1) increasing the curve number over the additional developed area to the curve number for 1/8 Acre residential land use. For development along US 31, the commercial CN was used instead. A comparison of the calibrated and "developed" condition curve numbers and percent impervious was included previously in Table A4-3. The calculation of these curve numbers is included in Appendix A4-3.

2) reflecting the 0.3 cfs/Ac release rate for the future developed area in the same manor described for the calibration. The percent of the area that was expected to develop was determined and diverted to an imaginary reservoir that had a release rate maximum equal to the area of the expected development times 0.3 cfs/Ac. Outflow from this "imaginary reservoir" was then added back to the previously controlled release rates as well as any uncontrolled area discharge for the subbasin. As with all of the model runs, the 6-, 12-, and 24-hour 10% All Cases rainfall distributions were used and the highest resulting discharge for each node in the model selected for comparison of results.

3) increasing the percent imperviousness by adding the additional percent of the basin that was expected to be small or medium residential and commercial land uses to the percent used for existing conditions then dividing that number in half and reducing it by 5. A comparison of the percent impervious area was included in Table A4-3.

The 10% and 50% annual chance rainfalls were also run on the "developed" conditions models created as described in the 3 items listed above. They could not be run in the same model as the 1% annual chance rainfall due to the difference in release rate limitations for the 10% annual chance rainfall and no limitations on the 50% annual chance rainfall runoff. For these two rainfalls in the model, the outflow from each of the added "imaginary" detention reservoirs was that subbasin's outflow from the 1957 condition (predeveloped) 50% annual chance flood model or 0.1 cfs /Ac depending which release rate requirement they were likely developed under (based on a comparison of the year the construction appeared on aerial photography and the ordinance requirements just before that time. These assumptions are valid for both the 10% and 50% annual chance rainfalls since the

50% annual chance flood is not required to meet any particular release rate under existing ordinances and will go through the model generally unaffected by the diversions set up for the 10% annual chance flood.

Results are discussed in Section 3.6 of the main section of the Master Plan. A digital copy of the model is included in Appendix 5 of the main report. Output is included in **Appendix A4-9**.

4.0 DATA SOURCES

Data used in this study was collected from various sources. Each data source is listed below, along with the data obtained from that source:

Source	Data Provided
Indiana Department of Natural Resources (IDNR)	Report, hydrologic model (HEC-HMS) and basin delineations which were the basis for the Williams Creek and Crooked Creek coordinated discharges, April 2008
State Climatologist	Hourly rainfall data for Eagle Creek Airport
Hamilton County	County's 2004 digital 1 foot contour interval data in GIS format
USGS	Peak flow data for Crooked Creek and Williams Creek stream flow gages
IndianaMaps	Historical aerial photography for 1956
National Climatic Data Center	Historic hourly rainfall for area gages
National Weather Service http://water.weather.gov/precip/download.php	Daily gridded rainfall totals for June 2008

APPENDIX A4-1

Hydrology for Crooked Creek & Williams Creek, Marion County

Appendix A4-1

INDIANA DEPARTMENT OF NATURAL RESOURCES

Division of Water
Indiana Department of Natural Resources
Memorandum

Date: April 11, 2008

From: David B. Knipe PE, CFM
Engineering Section Manager, Central Basin Team

Subject: Hydrology for Crooked Creek and Williams Creek, Marion County

The Division of Water, per a CTP agreement with FEMA, has completed a revision of the flood frequency hydrology for Crooked Creek and Williams Creek in Marion County, Indiana. Crooked Creek and Williams Creek are both tributaries to the West Fork White River, and are located in the north-central part of Marion County, extending into southern Hamilton County. This study is based on an HEC-HMS model of both streams, using ArcHydro and GeoHMS to derive the hydrologic parameters for the model. The model was then run with historical storms from 1957, 1978 and 2003, with the model ultimately calibrated to the 1957 storm.

Both Crooked Creek and Williams Creek are studied in detail in both the Marion County and Hamilton County Flood Insurance Studies, and the regulatory discharges are coordinated through the standard Division of Water Coordinated Discharge program with the Corps of Engineers, the U. S. Geological Survey, and the Natural Resources Conservation Service. The discharges derived in this study will be proposed for coordination through this process.

The City of Indianapolis is starting a hydraulic study on Payne Branch, a tributary to Crooked Creek. The modeling for the entire Crooked Creek watershed was used to derive regulatory discharges for Payne Brach for use in the City's study.

Parameter Development

The entire drainage basin for Crooked Creek and Williams Creek were divided into 28 and 27 subbasins, respectively, to determine runoff throughout the watersheds. The tributaries flowing into Crooked Creek include Oil Cree, Payne Branch, Howard Johnson Ditch and Delaware Creek. Tributaries flowing into Williams Creek include Spring Mill Creek, Elliot Creek, Henley Creek and Almond Ditch. While Crooked Creek is studied to the confluence with the West Fork White River, Williams Creek is studied to the "Williams Creek cutoff" at the West Fork White River, leaving a small stretch of Williams Creek unstudied. Since this area is completely in the West Fork White River floodplain, and flow in the cutoff is influenced by the West Fork White River, the study for Williams Creek was stopped at the entrance to the cutoff.

Subbasin boundaries were determined using ArcHydro tools to determine flow patterns throughout the watershed. Detailed contour mapping from Marion County (2' contours) and Hamilton County (1' contours) were used for deriving a DEM of the basin for use with ArcHydro. For the small portion of the basin in Boone County, the 5 meter DEM from the 2005 orthophotography for the state of Indiana was used. The DEM was then merged and resampled

Table 1: Basin Parameters, Crooked and Williams Creek

BasinID	Model	Drainage Area (sq mi)	Curve Number	Percent Impervious (%)	Time of Concentration (Hours)	Clark's R
1617	Williams Creek	0.350	71.1	7.2	2.152	1.38
1618	Crooked Creek	0.916	75.9	10.6	3.641	2.33
1619	Crooked Creek	0.668	79.1	6.2	2.605	1.67
1620	Crooked Creek	0.622	73.9	4.9	3.280	2.10
1621	Crooked Creek	0.643	77.5	15.0	3.001	1.92
1622	Crooked Creek	0.117	75.3	17.7	1.555	0.99
1623	Crooked Creek	0.540	79.0	4.9	3.449	2.20
1624	Crooked Creek	0.529	76.9	3.5	2.165	1.38
1625	Crooked Creek	0.716	77.9	11.4	3.394	2.17
1626	Crooked Creek	0.252	75.0	2.4	1.657	1.19
1627	Crooked Creek	0.484	75.8	4.0	2.394	1.53
1628	Crooked Creek	0.456	81.7	6.9	3.056	1.95
1629	Crooked Creek	1.195	77.6	6.4	3.024	1.93
1630	Crooked Creek	0.887	76.3	7.6	4.483	2.87
1631	Crooked Creek	1.326	77.9	8.4	2.898	1.85
1632	Crooked Creek	0.450	78.7	8.2	2.878	1.84
1633	Crooked Creek	0.458	78.9	8.1	3.014	1.93
1634	Crooked Creek	0.334	75.9	5.3	1.469	0.94
1635	Crooked Creek	0.796	86.3	5.9	1.419	0.91
1636	Crooked Creek	0.652	79.0	3.6	2.419	1.55
1637	Crooked Creek	0.726	78.3	3.3	3.266	2.09
1638	Crooked Creek	0.803	77.1	0.6	2.862	1.83
1639	Crooked Creek	0.891	81.4	6.3	2.849	1.62
1640	Crooked Creek	1.009	83.2	4.4	4.411	2.82
1641	Crooked Creek	1.413	79.9	17.1	3.008	1.92
1642	Crooked Creek	0.363	75.2	5.7	1.813	1.16
1643	Crooked Creek	0.985	81.3	6.8	2.526	1.62
1644	Crooked Creek	1.055	78.9	5.4	2.488	1.59
1645	Crooked Creek	0.673	81.3	5.2	2.499	1.60
1646	Williams Creek	0.484	77.6	5.7	2.552	1.63
1647	Williams Creek	0.779	72.6	7.8	1.564	1.01
1648	Williams Creek	1.017	73.8	6.0	2.834	1.81
1649	Williams Creek	0.528	78.5	3.0	2.388	1.53
1650	Williams Creek	0.582	73.2	3.5	1.895	1.21
1651	Williams Creek	0.663	77.0	2.0	2.316	1.48
1652	Williams Creek	0.352	74.5	2.2	2.086	1.33
1653	Williams Creek	0.779	75.8	8.3	2.194	1.40
1854	Williams Creek	0.644	78.6	4.8	2.079	1.33
1655	Williams Creek	0.931	75.2	8.8	3.309	2.12
1656	Williams Creek	1.366	77.8	5.7	3.233	2.07
1657	Williams Creek	0.227	73.9	10.4	1.431	0.91
1658	Williams Creek	0.767	78.1	3.9	2.450	1.57
1659	Williams Creek	1.528	79.8	0.9	2.712	1.73
1680	Williams Creek	0.014	72.2	0.0	0.691	0.44
1661	Williams Creek	1.220	79.1	0.1	4.673	2.99
1682	Williams Creek	0.672	78.0	0.2	4.236	2.71
1663	Williams Creek	1.498	79.9	0.0	3.435	2.20
1664	Williams Creek	0.777	79.7	0.0	2.074	1.33
1685	Williams Creek	1.741	80.1	0.0	3.367	2.15
1666	Williams Creek	1.025	78.2	4.6	4.541	2.90
1667	Williams Creek	0.698	77.4	10.2	2.785	1.78
1668	Williams Creek	1.052	80.0	2.5	3.847	2.46
1669	Williams Creek	0.386	78.4	6.7	2.373	1.52
1870	Williams Creek	0.370	77.5	12.7	2.051	1.31
1871	Williams Creek	0.802	78.7	0.0	2.883	1.84

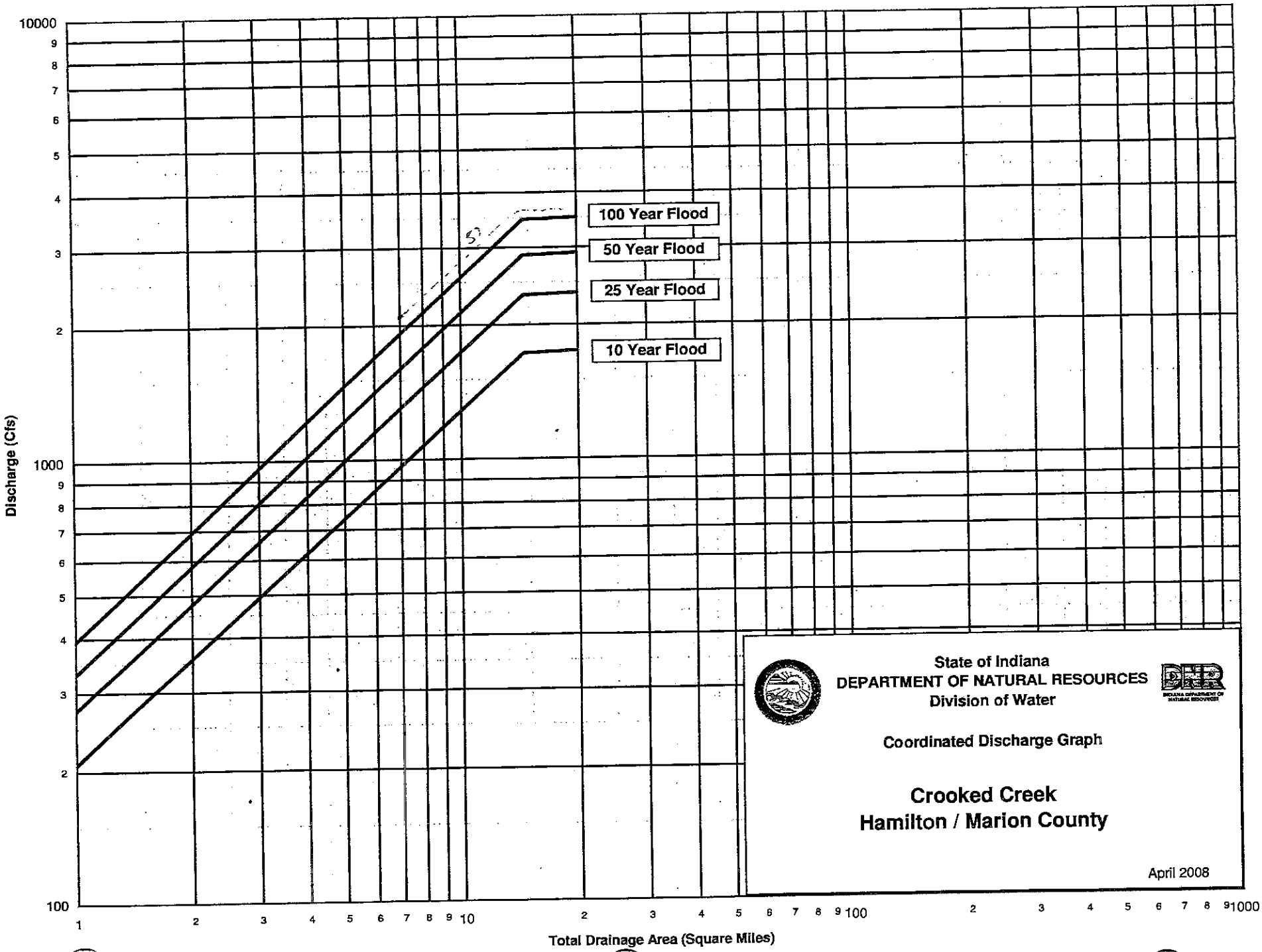
The final model is based on matching the results from the 1957 event, which matches very well. The 1978 event is underestimated using these parameters, and the 2003 event is overestimated. After much discussion with management at the Division of Water, it was the consensus that matching the 1957 event provided the best estimate of the frequency discharge that are to be used to determine the regulatory floodplain and floodway. The circumstances behind the 1978 discharge measurement cause a level of skepticism towards the reported value. The 2003 discharge discrepancy is more than likely based on changes in the watershed between 1957 and 2003. Specifically, a large amount of detention has been placed in the watershed as development (and impervious surface) has increased. While the goal of this study was not to evaluate the effect of detention and development in the watershed, it does seem that there has been an impact on the response of the watershed to rainfall events. Because this effect was not fully studied, and that the practice of the Division of Water is not to allow for the attenuation of the hydrograph based on localized detention, the 1957 flood was chosen for the final calibration.

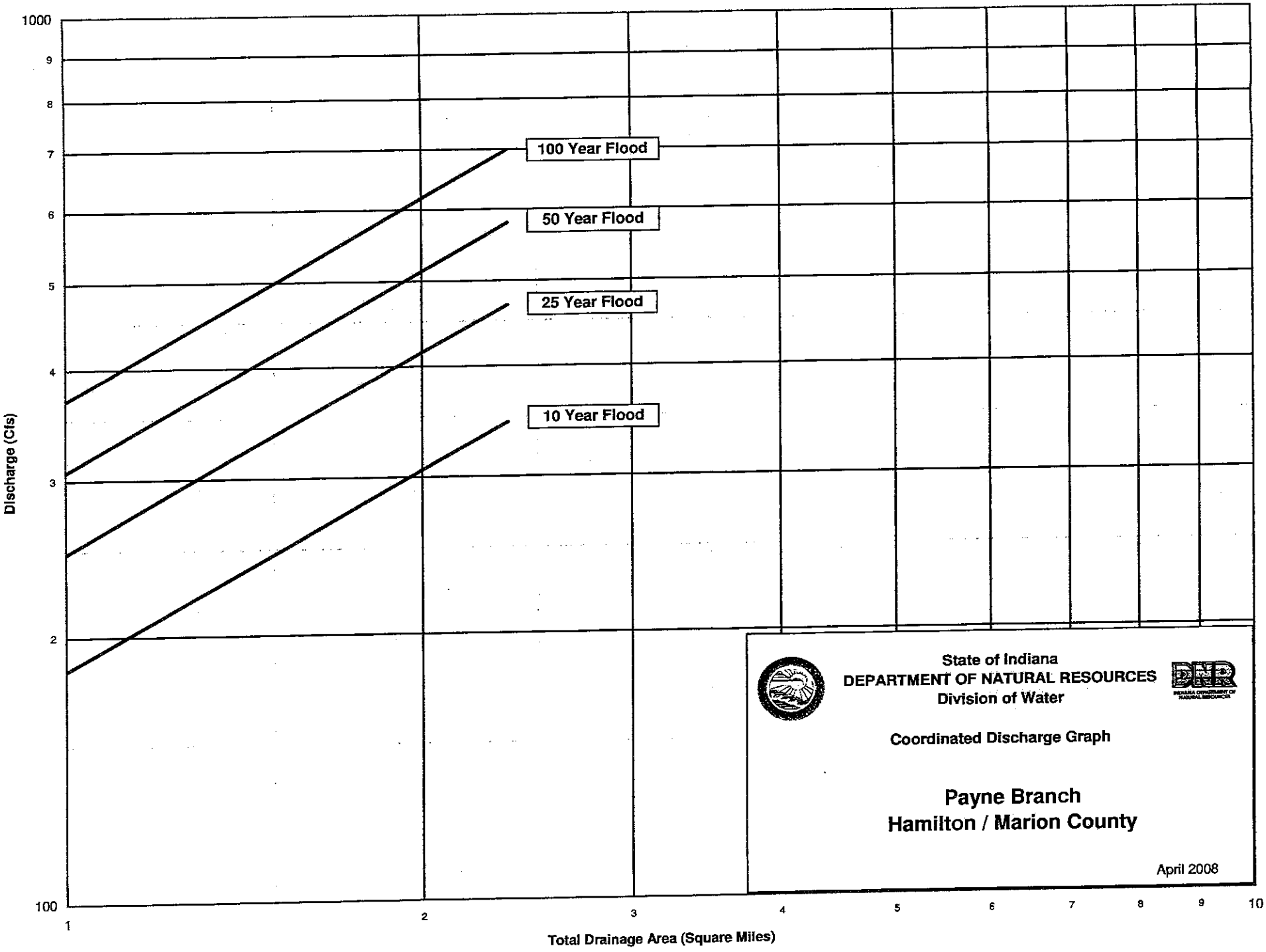
Flood Frequency Discharges

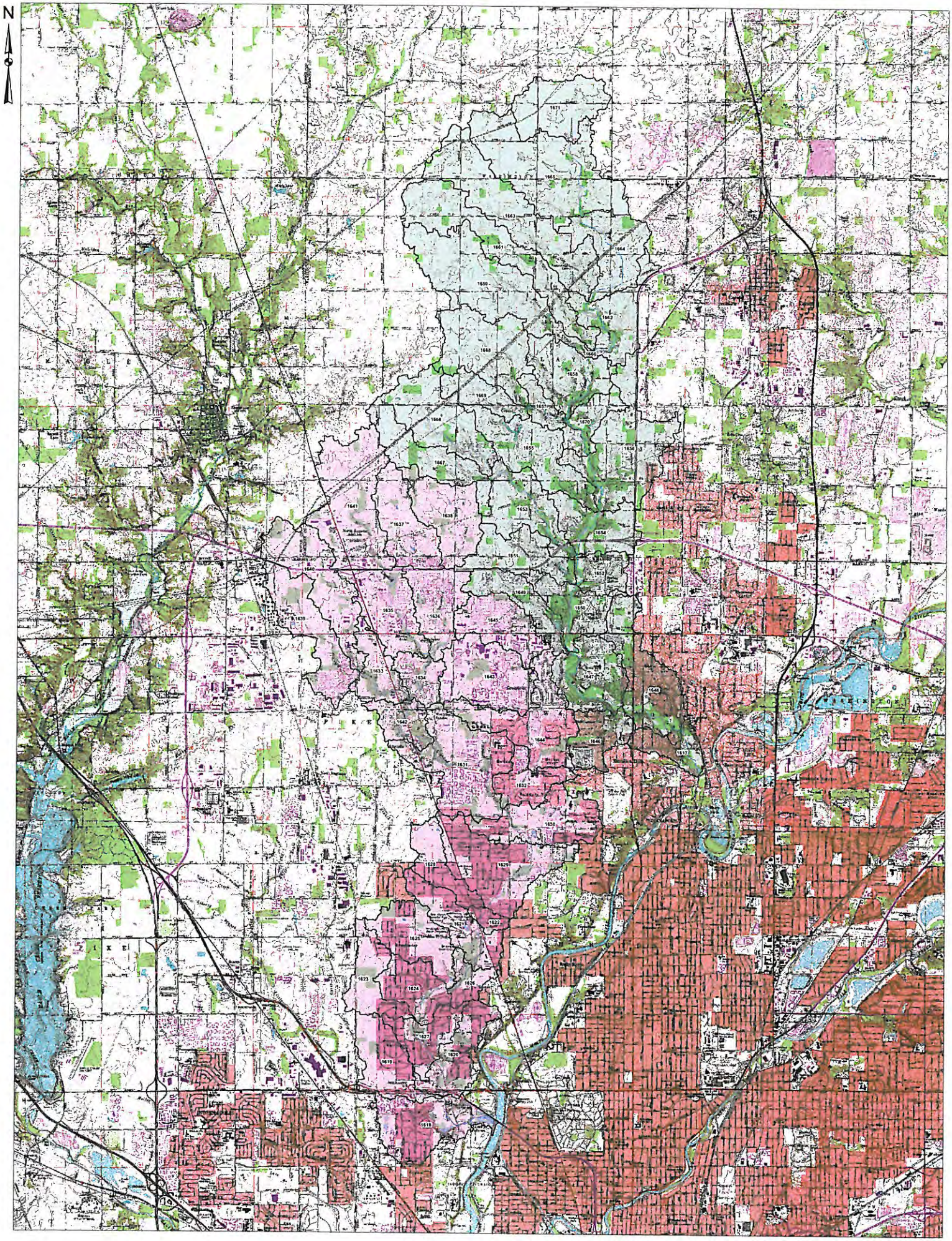
To determine the flood frequency discharges, the calibrated model was run using rainfall depths are durations from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 2, Version 3, which covers the states in the Ohio River basin. The storm frequencies modeled were the 10% annual percent chance storm (10-year), the 4% annual percent chance storm (the 25-year), the 2% annual percent chance storm (50-year), the 1% annual chance storm (100-year) and the 0.2% annual percent chance storm (500-year). The 6, 12 and 24 hour storms were run for all frequencies, using the temporal distribution for the 50% probability for all storms. Evaluating the results of each of the storms, the 6 and the 12 hour storms were most critical, with the 6 hour being chosen to represent the modeled storm.

For Payne Branch, since the time of concentration is smaller than the entire basin, the 2 and 3 hour storms were also run as a check if they would be the critical storm for the subbasin. The 3 hour storm ends up being critical, so the final discharges for Payne Branch are based on that storm.

Table 3 is the standard Flood Insurance Study table, "Summary of Discharges" for Crooked Creek, Williams Creek and Payne Branch. Figure 2, 3 and 4 are the proposed coordinated discharge graphs for each stream.


100 Year Flood
50 Year Flood
25 Year Flood
10 Year Flood
Discharge (Cfs)
Total Drainage Area (Square Miles)
State of Indiana
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Coordinated Discharge Graph
Crooked Creek
Hamilton / Marion County
April 2008


1000
9
8
7
6
5
4
3
2
100
Discharge (Cfs)
100 Year Flood
50 Year Flood
25 Year Flood
10 Year Flood
1
2
3
4
5
6
7
8
9
10
Total Drainage Area (Square Miles)
State of Indiana
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Coordinated Discharge Graph
Payne Branch
Hamilton / Marion County
April 2008



1 inch equals 2,000 feet

APPENDIX A4-2

Rainfall Data

Williams Creek area

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Indiana 39.977 N 86.105 W 830 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 2, Version 3
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2004

Extracted: Thu May 21 2009

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Docs | Return to State Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.38	0.60	0.73	0.97	1.18	1.38	1.47	1.74	2.06	2.40	2.80	3.18	3.78	4.30	5.86	7.22	9.15	10.99
2	0.45	0.71	0.87	1.16	1.42	1.66	1.76	2.09	2.46	2.88	3.36	3.79	4.49	5.10	6.93	8.50	10.73	12.86
5	0.54	0.84	1.03	1.41	1.77	2.08	2.21	2.62	3.05	3.55	4.10	4.58	5.38	6.08	8.15	9.87	12.33	14.68
10	0.61	0.95	1.16	1.62	2.06	2.44	2.59	3.08	3.56	4.08	4.67	5.20	6.09	6.86	9.11	10.92	13.56	16.07
25	0.70	1.07	1.33	1.88	2.43	2.92	3.12	3.72	4.25	4.79	5.46	6.04	7.04	7.91	10.39	12.31	15.14	17.84
50	0.78	1.18	1.46	2.08	2.74	3.32	3.57	4.27	4.83	5.37	6.08	6.70	7.79	8.74	11.38	13.36	16.32	19.15
100	0.85	1.27	1.58	2.29	3.06	3.74	4.04	4.85	5.43	5.95	6.71	7.36	8.56	9.57	12.36	14.38	17.44	20.40
200	0.92	1.37	1.71	2.49	3.38	4.18	4.54	5.46	6.06	6.55	7.36	8.04	9.33	10.41	13.34	15.38	18.53	21.59
500	1.02	1.50	1.87	2.77	3.83	4.80	5.24	6.35	6.95	7.37	8.22	8.95	10.36	11.53	14.63	16.66	19.90	23.07
1000	1.09	1.59	1.99	2.98	4.18	5.31	5.84	7.09	7.68	8.01	8.89	9.65	11.16	12.40	15.61	17.61	20.89	24.14

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

*** Upper bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.42	0.66	0.81	1.07	1.31	1.53	1.63	1.92	2.26	2.56	2.99	3.39	4.02	4.58	6.21	7.63	9.64	11.54
2	0.50	0.78	0.96	1.28	1.57	1.85	1.96	2.32	2.71	3.08	3.58	4.04	4.78	5.43	7.33	8.98	11.30	13.50
5	0.60	0.93	1.14	1.56	1.95	2.30	2.45	2.90	3.34	3.79	4.38	4.88	5.73	6.48	8.62	10.42	12.98	15.41
10	0.68	1.04	1.28	1.78	2.27	2.69	2.87	3.40	3.89	4.35	4.99	5.54	6.48	7.31	9.64	11.53	14.26	16.86

Williams Ch gage stmt values

15 min. gage ht. readings

June 3, 2008

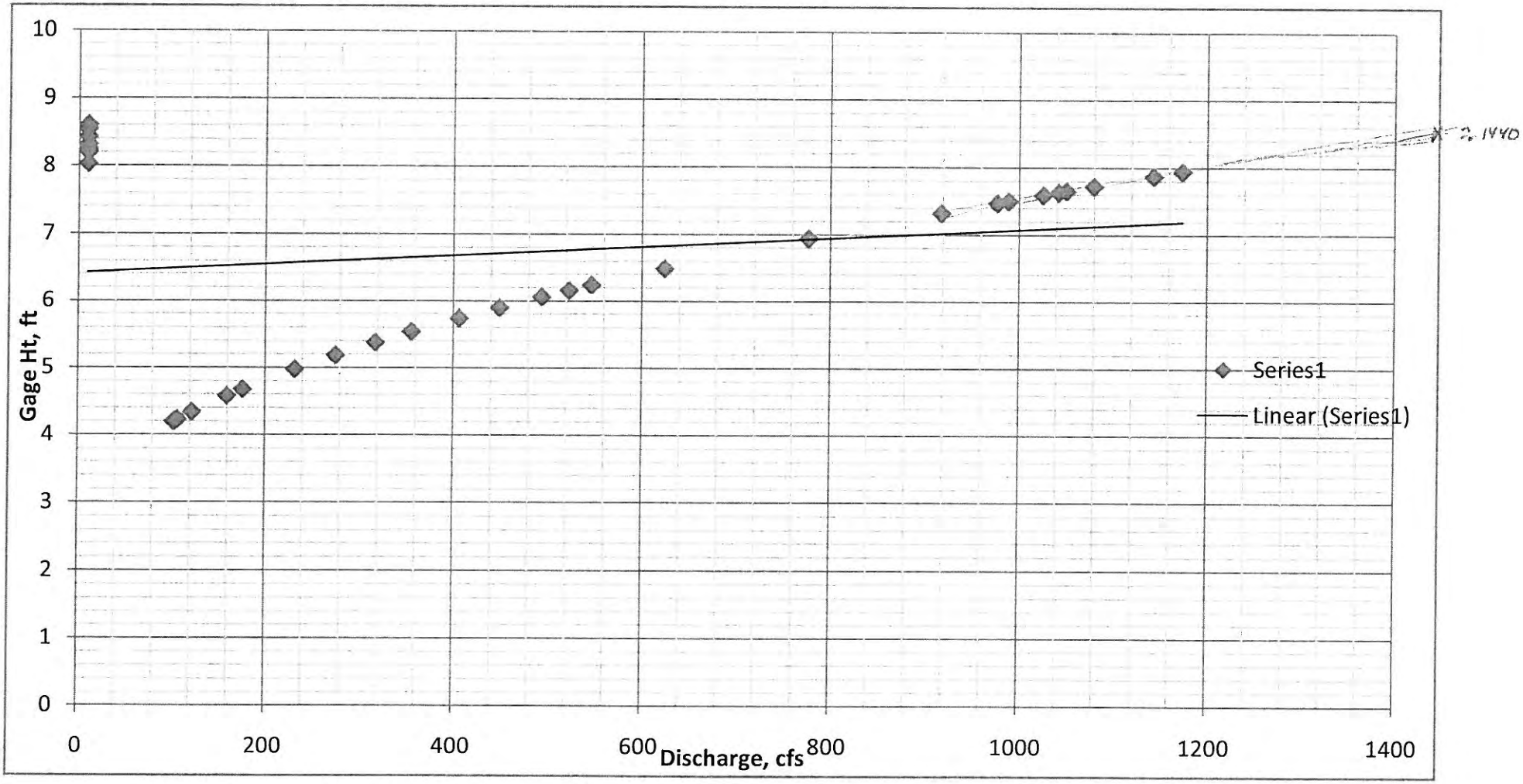
yr	mo	dy	min	cfs	GH
2008	6	3	15	22.47841	3.58
2008	6	3	30	21.45171	3.57
2008	6	3	45	22.47841	3.58
2008	6	3	60	21.45171	3.57
2008	6	3	75	21.45171	3.57
2008	6	3	90	21.45171	3.57
2008	6	3	105	21.45171	3.57
2008	6	3	120	21.45171	3.57
2008	6	3	135	21.45171	3.57
2008	6	3	150	21.45171	3.57
2008	6	3	165	21.45171	3.57
2008	6	3	180	21.45171	3.57
2008	6	3	195	21.45171	3.57
2008	6	3	210	21.45171	3.57
2008	6	3	225	20.46085	3.56
2008	6	3	240	21.45171	3.57
2008	6	3	255	20.46085	3.56
2008	6	3	270	20.46085	3.56
2008	6	3	285	21.45171	3.57
2008	6	3	300	21.45171	3.57
2008	6	3	315	22.47841	3.58
2008	6	3	330	22.47841	3.58
2008	6	3	345	22.47841	3.58
2008	6	3	360	22.47841	3.58
2008	6	3	375	23.54181	3.59
2008	6	3	390	23.54181	3.59
2008	6	3	405	24.64278	3.6
2008	6	3	420	24.64278	3.6
2008	6	3	435	24.64278	3.6
2008	6	3	450	24.64278	3.6
2008	6	3	465	24.64278	3.6
2008	6	3	480	25.78222	3.61
2008	6	3	495	24.64278	3.6
2008	6	3	510	25.78222	3.61
2008	6	3	525	25.78222	3.61
2008	6	3	540	25.78222	3.61
2008	6	3	555	26.96102	3.62
2008	6	3	570	26.96102	3.62
2008	6	3	585	28.18013	3.63
2008	6	3	600	29.4404	3.64
2008	6	3	615	32.08825	3.66
2008	6	3	630	36.39263	3.69
2008	6	3	645	40.65179	3.72
2008	6	3	660	45.00946	3.75
2008	6	3	675	46.5334	3.76
2008	6	3	690	49.69148	3.78
2008	6	3	705	49.69148	3.78
2008	6	3	720	53	3.8
2008	6	3	735	53	3.8
2008	6	3	750	54.25295	3.81
2008	6	3	765	55.52388	3.82
2008	6	3	780	56.81289	3.83
2008	6	3	795	56.81289	3.83
2008	6	3	810	56.81289	3.83
2008	6	3	825	59.44551	3.85
2008	6	3	840	67.43194	3.91
2008	6	3	855	69.62137	3.93
2008	6	3	870	74.10236	3.97
2008	6	3	885	81.07877	4.03
2008	6	3	900	87.12558	4.08
2008	6	3	915	94.66104	4.14
2008	6	3	930	103.8366	4.21
2008	6	3	945	114.8284	4.29
2008	6	3	960	120.526	4.33
2008	6	3	975	126.3579	4.37
2008	6	3	990	130.8198	4.4
2008	6	3	1005	135.3571	4.43
2008	6	3	1020	136.8863	4.44
2008	6	3	1035	135.3571	4.43
2008	6	3	1050	133.8363	4.42
2008	6	3	1065	130.8198	4.4
2008	6	3	1080	127.8368	4.38
2008	6	3	1095	124.8874	4.36
2008	6	3	1110	123.4252	4.35
2008	6	3	1125	120.526	4.33
2008	6	3	1140	119.089	4.32
2008	6	3	1155	116.2402	4.3
2008	6	3	1170	114.8284	4.29
2008	6	3	1185	113.425	4.28
2008	6	3	1200	110.6434	4.26
2008	6	3	1215	109.2652	4.25
2008	6	3	1230	107.8954	4.24
2008	6	3	1245	106.5341	4.23
2008	6	3	1260	105.1811	4.22
2008	6	3	1275	105.1811	4.22

008	6	3	1290	103.8366	4.21
2008	6	3	1305	102.5005	4.2
2008	6	3	1320	102.5005	4.2
2008	6	3	1335	101.1729	4.19
2008	6	3	1350	101.1729	4.19
2008	6	3	1365	99.85361	4.18
2008	6	3	1380	98.54285	4.17
2008	6	3	1395	98.54285	4.17
2008	6	3	1410	98.54285	4.17
2008	6	3	1425	99.85361	4.18
2008	6	3	1440	99.85361	4.18
2008	6	4	15	102.5005	4.2
2008	6	4	30	102.5005	4.2
2008	6	4	45	103.8366	4.21
2008	6	4	60	103.8366	4.21
2008	6	4	75	106.5341	4.23
2008	6	4	90	121.9714	4.34
2008	6	4	105	159.1716	4.58
2008	6	4	120	176.0898	4.68
2008	6	4	135	231.8215	4.98
2008	6	4	150	275.2543	5.19
2008	6	4	165	317.672	5.38
2008	6	4	180	355.6834	5.54
2008	6	4	195	406.1337	5.74
2008	6	4	210	448.8359	5.9
2008	6	4	225	493.6136	6.06
2008	6	4	240	522.6515	6.16
2008	6	4	255	546.4633	6.24
2008	6	4	270	624.2001	6.49
2008	6	4	285	776.7762	6.94
2008	6	4	300	918.2269	7.32
2008	6	4	315	1050.39	7.65
2008	6	4	330	1173.664	7.94
2008	6	4	345	ND	8.23
2008	6	4	360	ND	8.25
2008	6	4	375	ND	8.54
2008	6	4	390	ND	8.61
2008	6	4	405	ND	8.55
2008	6	4	420	ND	8.56
2008	6	4	435	ND	8.43
008	6	4	450	ND	8.32
008	6	4	465	ND	8.2
008	6	4	480	ND	8.03
008	6	4	495	1143.299	7.87
008	6	4	510	1079.536	7.72
008	6	4	525	1042.135	7.63
008	6	4	540	1025.718	7.59
008	6	4	555	989.2438	7.5
008	6	4	570	977.2286	7.47
008	6	4	585	937.6955	7.37
008	6	4	600	918.2269	7.32
008	6	4	615	876.0969	7.21
008	6	4	630	864.7739	7.18
008	6	4	645	820.2004	7.06
008	6	4	660	794.7299	6.99
008	6	4	675	783.9338	6.96
008	6	4	690	751.9769	6.87
008	6	4	705	734.503	6.82
008	6	4	720	720.668	6.78
008	6	4	735	693.3823	6.7
008	6	4	750	659.9969	6.6
008	6	4	765	637.1048	6.53
008	6	4	780	624.2001	6.49
008	6	4	795	601.9267	6.42
008	6	4	810	583.149	6.36
008	6	4	825	576.9542	6.34
008	6	4	840	552.4971	6.26
008	6	4	855	528.556	6.18
008	6	4	870	513.8553	6.13
008	6	4	885	490.7544	6.05
008	6	4	900	470.9656	5.98
008	6	4	915	454.3197	5.92
008	6	4	930	437.9656	5.86
008	6	4	945	416.6144	5.78
008	6	4	960	403.5339	5.73
008	6	4	975	390.6567	5.68
008	6	4	990	383.028	5.65
008	6	4	1005	370.4764	5.6
008	6	4	1020	360.5818	5.56
008	6	4	1035	348.3971	5.51
008	6	4	1050	338.796	5.47
008	6	4	1065	329.3258	5.43
008	6	4	1080	322.309	5.4
008	6	4	1095	315.3657	5.37
008	6	4	1110	306.2226	5.33

peak = 1440 gpm per rtg curve

Williams Ch. gage rtg. @ 96th St.

June 2008



U.S. Department of Commerce
National Oceanic & Atmospheric Administration
Data Version: VER2

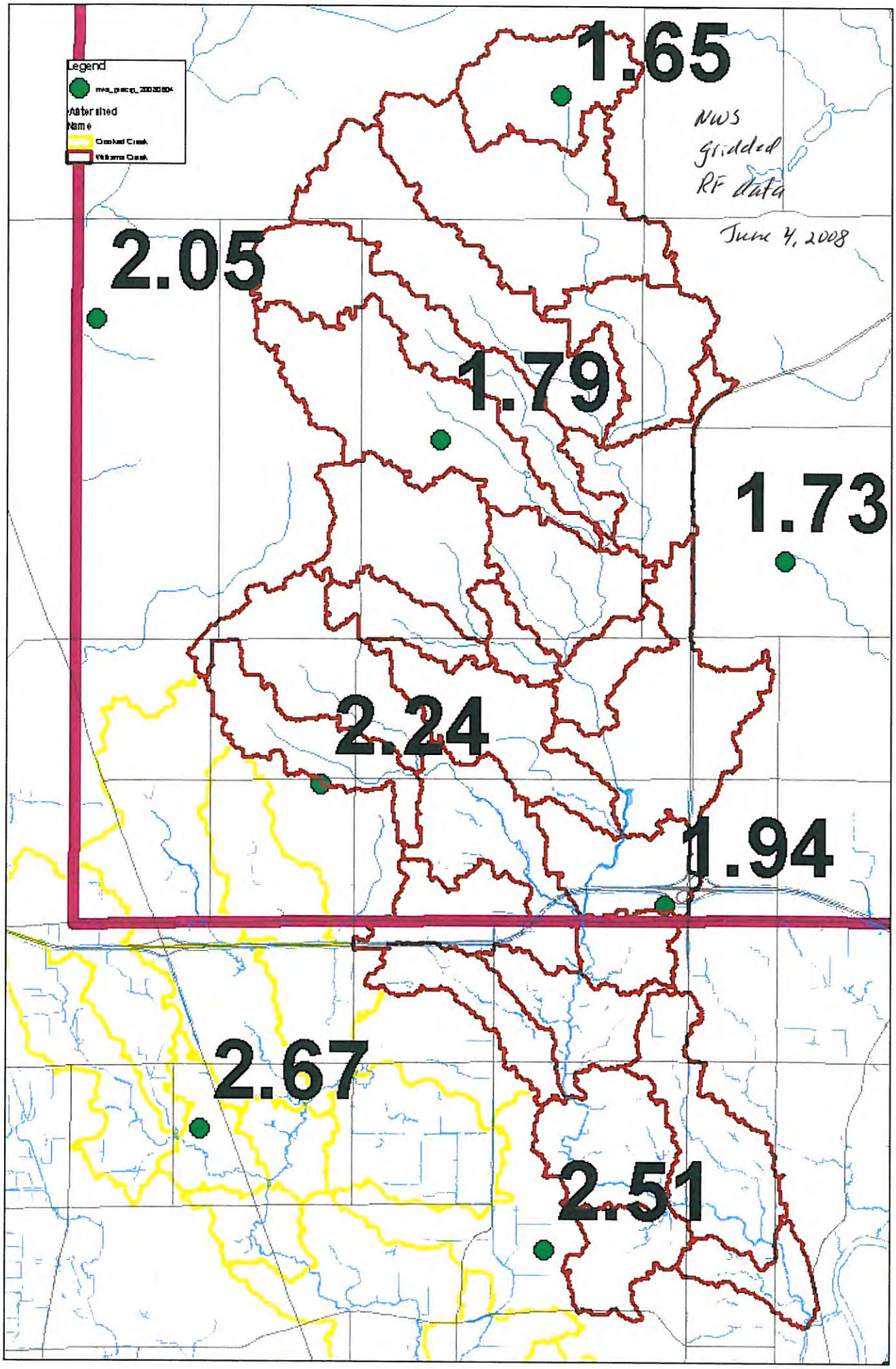
QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA
(final)
HOURLY PRECIPITATION TABLE
EAGLE CREEK AIRPARK ARPT (53842)
INDIANAPOLIS , IN
(06/2008)

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801

	A.M. HOUR(L.S.T) ENDING AT													P.M. HOUR(L.S.T) ENDING AT												
DT	--1--	--2--	--3--	--4--	--5--	--6--	--7--	--8--	--9--	--10--	--11--	--12--	--DT--	--1--	--2--	--3--	--4--	--5--	--6--	--7--	--8--	--9--	--10--	--11--	--12--	--DT--
01													01					T								01
02													02													02
03		T	T	0.02	0.06	0.01	T	0.02	0.03	0.12	0.11		03	0.02	0.22	T					T	0.01	0.06			03
04	0.01	0.48	0.07	1.44	0.78	0.04	0.10	0.12	0.01	T			04													04
05													05													05
06													06							0.10S	0.04	0.01	0.01	0.02	0.02	06
07	0.03	T	0.04	0.19	0.07	0.10	0.09	0.10	0.25	0.60	0.29	0.06	07													07
08													08													08
09													09			0.02	0.65			0.01	0.04	0.01	0.01	1.18	0.03	09
10	0.23	0.02	0.01	T		0.01		0.19					10													10
11													11													11
12													12													12
13							0.02S	0.12	0.03	0.04	T	0.05	13	0.11	0.02	T	0.24	0.05	T							13
14													14													14
15													15							0.06	0.09					15
16													16													16
17													17													17
18													18													18
19					T	T							19								T					19
20													20								0.01					20
21													21			0.05			0.08	T						21
22													22	0.19	T				0.01	0.01		0.01	T			22
23													23													23
24													24													24
25													25													25
26													26			0.31										26
27													27	T							0.17	0.17	0.04	0.04		27
28						0.03							28													28
29		0.16	T						0.01				29													29
30	T												30													30

Eagle Ck airport RF June 4, 2008

in/ hr	cumulative in/ hr	% cumulative RF
0.48	0.48	15.8
0.07	0.55	18.1
1.44	1.99	65.5
0.78	2.77	91.1
0.04	2.81	92.4
0.1	2.91	95.7
0.12	3.03	99.7
0.01	3.04	100.0


Legend
Watershed Name
Crooked Creek
Williams Creek
1.65
NWS gridded RF data
June 4, 2008
2.05
1.79
1.73
2.24
1.94
2.67
2.51

APPENDIX A4-3

Curve Number Calculations

2003 Ex Condition CN

7-760 Williams Ck CN calculations (estimated land use percentages & estimate 40% B soild & 60% C soi

SA	land use	% area	CN	Composite CN
1671	ag	50	80.2	
	med Res.	10	77.4	
	1/14 Ac Re	40	88	83.04
1665	ag	35	80.2	
	lg Res	5	72.2	
	med Res.	60	77.4	78.12
1664	med Res.	100	77.4	77.4
1663	ag	40	80.2	
	med Res.	30	77.4	
	lg Res	30	72.2	76.96
1661	med Res.	60	77.4	
	lg Res	40	72.2	75.32
1659	med Res.	100	77.4	77.4
1662	med Res.	40	77.4	
	commercia	30	93.2	
	open	30	65.8	78.66
1668	med Res.	80	77.4	
	open	20	65.8	75.08
1658	med Res.	20	77.4	
	ag	60	80.2	
	wooded	20	67.8	77.16
1657	ag	75	80.2	
	lg Res	25	72.2	78.2
1669	lg Res	50	72.2	
	open	50	65.8	69
1670	ag	50	80.2	
	lg Res	50	72.2	76.2
1666	ag	50	80.2	
	med Res.	50	77.4	78.8
1655	lg Res	100	72.2	72.2
1656	ag	15	80.2	
	lg Res	27	72.2	
	med Res.	28	77.4	
	commercia	20	93.2	
	wooded	10	67.8	78.616
1667	med Res.	30	77.4	
	open	30	65.8	
	lg Res	40	72.2	71.84
1653	golf	25	68.8	
	open	15	65.8	
	wooded	15	67.8	
	med Res.	45	77.4	72.07
1654	wooded	47	67.8	
	med Res.	33	77.4	

	commercia	20	93.2	76.048
1660	open	50	65.8	
	ag	50	80.2	73
1618	wooded	10	67.8	
	open	10	65.8	
	med Res.	80	77.4	75.28
1619	1/14 Ac Re	20	88	
	open	15	65.8	
	med Res.	65	77.4	77.78
1620	commercia	5	93.2	
	wooded	30	67.8	
	med Res.	65	77.4	75.31
1621	wooded	20	67.8	
	open	20	65.8	
	med Res.	60	77.4	73.16
1622	open	30	65.8	
	med Res.	70	77.4	73.92
1623	golf	40	68.8	
	wooded	10	67.8	
	med Res.	50	77.4	73
1624	open	20	65.8	
	1/14 Ac Re	80	88	83.56
1625	golf	30	68.8	
	open	20	65.8	
	med Res.	50	77.4	72.5
1626	wooded	20	67.8	
	open	10	65.8	
	med Res.	70	77.4	74.32
1627	wooded	20	67.8	
	med Res.	80	77.4	75.48
1628	1/14 Ac Re	100	88	88
1629	wooded	5	67.8	
	med Res.	95	77.4	76.92
1630	open	20	65.8	
	med Res.	80	77.4	75.08
1631	wooded	25	67.8	
	med Res.	65	77.4	
	commercia	10	93.2	76.58
1632	open	15	65.8	
	med Res.	85	77.4	75.66
1633	wooded	15	67.8	
	open	15	65.8	
	commercia	20	93.2	
	med Res.	50	77.4	77.38
1634	commercia	20	93.2	
	wooded	20	67.8	
	med Res.	60	77.4	78.64

1635	commercia	75	93.2	
	med Res.	25	77.4	89.25
1636	med Res.	80	77.4	
	open	20	65.8	75.08
1637	golf	30	68.8	
	med Res.	10	77.4	
	open	5	65.8	
	med Res.	55	77.4	74.24
1638	commercia	5	93.2	
	open	50	65.8	
	med Res.	20	77.4	
	lg Res	25	72.2	71.09
1639	open	40	65.8	
	commercia	30	93.2	
	med Res.	30	77.4	77.5
1640	open	50	65.8	
	commercia	50	93.2	79.5
1641	open	30	65.8	
	commercia	30	93.2	
	med Res.	30	77.4	
	wooded	10	67.8	77.7
1642	wooded	50	67.8	
	med Res.	40	77.4	
	commercia	10	93.2	74.18
1643	commercia	40	93.2	
	open	20	65.8	
	med Res.	40	77.4	81.4
1644	open	5	65.8	
	med Res.	95	77.4	76.82
1645	commercia	50	93.2	
	med Res.	50	77.4	85.3
1617	wooded	20	67.8	
	open	10	65.8	
	med Res.	70	77.4	74.32
1646	med Res.	100	77.4	77.4
1647	commercia	10	93.2	
	wooded	30	67.8	
	med Res.	60	77.4	76.1
1648	wooded	10	67.8	
	commercia	10	93.2	
	med Res.	80	77.4	78.02
1649	1/14 Ac Re	40	88	
	open	10	65.8	
	med Res.	50	77.4	80.48
1650	lg Res	30	72.2	
	1/14 Ac Re	20	88	
	med Res.	50	77.4	77.96

1651	lg Res	20	72.2	
	1/14 Ac Re	20	88	
	med Res.	60	77.4	78.48
1652	med Res.	100	77.4	77.4

ls

	CN - B	CN -C	40B60C CN
1/14 Ac Re	85	90	88
ag	76	83	80.2
commercia	92	94	93.2
golf	61	74	68.8
lg Res	65	77	72.2
med Res.	72	81	77.4
open	58	71	65.8
wooded	60	73	67.8

Future Condition Curve Numbers

7-760 Williams Ck CN calculations (estimated land use percentages & estimate 40% B soild & 60% C soi

SA	land use	% area	CN	Composite CN
1671	1/14 Ac Re	50	88	
	med Res.	10	77.4	
	1/14 Ac Re	40	88	86.94
1665	1/14 Ac Re	35	88	
	lg Res	5	72.2	
	med Res.	60	77.4	80.85
1664	med Res.	100	77.4	77.4
1663	1/14 Ac Re	40	88	
	med Res.	30	77.4	
	lg Res	30	72.2	80.08
1661	med Res.	71	77.4	
	lg Res	29	72.2	75.892
1659	med Res.	86	77.4	
	1/14 Ac Re	14	88	78.884
1662	med Res.	40	77.4	
	commercia	30	93.2	
	commercia	30	93.2	86.88
1668	med Res.	80	77.4	
	1/14 Ac Re	20	88	79.52
1658	med Res.	35	77.4	
	1/14 Ac Re	65	88	
	wooded	0	67.8	84.29
1657	1/14 Ac Re	42	88	
	lg Res	58	72.2	78.836
1669	lg Res	50	72.2	
	1/14 Ac Re	6	88	
	open	44	65.8	70.332
1670	1/14 Ac Re	50	88	
	lg Res	50	72.2	80.1
1666	1/14 Ac Re	50	88	
	med Res.	50	77.4	82.7
1655	lg Res	94	72.2	
	1/14 Ac Re	6	88	73.148
1656	1/14 Ac Re	10	88	
	lg Res	22	72.2	
	med Res.	28	77.4	
	commercia	40	93.2	
	wooded	0	67.8	83.636
1667	med Res.	36	77.4	
	open	30	65.8	
	lg Res	40	72.2	76.484
1653	golf	25	68.8	
	open	15	65.8	
	1/14 Ac Re	8	88	

	wooded	7	67.8	
	med Res.	45	77.4	73.686
1654	wooded	17	67.8	
	1/14 Ac Re	30	88	
	med Res.	33	77.4	
	commercia	20	93.2	82.108
1660	1/14 Ac Re	50	88	
	1/14 Ac Re	50	88	88
1618	wooded	10	67.8	
	open	10	65.8	
	med Res.	80	77.4	75.28
1619	1/14 Ac Re	20	88	
	open	15	65.8	
	med Res.	65	77.4	77.78
1620	commercia	5	93.2	
	wooded	30	67.8	
	med Res.	65	77.4	75.31
1621	wooded	20	67.8	
	open	20	65.8	
	med Res.	60	77.4	73.16
1622	open	30	65.8	
	med Res.	70	77.4	73.92
1623	golf	40	68.8	
	wooded	10	67.8	
	med Res.	50	77.4	73
1624	open	20	65.8	
	1/14 Ac Re	80	88	83.56
1625	golf	30	68.8	
	open	20	65.8	
	med Res.	50	77.4	72.5
1626	wooded	20	67.8	
	open	10	65.8	
	med Res.	70	77.4	74.32
1627	wooded	20	67.8	
	med Res.	80	77.4	75.48
1628	1/14 Ac Re	100	88	88
1629	wooded	5	67.8	
	med Res.	95	77.4	76.92
1630	open	20	65.8	
	med Res.	80	77.4	75.08
1631	wooded	25	67.8	
	med Res.	65	77.4	
	commercia	10	93.2	76.58
1632	open	15	65.8	
	med Res.	85	77.4	75.66
1633	wooded	15	67.8	
	open	15	65.8	

	commercia	20	93.2	
	med Res.	50	77.4	77.38
1634	commercia	20	93.2	
	wooded	20	67.8	
	med Res.	60	77.4	78.64
1635	commercia	75	93.2	
	med Res.	25	77.4	89.25
1636	med Res.	80	77.4	
	open	20	65.8	75.08
1637	golf	30	68.8	
	med Res.	10	77.4	
	open	5	65.8	
	med Res.	55	77.4	74.24
1638	commercia	5	93.2	
	open	50	65.8	
	med Res.	20	77.4	
	lg Res	25	72.2	71.09
1639	open	40	65.8	
	commercia	30	93.2	
	med Res.	30	77.4	77.5
1640	open	50	65.8	
	commercia	50	93.2	79.5
1641	open	30	65.8	
	commercia	30	93.2	
	med Res.	30	77.4	
	wooded	10	67.8	77.7
1642	wooded	50	67.8	
	med Res.	40	77.4	
	commercia	10	93.2	74.18
1643	commercia	40	93.2	
	open	20	65.8	
	med Res.	40	77.4	81.4
1644	open	5	65.8	
	med Res.	95	77.4	76.82
1645	commercia	50	93.2	
	med Res.	50	77.4	85.3
1617	wooded	20	67.8	
	open	10	65.8	
	med Res.	70	77.4	74.32
1646	med Res.	100	77.4	77.4
1647	commercia	10	93.2	
	wooded	30	67.8	
	med Res.	60	77.4	76.1
1648	wooded	10	67.8	
	commercia	10	93.2	
	med Res.	80	77.4	78.02
1649	1/14 Ac Re	40	88	

	open	10	65.8	
	med Res.	50	77.4	80.48
1650	lg Res	30	72.2	
	1/14 Ac Re	20	88	
	med Res.	50	77.4	77.96
1651	lg Res	20	72.2	
	1/14 Ac Re	20	88	
	med Res.	60	77.4	78.48
1652	1/14 Ac Re	2	88	
	med Res.	98	77.4	77.612

ls

	CN - B	CN -C	40B60C CN
1/14 Ac Re	85	90	88
ag	76	83	80.2
commercia	92	94	93.2
golf	61	74	68.8
lg Res	65	77	72.2
med Res.	72	81	77.4
open	58	71	65.8
wooded	60	73	67.8

% imp = (commercial +sm & med res /2) -5

APPENDIX A4-4

Detention Related Calculations

Detention Calculations

Hydrol D	Name	Area01	F_AREA	total future per subarea	%A future dev	dev ac * 0.3 release rate	dev ac*0.1 release rate
1652	Williams Cı	0.35172839905	5.07209065983	5.1	2.3	1.5	0.5
1653	Williams Cı	0.77889602703	19.62920721090				
1653	Williams Cı	0.77889602703	21.46558329980	41.1	8.2	12.3	4.1
1654	Williams Cı	0.64447296115	126.83222717100	126.8	30.7	38.0	12.7
1655	Williams Cı	0.93051430498	18.46399048320				
1655	Williams Cı	0.93051430498	16.37229269710	34.8	5.8	10.5	3.5
1656	Williams Cı	1.36564060348	148.14321586600				
1656	Williams Cı	1.36564060348	25.16212343070				
1656	Williams Cı	1.36564060348	28.47004701260				
1656	Williams Cı	1.36564060348	59.81162728470	261.6	29.9	78.5	26.2
1657	Williams Cı	0.22719201963	61.53499524130	61.5	42.3	18.5	6.2
1658	Williams Cı	0.76748486283	309.98471687300				
1658	Williams Cı	0.76748486283	8.26959177002	318.3	64.8	95.5	31.8
1659	Williams Cı	1.52761636249	44.19324841870				
1659	Williams Cı	1.52761636249	39.43296885310				
1659	Williams Cı	1.52761636249	11.02344225060				
1659	Williams Cı	1.52761636249	37.22925394810				
1659	Williams Cı	1.52761636249	0.08517562009	132.0	13.5	39.6	13.2
1660	Williams Cı	0.01443770087	9.24012855831	9.2	100.0	2.8	0.9
1661	Williams Cı	1.22047893710	10.44034614900				
1661	Williams Cı	1.22047893710	16.14307819680				
1661	Williams Cı	1.22047893710	13.62387179870				
1661	Williams Cı	1.22047893710	18.37276056580				
1661	Williams Cı	1.22047893710	28.70599668690	87.3	11.2	26.2	8.7
1662	Williams Cı	0.67189114153	31.17991027730	31.2	7.3	9.4	3.1
1663	Williams Cı	1.49815807220	223.64456539400				
1663	Williams Cı	1.49815807220	89.10723384780	312.8	32.6	93.8	31.3
1665	Williams Cı	1.74077421946	318.07382760100	318.1	28.5	95.4	31.8
1666	Williams Cı	1.02525611226	221.14111889100	221.1	33.7	66.3	22.1
1667	Williams Cı	0.69814354482	28.89645733150				
1667	Williams Cı	0.69814354482	0.02999323017	28.9	6.5	8.7	2.9
1668	Williams Cı	1.05233801079	86.60712096420				
1668	Williams Cı	1.05233801079	0.60198924414	87.2	12.9	26.2	8.7
1669	Williams Cı	0.38641026745	14.10093057760				
1669	Williams Cı	0.38641026745	1.02446912305	15.1	6.1	4.5	1.5
1670	Williams Cı	0.36991003788	23.60005421850				
1670	Williams Cı	0.36991003788	79.89108535280				
1670	Williams Cı	0.36991003788	12.91732982880	116.4	49.2	34.9	11.6
1671	Williams Cı	0.80239091914	266.27737708400	266.3	51.9	79.9	26.6

Detention Calculations

ID	Name	subbasin area	area w/ detention	total % SA w/ detention	assumed det req	Atlas 14 RI (10yr)Qcritical	divert reservoir return limit-10yr	% SA w/ future detention	Atlas 14 2yr Qcritical	divert reservoir return limit - 2yr
1619	Crooked C	0.668416	0.1857373	28	10	129	36.12			0
1621	Crooked C	0.642724	0.0550071	8	10	117	9.36			0
1622	Crooked C	0.117004	0.007567	6	10	31	1.86			0
1623	Crooked C	0.539553	0.3286504				0			0
1623	Crooked C	0.539553	0.0420309	69	10	91	62.79			0
1624	Crooked C	0.52877	0.0327955	6	10	116	6.96			0
1625	Crooked C	0.716123	0.0314224	4	10	122	4.88			0
1628	Crooked C	0.455796	0.164075	36	10	82	29.52			0
1629	Crooked C	1.195123	0.0645065	5	10	216	10.8			0
1630	Crooked C	0.886618	0.0394819				0			0
1630	Crooked C	0.886618	0.0988491	15	10	127	19.05			0
1631	Crooked C	1.32569	0.0755125				0			0
1631	Crooked C	1.32569	0.0242779	7	10	244	17.08			0
1633	Crooked C	0.457523	0.028371				0			0
1633	Crooked C	0.457523	0.0293948	13	10	83	10.79			0
1634	Crooked C	0.334219	0.0584623				0			0
1634	Crooked C	0.334219	0.0798927	40	10	92	36.8			0
1635	Crooked C	0.796383	0.0028651				0			0
1635	Crooked C	0.796383	0.3908947				0			0
1635	Crooked C	0.796383	0.0111399				0			0
1635	Crooked C	0.796383	0.1158067	64	10	222	142.08			0
1636	Crooked C	0.652409	0.2284202				0			0
1636	Crooked C	0.652409	0.0413005				0			0
1636	Crooked C	0.652409	0.0653505	51	10	132	67.32			0
1637	Crooked C	0.726391	0.6144669				0			0
1637	Crooked C	0.726391	0.0102642	85	10	126	107.1			0
1638	Crooked C	0.803086	0.2049449				0			0
1638	Crooked C	0.803086	0.0180618				0			0
1638	Crooked C	0.803086	0.2643969				0			0
1638	Crooked C	0.803086	0.0476162	64	2	-148	-94.72		86	55.04
1639	Crooked C	0.891169	0.067604	7	10	165	11.55			0
1640	Crooked C	1.009316	0.058401				0			0
1640	Crooked C	1.009316	0.0587288				0			0
1640	Crooked C	1.009316	0.0175475	12	10	146	17.52			0
1641	Crooked C	1.413437	0.0219961				0			0
1641	Crooked C	1.413437	0.0237827	3	10	256	7.68			0
1642	Crooked C	0.363005	0.0194193	5	10	89	4.45			0
1643	Crooked C	0.984835	0.0585137				0			0
1643	Crooked C	0.984835	0.0556818	11	10	194	21.34			0
1644	Crooked C	1.055208	0.0185944				0			0
1644	Crooked C	1.055208	0.0363442				0			0
1644	Crooked C	1.055208	0.0959103	14	10	210	29.4			0

1645	Crooked C	0.673483	0.0072437				0			0
1645	Crooked C	0.673483	0.0106965				0			0
1645	Crooked C	0.673483	0.0310249	7	10	133	9.31			0
1646	Williams C	0.484313	0.0699465	14	10	94	13.16			0
1648	Williams C	1.017028	0.0188138				0			0
1648	Williams C	1.017028	0.0226606				0			0
1648	Williams C	1.017028	0.0414638	8			0			0
1649	Williams C	0.52803	0.067426				0			0
1649	Williams C	0.52803	0.0946396				0			0
1649	Williams C	0.52803	0.0452985				0			0
1649	Williams C	0.52803	0.0378797	45	10	108	48.6			0
1651	Williams C	0.66317	0.2433669				0			0
1651	Williams C	0.66317	0.1170256				0			0
1651	Williams C	0.66317	0.0963466				0			0
1651	Williams C	0.66317	0.0069823	69	10	139	95.91			0
1652	Williams C	0.351728	0.0159236	4	10	79	3.16			0
1653	Williams C	0.778896	0.0549177				0			0
1653	Williams C	0.778896	0.1113725				0			0
1653	Williams C	0.778896	0.2234443	49	10	170	83.3			0
1654	Williams C	0.644473	0.0878573				0			0
1654	Williams C	0.644473	0.0431696				0			0
1654	Williams C	0.644473	0.1199104	38 rr .3			47	31		15
1655	Williams C	0.930514	0.4033038				0			0
1655	Williams C	0.930514	0.0755837	51	10	160	81.6			0
1656	Williams C	1.365641	0.0223004				0			0
1656	Williams C	1.365641	0.1634249				0			0
1656	Williams C	1.365641	0.0224204				0			0
1656	Williams C	1.365641	0.0307354				0			0
1656	Williams C	1.365641	0.0626593				0			0
1656	Williams C	1.365641	0.0160232	22	10	238	52.36	30		0
1657	Williams C	0.227192	0.0085611	3	10	63	1.89	42		0
1658	Williams C	0.767485	0.1354892				0			0
1658	Williams C	0.767485	0.0240838	20	10	155	31	65		0
1659	Williams C	1.527616	0.0272219				0			0
1659	Williams C	1.527616	0.0580049				0			0
1659	Williams C	1.527616	0.0315555				0			0
1659	Williams C	1.527616	0.1618328				0			0
1659	Williams C	1.527616	0.5829278				0			0
1659	Williams C	1.527616	0.1959825	68	2	-290	-197.2	14	168	114.24
1661	Williams C	1.220479	0.0197094				0			0
1661	Williams C	1.220479	0.0409041				0			0
1661	Williams C	1.220479	0.3096636				0			0
1661	Williams C	1.220479	0.0539214	34	2	-170	-57.8	11	98	33.32
1662	Williams C	0.671891	0.0295303				0			0
1662	Williams C	0.671891	0.2148047				0			0
1662	Williams C	0.671891	0.0330909	41	10	100	41			0
1663	Williams C	1.498158	0.3183818				0			0

1663	Williams C	1.498158	0.0418562				0			0
1663	Williams C	1.498158	0.1152438				0			0
1663	Williams C	1.498158	0.2147024	44	10 2	253	111.32	33		0
1664	Williams C	0.776968	0.045653				0			0
1664	Williams C	0.776968	0.3491999				0			0
1664	Williams C	0.776968	0.0954351				0			0
1664	Williams C	0.776968	0.2220789	91	10	175	159.25			0
1665	Williams C	1.740774	0.4200575				0			0
1665	Williams C	1.740774	0.4058432				0			0
1665	Williams C	1.740774	0.0900661				0			0
1665	Williams C	1.740774	0.0396003	55	2	-298	-163.9	29	171	94.05
1666	Williams C	1.025256	0.283053				0			0
1666	Williams C	1.025256	0.0831602				0			0
1666	Williams C	1.025256	0.0408022				0			0
1666	Williams C	1.025256	0.0510246				0			0
1666	Williams C	1.025256	0.0333849				0			0
1666	Williams C	1.025256	0.0332783	51	10	146	74.46	34		0
1667	Williams C	0.698144	0.0954436				0			0
1667	Williams C	0.698144	0.0830203				0			0
1667	Williams C	0.698144	0.0148699				0			0
1667	Williams C	0.698144	0.3360102	75	10	131	98.25			0
1668	Williams C	1.052338	0.2032926				0			0
1668	Williams C	1.052338	0.1308218				0			0
1668	Williams C	1.052338	0.026266				0			0
1668	Williams C	1.052338	0.142581				0			0
1668	Williams C	1.052338	0.059831				0			0
1668	Williams C	1.052338	0.2299235	73	2	-166	-121.18	13	96	70.08
1669	Williams C	0.38641	0.0866448				0			0
1669	Williams C	0.38641	0.0736884				0			0
1669	Williams C	0.38641	0.1717857	86	2	-79	-67.94		45	38.7
1670	Williams C	0.36991	0.0298088	8	2	-84	-6.72	49	46	3.68
1671	Williams C	0.802391	0.360655	45	2	-148	-66.6	52	86	38.7

APPENDIX A4-5

HEC-HMS Output – Calibration Models

1957 calibration

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 1957

Start of Run: 27Jun1957, 16:00 Basin Model: CW 1957CN
End of Run: 29Jun1957, 00:00 Meteorologic Model: June 1957
Compute Time: 17Jun2010, 10:48:04 Control Specifications: 1957 Calibration Contr

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	3137.2	28Jun1957, 13:17	2.81
1617	0.350	107.5	28Jun1957, 06:06	2.39
1618	0.916	179.3	28Jun1957, 07:14	1.96
1619	0.668	161.6	28Jun1957, 06:27	2.03
1620	0.622	130.8	28Jun1957, 06:57	1.98
1621	0.643	157.9	28Jun1957, 06:43	2.22
1622	0.117	37.4	28Jun1957, 05:38	2.17
1623	0.540	121.6	28Jun1957, 07:04	2.20
1624	0.529	145.3	28Jun1957, 06:07	2.12
1625	0.716	167.2	28Jun1957, 07:01	2.27
1626	0.252	71.9	28Jun1957, 05:53	2.07
1627	0.484	122.9	28Jun1957, 06:17	2.04
1628	0.456	120.6	28Jun1957, 06:45	2.44
1629	1.195	308.7	28Jun1957, 08:44	2.36
1630	0.887	185.8	28Jun1957, 07:52	2.42
1631	1.326	391.9	28Jun1957, 06:37	2.67
1632	0.450	125.5	28Jun1957, 06:37	2.50
1633	0.458	148.7	28Jun1957, 06:42	3.02
1634	0.334	142.2	28Jun1957, 05:33	2.94
1635	0.796	372.5	28Jun1957, 05:31	3.23
1636	0.652	245.5	28Jun1957, 06:15	3.16
1637	0.726	256.6	28Jun1957, 06:52	3.48
1638	0.803	299.2	28Jun1957, 06:34	3.41
1639	0.891	317.7	28Jun1957, 06:34	3.24
1640	1.009	295.8	28Jun1957, 07:45	3.43

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1641	1.413	546.7	28Jun1957, 06:40	3.65
1642	0.363	140.9	28Jun1957, 05:49	2.88
1643	0.985	334.9	28Jun1957, 06:21	2.89
1644	1.055	341.8	28Jun1957, 06:19	2.72
1645	0.673	236.4	28Jun1957, 06:19	2.98
1646	0.484	144.7	28Jun1957, 06:23	2.52
1647	0.779	307.3	28Jun1957, 05:38	2.77
1648	1.017	300.4	28Jun1957, 06:35	2.63
1649	0.528	191.8	28Jun1957, 06:14	3.02
1650	0.582	226.0	28Jun1957, 05:52	2.93
1651	0.663	255.9	28Jun1957, 06:11	3.18
1652	0.352	132.1	28Jun1957, 06:01	2.94
1653	0.779	317.9	28Jun1957, 06:05	3.30
1654	0.644	252.8	28Jun1957, 06:01	3.09
1655	0.931	321.9	28Jun1957, 06:54	3.42
1656	1.366	455.6	28Jun1957, 06:51	3.24
1657	0.227	114.2	28Jun1957, 05:31	3.50
1658	0.767	315.5	28Jun1957, 06:16	3.51
1659	1.528	672.9	28Jun1957, 06:26	3.98
1660	0.014	8.1	28Jun1957, 05:06	3.48
1661	1.220	398.3	28Jun1957, 07:57	4.00
1662	0.672	206.8	28Jun1957, 07:37	3.52
1663	1.498	588.0	28Jun1957, 06:59	4.02
1664	0.777	361.0	28Jun1957, 06:00	3.72
1665	1.741	684.5	28Jun1957, 06:56	3.97
1666	1.025	320.2	28Jun1957, 07:51	3.74
1667	0.698	280.6	28Jun1957, 06:30	3.66
1668	1.052	368.9	28Jun1957, 07:18	3.81
1669	0.386	169.7	28Jun1957, 06:13	3.72
1670	0.370	167.4	28Jun1957, 05:59	3.35
1671	0.802	345.6	28Jun1957, 06:34	4.02

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC01	19.043	3157.4	28Jun1957, 13:52	2.75
CC03	17.269	3131.3	28Jun1957, 12:39	2.84
CC04	16.200	3104.5	28Jun1957, 11:57	2.89
CC05	15.232	3067.1	28Jun1957, 11:30	2.94
CC06	14.589	3038.6	28Jun1957, 10:55	2.97
CC07	14.472	3037.5	28Jun1957, 10:42	2.98
CC08	12.821	2924.9	28Jun1957, 09:41	3.06
CC09D	11.934	2782.5	28Jun1957, 09:09	3.11
CC09U	8.771	2247.4	28Jun1957, 10:24	3.23
CC10	7.445	2141.4	28Jun1957, 08:54	3.33
CC11D	7.082	2106.6	28Jun1957, 08:01	3.36
CC11U	4.724	1404.5	28Jun1957, 08:18	3.40
CC12D	4.390	1369.6	28Jun1957, 07:41	3.43
CC12U	2.209	653.1	28Jun1957, 07:43	3.50
CC13	1.413	546.7	28Jun1957, 06:40	3.65
CCR1	19.043	3157.4	28Jun1957, 15:01	2.73
CCR10	7.445	2141.4	28Jun1957, 10:35	3.33
CCR11	7.082	2106.6	28Jun1957, 08:59	3.36
CCR12	4.390	1369.6	28Jun1957, 08:24	3.43
CCR13	1.413	546.7	28Jun1957, 08:14	3.65
CCR2	17.753	3137.2	28Jun1957, 13:54	2.81
CCR3	17.269	3131.3	28Jun1957, 13:17	2.83
CCR4	16.200	3104.5	28Jun1957, 12:41	2.89
CCR5	15.232	3067.1	28Jun1957, 12:00	2.94
CCR6	14.589	3038.6	28Jun1957, 11:33	2.97
CCR7	14.472	3037.5	28Jun1957, 10:55	2.98
CCR8	12.821	2924.9	28Jun1957, 10:53	3.06
CCR9	11.934	2782.5	28Jun1957, 09:50	3.11
Clay Creek	1.665	518.0	28Jun1957, 07:26	3.27
CLC01	1.438	518.0	28Jun1957, 06:51	3.78
CLCR1	1.438	518.0	28Jun1957, 07:26	3.78

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Crooked Creek	19.959	3173.1	28Jun1957, 14:59	2.70
DC01	1.529	554.0	28Jun1957, 06:42	3.44
DCR1	1.529	554.0	28Jun1957, 08:06	3.44
Delaware Creek	2.181	716.5	28Jun1957, 07:41	3.36
HJC01	2.713	862.4	28Jun1957, 07:03	2.85
HJC02	1.658	565.1	28Jun1957, 06:33	2.93
HJC03	0.673	236.4	28Jun1957, 06:19	2.98
HJCR1	2.713	862.4	28Jun1957, 07:42	2.85
HJCR2	1.658	565.1	28Jun1957, 07:26	2.93
HJCR3	0.673	236.4	28Jun1957, 06:50	2.98
Howard Johnson	3.180	970.8	28Jun1957, 07:35	2.80
Payne Branch	2.358	715.3	28Jun1957, 07:42	3.28
PB01	1.900	589.4	28Jun1957, 07:00	3.34
PBR1	1.900	589.4	28Jun1957, 07:57	3.34
SMR01	1.723	571.1	28Jun1957, 07:09	3.71
SMRR1	1.723	571.1	28Jun1957, 10:11	3.70
Spring Mill Run	2.502	317.9	28Jun1957, 06:05	1.03
WC01	20.902	4263.3	28Jun1957, 13:49	3.48
WC02	19.885	4244.8	28Jun1957, 12:53	3.54
WC03	18.622	4227.5	28Jun1957, 11:25	3.61
WC04	17.512	4198.5	28Jun1957, 10:31	3.66
WC05D	16.497	4147.8	28Jun1957, 10:09	3.70
WC05U	13.995	3526.7	28Jun1957, 10:15	3.72
WC06	13.351	3494.5	28Jun1957, 09:36	3.75
WC07	11.054	3132.1	28Jun1957, 09:12	3.85
WC08D	10.684	3091.6	28Jun1957, 08:33	3.87
WC08U	9.019	2634.6	28Jun1957, 09:03	3.89
WC09	8.252	2518.1	28Jun1957, 08:16	3.93
WC10	6.710	2143.4	28Jun1957, 08:54	3.92
WC11	4.818	1612.7	28Jun1957, 08:04	3.95
WC12	2.543	1009.1	28Jun1957, 07:15	3.99

Global Summary Results for Run: CBBEL 1957

Project: CBBEL Crooked & Williams Simulation Run: CBBEL 1957

Start of Run: 27Jun1957, 16:00 Basin Model: CW 1957CN
End of Run: 29Jun1957, 00:00 Meteorologic Model: June 1957
Compute Time: 17Jun2010, 10:48:04 Control Specifications: 1957 Calibration Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC08U	9.019	2534.6	28Jun1957, 09:03	3.89
WC09	8.252	2518.1	28Jun1957, 08:16	3.93
WC10	6.710	2143.4	28Jun1957, 08:54	3.92
WC11	4.818	1612.7	28Jun1957, 08:04	3.95
WC12	2.543	1009.1	28Jun1957, 07:15	3.99
WC13	0.802	345.6	28Jun1957, 06:34	4.02
WCR1	20.902	4263.3	28Jun1957, 14:32	3.46
WCR10	6.710	2143.4	28Jun1957, 09:00	3.92
WCR11	4.818	1612.7	28Jun1957, 09:21	3.95
WCR12	2.543	1009.1	28Jun1957, 08:58	3.98
WCR13	0.802	345.6	28Jun1957, 07:44	4.02
WCR2	19.885	4244.8	28Jun1957, 13:51	3.52
WCR3	18.622	4227.5	28Jun1957, 12:54	3.59
WCR4	17.512	4198.5	28Jun1957, 11:27	3.65
WCR5	16.497	4147.8	28Jun1957, 10:36	3.69
WCR6	13.351	3494.5	28Jun1957, 10:20	3.75
WCR7	11.054	3132.1	28Jun1957, 10:02	3.85
WCR8	10.684	3091.5	28Jun1957, 09:16	3.87
WCR9	8.252	2518.1	28Jun1957, 09:19	3.93
Williams Creek	21.252	4265.3	28Jun1957, 14:32	3.44

Print Close

3.41

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 2008 2008 calibration

Start of Run: 04Jun2008, 00:00 Basin Model: CW 2008CN-10&det-5
End of Run: 05Jun2008, 10:00 Meteorologic Model: June 2008
Compute Time: 18Jun2010, 13:01:17 Control Specifications: 2008 Calibration Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1029.4	04Jun2008, 10:44	0.79
1617	0.350	53.2	04Jun2008, 03:48	0.88
1618	0.916	115.4	04Jun2008, 05:01	1.06
1619	0.668	102.4	04Jun2008, 04:10	1.00
1620	0.622	61.5	04Jun2008, 04:42	0.77
1621	0.643	54.3	04Jun2008, 04:28	0.62
1622	0.117	18.7	04Jun2008, 03:20	0.78
1623	0.540	34.2	04Jun2008, 04:53	0.52
1624	0.529	77.5	04Jun2008, 03:49	0.85
1625	0.716	45.4	04Jun2008, 04:50	0.52
1626	0.252	31.1	04Jun2008, 03:31	0.65
1627	0.484	66.1	04Jun2008, 03:56	0.84
1628	0.456	70.8	04Jun2008, 04:30	1.12
1629	1.195	155.8	04Jun2008, 04:25	0.93
1630	0.887	60.3	04Jun2008, 05:42	0.67
1631	1.326	118.9	04Jun2008, 04:21	0.63
1632	0.450	44.6	04Jun2008, 04:18	0.69
1633	0.458	40.5	04Jun2008, 04:28	0.65
1634	0.334	50.4	04Jun2008, 03:14	0.71
1635	0.796	248.2	04Jun2008, 03:12	1.38
1636	0.652	74.0	04Jun2008, 03:55	0.70
1637	0.726	44.1	04Jun2008, 04:38	0.47
1638	0.803	55.5	04Jun2008, 04:21	0.49
1639	0.891	142.5	04Jun2008, 04:26	1.11
1640	1.009	77.4	04Jun2008, 05:52	0.75
1641	1.413	183.2	04Jun2008, 04:34	0.94
1642	0.363	28.3	04Jun2008, 03:30	0.42
1643	0.985	12.9	04Jun2008, 03:56	0.08
1644	1.055	192.8	04Jun2008, 04:02	1.15
1645	0.673	191.1	04Jun2008, 04:03	1.75
1646	0.484	99.5	04Jun2008, 04:04	1.31

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	137.5	04Jun2008, 03:24	0.87
1648	1.017	148.8	04Jun2008, 04:18	1.01
1649	0.528	86.9	04Jun2008, 03:58	1.01
1650	0.582	125.6	04Jun2008, 03:33	1.14
1651	0.663	139.0	04Jun2008, 03:55	1.24
1652	0.352	59.2	04Jun2008, 03:39	0.93
1653	0.779	89.6	04Jun2008, 03:59	0.68
1654	0.644	87.9	04Jun2008, 03:51	0.77
1655	0.931	38.1	04Jun2008, 05:22	0.34
1656	1.366	157.5	04Jun2008, 04:45	0.88
1657	0.227	30.4	04Jun2008, 03:30	0.61
1658	0.767	55.8	04Jun2008, 04:18	0.47
1659	1.528	238.7	04Jun2008, 04:14	1.04
1660	0.014	1.1	04Jun2008, 03:14	0.23
1661	1.220	130.8	04Jun2008, 05:55	1.08
1662	0.672	53.1	04Jun2008, 05:42	0.75
1663	1.498	151.4	04Jun2008, 04:55	0.81
1664	0.777	143.1	04Jun2008, 03:43	1.02
1665	1.741	163.6	04Jun2008, 04:51	0.74
1666	1.025	95.6	04Jun2008, 06:00	0.93
1667	0.698	57.4	04Jun2008, 04:35	0.58
1668	1.052	107.1	04Jun2008, 05:12	0.89
1669	0.386	12.7	04Jun2008, 04:35	0.22
1670	0.370	45.1	04Jun2008, 03:49	0.69
1671	0.802	87.3	04Jun2008, 04:30	0.76
CC01	19.043	1039.3	04Jun2008, 11:21	0.80
CC03	17.269	1027.1	04Jun2008, 10:08	0.79
CC04	16.200	1017.3	04Jun2008, 09:29	0.80
CC05	15.232	1004.4	04Jun2008, 09:06	0.81
CC06	14.589	992.4	04Jun2008, 08:34	0.82
CC07	14.472	991.6	04Jun2008, 08:22	0.82
CC08	12.821	931.9	04Jun2008, 07:44	0.80
CC09D	11.934	889.7	04Jun2008, 07:18	0.81
CC09U	8.771	671.2	04Jun2008, 07:34	0.79
CC10	7.445	637.5	04Jun2008, 07:01	0.81
CC11D	7.082	630.6	04Jun2008, 06:05	0.83
CC11U	4.724	409.2	04Jun2008, 06:27	0.82
CC12D	4.390	398.8	04Jun2008, 05:46	0.82

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	261.4	04Jun2008, 05:58	1.10
CC13	1.413	183.2	04Jun2008, 04:34	0.94
CCR1	19.043	1039.3	04Jun2008, 12:30	0.80
CCR10	7.445	637.5	04Jun2008, 08:42	0.81
CCR11	7.082	630.6	04Jun2008, 07:03	0.83
CCR12	4.390	398.8	04Jun2008, 06:29	0.82
CCR13	1.413	183.2	04Jun2008, 06:08	0.94
CCR2	17.753	1029.4	04Jun2008, 11:21	0.79
CCR3	17.269	1027.1	04Jun2008, 10:46	0.79
CCR4	16.200	1017.3	04Jun2008, 10:13	0.80
CCR5	15.232	1004.4	04Jun2008, 09:36	0.81
CCR6	14.589	992.4	04Jun2008, 09:12	0.82
CCR7	14.472	991.6	04Jun2008, 08:35	0.82
CCR8	12.821	931.9	04Jun2008, 08:56	0.80
CCR9	11.934	889.7	04Jun2008, 07:59	0.81
Clay Creek	1.665	127.8	04Jun2008, 05:37	0.69
CLC01	1.438	118.6	04Jun2008, 05:06	0.71
CLCR1	1.438	118.6	04Jun2008, 05:41	0.71
Crooked Creek	19.959	1048.9	04Jun2008, 12:30	0.81
D1619	0.668	28.7	04Jun2008, 04:10	0.28
D1623	0.540	23.6	04Jun2008, 04:53	0.36
D1628	0.456	25.5	04Jun2008, 04:30	0.40
D1630	0.887	9.1	04Jun2008, 05:42	0.10
D1633	0.458	5.3	04Jun2008, 04:28	0.08
D1634	0.334	20.1	04Jun2008, 03:14	0.28
D1635	0.796	158.8	04Jun2008, 03:12	0.88
D1636	0.652	37.8	04Jun2008, 03:55	0.36
D1637	0.726	37.5	04Jun2008, 04:38	0.40
D1638	0.803	35.5	04Jun2008, 04:21	0.32
D1640	1.009	9.3	04Jun2008, 05:52	0.09
D1643	0.985	1.4	04Jun2008, 03:56	0.01
D1644	1.055	27.0	04Jun2008, 04:02	0.16
D1646	0.484	13.9	04Jun2008, 04:04	0.18
D1649	0.528	39.1	04Jun2008, 03:58	0.45
D1651	0.663	95.9	04Jun2008, 03:55	0.86
D1653	0.779	43.9	04Jun2008, 03:59	0.33
D1654	0.644	33.4	04Jun2008, 03:51	0.29
D1655	0.931	19.4	04Jun2008, 05:22	0.17

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1656	1.366	34.6	04Jun2008, 04:45	0.19
D1658	0.767	11.2	04Jun2008, 04:18	0.09
D1659	1.528	162.3	04Jun2008, 04:14	0.70
D1661	1.220	44.5	04Jun2008, 05:55	0.37
D1662	0.672	21.8	04Jun2008, 05:42	0.31
D1663	1.498	66.6	04Jun2008, 04:55	0.36
D1664	0.777	130.2	04Jun2008, 03:43	0.93
D1665	1.741	90.0	04Jun2008, 04:51	0.41
D1666	1.025	48.8	04Jun2008, 06:00	0.47
D1667	0.698	43.1	04Jun2008, 04:35	0.44
d1668	1.052	78.2	04Jun2008, 05:12	0.65
D1669	0.386	10.9	04Jun2008, 04:35	0.19
D1671	0.802	39.3	04Jun2008, 04:30	0.34
DC01	1.529	99.2	04Jun2008, 04:28	0.48
DCR1	1.529	99.2	04Jun2008, 05:52	0.48
Delaware Creek	2.181	140.9	04Jun2008, 05:23	0.55
HJC01	2.713	346.2	04Jun2008, 04:58	0.91
HJC02	1.658	202.7	04Jun2008, 04:32	0.76
HJC03	0.673	191.1	04Jun2008, 04:03	1.75
HJCR1	2.713	346.2	04Jun2008, 05:37	0.91
HJCR2	1.658	202.7	04Jun2008, 05:25	0.76
HJCR3	0.673	191.1	04Jun2008, 04:34	1.75
Howard Johnson	3.168	379.6	04Jun2008, 05:33	0.88
J1619	0.668	102.4	04Jun2008, 04:10	1.00
J1623	0.540	34.2	04Jun2008, 04:53	0.52
J1628	0.456	70.8	04Jun2008, 04:30	1.12
J1630	0.887	60.3	04Jun2008, 05:42	0.67
J1633	0.458	40.5	04Jun2008, 04:28	0.65
J1634	0.334	50.4	04Jun2008, 03:14	0.71
J1635	0.796	232.4	04Jun2008, 03:12	1.38
J1636	0.652	74.0	04Jun2008, 03:55	0.70
J1637	0.726	44.1	04Jun2008, 04:38	0.47
J1638	0.803	55.5	04Jun2008, 04:21	0.49
J1640	1.009	77.4	04Jun2008, 05:52	0.75
J1643	0.985	12.9	04Jun2008, 03:56	0.08
J1644	1.055	192.8	04Jun2008, 04:02	1.15
J1646	0.484	98.6	04Jun2008, 04:04	1.31
J1649	0.528	86.9	04Jun2008, 03:58	1.01

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1651	0.663	138.1	04Jun2008, 03:55	1.24
J1653	0.779	69.6	04Jun2008, 03:59	0.68
J1654	0.644	87.9	04Jun2008, 03:51	0.77
J1655	0.931	38.1	04Jun2008, 05:22	0.34
J1656	1.366	157.5	04Jun2008, 04:45	0.88
J1658	0.767	55.8	04Jun2008, 04:18	0.47
J1659	1.528	238.7	04Jun2008, 04:14	1.04
J1661	1.220	130.8	04Jun2008, 05:55	1.08
J1662	0.672	53.1	04Jun2008, 05:42	0.75
J1663	1.498	151.4	04Jun2008, 04:55	0.81
J1664	0.777	143.1	04Jun2008, 03:43	1.02
J1665	1.741	163.6	04Jun2008, 04:52	0.74
J1666	1.025	95.6	04Jun2008, 06:00	0.93
J1667	0.698	57.4	04Jun2008, 04:35	0.58
J1668	1.052	107.1	04Jun2008, 05:12	0.89
J1669	0.386	12.7	04Jun2008, 04:35	0.22
J1671	0.802	87.3	04Jun2008, 04:30	0.76
Payne Branch	2.358	237.2	04Jun2008, 05:33	0.87
PB01	1.900	204.7	04Jun2008, 04:44	0.92
PBR1	1.900	204.7	04Jun2008, 05:41	0.92
R1619	0.668	28.7	04Jun2008, 04:10	0.28
R1623	0.540	23.6	04Jun2008, 04:53	0.36
R1628	0.456	25.5	04Jun2008, 04:30	0.40
R1630	0.887	9.1	04Jun2008, 05:43	0.10
R1633	0.458	5.3	04Jun2008, 04:28	0.08
R1634	0.334	20.1	04Jun2008, 03:14	0.28
R1635	0.796	143.0	04Jun2008, 03:41	0.88
R1636	0.652	37.8	04Jun2008, 03:55	0.36
R1637	0.726	37.5	04Jun2008, 04:38	0.40
R1638	0.803	35.5	04Jun2008, 04:21	0.32
R1640	1.009	9.3	04Jun2008, 05:52	0.09
R1643	0.985	1.4	04Jun2008, 03:56	0.01
R1644	1.055	27.0	04Jun2008, 04:02	0.16
R1648	0.484	13.0	04Jun2008, 04:35	0.18
R1649	0.528	39.1	04Jun2008, 03:58	0.45
R1651	0.663	95.0	04Jun2008, 04:06	0.86
R1653	0.779	43.9	04Jun2008, 03:59	0.33
R1654	0.644	33.4	04Jun2008, 03:51	0.29

Hydrologic Element	Drainage Area (Mi2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1655	0.931	19.4	04Jun2008, 05:22	0.17
R1656	1.366	34.6	04Jun2008, 04:45	0.19
R1658	0.767	11.2	04Jun2008, 04:18	0.09
R1659	1.528	162.3	04Jun2008, 04:14	0.70
R1661	1.220	44.5	04Jun2008, 05:55	0.37
R1662	0.672	21.8	04Jun2008, 05:42	0.31
R1663	1.498	66.6	04Jun2008, 04:55	0.36
R1664	0.777	130.2	04Jun2008, 03:43	0.93
R1665	1.741	90.0	04Jun2008, 04:52	0.41
R1666	1.025	48.8	04Jun2008, 06:00	0.47
R1667	0.698	43.1	04Jun2008, 04:35	0.44
R1668	1.052	78.2	04Jun2008, 05:12	0.65
R1669	0.386	10.9	04Jun2008, 04:35	0.19
R1671	0.802	39.3	04Jun2008, 04:30	0.34
SMR01	1.723	141.8	04Jun2008, 05:21	0.79
SMRR1	1.723	141.8	04Jun2008, 08:29	0.79
Spring Mill Run	2.502	157.5	04Jun2008, 08:07	0.76
WC01	20.902	1118.9	04Jun2008, 12:03	0.85
WC02	19.885	1113.7	04Jun2008, 11:07	0.84
WC03	18.622	1109.5	04Jun2008, 09:38	0.82
WC04	17.512	1099.6	04Jun2008, 08:46	0.81
WC05D	16.497	1076.7	04Jun2008, 08:23	0.79
WC05U	13.995	920.3	04Jun2008, 08:26	0.79
WC06	13.351	908.9	04Jun2008, 07:45	0.80
WC07	11.054	813.2	04Jun2008, 07:06	0.82
WC08D	10.684	800.2	04Jun2008, 06:26	0.83
WC08U	9.019	683.9	04Jun2008, 06:40	0.85
WC09	8.252	656.2	04Jun2008, 05:48	0.89
WC10	6.710	540.0	04Jun2008, 07:13	0.86
WC11	4.818	393.2	04Jun2008, 06:23	0.81
WC12	2.543	242.4	04Jun2008, 05:14	0.75
WC13	0.802	87.3	04Jun2008, 04:30	0.76
WCR1	20.902	1118.9	04Jun2008, 12:46	0.85
WCR10	6.710	540.0	04Jun2008, 07:19	0.86
WCR11	4.818	393.2	04Jun2008, 07:40	0.81
WCR12	2.543	242.4	04Jun2008, 06:55	0.75
WCR13	0.802	87.3	04Jun2008, 05:40	0.76
WCR2	19.885	1113.7	04Jun2008, 12:05	0.84

Global Summary Results for Run: CBBEL 2008

Project: CBBEL Crooked& Williams Simulation Run: CBBEL 2008

Start of Run: 04Jun2008, 00:00 Basin Model: CW 2008CN-108det-5
End of Run: 05Jun2008, 10:00 Meteorologic Model: June 2003
Compute Time: 18Jun2010, 13:01:17 Control Specifications: 2008 Calibration Control

Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC08D	10.684	800.2	04Jun2008, 06:26	0.83
WC08U	9.019	663.9	04Jun2008, 06:40	0.85
WC09	8.252	656.2	04Jun2008, 05:48	0.89
WC10	6.710	540.0	04Jun2008, 07:19	0.86
WC11	4.818	393.2	04Jun2008, 06:23	0.81
WC12	2.543	242.4	04Jun2008, 05:14	0.75
WC13	0.802	87.3	04Jun2008, 04:30	0.76
WCR1	20.902	1118.9	04Jun2008, 12:46	0.85
WCR10	6.710	540.0	04Jun2008, 07:19	0.86
WCR11	4.818	393.2	04Jun2008, 07:40	0.81
WCR12	2.543	242.4	04Jun2008, 05:55	0.75
WCR13	0.802	87.3	04Jun2008, 05:40	0.76
WCR2	19.885	1113.7	04Jun2008, 12:05	0.84
WCR3	18.622	1109.5	04Jun2008, 11:07	0.82
WCR4	17.512	1099.6	04Jun2008, 09:42	0.81
WCR5	16.497	1076.7	04Jun2008, 08:50	0.79
WCR6	13.351	908.9	04Jun2008, 06:29	0.80
WCR7	11.054	813.2	04Jun2008, 07:55	0.82
WCR8	10.684	800.2	04Jun2008, 07:09	0.83
WCR9	8.252	656.2	04Jun2008, 06:51	0.89
Williams Creek	21.252	1119.1	04Jun2008, 12:46	0.85

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 2003 Flood

Start of Run: 31Aug2003, 21:00 Basin Model: CW 2008CN-10&det-5
End of Run: 03Sep2003, 00:00 Meteorologic Model: Labor Day 2003
Compute Time: 17Jun2010, 16:28:21 Control Specifications: Gage Control

Volume Units: IN

2003 calibration

03351310	17.753	3894.5	01Sep2003, 13:38	4.84
1617	0.350	120.0	01Sep2003, 06:44	4.27
1618	0.916	264.2	01Sep2003, 07:58	4.53
1619	0.668	236.6	01Sep2003, 07:09	4.73
1620	0.622	182.4	01Sep2003, 07:42	4.34
1621	0.643	181.7	01Sep2003, 07:31	3.99
1622	0.117	45.5	01Sep2003, 06:06	4.27
1623	0.540	136.2	01Sep2003, 07:53	3.78
1624	0.529	217.5	01Sep2003, 06:41	5.08
1625	0.716	182.0	01Sep2003, 07:51	3.78
1626	0.252	91.4	01Sep2003, 06:25	4.27
1627	0.484	168.6	01Sep2003, 06:58	4.53
1628	0.456	183.2	01Sep2003, 07:25	5.81
1629	1.195	416.3	01Sep2003, 07:27	5.04
1630	0.887	227.1	01Sep2003, 08:36	4.53
1631	1.326	420.7	01Sep2003, 07:24	4.41
1632	0.450	148.1	01Sep2003, 07:22	4.60
1633	0.458	145.2	01Sep2003, 07:29	4.48
1634	0.334	147.1	01Sep2003, 05:59	4.73
1635	0.796	470.6	01Sep2003, 05:52	6.43
1636	0.652	226.1	01Sep2003, 07:00	4.53
1637	0.726	201.1	01Sep2003, 07:43	4.06
1638	0.803	211.4	01Sep2003, 07:27	3.62
1639	0.891	347.0	01Sep2003, 07:18	5.30
1640	1.009	312.6	01Sep2003, 08:30	5.26
1641	1.413	537.4	01Sep2003, 07:25	5.30
1642	0.363	122.9	01Sep2003, 06:25	3.86
1643	0.985	429.2	01Sep2003, 07:00	5.76
1644	1.055	386.2	01Sep2003, 07:02	4.85
1645	0.673	311.8	01Sep2003, 06:56	6.20
1646	0.484	180.8	01Sep2003, 07:04	5.04

1647	0.779	312.2	01Sep2003, 06:08	4.41
1648	1.017	358.7	01Sep2003, 07:19	4.91
1649	0.528	204.7	01Sep2003, 06:55	5.04
1650	0.582	246.2	01Sep2003, 06:24	5.09
1651	0.663	293.1	01Sep2003, 06:47	5.68
1652	0.352	141.8	01Sep2003, 06:36	5.04
1653	0.779	292.5	01Sep2003, 06:45	4.53
1654	0.644	270.7	01Sep2003, 06:36	5.01
1655	0.931	262.3	01Sep2003, 07:47	3.90
1656	1.366	512.1	01Sep2003, 07:35	5.43
1657	0.227	109.5	01Sep2003, 05:56	4.85
1658	0.767	292.1	01Sep2003, 07:01	4.70
1659	1.528	629.2	01Sep2003, 07:10	5.62
1660	0.014	7.5	01Sep2003, 05:17	4.00
1661	1.220	380.8	01Sep2003, 08:40	5.65
1662	0.672	213.3	01Sep2003, 08:22	5.26
1663	1.498	526.1	01Sep2003, 07:45	5.23
1664	0.777	353.9	01Sep2003, 06:33	5.62
1665	1.741	627.4	01Sep2003, 07:42	5.30
1666	1.025	307.1	01Sep2003, 08:37	5.18
1667	0.698	226.5	01Sep2003, 07:20	4.21
1668	1.052	351.9	01Sep2003, 08:04	5.36
1669	0.386	116.7	01Sep2003, 07:04	3.58
1670	0.370	156.4	01Sep2003, 06:34	5.01
1671	0.802	329.1	01Sep2003, 07:18	5.59
CC01	19.043	4146.5	01Sep2003, 14:06	4.82
CC03	17.269	3793.0	01Sep2003, 13:06	4.84
CC04	16.200	3562.8	01Sep2003, 12:37	4.87
CC05	15.232	3382.7	01Sep2003, 11:48	4.93
CC06	14.589	3299.3	01Sep2003, 10:59	4.97
CC07	14.472	3286.9	01Sep2003, 10:42	4.98
CC08	12.821	3061.0	01Sep2003, 09:35	4.95
CC09D	11.934	2865.6	01Sep2003, 08:59	4.98
CC09U	8.771	2138.6	01Sep2003, 11:50	4.83
CC10	7.445	1967.1	01Sep2003, 09:38	4.90
CC11D	7.082	1941.7	01Sep2003, 08:46	4.96
CC11U	4.724	1221.6	01Sep2003, 09:12	4.87
CC12D	4.390	1169.1	01Sep2003, 08:36	4.88

CC12U	2.209	716.4	01Sep2003, 08:45	5.71
CC13	1.413	537.4	01Sep2003, 07:25	5.30
CCR1	19.043	4146.5	01Sep2003, 15:15	4.82
CCR10	7.445	1967.1	01Sep2003, 11:19	4.90
CCR11	7.082	1941.7	01Sep2003, 09:44	4.96
CCR12	4.390	1169.1	01Sep2003, 09:19	4.88
CCR13	1.413	537.4	01Sep2003, 08:59	5.30
CCR2	17.753	3894.5	01Sep2003, 14:15	4.84
CCR3	17.269	3793.0	01Sep2003, 13:44	4.84
CCR4	16.200	3562.8	01Sep2003, 13:21	4.87
CCR5	15.232	3382.7	01Sep2003, 12:18	4.93
CCR6	14.589	3299.3	01Sep2003, 11:37	4.97
CCR7	14.472	3286.9	01Sep2003, 10:55	4.98
CCR8	12.821	3061.0	01Sep2003, 10:47	4.95
CCR9	11.934	2865.6	01Sep2003, 09:40	4.98
Clay Creek	1.665	365.9	01Sep2003, 07:15	4.88
CLC01	1.438	298.5	01Sep2003, 07:57	4.88
CLCR1	1.438	298.5	01Sep2003, 08:32	4.88
Crooked Creek	19.959	4296.4	01Sep2003, 15:09	4.80
D1619	0.668	66.2	01Sep2003, 07:09	1.33
D1623	0.540	94.0	01Sep2003, 07:53	2.61
D1628	0.456	66.0	01Sep2003, 07:25	2.09
D1630	0.887	34.1	01Sep2003, 08:36	0.68
D1633	0.458	18.9	01Sep2003, 07:29	0.58
D1634	0.334	58.8	01Sep2003, 05:59	1.89
D1635	0.796	301.2	01Sep2003, 05:52	4.12
D1636	0.652	116.3	01Sep2003, 07:00	2.31
D1637	0.726	171.0	01Sep2003, 07:43	3.45
D1638	0.803	135.3	01Sep2003, 07:27	2.32
D1640	1.009	37.5	01Sep2003, 08:30	0.63
D1643	0.985	47.2	01Sep2003, 07:00	0.63
D1644	1.055	54.1	01Sep2003, 07:02	0.68
D1646	0.484	25.3	01Sep2003, 07:04	0.71
D1649	0.528	92.1	01Sep2003, 06:55	2.27
D1651	0.663	202.2	01Sep2003, 06:47	3.92
D1653	0.779	143.3	01Sep2003, 06:46	2.22
D1654	0.644	102.8	01Sep2003, 06:36	1.91
D1655	0.931	133.8	01Sep2003, 07:47	1.99

D1656	1.366	112.7	01Sep2003, 07:35	1.19
D1658	0.767	58.4	01Sep2003, 07:01	0.94
D1659	1.528	427.8	01Sep2003, 07:10	3.82
D1661	1.220	129.5	01Sep2003, 08:40	1.92
D1662	0.672	87.4	01Sep2003, 08:22	2.16
D1663	1.498	231.5	01Sep2003, 07:45	2.30
D1664	0.777	322.0	01Sep2003, 06:33	5.12
D1665	1.741	345.1	01Sep2003, 07:42	2.92
D1666	1.025	156.6	01Sep2003, 08:37	2.64
D1667	0.698	169.8	01Sep2003, 07:20	3.16
d1668	1.052	256.9	01Sep2003, 08:04	3.91
D1669	0.366	100.3	01Sep2003, 07:04	3.08
D1671	0.802	148.1	01Sep2003, 07:18	2.52
DC01	1.529	309.4	01Sep2003, 07:32	3.83
DCR1	1.529	309.4	01Sep2003, 08:56	3.83
Delaware Creek	2.181	459.8	01Sep2003, 08:06	4.04
HJC01	2.713	1034.7	01Sep2003, 07:51	5.52
HJC02	1.658	710.3	01Sep2003, 07:13	5.94
HJC03	0.673	311.8	01Sep2003, 06:56	6.20
HJCR1	2.713	1034.7	01Sep2003, 08:30	5.52
HJCR2	1.658	710.3	01Sep2003, 08:06	6.94
HJCR3	0.673	311.8	01Sep2003, 07:27	6.20
Howard Johnson	3.[illegible]h	1162.1	01Sep2003, 08:23	5.39
J1619	0.668	207.6	01Sep2003, 07:09	4.73
J1623	0.540	106.4	01Sep2003, 07:54	3.76
J1628	0.456	147.6	01Sep2003, 07:26	5.81
J1630	0.887	213.2	01Sep2003, 08:37	4.53
J1633	0.458	138.4	01Sep2003, 07:30	4.48
J1634	0.334	126.3	01Sep2003, 06:00	4.73
J1635	0.796	312.7	01Sep2003, 05:52	6.43
J1636	0.652	179.0	01Sep2003, 07:00	4.53
J1637	0.726	138.4	01Sep2003, 07:45	4.07
J1638	0.803	171.2	01Sep2003, 07:28	3.62
J1640	1.009	293.9	01Sep2003, 08:31	6.26
J1643	0.985	404.2	01Sep2003, 07:00	5.76
J1644	1.055	362.3	01Sep2003, 07:02	4.85
J1646	0.484	168.6	01Sep2003, 07:05	5.04
J1649	0.528	161.9	01Sep2003, 06:56	5.04

J1651	0.663	186.4	01Sep2003, 06:48	5.69
J1653	0.779	232.4	01Sep2003, 06:46	4.53
J1654	0.644	215.2	01Sep2003, 06:36	5.01
J1655	0.931	209.8	01Sep2003, 07:47	3.90
J1656	1.366	452.0	01Sep2003, 07:35	5.43
J1658	0.767	264.9	01Sep2003, 07:01	4.70
J1659	1.528	398.4	01Sep2003, 07:10	5.63
J1661	1.220	319.0	01Sep2003, 08:40	5.65
J1662	0.672	167.4	01Sep2003, 08:23	5.26
J1663	1.498	406.3	01Sep2003, 07:46	5.23
J1664	0.777	191.1	01Sep2003, 06:34	5.63
J1665	1.741	445.8	01Sep2003, 07:42	5.31
J1666	1.025	225.3	01Sep2003, 08:38	5.18
J1667	0.698	155.0	01Sep2003, 07:21	4.21
J1668	1.052	216.8	01Sep2003, 08:05	5.36
J1669	0.386	83.5	01Sep2003, 07:06	3.58
J1671	0.802	247.6	01Sep2003, 07:19	5.60
Payne Branch	2.358	738.0	01Sep2003, 08:26	5.13
PB01	1.900	615.7	01Sep2003, 07:40	5.28
PBR1	1.900	615.7	01Sep2003, 08:37	5.28
R1619	0.668	37.5	01Sep2003, 09:15	1.33
R1623	0.540	64.4	01Sep2003, 09:46	2.61
R1628	0.456	30.8	01Sep2003, 14:48	2.09
R1630	0.887	20.4	01Sep2003, 16:00	0.68
R1633	0.458	12.1	01Sep2003, 09:26	0.58
R1634	0.334	38.2	01Sep2003, 07:46	1.89
R1635	0.796	143.7	01Sep2003, 08:04	4.12
R1636	0.652	68.6	01Sep2003, 08:58	2.31
R1637	0.726	108.6	01Sep2003, 09:45	3.46
R1638	0.803	95.3	01Sep2003, 09:07	2.32
R1640	1.009	19.2	01Sep2003, 16:17	0.63
R1643	0.985	22.5	01Sep2003, 09:25	0.63
R1644	1.055	30.4	01Sep2003, 09:07	0.68
R1646	0.484	13.2	01Sep2003, 09:19	0.71
R1649	0.528	49.7	01Sep2003, 09:05	2.27
R1651	0.663	96.2	01Sep2003, 09:10	3.92
R1653	0.779	83.6	01Sep2003, 08:46	2.22
R1654	0.644	47.9	01Sep2003, 08:57	1.91

R1655	0.931	81.6	01Sep2003, 09:55	1.99
R1656	1.366	53.3	01Sep2003, 15:03	1.20
R1658	0.767	31.5	01Sep2003, 09:10	0.94
R1659	1.528	197.1	01Sep2003, 14:30	3.83
R1661	1.220	68.7	01Sep2003, 16:22	1.92
R1662	0.672	42.5	01Sep2003, 16:14	2.16
R1663	1.498	112.6	01Sep2003, 15:15	2.30
R1664	0.777	159.7	01Sep2003, 08:50	5.12
R1665	1.741	164.0	01Sep2003, 15:13	2.92
R1666	1.025	76.3	01Sep2003, 16:39	2.64
R1667	0.698	98.7	01Sep2003, 09:26	3.16
R1668	1.052	123.0	01Sep2003, 15:46	3.91
R1669	0.386	67.4	01Sep2003, 08:45	3.08
R1671	0.802	67.5	01Sep2003, 14:42	2.52
SMR01	1.723	372.3	01Sep2003, 08:14	4.79
SMRR1	1.723	372.3	01Sep2003, 11:22	4.79
Spring Mill Run	2.502	539.1	01Sep2003, 12:17	4.71
WC01	20.902	4177.4	01Sep2003, 13:44	5.10
WC02	19.885	3989.0	01Sep2003, 14:32	5.11
WC03	18.622	3851.6	01Sep2003, 13:37	5.14
WC04	17.512	3644.7	01Sep2003, 13:57	5.15
WC05D	16.497	3450.6	01Sep2003, 13:49	5.13
WC05U	13.995	2991.0	01Sep2003, 13:54	5.21
WC06	13.351	2866.3	01Sep2003, 13:10	5.22
WC07	11.054	2381.0	01Sep2003, 12:20	5.30
WC08D	10.684	2290.1	01Sep2003, 09:33	5.31
WC08U	9.019	2003.7	01Sep2003, 10:06	5.39
WC09	8.252	1903.8	01Sep2003, 09:15	5.45
WC10	6.710	1604.3	01Sep2003, 09:41	5.42
WC11	4.818	1184.0	01Sep2003, 09:06	5.38
WC12	2.543	683.0	01Sep2003, 08:03	5.40
WC13	0.802	247.6	01Sep2003, 07:19	5.60
WCR1	20.902	4177.4	01Sep2003, 14:27	5.10
WCR10	6.710	1604.3	01Sep2003, 09:47	5.42
WCR11	4.818	1184.0	01Sep2003, 10:23	5.38
WCR12	2.543	683.0	01Sep2003, 09:44	5.40
WCR13	0.802	247.6	01Sep2003, 08:29	5.60
WCR2	19.885	3989.0	01Sep2003, 15:30	5.11

Global Summary Results for Run "CBBEL 2003 Flood"

Project: CBBEL Crooked& Williams Simulation Run: CBBEL 2003 Flood

Start of Run: 31Aug2003, 21:00 Basin Model: CW 2008CN-100det-S
End of Run: 03Sep2003, 00:00 Meteorologic Model: Labor Day 2003
Compute Time: 17Jun2010, 16:28:21 Control Specifications: Gage Control

Volume Units: ◉ IN ○ AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC07	11.054	2381.0	01Sep2003, 12:20	5.30
WC08D	10.684	2290.1	01Sep2003, 09:33	5.31
WC08U	9.019	2003.7	01Sep2003, 10:06	5.39
WC09	8.252	1903.8	01Sep2003, 09:15	5.45
WC10	6.710	1604.3	01Sep2003, 09:41	5.42
WC11	4.818	1164.0	01Sep2003, 09:06	5.38
WC12	2.543	683.0	01Sep2003, 08:03	5.40
WC13	0.802	247.6	01Sep2003, 07:19	5.60
WCR1	20.902	4177.4	01Sep2003, 14:27	5.10
WCR10	6.710	1604.3	01Sep2003, 09:47	5.42
WCR11	4.818	1164.0	01Sep2003, 10:23	5.38
WCR12	2.543	683.0	01Sep2003, 09:44	5.40
WCR13	0.802	247.6	01Sep2003, 08:29	5.60
WCR2	19.885	3969.0	01Sep2003, 15:30	5.11
WCR3	18.622	3651.6	01Sep2003, 15:06	5.14
WCR4	17.512	3644.7	01Sep2003, 14:53	5.15
WCR5	16.497	3450.6	01Sep2003, 14:16	5.13
WCR6	13.551	2866.3	01Sep2003, 13:54	5.22
WCR7	11.054	2381.0	01Sep2003, 12:10	5.30
WCR8	10.684	2290.1	01Sep2003, 10:16	5.31
WCR9	8.252	1903.8	01Sep2003, 10:18	5.45
Williams Creek	21.252	4225.7	01Sep2003, 14:25	5.09

Print Close

APPENDIX A4-6

HEC-HMS Output – Existing Condition Models

Existing - 1% - 6 hr.

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 100 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:49:58

Basin Model: CW 2008CN-10&det-5
Meteorologic Model: 100 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	3602.2	01Jan2000, 09:51	2.93
1617	0.350	156.8	01Jan2000, 03:17	2.49
1618	0.916	315.5	01Jan2000, 04:27	2.71
1619	0.668	305.5	01Jan2000, 03:37	2.85
1620	0.622	217.5	01Jan2000, 04:12	2.54
1621	0.643	214.1	01Jan2000, 04:01	2.27
1622	0.117	61.9	01Jan2000, 02:48	2.49
1623	0.540	151.3	01Jan2000, 04:25	2.10
1624	0.529	296.4	01Jan2000, 03:14	3.10
1625	0.716	202.8	01Jan2000, 04:22	2.10
1626	0.252	122.2	01Jan2000, 03:03	2.49
1627	0.484	221.1	01Jan2000, 03:27	2.71
1628	0.456	245.7	01Jan2000, 03:52	3.72
1629	1.195	541.0	01Jan2000, 03:53	3.12
1630	0.887	259.9	01Jan2000, 05:08	2.71
1631	1.326	516.2	01Jan2000, 03:53	2.59
1632	0.450	186.3	01Jan2000, 03:50	2.75
1633	0.458	176.9	01Jan2000, 03:58	2.64
1634	0.334	206.7	01Jan2000, 02:42	2.85
1635	0.796	743.4	01Jan2000, 02:29	4.24
1636	0.652	295.7	01Jan2000, 03:28	2.71
1637	0.726	233.3	01Jan2000, 04:13	2.33
1638	0.803	242.7	01Jan2000, 03:57	1.99
1639	0.891	444.9	01Jan2000, 03:47	3.26
1640	1.009	359.0	01Jan2000, 05:05	3.22

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1641	1.413	680.2	01Jan2000, 03:55	3.26
1642	0.363	156.4	01Jan2000, 03:06	2.16
1643	0.985	591.9	01Jan2000, 03:28	3.65
1644	1.055	514.6	01Jan2000, 03:29	2.96
1645	0.673	449.7	01Jan2000, 03:23	4.04
1646	0.484	244.5	01Jan2000, 03:30	3.12
1647	0.779	426.2	01Jan2000, 02:49	2.59
1648	1.017	464.2	01Jan2000, 03:46	3.00
1649	0.528	276.6	01Jan2000, 03:24	3.10
1650	0.582	352.4	01Jan2000, 02:59	3.16
1651	0.663	413.7	01Jan2000, 03:17	3.60
1652	0.352	200.0	01Jan2000, 03:08	3.12
1653	0.779	372.4	01Jan2000, 03:21	2.64
1654	0.644	362.4	01Jan2000, 03:12	3.02
1655	0.931	273.7	01Jan2000, 04:24	2.08
1656	1.366	644.0	01Jan2000, 04:05	3.37
1657	0.227	148.5	01Jan2000, 02:43	2.86
1658	0.767	358.9	01Jan2000, 03:34	2.73
1659	1.528	853.6	01Jan2000, 03:37	3.56
1660	0.014	9.2	01Jan2000, 02:12	2.16
1661	1.220	459.2	01Jan2000, 05:12	3.59
1662	0.672	247.0	01Jan2000, 04:56	3.22
1663	1.498	642.5	01Jan2000, 04:16	3.20
1664	0.777	508.4	01Jan2000, 03:06	3.56
1665	1.741	773.5	01Jan2000, 04:12	3.26
1666	1.025	348.9	01Jan2000, 05:12	3.15
1667	0.698	259.6	01Jan2000, 03:54	2.36
1668	1.052	430.4	01Jan2000, 04:34	3.34
1669	0.386	127.9	01Jan2000, 03:40	1.85
1670	0.370	210.0	01Jan2000, 03:10	3.02
1671	0.802	426.5	01Jan2000, 03:47	3.49

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC01	19.043	3662.8	01Jan2000, 10:27	2.92
CC03	17.269	3596.2	01Jan2000, 09:13	2.94
CC04	16.200	3516.9	01Jan2000, 08:29	2.96
CC05	15.232	3467.8	01Jan2000, 08:00	3.01
CC06	14.589	3424.3	01Jan2000, 07:22	3.04
CC07	14.472	3422.8	01Jan2000, 07:10	3.05
CC08	12.821	3189.3	01Jan2000, 06:10	3.02
CC09D	11.934	2975.2	01Jan2000, 05:39	3.04
CC09U	8.771	2312.4	01Jan2000, 07:59	2.92
CC10	7.445	2222.3	01Jan2000, 06:26	2.97
CC11D	7.082	2202.4	01Jan2000, 05:30	3.02
CC11U	4.724	1385.7	01Jan2000, 05:53	2.96
CC12D	4.390	1334.8	01Jan2000, 05:13	2.97
CC12U	2.209	861.7	01Jan2000, 05:20	3.62
CC13	1.413	680.2	01Jan2000, 03:55	3.26
CCR1	19.043	3662.8	01Jan2000, 11:36	2.92
CCR10	7.445	2222.3	01Jan2000, 08:07	2.97
CCR11	7.082	2202.4	01Jan2000, 06:28	3.02
CCR12	4.390	1334.8	01Jan2000, 05:56	2.97
CCR13	1.413	680.2	01Jan2000, 05:29	3.26
CCR2	17.753	3602.2	01Jan2000, 10:28	2.93
CCR3	17.269	3596.2	01Jan2000, 09:51	2.94
CCR4	16.200	3516.9	01Jan2000, 09:13	2.96
CCR5	15.232	3467.8	01Jan2000, 08:30	3.01
CCR6	14.589	3424.3	01Jan2000, 08:00	3.04
CCR7	14.472	3422.8	01Jan2000, 07:23	3.05
CCR8	12.821	3189.3	01Jan2000, 07:22	3.02
CCR9	11.934	2975.2	01Jan2000, 06:20	3.04
Clay Creek	1.665	392.0	01Jan2000, 03:16	2.93
CLC01	1.438	320.4	01Jan2000, 04:26	2.94
CLCR1	1.438	320.4	01Jan2000, 05:01	2.94

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Crooked Creek	19.959	3685.0	01Jan2000, 11:34	2.91
D1619	0.668	85.5	01Jan2000, 03:37	0.80
D1623	0.540	104.4	01Jan2000, 04:25	1.45
D1628	0.456	88.5	01Jan2000, 03:52	1.34
D1630	0.887	39.0	01Jan2000, 05:08	0.41
D1633	0.458	23.0	01Jan2000, 03:58	0.34
D1634	0.334	82.7	01Jan2000, 02:42	1.14
D1635	0.796	475.8	01Jan2000, 02:29	2.71
D1636	0.652	150.8	01Jan2000, 03:28	1.38
D1637	0.726	198.3	01Jan2000, 04:13	1.98
D1638	0.803	155.3	01Jan2000, 03:57	1.28
D1640	1.009	43.1	01Jan2000, 05:05	0.39
D1643	0.985	65.1	01Jan2000, 03:28	0.40
D1644	1.055	72.0	01Jan2000, 03:29	0.41
D1646	0.484	34.2	01Jan2000, 03:30	0.44
D1649	0.528	124.5	01Jan2000, 03:24	1.39
D1651	0.663	285.4	01Jan2000, 03:17	2.49
D1653	0.779	182.5	01Jan2000, 03:21	1.29
D1654	0.644	137.7	01Jan2000, 03:12	1.15
D1655	0.931	139.6	01Jan2000, 04:24	1.06
D1656	1.366	141.7	01Jan2000, 04:05	0.74
D1658	0.767	71.8	01Jan2000, 03:34	0.55
D1659	1.528	580.5	01Jan2000, 03:37	2.42
D1661	1.220	156.1	01Jan2000, 05:12	1.22
D1662	0.672	101.3	01Jan2000, 04:56	1.32
D1663	1.498	282.7	01Jan2000, 04:16	1.41
D1664	0.777	462.6	01Jan2000, 03:06	3.24
D1665	1.741	425.4	01Jan2000, 04:12	1.80
D1666	1.025	177.9	01Jan2000, 05:12	1.61
D1667	0.698	194.7	01Jan2000, 03:54	1.77
d1668	1.052	314.2	01Jan2000, 04:34	2.44

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1669	0.386	110.0	01Jan2000, 03:40	1.59
D1671	0.802	191.9	01Jan2000, 03:47	1.57
DC01	1.529	325.6	01Jan2000, 04:02	2.15
DCR1	1.529	325.6	01Jan2000, 05:26	2.15
Delaware Creek	2.181	487.2	01Jan2000, 04:29	2.32
HJC01	2.713	1385.9	01Jan2000, 04:18	3.48
HJC02	1.658	987.8	01Jan2000, 03:41	3.81
HJC03	0.673	449.7	01Jan2000, 03:23	4.04
HJCR1	2.713	1385.9	01Jan2000, 04:57	3.48
HJCR2	1.658	987.8	01Jan2000, 04:34	3.81
HJCR3	0.673	449.7	01Jan2000, 03:54	4.04
Howard Johnson Ditch	3.[illegible]	1537.4	01Jan2000, 04:52	3.38
J1619	0.668	257.3	01Jan2000, 03:37	2.85
J1623	0.540	111.1	01Jan2000, 04:26	2.10
J1628	0.456	187.8	01Jan2000, 03:52	3.72
J1630	0.887	241.1	01Jan2000, 05:08	2.71
J1633	0.458	166.0	01Jan2000, 03:58	2.64
J1634	0.334	162.3	01Jan2000, 02:42	2.85
J1635	0.796	411.4	01Jan2000, 02:29	4.24
J1636	0.652	213.3	01Jan2000, 03:28	2.71
J1637	0.726	143.4	01Jan2000, 04:15	2.33
J1638	0.803	182.6	01Jan2000, 03:58	1.99
J1640	1.009	334.7	01Jan2000, 05:05	3.22
J1643	0.985	549.1	01Jan2000, 03:28	3.65
J1644	1.055	472.9	01Jan2000, 03:29	2.96
J1646	0.484	223.4	01Jan2000, 03:30	3.12
J1649	0.528	201.6	01Jan2000, 03:24	3.10
J1651	0.663	224.1	01Jan2000, 03:18	3.60
J1653	0.779	273.4	01Jan2000, 03:21	2.64
J1654	0.644	272.3	01Jan2000, 03:12	3.02
J1655	0.931	215.4	01Jan2000, 04:25	2.08

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1656	1.366	555.0	01Jan2000, 04:05	3.37
J1658	0.767	318.4	01Jan2000, 03:34	2.73
J1659	1.528	470.2	01Jan2000, 03:37	3.56
J1661	1.220	370.8	01Jan2000, 05:12	3.59
J1662	0.672	187.3	01Jan2000, 04:57	3.22
J1663	1.498	471.6	01Jan2000, 04:16	3.20
J1664	0.777	205.3	01Jan2000, 03:07	3.56
J1665	1.741	511.6	01Jan2000, 04:13	3.27
J1666	1.025	245.8	01Jan2000, 05:13	3.15
J1667	0.698	163.3	01Jan2000, 03:55	2.36
J1668	1.052	238.1	01Jan2000, 04:35	3.34
J1669	0.386	85.1	01Jan2000, 03:42	1.85
J1671	0.802	301.4	01Jan2000, 03:48	3.49
Payne Branch	2.358	868.8	01Jan2000, 04:58	3.12
PB01	1.900	731.0	01Jan2000, 04:13	3.24
PBR1	1.900	731.0	01Jan2000, 05:10	3.24
R1619	0.668	37.8	01Jan2000, 05:54	0.80
R1623	0.540	64.5	01Jan2000, 06:21	1.45
R1628	0.456	31.2	01Jan2000, 06:52	1.34
R1630	0.887	20.4	01Jan2000, 07:58	0.41
R1633	0.458	12.2	01Jan2000, 06:06	0.34
R1634	0.334	38.5	01Jan2000, 04:18	1.14
R1635	0.796	144.7	01Jan2000, 04:36	2.71
R1636	0.652	69.0	01Jan2000, 05:36	1.38
R1637	0.726	108.8	01Jan2000, 06:22	1.98
R1638	0.803	95.5	01Jan2000, 05:41	1.28
R1640	1.009	19.1	01Jan2000, 08:20	0.39
R1643	0.985	22.8	01Jan2000, 06:07	0.40
R1644	1.055	30.7	01Jan2000, 05:47	0.41
R1646	0.484	13.4	01Jan2000, 05:59	0.44
R1649	0.528	50.1	01Jan2000, 05:44	1.39

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1651	0.663	97.0	01Jan2000, 05:51	2.49
R1653	0.779	84.0	01Jan2000, 05:19	1.29
R1654	0.644	48.3	01Jan2000, 05:32	1.15
R1655	0.931	81.6	01Jan2000, 06:22	1.06
R1656	1.366	53.6	01Jan2000, 07:02	0.74
R1658	0.767	31.6	01Jan2000, 05:44	0.55
R1659	1.528	197.1	01Jan2000, 06:26	2.42
R1661	1.220	68.7	01Jan2000, 08:39	1.22
R1662	0.672	42.3	01Jan2000, 08:15	1.32
R1663	1.498	112.8	01Jan2000, 07:14	1.41
R1664	0.777	160.2	01Jan2000, 05:29	3.24
R1665	1.741	164.2	01Jan2000, 07:11	1.80
R1666	1.025	75.8	01Jan2000, 08:38	1.61
R1667	0.698	98.9	01Jan2000, 05:58	1.77
R1668	1.052	123.0	01Jan2000, 07:50	2.44
R1669	0.386	67.4	01Jan2000, 05:11	1.59
R1671	0.802	67.9	01Jan2000, 06:39	1.57
SMR01	1.723	395.7	01Jan2000, 04:48	2.83
SMRR1	1.723	395.7	01Jan2000, 07:56	2.83
Spring Mill Run	2.502	494.4	01Jan2000, 07:43	2.77
WC01	20.902	3374.9	01Jan2000, 12:25	3.11
WC02	19.885	3370.2	01Jan2000, 11:27	3.12
WC03	18.622	3355.2	01Jan2000, 09:58	3.14
WC04	17.512	3301.5	01Jan2000, 09:02	3.14
WC05D	16.497	3195.7	01Jan2000, 08:36	3.13
WC05U	13.995	2718.6	01Jan2000, 08:36	3.19
WC06	13.351	2663.1	01Jan2000, 07:52	3.20
WC07	11.054	2408.4	01Jan2000, 07:54	3.27
WC08D	10.684	2396.5	01Jan2000, 07:11	3.28
WC08U	9.019	2126.1	01Jan2000, 07:13	3.34
WC09	8.252	2048.1	01Jan2000, 06:25	3.40
Williams Creek	21.252	3374.9	01Jan 2000, 13:08	3.10

Global Summary Results for Run "CBBEL 100 yr 6 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: CBBEL 100 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-108det-5
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100 year / 6 hr 10%
Compute Time: 18Jun2010, 13:00:19 Control Specifications: Frequency Control

Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC06	13.351	2663.1	01Jan2000, 07:52	3.20
WC07	11.054	2408.4	01Jan2000, 07:54	3.27
WC08D	10.684	2396.5	01Jan2000, 07:11	3.28
WC08U	9.019	2126.1	01Jan2000, 07:13	3.34
WC09	8.252	2048.1	01Jan2000, 06:25	3.40
WC10	6.710	1764.2	01Jan2000, 06:35	3.37
WC11	4.818	1318.5	01Jan2000, 05:48	3.33
WC12	2.543	796.9	01Jan2000, 04:35	3.34
WC13	0.802	301.4	01Jan2000, 03:48	3.49
WCR1	20.902	3374.9	01Jan2000, 13:08	3.11
WCR10	6.710	1764.2	01Jan2000, 06:41	3.37
WCR11	4.818	1318.5	01Jan2000, 07:05	3.33
WCR12	2.543	796.9	01Jan2000, 06:16	3.34
WCR13	0.802	301.4	01Jan2000, 04:58	3.49
WCR2	19.865	3370.2	01Jan2000, 12:25	3.12
WCR3	18.622	3355.2	01Jan2000, 11:27	3.14
WCR4	17.512	3301.5	01Jan2000, 09:58	3.14
WCR5	16.497	3195.7	01Jan2000, 09:03	3.13
WCR6	13.351	2663.1	01Jan2000, 08:35	3.20
WCR7	11.054	2408.4	01Jan2000, 08:44	3.27
WCR8	10.684	2396.5	01Jan2000, 07:54	3.28
WCR9	8.252	2048.1	01Jan2000, 07:28	3.40
Williams Creek	21.252	3374.9	01Jan2000, 13:08	3.10

Print Close

Existing - 1% - 12 hr

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 100 yr 12 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:49:26

Basin Model: CW 2008CN-10&det-5
Meteorologic Model: 100 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	3860.1	01Jan2000, 10:52	3.45
1617	0.350	137.0	01Jan2000, 04:08	2.97
1618	0.916	304.4	01Jan2000, 05:22	3.20
1619	0.668	275.6	01Jan2000, 04:26	3.36
1620	0.622	206.8	01Jan2000, 05:07	3.02
1621	0.643	201.7	01Jan2000, 04:57	2.73
1622	0.117	50.9	01Jan2000, 03:32	2.97
1623	0.540	148.3	01Jan2000, 05:25	2.55
1624	0.529	257.2	01Jan2000, 04:00	3.64
1625	0.716	198.1	01Jan2000, 05:22	2.55
1626	0.252	103.8	01Jan2000, 03:50	2.97
1627	0.484	196.2	01Jan2000, 04:16	3.20
1628	0.456	225.1	01Jan2000, 04:38	4.29
1629	1.195	497.3	01Jan2000, 04:42	3.64
1630	0.887	261.1	01Jan2000, 06:05	3.20
1631	1.326	478.3	01Jan2000, 04:46	3.08
1632	0.450	171.4	01Jan2000, 04:41	3.25
1633	0.458	165.2	01Jan2000, 04:52	3.14
1634	0.334	167.9	01Jan2000, 03:22	3.36
1635	0.796	598.2	01Jan2000, 02:58	4.85
1636	0.652	262.9	01Jan2000, 04:18	3.20
1637	0.726	223.5	01Jan2000, 05:11	2.79
1638	0.803	229.0	01Jan2000, 04:56	2.42
1639	0.891	407.8	01Jan2000, 04:36	3.82
1640	1.009	359.5	01Jan2000, 05:59	3.78

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1641	1.413	629.9	01Jan2000, 04:44	3.82
1642	0.363	134.2	01Jan2000, 03:58	2.61
1643	0.985	525.6	01Jan2000, 04:13	4.23
1644	1.055	457.6	01Jan2000, 04:17	3.47
1645	0.673	395.7	01Jan2000, 04:06	4.64
1646	0.484	217.5	01Jan2000, 04:18	3.64
1647	0.779	351.7	01Jan2000, 03:33	3.08
1648	1.017	423.2	01Jan2000, 04:35	3.52
1649	0.528	244.0	01Jan2000, 04:11	3.62
1650	0.582	296.5	01Jan2000, 03:40	3.68
1651	0.663	360.7	01Jan2000, 04:01	4.17
1652	0.352	171.1	01Jan2000, 03:52	3.64
1653	0.779	329.5	01Jan2000, 04:11	3.15
1654	0.644	314.4	01Jan2000, 03:58	3.56
1655	0.931	272.7	01Jan2000, 05:25	2.57
1656	1.366	603.4	01Jan2000, 04:55	3.93
1657	0.227	121.7	01Jan2000, 03:23	3.40
1658	0.767	326.1	01Jan2000, 04:25	3.27
1659	1.528	767.2	01Jan2000, 04:23	4.12
1660	0.014	6.9	01Jan2000, 03:07	2.65
1661	1.220	456.8	01Jan2000, 06:03	4.15
1662	0.672	245.4	01Jan2000, 05:50	3.78
1663	1.498	611.6	01Jan2000, 05:08	3.76
1664	0.777	434.6	01Jan2000, 03:47	4.12
1665	1.741	732.4	01Jan2000, 05:04	3.82
1666	1.025	351.8	01Jan2000, 06:06	3.70
1667	0.698	244.6	01Jan2000, 04:49	2.86
1668	1.052	415.8	01Jan2000, 05:26	3.89
1669	0.386	120.2	01Jan2000, 04:39	2.31
1670	0.370	181.6	01Jan2000, 03:56	3.56
1671	0.802	391.0	01Jan2000, 04:35	4.07

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC01	19.043	3934.7	01Jan2000, 11:17	3.43
CC03	17.269	3849.7	01Jan2000, 10:20	3.45
CC04	16.200	3762.2	01Jan2000, 09:48	3.48
CC05	15.232	3702.4	01Jan2000, 09:35	3.53
CC06	14.589	3654.5	01Jan2000, 09:06	3.57
CC07	14.472	3651.9	01Jan2000, 08:55	3.57
CC08	12.821	3454.0	01Jan2000, 08:22	3.54
CC09D	11.934	3275.5	01Jan2000, 07:53	3.56
CC09U	8.771	2434.3	01Jan2000, 08:35	3.43
CC10	7.445	2277.1	01Jan2000, 07:10	3.50
CC11D	7.082	2232.8	01Jan2000, 06:17	3.54
CC11U	4.724	1396.9	01Jan2000, 06:32	3.48
CC12D	4.390	1327.1	01Jan2000, 05:55	3.49
CC12U	2.209	844.2	01Jan2000, 06:01	4.19
CC13	1.413	629.9	01Jan2000, 04:44	3.82
CCR1	19.043	3934.7	01Jan2000, 12:26	3.43
CCR10	7.445	2277.1	01Jan2000, 08:51	3.50
CCR11	7.082	2232.8	01Jan2000, 07:15	3.54
CCR12	4.390	1327.1	01Jan2000, 06:38	3.49
CCR13	1.413	629.9	01Jan2000, 06:18	3.82
CCR2	17.753	3860.1	01Jan2000, 11:29	3.45
CCR3	17.269	3849.7	01Jan2000, 10:58	3.45
CCR4	16.200	3762.2	01Jan2000, 10:32	3.48
CCR5	15.232	3702.4	01Jan2000, 10:05	3.53
CCR6	14.589	3654.5	01Jan2000, 09:44	3.57
CCR7	14.472	3651.9	01Jan2000, 09:08	3.57
CCR8	12.821	3454.0	01Jan2000, 09:34	3.54
CCR9	11.934	3275.5	01Jan2000, 08:34	3.56
Clay Creek	1.665	392.2	01Jan2000, 04:43	3.46
CLC01	1.438	317.3	01Jan2000, 05:20	3.47
CLCR1	1.438	317.3	01Jan2000, 05:55	3.47

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Crooked Creek	19.959	3968.7	01Jan2000, 12:21	3.42
D1619	0.668	77.2	01Jan2000, 04:26	0.94
D1623	0.540	102.3	01Jan2000, 05:25	1.76
D1628	0.456	81.0	01Jan2000, 04:38	1.55
D1630	0.887	39.2	01Jan2000, 06:05	0.48
D1633	0.458	21.5	01Jan2000, 04:52	0.41
D1634	0.334	67.2	01Jan2000, 03:22	1.34
D1635	0.796	382.8	01Jan2000, 02:58	3.10
D1636	0.652	134.1	01Jan2000, 04:18	1.63
D1637	0.726	190.0	01Jan2000, 05:11	2.37
D1638	0.803	146.6	01Jan2000, 04:56	1.55
D1640	1.009	43.1	01Jan2000, 05:59	0.45
D1643	0.985	57.8	01Jan2000, 04:13	0.47
D1644	1.055	64.1	01Jan2000, 04:17	0.49
D1646	0.484	30.4	01Jan2000, 04:18	0.51
D1649	0.528	109.8	01Jan2000, 04:11	1.63
D1651	0.663	248.9	01Jan2000, 04:01	2.88
D1653	0.779	161.4	01Jan2000, 04:11	1.54
D1654	0.644	119.5	01Jan2000, 03:58	1.35
D1655	0.931	139.1	01Jan2000, 05:25	1.31
D1656	1.366	132.8	01Jan2000, 04:55	0.87
D1658	0.767	65.2	01Jan2000, 04:25	0.65
D1659	1.528	521.7	01Jan2000, 04:23	2.80
D1661	1.220	155.3	01Jan2000, 06:03	1.41
D1662	0.672	100.6	01Jan2000, 05:50	1.55
D1663	1.498	269.1	01Jan2000, 05:08	1.65
D1664	0.777	395.5	01Jan2000, 03:47	3.75
D1665	1.741	402.8	01Jan2000, 05:04	2.10
D1666	1.025	179.4	01Jan2000, 06:06	1.89
D1667	0.698	183.4	01Jan2000, 04:49	2.14
d1668	1.052	303.6	01Jan2000, 05:26	2.84

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1669	0.386	103.3	01Jan2000, 04:39	1.98
D1671	0.802	176.0	01Jan2000, 04:35	1.83
DC01	1.529	319.5	01Jan2000, 05:02	2.60
DCR1	1.529	319.5	01Jan2000, 06:26	2.60
Delaware Creek	2.181	486.8	01Jan2000, 05:30	2.78
HJC01	2.713	1275.5	01Jan2000, 05:02	4.04
HJC02	1.658	881.5	01Jan2000, 04:24	4.40
HJC03	0.673	395.7	01Jan2000, 04:06	4.64
HJCR1	2.713	1275.5	01Jan2000, 05:41	4.04
HJCR2	1.658	881.5	01Jan2000, 05:17	4.40
HJCR3	0.673	395.7	01Jan2000, 04:37	4.64
Howard Johnson Branch	3.063	1432.7	01Jan2000, 05:36	3.92
J1619	0.668	235.8	01Jan2000, 04:26	3.36
J1623	0.540	110.2	01Jan2000, 05:26	2.55
J1628	0.456	174.6	01Jan2000, 04:39	4.29
J1630	0.887	242.2	01Jan2000, 06:05	3.20
J1633	0.458	155.9	01Jan2000, 04:52	3.14
J1634	0.334	138.9	01Jan2000, 03:22	3.36
J1635	0.796	359.0	01Jan2000, 02:59	4.85
J1636	0.652	197.3	01Jan2000, 04:18	3.20
J1637	0.726	142.0	01Jan2000, 05:13	2.79
J1638	0.803	177.7	01Jan2000, 04:57	2.42
J1640	1.009	335.1	01Jan2000, 05:59	3.78
J1643	0.985	490.2	01Jan2000, 04:13	4.23
J1644	1.055	423.8	01Jan2000, 04:17	3.47
J1646	0.484	200.2	01Jan2000, 04:18	3.64
J1649	0.528	183.7	01Jan2000, 04:12	3.62
J1651	0.663	207.7	01Jan2000, 04:03	4.17
J1653	0.779	251.5	01Jan2000, 04:11	3.15
J1654	0.644	242.5	01Jan2000, 03:59	3.56
J1655	0.931	215.0	01Jan2000, 05:25	2.57

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1656	1.366	523.4	01Jan2000, 04:55	3.93
J1658	0.767	292.2	01Jan2000, 04:25	3.27
J1659	1.528	442.6	01Jan2000, 04:23	4.12
J1661	1.220	369.3	01Jan2000, 06:04	4.15
J1662	0.672	186.5	01Jan2000, 05:51	3.78
J1663	1.498	454.4	01Jan2000, 05:09	3.76
J1664	0.777	198.6	01Jan2000, 03:49	4.12
J1665	1.741	493.2	01Jan2000, 05:04	3.82
J1666	1.025	247.3	01Jan2000, 06:07	3.70
J1667	0.698	159.6	01Jan2000, 04:51	2.86
J1668	1.052	234.3	01Jan2000, 05:27	3.89
J1669	0.386	84.0	01Jan2000, 04:42	2.31
J1671	0.802	281.9	01Jan2000, 04:36	4.07
Payne Branch	2.358	849.3	01Jan2000, 05:57	3.67
PB01	1.900	710.7	01Jan2000, 05:11	3.80
PBR1	1.900	710.7	01Jan2000, 06:08	3.80
R1619	0.668	37.8	01Jan2000, 07:21	0.94
R1623	0.540	64.6	01Jan2000, 07:54	1.76
R1628	0.456	31.3	01Jan2000, 08:21	1.55
R1630	0.887	20.5	01Jan2000, 09:36	0.48
R1633	0.458	12.2	01Jan2000, 07:33	0.41
R1634	0.334	38.4	01Jan2000, 05:29	1.34
R1635	0.796	144.6	01Jan2000, 05:54	3.10
R1636	0.652	69.0	01Jan2000, 07:01	1.63
R1637	0.726	108.9	01Jan2000, 07:55	2.37
R1638	0.803	95.6	01Jan2000, 07:08	1.55
R1640	1.009	19.2	01Jan2000, 09:58	0.45
R1643	0.985	22.9	01Jan2000, 07:34	0.47
R1644	1.055	30.7	01Jan2000, 07:12	0.49
R1646	0.484	13.4	01Jan2000, 07:27	0.51
R1649	0.528	50.2	01Jan2000, 07:10	1.63

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1651	0.663	97.2	01Jan2000, 07:18	2.88
R1653	0.779	84.0	01Jan2000, 06:44	1.54
R1654	0.644	48.4	01Jan2000, 07:01	1.35
R1655	0.931	81.8	01Jan2000, 08:01	1.31
R1656	1.366	53.8	01Jan2000, 08:35	0.87
R1658	0.767	31.7	01Jan2000, 07:14	0.65
R1659	1.528	197.1	01Jan2000, 07:56	2.80
R1661	1.220	69.0	01Jan2000, 10:13	1.41
R1662	0.672	42.6	01Jan2000, 09:53	1.55
R1663	1.498	113.1	01Jan2000, 08:48	1.65
R1664	0.777	160.2	01Jan2000, 06:53	3.75
R1665	1.741	164.3	01Jan2000, 08:46	2.10
R1666	1.025	76.3	01Jan2000, 10:18	1.89
R1667	0.698	99.0	01Jan2000, 07:30	2.14
R1668	1.052	123.3	01Jan2000, 09:25	2.84
R1669	0.386	67.4	01Jan2000, 06:39	1.98
R1671	0.802	68.1	01Jan2000, 08:10	1.83
SMR01	1.723	400.0	01Jan2000, 05:46	3.36
SMRR1	1.723	400.0	01Jan2000, 08:54	3.36
Spring Mill Run	2.502	515.5	01Jan2000, 08:21	3.29
WC01	20.902	3732.4	01Jan2000, 12:52	3.66
WC02	19.885	3720.1	01Jan2000, 11:54	3.66
WC03	18.622	3700.1	01Jan2000, 10:25	3.69
WC04	17.512	3632.9	01Jan2000, 09:29	3.69
WC05D	16.497	3508.9	01Jan2000, 09:02	3.67
WC05U	13.995	3000.9	01Jan2000, 09:02	3.74
WC06	13.351	2930.1	01Jan2000, 08:40	3.75
WC07	11.054	2586.8	01Jan2000, 08:19	3.82
WC08D	10.684	2553.4	01Jan2000, 07:43	3.83
WC08U	9.019	2251.9	01Jan2000, 08:00	3.90
WC09	8.252	2137.8	01Jan2000, 07:13	3.96
Williams Ck	21.252	3732.8	01Jan 2000, 13:35	3.64

Global Summary Results for Run "CBBEL 100 yr 12 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: CBBEL 100 yr 12 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-10&det-5
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100 year / 12 hr 10%
Compute Time: 18Jun2010, 13:00:09 Control Specifications: Frequency Control

Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC08D	10.684	2553.4	01Jan2000, 07:43	3.83
WC08U	9.019	2251.9	01Jan2000, 08:00	3.90
WC09	8.252	2137.8	01Jan2000, 07:13	3.96
WC10	6.710	1820.7	01Jan2000, 07:24	3.93
WC11	4.818	1332.1	01Jan2000, 06:31	3.89
WC12	2.543	767.8	01Jan2000, 05:24	3.90
WC13	0.802	281.9	01Jan2000, 04:36	4.07
WCR1	20.902	3732.4	01Jan2000, 13:35	3.66
WCR10	6.710	1820.7	01Jan2000, 07:30	3.93
WCR11	4.818	1332.1	01Jan2000, 07:48	3.89
WCR12	2.543	767.8	01Jan2000, 07:05	3.90
WCR13	0.802	281.9	01Jan2000, 05:46	4.07
WCR2	19.885	3720.1	01Jan2000, 12:52	3.66
WCR3	18.622	3700.1	01Jan2000, 11:54	3.69
WCR4	17.512	3632.9	01Jan2000, 10:25	3.69
WCR5	16.497	3508.0	01Jan2000, 09:29	3.67
WCR6	13.351	2930.1	01Jan2000, 09:24	3.75
WCR7	11.054	2586.8	01Jan2000, 09:09	3.82
WCR8	10.684	2553.4	01Jan2000, 08:26	3.83
WCR9	8.252	2137.8	01Jan2000, 08:16	3.96
Williams Creek	21.252	3732.8	01Jan2000, 13:35	3.64

Print Close

Existing 1% - 24 hr

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 100 yr 24 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:49:50

Basin Model: CW 2008CN-10&det-5
Meteorologic Model: 100 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

03351310	17.753	3747.3	01Jan2000, 13:00	3.91
1617	0.350	93.3	01Jan2000, 05:16	3.39
1618	0.916	227.8	01Jan2000, 06:50	3.64
1619	0.668	193.6	01Jan2000, 05:38	3.81
1620	0.622	151.8	01Jan2000, 06:36	3.45
1621	0.643	145.7	01Jan2000, 06:29	3.14
1622	0.117	33.5	01Jan2000, 04:41	3.39
1623	0.540	110.6	01Jan2000, 07:04	2.95
1624	0.529	177.0	01Jan2000, 05:04	4.12
1625	0.716	147.3	01Jan2000, 07:01	2.95
1626	0.252	69.5	01Jan2000, 04:57	3.39
1627	0.484	135.6	01Jan2000, 05:25	3.64
1628	0.456	163.6	01Jan2000, 05:43	4.80
1629	1.195	358.3	01Jan2000, 05:57	4.10
1630	0.887	204.5	01Jan2000, 07:42	3.64
1631	1.326	342.6	01Jan2000, 06:11	3.52
1632	0.450	122.4	01Jan2000, 06:02	3.69
1633	0.458	119.4	01Jan2000, 06:17	3.58
1634	0.334	110.2	01Jan2000, 04:32	3.81
1635	0.796	390.3	01Jan2000, 03:13	5.38
1636	0.652	182.1	01Jan2000, 05:27	3.64
1637	0.726	164.3	01Jan2000, 06:43	3.21
1638	0.803	164.2	01Jan2000, 06:32	2.81
1639	0.891	293.1	01Jan2000, 05:48	4.31
1640	1.009	282.3	01Jan2000, 07:29	4.27

1641	1.413	457.3	01Jan2000, 06:00	4.31
1642	0.363	89.6	01Jan2000, 05:05	3.02
1643	0.985	371.7	01Jan2000, 05:13	4.74
1644	1.055	319.0	01Jan2000, 05:24	3.93
1645	0.673	280.4	01Jan2000, 05:00	5.16
1646	0.484	152.3	01Jan2000, 05:22	4.10
1647	0.779	232.4	01Jan2000, 04:42	3.52
1648	1.017	301.6	01Jan2000, 05:48	3.98
1649	0.528	169.6	01Jan2000, 05:16	4.09
1650	0.582	199.9	01Jan2000, 04:44	4.15
1651	0.663	251.5	01Jan2000, 05:01	4.68
1652	0.352	116.7	01Jan2000, 04:55	4.10
1653	0.779	226.8	01Jan2000, 05:20	3.60
1654	0.644	216.0	01Jan2000, 05:03	4.04
1655	0.931	205.6	01Jan2000, 07:06	3.00
1656	1.366	444.3	01Jan2000, 06:12	4.43
1657	0.227	80.7	01Jan2000, 04:33	3.88
1658	0.767	229.6	01Jan2000, 05:40	3.74
1659	1.528	546.3	01Jan2000, 05:25	4.62
1660	0.014	4.5	01Jan2000, 04:11	3.10
1661	1.220	360.4	01Jan2000, 07:27	4.65
1662	0.672	191.1	01Jan2000, 07:19	4.27
1663	1.498	455.6	01Jan2000, 06:29	4.24
1664	0.777	298.6	01Jan2000, 04:48	4.62
1665	1.741	543.5	01Jan2000, 06:23	4.31
1666	1.025	278.0	01Jan2000, 07:39	4.19
1667	0.698	176.3	01Jan2000, 06:20	3.30
1668	1.052	315.8	01Jan2000, 06:47	4.38
1669	0.386	84.7	01Jan2000, 06:16	2.72
1670	0.370	124.6	01Jan2000, 05:01	4.04
1671	0.802	282.6	01Jan2000, 05:44	4.58

CC01	19.043	3869.4	01Jan2000, 13:27	3.89
CC03	17.269	3712.9	01Jan2000, 12:26	3.91
CC04	16.200	3587.4	01Jan2000, 11:49	3.94
CC05	15.232	3483.6	01Jan2000, 11:28	3.99
CC06	14.589	3406.1	01Jan2000, 10:57	4.03
CC07	14.472	3395.0	01Jan2000, 10:45	4.04
CC08	12.821	3119.0	01Jan2000, 09:53	4.00
CC09D	11.934	2945.0	01Jan2000, 09:17	4.03
CC09U	8.771	2142.0	01Jan2000, 09:52	3.89
CC10	7.445	1912.1	01Jan2000, 08:24	3.96
CC11D	7.082	1849.2	01Jan2000, 07:31	4.01
CC11U	4.724	1194.7	01Jan2000, 07:39	3.94
CC12D	4.390	1114.9	01Jan2000, 07:03	3.95
CC12U	2.209	681.9	01Jan2000, 07:03	4.70
CC13	1.413	457.3	01Jan2000, 06:00	4.31
CCR1	19.043	3869.4	01Jan2000, 14:36	3.89
CCR10	7.445	1912.1	01Jan2000, 10:05	3.96
CCR11	7.082	1849.2	01Jan2000, 08:29	4.01
CCR12	4.390	1114.9	01Jan2000, 07:46	3.95
CCR13	1.413	457.3	01Jan2000, 07:34	4.31
CCR2	17.753	3747.3	01Jan2000, 13:37	3.91
CCR3	17.269	3712.9	01Jan2000, 13:04	3.91
CCR4	16.200	3587.4	01Jan2000, 12:33	3.94
CCR5	15.232	3483.6	01Jan2000, 11:58	3.99
CCR6	14.589	3406.1	01Jan2000, 11:35	4.03
CCR7	14.472	3395.0	01Jan2000, 10:58	4.04
CCR8	12.821	3119.0	01Jan2000, 11:05	4.00
CCR9	11.934	2945.0	01Jan2000, 09:58	4.03
Clay Creek	1.665	348.0	01Jan2000, 06:25	3.93
CLC01	1.438	285.8	01Jan2000, 06:47	3.93
CLCR1	1.438	285.8	01Jan2000, 07:22	3.93

Crooked Creek	19.959	3936.6	01Jan2000, 14:29	3.88
D1619	0.668	54.2	01Jan2000, 05:38	1.07
D1623	0.540	76.3	01Jan2000, 07:04	2.03
D1628	0.456	58.9	01Jan2000, 05:43	1.73
D1630	0.887	30.7	01Jan2000, 07:42	0.55
D1633	0.458	15.5	01Jan2000, 06:17	0.47
D1634	0.334	44.1	01Jan2000, 04:32	1.52
D1635	0.796	249.8	01Jan2000, 03:13	3.44
D1636	0.652	92.9	01Jan2000, 05:27	1.85
D1637	0.726	139.7	01Jan2000, 06:43	2.72
D1638	0.803	105.1	01Jan2000, 06:32	1.80
D1640	1.009	33.9	01Jan2000, 07:29	0.51
D1643	0.985	40.9	01Jan2000, 05:13	0.52
D1644	1.055	44.7	01Jan2000, 05:24	0.55
D1646	0.484	21.3	01Jan2000, 05:22	0.57
D1649	0.528	76.3	01Jan2000, 05:16	1.84
D1651	0.663	173.5	01Jan2000, 05:01	3.23
D1653	0.779	111.1	01Jan2000, 05:20	1.77
D1654	0.644	82.1	01Jan2000, 05:03	1.54
D1655	0.931	104.9	01Jan2000, 07:06	1.53
D1656	1.366	97.8	01Jan2000, 06:12	0.97
D1658	0.767	45.9	01Jan2000, 05:40	0.75
D1659	1.528	371.5	01Jan2000, 05:25	3.14
D1661	1.220	122.5	01Jan2000, 07:27	1.58
D1662	0.672	78.3	01Jan2000, 07:19	1.75
D1663	1.498	200.5	01Jan2000, 06:29	1.87
D1664	0.777	271.7	01Jan2000, 04:48	4.21
D1665	1.741	298.9	01Jan2000, 06:23	2.37
D1666	1.025	141.8	01Jan2000, 07:39	2.14
D1667	0.698	132.2	01Jan2000, 06:20	2.48
d1668	1.052	230.5	01Jan2000, 06:47	3.20

D1669	0.386	72.9	01Jan2000, 06:16	2.34
D1671	0.802	127.2	01Jan2000, 05:44	2.06
DC01	1.529	287.0	01Jan2000, 06:36	3.00
DCR1	1.529	287.0	01Jan2000, 08:00	3.00
Delaware Creek	2.181	433.0	01Jan2000, 07:03	3.19
HJC01	2.713	930.5	01Jan2000, 06:03	4.53
HJC02	1.658	632.6	01Jan2000, 05:21	4.91
HJC03	0.673	280.4	01Jan2000, 05:00	5.16
HJCR1	2.713	930.5	01Jan2000, 06:42	4.53
HJCR2	1.658	632.6	01Jan2000, 06:14	4.91
HJCR3	0.673	280.4	01Jan2000, 05:31	5.16
Howard Johnson Branch	3.[illegible]	1050.8	01Jan2000, 06:38	4.41
J1619	0.668	176.6	01Jan2000, 05:39	3.81
J1623	0.540	98.4	01Jan2000, 07:06	2.95
J1628	0.456	135.1	01Jan2000, 05:45	4.80
J1630	0.887	194.0	01Jan2000, 07:43	3.64
J1633	0.458	115.9	01Jan2000, 06:18	3.58
J1634	0.334	104.1	01Jan2000, 04:32	3.81
J1635	0.796	283.8	01Jan2000, 03:14	5.38
J1636	0.652	157.4	01Jan2000, 05:28	3.64
J1637	0.726	132.8	01Jan2000, 06:47	3.21
J1638	0.803	154.2	01Jan2000, 06:32	2.81
J1640	1.009	267.2	01Jan2000, 07:30	4.27
J1643	0.985	353.1	01Jan2000, 05:14	4.74
J1644	1.055	304.5	01Jan2000, 05:24	3.93
J1646	0.484	144.1	01Jan2000, 05:23	4.10
J1649	0.528	142.6	01Jan2000, 05:16	4.09
J1651	0.663	173.6	01Jan2000, 05:02	4.68
J1653	0.779	198.8	01Jan2000, 05:21	3.60
J1654	0.644	181.3	01Jan2000, 05:04	4.04
J1655	0.931	181.9	01Jan2000, 07:07	3.00

J1656	1.366	399.1	01Jan2000, 06:12	4.43
J1658	0.767	214.8	01Jan2000, 05:40	3.74
J1659	1.528	371.9	01Jan2000, 05:26	4.62
J1661	1.220	305.6	01Jan2000, 07:28	4.65
J1662	0.672	154.3	01Jan2000, 07:20	4.27
J1663	1.498	366.8	01Jan2000, 06:30	4.24
J1664	0.777	186.2	01Jan2000, 04:51	4.62
J1665	1.741	408.0	01Jan2000, 06:24	4.31
J1666	1.025	211.0	01Jan2000, 07:42	4.19
J1667	0.698	142.3	01Jan2000, 06:22	3.30
J1668	1.052	207.0	01Jan2000, 06:50	4.38
J1669	0.386	78.9	01Jan2000, 06:18	2.72
J1671	0.802	222.0	01Jan2000, 05:45	4.58
Payne Branch	2.358	655.8	01Jan2000, 07:21	4.15
PB01	1.900	544.9	01Jan2000, 06:33	4.29
PBR1	1.900	544.9	01Jan2000, 07:30	4.29
R1619	0.668	37.4	01Jan2000, 09:13	1.07
R1623	0.540	64.2	01Jan2000, 09:36	2.03
R1628	0.456	31.0	01Jan2000, 10:45	1.73
R1630	0.887	20.4	01Jan2000, 12:05	0.55
R1633	0.458	12.1	01Jan2000, 09:11	0.47
R1634	0.334	38.1	01Jan2000, 05:50	1.52
R1635	0.796	143.9	01Jan2000, 07:17	3.44
R1636	0.652	68.4	01Jan2000, 08:37	1.85
R1637	0.726	108.4	01Jan2000, 08:47	2.72
R1638	0.803	95.1	01Jan2000, 08:20	1.80
R1640	1.009	19.1	01Jan2000, 12:42	0.51
R1643	0.985	22.6	01Jan2000, 09:45	0.52
R1644	1.055	30.4	01Jan2000, 09:00	0.55
R1646	0.484	13.3	01Jan2000, 09:28	0.57
R1649	0.528	49.6	01Jan2000, 09:02	1.84

R1651	0.663	96.4	01Jan2000, 09:24	3.23
R1653	0.779	83.4	01Jan2000, 08:16	1.77
R1654	0.644	47.9	01Jan2000, 09:11	1.54
R1655	0.931	81.4	01Jan2000, 10:09	1.53
R1656	1.366	53.3	01Jan2000, 11:05	0.97
R1658	0.767	31.4	01Jan2000, 09:12	0.75
R1659	1.528	197.1	01Jan2000, 10:16	3.14
R1661	1.220	68.6	01Jan2000, 12:50	1.58
R1662	0.672	42.3	01Jan2000, 12:41	1.75
R1663	1.498	112.6	01Jan2000, 11:20	1.87
R1664	0.777	159.7	01Jan2000, 08:45	4.21
R1665	1.741	164.0	01Jan2000, 11:18	2.37
R1666	1.025	75.9	01Jan2000, 13:10	2.14
R1667	0.698	98.5	01Jan2000, 09:27	2.48
R1668	1.052	122.9	01Jan2000, 12:05	3.20
R1669	0.386	67.1	01Jan2000, 07:46	2.34
R1671	0.802	67.6	01Jan2000, 10:36	2.06
SMR01	1.723	351.1	01Jan2000, 07:23	3.83
SMRR1	1.723	351.1	01Jan2000, 10:31	3.83
Spring Mill Run	2.502	497.2	01Jan2000, 09:27	3.76
WC01	20.902	3934.5	01Jan2000, 13:42	4.14
WC02	19.885	3861.1	01Jan2000, 12:50	4.14
WC03	18.622	3777.8	01Jan2000, 11:49	4.17
WC04	17.512	3646.6	01Jan2000, 11:00	4.17
WC05D	16.497	3478.2	01Jan2000, 10:35	4.16
WC05U	13.995	2989.6	01Jan2000, 10:36	4.23
WC06	13.351	2886.3	01Jan2000, 09:58	4.23
WC07	11.054	2451.0	01Jan2000, 09:38	4.31
WC08D	10.684	2387.3	01Jan2000, 09:04	4.32
WC08U	9.019	2073.5	01Jan2000, 09:16	4.40
WC09	8.252	1920.8	01Jan2000, 08:27	4.46
Williams Creek	21.252	3947.2	01 Jan 2000, 10:25	4.12

Global Summary Results for Run "CBBEL 100 yr 24 hr 10%"

Project: CBBEL Crooked & Williams Simulation Run: CBBEL 100 yr 24 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-108dat-5
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100 year / 24 hr 10%
Compute Time: 18Jun2010, 13:00:14 Control Specifications: Frequency Control

Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC07	11.054	2451.0	01Jan2000, 09:38	4.31
WC08D	10.684	2387.3	01Jan2000, 09:04	4.32
WC08U	9.015	2073.5	01Jan2000, 09:16	4.40
WC09	8.252	1920.8	01Jan2000, 08:27	4.46
WC10	6.710	1594.6	01Jan2000, 08:38	4.42
WC11	4.818	1153.6	01Jan2000, 07:46	4.39
WC12	2.543	628.7	01Jan2000, 06:37	4.40
WC13	0.802	222.0	01Jan2000, 05:45	4.58
WCR1	20.902	3934.5	01Jan2000, 14:25	4.14
WCR10	6.710	1594.6	01Jan2000, 08:44	4.42
WCR11	4.818	1153.6	01Jan2000, 09:03	4.39
WCR12	2.543	628.7	01Jan2000, 08:18	4.40
WCR13	0.802	222.0	01Jan2000, 05:55	4.58
WCR2	19.885	3861.1	01Jan2000, 13:48	4.14
WCR3	18.622	3777.8	01Jan2000, 13:18	4.17
WCR4	17.512	3646.6	01Jan2000, 11:56	4.17
WCR5	16.497	3478.2	01Jan2000, 11:02	4.16
WCR6	13.351	2886.3	01Jan2000, 10:42	4.23
WCR7	11.054	2451.0	01Jan2000, 10:28	4.31
WCR8	10.684	2387.3	01Jan2000, 09:47	4.32
WCR9	8.252	1920.8	01Jan2000, 09:30	4.32
Williams Creek	21.252	3947.2	01Jan2000, 14:25	4.12

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: 1% 24hr, existing con, SCS

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-10&det-5
End of Run: 03Jan2000, 00:00 Meteorologic Model: SCS Type 2
Compute Time: 21Jun2010, 15:27:49 Control Specifications: Frequency Control

Volume Units: IN

Existing 1% - SCS

03351310	17.753	3813.8	01Jan2000, 20:35	3.91
1617	0.350	164.5	01Jan2000, 13:46	3.39
1618	0.916	309.8	01Jan2000, 15:06	3.64
1619	0.668	308.6	01Jan2000, 14:09	3.81
1620	0.622	216.8	01Jan2000, 14:48	3.45
1621	0.643	216.9	01Jan2000, 14:33	3.14
1622	0.117	70.6	01Jan2000, 13:13	3.39
1623	0.540	154.4	01Jan2000, 14:59	2.95
1624	0.529	309.3	01Jan2000, 13:45	4.12
1625	0.716	207.0	01Jan2000, 14:56	2.95
1626	0.252	132.5	01Jan2000, 13:30	3.39
1627	0.484	225.5	01Jan2000, 13:58	3.64
1628	0.456	237.6	01Jan2000, 14:31	4.80
1629	1.195	526.2	01Jan2000, 14:31	4.10
1630	0.887	255.9	01Jan2000, 15:52	3.64
1631	1.326	520.0	01Jan2000, 14:26	3.52
1632	0.450	185.7	01Jan2000, 14:25	3.69
1633	0.458	177.8	01Jan2000, 14:33	3.58
1634	0.334	238.6	01Jan2000, 13:08	3.81
1635	0.796	832.2	01Jan2000, 13:03	5.38
1636	0.652	301.0	01Jan2000, 14:00	3.64
1637	0.726	235.4	01Jan2000, 14:48	3.21
1638	0.803	249.6	01Jan2000, 14:27	2.81
1639	0.891	449.2	01Jan2000, 14:21	4.31
1640	1.009	360.9	01Jan2000, 15:46	4.27
1641	1.413	683.3	01Jan2000, 14:30	4.31
1642	0.363	174.3	01Jan2000, 13:28	3.02
1643	0.985	593.3	01Jan2000, 14:03	4.74
1644	1.055	517.4	01Jan2000, 14:03	3.93
1645	0.673	441.9	01Jan2000, 14:00	5.16
1646	0.484	242.5	01Jan2000, 14:06	4.10

1647	0.779	484.1	01Jan2000, 13:15	3.52
1648	1.017	459.3	01Jan2000, 14:21	3.98
1649	0.528	280.5	01Jan2000, 13:57	4.09
1650	0.582	370.9	01Jan2000, 13:30	4.15
1651	0.663	417.9	01Jan2000, 13:52	4.68
1652	0.352	205.6	01Jan2000, 13:40	4.10
1653	0.779	400.1	01Jan2000, 13:48	3.60
1654	0.644	388.3	01Jan2000, 13:41	4.04
1655	0.931	297.2	01Jan2000, 14:53	3.00
1656	1.366	640.5	01Jan2000, 14:42	4.43
1657	0.227	179.1	01Jan2000, 13:06	3.88
1658	0.767	385.4	01Jan2000, 14:02	3.74
1659	1.528	843.0	01Jan2000, 14:13	4.62
1660	0.014	15.3	01Jan2000, 12:28	3.10
1661	1.220	442.2	01Jan2000, 15:58	4.65
1662	0.672	248.0	01Jan2000, 15:37	4.27
1663	1.498	640.9	01Jan2000, 14:53	4.24
1664	0.777	524.7	01Jan2000, 13:39	4.62
1665	1.741	771.5	01Jan2000, 14:49	4.31
1666	1.025	351.6	01Jan2000, 15:54	4.19
1667	0.698	276.7	01Jan2000, 14:22	3.30
1668	1.052	420.1	01Jan2000, 15:15	4.38
1669	0.386	143.2	01Jan2000, 14:01	2.72
1670	0.370	225.6	01Jan2000, 13:39	4.04
1671	0.802	430.5	01Jan2000, 14:22	4.58
CC01	19.043	3928.7	01Jan2000, 21:12	3.89
CC03	17.269	3782.5	01Jan2000, 19:57	3.91
CC04	16.200	3664.0	01Jan2000, 19:14	3.94
CC05	15.232	3572.5	01Jan2000, 18:46	3.99
CC06	14.589	3502.7	01Jan2000, 18:09	4.03
CC07	14.472	3494.6	01Jan2000, 17:57	4.04
CC08	12.821	3214.5	01Jan2000, 16:52	4.00
CC09D	11.934	3021.0	01Jan2000, 17:57	4.03
CC09U	8.771	2380.0	01Jan2000, 18:41	3.89
CC10	7.445	2227.7	01Jan2000, 17:08	3.96
CC11D	7.082	2190.3	01Jan2000, 16:13	4.01
CC11U	4.724	1412.3	01Jan2000, 16:36	3.94
CC12D	4.390	1350.6	01Jan2000, 15:54	3.95

CC12U	2.209	878.3	01Jan2000, 16:00	4.70
CC13	1.413	683.3	01Jan2000, 14:30	4.31
CCR1	19.043	3928.7	01Jan2000, 22:21	3.89
CCR10	7.445	2227.7	01Jan2000, 18:49	3.96
CCR11	7.082	2190.3	01Jan2000, 17:11	4.01
CCR12	4.390	1350.6	01Jan2000, 16:37	3.95
CCR13	1.413	683.3	01Jan2000, 16:04	4.31
CCR2	17.753	3813.8	01Jan2000, 21:12	3.91
CCR3	17.269	3782.5	01Jan2000, 20:35	3.91
CCR4	16.200	3664.0	01Jan2000, 19:58	3.94
CCR5	15.232	3572.5	01Jan2000, 19:16	3.99
CCR6	14.589	3502.7	01Jan2000, 18:47	4.03
CCR7	14.472	3494.6	01Jan2000, 18:10	4.04
CCR8	12.821	3214.5	01Jan2000, 18:04	4.00
CCR9	11.934	3021.0	01Jan2000, 18:38	4.03
Clay Creek	1.665	397.1	01Jan2000, 13:29	3.93
CLC01	1.438	316.9	01Jan2000, 15:06	3.93
CLCR1	1.438	316.9	01Jan2000, 15:41	3.93
Crooked Creek	19.959	3992.3	01Jan2000, 22:21	3.88
D1619	0.668	86.4	01Jan2000, 14:09	1.07
D1623	0.540	106.5	01Jan2000, 14:59	2.03
D1628	0.456	85.5	01Jan2000, 14:31	1.73
D1630	0.887	38.4	01Jan2000, 15:52	0.55
D1633	0.458	23.1	01Jan2000, 14:33	0.47
D1634	0.334	95.4	01Jan2000, 13:08	1.52
D1635	0.796	532.6	01Jan2000, 13:03	3.44
D1636	0.652	153.5	01Jan2000, 14:00	1.85
D1637	0.726	200.1	01Jan2000, 14:48	2.72
D1638	0.803	159.7	01Jan2000, 14:27	1.80
D1640	1.009	43.3	01Jan2000, 15:46	0.51
D1643	0.985	65.3	01Jan2000, 14:03	0.52
D1644	1.055	72.4	01Jan2000, 14:03	0.55
D1646	0.484	33.9	01Jan2000, 14:06	0.57
D1649	0.528	126.2	01Jan2000, 13:57	1.84
D1651	0.663	288.3	01Jan2000, 13:52	3.23
D1653	0.779	196.1	01Jan2000, 13:48	1.77
D1654	0.644	147.6	01Jan2000, 13:41	1.54
D1655	0.931	161.6	01Jan2000, 14:53	1.53

D1656	1.366	140.9	01Jan2000, 14:42	0.97
D1658	0.767	77.1	01Jan2000, 14:02	0.75
D1659	1.528	573.2	01Jan2000, 14:13	3.14
D1661	1.220	150.3	01Jan2000, 15:58	1.58
D1662	0.672	101.7	01Jan2000, 15:37	1.75
D1663	1.498	282.0	01Jan2000, 14:53	1.87
D1664	0.777	477.5	01Jan2000, 13:39	4.21
D1665	1.741	424.3	01Jan2000, 14:49	2.37
D1666	1.025	179.3	01Jan2000, 15:54	2.14
D1667	0.698	207.5	01Jan2000, 14:22	2.48
d1668	1.052	306.7	01Jan2000, 15:15	3.20
D1669	0.386	123.1	01Jan2000, 14:01	2.34
D1671	0.802	193.7	01Jan2000, 14:22	2.06
DC01	1.529	328.0	01Jan2000, 14:32	3.00
DCR1	1.529	328.0	01Jan2000, 15:56	3.00
Delaware Creek	2.181	481.4	01Jan2000, 15:16	3.19
HJC01	2.713	1337.3	01Jan2000, 14:56	4.53
HJC02	1.658	973.4	01Jan2000, 14:14	4.91
HJC03	0.673	441.9	01Jan2000, 14:00	5.16
HJCR1	2.713	1337.3	01Jan2000, 15:35	4.53
HJCR2	1.658	973.4	01Jan2000, 15:07	4.91
HJCR3	0.673	441.9	01Jan2000, 14:31	5.16
Howard Johnson	[illegible]	1477.3	01Jan2000, 15:30	4.41
J1619	0.668	259.5	01Jan2000, 14:10	3.81
J1623	0.540	112.1	01Jan2000, 15:00	2.95
J1628	0.456	182.5	01Jan2000, 14:31	4.80
J1630	0.887	237.7	01Jan2000, 15:52	3.64
J1633	0.458	166.8	01Jan2000, 14:33	3.58
J1634	0.334	181.4	01Jan2000, 13:08	3.81
J1635	0.796	443.2	01Jan2000, 13:03	5.38
J1636	0.652	215.9	01Jan2000, 14:00	3.64
J1637	0.726	143.7	01Jan2000, 14:49	3.21
J1638	0.803	185.1	01Jan2000, 14:27	2.81
J1640	1.009	336.4	01Jan2000, 15:46	4.27
J1643	0.985	550.4	01Jan2000, 14:03	4.74
J1644	1.055	475.2	01Jan2000, 14:03	3.93
J1646	0.484	221.7	01Jan2000, 14:06	4.10
J1649	0.528	203.7	01Jan2000, 13:57	4.09

J1651	0.663	225.3	01Jan2000, 13:52	4.68
J1653	0.779	287.5	01Jan2000, 13:48	3.60
J1654	0.644	288.3	01Jan2000, 13:41	4.04
J1655	0.931	227.0	01Jan2000, 14:53	3.00
J1656	1.366	552.3	01Jan2000, 14:42	4.43
J1658	0.767	339.6	01Jan2000, 14:02	3.74
J1659	1.528	466.8	01Jan2000, 14:13	4.62
J1661	1.220	359.6	01Jan2000, 15:58	4.65
J1662	0.672	187.9	01Jan2000, 15:37	4.27
J1663	1.498	470.7	01Jan2000, 14:54	4.24
J1664	0.777	206.7	01Jan2000, 13:40	4.62
J1665	1.741	510.7	01Jan2000, 14:49	4.32
J1666	1.025	247.2	01Jan2000, 15:55	4.19
J1667	0.698	167.6	01Jan2000, 14:22	3.30
J1668	1.052	235.3	01Jan2000, 15:16	4.38
J1669	0.386	87.3	01Jan2000, 14:02	2.72
J1671	0.802	303.6	01Jan2000, 14:23	4.58
Payne Branch	2.358	868.7	01Jan2000, 15:27	4.15
PB01	1.900	731.7	01Jan2000, 14:37	4.29
PBR1	1.900	731.7	01Jan2000, 15:34	4.29
R1619	0.668	37.7	01Jan2000, 16:42	1.07
R1623	0.540	64.5	01Jan2000, 17:14	2.03
R1628	0.456	31.1	01Jan2000, 17:59	1.73
R1630	0.887	20.4	01Jan2000, 19:19	0.55
R1633	0.458	12.2	01Jan2000, 16:53	0.47
R1634	0.334	38.5	01Jan2000, 14:42	1.52
R1635	0.796	144.4	01Jan2000, 15:07	3.44
R1636	0.652	68.9	01Jan2000, 16:18	1.86
R1637	0.726	108.8	01Jan2000, 17:17	2.73
R1638	0.803	95.5	01Jan2000, 16:22	1.80
R1640	1.009	19.2	01Jan2000, 19:57	0.51
R1643	0.985	22.8	01Jan2000, 17:03	0.52
R1644	1.055	30.6	01Jan2000, 16:33	0.55
R1646	0.484	13.4	01Jan2000, 16:50	0.57
R1649	0.528	50.0	01Jan2000, 16:31	1.84
R1651	0.663	96.9	01Jan2000, 16:43	3.23
R1653	0.779	84.0	01Jan2000, 16:00	1.77
R1654	0.644	48.3	01Jan2000, 16:23	1.54

R1655	0.931	81.8	01Jan2000, 17:28	1.53
R1656	1.366	53.6	01Jan2000, 18:16	0.97
R1658	0.767	31.7	01Jan2000, 16:36	0.75
R1659	1.528	197.1	01Jan2000, 17:29	3.14
R1661	1.220	68.7	01Jan2000, 20:10	1.58
R1662	0.672	42.4	01Jan2000, 19:54	1.75
R1663	1.498	112.9	01Jan2000, 18:31	1.87
R1664	0.777	160.1	01Jan2000, 16:13	4.21
R1665	1.741	164.2	01Jan2000, 18:29	2.37
R1666	1.025	76.1	01Jan2000, 20:25	2.14
R1667	0.698	99.0	01Jan2000, 16:53	2.48
R1668	1.052	123.0	01Jan2000, 19:17	3.20
R1669	0.386	67.5	01Jan2000, 15:52	2.34
R1671	0.802	67.9	01Jan2000, 17:47	2.06
SMR01	1.723	394.7	01Jan2000, 15:25	3.83
SMRR1	1.723	394.7	01Jan2000, 18:33	3.83
Spring Mill Run	2.502	518.5	01Jan2000, 18:08	3.76
WC01	20.902	3755.2	01Jan2000, 22:59	4.14
WC02	19.885	3703.1	01Jan2000, 22:01	4.14
WC03	18.622	3634.9	01Jan2000, 20:32	4.17
WC04	17.512	3531.6	01Jan2000, 19:36	4.17
WC05D	16.497	3390.3	01Jan2000, 19:09	4.16
WC05U	13.995	2895.8	01Jan2000, 20:01	4.23
WC06	13.351	2820.3	01Jan2000, 19:18	4.23
WC07	11.054	2489.8	01Jan2000, 18:30	4.31
WC08D	10.684	2453.6	01Jan2000, 17:47	4.32
WC08U	9.019	2161.9	01Jan2000, 17:49	4.40
WC09	8.252	2050.6	01Jan2000, 17:12	4.46
WC10	6.710	1757.1	01Jan2000, 17:27	4.42
WC11	4.818	1320.5	01Jan2000, 16:32	4.39
WC12	2.543	796.7	01Jan2000, 15:07	4.40
WC13	0.802	303.6	01Jan2000, 14:23	4.58
WCR1	20.902	3755.2	01Jan2000, 23:42	4.14
WCR10	6.710	1757.1	01Jan2000, 17:33	4.42
WCR11	4.818	1320.5	01Jan2000, 17:49	4.39
WCR12	2.543	796.7	01Jan2000, 16:48	4.40
WCR13	0.802	303.6	01Jan2000, 15:33	4.58
WCR2	19.885	3703.1	01Jan2000, 22:59	4.14

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1651	0.663	167.3	01Jan2000, 03:19	2.04
J1653	0.779	175.8	01Jan2000, 03:25	1.30
J1654	0.644	131.5	01Jan2000, 03:16	1.57
J1655	0.931	113.6	01Jan2000, 04:33	0.86
J1656	1.366	324.4	01Jan2000, 04:08	1.83
J1658	0.767	170.1	01Jan2000, 03:40	1.32
J1659	1.528	268.0	01Jan2000, 03:39	2.01
J1661	1.220	205.9	01Jan2000, 05:13	2.05
J1662	0.672	118.1	01Jan2000, 05:00	1.71
J1663	1.498	302.6	01Jan2000, 04:19	1.71
J1664	0.777	184.7	01Jan2000, 03:08	2.01
J1665	1.741	281.0	01Jan2000, 04:15	1.75
J1666	1.025	163.9	01Jan2000, 05:15	1.66
J1667	0.698	118.3	01Jan2000, 04:00	1.08
J1668	1.052	134.5	01Jan2000, 04:37	1.84
J1669	0.386	46.0	01Jan2000, 03:50	0.71
J1671	0.802	166.2	01Jan2000, 03:52	1.90
Payne Branch	2.358	471.2	01Jan2000, 04:59	1.66
PB01	1.900	398.0	01Jan2000, 04:15	1.73
PBR1	1.900	398.0	01Jan2000, 05:12	1.73
R1619	0.668	37.1	01Jan2000, 04:36	0.42
R1623	0.540	48.4	01Jan2000, 04:26	0.68
R1628	0.456	30.3	01Jan2000, 05:47	0.77
R1630	0.887	20.0	01Jan2000, 05:34	0.21
R1633	0.458	11.7	01Jan2000, 04:00	0.18
R1634	0.334	38.0	01Jan2000, 03:18	0.61
R1635	0.796	143.6	01Jan2000, 04:01	1.62
R1636	0.652	68.1	01Jan2000, 04:16	0.73
R1637	0.726	96.5	01Jan2000, 04:13	0.98
R1638	0.803	55.1	01Jan2000, 05:09	0.60
R1640	1.009	18.6	01Jan2000, 06:31	0.20
R1643	0.985	22.2	01Jan2000, 05:09	0.23
R1644	1.055	30.1	01Jan2000, 04:36	0.23
R1646	0.484	13.1	01Jan2000, 04:54	0.24
R1649	0.528	49.2	01Jan2000, 04:38	0.76
R1651	0.663	95.5	01Jan2000, 04:56	1.41
R1653	0.779	83.0	01Jan2000, 03:55	0.64
R1654	0.644	16.1	01Jan2000, 06:11	0.60

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1655	0.931	58.0	01Jan2000, 04:33	0.44
R1656	1.366	52.3	01Jan2000, 05:45	0.40
R1658	0.767	31.0	01Jan2000, 04:21	0.26
R1659	1.528	116.0	01Jan2000, 06:23	1.36
R1661	1.220	34.4	01Jan2000, 09:03	0.70
R1662	0.672	41.2	01Jan2000, 06:32	0.70
R1663	1.498	111.2	01Jan2000, 05:47	0.75
R1664	0.777	159.3	01Jan2000, 04:36	1.83
R1665	1.741	95.6	01Jan2000, 07:03	0.97
R1666	1.025	74.2	01Jan2000, 06:45	0.85
R1667	0.698	88.7	01Jan2000, 04:00	0.81
R1668	1.052	71.7	01Jan2000, 07:42	1.34
R1669	0.386	39.0	01Jan2000, 04:26	0.61
R1671	0.802	39.2	01Jan2000, 06:35	0.86
SMR01	1.723	269.7	01Jan2000, 04:22	1.42
SMRR1	1.723	269.7	01Jan2000, 07:30	1.42
Spring Mill Run	2.502	296.4	01Jan2000, 07:14	1.39
WC01	20.902	1959.5	01Jan2000, 10:50	1.66
WC02	19.885	1950.9	01Jan2000, 09:52	1.66
WC03	18.622	1946.1	01Jan2000, 08:23	1.68
WC04	17.512	1935.6	01Jan2000, 07:27	1.67
WC05D	16.497	1867.6	01Jan2000, 07:50	1.66
WC05U	13.995	1599.1	01Jan2000, 08:42	1.71
WC06	13.351	1579.4	01Jan2000, 07:58	1.71
WC07	11.054	1435.5	01Jan2000, 07:58	1.77
WC08D	10.684	1429.4	01Jan2000, 07:15	1.78
WC08U	9.019	1300.2	01Jan2000, 07:17	1.82
WC09	8.252	1267.2	01Jan2000, 06:24	1.87
WC10	6.710	1101.9	01Jan2000, 06:36	1.84
WC11	4.818	840.6	01Jan2000, 05:51	1.81
WC12	2.543	438.3	01Jan2000, 04:38	1.80
WC13	0.802	166.2	01Jan2000, 03:52	1.90
WCR1	20.902	1959.5	01Jan2000, 11:33	1.66
WCR10	6.710	1101.9	01Jan2000, 06:42	1.84
WCR11	4.818	840.6	01Jan2000, 07:08	1.81
WCR12	2.543	438.3	01Jan2000, 06:19	1.80
WCR13	0.802	166.2	01Jan2000, 05:02	1.90
WCR2	19.885	1950.9	01Jan2000, 10:50	1.66

Global Summary Results for Run "CBBEL 10 yr 6 hr 10%"

Project: CBBEL Crooked & Williams Simulation Run: CBBEL 10 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-100det-5-10YR
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10 year / 6 hr 10%
Compute Time: 11May2010, 15:51:11 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC07	11.054	1435.5	01Jan2000, 07:58	1.77
WC08D	10.684	1429.4	01Jan2000, 07:15	1.78
WC06U	9.019	1300.2	01Jan2000, 07:17	1.82
WC09	8.252	1267.2	01Jan2000, 06:24	1.87
WC10	6.710	1101.9	01Jan2000, 06:36	1.84
WC11	4.818	840.6	01Jan2000, 05:51	1.81
WC12	2.543	438.3	01Jan2000, 04:38	1.80
WC13	0.802	166.2	01Jan2000, 03:52	1.90
WCR1	20.902	1959.5	01Jan2000, 11:33	1.66
WCR10	6.710	1101.9	01Jan2000, 06:42	1.84
WCR11	4.818	840.6	01Jan2000, 07:08	1.81
WCR12	2.543	438.3	01Jan2000, 06:19	1.80
WCR13	0.802	166.2	01Jan2000, 05:02	1.90
WCR2	19.885	1950.9	01Jan2000, 10:50	1.66
WCR3	18.622	1946.1	01Jan2000, 09:52	1.68
WCR4	17.512	1935.6	01Jan2000, 08:23	1.67
WCR5	16.497	1867.6	01Jan2000, 08:17	1.66
WCR6	13.351	1579.4	01Jan2000, 08:42	1.71
WCR7	11.054	1435.5	01Jan2000, 08:48	1.77
WCR8	10.684	1429.4	01Jan2000, 07:58	1.78
WCR9	8.252	1267.2	01Jan2000, 07:27	1.87
Williams Creek	21.252	1959.6	01Jan2000, 11:33	1.66

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 10 yr 12 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:50:22

Basin Model: CW 2008CN-10&del-5 10YR
Meteorologic Model: 10 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Existing 10% -12 hr.

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	2284.8	01Jan2000, 11:10	1.92
1617	0.350	71.1	01Jan2000, 04:11	1.58
1618	0.916	164.7	01Jan2000, 05:23	1.76
1619	0.668	149.5	01Jan2000, 04:29	1.85
1620	0.622	108.6	01Jan2000, 05:09	1.62
1621	0.643	101.5	01Jan2000, 05:01	1.41
1622	0.117	26.2	01Jan2000, 03:36	1.58
1623	0.540	72.0	01Jan2000, 05:30	1.26
1624	0.529	141.8	01Jan2000, 04:05	2.04
1625	0.716	96.1	01Jan2000, 05:27	1.26
1626	0.252	53.6	01Jan2000, 03:54	1.58
1627	0.484	105.3	01Jan2000, 04:18	1.76
1628	0.456	132.8	01Jan2000, 04:41	2.55
1629	1.195	281.8	01Jan2000, 04:43	2.09
1630	0.887	141.7	01Jan2000, 06:05	1.76
1631	1.326	251.5	01Jan2000, 04:49	1.65
1632	0.450	92.6	01Jan2000, 04:43	1.79
1633	0.458	87.3	01Jan2000, 04:55	1.69
1634	0.334	90.1	01Jan2000, 03:25	1.85
1635	0.796	366.6	01Jan2000, 03:03	2.99
1636	0.652	141.2	01Jan2000, 04:19	1.76
1637	0.726	113.2	01Jan2000, 05:14	1.44
1638	0.803	109.4	01Jan2000, 05:02	1.19
1639	0.891	227.2	01Jan2000, 04:41	2.15
1640	1.009	199.0	01Jan2000, 06:05	2.10
1641	1.413	351.1	01Jan2000, 04:50	2.15
1642	0.363	64.7	01Jan2000, 04:06	1.30
1643	0.985	305.5	01Jan2000, 04:17	2.48
1644	1.055	253.2	01Jan2000, 04:19	1.95
1645	0.673	238.9	01Jan2000, 04:09	2.81
1646	0.484	123.0	01Jan2000, 04:18	2.09

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	182.6	01Jan2000, 03:38	1.65
1648	1.017	235.1	01Jan2000, 04:37	1.99
1649	0.528	135.9	01Jan2000, 04:14	2.05
1650	0.582	167.2	01Jan2000, 03:41	2.12
1651	0.663	209.6	01Jan2000, 04:05	2.45
1652	0.352	96.4	01Jan2000, 03:53	2.09
1653	0.779	169.1	01Jan2000, 04:19	1.64
1654	0.644	169.6	01Jan2000, 04:06	1.95
1655	0.931	124.6	01Jan2000, 05:39	1.16
1656	1.366	340.6	01Jan2000, 05:00	2.24
1657	0.227	63.5	01Jan2000, 03:35	1.79
1658	0.767	167.6	01Jan2000, 04:36	1.68
1659	1.528	444.8	01Jan2000, 04:26	2.41
1660	0.014	3.3	01Jan2000, 03:13	1.22
1661	1.220	268.2	01Jan2000, 06:05	2.45
1662	0.672	135.8	01Jan2000, 05:56	2.10
1663	1.498	339.4	01Jan2000, 05:13	2.10
1664	0.777	251.3	01Jan2000, 03:51	2.41
1665	1.741	408.7	01Jan2000, 05:09	2.15
1666	1.025	193.5	01Jan2000, 06:12	2.05
1667	0.698	119.2	01Jan2000, 05:02	1.40
1668	1.052	236.6	01Jan2000, 05:29	2.23
1669	0.386	52.4	01Jan2000, 04:56	0.99
1670	0.370	98.0	01Jan2000, 04:04	1.95
1671	0.802	222.1	01Jan2000, 04:41	2.32
CC01	19.043	2304.4	01Jan2000, 11:39	1.91
CC03	17.269	2280.1	01Jan2000, 10:35	1.92
CC04	16.200	2257.9	01Jan2000, 09:58	1.94
CC05	15.232	2228.8	01Jan2000, 09:37	1.98
CC06	14.589	2204.2	01Jan2000, 09:06	2.01
CC07	14.472	2202.8	01Jan2000, 08:55	2.01
CC08	12.821	2066.5	01Jan2000, 08:02	1.98
CC09D	11.934	1956.4	01Jan2000, 07:42	2.00
CC09U	8.771	1458.7	01Jan2000, 08:44	1.90
CC10	7.445	1378.8	01Jan2000, 07:17	1.94
CC11D	7.082	1357.4	01Jan2000, 06:23	1.97
CC11U	4.724	885.6	01Jan2000, 06:31	1.94
CC12D	4.390	854.9	01Jan2000, 05:48	1.95

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	536.7	01Jan2000, 06:04	2.45
CC13	1.413	351.1	01Jan2000, 04:50	2.15
CCR1	19.043	2304.4	01Jan2000, 12:48	1.91
CCR10	7.445	1378.8	01Jan2000, 08:58	1.94
CCR11	7.082	1357.4	01Jan2000, 07:21	1.97
CCR12	4.390	854.9	01Jan2000, 06:31	1.95
CCR13	1.413	351.1	01Jan2000, 06:24	2.15
CCR2	17.753	2284.8	01Jan2000, 11:47	1.92
CCR3	17.269	2280.1	01Jan2000, 11:13	1.92
CCR4	16.200	2257.9	01Jan2000, 10:42	1.94
CCR5	15.232	2228.8	01Jan2000, 10:07	1.98
CCR6	14.589	2204.2	01Jan2000, 09:44	2.01
CCR7	14.472	2202.8	01Jan2000, 09:08	2.01
CCR8	12.821	2066.5	01Jan2000, 09:14	1.98
CCR9	11.934	1956.4	01Jan2000, 08:23	2.00
Clay Creek	1.665	220.7	01Jan2000, 04:50	1.88
CLC01	1.438	180.9	01Jan2000, 05:27	1.90
CLCR1	1.438	180.9	01Jan2000, 06:02	1.90
Crooked Creek	19.959	2320.3	01Jan2000, 12:44	1.90
D1619	0.668	41.8	01Jan2000, 04:29	0.52
D1623	0.540	49.7	01Jan2000, 05:30	0.87
D1628	0.456	47.8	01Jan2000, 04:41	0.92
D1630	0.887	21.3	01Jan2000, 06:05	0.26
D1633	0.458	11.3	01Jan2000, 04:55	0.22
D1634	0.334	36.0	01Jan2000, 03:25	0.74
D1635	0.796	234.6	01Jan2000, 03:03	1.91
D1636	0.652	72.0	01Jan2000, 04:19	0.90
D1637	0.726	96.3	01Jan2000, 05:14	1.23
D1638	0.803	70.0	01Jan2000, 05:02	0.76
D1640	1.009	23.9	01Jan2000, 06:05	0.25
D1643	0.985	33.6	01Jan2000, 04:17	0.27
D1644	1.055	35.4	01Jan2000, 04:19	0.27
D1646	0.484	17.2	01Jan2000, 04:18	0.29
D1649	0.528	61.2	01Jan2000, 04:14	0.92
D1651	0.663	144.6	01Jan2000, 04:05	1.69
D1653	0.779	82.9	01Jan2000, 04:19	0.80
D1654	0.644	64.4	01Jan2000, 04:06	0.74
D1655	0.931	63.5	01Jan2000, 05:39	0.59

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1656	1.366	74.9	01Jan2000, 05:00	0.49
D1658	0.767	33.5	01Jan2000, 04:36	0.34
D1659	1.528	302.5	01Jan2000, 04:26	1.64
D1661	1.220	91.2	01Jan2000, 06:05	0.83
D1662	0.672	55.7	01Jan2000, 05:56	0.86
D1663	1.498	149.3	01Jan2000, 05:13	0.92
D1664	0.777	228.7	01Jan2000, 03:51	2.20
D1665	1.741	224.8	01Jan2000, 05:09	1.18
D1666	1.025	98.7	01Jan2000, 06:12	1.04
D1667	0.698	89.4	01Jan2000, 05:02	1.05
d1668	1.052	172.7	01Jan2000, 05:29	1.63
D1669	0.386	45.0	01Jan2000, 04:56	0.85
D1671	0.802	99.9	01Jan2000, 04:41	1.04
DC01	1.529	207.6	01Jan2000, 05:11	1.31
DCR1	1.529	207.6	01Jan2000, 06:35	1.31
Delaware Creek	2.181	321.4	01Jan2000, 05:48	1.44
HJC01	2.713	760.3	01Jan2000, 05:07	2.36
HJC02	1.658	530.4	01Jan2000, 04:28	2.61
HJC03	0.673	238.9	01Jan2000, 04:09	2.81
HJCR1	2.713	760.3	01Jan2000, 05:46	2.36
HJCR2	1.658	530.4	01Jan2000, 05:21	2.61
HJCR3	0.673	238.9	01Jan2000, 04:40	2.81
Howard Johnson	3.165	844.7	01Jan2000, 05:41	2.28
J1619	0.668	144.6	01Jan2000, 04:29	1.85
J1623	0.540	72.0	01Jan2000, 05:30	1.26
J1628	0.456	115.1	01Jan2000, 04:41	2.55
J1630	0.887	140.4	01Jan2000, 06:05	1.76
J1633	0.458	87.3	01Jan2000, 04:55	1.69
J1634	0.334	90.1	01Jan2000, 03:25	1.85
J1635	0.796	275.2	01Jan2000, 03:03	2.99
J1636	0.652	137.2	01Jan2000, 04:19	1.76
J1637	0.726	113.2	01Jan2000, 05:14	1.44
J1638	0.803	94.5	01Jan2000, 05:02	1.19
J1640	1.009	193.7	01Jan2000, 06:05	2.10
J1643	0.985	294.0	01Jan2000, 04:17	2.48
J1644	1.055	247.7	01Jan2000, 04:19	1.95
J1646	0.484	118.8	01Jan2000, 04:18	2.09
J1649	0.528	123.8	01Jan2000, 04:14	2.05

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1651	0.663	160.2	01Jan2000, 04:05	2.45
J1653	0.779	169.1	01Jan2000, 04:20	1.64
J1654	0.644	120.7	01Jan2000, 04:06	1.95
J1655	0.931	124.6	01Jan2000, 05:39	1.16
J1656	1.366	317.8	01Jan2000, 05:00	2.24
J1658	0.767	165.1	01Jan2000, 04:36	1.68
J1659	1.528	257.3	01Jan2000, 04:27	2.41
J1661	1.220	210.8	01Jan2000, 06:06	2.45
J1662	0.672	121.3	01Jan2000, 05:56	2.10
J1663	1.498	301.2	01Jan2000, 05:14	2.10
J1664	0.777	181.7	01Jan2000, 03:52	2.41
J1665	1.741	278.8	01Jan2000, 05:10	2.15
J1666	1.025	169.0	01Jan2000, 06:13	2.05
J1667	0.698	119.2	01Jan2000, 05:02	1.40
J1668	1.052	134.8	01Jan2000, 05:32	2.23
J1669	0.386	46.4	01Jan2000, 04:57	0.99
J1671	0.802	160.7	01Jan2000, 04:42	2.32
Payne Branch	2.358	479.8	01Jan2000, 06:01	2.04
PB01	1.900	403.2	01Jan2000, 05:17	2.12
PBR1	1.900	403.2	01Jan2000, 06:14	2.12
R1619	0.668	37.0	01Jan2000, 05:35	0.52
R1623	0.540	49.7	01Jan2000, 05:30	0.87
R1628	0.456	30.3	01Jan2000, 07:05	0.92
R1630	0.887	20.0	01Jan2000, 07:02	0.26
R1633	0.458	11.3	01Jan2000, 04:56	0.22
R1634	0.334	36.0	01Jan2000, 03:25	0.74
R1635	0.796	143.5	01Jan2000, 05:00	1.91
R1636	0.652	68.0	01Jan2000, 05:03	0.90
R1637	0.726	96.3	01Jan2000, 05:14	1.23
R1638	0.803	55.2	01Jan2000, 06:37	0.76
R1640	1.009	18.6	01Jan2000, 08:04	0.25
R1643	0.985	22.2	01Jan2000, 06:23	0.27
R1644	1.055	30.1	01Jan2000, 05:35	0.27
R1646	0.484	13.1	01Jan2000, 06:01	0.29
R1649	0.528	49.1	01Jan2000, 05:41	0.92
R1651	0.663	95.5	01Jan2000, 06:07	1.69
R1653	0.779	82.9	01Jan2000, 04:20	0.80
R1654	0.644	16.4	01Jan2000, 07:59	0.74

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1655	0.931	63.5	01Jan2000, 05:39	0.59
R1656	1.366	52.3	01Jan2000, 07:08	0.49
R1658	0.767	31.0	01Jan2000, 05:24	0.34
R1659	1.528	116.3	01Jan2000, 07:58	1.64
R1661	1.220	34.8	01Jan2000, 10:45	0.83
R1662	0.672	41.2	01Jan2000, 08:05	0.86
R1663	1.498	111.3	01Jan2000, 07:10	0.92
R1664	0.777	159.2	01Jan2000, 05:42	2.20
R1665	1.741	96.1	01Jan2000, 08:44	1.18
R1666	1.025	74.3	01Jan2000, 08:21	1.04
R1667	0.698	89.4	01Jan2000, 05:02	1.05
R1668	1.052	72.1	01Jan2000, 09:24	1.63
R1669	0.386	39.1	01Jan2000, 06:00	0.85
R1671	0.802	39.4	01Jan2000, 08:13	1.04
SMR01	1.723	281.1	01Jan2000, 05:28	1.79
SMRR1	1.723	281.1	01Jan2000, 08:36	1.79
Spring Mill Run	2.502	323.1	01Jan2000, 07:55	1.74
WC01	20.902	2291.8	01Jan2000, 12:15	2.04
WC02	19.885	2281.2	01Jan2000, 11:17	2.04
WC03	18.622	2273.7	01Jan2000, 09:48	2.06
WC04	17.512	2244.5	01Jan2000, 08:55	2.05
WC05D	16.497	2137.5	01Jan2000, 09:06	2.04
WC05U	13.995	1835.5	01Jan2000, 09:06	2.09
WC06	13.351	1806.4	01Jan2000, 08:24	2.10
WC07	11.054	1599.5	01Jan2000, 08:24	2.16
WC08D	10.684	1580.9	01Jan2000, 07:41	2.17
WC08U	9.019	1405.7	01Jan2000, 07:57	2.22
WC09	8.252	1345.8	01Jan2000, 07:16	2.27
WC10	6.710	1159.8	01Jan2000, 07:27	2.24
WC11	4.818	867.3	01Jan2000, 06:37	2.21
WC12	2.543	435.5	01Jan2000, 05:31	2.20
WC13	0.802	160.7	01Jan2000, 04:42	2.32
WCR1	20.902	2291.8	01Jan2000, 12:58	2.04
WCR10	6.710	1159.8	01Jan2000, 07:33	2.24
WCR11	4.818	867.3	01Jan2000, 07:54	2.21
WCR12	2.543	435.5	01Jan2000, 07:12	2.20
WCR13	0.802	160.7	01Jan2000, 05:52	2.32
WCR2	19.885	2281.2	01Jan2000, 12:15	2.04

Global Summary Results for Run "CBBEL 10 yr 12 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: CBBEL 10 yr 12 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-10&det-5 10YR
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10 year / 12 hr 10%
Compute Time: 11May2010, 15:50:22 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC07	11.054	1599.5	01Jan2000, 08:24	2.16
WC08D	10.684	1580.9	01Jan2000, 07:41	2.17
WC08U	9.019	1405.7	01Jan2000, 07:57	2.22
WC09	8.252	1345.8	01Jan2000, 07:16	2.27
WC10	6.710	1159.8	01Jan2000, 07:27	2.24
WC11	4.818	867.3	01Jan2000, 05:37	2.21
WC12	2.543	435.5	01Jan2000, 05:31	2.20
WC13	0.802	160.7	01Jan2000, 04:42	2.32
WCR1	20.902	2291.8	01Jan2000, 12:58	2.04
WCR10	6.710	1159.8	01Jan2000, 07:33	2.24
WCR11	4.818	867.3	01Jan2000, 07:54	2.21
WCR12	2.543	435.5	01Jan2000, 07:12	2.20
WCR13	0.802	160.7	01Jan2000, 05:52	2.32
WCR2	19.885	2281.2	01Jan2000, 12:15	2.04
WCR3	18.622	2273.7	01Jan2000, 11:17	2.06
WCR4	17.512	2244.5	01Jan2000, 09:51	2.05
WCR5	16.497	2137.5	01Jan2000, 09:33	2.04
WCR6	13.351	1806.4	01Jan2000, 09:08	2.10
WCR7	11.054	1599.5	01Jan2000, 09:14	2.16
WCR8	10.684	1580.9	01Jan2000, 08:24	2.17
WCR9	8.252	1345.8	01Jan2000, 08:19	2.27
Williams Creek	21.252	2292.1	01Jan2000, 12:58	2.03

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 10 yr 24 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:50:47

Basin Model: CW 2008CN-10&det-5 10YR
Meteorologic Model: 10 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Existing 10% - 24 hr.

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	2289.9	01Jan2000, 12:55	2.32
1617	0.350	51.0	01Jan2000, 05:21	1.94
1618	0.916	130.1	01Jan2000, 06:54	2.13
1619	0.668	110.7	01Jan2000, 05:45	2.24
1620	0.622	84.4	01Jan2000, 06:42	1.98
1621	0.643	77.9	01Jan2000, 06:37	1.74
1622	0.117	18.2	01Jan2000, 04:45	1.94
1623	0.540	57.4	01Jan2000, 07:18	1.59
1624	0.529	102.7	01Jan2000, 05:10	2.46
1625	0.716	76.5	01Jan2000, 07:15	1.59
1626	0.252	37.9	01Jan2000, 05:01	1.94
1627	0.484	76.7	01Jan2000, 05:29	2.13
1628	0.456	101.3	01Jan2000, 05:50	3.02
1629	1.195	213.4	01Jan2000, 05:59	2.49
1630	0.887	117.2	01Jan2000, 07:47	2.13
1631	1.326	190.7	01Jan2000, 06:19	2.02
1632	0.450	69.8	01Jan2000, 06:08	2.17
1633	0.458	66.8	01Jan2000, 06:25	2.06
1634	0.334	62.4	01Jan2000, 04:36	2.24
1635	0.796	250.3	01Jan2000, 04:10	3.49
1636	0.652	103.0	01Jan2000, 05:31	2.13
1637	0.726	88.5	01Jan2000, 06:53	1.78
1638	0.803	83.7	01Jan2000, 06:45	1.50
1639	0.891	172.6	01Jan2000, 06:02	2.59
1640	1.009	166.1	01Jan2000, 07:43	2.54
1641	1.413	269.6	01Jan2000, 06:12	2.59
1642	0.363	45.7	01Jan2000, 05:15	1.63
1643	0.985	227.0	01Jan2000, 05:21	2.95
1644	1.055	185.6	01Jan2000, 05:27	2.35
1645	0.673	177.3	01Jan2000, 05:06	3.30
1646	0.484	90.5	01Jan2000, 05:24	2.49

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	127.4	01Jan2000, 04:46	2.02
1648	1.017	176.4	01Jan2000, 05:53	2.39
1649	0.528	99.4	01Jan2000, 05:20	2.46
1650	0.582	118.4	01Jan2000, 04:46	2.53
1651	0.663	153.4	01Jan2000, 05:06	2.91
1652	0.352	69.1	01Jan2000, 04:56	2.49
1653	0.779	123.5	01Jan2000, 05:35	2.03
1654	0.644	123.0	01Jan2000, 05:12	2.37
1655	0.931	103.7	01Jan2000, 07:43	1.52
1656	1.366	265.0	01Jan2000, 06:22	2.69
1657	0.227	44.9	01Jan2000, 04:41	2.21
1658	0.767	126.1	01Jan2000, 06:04	2.10
1659	1.528	332.7	01Jan2000, 05:32	2.87
1660	0.014	2.3	01Jan2000, 04:15	1.59
1661	1.220	222.6	01Jan2000, 07:32	2.90
1662	0.672	112.3	01Jan2000, 07:32	2.54
1663	1.498	267.7	01Jan2000, 06:40	2.54
1664	0.777	181.4	01Jan2000, 04:53	2.87
1665	1.741	320.9	01Jan2000, 06:34	2.59
1666	1.025	162.7	01Jan2000, 07:53	2.48
1667	0.698	92.8	01Jan2000, 06:41	1.77
1668	1.052	189.5	01Jan2000, 06:54	2.67
1669	0.386	41.2	01Jan2000, 06:58	1.32
1670	0.370	71.0	01Jan2000, 05:10	2.37
1671	0.802	169.5	01Jan2000, 05:59	2.79
CC01	19.043	2349.7	01Jan2000, 13:22	2.30
CC03	17.269	2268.8	01Jan2000, 12:20	2.32
CC04	16.200	2209.0	01Jan2000, 11:45	2.34
CC05	15.232	2150.2	01Jan2000, 11:24	2.38
CC06	14.589	2105.8	01Jan2000, 10:53	2.41
CC07	14.472	2099.1	01Jan2000, 10:41	2.42
CC08	12.821	1916.3	01Jan2000, 09:51	2.39
CC09D	11.934	1811.0	01Jan2000, 09:16	2.41
CC09U	8.771	1313.9	01Jan2000, 10:03	2.30
CC10	7.445	1185.4	01Jan2000, 08:34	2.35
CC11D	7.082	1151.3	01Jan2000, 07:36	2.38
CC11U	4.724	759.6	01Jan2000, 07:36	2.34
CC12D	4.390	717.5	01Jan2000, 06:53	2.35

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	462.3	01Jan2000, 06:53	2.91
CC13	1.413	269.6	01Jan2000, 06:12	2.59
CCR1	19.043	2349.7	01Jan2000, 14:31	2.30
CCR10	7.445	1185.4	01Jan2000, 10:15	2.35
CCR11	7.082	1151.3	01Jan2000, 08:34	2.38
CCR12	4.390	717.5	01Jan2000, 07:36	2.35
CCR13	1.413	269.6	01Jan2000, 07:46	2.59
CCR2	17.753	2289.9	01Jan2000, 13:32	2.32
CCR3	17.269	2268.8	01Jan2000, 12:58	2.32
CCR4	16.200	2209.0	01Jan2000, 12:29	2.34
CCR5	15.232	2150.2	01Jan2000, 11:54	2.38
CCR6	14.589	2105.8	01Jan2000, 11:31	2.41
CCR7	14.472	2099.1	01Jan2000, 10:54	2.42
CCR8	12.821	1916.3	01Jan2000, 11:03	2.39
CCR9	11.934	1811.0	01Jan2000, 09:57	2.41
Clay Creek	1.665	197.7	01Jan2000, 06:46	2.29
CLC01	1.438	163.2	01Jan2000, 06:59	2.31
CLCR1	1.438	163.2	01Jan2000, 07:34	2.31
Crooked Creek	19.959	2390.6	01Jan2000, 14:25	2.29
D1619	0.668	31.0	01Jan2000, 05:45	0.63
D1623	0.540	39.6	01Jan2000, 07:18	1.09
D1628	0.456	36.5	01Jan2000, 05:50	1.09
D1630	0.887	17.6	01Jan2000, 07:47	0.32
D1633	0.458	8.7	01Jan2000, 06:25	0.27
D1634	0.334	25.0	01Jan2000, 04:36	0.90
D1635	0.796	160.2	01Jan2000, 04:10	2.23
D1636	0.652	52.5	01Jan2000, 05:31	1.08
D1637	0.726	75.2	01Jan2000, 06:53	1.52
D1638	0.803	53.6	01Jan2000, 06:45	0.96
D1640	1.009	19.9	01Jan2000, 07:43	0.30
D1643	0.985	25.0	01Jan2000, 05:21	0.32
D1644	1.055	26.0	01Jan2000, 05:27	0.33
D1646	0.484	12.7	01Jan2000, 05:24	0.35
D1649	0.528	44.7	01Jan2000, 05:20	1.11
D1651	0.663	105.9	01Jan2000, 05:06	2.01
D1653	0.779	60.5	01Jan2000, 05:35	0.99
D1654	0.644	46.8	01Jan2000, 05:12	0.90
D1655	0.931	52.9	01Jan2000, 07:43	0.77

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1656	1.366	58.3	01Jan2000, 06:22	0.59
D1658	0.767	25.2	01Jan2000, 06:04	0.42
D1659	1.528	226.2	01Jan2000, 05:32	1.95
D1661	1.220	75.7	01Jan2000, 07:32	0.99
D1662	0.672	46.1	01Jan2000, 07:32	1.04
D1663	1.498	117.8	01Jan2000, 06:40	1.12
D1664	0.777	165.1	01Jan2000, 04:53	2.61
D1665	1.741	176.5	01Jan2000, 06:34	1.42
D1666	1.025	83.0	01Jan2000, 07:53	1.27
D1667	0.698	69.6	01Jan2000, 06:41	1.33
d1668	1.052	138.3	01Jan2000, 06:54	1.95
D1669	0.386	35.4	01Jan2000, 06:58	1.13
D1671	0.802	76.3	01Jan2000, 05:59	1.25
DC01	1.529	172.2	01Jan2000, 06:49	1.63
DCR1	1.529	172.2	01Jan2000, 08:13	1.63
Delaware Creek	2.181	259.3	01Jan2000, 07:32	1.78
HJC01	2.713	581.8	01Jan2000, 06:09	2.80
HJC02	1.658	400.9	01Jan2000, 05:29	3.09
HJC03	0.673	177.3	01Jan2000, 05:06	3.30
HJCR1	2.713	581.8	01Jan2000, 06:48	2.80
HJCR2	1.658	400.9	01Jan2000, 06:22	3.09
HJCR3	0.673	177.3	01Jan2000, 05:37	3.30
Howard Johnson	3.168	650.3	01Jan2000, 06:45	2.71
J1619	0.668	110.7	01Jan2000, 05:45	2.24
J1623	0.540	57.4	01Jan2000, 07:18	1.59
J1628	0.456	94.9	01Jan2000, 05:50	3.02
J1630	0.887	117.2	01Jan2000, 07:47	2.13
J1633	0.458	66.8	01Jan2000, 06:25	2.06
J1634	0.334	62.4	01Jan2000, 04:36	2.24
J1635	0.796	233.2	01Jan2000, 04:10	3.49
J1636	0.652	103.0	01Jan2000, 05:31	2.13
J1637	0.726	88.5	01Jan2000, 06:53	1.78
J1638	0.803	83.7	01Jan2000, 06:45	1.50
J1640	1.009	164.7	01Jan2000, 07:43	2.54
J1643	0.985	224.0	01Jan2000, 05:21	2.95
J1644	1.055	185.6	01Jan2000, 05:27	2.35
J1646	0.484	90.5	01Jan2000, 05:24	2.49
J1649	0.528	99.4	01Jan2000, 05:20	2.46

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1651	0.663	142.6	01Jan2000, 05:06	2.91
J1653	0.779	123.5	01Jan2000, 05:35	2.03
J1654	0.644	91.8	01Jan2000, 05:14	2.37
J1655	0.931	103.7	01Jan2000, 07:44	1.52
J1656	1.366	258.7	01Jan2000, 06:22	2.69
J1658	0.767	126.1	01Jan2000, 06:04	2.10
J1659	1.528	221.2	01Jan2000, 05:34	2.87
J1661	1.220	180.7	01Jan2000, 07:34	2.90
J1662	0.672	107.3	01Jan2000, 07:32	2.54
J1663	1.498	260.9	01Jan2000, 06:40	2.54
J1664	0.777	175.3	01Jan2000, 04:53	2.87
J1665	1.741	239.1	01Jan2000, 06:36	2.59
J1666	1.025	153.8	01Jan2000, 07:54	2.48
J1667	0.698	92.8	01Jan2000, 06:41	1.77
J1668	1.052	122.0	01Jan2000, 07:00	2.67
J1669	0.386	41.2	01Jan2000, 06:58	1.32
J1671	0.802	131.7	01Jan2000, 06:01	2.79
Payne Branch	2.358	391.7	01Jan2000, 07:32	2.47
PB01	1.900	328.2	01Jan2000, 06:46	2.56
PBR1	1.900	328.2	01Jan2000, 07:43	2.56
R1619	0.668	31.0	01Jan2000, 05:45	0.63
R1623	0.540	39.6	01Jan2000, 07:19	1.09
R1628	0.456	30.1	01Jan2000, 08:17	1.09
R1630	0.887	17.6	01Jan2000, 07:47	0.32
R1633	0.458	8.7	01Jan2000, 06:25	0.27
R1634	0.334	25.0	01Jan2000, 04:35	0.90
R1635	0.796	143.1	01Jan2000, 05:09	2.23
R1636	0.652	52.5	01Jan2000, 05:31	1.08
R1637	0.726	75.2	01Jan2000, 06:53	1.52
R1638	0.803	53.6	01Jan2000, 06:45	0.96
R1640	1.009	18.5	01Jan2000, 09:22	0.30
R1643	0.985	22.0	01Jan2000, 07:09	0.32
R1644	1.055	26.0	01Jan2000, 05:27	0.33
R1646	0.484	12.7	01Jan2000, 05:24	0.35
R1649	0.528	44.7	01Jan2000, 05:20	1.11
R1651	0.663	95.1	01Jan2000, 06:39	2.01
R1653	0.779	60.5	01Jan2000, 05:35	0.99
R1654	0.644	16.3	01Jan2000, 11:35	0.90

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1655	0.931	52.9	01Jan2000, 07:44	0.77
R1656	1.366	52.1	01Jan2000, 08:13	0.59
R1658	0.767	25.2	01Jan2000, 06:04	0.42
R1659	1.528	115.9	01Jan2000, 10:37	1.95
R1661	1.220	34.8	01Jan2000, 13:57	0.99
R1662	0.672	41.1	01Jan2000, 09:37	1.04
R1663	1.498	111.0	01Jan2000, 07:59	1.12
R1664	0.777	159.0	01Jan2000, 05:36	2.61
R1665	1.741	95.8	01Jan2000, 11:36	1.42
R1666	1.025	74.1	01Jan2000, 09:59	1.27
R1667	0.698	69.6	01Jan2000, 06:41	1.33
R1668	1.052	72.0	01Jan2000, 12:23	1.95
R1669	0.386	35.4	01Jan2000, 06:58	1.13
R1671	0.802	39.2	01Jan2000, 11:01	1.25
SMR01	1.723	244.5	01Jan2000, 07:17	2.20
SMRR1	1.723	244.5	01Jan2000, 10:25	2.20
Spring Mill Run	2.502	319.8	01Jan2000, 09:20	2.14
WC01	20.902	2457.6	01Jan2000, 13:44	2.46
WC02	19.885	2413.0	01Jan2000, 12:46	2.47
WC03	18.622	2362.2	01Jan2000, 11:27	2.48
WC04	17.512	2290.0	01Jan2000, 10:45	2.48
WC05D	16.497	2198.4	01Jan2000, 10:35	2.47
WC05U	13.995	1891.4	01Jan2000, 10:39	2.52
WC06	13.351	1841.0	01Jan2000, 09:55	2.53
WC07	11.054	1563.3	01Jan2000, 09:36	2.60
WC08D	10.684	1523.3	01Jan2000, 08:53	2.61
WC08U	9.019	1341.1	01Jan2000, 08:53	2.66
WC09	8.252	1243.4	01Jan2000, 07:50	2.72
WC10	6.710	1037.7	01Jan2000, 08:23	2.69
WC11	4.818	754.8	01Jan2000, 07:18	2.65
WC12	2.543	370.0	01Jan2000, 06:50	2.65
WC13	0.802	131.7	01Jan2000, 06:01	2.79
WCR1	20.902	2457.6	01Jan2000, 14:27	2.46
WCR10	6.710	1037.7	01Jan2000, 08:29	2.69
WCR11	4.818	754.8	01Jan2000, 08:35	2.65
WCR12	2.543	370.0	01Jan2000, 08:31	2.65
WCR13	0.802	131.7	01Jan2000, 07:11	2.79
WCR2	19.885	2413.0	01Jan2000, 13:44	2.47

Global Summary Results for Run "CBBEL 10 yr 24 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: CBBEL 10 yr 24 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-10%det-5 10YR
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10 year / 24 hr 10%
Compute Time: 11May2010, 15:50:47 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC06	13.351	1841.0	01Jan2000, 09:55	2.53
WC07	11.054	1563.3	01Jan2000, 09:36	2.60
WC08D	10.684	1523.3	01Jan2000, 08:53	2.61
WC08U	9.019	1341.1	01Jan2000, 08:53	2.66
WC09	8.252	1243.4	01Jan2000, 07:50	2.72
WC10	6.710	1037.7	01Jan2000, 08:23	2.69
WC11	4.818	754.8	01Jan2000, 07:18	2.65
WC12	2.543	370.0	01Jan2000, 06:50	2.65
WC13	0.802	131.7	01Jan2000, 06:01	2.79
WCR1	20.902	2457.6	01Jan2000, 14:27	2.46
WCR10	6.710	1037.7	01Jan2000, 08:29	2.69
WCR11	4.818	754.8	01Jan2000, 08:35	2.65
WCR12	2.543	370.0	01Jan2000, 08:31	2.65
WCR13	0.802	131.7	01Jan2000, 07:11	2.79
WCR2	19.885	2413.0	01Jan2000, 13:44	2.47
WCR3	18.622	2362.2	01Jan2000, 12:55	2.48
WCR4	17.512	2290.0	01Jan2000, 11:41	2.48
WCR5	16.497	2198.4	01Jan2000, 11:02	2.47
WCR6	13.351	1841.0	01Jan2000, 10:39	2.53
WCR7	11.054	1563.3	01Jan2000, 10:26	2.60
WCR8	10.684	1523.3	01Jan2000, 09:36	2.61
WCR9	8.252	1243.4	01Jan2000, 08:53	2.72
Williams Creek	21.252	2465.0	01Jan2000, 14:27	2.45

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 2 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:52:27

Basin Model: CW 2008CN-10&det-5 10YR
Meteorologic Model: 2 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Existing 10% - 6hr

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1265.3	01Jan2000, 09:55	0.91
1617	0.350	43.9	01Jan2000, 03:11	0.73
1618	0.916	96.0	01Jan2000, 04:20	0.84
1619	0.668	91.8	01Jan2000, 03:34	0.88
1620	0.622	61.8	01Jan2000, 04:05	0.74
1621	0.643	56.1	01Jan2000, 03:53	0.62
1622	0.117	17.0	01Jan2000, 02:44	0.73
1623	0.540	36.0	01Jan2000, 04:18	0.52
1624	0.529	89.9	01Jan2000, 03:15	0.97
1625	0.716	48.3	01Jan2000, 04:15	0.52
1626	0.252	33.9	01Jan2000, 02:58	0.73
1627	0.484	66.4	01Jan2000, 03:21	0.84
1628	0.456	85.9	01Jan2000, 03:53	1.31
1629	1.195	180.1	01Jan2000, 03:49	1.05
1630	0.887	79.5	01Jan2000, 05:01	0.84
1631	1.326	146.0	01Jan2000, 03:48	0.75
1632	0.450	56.2	01Jan2000, 03:45	0.85
1633	0.458	50.2	01Jan2000, 03:55	0.77
1634	0.334	60.7	01Jan2000, 02:41	0.88
1635	0.796	278.9	01Jan2000, 02:33	1.60
1636	0.652	88.8	01Jan2000, 03:22	0.84
1637	0.726	61.3	01Jan2000, 04:07	0.63
1638	0.803	57.3	01Jan2000, 03:47	0.49
1639	0.891	134.7	01Jan2000, 03:51	1.00
1640	1.009	105.7	01Jan2000, 05:10	0.95
1641	1.413	208.0	01Jan2000, 03:59	1.00
1642	0.363	35.8	01Jan2000, 03:04	0.53
1643	0.985	197.6	01Jan2000, 03:31	1.23
1644	1.055	162.8	01Jan2000, 03:25	0.96
1645	0.673	163.1	01Jan2000, 03:26	1.48
1646	0.484	81.1	01Jan2000, 03:26	1.05

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	117.1	01Jan2000, 02:47	0.75
1648	1.017	147.3	01Jan2000, 03:42	0.97
1649	0.528	87.4	01Jan2000, 03:22	1.00
1650	0.582	115.7	01Jan2000, 02:56	1.06
1651	0.663	139.7	01Jan2000, 03:19	1.24
1652	0.352	66.0	01Jan2000, 03:04	1.05
1653	0.779	93.4	01Jan2000, 03:26	0.68
1654	0.644	101.8	01Jan2000, 03:17	0.87
1655	0.931	44.5	01Jan2000, 04:44	0.33
1656	1.366	200.4	01Jan2000, 04:09	1.06
1657	0.227	37.4	01Jan2000, 02:52	0.72
1658	0.767	85.8	01Jan2000, 03:45	0.66
1659	1.528	287.5	01Jan2000, 03:38	1.21
1660	0.014	1.7	01Jan2000, 02:26	0.36
1661	1.220	160.0	01Jan2000, 05:11	1.26
1662	0.672	72.7	01Jan2000, 05:01	0.95
1663	1.498	193.1	01Jan2000, 04:19	0.98
1664	0.777	170.5	01Jan2000, 03:07	1.21
1665	1.741	234.6	01Jan2000, 04:16	1.00
1666	1.025	101.5	01Jan2000, 05:16	0.92
1667	0.698	54.8	01Jan2000, 04:04	0.51
1668	1.052	139.3	01Jan2000, 04:34	1.09
1669	0.386	17.9	01Jan2000, 04:01	0.25
1670	0.370	59.0	01Jan2000, 03:16	0.87
1671	0.802	132.4	01Jan2000, 03:54	1.09
CC01	19.043	1272.5	01Jan2000, 10:30	0.91
CC03	17.269	1263.7	01Jan2000, 09:19	0.91
CC04	16.200	1255.8	01Jan2000, 08:35	0.93
CC05	15.232	1244.9	01Jan2000, 08:07	0.95
CC06	14.589	1234.5	01Jan2000, 07:31	0.96
CC07	14.472	1234.2	01Jan2000, 07:20	0.97
CC08	12.821	1164.5	01Jan2000, 06:21	0.95
CC09D	11.934	1098.6	01Jan2000, 05:47	0.95
CC09U	8.771	816.1	01Jan2000, 07:41	0.89
CC10	7.445	785.2	01Jan2000, 06:00	0.91
CC11D	7.082	778.2	01Jan2000, 05:02	0.93
CC11U	4.724	513.6	01Jan2000, 05:02	0.93
CC12D	4.390	498.3	01Jan2000, 04:19	0.93

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	328.5	01Jan2000, 04:19	1.22
CC13	1.413	206.0	01Jan2000, 03:59	1.00
CCR1	19.043	1272.5	01Jan2000, 11:39	0.91
CCR10	7.445	785.2	01Jan2000, 07:41	0.91
CCR11	7.082	778.2	01Jan2000, 06:00	0.93
CCR12	4.390	498.3	01Jan2000, 05:02	0.93
CCR13	1.413	206.0	01Jan2000, 05:33	1.00
CCR2	17.753	1265.3	01Jan2000, 10:32	0.91
CCR3	17.269	1263.7	01Jan2000, 09:57	0.91
CCR4	16.200	1255.8	01Jan2000, 09:19	0.93
CCR5	15.232	1244.9	01Jan2000, 08:37	0.95
CCR6	14.589	1234.5	01Jan2000, 08:09	0.96
CCR7	14.472	1234.2	01Jan2000, 07:33	0.97
CCR8	12.821	1164.5	01Jan2000, 07:33	0.95
CCR9	11.934	1098.6	01Jan2000, 06:28	0.95
Clay Creek	1.665	139.7	01Jan2000, 04:16	0.85
CLC01	1.438	124.8	01Jan2000, 04:18	0.87
CLCR1	1.438	124.8	01Jan2000, 04:53	0.87
Crooked Creek	19.959	1279.0	01Jan2000, 11:39	0.90
D1619	0.668	25.7	01Jan2000, 03:34	0.25
D1623	0.540	24.9	01Jan2000, 04:18	0.36
D1628	0.456	30.9	01Jan2000, 03:53	0.47
D1630	0.887	11.9	01Jan2000, 05:01	0.13
D1633	0.458	6.5	01Jan2000, 03:55	0.10
D1634	0.334	24.3	01Jan2000, 02:41	0.35
D1635	0.796	178.5	01Jan2000, 02:33	1.02
D1636	0.652	45.3	01Jan2000, 03:22	0.43
D1637	0.726	52.1	01Jan2000, 04:07	0.53
D1638	0.803	36.7	01Jan2000, 03:47	0.31
D1640	1.009	12.7	01Jan2000, 05:10	0.11
D1643	0.985	21.7	01Jan2000, 03:31	0.14
D1644	1.055	22.8	01Jan2000, 03:25	0.13
D1646	0.484	11.4	01Jan2000, 03:26	0.15
D1649	0.528	39.3	01Jan2000, 03:22	0.45
D1651	0.663	96.4	01Jan2000, 03:19	0.85
D1653	0.779	45.8	01Jan2000, 03:26	0.33
D1654	0.644	38.7	01Jan2000, 03:17	0.33
D1655	0.931	22.7	01Jan2000, 04:44	0.17

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1656	1.366	44.1	01Jan2000, 04:09	0.23
D1658	0.767	17.2	01Jan2000, 03:45	0.13
D1659	1.528	195.5	01Jan2000, 03:38	0.83
D1661	1.220	54.4	01Jan2000, 05:11	0.43
D1662	0.672	29.8	01Jan2000, 05:01	0.39
D1663	1.498	85.0	01Jan2000, 04:19	0.43
D1664	0.777	155.2	01Jan2000, 03:07	1.10
D1665	1.741	129.0	01Jan2000, 04:16	0.55
D1666	1.025	51.8	01Jan2000, 05:16	0.47
D1667	0.698	41.1	01Jan2000, 04:04	0.38
d1668	1.052	101.7	01Jan2000, 04:34	0.80
D1669	0.386	15.4	01Jan2000, 04:01	0.21
D1671	0.802	59.6	01Jan2000, 03:54	0.49
DC01	1.529	118.1	01Jan2000, 03:57	0.56
DCR1	1.529	118.1	01Jan2000, 05:21	0.56
Delaware Creek	2.181	173.0	01Jan2000, 04:42	0.64
HJC01	2.713	488.6	01Jan2000, 04:20	1.19
HJC02	1.658	356.9	01Jan2000, 03:44	1.33
HJC03	0.673	163.1	01Jan2000, 03:26	1.48
HJCR1	2.713	488.6	01Jan2000, 04:59	1.19
HJCR2	1.658	356.9	01Jan2000, 04:37	1.33
HJCR3	0.673	163.1	01Jan2000, 03:57	1.48
Howard Johnson	[illegible]	533.1	01Jan2000, 04:55	1.14
J1619	0.668	91.8	01Jan2000, 03:34	0.88
J1623	0.540	36.0	01Jan2000, 04:18	0.52
J1628	0.456	85.0	01Jan2000, 03:53	1.31
J1630	0.887	79.5	01Jan2000, 05:01	0.84
J1633	0.458	50.2	01Jan2000, 03:55	0.77
J1634	0.334	60.7	01Jan2000, 02:41	0.88
J1635	0.796	243.5	01Jan2000, 02:33	1.60
J1636	0.652	88.8	01Jan2000, 03:22	0.84
J1637	0.726	61.3	01Jan2000, 04:07	0.63
J1638	0.803	57.3	01Jan2000, 03:47	0.49
J1640	1.009	105.7	01Jan2000, 05:10	0.95
J1643	0.985	197.6	01Jan2000, 03:31	1.23
J1644	1.055	162.8	01Jan2000, 03:25	0.96
J1646	0.484	81.1	01Jan2000, 03:26	1.05
J1649	0.528	87.4	01Jan2000, 03:22	1.00

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1651	0.663	138.3	01Jan2000, 03:19	1.24
J1653	0.779	93.4	01Jan2000, 03:26	0.68
J1654	0.644	78.3	01Jan2000, 03:17	0.87
J1655	0.931	44.5	01Jan2000, 04:44	0.33
J1656	1.366	200.4	01Jan2000, 04:09	1.06
J1658	0.767	85.8	01Jan2000, 03:45	0.66
J1659	1.528	206.3	01Jan2000, 03:38	1.21
J1661	1.220	138.8	01Jan2000, 05:11	1.26
J1662	0.672	72.7	01Jan2000, 05:01	0.95
J1663	1.498	193.1	01Jan2000, 04:19	0.98
J1664	0.777	170.5	01Jan2000, 03:08	1.21
J1665	1.741	199.7	01Jan2000, 04:16	1.00
J1666	1.025	101.5	01Jan2000, 05:16	0.92
J1667	0.698	54.8	01Jan2000, 04:04	0.51
J1668	1.052	107.8	01Jan2000, 04:35	1.09
J1669	0.386	17.9	01Jan2000, 04:01	0.25
J1671	0.802	110.9	01Jan2000, 03:54	1.09
Payne Branch	2.358	264.7	01Jan2000, 05:03	0.94
PB01	1.900	225.2	01Jan2000, 04:18	0.98
PBR1	1.900	225.2	01Jan2000, 05:15	0.98
R1619	0.668	25.7	01Jan2000, 03:34	0.25
R1623	0.540	24.9	01Jan2000, 04:18	0.36
R1628	0.456	30.0	01Jan2000, 04:18	0.47
R1630	0.887	11.9	01Jan2000, 05:01	0.13
R1633	0.458	6.5	01Jan2000, 03:55	0.10
R1634	0.334	24.3	01Jan2000, 02:41	0.35
R1635	0.796	143.1	01Jan2000, 03:21	1.02
R1636	0.652	45.3	01Jan2000, 03:22	0.43
R1637	0.726	52.1	01Jan2000, 04:07	0.53
R1638	0.803	36.7	01Jan2000, 03:47	0.31
R1640	1.009	12.7	01Jan2000, 05:09	0.11
R1643	0.985	21.7	01Jan2000, 03:32	0.14
R1644	1.055	22.8	01Jan2000, 03:25	0.13
R1646	0.484	11.4	01Jan2000, 03:26	0.15
R1649	0.528	39.3	01Jan2000, 03:22	0.45
R1651	0.663	95.0	01Jan2000, 03:34	0.85
R1653	0.779	45.8	01Jan2000, 03:26	0.33
R1654	0.644	15.4	01Jan2000, 05:26	0.33

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1655	0.931	22.7	01Jan2000, 04:44	0.17
R1656	1.366	44.1	01Jan2000, 04:09	0.23
R1658	0.767	17.2	01Jan2000, 03:45	0.13
R1659	1.528	114.6	01Jan2000, 05:27	0.83
R1661	1.220	33.4	01Jan2000, 07:38	0.43
R1662	0.672	29.8	01Jan2000, 05:01	0.39
R1663	1.498	85.0	01Jan2000, 04:19	0.43
R1664	0.777	155.2	01Jan2000, 03:08	1.10
R1665	1.741	94.3	01Jan2000, 05:45	0.55
R1666	1.025	51.8	01Jan2000, 05:16	0.47
R1667	0.698	41.1	01Jan2000, 04:04	0.38
R1668	1.052	70.4	01Jan2000, 06:22	0.80
R1669	0.386	15.4	01Jan2000, 04:01	0.21
R1671	0.802	38.3	01Jan2000, 05:32	0.49
SMR01	1.723	147.8	01Jan2000, 04:43	0.76
SMRR1	1.723	147.8	01Jan2000, 07:51	0.76
Spring Mill Run	2.502	156.0	01Jan2000, 07:42	0.73
WC01	20.902	1223.5	01Jan2000, 11:52	0.95
WC02	19.885	1221.1	01Jan2000, 10:54	0.95
WC03	18.622	1219.9	01Jan2000, 09:27	0.95
WC04	17.512	1216.1	01Jan2000, 08:33	0.95
WC05D	16.497	1204.6	01Jan2000, 08:10	0.94
WC05U	13.995	1053.8	01Jan2000, 08:23	0.97
WC06	13.351	1035.8	01Jan2000, 07:41	0.98
WC07	11.054	972.9	01Jan2000, 07:33	1.02
WC08D	10.684	968.4	01Jan2000, 06:55	1.03
WC08U	9.019	865.9	01Jan2000, 07:07	1.06
WC09	8.252	848.3	01Jan2000, 06:04	1.10
WC10	6.710	695.2	01Jan2000, 06:00	1.07
WC11	4.818	503.1	01Jan2000, 05:14	1.04
WC12	2.543	305.3	01Jan2000, 04:40	1.03
WC13	0.802	110.9	01Jan2000, 03:54	1.09
WCR1	20.902	1223.5	01Jan2000, 12:35	0.95
WCR10	6.710	695.2	01Jan2000, 06:06	1.07
WCR11	4.818	503.1	01Jan2000, 06:31	1.04
WCR12	2.543	305.3	01Jan2000, 06:21	1.03
WCR13	0.802	110.9	01Jan2000, 05:04	1.09
WCR2	19.885	1221.1	01Jan2000, 11:52	0.95

Global Summary Results for Run "CBBEL 2 yr 6 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: CBBEL 2 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-10&det-5 10YR
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 6 hr 10%
Compute Time: 11May2010, 15:52:27 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC07	11.054	972.9	01Jan2000, 07:33	1.02
WC08D	10.684	968.4	01Jan2000, 06:55	1.03
WC08U	9.019	865.9	01Jan2000, 07:07	1.06
WC09	8.252	848.3	01Jan2000, 06:04	1.10
WC10	6.710	695.2	01Jan2000, 06:00	1.07
WC11	4.818	503.1	01Jan2000, 05:14	1.04
WC12	2.543	305.3	01Jan2000, 04:40	1.03
WC13	0.802	110.9	01Jan2000, 03:54	1.09
WCR1	20.902	1223.5	01Jan2000, 12:35	0.95
WCR10	6.710	695.2	01Jan2000, 06:06	1.07
WCR11	4.818	503.1	01Jan2000, 06:31	1.04
WCR12	2.543	305.3	01Jan2000, 06:21	1.03
WCR13	0.802	110.9	01Jan2000, 05:04	1.09
WCR2	19.885	1221.1	01Jan2000, 11:52	0.95
WCR3	18.522	1219.9	01Jan2000, 10:56	0.95
WCR4	17.512	1216.1	01Jan2000, 09:29	0.95
WCR5	16.497	1204.6	01Jan2000, 08:37	0.94
WCR6	13.351	1035.8	01Jan2000, 08:25	0.98
WCR7	11.054	972.9	01Jan2000, 08:23	1.02
WCR8	10.684	968.4	01Jan2000, 07:38	1.03
WCR9	8.252	848.3	01Jan2000, 07:07	1.10
Williams Creek	21.252	1223.5	01Jan2000, 12:35	0.95

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 2 yr 12 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:51:39

Basin Model: CW 2008CN-10&det-5 10YR
Meteorologic Model: 2 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Existing 50% - 12 hr

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1423.9	01Jan2000, 10:58	1.15
1617	0.350	39.9	01Jan2000, 04:05	0.92
1618	0.916	96.6	01Jan2000, 05:18	1.04
1619	0.668	87.0	01Jan2000, 04:27	1.10
1620	0.622	61.6	01Jan2000, 05:05	0.94
1621	0.643	55.2	01Jan2000, 04:55	0.79
1622	0.117	14.5	01Jan2000, 03:30	0.92
1623	0.540	37.3	01Jan2000, 05:26	0.68
1624	0.529	82.8	01Jan2000, 04:06	1.22
1625	0.716	49.8	01Jan2000, 05:24	0.68
1626	0.252	30.0	01Jan2000, 03:48	0.92
1627	0.484	61.3	01Jan2000, 04:13	1.04
1628	0.456	83.1	01Jan2000, 04:42	1.61
1629	1.195	172.7	01Jan2000, 04:39	1.29
1630	0.887	83.4	01Jan2000, 06:00	1.04
1631	1.326	142.1	01Jan2000, 04:46	0.96
1632	0.450	54.0	01Jan2000, 04:39	1.06
1633	0.458	49.4	01Jan2000, 04:53	0.98
1634	0.334	51.7	01Jan2000, 03:24	1.10
1635	0.796	238.3	01Jan2000, 03:07	1.94
1636	0.652	82.2	01Jan2000, 04:14	1.04
1637	0.726	61.7	01Jan2000, 05:10	0.81
1638	0.803	56.3	01Jan2000, 04:54	0.64
1639	0.891	132.7	01Jan2000, 04:45	1.27
1640	1.009	115.0	01Jan2000, 06:09	1.22
1641	1.413	205.2	01Jan2000, 04:54	1.27
1642	0.363	32.7	01Jan2000, 04:07	0.70
1643	0.985	186.9	01Jan2000, 04:20	1.53
1644	1.055	151.2	01Jan2000, 04:15	1.19
1645	0.673	152.0	01Jan2000, 04:11	1.80
1646	0.484	75.2	01Jan2000, 04:15	1.29

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	101.4	01Jan2000, 03:35	0.96
1648	1.017	140.6	01Jan2000, 04:34	1.21
1649	0.528	81.0	01Jan2000, 04:12	1.25
1650	0.582	101.7	01Jan2000, 03:38	1.31
1651	0.663	128.8	01Jan2000, 04:06	1.53
1652	0.352	58.8	01Jan2000, 03:48	1.29
1653	0.779	90.2	01Jan2000, 04:25	0.90
1654	0.644	95.4	01Jan2000, 04:11	1.12
1655	0.931	55.3	01Jan2000, 05:55	0.51
1656	1.366	201.7	01Jan2000, 05:04	1.34
1657	0.227	33.9	01Jan2000, 03:44	0.97
1658	0.767	87.9	01Jan2000, 04:46	0.89
1659	1.528	273.3	01Jan2000, 04:27	1.50
1660	0.014	1.5	01Jan2000, 03:19	0.55
1661	1.220	167.9	01Jan2000, 06:05	1.54
1662	0.672	78.5	01Jan2000, 06:01	1.22
1663	1.498	197.8	01Jan2000, 05:17	1.24
1664	0.777	153.9	01Jan2000, 03:52	1.50
1665	1.741	239.2	01Jan2000, 05:13	1.27
1666	1.025	111.2	01Jan2000, 06:16	1.19
1667	0.698	59.0	01Jan2000, 05:12	0.70
1668	1.052	142.9	01Jan2000, 05:30	1.36
1669	0.386	21.7	01Jan2000, 05:13	0.40
1670	0.370	55.1	01Jan2000, 04:10	1.12
1671	0.802	131.3	01Jan2000, 04:47	1.38
CC01	19.043	1435.9	01Jan2000, 11:29	1.14
CC03	17.269	1420.7	01Jan2000, 10:22	1.15
CC04	16.200	1407.0	01Jan2000, 09:44	1.16
CC05	15.232	1389.6	01Jan2000, 09:20	1.19
CC06	14.589	1374.3	01Jan2000, 08:48	1.21
CC07	14.472	1373.2	01Jan2000, 08:35	1.21
CC08	12.821	1290.5	01Jan2000, 07:53	1.19
CC09D	11.934	1224.1	01Jan2000, 07:24	1.20
CC09U	8.771	870.4	01Jan2000, 08:16	1.12
CC10	7.445	814.7	01Jan2000, 06:49	1.15
CC11D	7.082	800.2	01Jan2000, 05:55	1.17
CC11U	4.724	522.4	01Jan2000, 05:47	1.16
CC12D	4.390	496.7	01Jan2000, 05:16	1.17

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	319.7	01Jan2000, 05:02	1.51
CC13	1.413	205.2	01Jan2000, 04:54	1.27
CCR1	19.043	1435.9	01Jan2000, 12:38	1.14
CCR10	7.445	814.7	01Jan2000, 08:30	1.15
CCR11	7.082	800.2	01Jan2000, 06:53	1.17
CCR12	4.390	496.7	01Jan2000, 05:59	1.17
CCR13	1.413	205.2	01Jan2000, 06:28	1.27
CCR2	17.753	1423.9	01Jan2000, 11:35	1.15
CCR3	17.269	1420.7	01Jan2000, 11:00	1.15
CCR4	16.200	1407.0	01Jan2000, 10:28	1.16
CCR5	15.232	1389.6	01Jan2000, 09:50	1.19
CCR6	14.589	1374.3	01Jan2000, 09:26	1.21
CCR7	14.472	1373.2	01Jan2000, 08:48	1.21
CCR8	12.821	1290.5	01Jan2000, 09:05	1.19
CCR9	11.934	1224.1	01Jan2000, 08:05	1.20
Clay Creek	1.665	151.0	01Jan2000, 05:17	1.08
CLC01	1.438	130.4	01Jan2000, 05:22	1.10
CLCR1	1.438	130.4	01Jan2000, 05:57	1.10
Crooked Creek	19.959	1445.8	01Jan2000, 12:34	1.13
D1619	0.668	24.3	01Jan2000, 04:27	0.31
D1623	0.540	25.7	01Jan2000, 05:26	0.47
D1628	0.456	29.9	01Jan2000, 04:42	0.58
D1630	0.887	12.5	01Jan2000, 06:00	0.16
D1633	0.458	6.4	01Jan2000, 04:53	0.13
D1634	0.334	20.7	01Jan2000, 03:24	0.44
D1635	0.796	151.2	01Jan2000, 03:07	1.24
D1636	0.652	41.9	01Jan2000, 04:14	0.53
D1637	0.726	52.4	01Jan2000, 05:10	0.69
D1638	0.803	36.0	01Jan2000, 04:54	0.41
D1640	1.009	13.8	01Jan2000, 06:09	0.15
D1643	0.985	20.6	01Jan2000, 04:20	0.17
D1644	1.055	21.2	01Jan2000, 04:15	0.17
D1646	0.484	10.5	01Jan2000, 04:15	0.18
D1649	0.528	36.5	01Jan2000, 04:12	0.56
D1651	0.663	88.9	01Jan2000, 04:06	1.05
D1653	0.779	44.2	01Jan2000, 04:25	0.44
D1654	0.644	36.3	01Jan2000, 04:11	0.42
D1655	0.931	28.2	01Jan2000, 05:55	0.26

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1656	1.366	44.4	01Jan2000, 05:04	0.29
D1658	0.767	17.6	01Jan2000, 04:46	0.18
D1659	1.528	185.9	01Jan2000, 04:27	1.02
D1661	1.220	57.1	01Jan2000, 06:05	0.52
D1662	0.672	32.2	01Jan2000, 06:01	0.50
D1663	1.498	87.0	01Jan2000, 05:17	0.55
D1664	0.777	140.1	01Jan2000, 03:52	1.37
D1665	1.741	131.6	01Jan2000, 05:13	0.70
D1666	1.025	56.7	01Jan2000, 06:16	0.61
D1667	0.698	44.2	01Jan2000, 05:12	0.53
d1668	1.052	104.3	01Jan2000, 05:30	0.99
D1669	0.386	18.7	01Jan2000, 05:13	0.35
D1671	0.802	59.1	01Jan2000, 04:47	0.62
DC01	1.529	117.8	01Jan2000, 05:03	0.72
DCR1	1.529	117.8	01Jan2000, 06:27	0.72
Delaware Creek	2.181	179.5	01Jan2000, 05:37	0.82
HJC01	2.713	474.5	01Jan2000, 05:08	1.47
HJC02	1.658	337.2	01Jan2000, 04:30	1.64
HJC03	0.673	152.0	01Jan2000, 04:11	1.80
HJCR1	2.713	474.5	01Jan2000, 05:47	1.47
HJCR2	1.658	337.2	01Jan2000, 05:23	1.64
HJCR3	0.673	152.0	01Jan2000, 04:42	1.80
Howard Johnson	3.168	523.3	01Jan2000, 05:42	1.41
J1619	0.668	87.0	01Jan2000, 04:27	1.10
J1623	0.540	37.3	01Jan2000, 05:27	0.68
J1628	0.456	83.1	01Jan2000, 04:42	1.61
J1630	0.887	83.4	01Jan2000, 06:00	1.04
J1633	0.458	49.4	01Jan2000, 04:53	0.98
J1634	0.334	51.7	01Jan2000, 03:24	1.10
J1635	0.796	228.1	01Jan2000, 03:07	1.94
J1636	0.652	82.2	01Jan2000, 04:14	1.04
J1637	0.726	61.7	01Jan2000, 05:10	0.81
J1638	0.803	56.3	01Jan2000, 04:54	0.64
J1640	1.009	115.0	01Jan2000, 06:09	1.22
J1643	0.985	186.9	01Jan2000, 04:20	1.53
J1644	1.055	151.2	01Jan2000, 04:15	1.19
J1646	0.484	75.2	01Jan2000, 04:15	1.29
J1649	0.528	81.0	01Jan2000, 04:12	1.25

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1651	0.663	128.8	01Jan2000, 04:06	1.53
J1653	0.779	90.2	01Jan2000, 04:25	0.90
J1654	0.644	74.4	01Jan2000, 04:12	1.12
J1655	0.931	55.3	01Jan2000, 05:55	0.51
J1656	1.366	201.7	01Jan2000, 05:04	1.34
J1658	0.767	87.9	01Jan2000, 04:46	0.89
J1659	1.528	201.8	01Jan2000, 04:27	1.50
J1661	1.220	144.1	01Jan2000, 06:05	1.54
J1662	0.672	78.5	01Jan2000, 06:01	1.22
J1663	1.498	197.8	01Jan2000, 05:17	1.24
J1664	0.777	153.9	01Jan2000, 03:52	1.50
J1665	1.741	201.8	01Jan2000, 05:13	1.27
J1666	1.025	111.2	01Jan2000, 06:16	1.19
J1667	0.698	59.0	01Jan2000, 05:12	0.70
J1668	1.052	108.8	01Jan2000, 05:31	1.36
J1669	0.386	21.7	01Jan2000, 05:14	0.40
J1671	0.802	110.4	01Jan2000, 04:47	1.38
Payne Branch	2.358	279.3	01Jan2000, 06:08	1.19
PB01	1.900	236.9	01Jan2000, 05:23	1.25
PBR1	1.900	236.9	01Jan2000, 06:20	1.25
R1619	0.668	24.3	01Jan2000, 04:27	0.31
R1623	0.540	25.7	01Jan2000, 05:27	0.47
R1628	0.456	29.9	01Jan2000, 04:42	0.58
R1630	0.887	12.5	01Jan2000, 06:00	0.16
R1633	0.458	6.4	01Jan2000, 04:53	0.13
R1634	0.334	20.7	01Jan2000, 03:24	0.44
R1635	0.796	143.0	01Jan2000, 03:42	1.24
R1636	0.652	41.9	01Jan2000, 04:14	0.53
R1637	0.726	52.4	01Jan2000, 05:10	0.69
R1638	0.803	36.0	01Jan2000, 04:54	0.41
R1640	1.009	13.8	01Jan2000, 06:09	0.15
R1643	0.985	20.6	01Jan2000, 04:20	0.17
R1644	1.055	21.2	01Jan2000, 04:15	0.17
R1646	0.484	10.5	01Jan2000, 04:15	0.18
R1649	0.528	36.5	01Jan2000, 04:12	0.56
R1651	0.663	88.9	01Jan2000, 04:06	1.05
R1653	0.779	44.2	01Jan2000, 04:25	0.44
R1654	0.644	15.5	01Jan2000, 07:07	0.42

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1655	0.931	28.2	01Jan2000, 05:55	0.26
R1656	1.366	44.4	01Jan2000, 05:04	0.29
R1658	0.767	17.6	01Jan2000, 04:46	0.18
R1659	1.528	114.7	01Jan2000, 06:50	1.02
R1661	1.220	33.6	01Jan2000, 09:18	0.52
R1662	0.672	32.2	01Jan2000, 06:01	0.50
R1663	1.498	87.0	01Jan2000, 05:17	0.55
R1664	0.777	140.1	01Jan2000, 03:52	1.37
R1665	1.741	94.4	01Jan2000, 07:17	0.70
R1666	1.025	56.7	01Jan2000, 06:16	0.61
R1667	0.698	44.2	01Jan2000, 05:12	0.53
R1668	1.052	70.5	01Jan2000, 07:56	0.99
R1669	0.386	18.7	01Jan2000, 05:14	0.35
R1671	0.802	38.4	01Jan2000, 07:02	0.62
SMR01	1.723	165.6	01Jan2000, 05:50	0.99
SMRR1	1.723	165.6	01Jan2000, 08:58	0.99
Spring Mill Run	2.502	183.4	01Jan2000, 08:33	0.96
WC01	20.902	1435.9	01Jan2000, 12:37	1.20
WC02	19.885	1431.1	01Jan2000, 11:43	1.20
WC03	18.622	1428.0	01Jan2000, 10:16	1.21
WC04	17.512	1418.6	01Jan2000, 09:28	1.21
WC05D	16.497	1399.5	01Jan2000, 09:15	1.19
WC05U	13.995	1224.5	01Jan2000, 09:33	1.23
WC06	13.351	1203.7	01Jan2000, 08:54	1.24
WC07	11.054	1109.0	01Jan2000, 08:23	1.29
WC08D	10.684	1098.0	01Jan2000, 07:41	1.30
WC08U	9.019	975.3	01Jan2000, 07:41	1.33
WC09	8.252	937.5	01Jan2000, 06:53	1.38
WC10	6.710	772.2	01Jan2000, 07:03	1.35
WC11	4.818	565.0	01Jan2000, 05:57	1.32
WC12	2.543	309.6	01Jan2000, 05:35	1.31
WC13	0.802	110.4	01Jan2000, 04:47	1.38
WCR1	20.902	1435.9	01Jan2000, 13:20	1.20
WCR10	6.710	772.2	01Jan2000, 07:09	1.35
WCR11	4.818	565.0	01Jan2000, 07:14	1.32
WCR12	2.543	309.6	01Jan2000, 07:16	1.31
WCR13	0.802	110.4	01Jan2000, 05:57	1.38
WCR2	19.885	1431.1	01Jan2000, 12:41	1.20

Global Summary Results for Run "CBBEL 2 yr 12 hr 10%"

Project: CBBEL Crooked & Williams Simulation Run: CBBEL 2 yr 12 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-108dat-5 10YR
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 12 hr 10%
Compute Time: 18Jun2010, 13:01:28 Control Specifications: Frequency Control

Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC07	11.054	1109.0	01Jan2000, 08:23	1.29
WC08D	10.684	1098.0	01Jan2000, 07:41	1.30
WC08U	9.019	975.3	01Jan2000, 07:41	1.33
WC09	8.252	937.5	01Jan2000, 06:53	1.38
WC10	6.710	772.2	01Jan2000, 07:03	1.35
WC11	4.818	565.0	01Jan2000, 05:57	1.32
WC12	2.543	309.6	01Jan2000, 05:35	1.31
WC13	0.802	110.4	01Jan2000, 04:47	1.38
WCR1	20.902	1435.9	01Jan2000, 13:20	1.20
WCR10	6.710	772.2	01Jan2000, 07:09	1.35
WCR11	4.818	565.0	01Jan2000, 07:14	1.32
WCR12	2.543	309.6	01Jan2000, 07:16	1.31
WCR13	0.802	110.4	01Jan2000, 05:57	1.38
WCR2	19.865	1431.1	01Jan2000, 12:41	1.20
WCR3	18.622	1428.0	01Jan2000, 11:45	1.21
WCR4	17.512	1418.6	01Jan2000, 10:24	1.21
WCR5	16.497	1399.5	01Jan2000, 09:42	1.19
WCR6	13.351	1203.7	01Jan2000, 09:38	1.24
WCR7	11.054	1109.0	01Jan2000, 09:13	1.29
WCR8	10.684	1098.0	01Jan2000, 08:24	1.30
WCR9	8.252	937.5	01Jan2000, 07:56	1.38
Williams Creek	21.252	1436.0	01Jan2000, 13:20	1.20

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: CBBEL 2 yr 24 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:52:03

Basin Model: CW 2008CN-10&det-5 10YR
Meteorologic Model: 2 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Existing 50% - 24hr.

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1408.5	01Jan2000, 12:37	1.43
1617	0.350	29.2	01Jan2000, 05:14	1.16
1618	0.916	77.8	01Jan2000, 06:48	1.30
1619	0.668	65.8	01Jan2000, 05:43	1.38
1620	0.622	48.8	01Jan2000, 06:39	1.18
1621	0.643	43.0	01Jan2000, 06:35	1.01
1622	0.117	10.3	01Jan2000, 04:42	1.16
1623	0.540	30.4	01Jan2000, 07:23	0.88
1624	0.529	61.4	01Jan2000, 05:13	1.52
1625	0.716	40.5	01Jan2000, 07:20	0.88
1626	0.252	21.5	01Jan2000, 04:57	1.16
1627	0.484	45.5	01Jan2000, 05:21	1.30
1628	0.456	64.9	01Jan2000, 05:53	1.96
1629	1.195	133.5	01Jan2000, 05:50	1.59
1630	0.887	70.3	01Jan2000, 07:41	1.30
1631	1.326	109.9	01Jan2000, 06:18	1.21
1632	0.450	41.5	01Jan2000, 06:03	1.33
1633	0.458	38.6	01Jan2000, 06:26	1.23
1634	0.334	36.6	01Jan2000, 04:36	1.38
1635	0.796	166.0	01Jan2000, 04:15	2.34
1636	0.652	61.1	01Jan2000, 05:23	1.30
1637	0.726	49.1	01Jan2000, 06:52	1.03
1638	0.803	43.7	01Jan2000, 06:45	0.83
1639	0.891	103.9	01Jan2000, 06:11	1.59
1640	1.009	99.5	01Jan2000, 07:55	1.55
1641	1.413	162.4	01Jan2000, 06:21	1.59
1642	0.363	23.5	01Jan2000, 05:21	0.91
1643	0.985	142.4	01Jan2000, 05:27	1.89
1644	1.055	113.2	01Jan2000, 05:21	1.47
1645	0.673	115.5	01Jan2000, 05:11	2.18
1646	0.484	56.5	01Jan2000, 05:17	1.59

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	72.1	01Jan2000, 04:45	1.21
1648	1.017	107.7	01Jan2000, 05:49	1.49
1649	0.528	60.6	01Jan2000, 05:18	1.54
1650	0.582	73.5	01Jan2000, 04:42	1.61
1651	0.663	96.6	01Jan2000, 05:09	1.87
1652	0.352	43.0	01Jan2000, 04:50	1.59
1653	0.779	67.9	01Jan2000, 05:53	1.17
1654	0.644	71.2	01Jan2000, 05:21	1.42
1655	0.931	51.0	01Jan2000, 08:21	0.74
1656	1.366	161.7	01Jan2000, 06:30	1.67
1657	0.227	24.8	01Jan2000, 04:49	1.26
1658	0.767	69.4	01Jan2000, 06:28	1.18
1659	1.528	209.4	01Jan2000, 05:35	1.84
1660	0.014	1.1	01Jan2000, 04:20	0.78
1661	1.220	142.7	01Jan2000, 07:33	1.88
1662	0.672	67.3	01Jan2000, 07:44	1.55
1663	1.498	160.8	01Jan2000, 06:48	1.56
1664	0.777	113.8	01Jan2000, 04:56	1.84
1665	1.741	193.7	01Jan2000, 06:43	1.59
1666	1.025	97.0	01Jan2000, 08:05	1.50
1667	0.698	48.5	01Jan2000, 07:12	0.95
1668	1.052	117.4	01Jan2000, 06:58	1.68
1669	0.386	19.1	01Jan2000, 07:29	0.61
1670	0.370	41.0	01Jan2000, 05:19	1.42
1671	0.802	103.6	01Jan2000, 06:11	1.73
CC01	19.043	1447.3	01Jan2000, 13:08	1.42
CC03	17.269	1394.5	01Jan2000, 12:02	1.43
CC04	16.200	1356.2	01Jan2000, 11:23	1.45
CC05	15.232	1320.3	01Jan2000, 10:58	1.48
CC06	14.589	1292.7	01Jan2000, 10:23	1.50
CC07	14.472	1288.2	01Jan2000, 10:10	1.50
CC08	12.821	1166.1	01Jan2000, 09:17	1.48
CC09D	11.934	1100.1	01Jan2000, 08:42	1.49
CC09U	8.771	769.8	01Jan2000, 09:49	1.40
CC10	7.445	690.9	01Jan2000, 08:21	1.44
CC11D	7.082	671.8	01Jan2000, 07:25	1.47
CC11U	4.724	439.4	01Jan2000, 07:16	1.45
CC12D	4.390	412.6	01Jan2000, 06:42	1.45

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	268.9	01Jan2000, 06:35	1.86
CC13	1.413	162.4	01Jan2000, 06:21	1.59
CCR1	19.043	1447.3	01Jan2000, 14:17	1.42
CCR10	7.445	690.9	01Jan2000, 10:02	1.44
CCR11	7.082	671.8	01Jan2000, 08:23	1.47
CCR12	4.390	412.6	01Jan2000, 07:25	1.45
CCR13	1.413	162.4	01Jan2000, 07:55	1.59
CCR2	17.753	1408.5	01Jan2000, 13:14	1.43
CCR3	17.269	1394.5	01Jan2000, 12:40	1.43
CCR4	16.200	1356.2	01Jan2000, 12:07	1.45
CCR5	15.232	1320.3	01Jan2000, 11:28	1.48
CCR6	14.589	1292.7	01Jan2000, 11:01	1.50
CCR7	14.472	1288.2	01Jan2000, 10:23	1.50
CCR8	12.821	1166.1	01Jan2000, 10:29	1.48
CCR9	11.934	1100.1	01Jan2000, 09:23	1.49
Clay Creek	1.665	140.2	01Jan2000, 06:58	1.38
CLC01	1.438	120.8	01Jan2000, 07:15	1.39
CLCR1	1.438	120.8	01Jan2000, 07:50	1.39
Crooked Creek	19.959	1473.5	01Jan2000, 14:13	1.41
D1619	0.668	18.4	01Jan2000, 05:43	0.39
D1623	0.540	21.0	01Jan2000, 07:23	0.61
D1628	0.456	23.4	01Jan2000, 05:53	0.71
D1630	0.887	10.6	01Jan2000, 07:41	0.20
D1633	0.458	5.0	01Jan2000, 06:26	0.16
D1634	0.334	14.6	01Jan2000, 04:36	0.55
D1635	0.796	106.3	01Jan2000, 04:15	1.49
D1636	0.652	31.2	01Jan2000, 05:23	0.66
D1637	0.726	41.8	01Jan2000, 06:52	0.88
D1638	0.803	28.0	01Jan2000, 06:45	0.53
D1640	1.009	11.9	01Jan2000, 07:55	0.19
D1643	0.985	15.7	01Jan2000, 05:27	0.21
D1644	1.055	15.8	01Jan2000, 05:21	0.21
D1646	0.484	7.9	01Jan2000, 05:17	0.22
D1649	0.528	27.3	01Jan2000, 05:18	0.69
D1651	0.663	66.6	01Jan2000, 05:09	1.29
D1653	0.779	33.3	01Jan2000, 05:53	0.57
D1654	0.644	27.1	01Jan2000, 05:21	0.54
D1655	0.931	26.0	01Jan2000, 08:21	0.38

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1656	1.366	35.6	01Jan2000, 06:30	0.37
D1658	0.767	13.9	01Jan2000, 06:28	0.24
D1659	1.528	142.4	01Jan2000, 05:35	1.25
D1661	1.220	48.5	01Jan2000, 07:33	0.64
D1662	0.672	27.6	01Jan2000, 07:44	0.63
D1663	1.498	70.8	01Jan2000, 06:48	0.68
D1664	0.777	103.5	01Jan2000, 04:56	1.67
D1665	1.741	106.5	01Jan2000, 06:43	0.88
D1666	1.025	49.5	01Jan2000, 08:05	0.77
D1667	0.698	36.4	01Jan2000, 07:12	0.71
d1668	1.052	85.7	01Jan2000, 06:58	1.23
D1669	0.386	16.5	01Jan2000, 07:29	0.52
D1671	0.802	46.6	01Jan2000, 06:11	0.78
DC01	1.529	92.8	01Jan2000, 06:49	0.93
DCR1	1.529	92.8	01Jan2000, 08:13	0.93
Delaware Creek	2.181	145.2	01Jan2000, 07:19	1.04
HJC01	2.713	366.9	01Jan2000, 06:14	1.80
HJC02	1.658	257.6	01Jan2000, 05:34	2.01
HJC03	0.673	115.5	01Jan2000, 05:11	2.18
HJCR1	2.713	366.9	01Jan2000, 06:53	1.80
HJCR2	1.658	257.6	01Jan2000, 06:27	2.01
HJCR3	0.673	115.5	01Jan2000, 05:42	2.18
Howard Johnson	3.165	407.4	01Jan2000, 06:50	1.73
J1619	0.668	65.8	01Jan2000, 05:43	1.38
J1623	0.540	30.4	01Jan2000, 07:22	0.88
J1628	0.456	64.9	01Jan2000, 05:53	1.96
J1630	0.887	70.3	01Jan2000, 07:41	1.30
J1633	0.458	38.6	01Jan2000, 06:26	1.23
J1634	0.334	36.6	01Jan2000, 04:36	1.38
J1635	0.796	166.0	01Jan2000, 04:15	2.34
J1636	0.652	61.1	01Jan2000, 05:23	1.30
J1637	0.726	49.1	01Jan2000, 06:52	1.03
J1638	0.803	43.7	01Jan2000, 06:45	0.83
J1640	1.009	99.5	01Jan2000, 07:55	1.55
J1643	0.985	142.4	01Jan2000, 05:27	1.89
J1644	1.055	113.2	01Jan2000, 05:21	1.47
J1646	0.484	56.5	01Jan2000, 05:17	1.59
J1649	0.528	60.6	01Jan2000, 05:18	1.54

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1651	0.663	96.6	01Jan2000, 05:09	1.87
J1653	0.779	67.9	01Jan2000, 05:53	1.17
J1654	0.644	59.3	01Jan2000, 05:22	1.42
J1655	0.931	51.0	01Jan2000, 08:21	0.74
J1656	1.366	161.7	01Jan2000, 06:30	1.67
J1658	0.767	69.4	01Jan2000, 06:28	1.18
J1659	1.528	181.1	01Jan2000, 05:36	1.84
J1661	1.220	127.4	01Jan2000, 07:34	1.88
J1662	0.672	67.3	01Jan2000, 07:44	1.55
J1663	1.498	160.8	01Jan2000, 06:48	1.56
J1664	0.777	113.8	01Jan2000, 04:55	1.84
J1665	1.741	181.2	01Jan2000, 06:43	1.59
J1666	1.025	97.0	01Jan2000, 08:05	1.50
J1667	0.698	48.5	01Jan2000, 07:12	0.95
J1668	1.052	101.8	01Jan2000, 07:00	1.68
J1669	0.386	19.1	01Jan2000, 07:29	0.61
J1671	0.802	95.1	01Jan2000, 06:12	1.73
Payne Branch	2.358	233.9	01Jan2000, 07:46	1.50
PB01	1.900	197.6	01Jan2000, 07:03	1.57
PBR1	1.900	197.6	01Jan2000, 08:00	1.57
R1619	0.668	18.4	01Jan2000, 05:43	0.39
R1623	0.540	21.0	01Jan2000, 07:22	0.61
R1628	0.456	23.4	01Jan2000, 05:53	0.71
R1630	0.887	10.6	01Jan2000, 07:40	0.20
R1633	0.458	5.0	01Jan2000, 06:26	0.16
R1634	0.334	14.6	01Jan2000, 04:36	0.55
R1635	0.796	106.3	01Jan2000, 04:15	1.49
R1636	0.652	31.2	01Jan2000, 05:23	0.66
R1637	0.726	41.8	01Jan2000, 06:53	0.88
R1638	0.803	28.0	01Jan2000, 06:45	0.53
R1640	1.009	11.9	01Jan2000, 07:55	0.19
R1643	0.985	15.7	01Jan2000, 05:27	0.21
R1644	1.055	15.8	01Jan2000, 05:21	0.21
R1646	0.484	7.9	01Jan2000, 05:17	0.22
R1649	0.528	27.3	01Jan2000, 05:18	0.69
R1651	0.663	66.6	01Jan2000, 05:09	1.29
R1653	0.779	33.3	01Jan2000, 05:52	0.57
R1654	0.644	15.4	01Jan2000, 09:53	0.54

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1655	0.931	26.0	01Jan2000, 08:22	0.38
R1656	1.366	35.6	01Jan2000, 06:30	0.37
R1658	0.767	13.9	01Jan2000, 06:28	0.24
R1659	1.528	114.3	01Jan2000, 08:15	1.25
R1661	1.220	33.5	01Jan2000, 11:47	0.64
R1662	0.672	27.6	01Jan2000, 07:44	0.63
R1663	1.498	70.8	01Jan2000, 06:48	0.68
R1664	0.777	103.5	01Jan2000, 04:55	1.67
R1665	1.741	94.1	01Jan2000, 08:47	0.88
R1666	1.025	49.5	01Jan2000, 08:05	0.77
R1667	0.698	36.4	01Jan2000, 07:12	0.71
R1668	1.052	70.3	01Jan2000, 09:46	1.23
R1669	0.386	16.5	01Jan2000, 07:29	0.52
R1671	0.802	38.2	01Jan2000, 08:41	0.78
SMR01	1.723	144.6	01Jan2000, 07:46	1.28
SMRR1	1.723	144.6	01Jan2000, 10:54	1.28
Spring Mill Run	2.502	183.0	01Jan2000, 10:04	1.24
WC01	20.902	1573.8	01Jan2000, 14:08	1.51
WC02	19.885	1550.0	01Jan2000, 13:19	1.51
WC03	18.622	1525.0	01Jan2000, 12:01	1.52
WC04	17.512	1485.8	01Jan2000, 11:17	1.52
WC05D	16.497	1434.6	01Jan2000, 11:02	1.50
WC05U	13.995	1256.7	01Jan2000, 11:12	1.55
WC06	13.351	1222.9	01Jan2000, 10:33	1.56
WC07	11.054	1076.7	01Jan2000, 09:57	1.61
WC08D	10.684	1053.9	01Jan2000, 09:15	1.62
WC08U	9.019	923.1	01Jan2000, 09:23	1.66
WC09	8.252	870.7	01Jan2000, 08:29	1.71
WC10	6.710	704.4	01Jan2000, 08:29	1.68
WC11	4.818	513.1	01Jan2000, 07:17	1.65
WC12	2.543	275.6	01Jan2000, 07:00	1.64
WC13	0.802	95.1	01Jan2000, 06:12	1.73
WCR1	20.902	1573.8	01Jan2000, 14:51	1.51
WCR10	6.710	704.4	01Jan2000, 08:35	1.68
WCR11	4.818	513.1	01Jan2000, 08:34	1.65
WCR12	2.543	275.6	01Jan2000, 08:41	1.64
WCR13	0.802	95.1	01Jan2000, 07:22	1.73
WCR2	19.885	1550.0	01Jan2000, 14:17	1.51

Global Summary Results for Run "CBBEL 2 yr 24 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: CBBEL 2 yr 24 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-10&det-5 10YR
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 24 hr 10%
Compute Time: 11May2010, 15:52:03 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC07	11.054	1076.7	01Jan2000, 09:57	1.61
WC08D	10.684	1053.9	01Jan2000, 09:15	1.62
WC08U	9.019	923.1	01Jan2000, 09:23	1.66
WC09	8.252	870.7	01Jan2000, 08:29	1.71
WC10	6.710	704.4	01Jan2000, 08:29	1.68
WC11	4.818	513.1	01Jan2000, 07:17	1.65
WC12	2.543	275.6	01Jan2000, 07:00	1.64
WC13	0.802	95.1	01Jan2000, 06:12	1.73
WCR1	20.902	1573.8	01Jan2000, 14:51	1.51
WCR10	6.710	704.4	01Jan2000, 08:35	1.68
WCR11	4.818	513.1	01Jan2000, 08:34	1.65
WCR12	2.543	275.6	01Jan2000, 08:41	1.64
WCR13	0.802	95.1	01Jan2000, 07:22	1.73
WCR2	19.885	1550.0	01Jan2000, 14:17	1.51
WCR3	18.622	1525.0	01Jan2000, 13:30	1.52
WCR4	17.512	1485.8	01Jan2000, 12:13	1.52
WCR5	16.497	1434.6	01Jan2000, 11:29	1.50
WCR6	13.351	1222.9	01Jan2000, 11:17	1.56
WCR7	11.054	1076.7	01Jan2000, 10:47	1.61
WCR8	10.684	1053.9	01Jan2000, 09:58	1.62
WCR9	8.252	870.7	01Jan2000, 09:32	1.71
Williams Creek	21.252	1577.6	01Jan2000, 14:49	1.50

Print Close

APPENDIX A4-7

HEC-HMS Output – 1%, 10%, & 2% Annual Chance Rainfall on 1957 Condition

Predeveloped 100 - 6 hr.

Project: CBBEL Crooked& WilliamsSimulation Run: predev100yr 6hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:53:25

Basin Model: CW 1957CN
Meteorologic Model: 100 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	3458.4	01Jan2000, 10:14	2.76
1617	0.350	181.1	01Jan2000, 03:20	2.76
1618	0.916	329.8	01Jan2000, 04:34	2.76
1619	0.668	306.2	01Jan2000, 03:43	2.76
1620	0.622	242.4	01Jan2000, 04:16	2.76
1621	0.643	267.5	01Jan2000, 04:02	2.76
1622	0.117	72.5	01Jan2000, 02:50	2.76
1623	0.540	203.0	01Jan2000, 04:24	2.76
1624	0.529	273.4	01Jan2000, 03:21	2.76
1625	0.716	272.2	01Jan2000, 04:21	2.76
1626	0.252	142.1	01Jan2000, 03:06	2.76
1627	0.484	234.7	01Jan2000, 03:32	2.76
1628	0.456	187.5	01Jan2000, 04:05	2.76
1629	1.195	495.0	01Jan2000, 04:03	2.76
1630	0.887	270.0	01Jan2000, 05:16	2.76
1631	1.326	566.0	01Jan2000, 03:57	2.76
1632	0.450	192.9	01Jan2000, 03:56	2.76
1633	0.458	189.9	01Jan2000, 04:03	2.76
1634	0.334	212.3	01Jan2000, 02:46	2.76
1635	0.796	513.8	01Jan2000, 02:44	2.76
1636	0.652	313.8	01Jan2000, 03:33	2.76
1637	0.726	283.9	01Jan2000, 04:15	2.76
1638	0.803	345.5	01Jan2000, 03:55	2.76
1639	0.891	384.8	01Jan2000, 03:54	2.76
1640	1.009	311.5	01Jan2000, 05:12	2.76
1641	1.413	587.5	01Jan2000, 04:02	2.76
1642	0.363	207.5	01Jan2000, 03:03	2.76
1643	0.985	460.7	01Jan2000, 03:39	2.76
1644	1.055	499.2	01Jan2000, 03:37	2.76

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1645	0.673	317.2	01Jan2000, 03:37	2.76
1646	0.484	225.3	01Jan2000, 03:40	2.76
1647	0.779	478.2	01Jan2000, 02:52	2.76
1648	1.017	440.9	01Jan2000, 03:54	2.76
1649	0.528	256.2	01Jan2000, 03:32	2.76
1650	0.582	324.9	01Jan2000, 03:07	2.76
1651	0.663	328.4	01Jan2000, 03:28	2.76
1652	0.352	186.0	01Jan2000, 03:17	2.76
1653	0.779	399.3	01Jan2000, 03:22	2.76
1654	0.644	340.6	01Jan2000, 03:16	2.76
1655	0.931	360.4	01Jan2000, 04:17	2.76
1656	1.366	538.1	01Jan2000, 04:13	2.76
1657	0.227	146.4	01Jan2000, 02:44	2.76
1658	0.767	366.1	01Jan2000, 03:35	2.76
1659	1.528	683.1	01Jan2000, 03:48	2.76
1660	0.014	11.4	01Jan2000, 02:07	2.76
1661	1.220	358.7	01Jan2000, 05:26	2.76
1662	0.672	214.4	01Jan2000, 05:03	2.76
1663	1.498	563.8	01Jan2000, 04:23	2.76
1664	0.777	411.1	01Jan2000, 03:16	2.76
1665	1.741	666.2	01Jan2000, 04:20	2.76
1666	1.025	309.0	01Jan2000, 05:19	2.76
1667	0.698	306.2	01Jan2000, 03:51	2.76
1668	1.052	362.9	01Jan2000, 04:44	2.76
1669	0.386	188.1	01Jan2000, 03:31	2.76
1670	0.370	197.4	01Jan2000, 03:15	2.76
1671	0.802	343.6	01Jan2000, 03:56	2.76
CC01	19.043	3481.9	01Jan2000, 10:49	2.76
CC03	17.269	3453.5	01Jan2000, 09:36	2.76
CC04	16.200	3420.1	01Jan2000, 08:55	2.76
CC05	15.232	3368.5	01Jan2000, 08:28	2.76
CC06	14.589	3326.6	01Jan2000, 07:53	2.76
CC07	14.472	3325.7	01Jan2000, 07:40	2.76
CC08	12.821	3165.9	01Jan2000, 06:40	2.76
CC09D	11.934	2952.1	01Jan2000, 06:07	2.76

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC09U	8.771	2367.7	01Jan2000, 08:05	2.76
CC10	7.445	2272.5	01Jan2000, 06:31	2.76
CC11D	7.082	2248.8	01Jan2000, 05:35	2.76
CC11U	4.724	1491.2	01Jan2000, 05:50	2.76
CC12D	4.390	1467.7	01Jan2000, 05:10	2.76
CC12U	2.209	668.3	01Jan2000, 05:15	2.76
CC13	1.413	587.5	01Jan2000, 04:02	2.76
CCR1	19.043	3481.9	01Jan2000, 11:58	2.76
CCR10	7.445	2272.5	01Jan2000, 08:12	2.76
CCR11	7.082	2248.8	01Jan2000, 06:33	2.76
CCR12	4.390	1467.7	01Jan2000, 05:53	2.76
CCR13	1.413	587.5	01Jan2000, 05:36	2.76
CCR2	17.753	3458.4	01Jan2000, 10:51	2.76
CCR3	17.269	3453.5	01Jan2000, 10:14	2.76
CCR4	16.200	3420.1	01Jan2000, 09:39	2.76
CCR5	15.232	3368.5	01Jan2000, 08:58	2.76
CCR6	14.589	3326.6	01Jan2000, 08:31	2.76
CCR7	14.472	3325.7	01Jan2000, 07:53	2.76
CCR8	12.821	3165.9	01Jan2000, 07:52	2.76
CCR9	11.934	2952.1	01Jan2000, 06:48	2.76
Clay Creek	1.665	559.3	01Jan2000, 04:36	2.76
CLC01	1.438	513.2	01Jan2000, 04:17	2.76
CLCR1	1.438	513.2	01Jan2000, 04:52	2.76
Crooked Creek	19.959	3502.3	01Jan2000, 11:57	2.76
DC01	1.529	625.7	01Jan2000, 04:04	2.76
DCR1	1.529	625.7	01Jan2000, 05:28	2.76
Delaware Creek	2.181	800.4	01Jan2000, 05:07	2.76
HJC01	2.713	1172.3	01Jan2000, 04:24	2.76
HJC02	1.658	765.7	01Jan2000, 03:52	2.76
HJC03	0.673	317.2	01Jan2000, 03:37	2.76
HJCR1	2.713	1172.3	01Jan2000, 05:03	2.76
HJCR2	1.658	765.7	01Jan2000, 04:45	2.76
HJCR3	0.673	317.2	01Jan2000, 04:08	2.76
Howard Johnson Ditch	3.168	1327.7	01Jan2000, 04:57	2.76
Payne Branch	2.358	799.7	01Jan2000, 05:03	2.76

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
PB01	1.900	648.8	01Jan2000, 04:22	2.76
PBR1	1.900	648.8	01Jan2000, 05:19	2.76
SMR01	1.723	562.3	01Jan2000, 04:26	2.76
SMRR1	1.723	562.3	01Jan2000, 07:34	2.76
Spring Mill Run	2.502	603.7	01Jan2000, 07:22	2.76
WC01	20.902	3760.5	01Jan2000, 11:20	2.76
WC02	19.885	3748.6	01Jan2000, 10:22	2.76
WC03	18.622	3742.2	01Jan2000, 08:54	2.76
WC04	17.512	3723.7	01Jan2000, 07:59	2.76
WC05D	16.497	3684.7	01Jan2000, 07:35	2.76
WC05U	13.995	3085.6	01Jan2000, 07:40	2.76
WC06	13.351	3060.6	01Jan2000, 06:58	2.76
WC07	11.054	2720.3	01Jan2000, 06:34	2.76
WC08D	10.684	2688.9	01Jan2000, 05:55	2.76
WC08U	9.019	2269.0	01Jan2000, 06:32	2.76
WC09	8.252	2180.4	01Jan2000, 05:51	2.76
WC10	6.710	1915.7	01Jan2000, 06:35	2.76
WC11	4.818	1467.3	01Jan2000, 05:43	2.76
WC12	2.543	980.6	01Jan2000, 04:40	2.76
WC13	0.802	343.6	01Jan2000, 03:56	2.76
WCR1	20.902	3760.5	01Jan2000, 12:03	2.76
WCR10	6.710	1915.7	01Jan2000, 06:41	2.76
WCR11	4.818	1467.3	01Jan2000, 07:00	2.76
WCR12	2.543	980.6	01Jan2000, 06:21	2.76
WCR13	0.802	343.6	01Jan2000, 05:06	2.76
WCR2	19.885	3748.6	01Jan2000, 11:20	2.76
WCR3	18.622	3742.2	01Jan2000, 10:23	2.76
WCR4	17.512	3723.7	01Jan2000, 08:55	2.76
WCR5	16.497	3684.7	01Jan2000, 08:02	2.76
WCR6	13.351	3060.6	01Jan2000, 07:42	2.76
WCR7	11.054	2720.3	01Jan2000, 07:24	2.76
WCR8	10.684	2688.9	01Jan2000, 06:38	2.76
WCR9	8.252	2180.4	01Jan2000, 06:54	2.76
Williams Creek	21.252	3760.5	01Jan2000, 12:03	2.76

Predeveloped 1% - 12 hr

Project: CBBEL Crooked& WilliamsSimulation Run: predev100yr 12hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:52:48

Basin Model: CW 1957CN
Meteorologic Model: 100 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	3855.0	01Jan2000, 11:23	3.31
1617	0.350	161.0	01Jan2000, 04:10	3.31
1618	0.916	325.9	01Jan2000, 05:29	3.31
1619	0.668	282.8	01Jan2000, 04:34	3.31
1620	0.622	234.5	01Jan2000, 05:10	3.31
1621	0.643	254.1	01Jan2000, 04:55	3.31
1622	0.117	60.6	01Jan2000, 03:33	3.31
1623	0.540	198.4	01Jan2000, 05:19	3.31
1624	0.529	243.3	01Jan2000, 04:10	3.31
1625	0.716	265.1	01Jan2000, 05:16	3.31
1626	0.252	122.7	01Jan2000, 03:52	3.31
1627	0.484	213.2	01Jan2000, 04:22	3.31
1628	0.456	178.7	01Jan2000, 04:58	3.31
1629	1.195	470.8	01Jan2000, 04:56	3.31
1630	0.887	277.8	01Jan2000, 06:12	3.31
1631	1.326	533.7	01Jan2000, 04:49	3.31
1632	0.450	181.7	01Jan2000, 04:48	3.31
1633	0.458	180.5	01Jan2000, 04:56	3.31
1634	0.334	175.9	01Jan2000, 03:28	3.31
1635	0.796	423.3	01Jan2000, 03:26	3.31
1636	0.652	285.6	01Jan2000, 04:24	3.31
1637	0.726	274.4	01Jan2000, 05:10	3.31
1638	0.803	325.0	01Jan2000, 04:48	3.31
1639	0.891	361.6	01Jan2000, 04:47	3.31
1640	1.009	319.6	01Jan2000, 06:09	3.31
1641	1.413	558.1	01Jan2000, 04:56	3.31
1642	0.363	178.3	01Jan2000, 03:49	3.31
1643	0.985	422.9	01Jan2000, 04:29	3.31
1644	1.055	456.7	01Jan2000, 04:27	3.31

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1645	0.673	290.5	01Jan2000, 04:28	3.31
1646	0.484	207.1	01Jan2000, 04:31	3.31
1647	0.779	401.1	01Jan2000, 03:35	3.31
1648	1.017	413.9	01Jan2000, 04:46	3.31
1649	0.528	232.6	01Jan2000, 04:22	3.31
1650	0.582	281.5	01Jan2000, 03:54	3.31
1651	0.663	296.2	01Jan2000, 04:18	3.31
1652	0.352	164.3	01Jan2000, 04:06	3.31
1653	0.779	356.2	01Jan2000, 04:11	3.31
1654	0.644	300.6	01Jan2000, 04:05	3.31
1655	0.931	349.3	01Jan2000, 05:12	3.31
1656	1.366	519.0	01Jan2000, 05:08	3.31
1657	0.227	120.7	01Jan2000, 03:26	3.31
1658	0.767	334.0	01Jan2000, 04:25	3.31
1659	1.528	635.6	01Jan2000, 04:39	3.31
1660	0.014	8.6	01Jan2000, 02:25	3.31
1661	1.220	372.0	01Jan2000, 06:22	3.31
1662	0.672	218.3	01Jan2000, 06:00	3.31
1663	1.498	550.6	01Jan2000, 05:18	3.31
1664	0.777	362.8	01Jan2000, 04:05	3.31
1665	1.741	647.8	01Jan2000, 05:15	3.31
1666	1.025	318.8	01Jan2000, 06:15	3.31
1667	0.698	286.4	01Jan2000, 04:43	3.31
1668	1.052	362.5	01Jan2000, 05:40	3.31
1669	0.386	170.5	01Jan2000, 04:21	3.31
1670	0.370	173.7	01Jan2000, 04:04	3.31
1671	0.802	323.7	01Jan2000, 04:49	3.31
CC01	19.043	3889.1	01Jan2000, 11:54	3.31
CC03	17.269	3847.0	01Jan2000, 10:47	3.31
CC04	16.200	3800.8	01Jan2000, 10:11	3.31
CC05	15.232	3734.9	01Jan2000, 09:51	3.31
CC06	14.589	3683.9	01Jan2000, 09:22	3.31
CC07	14.472	3681.6	01Jan2000, 09:10	3.31
CC08	12.821	3508.4	01Jan2000, 08:23	3.31
CC09D	11.934	3307.7	01Jan2000, 07:56	3.31

Hydrologic Element	Drainage Area (MI2)	Peek Discharge (CFS)	Time of Peak	Volume (IN)
CC09U	8.771	2603.3	01Jan2000, 08:45	3.31
CC10	7.445	2438.1	01Jan2000, 07:16	3.31
CC11D	7.082	2386.5	01Jan2000, 06:22	3.31
CC11U	4.724	1589.4	01Jan2000, 06:29	3.31
CC12D	4.390	1531.6	01Jan2000, 05:53	3.31
CC12U	2.209	727.1	01Jan2000, 05:49	3.31
CC13	1.413	558.1	01Jan2000, 04:56	3.31
CCR1	19.043	3889.1	01Jan2000, 13:03	3.31
CCR10	7.445	2438.1	01Jan2000, 08:57	3.31
CCR11	7.082	2386.5	01Jan2000, 07:20	3.31
CCR12	4.390	1531.6	01Jan2000, 06:36	3.31
CCR13	1.413	558.1	01Jan2000, 06:30	3.31
CCR2	17.753	3855.0	01Jan2000, 12:00	3.31
CCR3	17.269	3847.0	01Jan2000, 11:25	3.31
CCR4	16.200	3800.8	01Jan2000, 10:55	3.31
CCR5	15.232	3734.9	01Jan2000, 10:21	3.31
CCR6	14.589	3683.9	01Jan2000, 10:00	3.31
CCR7	14.472	3681.6	01Jan2000, 09:23	3.31
CCR8	12.821	3508.4	01Jan2000, 09:35	3.31
CCR9	11.934	3307.7	01Jan2000, 08:37	3.31
Clay Creek	1.665	573.0	01Jan2000, 05:33	3.31
CLC01	1.438	511.3	01Jan2000, 05:15	3.31
CLCR1	1.438	511.3	01Jan2000, 05:50	3.31
Crooked Creek	19.959	3917.6	01Jan2000, 12:59	3.31
DC01	1.529	597.2	01Jan2000, 04:58	3.31
DCR1	1.529	597.2	01Jan2000, 06:22	3.31
Delaware Creek	2.181	805.2	01Jan2000, 05:56	3.31
HJC01	2.713	1120.0	01Jan2000, 05:15	3.31
HJC02	1.658	707.7	01Jan2000, 04:44	3.31
HJC03	0.673	290.5	01Jan2000, 04:28	3.31
HJCR1	2.713	1120.0	01Jan2000, 05:54	3.31
HJCR2	1.658	707.7	01Jan2000, 05:37	3.31
HJCR3	0.673	290.5	01Jan2000, 04:59	3.31
Howard Johnson	3.168	1283.0	01Jan2000, 05:47	3.31
Payne Branch	2.358	804.2	01Jan2000, 06:07	3.31

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
PB01	1.900	650.5	01Jan2000, 05:25	3.31
PBR1	1.900	650.5	01Jan2000, 06:22	3.31
SMR01	1.723	571.1	01Jan2000, 05:31	3.31
SMRR1	1.723	571.1	01Jan2000, 08:39	3.31
Spring Mill Run	2.502	646.6	01Jan2000, 08:12	3.31
WC01	20.902	4217.2	01Jan2000, 12:10	3.31
WC02	19.885	4196.8	01Jan2000, 11:14	3.31
WC03	18.622	4183.1	01Jan2000, 09:47	3.31
WC04	17.512	4142.6	01Jan2000, 08:56	3.31
WC05D	16.497	4070.2	01Jan2000, 08:37	3.31
WC05U	13.995	3433.8	01Jan2000, 08:45	3.31
WC06	13.351	3389.4	01Jan2000, 08:08	3.31
WC07	11.054	2995.3	01Jan2000, 08:01	3.31
WC08D	10.684	2955.4	01Jan2000, 07:24	3.31
WC08U	9.019	2543.9	01Jan2000, 07:56	3.31
WC09	8.252	2433.4	01Jan2000, 07:06	3.31
WC10	6.710	2092.5	01Jan2000, 07:28	3.31
WC11	4.818	1575.6	01Jan2000, 06:29	3.31
WC12	2.543	957.6	01Jan2000, 05:33	3.31
WC13	0.802	323.7	01Jan2000, 04:49	3.31
WCR1	20.902	4217.2	01Jan2000, 12:53	3.31
WCR10	6.710	2092.5	01Jan2000, 07:34	3.31
WCR11	4.818	1575.6	01Jan2000, 07:46	3.31
WCR12	2.543	957.6	01Jan2000, 07:14	3.31
WCR13	0.802	323.7	01Jan2000, 05:59	3.31
WCR2	19.885	4196.8	01Jan2000, 12:12	3.31
WCR3	18.622	4183.1	01Jan2000, 11:16	3.31
WCR4	17.512	4142.6	01Jan2000, 09:52	3.31
WCR5	16.497	4070.2	01Jan2000, 09:04	3.31
WCR6	13.351	3389.4	01Jan2000, 08:52	3.31
WCR7	11.054	2995.3	01Jan2000, 08:51	3.31
WCR8	10.684	2955.4	01Jan2000, 08:07	3.31
WCR9	8.252	2433.4	01Jan2000, 08:09	3.31
Williams Creek	21.252	4218.1	01Jan2000, 12:52	3.31

Predeveloped 1% - 24hr

Project: CBBEL Crooked& WilliamsSimulation Run: predev100yr 24hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:53:06

Basin Model: CW 1957CN
Meteorologic Model: 100 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	3770.7	01Jan2000, 13:22	3.79
1617	0.350	111.9	01Jan2000, 05:18	3.79
1618	0.916	248.7	01Jan2000, 07:02	3.79
1619	0.668	202.0	01Jan2000, 05:54	3.79
1620	0.622	175.3	01Jan2000, 06:39	3.79
1621	0.643	186.6	01Jan2000, 06:22	3.79
1622	0.117	40.7	01Jan2000, 04:41	3.79
1623	0.540	149.7	01Jan2000, 06:49	3.79
1624	0.529	169.0	01Jan2000, 05:18	3.79
1625	0.716	199.4	01Jan2000, 06:46	3.79
1626	0.252	83.9	01Jan2000, 04:58	3.79
1627	0.484	150.1	01Jan2000, 05:36	3.79
1628	0.456	131.7	01Jan2000, 06:25	3.79
1629	1.195	346.2	01Jan2000, 06:23	3.79
1630	0.887	221.8	01Jan2000, 07:55	3.79
1631	1.326	389.2	01Jan2000, 06:15	3.79
1632	0.450	132.3	01Jan2000, 06:14	3.79
1633	0.458	132.7	01Jan2000, 06:23	3.79
1634	0.334	117.6	01Jan2000, 04:37	3.79
1635	0.796	282.1	01Jan2000, 04:34	3.79
1636	0.652	201.5	01Jan2000, 05:38	3.79
1637	0.726	204.9	01Jan2000, 06:38	3.79
1638	0.803	236.5	01Jan2000, 06:13	3.79
1639	0.891	262.8	01Jan2000, 06:12	3.79
1640	1.009	254.1	01Jan2000, 07:51	3.79
1641	1.413	410.0	01Jan2000, 06:22	3.79
1642	0.363	121.6	01Jan2000, 04:55	3.79
1643	0.985	300.5	01Jan2000, 05:47	3.79
1644	1.055	323.6	01Jan2000, 05:43	3.79

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1645	0.673	206.0	01Jan2000, 05:45	3.79
1646	0.484	147.4	01Jan2000, 05:49	3.79
1647	0.779	269.9	01Jan2000, 04:42	3.79
1648	1.017	300.5	01Jan2000, 06:11	3.79
1649	0.528	163.8	01Jan2000, 05:35	3.79
1650	0.582	192.8	01Jan2000, 05:00	3.79
1651	0.663	207.6	01Jan2000, 05:30	3.79
1652	0.352	113.6	01Jan2000, 05:13	3.79
1653	0.779	247.9	01Jan2000, 05:20	3.79
1654	0.644	207.9	01Jan2000, 05:12	3.79
1655	0.931	261.5	01Jan2000, 06:41	3.79
1656	1.366	386.8	01Jan2000, 06:36	3.79
1657	0.227	80.4	01Jan2000, 04:34	3.79
1658	0.767	236.1	01Jan2000, 05:41	3.79
1659	1.528	457.4	01Jan2000, 06:03	3.79
1660	0.014	5.4	01Jan2000, 04:08	3.79
1661	1.220	299.9	01Jan2000, 08:07	3.79
1662	0.672	172.0	01Jan2000, 07:39	3.79
1663	1.498	415.3	01Jan2000, 06:49	3.79
1664	0.777	250.9	01Jan2000, 05:12	3.79
1665	1.741	486.5	01Jan2000, 06:44	3.79
1666	1.025	255.2	01Jan2000, 07:59	3.79
1667	0.698	207.2	01Jan2000, 06:08	3.79
1668	1.052	279.8	01Jan2000, 07:14	3.79
1669	0.386	120.0	01Jan2000, 05:34	3.79
1670	0.370	120.0	01Jan2000, 05:10	3.79
1671	0.802	235.8	01Jan2000, 06:14	3.79
CC01	19.043	3867.2	01Jan2000, 13:48	3.79
CC03	17.269	3737.1	01Jan2000, 12:48	3.79
CC04	16.200	3633.4	01Jan2000, 12:13	3.79
CC05	15.232	3517.2	01Jan2000, 11:51	3.79
CC06	14.589	3431.5	01Jan2000, 11:19	3.79
CC07	14.472	3420.3	01Jan2000, 11:07	3.79
CC08	12.821	3163.9	01Jan2000, 10:10	3.79
CC09D	11.934	2970.3	01Jan2000, 09:34	3.79

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC09U	8.771	2235.6	01Jan2000, 10:04	3.79
CC10	7.445	1985.7	01Jan2000, 08:37	3.79
CC11D	7.082	1910.6	01Jan2000, 07:43	3.79
CC11U	4.724	1285.8	01Jan2000, 07:44	3.79
CC12D	4.390	1211.9	01Jan2000, 07:08	3.79
CC12U	2.209	599.2	01Jan2000, 06:56	3.79
CC13	1.413	410.0	01Jan2000, 06:22	3.79
CCR1	19.043	3867.2	01Jan2000, 14:57	3.79
CCR10	7.445	1985.7	01Jan2000, 10:18	3.79
CCR11	7.082	1910.6	01Jan2000, 08:41	3.79
CCR12	4.390	1211.9	01Jan2000, 07:51	3.79
CCR13	1.413	410.0	01Jan2000, 07:56	3.79
CCR2	17.753	3770.7	01Jan2000, 13:59	3.79
CCR3	17.269	3737.1	01Jan2000, 13:26	3.79
CCR4	16.200	3633.4	01Jan2000, 12:57	3.79
CCR5	15.232	3517.2	01Jan2000, 12:21	3.79
CCR6	14.589	3431.5	01Jan2000, 11:57	3.79
CCR7	14.472	3420.3	01Jan2000, 11:20	3.79
CCR8	12.821	3163.9	01Jan2000, 11:22	3.79
CCR9	11.934	2970.3	01Jan2000, 10:15	3.79
Clay Creek	1.665	446.8	01Jan2000, 07:01	3.79
CLC01	1.438	390.3	01Jan2000, 06:51	3.79
CLCR1	1.438	390.3	01Jan2000, 07:26	3.79
Crooked Creek	19.959	3934.3	01Jan2000, 14:51	3.79
DC01	1.529	440.3	01Jan2000, 06:25	3.79
DCR1	1.529	440.3	01Jan2000, 07:49	3.79
Delaware Creek	2.181	615.7	01Jan2000, 07:22	3.79
HJC01	2.713	815.6	01Jan2000, 06:33	3.79
HJC02	1.658	505.1	01Jan2000, 06:01	3.79
HJC03	0.673	206.0	01Jan2000, 05:45	3.79
HJCR1	2.713	815.6	01Jan2000, 07:12	3.79
HJCR2	1.658	505.1	01Jan2000, 06:54	3.79
HJCR3	0.673	206.0	01Jan2000, 06:16	3.79
Howard Johnson	3.168	943.0	01Jan2000, 07:06	3.79
Payne Branch	2.358	625.0	01Jan2000, 07:41	3.79

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
PB01	1.900	502.2	01Jan2000, 07:02	3.79
PBR1	1.900	502.2	01Jan2000, 07:59	3.79
SMR01	1.723	446.7	01Jan2000, 07:12	3.79
SMRR1	1.723	446.7	01Jan2000, 10:20	3.79
Spring Mill Run	2.502	581.7	01Jan2000, 09:27	3.79
WC01	20.902	4134.5	01Jan2000, 13:49	3.79
WC02	19.885	4062.2	01Jan2000, 13:02	3.79
WC03	18.622	3983.0	01Jan2000, 11:47	3.79
WC04	17.512	3871.6	01Jan2000, 11:03	3.79
WC05D	16.497	3740.1	01Jan2000, 10:47	3.79
WC05U	13.995	3192.1	01Jan2000, 11:00	3.79
WC06	13.351	3110.7	01Jan2000, 10:22	3.79
WC07	11.054	2682.8	01Jan2000, 09:55	3.79
WC08D	10.684	2622.8	01Jan2000, 09:17	3.79
WC08U	9.019	2242.6	01Jan2000, 09:31	3.79
WC09	8.252	2093.7	01Jan2000, 08:38	3.79
WC10	6.710	1739.3	01Jan2000, 08:57	3.79
WC11	4.818	1285.2	01Jan2000, 07:55	3.79
WC12	2.543	718.7	01Jan2000, 06:59	3.79
WC13	0.802	235.8	01Jan2000, 06:14	3.79
WCR1	20.902	4134.5	01Jan2000, 14:32	3.79
WCR10	6.710	1739.3	01Jan2000, 09:03	3.79
WCR11	4.818	1285.2	01Jan2000, 09:12	3.79
WCR12	2.543	718.7	01Jan2000, 08:40	3.79
WCR13	0.802	235.8	01Jan2000, 07:24	3.79
WCR2	19.885	4062.2	01Jan2000, 14:00	3.79
WCR3	18.622	3983.0	01Jan2000, 13:16	3.79
WCR4	17.512	3871.6	01Jan2000, 11:59	3.79
WCR5	16.497	3740.1	01Jan2000, 11:14	3.79
WCR6	13.351	3110.7	01Jan2000, 11:06	3.79
WCR7	11.054	2682.8	01Jan2000, 10:45	3.79
WCR8	10.684	2622.8	01Jan2000, 10:00	3.79
WCR9	8.252	2093.7	01Jan2000, 09:41	3.79
Williams Creek	21.252	4148.4	01Jan2000, 14:30	3.79

Predeveloped 10% - 6r.

Project: CBBEL Crooked& WilliamsSimulation Run: predev10yr 6hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:54:20

Basin Model: CW 1957CN
Meteorologic Model: 10 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1645.8	01Jan2000, 10:21	1.31
1617	0.350	87.0	01Jan2000, 03:27	1.31
1618	0.916	157.5	01Jan2000, 04:41	1.31
1619	0.668	146.7	01Jan2000, 03:49	1.31
1620	0.622	115.9	01Jan2000, 04:23	1.31
1621	0.643	128.0	01Jan2000, 04:09	1.31
1622	0.117	35.0	01Jan2000, 02:57	1.31
1623	0.540	97.0	01Jan2000, 04:31	1.31
1624	0.529	131.4	01Jan2000, 03:28	1.31
1625	0.716	130.0	01Jan2000, 04:29	1.31
1626	0.252	68.4	01Jan2000, 03:12	1.31
1627	0.484	112.6	01Jan2000, 03:39	1.31
1628	0.456	89.7	01Jan2000, 04:12	1.31
1629	1.195	236.8	01Jan2000, 04:10	1.31
1630	0.887	128.6	01Jan2000, 05:23	1.31
1631	1.326	270.9	01Jan2000, 04:04	1.31
1632	0.450	92.3	01Jan2000, 04:03	1.31
1633	0.458	90.8	01Jan2000, 04:10	1.31
1634	0.334	102.6	01Jan2000, 02:52	1.31
1635	0.796	248.5	01Jan2000, 02:50	1.31
1636	0.652	150.5	01Jan2000, 03:40	1.31
1637	0.726	135.7	01Jan2000, 04:22	1.31
1638	0.803	165.4	01Jan2000, 04:02	1.31
1639	0.891	184.2	01Jan2000, 04:02	1.31
1640	1.009	148.5	01Jan2000, 05:20	1.31
1641	1.413	281.0	01Jan2000, 04:09	1.31
1642	0.363	99.9	01Jan2000, 03:10	1.31
1643	0.985	220.9	01Jan2000, 03:46	1.31
1644	1.055	239.3	01Jan2000, 03:44	1.31

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1645	0.673	152.1	01Jan2000, 03:44	1.31
1646	0.484	108.0	01Jan2000, 03:47	1.31
1647	0.779	230.8	01Jan2000, 02:58	1.31
1648	1.017	211.0	01Jan2000, 04:01	1.31
1649	0.528	122.9	01Jan2000, 03:39	1.31
1650	0.582	156.4	01Jan2000, 03:14	1.31
1651	0.663	157.6	01Jan2000, 03:35	1.31
1652	0.352	89.4	01Jan2000, 03:24	1.31
1653	0.779	191.8	01Jan2000, 03:29	1.31
1654	0.644	163.7	01Jan2000, 03:23	1.31
1655	0.931	172.2	01Jan2000, 04:24	1.31
1656	1.366	257.2	01Jan2000, 04:21	1.31
1657	0.227	70.8	01Jan2000, 02:50	1.31
1658	0.767	175.6	01Jan2000, 03:42	1.31
1659	1.528	327.2	01Jan2000, 03:55	1.31
1660	0.014	5.6	01Jan2000, 02:13	1.31
1661	1.220	170.9	01Jan2000, 05:33	1.31
1662	0.672	102.2	01Jan2000, 05:11	1.31
1663	1.498	269.3	01Jan2000, 04:31	1.31
1664	0.777	197.6	01Jan2000, 03:23	1.31
1665	1.741	318.3	01Jan2000, 04:27	1.31
1666	1.025	147.2	01Jan2000, 05:26	1.31
1667	0.698	146.6	01Jan2000, 03:58	1.31
1668	1.052	173.2	01Jan2000, 04:51	1.31
1669	0.386	90.2	01Jan2000, 03:38	1.31
1670	0.370	94.9	01Jan2000, 03:22	1.31
1671	0.802	164.5	01Jan2000, 04:03	1.31
CC01	19.043	1656.8	01Jan2000, 10:57	1.31
CC03	17.269	1643.5	01Jan2000, 09:44	1.31
CC04	16.200	1627.9	01Jan2000, 09:02	1.31
CC05	15.232	1603.6	01Jan2000, 08:35	1.31
CC06	14.589	1583.8	01Jan2000, 08:00	1.31
CC07	14.472	1583.5	01Jan2000, 07:47	1.31
CC08	12.821	1507.3	01Jan2000, 06:45	1.31
CC09D	11.934	1404.8	01Jan2000, 06:12	1.31

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC09U	8.771	1125.7	01Jan2000, 08:13	1.31
CC10	7.445	1081.0	01Jan2000, 06:39	1.31
CC11D	7.082	1070.0	01Jan2000, 05:43	1.31
CC11U	4.724	710.2	01Jan2000, 05:58	1.31
CC12D	4.390	699.4	01Jan2000, 05:18	1.31
CC12U	2.209	318.2	01Jan2000, 05:23	1.31
CC13	1.413	281.0	01Jan2000, 04:09	1.31
CCR1	19.043	1656.8	01Jan2000, 12:06	1.31
CCR10	7.445	1081.0	01Jan2000, 08:20	1.31
CCR11	7.082	1070.0	01Jan2000, 06:41	1.31
CCR12	4.390	699.4	01Jan2000, 06:01	1.31
CCR13	1.413	281.0	01Jan2000, 05:43	1.31
CCR2	17.753	1645.8	01Jan2000, 10:58	1.31
CCR3	17.269	1643.5	01Jan2000, 10:22	1.31
CCR4	16.200	1627.9	01Jan2000, 09:46	1.31
CCR5	15.232	1603.6	01Jan2000, 09:05	1.31
CCR6	14.589	1583.8	01Jan2000, 08:38	1.31
CCR7	14.472	1583.5	01Jan2000, 08:00	1.31
CCR8	12.821	1507.3	01Jan2000, 07:57	1.31
CCR9	11.934	1404.8	01Jan2000, 06:53	1.31
Clay Creek	1.665	266.5	01Jan2000, 04:42	1.31
CLC01	1.438	244.6	01Jan2000, 04:24	1.31
CLCR1	1.438	244.6	01Jan2000, 04:59	1.31
Crooked Creek	19.959	1666.4	01Jan2000, 12:05	1.31
DC01	1.529	299.2	01Jan2000, 04:11	1.31
DCR1	1.529	299.2	01Jan2000, 05:35	1.31
Delaware Creek	2.181	381.8	01Jan2000, 05:15	1.31
HJC01	2.713	560.3	01Jan2000, 04:31	1.31
HJC02	1.658	366.8	01Jan2000, 03:59	1.31
HJC03	0.673	152.1	01Jan2000, 03:44	1.31
HJCR1	2.713	560.3	01Jan2000, 05:10	1.31
HJCR2	1.658	366.8	01Jan2000, 04:52	1.31
HJCR3	0.673	152.1	01Jan2000, 04:15	1.31
Howard Johnson Ditch	3.168	634.2	01Jan2000, 05:04	1.31
Payne Branch	2.358	381.5	01Jan2000, 05:10	1.31

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
PB01	1.900	309.5	01Jan2000, 04:28	1.31
PBR1	1.900	309.5	01Jan2000, 05:25	1.31
SMR01	1.723	268.0	01Jan2000, 04:32	1.31
SMRR1	1.723	268.0	01Jan2000, 07:40	1.31
Spring Mill Run	2.502	287.7	01Jan2000, 07:28	1.31
WC01	20.902	1788.3	01Jan2000, 11:27	1.31
WC02	19.885	1782.7	01Jan2000, 10:29	1.31
WC03	18.622	1779.7	01Jan2000, 09:01	1.31
WC04	17.512	1771.0	01Jan2000, 08:06	1.31
WC05D	16.497	1752.7	01Jan2000, 07:42	1.31
WC05U	13.995	1467.3	01Jan2000, 07:46	1.31
WC06	13.351	1455.5	01Jan2000, 07:05	1.31
WC07	11.054	1293.8	01Jan2000, 06:40	1.31
WC08D	10.684	1278.9	01Jan2000, 06:01	1.31
WC08U	9.019	1077.8	01Jan2000, 06:38	1.31
WC09	8.252	1035.7	01Jan2000, 05:57	1.31
WC10	6.710	910.3	01Jan2000, 06:42	1.31
WC11	4.818	698.0	01Jan2000, 05:51	1.31
WC12	2.543	468.4	01Jan2000, 04:47	1.31
WC13	0.802	164.5	01Jan2000, 04:03	1.31
WCR1	20.902	1788.3	01Jan2000, 12:10	1.31
WCR10	6.710	910.3	01Jan2000, 06:48	1.31
WCR11	4.818	698.0	01Jan2000, 07:08	1.31
WCR12	2.543	468.4	01Jan2000, 06:28	1.31
WCR13	0.802	164.5	01Jan2000, 05:13	1.31
WCR2	19.885	1782.7	01Jan2000, 11:27	1.31
WCR3	18.622	1779.7	01Jan2000, 10:30	1.31
WCR4	17.512	1771.0	01Jan2000, 09:02	1.31
WCR5	16.497	1752.7	01Jan2000, 08:09	1.31
WCR6	13.351	1455.5	01Jan2000, 07:49	1.31
WCR7	11.054	1293.8	01Jan2000, 07:30	1.31
WCR8	10.684	1278.9	01Jan2000, 06:44	1.31
WCR9	8.252	1035.7	01Jan2000, 07:00	1.31
Williams Creek	21.252	1788.3	01Jan2000, 12:10	1.31

Predeveloped 10% - 12hr

Project: CBBEL Crooked& WilliamsSimulation Run: predev10yr 12hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:53:42

Basin Model: CW 1957CN
Meteorologic Model: 10 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1968.0	01Jan2000, 11:33	1.68
1617	0.350	82.7	01Jan2000, 04:22	1.68
1618	0.916	166.9	01Jan2000, 05:41	1.68
1619	0.668	145.0	01Jan2000, 04:47	1.68
1620	0.622	120.2	01Jan2000, 05:23	1.68
1621	0.643	130.3	01Jan2000, 05:08	1.68
1622	0.117	31.1	01Jan2000, 03:47	1.68
1623	0.540	101.6	01Jan2000, 05:31	1.68
1624	0.529	124.9	01Jan2000, 04:23	1.68
1625	0.716	135.8	01Jan2000, 05:28	1.68
1626	0.252	63.0	01Jan2000, 04:06	1.68
1627	0.484	109.3	01Jan2000, 04:35	1.68
1628	0.456	91.6	01Jan2000, 05:11	1.68
1629	1.195	241.3	01Jan2000, 05:10	1.68
1630	0.887	142.2	01Jan2000, 06:24	1.68
1631	1.326	273.6	01Jan2000, 05:03	1.68
1632	0.450	93.1	01Jan2000, 05:02	1.68
1633	0.458	92.5	01Jan2000, 05:09	1.68
1634	0.334	90.4	01Jan2000, 03:42	1.68
1635	0.796	217.5	01Jan2000, 03:39	1.68
1636	0.652	146.4	01Jan2000, 04:36	1.68
1637	0.726	140.6	01Jan2000, 05:22	1.68
1638	0.803	166.6	01Jan2000, 05:01	1.68
1639	0.891	185.4	01Jan2000, 05:00	1.68
1640	1.009	163.6	01Jan2000, 06:20	1.68
1641	1.413	286.1	01Jan2000, 05:09	1.68
1642	0.363	91.6	01Jan2000, 04:04	1.68
1643	0.985	216.8	01Jan2000, 04:42	1.68
1644	1.055	234.1	01Jan2000, 04:40	1.68

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1645	0.673	149.0	01Jan2000, 04:41	1.68
1646	0.484	106.2	01Jan2000, 04:44	1.68
1647	0.779	205.9	01Jan2000, 03:49	1.68
1648	1.017	212.2	01Jan2000, 04:59	1.68
1649	0.528	119.3	01Jan2000, 04:35	1.68
1650	0.582	144.6	01Jan2000, 04:08	1.68
1651	0.663	152.0	01Jan2000, 04:31	1.68
1652	0.352	84.4	01Jan2000, 04:18	1.68
1653	0.779	182.8	01Jan2000, 04:24	1.68
1654	0.644	154.4	01Jan2000, 04:18	1.68
1655	0.931	179.0	01Jan2000, 05:24	1.68
1656	1.366	266.0	01Jan2000, 05:20	1.68
1657	0.227	62.0	01Jan2000, 03:39	1.68
1658	0.767	171.3	01Jan2000, 04:38	1.68
1659	1.528	325.8	01Jan2000, 04:53	1.68
1660	0.014	4.4	01Jan2000, 03:07	1.68
1661	1.220	190.3	01Jan2000, 06:33	1.68
1662	0.672	111.7	01Jan2000, 06:11	1.68
1663	1.498	282.1	01Jan2000, 05:31	1.68
1664	0.777	186.3	01Jan2000, 04:18	1.68
1665	1.741	332.0	01Jan2000, 05:27	1.68
1666	1.025	163.1	01Jan2000, 06:27	1.68
1667	0.698	146.8	01Jan2000, 04:57	1.68
1668	1.052	185.6	01Jan2000, 05:51	1.68
1669	0.386	87.5	01Jan2000, 04:34	1.68
1670	0.370	89.2	01Jan2000, 04:17	1.68
1671	0.802	165.9	01Jan2000, 05:02	1.68
CC01	19.043	1985.2	01Jan2000, 12:04	1.68
CC03	17.269	1963.9	01Jan2000, 10:57	1.68
CC04	16.200	1940.4	01Jan2000, 10:20	1.68
CC05	15.232	1906.8	01Jan2000, 10:02	1.68
CC06	14.589	1880.9	01Jan2000, 09:32	1.68
CC07	14.472	1879.8	01Jan2000, 09:20	1.68
CC08	12.821	1791.4	01Jan2000, 08:34	1.68
CC09D	11.934	1686.9	01Jan2000, 08:06	1.68

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC09U	8.771	1329.8	01Jan2000, 08:58	1.68
CC10	7.445	1247.0	01Jan2000, 07:28	1.68
CC11D	7.082	1220.9	01Jan2000, 06:34	1.68
CC11U	4.724	812.8	01Jan2000, 06:41	1.68
CC12D	4.390	783.6	01Jan2000, 06:04	1.68
CC12U	2.209	371.7	01Jan2000, 06:00	1.68
CC13	1.413	286.1	01Jan2000, 05:09	1.68
CCR1	19.043	1985.2	01Jan2000, 13:13	1.68
CCR10	7.445	1247.0	01Jan2000, 09:09	1.68
CCR11	7.082	1220.9	01Jan2000, 07:32	1.68
CCR12	4.390	783.6	01Jan2000, 06:47	1.68
CCR13	1.413	286.1	01Jan2000, 06:43	1.68
CCR2	17.753	1968.0	01Jan2000, 12:10	1.68
CCR3	17.269	1963.9	01Jan2000, 11:35	1.68
CCR4	16.200	1940.4	01Jan2000, 11:04	1.68
CCR5	15.232	1906.8	01Jan2000, 10:32	1.68
CCR6	14.589	1880.9	01Jan2000, 10:10	1.68
CCR7	14.472	1879.8	01Jan2000, 09:33	1.68
CCR8	12.821	1791.4	01Jan2000, 09:46	1.68
CCR9	11.934	1688.9	01Jan2000, 08:47	1.68
Clay Creek	1.665	293.4	01Jan2000, 05:44	1.68
CLC01	1.438	261.8	01Jan2000, 05:27	1.68
CLCR1	1.438	261.8	01Jan2000, 06:02	1.68
Crooked Creek	19.959	1999.7	01Jan2000, 13:09	1.68
DC01	1.529	306.2	01Jan2000, 05:11	1.68
DCR1	1.529	306.2	01Jan2000, 06:35	1.68
Delaware Creek	2.181	412.2	01Jan2000, 06:08	1.68
HJC01	2.713	573.8	01Jan2000, 05:26	1.68
HJC02	1.658	363.0	01Jan2000, 04:56	1.68
HJC03	0.673	149.0	01Jan2000, 04:41	1.68
HJCR1	2.713	573.8	01Jan2000, 06:05	1.68
HJCR2	1.658	363.0	01Jan2000, 05:49	1.68
HJCR3	0.673	149.0	01Jan2000, 05:12	1.68
Howard Johnson Ditch	3.168	657.3	01Jan2000, 05:59	1.68
Payne Branch	2.358	412.0	01Jan2000, 06:18	1.68

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
PB01	1.900	333.1	01Jan2000, 05:35	1.68
PBR1	1.900	333.1	01Jan2000, 06:32	1.68
SMR01	1.723	292.3	01Jan2000, 05:42	1.68
SMRR1	1.723	292.3	01Jan2000, 08:50	1.68
Spring Mill Run	2.502	330.3	01Jan2000, 08:24	1.68
WC01	20.902	2152.4	01Jan2000, 12:21	1.68
WC02	19.885	2142.1	01Jan2000, 11:25	1.68
WC03	18.622	2135.3	01Jan2000, 09:58	1.68
WC04	17.512	2114.9	01Jan2000, 09:06	1.68
WC05D	16.497	2078.4	01Jan2000, 08:47	1.68
WC05U	13.995	1753.2	01Jan2000, 08:56	1.68
WC06	13.351	1730.9	01Jan2000, 08:19	1.68
WC07	11.054	1530.1	01Jan2000, 08:10	1.68
WC08D	10.684	1509.8	01Jan2000, 07:34	1.68
WC08U	9.019	1299.4	01Jan2000, 08:07	1.68
WC09	8.252	1243.4	01Jan2000, 07:17	1.68
WC10	6.710	1069.5	01Jan2000, 07:39	1.68
WC11	4.818	805.5	01Jan2000, 06:41	1.68
WC12	2.543	490.7	01Jan2000, 05:45	1.68
WC13	0.802	165.9	01Jan2000, 05:02	1.68
WCR1	20.902	2152.4	01Jan2000, 13:04	1.68
WCR10	6.710	1069.5	01Jan2000, 07:45	1.68
WCR11	4.818	805.5	01Jan2000, 07:58	1.68
WCR12	2.543	490.7	01Jan2000, 07:26	1.68
WCR13	0.802	165.9	01Jan2000, 06:12	1.68
WCR2	19.885	2142.1	01Jan2000, 12:23	1.68
WCR3	18.622	2135.3	01Jan2000, 11:27	1.68
WCR4	17.512	2114.9	01Jan2000, 10:02	1.68
WCR5	16.497	2078.4	01Jan2000, 09:14	1.68
WCR6	13.351	1730.9	01Jan2000, 09:03	1.68
WCR7	11.054	1530.1	01Jan2000, 09:00	1.68
WCR8	10.684	1509.8	01Jan2000, 08:17	1.68
WCR9	8.252	1243.4	01Jan2000, 08:20	1.68
Williams Creek	21.252	2152.8	01Jan2000, 13:04	1.68

Predeveloped 10% - 24hr

Project: CBBEL Crooked& WilliamsSimulation Run: pradev10yr 24hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:54:00

Basin Model: CW 1957CN
Meteorologic Model: 10 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	2098.2	01Jan2000, 13:46	2.11
1617	0.350	61.2	01Jan2000, 05:38	2.11
1618	0.916	137.6	01Jan2000, 07:24	2.11
1619	0.668	111.4	01Jan2000, 06:18	2.11
1620	0.622	96.9	01Jan2000, 07:01	2.11
1621	0.643	103.1	01Jan2000, 06:43	2.11
1622	0.117	22.3	01Jan2000, 04:51	2.11
1623	0.540	82.8	01Jan2000, 07:11	2.11
1624	0.529	92.5	01Jan2000, 05:39	2.11
1625	0.716	110.3	01Jan2000, 07:08	2.11
1626	0.252	45.8	01Jan2000, 05:13	2.11
1627	0.484	82.5	01Jan2000, 06:03	2.11
1628	0.456	72.7	01Jan2000, 06:46	2.11
1629	1.195	191.2	01Jan2000, 06:44	2.11
1630	0.887	123.1	01Jan2000, 08:18	2.11
1631	1.326	214.9	01Jan2000, 06:36	2.11
1632	0.450	73.1	01Jan2000, 06:35	2.11
1633	0.458	73.3	01Jan2000, 06:44	2.11
1634	0.334	64.4	01Jan2000, 04:46	2.11
1635	0.796	154.7	01Jan2000, 04:43	2.11
1636	0.652	110.8	01Jan2000, 06:05	2.11
1637	0.726	113.2	01Jan2000, 07:00	2.11
1638	0.803	130.6	01Jan2000, 06:34	2.11
1639	0.891	145.1	01Jan2000, 06:33	2.11
1640	1.009	141.1	01Jan2000, 08:14	2.11
1641	1.413	226.5	01Jan2000, 06:43	2.11
1642	0.363	66.4	01Jan2000, 05:09	2.11
1643	0.985	165.6	01Jan2000, 06:13	2.11
1644	1.055	178.2	01Jan2000, 06:10	2.11

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1645	0.673	113.5	01Jan2000, 06:11	2.11
1646	0.484	81.2	01Jan2000, 06:14	2.11
1647	0.779	147.6	01Jan2000, 04:53	2.11
1648	1.017	165.9	01Jan2000, 06:32	2.11
1649	0.528	90.0	01Jan2000, 06:02	2.11
1650	0.582	105.3	01Jan2000, 05:15	2.11
1651	0.663	113.9	01Jan2000, 05:54	2.11
1652	0.352	62.1	01Jan2000, 05:32	2.11
1653	0.779	135.7	01Jan2000, 05:42	2.11
1654	0.644	113.7	01Jan2000, 05:31	2.11
1655	0.931	144.5	01Jan2000, 07:02	2.11
1656	1.366	213.8	01Jan2000, 06:58	2.11
1657	0.227	44.1	01Jan2000, 04:44	2.11
1658	0.767	130.0	01Jan2000, 06:07	2.11
1659	1.528	252.5	01Jan2000, 06:24	2.11
1660	0.014	3.0	01Jan2000, 04:11	2.11
1661	1.220	166.5	01Jan2000, 08:29	2.11
1662	0.672	95.4	01Jan2000, 08:03	2.11
1663	1.498	229.6	01Jan2000, 07:11	2.11
1664	0.777	137.2	01Jan2000, 05:31	2.11
1665	1.741	268.9	01Jan2000, 07:06	2.11
1666	1.025	141.7	01Jan2000, 08:21	2.11
1667	0.698	114.4	01Jan2000, 06:29	2.11
1668	1.052	154.9	01Jan2000, 07:37	2.11
1669	0.386	65.9	01Jan2000, 06:01	2.11
1670	0.370	65.6	01Jan2000, 05:29	2.11
1671	0.802	130.2	01Jan2000, 06:35	2.11
CC01	19.043	2150.1	01Jan2000, 14:13	2.11
CC03	17.269	2080.2	01Jan2000, 13:12	2.11
CC04	16.200	2023.6	01Jan2000, 12:37	2.11
CC05	15.232	1959.3	01Jan2000, 12:14	2.11
CC06	14.589	1911.6	01Jan2000, 11:41	2.11
CC07	14.472	1905.6	01Jan2000, 11:29	2.11
CC08	12.821	1761.6	01Jan2000, 10:30	2.11
CC09D	11.934	1653.1	01Jan2000, 09:53	2.11

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC09U	8.771	1239.5	01Jan2000, 10:23	2.11
CC10	7.445	1099.3	01Jan2000, 09:00	2.11
CC11D	7.082	1057.6	01Jan2000, 08:10	2.11
CC11U	4.724	711.1	01Jan2000, 08:12	2.11
CC12D	4.390	669.5	01Jan2000, 07:39	2.11
CC12U	2.209	329.7	01Jan2000, 07:14	2.11
CC13	1.413	226.5	01Jan2000, 06:43	2.11
CCR1	19.043	2150.1	01Jan2000, 15:22	2.11
CCR10	7.445	1099.3	01Jan2000, 10:41	2.11
CCR11	7.082	1057.6	01Jan2000, 09:08	2.11
CCR12	4.390	669.5	01Jan2000, 08:22	2.11
CCR13	1.413	226.5	01Jan2000, 08:17	2.11
CCR2	17.753	2098.2	01Jan2000, 14:23	2.11
CCR3	17.269	2080.2	01Jan2000, 13:50	2.11
CCR4	16.200	2023.6	01Jan2000, 13:21	2.11
CCR5	15.232	1959.3	01Jan2000, 12:44	2.11
CCR6	14.589	1911.6	01Jan2000, 12:19	2.11
CCR7	14.472	1905.6	01Jan2000, 11:42	2.11
CCR8	12.821	1761.6	01Jan2000, 11:42	2.11
CCR9	11.934	1653.1	01Jan2000, 10:34	2.11
Clay Creek	1.665	247.1	01Jan2000, 07:26	2.11
CLC01	1.438	216.4	01Jan2000, 07:13	2.11
CLCR1	1.438	216.4	01Jan2000, 07:48	2.11
Crooked Creek	19.959	2186.3	01Jan2000, 15:14	2.11
DC01	1.529	243.3	01Jan2000, 06:46	2.11
DCR1	1.529	243.3	01Jan2000, 08:10	2.11
Delaware Creek	2.181	341.0	01Jan2000, 07:44	2.11
HJC01	2.713	450.4	01Jan2000, 06:58	2.11
HJC02	1.658	278.3	01Jan2000, 06:24	2.11
HJC03	0.673	113.5	01Jan2000, 06:11	2.11
HJCR1	2.713	450.4	01Jan2000, 07:37	2.11
HJCR2	1.658	278.3	01Jan2000, 07:17	2.11
HJCR3	0.673	113.5	01Jan2000, 06:42	2.11
Howard Johnson	3.163	520.9	01Jan2000, 07:31	2.11
Payne Branch	2.358	346.5	01Jan2000, 08:08	2.11

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
PB01	1.900	278.6	01Jan2000, 07:27	2.11
PBR1	1.900	278.6	01Jan2000, 08:24	2.11
SMR01	1.723	247.9	01Jan2000, 07:36	2.11
SMRR1	1.723	247.9	01Jan2000, 10:44	2.11
Spring Mill Run	2.502	322.5	01Jan2000, 09:47	2.11
WC01	20.902	2299.7	01Jan2000, 14:16	2.11
WC02	19.885	2261.2	01Jan2000, 13:27	2.11
WC03	18.622	2219.5	01Jan2000, 12:10	2.11
WC04	17.512	2157.8	01Jan2000, 11:24	2.11
WC05D	16.497	2084.4	01Jan2000, 11:07	2.11
WC05U	13.995	1778.4	01Jan2000, 11:19	2.11
WC06	13.351	1732.7	01Jan2000, 10:42	2.11
WC07	11.054	1492.0	01Jan2000, 10:15	2.11
WC08D	10.684	1458.1	01Jan2000, 09:37	2.11
WC08U	9.019	1245.3	01Jan2000, 09:53	2.11
WC09	8.252	1162.4	01Jan2000, 09:03	2.11
WC10	6.710	965.8	01Jan2000, 09:23	2.11
WC11	4.818	713.8	01Jan2000, 08:20	2.11
WC12	2.543	397.3	01Jan2000, 07:23	2.11
WC13	0.802	130.2	01Jan2000, 06:35	2.11
WCR1	20.902	2299.7	01Jan2000, 14:59	2.11
WCR10	6.710	965.8	01Jan2000, 09:29	2.11
WCR11	4.818	713.8	01Jan2000, 09:37	2.11
WCR12	2.543	397.3	01Jan2000, 09:04	2.11
WCR13	0.802	130.2	01Jan2000, 07:45	2.11
WCR2	19.885	2261.2	01Jan2000, 14:25	2.11
WCR3	18.622	2219.5	01Jan2000, 13:39	2.11
WCR4	17.512	2157.8	01Jan2000, 12:20	2.11
WCR5	16.497	2084.4	01Jan2000, 11:34	2.11
WCR6	13.351	1732.7	01Jan2000, 11:26	2.11
WCR7	11.054	1492.0	01Jan2000, 11:05	2.11
WCR8	10.684	1458.1	01Jan2000, 10:20	2.11
WCR9	8.252	1162.4	01Jan2000, 10:06	2.11
Williams Creek	21.252	2306.9	01Jan2000, 14:56	2.11

Predeveloped 50% - 6hr.

Project: CBBEL Crooked& WilliamsSimulation Run: predev2yr 6hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:55:11

Basin Model: CW 1957CN
Meteorologic Model: 2 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	779.5	01Jan2000, 10:30	0.62
1617	0.350	41.6	01Jan2000, 03:34	0.62
1618	0.916	74.8	01Jan2000, 04:49	0.62
1619	0.668	70.0	01Jan2000, 03:57	0.62
1620	0.622	55.1	01Jan2000, 04:31	0.62
1621	0.643	61.0	01Jan2000, 04:17	0.62
1622	0.117	16.8	01Jan2000, 03:04	0.62
1623	0.540	46.1	01Jan2000, 04:39	0.62
1624	0.529	62.9	01Jan2000, 03:35	0.62
1625	0.716	61.9	01Jan2000, 04:36	0.62
1626	0.252	32.8	01Jan2000, 03:19	0.62
1627	0.484	53.8	01Jan2000, 03:46	0.62
1628	0.456	42.7	01Jan2000, 04:19	0.62
1629	1.195	112.8	01Jan2000, 04:18	0.62
1630	0.887	61.0	01Jan2000, 05:31	0.62
1631	1.326	129.1	01Jan2000, 04:11	0.62
1632	0.450	44.0	01Jan2000, 04:10	0.62
1633	0.458	43.3	01Jan2000, 04:17	0.62
1634	0.334	49.4	01Jan2000, 03:00	0.62
1635	0.796	119.8	01Jan2000, 02:57	0.62
1636	0.652	71.9	01Jan2000, 03:47	0.62
1637	0.726	64.6	01Jan2000, 04:30	0.62
1638	0.803	78.8	01Jan2000, 04:10	0.62
1639	0.891	87.8	01Jan2000, 04:09	0.62
1640	1.009	70.4	01Jan2000, 05:27	0.62
1641	1.413	133.9	01Jan2000, 04:17	0.62
1642	0.363	47.9	01Jan2000, 03:17	0.62
1643	0.985	105.4	01Jan2000, 03:53	0.62
1644	1.055	114.3	01Jan2000, 03:51	0.62

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1645	0.673	72.6	01Jan2000, 03:51	0.62
1646	0.484	51.5	01Jan2000, 03:54	0.62
1647	0.779	111.0	01Jan2000, 03:05	0.62
1648	1.017	100.6	01Jan2000, 04:08	0.62
1649	0.528	58.7	01Jan2000, 03:46	0.62
1650	0.582	75.0	01Jan2000, 03:21	0.62
1651	0.663	75.3	01Jan2000, 03:42	0.62
1652	0.352	42.8	01Jan2000, 03:31	0.62
1653	0.779	91.7	01Jan2000, 03:36	0.62
1654	0.644	78.4	01Jan2000, 03:30	0.62
1655	0.931	81.9	01Jan2000, 04:32	0.62
1656	1.366	122.4	01Jan2000, 04:28	0.62
1657	0.227	34.1	01Jan2000, 02:57	0.62
1658	0.767	83.9	01Jan2000, 03:49	0.62
1659	1.528	156.1	01Jan2000, 04:02	0.62
1660	0.014	2.8	01Jan2000, 02:19	0.62
1661	1.220	81.0	01Jan2000, 05:41	0.62
1662	0.672	48.5	01Jan2000, 05:19	0.62
1663	1.498	128.1	01Jan2000, 04:38	0.62
1664	0.777	94.6	01Jan2000, 03:30	0.62
1665	1.741	151.4	01Jan2000, 04:35	0.62
1666	1.025	69.8	01Jan2000, 05:34	0.62
1667	0.698	69.9	01Jan2000, 04:06	0.62
1668	1.052	82.3	01Jan2000, 04:59	0.62
1669	0.386	43.1	01Jan2000, 03:45	0.62
1670	0.370	45.4	01Jan2000, 03:29	0.62
1671	0.802	78.4	01Jan2000, 04:11	0.62
CC01	19.043	784.7	01Jan2000, 11:05	0.62
CC03	17.269	778.4	01Jan2000, 09:52	0.62
CC04	16.200	771.1	01Jan2000, 09:10	0.62
CC05	15.232	759.7	01Jan2000, 08:42	0.62
CC06	14.589	750.3	01Jan2000, 08:06	0.62
CC07	14.472	750.1	01Jan2000, 07:53	0.62
CC08	12.821	713.9	01Jan2000, 06:50	0.62
CC09D	11.934	665.0	01Jan2000, 06:17	0.62

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC09U	8.771	532.5	01Jan2000, 08:21	0.62
CC10	7.445	511.7	01Jan2000, 06:47	0.62
CC11D	7.082	506.7	01Jan2000, 05:51	0.62
CC11U	4.724	336.7	01Jan2000, 06:07	0.62
CC12D	4.390	331.8	01Jan2000, 05:26	0.62
CC12U	2.209	150.8	01Jan2000, 05:32	0.62
CC13	1.413	133.9	01Jan2000, 04:17	0.62
CCR1	19.043	784.7	01Jan2000, 12:14	0.62
CCR10	7.445	511.7	01Jan2000, 08:28	0.62
CCR11	7.082	506.7	01Jan2000, 06:49	0.62
CCR12	4.390	331.8	01Jan2000, 06:09	0.62
CCR13	1.413	133.9	01Jan2000, 05:51	0.62
CCR2	17.753	779.5	01Jan2000, 11:07	0.62
CCR3	17.269	778.4	01Jan2000, 10:30	0.62
CCR4	16.200	771.1	01Jan2000, 09:54	0.62
CCR5	15.232	759.7	01Jan2000, 09:12	0.62
CCR6	14.589	750.3	01Jan2000, 08:44	0.62
CCR7	14.472	750.1	01Jan2000, 08:06	0.62
CCR8	12.821	713.9	01Jan2000, 08:02	0.62
CCR9	11.934	665.0	01Jan2000, 06:58	0.62
Clay Creek	1.665	126.3	01Jan2000, 04:49	0.62
CLC01	1.438	116.1	01Jan2000, 04:32	0.62
CLCR1	1.438	116.1	01Jan2000, 05:07	0.62
Crooked Creek	19.959	789.1	01Jan2000, 12:13	0.62
DC01	1.529	142.5	01Jan2000, 04:18	0.62
DCR1	1.529	142.5	01Jan2000, 05:42	0.62
Delaware Creek	2.181	181.3	01Jan2000, 05:23	0.62
HJC01	2.713	266.7	01Jan2000, 04:39	0.62
HJC02	1.658	175.0	01Jan2000, 04:06	0.62
HJC03	0.673	72.6	01Jan2000, 03:51	0.62
HJCR1	2.713	266.7	01Jan2000, 05:18	0.62
HJCR2	1.658	175.0	01Jan2000, 04:59	0.62
HJCR3	0.673	72.6	01Jan2000, 04:22	0.62
Howard Johnson	3.188	301.6	01Jan2000, 05:12	0.62
Payne Branch	2.358	181.2	01Jan2000, 05:17	0.62

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
PB01	1.900	146.9	01Jan2000, 04:35	0.62
PBR1	1.900	146.9	01Jan2000, 05:32	0.62
SMR01	1.723	127.1	01Jan2000, 04:39	0.62
SMRR1	1.723	127.1	01Jan2000, 07:47	0.62
Spring Mill Run	2.502	136.4	01Jan2000, 07:35	0.62
WC01	20.902	846.1	01Jan2000, 11:34	0.62
WC02	19.885	843.4	01Jan2000, 10:37	0.62
WC03	18.622	842.0	01Jan2000, 09:08	0.62
WC04	17.512	838.0	01Jan2000, 08:14	0.62
WC05D	16.497	829.4	01Jan2000, 07:49	0.62
WC05U	13.995	694.1	01Jan2000, 07:54	0.62
WC06	13.351	688.6	01Jan2000, 07:12	0.62
WC07	11.054	612.2	01Jan2000, 06:46	0.62
WC08D	10.684	605.1	01Jan2000, 06:07	0.62
WC08U	9.019	509.2	01Jan2000, 06:45	0.62
WC09	8.252	489.3	01Jan2000, 06:05	0.62
WC10	6.710	430.4	01Jan2000, 06:50	0.62
WC11	4.818	330.5	01Jan2000, 05:59	0.62
WC12	2.543	222.8	01Jan2000, 04:54	0.62
WC13	0.802	78.4	01Jan2000, 04:11	0.62
WCR1	20.902	846.1	01Jan2000, 12:17	0.62
WCR10	6.710	430.4	01Jan2000, 06:56	0.62
WCR11	4.818	330.5	01Jan2000, 07:16	0.62
WCR12	2.543	222.8	01Jan2000, 06:35	0.62
WCR13	0.802	78.4	01Jan2000, 05:21	0.62
WCR2	19.885	843.4	01Jan2000, 11:35	0.62
WCR3	18.622	842.0	01Jan2000, 10:37	0.62
WCR4	17.512	838.0	01Jan2000, 09:10	0.62
WCR5	16.497	829.4	01Jan2000, 08:16	0.62
WCR6	13.351	688.6	01Jan2000, 07:56	0.62
WCR7	11.054	612.2	01Jan2000, 07:36	0.62
WCR8	10.684	605.1	01Jan2000, 06:50	0.62
WCR9	8.252	489.3	01Jan2000, 07:08	0.62
Williams Creek	21.252	846.1	01Jan2000, 12:17	0.62

Predeveloped 50% - 12 hr

Project: CBBEL Crooked& WilliamsSimulation Run: predev2yr 12hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:54:37

Basin Model: CW 1957CN
Meteorologic Model: 2 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1009.1	01Jan2000, 11:43	0.86
1617	0.350	42.7	01Jan2000, 04:35	0.86
1618	0.916	86.0	01Jan2000, 05:54	0.86
1619	0.668	74.9	01Jan2000, 05:00	0.86
1620	0.622	62.0	01Jan2000, 05:35	0.86
1621	0.643	67.2	01Jan2000, 05:21	0.86
1622	0.117	16.1	01Jan2000, 04:01	0.86
1623	0.540	52.4	01Jan2000, 05:44	0.86
1624	0.529	64.5	01Jan2000, 04:35	0.86
1625	0.716	70.0	01Jan2000, 05:41	0.86
1626	0.252	32.6	01Jan2000, 04:18	0.86
1627	0.484	56.5	01Jan2000, 04:48	0.86
1628	0.456	47.3	01Jan2000, 05:24	0.86
1629	1.195	124.6	01Jan2000, 05:22	0.86
1630	0.887	73.2	01Jan2000, 06:36	0.86
1631	1.326	141.3	01Jan2000, 05:16	0.86
1632	0.450	48.1	01Jan2000, 05:15	0.86
1633	0.458	47.8	01Jan2000, 05:22	0.86
1634	0.334	46.8	01Jan2000, 03:55	0.86
1635	0.796	112.6	01Jan2000, 03:51	0.86
1636	0.652	75.6	01Jan2000, 04:50	0.86
1637	0.726	72.5	01Jan2000, 05:35	0.86
1638	0.803	86.1	01Jan2000, 05:14	0.86
1639	0.891	95.7	01Jan2000, 05:13	0.86
1640	1.009	84.2	01Jan2000, 06:33	0.86
1641	1.413	147.7	01Jan2000, 05:21	0.86
1642	0.363	47.4	01Jan2000, 04:16	0.86
1643	0.985	112.0	01Jan2000, 04:56	0.86
1644	1.055	120.9	01Jan2000, 04:53	0.86

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1645	0.673	76.9	01Jan2000, 04:54	0.86
1646	0.484	54.8	01Jan2000, 04:57	0.86
1647	0.779	106.7	01Jan2000, 04:03	0.86
1648	1.017	109.6	01Jan2000, 05:12	0.86
1649	0.528	61.6	01Jan2000, 04:48	0.86
1650	0.582	74.9	01Jan2000, 04:20	0.86
1651	0.663	78.5	01Jan2000, 04:44	0.86
1652	0.352	43.6	01Jan2000, 04:31	0.86
1653	0.779	94.5	01Jan2000, 04:37	0.86
1654	0.644	79.8	01Jan2000, 04:30	0.86
1655	0.931	92.3	01Jan2000, 05:37	0.86
1656	1.366	137.2	01Jan2000, 05:33	0.86
1657	0.227	32.1	01Jan2000, 03:52	0.86
1658	0.767	88.5	01Jan2000, 04:51	0.86
1659	1.528	168.3	01Jan2000, 05:06	0.86
1660	0.014	2.3	01Jan2000, 03:13	0.86
1661	1.220	97.9	01Jan2000, 06:46	0.86
1662	0.672	57.5	01Jan2000, 06:24	0.86
1663	1.498	145.5	01Jan2000, 05:43	0.86
1664	0.777	96.3	01Jan2000, 04:30	0.86
1665	1.741	171.2	01Jan2000, 05:40	0.86
1666	1.025	83.9	01Jan2000, 06:39	0.86
1667	0.698	75.8	01Jan2000, 05:10	0.86
1668	1.052	95.6	01Jan2000, 06:04	0.86
1669	0.386	45.2	01Jan2000, 04:47	0.86
1670	0.370	46.1	01Jan2000, 04:29	0.86
1671	0.802	85.7	01Jan2000, 05:15	0.86
CC01	19.043	1018.0	01Jan2000, 12:14	0.86
CC03	17.269	1007.0	01Jan2000, 11:07	0.86
CC04	16.200	995.1	01Jan2000, 10:32	0.86
CC05	15.232	978.0	01Jan2000, 10:12	0.86
CC06	14.589	964.7	01Jan2000, 09:42	0.86
CC07	14.472	964.2	01Jan2000, 09:30	0.86
CC08	12.821	919.1	01Jan2000, 08:45	0.86
CC09D	11.934	866.3	01Jan2000, 08:17	0.86

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC09U	8.771	683.1	01Jan2000, 09:10	0.86
CC10	7.445	641.1	01Jan2000, 07:39	0.86
CC11D	7.082	628.0	01Jan2000, 06:46	0.86
CC11U	4.724	417.8	01Jan2000, 06:52	0.86
CC12D	4.390	402.9	01Jan2000, 06:16	0.86
CC12U	2.209	190.9	01Jan2000, 06:11	0.86
CC13	1.413	147.7	01Jan2000, 05:21	0.86
CCR1	19.043	1018.0	01Jan2000, 13:23	0.86
CCR10	7.445	641.1	01Jan2000, 09:20	0.86
CCR11	7.082	628.0	01Jan2000, 07:44	0.86
CCR12	4.390	402.9	01Jan2000, 06:59	0.86
CCR13	1.413	147.7	01Jan2000, 06:55	0.86
CCR2	17.753	1009.1	01Jan2000, 12:20	0.86
CCR3	17.269	1007.0	01Jan2000, 11:45	0.86
CCR4	16.200	995.1	01Jan2000, 11:16	0.86
CCR5	15.232	978.0	01Jan2000, 10:42	0.86
CCR6	14.589	964.7	01Jan2000, 10:20	0.86
CCR7	14.472	964.2	01Jan2000, 09:43	0.86
CCR8	12.821	919.1	01Jan2000, 09:57	0.86
CCR9	11.934	866.3	01Jan2000, 08:58	0.86
Clay Creek	1.665	151.1	01Jan2000, 05:56	0.86
CLC01	1.438	134.9	01Jan2000, 05:39	0.86
CLCR1	1.438	134.9	01Jan2000, 06:14	0.86
Crooked Creek	19.959	1025.3	01Jan2000, 13:20	0.86
DC01	1.529	158.0	01Jan2000, 05:23	0.86
DCR1	1.529	158.0	01Jan2000, 06:47	0.86
Delaware Creek	2.181	212.2	01Jan2000, 06:20	0.86
HJC01	2.713	295.9	01Jan2000, 05:40	0.86
HJC02	1.658	187.4	01Jan2000, 05:08	0.86
HJC03	0.673	76.9	01Jan2000, 04:54	0.86
HJCR1	2.713	295.9	01Jan2000, 06:19	0.86
HJCR2	1.658	187.4	01Jan2000, 06:01	0.86
HJCR3	0.673	76.9	01Jan2000, 05:25	0.86
Howard Johnson	3.168	338.8	01Jan2000, 06:12	0.86
Payne Branch	2.358	212.2	01Jan2000, 06:29	0.86

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
PB01	1.900	171.5	01Jan2000, 05:47	0.86
PBR1	1.900	171.5	01Jan2000, 06:44	0.86
SMR01	1.723	150.5	01Jan2000, 05:55	0.86
SMRR1	1.723	150.5	01Jan2000, 09:03	0.86
Spring Mill Run	2.502	169.6	01Jan2000, 08:35	0.86
WC01	20.902	1103.5	01Jan2000, 12:32	0.86
WC02	19.885	1098.3	01Jan2000, 11:36	0.86
WC03	18.622	1094.9	01Jan2000, 10:09	0.86
WC04	17.512	1084.7	01Jan2000, 09:18	0.86
WC05D	16.497	1066.4	01Jan2000, 08:59	0.86
WC05U	13.995	899.3	01Jan2000, 09:08	0.86
WC06	13.351	888.3	01Jan2000, 08:32	0.86
WC07	11.054	785.3	01Jan2000, 08:21	0.86
WC08D	10.684	774.9	01Jan2000, 07:45	0.86
WC08U	9.019	667.0	01Jan2000, 08:19	0.86
WC09	8.252	638.4	01Jan2000, 07:28	0.86
WC10	6.710	549.4	01Jan2000, 07:51	0.86
WC11	4.818	414.1	01Jan2000, 06:53	0.86
WC12	2.543	252.9	01Jan2000, 05:57	0.86
WC13	0.802	85.7	01Jan2000, 05:15	0.86
WCR1	20.902	1103.5	01Jan2000, 13:15	0.86
WCR10	6.710	549.4	01Jan2000, 07:57	0.86
WCR11	4.818	414.1	01Jan2000, 08:10	0.86
WCR12	2.543	252.9	01Jan2000, 07:38	0.86
WCR13	0.802	85.7	01Jan2000, 06:25	0.86
WCR2	19.885	1098.3	01Jan2000, 12:34	0.86
WCR3	18.622	1094.9	01Jan2000, 11:38	0.86
WCR4	17.512	1084.7	01Jan2000, 10:14	0.86
WCR5	16.497	1066.4	01Jan2000, 09:26	0.86
WCR6	13.351	888.3	01Jan2000, 09:16	0.86
WCR7	11.054	785.3	01Jan2000, 09:11	0.86
WCR8	10.684	774.9	01Jan2000, 08:28	0.86
WCR9	8.252	638.4	01Jan2000, 08:31	0.86
Williams Creek	21.252	1103.7	01Jan2000, 13:15	0.86

Predeveloped @50% -24hr.

Project: CBBEL Crooked& WilliamsSimulation Run: predev2yr 24hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:54:53

Basin Model: CW 1957CN
Meteorologic Model: 2 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1159.4	01Jan2000, 14:10	1.16
1617	0.350	33.4	01Jan2000, 06:23	1.16
1618	0.916	75.6	01Jan2000, 07:57	1.16
1619	0.668	61.1	01Jan2000, 06:48	1.16
1620	0.622	53.2	01Jan2000, 07:31	1.16
1621	0.643	56.5	01Jan2000, 07:13	1.16
1622	0.117	11.9	01Jan2000, 05:05	1.16
1623	0.540	45.4	01Jan2000, 07:43	1.16
1624	0.529	50.5	01Jan2000, 06:23	1.16
1625	0.716	60.5	01Jan2000, 07:39	1.16
1626	0.252	24.7	01Jan2000, 05:37	1.16
1627	0.484	45.2	01Jan2000, 06:36	1.16
1628	0.456	39.9	01Jan2000, 07:16	1.16
1629	1.195	104.8	01Jan2000, 07:14	1.16
1630	0.887	67.9	01Jan2000, 08:46	1.16
1631	1.326	117.8	01Jan2000, 07:06	1.16
1632	0.450	40.0	01Jan2000, 07:05	1.16
1633	0.458	40.2	01Jan2000, 07:14	1.16
1634	0.334	34.5	01Jan2000, 04:58	1.16
1635	0.798	82.9	01Jan2000, 04:55	1.16
1636	0.652	60.7	01Jan2000, 06:37	1.16
1637	0.726	62.1	01Jan2000, 07:30	1.16
1638	0.803	71.6	01Jan2000, 07:04	1.16
1639	0.891	79.5	01Jan2000, 07:03	1.16
1640	1.009	77.7	01Jan2000, 08:42	1.16
1641	1.413	124.2	01Jan2000, 07:13	1.16
1642	0.363	35.7	01Jan2000, 05:31	1.16
1643	0.985	90.8	01Jan2000, 06:44	1.16
1644	1.055	97.6	01Jan2000, 06:41	1.16

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1645	0.673	62.2	01Jan2000, 06:42	1.16
1646	0.484	44.5	01Jan2000, 06:45	1.16
1647	0.779	79.1	01Jan2000, 05:08	1.16
1648	1.017	90.9	01Jan2000, 07:02	1.16
1649	0.528	49.3	01Jan2000, 06:36	1.16
1650	0.582	56.8	01Jan2000, 05:41	1.16
1651	0.663	62.4	01Jan2000, 06:31	1.16
1652	0.352	33.8	01Jan2000, 06:19	1.16
1653	0.779	74.1	01Jan2000, 06:25	1.16
1654	0.644	61.9	01Jan2000, 06:19	1.16
1655	0.931	79.3	01Jan2000, 07:34	1.16
1656	1.366	117.3	01Jan2000, 07:28	1.16
1657	0.227	23.6	01Jan2000, 04:55	1.16
1658	0.767	71.2	01Jan2000, 06:39	1.16
1659	1.528	138.4	01Jan2000, 06:54	1.16
1660	0.014	1.7	01Jan2000, 04:14	1.16
1661	1.220	91.8	01Jan2000, 08:57	1.16
1662	0.672	52.6	01Jan2000, 08:32	1.16
1663	1.498	126.1	01Jan2000, 07:42	1.16
1664	0.777	74.7	01Jan2000, 06:19	1.16
1665	1.741	147.6	01Jan2000, 07:37	1.16
1666	1.025	78.1	01Jan2000, 08:49	1.16
1667	0.698	62.7	01Jan2000, 06:59	1.16
1668	1.052	85.3	01Jan2000, 08:10	1.16
1669	0.386	36.1	01Jan2000, 06:35	1.16
1670	0.370	35.6	01Jan2000, 06:18	1.16
1671	0.802	71.4	01Jan2000, 07:05	1.16
CC01	19.043	1187.1	01Jan2000, 14:39	1.16
CC03	17.269	1149.7	01Jan2000, 13:35	1.16
CC04	16.200	1118.8	01Jan2000, 12:58	1.16
CC05	15.232	1083.1	01Jan2000, 12:35	1.16
CC06	14.589	1056.5	01Jan2000, 12:02	1.16
CC07	14.472	1053.2	01Jan2000, 11:49	1.16
CC08	12.821	972.5	01Jan2000, 10:50	1.16
CC09D	11.934	912.1	01Jan2000, 10:14	1.16

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC09U	8.771	681.7	01Jan2000, 10:50	1.16
CC10	7.445	605.7	01Jan2000, 09:31	1.16
CC11D	7.082	583.4	01Jan2000, 08:41	1.16
CC11U	4.724	392.5	01Jan2000, 08:44	1.16
CC12D	4.390	369.7	01Jan2000, 08:10	1.16
CC12U	2.209	182.4	01Jan2000, 08:12	1.16
CC13	1.413	124.2	01Jan2000, 07:13	1.16
CCR1	19.043	1187.1	01Jan2000, 15:48	1.16
CCR10	7.445	605.7	01Jan2000, 11:12	1.16
CCR11	7.082	583.4	01Jan2000, 09:39	1.16
CCR12	4.390	369.7	01Jan2000, 08:53	1.16
CCR13	1.413	124.2	01Jan2000, 08:47	1.16
CCR2	17.753	1159.4	01Jan2000, 14:47	1.16
CCR3	17.269	1149.7	01Jan2000, 14:13	1.16
CCR4	16.200	1118.8	01Jan2000, 13:42	1.16
CCR5	15.232	1083.1	01Jan2000, 13:05	1.16
CCR6	14.589	1056.5	01Jan2000, 12:40	1.16
CCR7	14.472	1053.2	01Jan2000, 12:02	1.16
CCR8	12.821	972.5	01Jan2000, 12:02	1.16
CCR9	11.934	912.1	01Jan2000, 10:55	1.16
Clay Creek	1.665	136.2	01Jan2000, 08:00	1.16
CLC01	1.438	118.9	01Jan2000, 07:37	1.16
CLCR1	1.438	118.9	01Jan2000, 08:12	1.16
Crooked Creek	19.959	1206.2	01Jan2000, 15:42	1.16
DC01	1.529	133.5	01Jan2000, 07:15	1.16
DCR1	1.529	133.5	01Jan2000, 08:39	1.16
Delaware Creek	2.181	187.3	01Jan2000, 08:08	1.16
HJC01	2.713	247.1	01Jan2000, 07:23	1.16
HJC02	1.658	152.6	01Jan2000, 06:55	1.16
HJC03	0.673	62.2	01Jan2000, 06:42	1.16
HJCR1	2.713	247.1	01Jan2000, 08:02	1.16
HJCR2	1.658	152.6	01Jan2000, 07:48	1.16
HJCR3	0.673	62.2	01Jan2000, 07:13	1.16
Howard Johnson	3.165	286.0	01Jan2000, 07:56	1.16
Payne Branch	2.358	191.0	01Jan2000, 08:33	1.16

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
PB01	1.900	153.5	01Jan2000, 07:54	1.16
PBR1	1.900	153.5	01Jan2000, 08:51	1.16
SMR01	1.723	136.7	01Jan2000, 08:03	1.16
SMRR1	1.723	136.7	01Jan2000, 11:11	1.16
Spring Mill Run	2.502	177.6	01Jan2000, 10:19	1.16
WC01	20.902	1269.3	01Jan2000, 14:42	1.16
WC02	19.885	1248.9	01Jan2000, 13:52	1.16
WC03	18.622	1226.8	01Jan2000, 12:32	1.16
WC04	17.512	1192.5	01Jan2000, 11:45	1.16
WC05D	16.497	1151.7	01Jan2000, 11:28	1.16
WC05U	13.995	982.3	01Jan2000, 11:40	1.16
WC06	13.351	957.0	01Jan2000, 11:03	1.16
WC07	11.054	823.2	01Jan2000, 10:41	1.16
WC08D	10.684	804.4	01Jan2000, 10:03	1.16
WC08U	9.019	687.0	01Jan2000, 10:21	1.16
WC09	8.252	641.6	01Jan2000, 09:30	1.16
WC10	6.710	533.0	01Jan2000, 09:48	1.16
WC11	4.818	393.6	01Jan2000, 08:43	1.16
WC12	2.543	218.3	01Jan2000, 07:52	1.16
WC13	0.802	71.4	01Jan2000, 07:05	1.16
WCR1	20.902	1269.3	01Jan2000, 15:25	1.16
WCR10	6.710	533.0	01Jan2000, 09:54	1.16
WCR11	4.818	393.6	01Jan2000, 10:00	1.16
WCR12	2.543	218.3	01Jan2000, 09:33	1.16
WCR13	0.802	71.4	01Jan2000, 08:15	1.16
WCR2	19.885	1248.9	01Jan2000, 14:50	1.16
WCR3	18.622	1226.8	01Jan2000, 14:01	1.16
WCR4	17.512	1192.5	01Jan2000, 12:41	1.16
WCR5	16.497	1151.7	01Jan2000, 11:55	1.16
WCR6	13.351	957.0	01Jan2000, 11:47	1.16
WCR7	11.054	823.2	01Jan2000, 11:31	1.16
WCR8	10.684	804.4	01Jan2000, 10:46	1.16
WCR9	8.252	641.6	01Jan2000, 10:33	1.16
Williams Creek	21.252	1273.0	01Jan2000, 15:23	1.16

APPENDIX A4-8

HEC-HMS Output – Existing Condition if No Detention

Project: CBBEL Crooked& WilliamsSimulation Run: 2008noDet 100 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:45:19

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 100 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

1% - 6hr

Current - no detention

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	3971.9	01Jan2000, 10:04	2.93
1617	0.350	156.8	01Jan2000, 03:17	2.49
1618	0.916	315.5	01Jan2000, 04:27	2.71
1619	0.668	305.5	01Jan2000, 03:37	2.85
1620	0.622	217.5	01Jan2000, 04:12	2.54
1621	0.643	214.1	01Jan2000, 04:01	2.27
1622	0.117	61.9	01Jan2000, 02:48	2.49
1623	0.540	151.3	01Jan2000, 04:25	2.10
1624	0.529	296.4	01Jan2000, 03:14	3.10
1625	0.716	202.8	01Jan2000, 04:22	2.10
1626	0.252	122.2	01Jan2000, 03:03	2.49
1627	0.484	221.1	01Jan2000, 03:27	2.71
1628	0.456	245.7	01Jan2000, 03:52	3.72
1629	1.195	541.0	01Jan2000, 03:53	3.12
1630	0.887	259.9	01Jan2000, 05:08	2.71
1631	1.326	516.2	01Jan2000, 03:53	2.59
1632	0.450	186.3	01Jan2000, 03:50	2.75
1633	0.458	176.9	01Jan2000, 03:58	2.64
1634	0.334	206.7	01Jan2000, 02:42	2.85
1635	0.796	743.4	01Jan2000, 02:29	4.24
1636	0.652	295.7	01Jan2000, 03:28	2.71
1637	0.726	233.3	01Jan2000, 04:13	2.33
1638	0.803	242.7	01Jan2000, 03:57	1.99
1639	0.891	444.9	01Jan2000, 03:47	3.26
1640	1.009	359.0	01Jan2000, 05:05	3.22
1641	1.413	680.2	01Jan2000, 03:55	3.26
1642	0.363	156.4	01Jan2000, 03:06	2.16
1643	0.985	591.9	01Jan2000, 03:28	3.65
1644	1.055	514.6	01Jan2000, 03:29	2.96
1645	0.673	449.7	01Jan2000, 03:23	4.04
1646	0.484	244.5	01Jan2000, 03:30	3.12

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	426.2	01Jan2000, 02:49	2.59
1648	1.017	464.2	01Jan2000, 03:46	3.00
1649	0.528	276.6	01Jan2000, 03:24	3.10
1650	0.582	352.4	01Jan2000, 02:59	3.16
1651	0.663	413.7	01Jan2000, 03:17	3.60
1652	0.352	200.0	01Jan2000, 03:08	3.12
1653	0.779	372.4	01Jan2000, 03:21	2.64
1654	0.644	362.4	01Jan2000, 03:12	3.02
1655	0.931	273.7	01Jan2000, 04:24	2.08
1656	1.366	644.0	01Jan2000, 04:05	3.37
1657	0.227	148.5	01Jan2000, 02:43	2.86
1658	0.767	358.9	01Jan2000, 03:34	2.73
1659	1.528	853.6	01Jan2000, 03:37	3.56
1660	0.014	9.2	01Jan2000, 02:12	2.16
1661	1.220	459.2	01Jan2000, 05:12	3.59
1662	0.672	247.0	01Jan2000, 04:56	3.22
1663	1.498	642.5	01Jan2000, 04:16	3.20
1664	0.777	508.4	01Jan2000, 03:06	3.56
1665	1.741	773.5	01Jan2000, 04:12	3.26
1666	1.025	348.9	01Jan2000, 05:12	3.15
1667	0.698	259.6	01Jan2000, 03:54	2.36
1668	1.052	430.4	01Jan2000, 04:34	3.34
1669	0.386	127.9	01Jan2000, 03:40	1.85
1670	0.370	210.0	01Jan2000, 03:10	3.02
1671	0.802	426.5	01Jan2000, 03:47	3.49
CC01	19.043	3995.0	01Jan2000, 10:40	2.92
CC03	17.269	3966.9	01Jan2000, 09:26	2.94
CC04	16.200	3937.8	01Jan2000, 08:44	2.96
CC05	15.232	3894.6	01Jan2000, 08:15	3.01
CC06	14.589	3856.9	01Jan2000, 07:39	3.04
CC07	14.472	3855.8	01Jan2000, 07:26	3.05
CC08	12.821	3657.4	01Jan2000, 06:23	3.02
CC09D	11.934	3439.6	01Jan2000, 05:48	3.04
CC09U	8.771	2458.9	01Jan2000, 07:47	2.92
CC10	7.445	2359.5	01Jan2000, 06:16	2.97
CC11D	7.082	2336.4	01Jan2000, 05:20	3.02
CC11U	4.724	1467.5	01Jan2000, 05:36	2.96
CC12D	4.390	1440.0	01Jan2000, 04:59	2.97

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	801.4	01Jan2000, 04:57	3.62
CC13	1.413	680.2	01Jan2000, 03:55	3.26
CCR1	19.043	3995.0	01Jan2000, 11:49	2.92
CCR10	7.445	2359.5	01Jan2000, 07:57	2.97
CCR11	7.082	2336.4	01Jan2000, 06:18	3.02
CCR12	4.390	1440.0	01Jan2000, 05:42	2.97
CCR13	1.413	680.2	01Jan2000, 05:29	3.26
CCR2	17.753	3971.9	01Jan2000, 10:41	2.93
CCR3	17.269	3966.9	01Jan2000, 10:04	2.94
CCR4	16.200	3937.8	01Jan2000, 09:28	2.96
CCR5	15.232	3894.6	01Jan2000, 08:45	3.01
CCR6	14.589	3856.9	01Jan2000, 08:17	3.04
CCR7	14.472	3855.8	01Jan2000, 07:39	3.05
CCR8	12.821	3657.4	01Jan2000, 07:35	3.02
CCR9	11.934	3439.6	01Jan2000, 06:29	3.04
Clay Creek	1.665	585.6	01Jan2000, 04:39	2.93
CLC01	1.438	540.7	01Jan2000, 04:18	2.94
CLCR1	1.438	540.7	01Jan2000, 04:53	2.94
Crooked Creek	19.959	4015.2	01Jan2000, 11:48	2.91
DC01	1.529	474.2	01Jan2000, 04:05	2.15
DCR1	1.529	474.2	01Jan2000, 05:29	2.15
Delaware Creek	2.181	638.6	01Jan2000, 05:00	2.32
HJC01	2.713	1460.9	01Jan2000, 04:16	3.48
HJC02	1.658	1029.9	01Jan2000, 03:40	3.81
HJC03	0.673	449.7	01Jan2000, 03:23	4.04
HJCR1	2.713	1460.9	01Jan2000, 04:55	3.48
HJCR2	1.658	1029.9	01Jan2000, 04:33	3.81
HJCR3	0.673	449.7	01Jan2000, 03:54	4.04
Howard Johnson Ditch	3.168	1613.8	01Jan2000, 04:50	3.38
J1619	0.668	305.5	01Jan2000, 03:37	2.85
J1623	0.540	151.3	01Jan2000, 04:25	2.10
J1628	0.456	245.7	01Jan2000, 03:52	3.72
J1630	0.887	259.9	01Jan2000, 05:08	2.71
J1633	0.458	176.9	01Jan2000, 03:58	2.64
J1634	0.334	206.7	01Jan2000, 02:42	2.85
J1635	0.796	743.4	01Jan2000, 02:29	4.24
J1636	0.652	295.7	01Jan2000, 03:28	2.71
J1637	0.726	233.3	01Jan2000, 04:13	2.33

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1638	0.803	242.7	01Jan2000, 03:57	1.99
J1640	1.009	359.0	01Jan2000, 05:05	3.22
J1643	0.985	591.9	01Jan2000, 03:28	3.65
J1644	1.055	514.6	01Jan2000, 03:29	2.96
J1646	0.484	244.5	01Jan2000, 03:30	3.12
J1649	0.528	276.6	01Jan2000, 03:24	3.10
J1651	0.663	413.7	01Jan2000, 03:17	3.60
J1653	0.779	372.4	01Jan2000, 03:21	2.64
J1654	0.644	362.4	01Jan2000, 03:12	3.02
J1655	0.931	273.7	01Jan2000, 04:24	2.08
J1656	1.366	644.0	01Jan2000, 04:05	3.37
J1658	0.767	358.9	01Jan2000, 03:34	2.73
J1659	1.528	853.6	01Jan2000, 03:37	3.56
J1661	1.220	459.2	01Jan2000, 05:12	3.59
J1662	0.672	247.0	01Jan2000, 04:56	3.22
J1663	1.498	642.5	01Jan2000, 04:16	3.20
J1664	0.777	508.4	01Jan2000, 03:06	3.56
J1666	1.025	348.9	01Jan2000, 05:12	3.15
J1667	0.698	259.6	01Jan2000, 03:54	2.36
J1668	1.052	430.4	01Jan2000, 04:34	3.34
J1669	0.386	127.9	01Jan2000, 03:40	1.85
Payne Branch	2.358	894.0	01Jan2000, 04:59	3.12
PB01	1.900	751.3	01Jan2000, 04:15	3.24
PBR1	1.900	751.3	01Jan2000, 05:12	3.24
SMR01	1.723	567.0	01Jan2000, 04:31	2.83
SMRR1	1.723	567.0	01Jan2000, 07:39	2.83
Spring Mill Run	2.502	602.9	01Jan2000, 07:28	2.77
WC01	20.902	4306.3	01Jan2000, 11:18	3.11
WC02	19.885	4294.4	01Jan2000, 10:21	3.12
WC03	18.622	4288.1	01Jan2000, 08:53	3.14
WC04	17.512	4269.2	01Jan2000, 07:58	3.14
WC05D	16.497	4224.8	01Jan2000, 07:34	3.13
WC05U	13.995	3622.7	01Jan2000, 07:36	3.19
WC06	13.351	3595.7	01Jan2000, 06:54	3.20
WC07	11.054	3243.3	01Jan2000, 06:27	3.27
WC08D	10.684	3208.4	01Jan2000, 05:49	3.28
WC08U	9.019	2740.5	01Jan2000, 06:18	3.34
WC09	8.252	2639.2	01Jan2000, 05:36	3.40

Global Summary Results for Run "2008noDet 100 yr 6 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: 2008noDet 100 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-10NoDet
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100 year / 6 hr 10%
Compute Time: 11May2010, 15:45:19 Control Specifications: Frequency Control

Volume Units: (•) IN. ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC05D	16.497	4224.8	01Jan2000, 07:34	3.13
WC05U	13.995	3622.7	01Jan2000, 07:36	3.19
WC06	13.351	3595.7	01Jan2000, 06:54	3.20
WC07	11.054	3243.3	01Jan2000, 06:27	3.27
WC08D	10.684	3208.4	01Jan2000, 05:49	3.28
WC08U	9.019	2740.5	01Jan2000, 06:18	3.34
WC09	8.252	2639.2	01Jan2000, 05:36	3.40
WC10	6.710	2296.4	01Jan2000, 05:25	3.37
WC11	4.818	1741.2	01Jan2000, 05:35	3.33
WC12	2.543	1168.0	01Jan2000, 04:32	3.34
WC13	0.802	426.5	01Jan2000, 03:47	3.49
WCR1	20.902	4306.3	01Jan2000, 12:01	3.11
WCR10	6.710	2296.4	01Jan2000, 06:31	3.37
WCR11	4.818	1741.2	01Jan2000, 06:52	3.33
WCR12	2.543	1168.0	01Jan2000, 06:13	3.34
WCR13	0.302	426.5	01Jan2000, 04:57	3.49
WCR2	19.885	4294.4	01Jan2000, 11:19	3.12
WCR3	18.622	4268.1	01Jan2000, 10:22	3.14
WCR4	17.512	4269.2	01Jan2000, 08:54	3.14
WCR5	16.497	4224.8	01Jan2000, 08:01	3.13
WCR6	13.351	3595.7	01Jan2000, 07:38	3.20
WCR7	11.054	3243.3	01Jan2000, 07:17	3.27
WCR8	10.684	3208.4	01Jan2000, 06:32	3.28
WCR9	8.252	2639.2	01Jan2000, 06:39	3.40
Williams Creek	21.252	4306.3	01Jan2000, 12:01	3.10

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: 2008noDet 100 yr12 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:44:40

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 100 year / 12 hr 10%
Control Specifications: Frequency Control

1% - 12 hr.

Volume Units: IN

Current: no detention

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	4200.9	01Jan2000, 10:54	3.45
1617	0.350	137.0	01Jan2000, 04:08	2.97
1618	0.916	304.4	01Jan2000, 05:22	3.20
1619	0.668	275.6	01Jan2000, 04:26	3.36
1620	0.622	206.8	01Jan2000, 05:07	3.02
1621	0.643	201.7	01Jan2000, 04:57	2.73
1622	0.117	50.9	01Jan2000, 03:32	2.97
1623	0.540	148.3	01Jan2000, 05:25	2.55
1624	0.529	257.2	01Jan2000, 04:00	3.64
1625	0.716	198.1	01Jan2000, 05:22	2.55
1626	0.252	103.8	01Jan2000, 03:50	2.97
1627	0.484	196.2	01Jan2000, 04:16	3.20
1628	0.456	225.1	01Jan2000, 04:38	4.29
1629	1.195	497.3	01Jan2000, 04:42	3.64
1630	0.887	261.1	01Jan2000, 06:05	3.20
1631	1.326	478.3	01Jan2000, 04:46	3.08
1632	0.450	171.4	01Jan2000, 04:41	3.25
1633	0.458	165.2	01Jan2000, 04:52	3.14
1634	0.334	167.9	01Jan2000, 03:22	3.36
1635	0.796	598.2	01Jan2000, 02:58	4.85
1636	0.652	262.9	01Jan2000, 04:18	3.20
1637	0.726	223.5	01Jan2000, 05:11	2.79
1638	0.803	229.0	01Jan2000, 04:56	2.42
1639	0.891	407.8	01Jan2000, 04:36	3.82
1640	1.009	359.5	01Jan2000, 05:59	3.78
1641	1.413	629.9	01Jan2000, 04:44	3.82
1642	0.363	134.2	01Jan2000, 03:58	2.61
1643	0.985	525.6	01Jan2000, 04:13	4.23
1644	1.055	457.6	01Jan2000, 04:17	3.47
1645	0.673	395.7	01Jan2000, 04:06	4.64
1646	0.484	217.5	01Jan2000, 04:18	3.64

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	351.7	01Jan2000, 03:33	3.08
1648	1.017	423.2	01Jan2000, 04:35	3.52
1649	0.528	244.0	01Jan2000, 04:11	3.62
1650	0.582	296.5	01Jan2000, 03:40	3.68
1651	0.663	360.7	01Jan2000, 04:01	4.17
1652	0.352	171.1	01Jan2000, 03:52	3.64
1653	0.779	329.5	01Jan2000, 04:11	3.15
1654	0.644	314.4	01Jan2000, 03:58	3.56
1655	0.931	272.7	01Jan2000, 05:25	2.57
1656	1.366	603.4	01Jan2000, 04:55	3.93
1657	0.227	121.7	01Jan2000, 03:23	3.40
1658	0.767	326.1	01Jan2000, 04:25	3.27
1659	1.528	767.2	01Jan2000, 04:23	4.12
1660	0.014	6.9	01Jan2000, 03:07	2.65
1661	1.220	456.8	01Jan2000, 06:03	4.15
1662	0.672	245.4	01Jan2000, 05:50	3.78
1663	1.498	611.6	01Jan2000, 05:08	3.76
1664	0.777	434.6	01Jan2000, 03:47	4.12
1665	1.741	732.4	01Jan2000, 05:04	3.82
1666	1.025	351.8	01Jan2000, 06:06	3.70
1667	0.698	244.6	01Jan2000, 04:49	2.86
1668	1.052	415.8	01Jan2000, 05:26	3.89
1669	0.386	120.2	01Jan2000, 04:39	2.31
1670	0.370	181.6	01Jan2000, 03:56	3.56
1671	0.802	391.0	01Jan2000, 04:35	4.07
CC01	19.043	4240.6	01Jan2000, 11:25	3.43
CC03	17.269	4190.5	01Jan2000, 10:17	3.45
CC04	16.200	4141.0	01Jan2000, 09:40	3.48
CC05	15.232	4074.0	01Jan2000, 09:16	3.53
CC06	14.589	4018.3	01Jan2000, 08:44	3.57
CC07	14.472	4014.7	01Jan2000, 08:32	3.57
CC08	12.821	3774.8	01Jan2000, 07:45	3.54
CC09D	11.934	3560.0	01Jan2000, 07:15	3.56
CC09U	8.771	2643.1	01Jan2000, 08:28	3.43
CC10	7.445	2475.7	01Jan2000, 07:00	3.50
CC11D	7.082	2427.0	01Jan2000, 06:06	3.54
CC11U	4.724	1552.1	01Jan2000, 06:13	3.48
CC12D	4.390	1489.4	01Jan2000, 05:39	3.49

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	859.0	01Jan2000, 05:21	4.19
CC13	1.413	629.9	01Jan2000, 04:44	3.82
CCR1	19.043	4240.6	01Jan2000, 12:34	3.43
CCR10	7.445	2475.7	01Jan2000, 08:41	3.50
CCR11	7.082	2427.0	01Jan2000, 07:04	3.54
CCR12	4.390	1489.4	01Jan2000, 06:22	3.49
CCR13	1.413	629.9	01Jan2000, 06:18	3.82
CCR2	17.753	4200.9	01Jan2000, 11:31	3.45
CCR3	17.269	4190.5	01Jan2000, 10:55	3.45
CCR4	16.200	4141.0	01Jan2000, 10:24	3.48
CCR5	15.232	4074.0	01Jan2000, 09:46	3.53
CCR6	14.589	4018.3	01Jan2000, 09:22	3.57
CCR7	14.472	4014.7	01Jan2000, 08:45	3.57
CCR8	12.821	3774.8	01Jan2000, 08:57	3.54
CCR9	11.934	3560.0	01Jan2000, 07:56	3.56
Clay Creek	1.665	592.1	01Jan2000, 05:31	3.46
CLC01	1.438	529.4	01Jan2000, 05:13	3.46
CLCR1	1.438	529.4	01Jan2000, 05:48	3.46
Crooked Creek	19.959	4272.3	01Jan2000, 12:31	3.42
DC01	1.529	451.9	01Jan2000, 05:04	2.60
DCR1	1.529	451.9	01Jan2000, 06:28	2.60
Delaware Creek	2.181	638.6	01Jan2000, 05:54	2.78
HJC01	2.713	1340.8	01Jan2000, 05:01	4.04
HJC02	1.658	916.7	01Jan2000, 04:23	4.40
HJC03	0.673	395.7	01Jan2000, 04:06	4.64
HJCR1	2.713	1340.8	01Jan2000, 05:40	4.04
HJCR2	1.658	916.7	01Jan2000, 05:16	4.40
HJCR3	0.673	395.7	01Jan2000, 04:37	4.64
Howard Johnson	3.168	1498.6	01Jan2000, 05:35	3.92
J1619	0.668	275.6	01Jan2000, 04:26	3.36
J1623	0.540	148.3	01Jan2000, 05:25	2.55
J1628	0.456	225.1	01Jan2000, 04:38	4.29
J1630	0.887	261.1	01Jan2000, 06:05	3.20
J1633	0.458	165.2	01Jan2000, 04:52	3.14
J1634	0.334	167.9	01Jan2000, 03:22	3.36
J1635	0.796	598.2	01Jan2000, 02:58	4.85
J1636	0.652	262.9	01Jan2000, 04:18	3.20
J1637	0.726	223.5	01Jan2000, 05:11	2.79

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1638	0.803	229.0	01Jan2000, 04:56	2.42
J1640	1.009	359.5	01Jan2000, 05:59	3.78
J1643	0.985	525.6	01Jan2000, 04:13	4.23
J1644	1.055	457.6	01Jan2000, 04:17	3.47
J1646	0.484	217.5	01Jan2000, 04:18	3.64
J1649	0.528	244.0	01Jan2000, 04:11	3.62
J1651	0.663	360.7	01Jan2000, 04:01	4.17
J1653	0.779	329.5	01Jan2000, 04:11	3.15
J1654	0.644	314.4	01Jan2000, 03:58	3.56
J1655	0.931	272.7	01Jan2000, 05:25	2.57
J1656	1.366	603.4	01Jan2000, 04:55	3.93
J1658	0.767	326.1	01Jan2000, 04:25	3.27
J1659	1.528	767.2	01Jan2000, 04:23	4.12
J1661	1.220	456.8	01Jan2000, 06:03	4.15
J1662	0.672	245.4	01Jan2000, 05:50	3.78
J1663	1.498	611.6	01Jan2000, 05:08	3.76
J1664	0.777	434.6	01Jan2000, 03:47	4.12
J1666	1.025	351.8	01Jan2000, 06:06	3.70
J1667	0.698	244.6	01Jan2000, 04:49	2.86
J1668	1.052	415.8	01Jan2000, 05:26	3.89
J1669	0.386	120.2	01Jan2000, 04:39	2.31
Payne Branch	2.358	877.2	01Jan2000, 05:58	3.67
PB01	1.900	732.9	01Jan2000, 05:14	3.80
PBR1	1.900	732.9	01Jan2000, 06:11	3.80
SMR01	1.723	573.9	01Jan2000, 05:32	3.36
SMRR1	1.723	573.9	01Jan2000, 08:40	3.36
Spring Mill Run	2.502	643.0	01Jan2000, 08:15	3.29
WC01	20.902	4712.0	01Jan2000, 12:06	3.66
WC02	19.885	4691.7	01Jan2000, 11:10	3.66
WC03	18.622	4678.1	01Jan2000, 09:43	3.69
WC04	17.512	4636.6	01Jan2000, 08:52	3.69
WC05D	16.497	4557.4	01Jan2000, 08:33	3.67
WC05U	13.995	3919.6	01Jan2000, 08:38	3.74
WC06	13.351	3871.6	01Jan2000, 08:01	3.75
WC07	11.054	3461.3	01Jan2000, 07:51	3.82
WC08D	10.684	3417.2	01Jan2000, 07:14	3.83
WC08U	9.019	2969.2	01Jan2000, 07:40	3.90
WC09	8.252	2845.6	01Jan2000, 06:50	3.96

Global Summary Results for Run "2008noDet 100 yr12 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: 2008noDet 100 yr12 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-10NoDet
End of Run: 03Jan2000, 00:00 Metsorologic Model: 100 year / 12 hr 10%
Compute Time: 11May2010, 15:44:40 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC08D	10.684	3417.2	01Jan2000, 07:14	3.83
WC08U	9.019	2969.2	01Jan2000, 07:40	3.90
WC09	8.252	2845.6	01Jan2000, 06:50	3.96
WC10	6.710	2430.8	01Jan2000, 07:14	3.93
WC11	4.818	1816.2	01Jan2000, 06:16	3.89
WC12	2.543	1109.0	01Jan2000, 05:21	3.90
WC13	0.802	391.0	01Jan2000, 04:35	4.07
WCR1	20.902	4712.0	01Jan2000, 12:49	3.66
WCR10	6.710	2430.8	01Jan2000, 07:20	3.93
WCR11	4.818	1816.2	01Jan2000, 07:33	3.89
WCR12	2.543	1109.0	01Jan2000, 07:02	3.90
WCR13	0.802	391.0	01Jan2000, 05:45	4.07
WCR2	19.885	4691.7	01Jan2000, 12:08	3.66
WCR3	18.622	4678.1	01Jan2000, 11:12	3.69
WCR4	17.512	4636.6	01Jan2000, 09:48	3.69
WCR5	16.497	4557.4	01Jan2000, 09:00	3.67
WCR6	13.351	3871.6	01Jan2000, 08:45	3.75
WCR7	11.054	3461.3	01Jan2000, 08:41	3.82
WCR8	10.684	3417.2	01Jan2000, 07:57	3.83
WCR9	8.252	2845.6	01Jan2000, 07:53	3.96
Williams Creek	21.252	4712.8	01Jan2000, 12:49	3.64

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Project: CBBEL Crooked& WilliamsSimulation Run: 2008noDet 100 yr 24 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:44:58

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 100 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

P/0 - 24 hr
Current: no detention

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	3879.4	01Jan2000, 12:42	3.91
1617	0.350	93.3	01Jan2000, 05:16	3.39
1618	0.916	227.8	01Jan2000, 06:50	3.64
1619	0.668	193.6	01Jan2000, 05:38	3.81
1620	0.622	151.8	01Jan2000, 06:36	3.45
1621	0.643	145.7	01Jan2000, 06:29	3.14
1622	0.117	33.5	01Jan2000, 04:41	3.39
1623	0.540	110.6	01Jan2000, 07:04	2.95
1624	0.529	177.0	01Jan2000, 05:04	4.12
1625	0.716	147.3	01Jan2000, 07:01	2.95
1626	0.252	69.5	01Jan2000, 04:57	3.39
1627	0.484	135.6	01Jan2000, 05:25	3.64
1628	0.456	163.6	01Jan2000, 05:43	4.80
1629	1.195	358.3	01Jan2000, 05:57	4.10
1630	0.887	204.5	01Jan2000, 07:42	3.64
1631	1.326	342.6	01Jan2000, 06:11	3.52
1632	0.450	122.4	01Jan2000, 06:02	3.69
1633	0.458	119.4	01Jan2000, 06:17	3.58
1634	0.334	110.2	01Jan2000, 04:32	3.81
1635	0.796	390.3	01Jan2000, 03:13	5.38
1636	0.652	182.1	01Jan2000, 05:27	3.64
1637	0.726	164.3	01Jan2000, 06:43	3.21
1638	0.803	164.2	01Jan2000, 06:32	2.81
1639	0.891	293.1	01Jan2000, 05:48	4.31
1640	1.009	282.3	01Jan2000, 07:29	4.27
1641	1.413	457.3	01Jan2000, 06:00	4.31
1642	0.363	89.6	01Jan2000, 05:05	3.02
1643	0.985	371.7	01Jan2000, 05:13	4.74
1644	1.055	319.0	01Jan2000, 05:24	3.93
1645	0.673	280.4	01Jan2000, 05:00	5.16
1646	0.484	152.3	01Jan2000, 05:22	4.10

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	232.4	01Jan2000, 04:42	3.52
1648	1.017	301.6	01Jan2000, 05:48	3.98
1649	0.528	169.6	01Jan2000, 05:16	4.09
1650	0.582	199.9	01Jan2000, 04:44	4.15
1651	0.663	251.5	01Jan2000, 05:01	4.68
1652	0.352	116.7	01Jan2000, 04:55	4.10
1653	0.779	226.8	01Jan2000, 05:20	3.60
1654	0.644	216.0	01Jan2000, 05:03	4.04
1655	0.931	205.6	01Jan2000, 07:06	3.00
1656	1.366	444.3	01Jan2000, 06:12	4.43
1657	0.227	80.7	01Jan2000, 04:33	3.88
1658	0.767	229.6	01Jan2000, 05:40	3.74
1659	1.528	546.3	01Jan2000, 05:25	4.62
1660	0.014	4.5	01Jan2000, 04:11	3.10
1661	1.220	360.4	01Jan2000, 07:27	4.65
1662	0.672	191.1	01Jan2000, 07:19	4.27
1663	1.498	455.6	01Jan2000, 06:29	4.24
1664	0.777	298.6	01Jan2000, 04:48	4.62
1665	1.741	543.5	01Jan2000, 06:23	4.31
1666	1.025	278.0	01Jan2000, 07:39	4.19
1667	0.698	176.3	01Jan2000, 06:20	3.30
1668	1.052	315.8	01Jan2000, 06:47	4.38
1669	0.386	84.7	01Jan2000, 06:16	2.72
1670	0.370	124.6	01Jan2000, 05:01	4.04
1671	0.802	282.6	01Jan2000, 05:44	4.58
CC01	19.043	3985.6	01Jan2000, 13:12	3.89
CC03	17.269	3841.6	01Jan2000, 12:07	3.91
CC04	16.200	3732.9	01Jan2000, 11:30	3.94
CC05	15.232	3621.1	01Jan2000, 11:07	3.99
CC06	14.589	3537.4	01Jan2000, 10:34	4.03
CC07	14.472	3525.0	01Jan2000, 10:22	4.04
CC08	12.821	3227.8	01Jan2000, 09:34	4.00
CC09D	11.934	3041.9	01Jan2000, 09:01	4.03
CC09U	8.771	2216.4	01Jan2000, 09:47	3.89
CC10	7.445	1983.4	01Jan2000, 08:19	3.96
CC11D	7.082	1919.4	01Jan2000, 07:24	4.01
CC11U	4.724	1247.2	01Jan2000, 07:24	3.94
CC12D	4.390	1174.1	01Jan2000, 06:49	3.95

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	702.8	01Jan2000, 06:33	4.70
CC13	1.413	457.3	01Jan2000, 06:00	4.31
CCR1	19.043	3985.6	01Jan2000, 14:21	3.89
CCR10	7.445	1983.4	01Jan2000, 10:00	3.96
CCR11	7.082	1919.4	01Jan2000, 08:22	4.01
CCR12	4.390	1174.1	01Jan2000, 07:32	3.95
CCR13	1.413	457.3	01Jan2000, 07:34	4.31
CCR2	17.753	3879.4	01Jan2000, 13:19	3.91
CCR3	17.269	3841.6	01Jan2000, 12:45	3.91
CCR4	16.200	3732.9	01Jan2000, 12:14	3.94
CCR5	15.232	3621.1	01Jan2000, 11:37	3.99
CCR6	14.589	3537.4	01Jan2000, 11:12	4.03
CCR7	14.472	3525.0	01Jan2000, 10:35	4.04
CCR8	12.821	3227.8	01Jan2000, 10:46	4.00
CCR9	11.934	3041.9	01Jan2000, 09:42	4.03
Clay Creek	1.665	458.3	01Jan2000, 06:52	3.93
CLC01	1.438	399.9	01Jan2000, 06:42	3.93
CLCR1	1.438	399.9	01Jan2000, 07:17	3.93
Crooked Creek	19.959	4057.6	01Jan2000, 14:16	3.88
DC01	1.529	328.4	01Jan2000, 06:37	3.00
DCR1	1.529	328.4	01Jan2000, 08:01	3.00
Delaware Creek	2.181	482.0	01Jan2000, 07:26	3.19
HJC01	2.713	962.7	01Jan2000, 06:02	4.53
HJC02	1.658	651.2	01Jan2000, 05:21	4.91
HJC03	0.673	280.4	01Jan2000, 05:00	5.16
HJCR1	2.713	962.7	01Jan2000, 06:41	4.53
HJCR2	1.658	651.2	01Jan2000, 06:14	4.91
HJCR3	0.673	280.4	01Jan2000, 05:31	5.16
Howard Johnson Ditch	3.168	1083.2	01Jan2000, 06:37	4.41
J1619	0.668	193.6	01Jan2000, 05:38	3.81
J1623	0.540	110.6	01Jan2000, 07:04	2.95
J1628	0.456	163.6	01Jan2000, 05:43	4.80
J1630	0.887	204.5	01Jan2000, 07:42	3.64
J1633	0.458	119.4	01Jan2000, 06:17	3.58
J1634	0.334	110.2	01Jan2000, 04:32	3.81
J1635	0.796	390.3	01Jan2000, 03:13	5.38
J1636	0.652	182.1	01Jan2000, 05:27	3.64
J1637	0.726	164.3	01Jan2000, 06:43	3.21

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1638	0.803	164.2	01Jan2000, 06:32	2.81
J1640	1.009	282.3	01Jan2000, 07:29	4.27
J1643	0.985	371.7	01Jan2000, 05:13	4.74
J1644	1.055	319.0	01Jan2000, 05:24	3.93
J1646	0.484	152.3	01Jan2000, 05:22	4.10
J1649	0.528	169.6	01Jan2000, 05:16	4.09
J1651	0.663	251.5	01Jan2000, 05:01	4.68
J1653	0.779	226.8	01Jan2000, 05:20	3.60
J1654	0.644	216.0	01Jan2000, 05:03	4.04
J1655	0.931	205.6	01Jan2000, 07:06	3.00
J1656	1.366	444.3	01Jan2000, 06:12	4.43
J1658	0.767	229.6	01Jan2000, 05:40	3.74
J1659	1.528	546.3	01Jan2000, 05:25	4.62
J1661	1.220	360.4	01Jan2000, 07:27	4.65
J1662	0.672	191.1	01Jan2000, 07:19	4.27
J1663	1.498	455.6	01Jan2000, 06:29	4.24
J1664	0.777	298.6	01Jan2000, 04:48	4.62
J1666	1.025	278.0	01Jan2000, 07:39	4.19
J1667	0.698	176.3	01Jan2000, 06:20	3.30
J1668	1.052	315.8	01Jan2000, 06:47	4.38
J1669	0.386	84.7	01Jan2000, 06:16	2.72
Payne Branch	2.358	672.3	01Jan2000, 07:23	4.15
PB01	1.900	559.0	01Jan2000, 06:37	4.29
PBR1	1.900	559.0	01Jan2000, 07:34	4.29
SMR01	1.723	447.0	01Jan2000, 07:09	3.83
SMRR1	1.723	447.0	01Jan2000, 10:17	3.83
Spring Mill Run	2.502	573.3	01Jan2000, 09:28	3.76
WC01	20.902	4536.4	01Jan2000, 13:37	4.14
WC02	19.885	4462.1	01Jan2000, 12:46	4.14
WC03	18.622	4379.0	01Jan2000, 11:26	4.17
WC04	17.512	4259.3	01Jan2000, 10:43	4.17
WC05D	16.497	4114.1	01Jan2000, 10:27	4.16
WC05U	13.995	3560.2	01Jan2000, 10:37	4.23
WC06	13.351	3471.2	01Jan2000, 09:59	4.23
WC07	11.054	3024.0	01Jan2000, 09:32	4.31
WC08D	10.684	2958.2	01Jan2000, 08:53	4.32
WC08U	9.019	2556.5	01Jan2000, 09:07	4.40
WC09	8.252	2399.4	01Jan2000, 08:13	4.46

Global Summary Results for Run "2008noDet 100 yr 24 hr 10%"

Project: CBBEL Crooked & Williams Simulation Run: 2008noDet 100 yr 24 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-10NoDet
End of Run: 09Jan2000, 00:00 Meteorologic Model: 100 year / 24 hr 10%
Compute Time: 11May2010, 15:44:58 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC05U	13.995	3550.2	01Jan2000, 10:37	4.23
WC06	13.351	3471.2	01Jan2000, 09:59	4.23
WC07	11.054	3024.0	01Jan2000, 09:32	4.31
WC08D	10.684	2958.2	01Jan2000, 08:53	4.32
WC08U	9.019	2556.5	01Jan2000, 09:07	4.40
WC09	8.252	2399.4	01Jan2000, 08:13	4.46
WC10	6.710	1986.6	01Jan2000, 08:29	4.42
WC11	4.818	1457.8	01Jan2000, 07:27	4.39
WC12	2.543	823.6	01Jan2000, 06:35	4.40
WC13	0.802	282.6	01Jan2000, 05:44	4.58
WCR1	20.902	4536.4	01Jan2000, 14:20	4.14
WCR10	6.710	1986.6	01Jan2000, 08:35	4.42
WCR11	4.818	1457.8	01Jan2000, 08:44	4.39
WCR12	2.543	823.6	01Jan2000, 08:16	4.40
WCR13	0.802	282.6	01Jan2000, 06:54	4.58
WCR2	19.885	4452.1	01Jan2000, 13:44	4.14
WCR3	18.622	4379.0	01Jan2000, 12:55	4.17
WCR4	17.512	4259.3	01Jan2000, 11:39	4.17
WCR5	16.497	4114.1	01Jan2000, 10:54	4.16
WCR6	13.351	3471.2	01Jan2000, 10:43	4.23
WCR7	11.054	3024.0	01Jan2000, 10:22	4.31
WCR8	10.684	2958.2	01Jan2000, 09:36	4.32
WCR9	11.054 52	2399.4	01Jan2000, 09:16	4.46
Williams Creek	21.252	4549.6	01Jan2000, 14:19	4.12

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: 2008noDet 10 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:46:21

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 10 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Current modification 10% - 6 hr.

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	2176.6	01Jan2000, 10:09	1.57
1617	0.350	78.6	01Jan2000, 03:17	1.28
1618	0.916	165.3	01Jan2000, 04:26	1.43
1619	0.668	160.1	01Jan2000, 03:37	1.51
1620	0.622	110.2	01Jan2000, 04:11	1.30
1621	0.643	103.7	01Jan2000, 04:00	1.12
1622	0.117	30.8	01Jan2000, 02:49	1.28
1623	0.540	70.1	01Jan2000, 04:26	0.99
1624	0.529	157.5	01Jan2000, 03:16	1.67
1625	0.716	94.0	01Jan2000, 04:23	0.99
1626	0.252	61.1	01Jan2000, 03:04	1.28
1627	0.484	115.1	01Jan2000, 03:26	1.43
1628	0.456	140.4	01Jan2000, 03:53	2.13
1629	1.195	297.8	01Jan2000, 03:52	1.73
1630	0.887	136.5	01Jan2000, 05:06	1.43
1631	1.326	261.7	01Jan2000, 03:53	1.33
1632	0.450	97.4	01Jan2000, 03:50	1.46
1633	0.458	90.0	01Jan2000, 03:59	1.36
1634	0.334	107.4	01Jan2000, 02:43	1.51
1635	0.796	442.8	01Jan2000, 02:31	2.53
1636	0.652	153.9	01Jan2000, 03:28	1.43
1637	0.726	113.5	01Jan2000, 04:13	1.15
1638	0.803	111.0	01Jan2000, 03:57	0.93
1639	0.891	237.9	01Jan2000, 03:50	1.75
1640	1.009	189.8	01Jan2000, 05:08	1.71
1641	1.413	363.8	01Jan2000, 03:58	1.75
1642	0.363	71.9	01Jan2000, 03:08	1.02
1643	0.985	332.0	01Jan2000, 03:30	2.06
1644	1.055	276.1	01Jan2000, 03:29	1.61
1645	0.673	262.9	01Jan2000, 03:25	2.37
1646	0.484	134.3	01Jan2000, 03:30	1.73

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	213.7	01Jan2000, 02:51	1.33
1648	1.017	249.8	01Jan2000, 03:45	1.63
1649	0.528	149.1	01Jan2000, 03:24	1.69
1650	0.582	193.1	01Jan2000, 02:59	1.75
1651	0.663	232.5	01Jan2000, 03:19	2.04
1652	0.352	109.6	01Jan2000, 03:08	1.73
1653	0.779	181.9	01Jan2000, 03:25	1.30
1654	0.644	187.2	01Jan2000, 03:15	1.57
1655	0.931	113.6	01Jan2000, 04:33	0.86
1656	1.366	349.0	01Jan2000, 04:08	1.83
1657	0.227	73.7	01Jan2000, 02:48	1.41
1658	0.767	173.8	01Jan2000, 03:40	1.32
1659	1.528	478.7	01Jan2000, 03:38	2.01
1660	0.014	4.1	01Jan2000, 02:19	0.91
1661	1.220	261.1	01Jan2000, 05:12	2.05
1662	0.672	130.6	01Jan2000, 04:59	1.71
1663	1.498	341.9	01Jan2000, 04:19	1.71
1664	0.777	284.6	01Jan2000, 03:07	2.01
1665	1.741	413.9	01Jan2000, 04:15	1.75
1666	1.025	183.2	01Jan2000, 05:15	1.66
1667	0.698	118.3	01Jan2000, 03:59	1.08
1668	1.052	236.2	01Jan2000, 04:35	1.84
1669	0.386	50.1	01Jan2000, 03:50	0.71
1670	0.370	108.4	01Jan2000, 03:14	1.57
1671	0.802	232.2	01Jan2000, 03:51	1.90
CC01	19.043	2187.9	01Jan2000, 10:45	1.56
CC03	17.269	2174.2	01Jan2000, 09:31	1.57
CC04	16.200	2160.7	01Jan2000, 08:48	1.59
CC05	15.232	2141.1	01Jan2000, 08:20	1.62
CC06	14.589	2123.3	01Jan2000, 07:43	1.64
CC07	14.472	2122.8	01Jan2000, 07:30	1.65
CC08	12.821	2014.8	01Jan2000, 06:26	1.62
CC09D	11.934	1901.5	01Jan2000, 05:49	1.64
CC09U	8.771	1299.9	01Jan2000, 07:38	1.55
CC10	7.445	1245.1	01Jan2000, 06:09	1.58
CC11D	7.082	1233.1	01Jan2000, 05:14	1.61
CC11U	4.724	766.7	01Jan2000, 05:28	1.59
CC12D	4.390	750.0	01Jan2000, 04:52	1.60

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	468.0	01Jan2000, 02:45	2.03
CC13	1.413	363.8	01Jan2000, 03:58	1.75
CCR1	19.043	2187.9	01Jan2000, 11:54	1.56
CCR10	7.445	1245.1	01Jan2000, 07:50	1.58
CCR11	7.082	1233.1	01Jan2000, 06:12	1.61
CCR12	4.390	750.0	01Jan2000, 05:35	1.60
CCR13	1.413	363.8	01Jan2000, 05:32	1.75
CCR2	17.753	2176.6	01Jan2000, 10:46	1.57
CCR3	17.269	2174.2	01Jan2000, 10:09	1.57
CCR4	16.200	2160.7	01Jan2000, 09:32	1.59
CCR5	15.232	2141.1	01Jan2000, 08:50	1.62
CCR6	14.589	2123.3	01Jan2000, 08:21	1.64
CCR7	14.472	2122.8	01Jan2000, 07:43	1.65
CCR8	12.821	2014.8	01Jan2000, 07:38	1.62
CCR9	11.934	1901.5	01Jan2000, 06:30	1.64
Clay Creek	1.665	302.5	01Jan2000, 04:45	1.52
CLC01	1.438	280.7	01Jan2000, 04:24	1.54
CLCR1	1.438	280.7	01Jan2000, 04:59	1.54
Crooked Creek	19.959	2198.2	01Jan2000, 11:53	1.55
DC01	1.529	223.8	01Jan2000, 04:05	1.04
DCR1	1.529	223.8	01Jan2000, 05:29	1.04
Delaware Creek	2.181	312.2	01Jan2000, 04:53	1.15
HJC01	2.713	816.6	01Jan2000, 04:19	1.96
HJC02	1.658	588.4	01Jan2000, 03:42	2.18
HJC03	0.673	262.9	01Jan2000, 03:25	2.37
HJCR1	2.713	816.6	01Jan2000, 04:58	1.96
HJCR2	1.658	588.4	01Jan2000, 04:35	2.18
HJCR3	0.673	262.9	01Jan2000, 03:56	2.37
Howard Johnson Ditch	3.168	895.4	01Jan2000, 04:53	1.89
J1619	0.668	160.1	01Jan2000, 03:37	1.51
J1623	0.540	70.1	01Jan2000, 04:26	0.99
J1628	0.456	140.4	01Jan2000, 03:53	2.13
J1630	0.887	136.5	01Jan2000, 05:06	1.43
J1633	0.458	90.0	01Jan2000, 03:59	1.36
J1634	0.334	107.4	01Jan2000, 02:43	1.51
J1635	0.796	442.8	01Jan2000, 02:31	2.53
J1636	0.652	153.9	01Jan2000, 03:28	1.43
J1637	0.726	113.5	01Jan2000, 04:13	1.15

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1638	0.803	111.0	01Jan2000, 03:57	0.93
J1640	1.009	189.8	01Jan2000, 05:08	1.71
J1643	0.985	332.0	01Jan2000, 03:30	2.06
J1644	1.055	276.1	01Jan2000, 03:29	1.61
J1646	0.484	134.3	01Jan2000, 03:30	1.73
J1649	0.528	149.1	01Jan2000, 03:24	1.69
J1651	0.663	232.5	01Jan2000, 03:19	2.04
J1653	0.779	181.9	01Jan2000, 03:25	1.30
J1654	0.644	187.2	01Jan2000, 03:15	1.57
J1655	0.931	113.6	01Jan2000, 04:33	0.86
J1656	1.366	349.0	01Jan2000, 04:08	1.83
J1658	0.767	173.8	01Jan2000, 03:40	1.32
J1659	1.528	478.7	01Jan2000, 03:38	2.01
J1661	1.220	261.1	01Jan2000, 05:12	2.05
J1662	0.672	130.6	01Jan2000, 04:59	1.71
J1663	1.498	341.9	01Jan2000, 04:19	1.71
J1664	0.777	284.6	01Jan2000, 03:07	2.01
J1666	1.025	183.2	01Jan2000, 05:15	1.66
J1667	0.698	118.3	01Jan2000, 03:59	1.08
J1668	1.052	236.2	01Jan2000, 04:35	1.84
J1669	0.386	50.1	01Jan2000, 03:50	0.71
Payne Branch	2.358	472.1	01Jan2000, 05:02	1.66
PB01	1.900	400.1	01Jan2000, 04:18	1.73
PBR1	1.900	400.1	01Jan2000, 05:15	1.73
SMR01	1.723	282.8	01Jan2000, 04:38	1.42
SMRR1	1.723	282.8	01Jan2000, 07:46	1.42
Spring Mill Run	2.502	299.6	01Jan2000, 07:36	1.39
WC01	20.902	2301.8	01Jan2000, 11:24	1.66
WC02	19.885	2295.8	01Jan2000, 10:27	1.66
WC03	18.622	2292.5	01Jan2000, 08:58	1.68
WC04	17.512	2282.9	01Jan2000, 08:03	1.67
WC05D	16.497	2259.2	01Jan2000, 07:39	1.66
WC05U	13.995	1959.8	01Jan2000, 07:40	1.71
WC06	13.351	1946.1	01Jan2000, 06:59	1.71
WC07	11.054	1768.9	01Jan2000, 06:29	1.77
WC08D	10.684	1750.6	01Jan2000, 05:50	1.78
WC08U	9.019	1500.2	01Jan2000, 06:14	1.82
WC09	8.252	1445.7	01Jan2000, 05:30	1.87

Global Summary Results for Run "2008noDet 10 yr 6 hr 10%"

Project: CBREL Crooked& Williams Simulation Run: 2008noDet 10 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:46:21

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 10 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC08D	10.684	1750.6	01Jan2000, 05:50	1.78
WC08U	9.019	1530.2	01Jan2000, 06:14	1.82
WC09	8.252	1445.7	01Jan2000, 05:30	1.87
WC10	6.710	1244.8	01Jan2000, 06:25	1.84
WC11	4.818	935.3	01Jan2000, 05:37	1.81
WC12	2.543	628.2	01Jan2000, 04:36	1.80
WC13	0.802	232.2	01Jan2000, 03:51	1.90
WCR1	20.902	2301.8	01Jan2000, 12:07	1.66
WCR10	6.710	1244.8	01Jan2000, 06:31	1.84
WCR11	4.818	935.3	01Jan2000, 06:54	1.81
WCR12	2.543	628.2	01Jan2000, 06:17	1.80
WCR13	0.802	232.2	01Jan2000, 05:01	1.90
WCR2	19.865	2295.8	01Jan2000, 11:25	1.66
WCR3	18.622	2292.5	01Jan2000, 10:27	1.68
WCR4	17.512	2282.9	01Jan2000, 09:59	1.67
WCR5	16.497	2259.2	01Jan2000, 08:06	1.66
WCR6	13.351	1946.1	01Jan2000, 07:43	1.71
WCR7	11.054	1768.9	01Jan2000, 07:19	1.77
WCR8	10.684	1750.6	01Jan2000, 06:33	1.78
WCR9	8.252	1445.7	01Jan2000, 06:33	1.87
Williams Creek	21.252	2301.8	01Jan2000, 12:07	1.66

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: 2008noDet 10 yr 12 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:45:39

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 10 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

10% - 12 hr
Current w/o detention

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	2373.1	01Jan2000, 10:58	1.92
1617	0.350	71.1	01Jan2000, 04:11	1.58
1618	0.916	164.7	01Jan2000, 05:23	1.76
1619	0.668	149.5	01Jan2000, 04:29	1.85
1620	0.622	108.6	01Jan2000, 05:09	1.62
1621	0.643	101.5	01Jan2000, 05:01	1.41
1622	0.117	26.2	01Jan2000, 03:36	1.58
1623	0.540	72.0	01Jan2000, 05:30	1.26
1624	0.529	141.8	01Jan2000, 04:05	2.04
1625	0.716	96.1	01Jan2000, 05:27	1.26
1626	0.252	53.6	01Jan2000, 03:54	1.58
1627	0.484	105.3	01Jan2000, 04:18	1.76
1628	0.456	132.8	01Jan2000, 04:41	2.55
1629	1.195	281.8	01Jan2000, 04:43	2.09
1630	0.887	141.7	01Jan2000, 06:05	1.76
1631	1.326	251.5	01Jan2000, 04:49	1.65
1632	0.450	92.6	01Jan2000, 04:43	1.79
1633	0.458	87.3	01Jan2000, 04:55	1.69
1634	0.334	90.1	01Jan2000, 03:25	1.85
1635	0.796	366.6	01Jan2000, 03:03	2.99
1636	0.652	141.2	01Jan2000, 04:19	1.76
1637	0.726	113.2	01Jan2000, 05:14	1.44
1638	0.803	109.4	01Jan2000, 05:02	1.19
1639	0.891	227.2	01Jan2000, 04:41	2.15
1640	1.009	199.0	01Jan2000, 06:05	2.10
1641	1.413	351.1	01Jan2000, 04:50	2.15
1642	0.363	64.7	01Jan2000, 04:06	1.30
1643	0.985	305.5	01Jan2000, 04:17	2.48
1644	1.055	253.2	01Jan2000, 04:19	1.95
1645	0.673	238.9	01Jan2000, 04:09	2.81
1646	0.484	123.0	01Jan2000, 04:18	2.09

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	182.6	01Jan2000, 03:38	1.65
1648	1.017	235.1	01Jan2000, 04:37	1.99
1649	0.528	135.9	01Jan2000, 04:14	2.05
1650	0.582	167.2	01Jan2000, 03:41	2.12
1651	0.663	209.6	01Jan2000, 04:05	2.45
1652	0.352	96.4	01Jan2000, 03:53	2.09
1653	0.779	169.1	01Jan2000, 04:19	1.64
1654	0.644	169.6	01Jan2000, 04:06	1.95
1655	0.931	124.6	01Jan2000, 05:39	1.16
1656	1.366	340.6	01Jan2000, 05:00	2.24
1657	0.227	63.5	01Jan2000, 03:35	1.79
1658	0.767	167.6	01Jan2000, 04:36	1.68
1659	1.528	444.8	01Jan2000, 04:26	2.41
1660	0.014	3.3	01Jan2000, 03:13	1.22
1661	1.220	268.2	01Jan2000, 06:05	2.45
1662	0.672	135.8	01Jan2000, 05:56	2.10
1663	1.498	339.4	01Jan2000, 05:13	2.10
1664	0.777	251.3	01Jan2000, 03:51	2.41
1665	1.741	408.7	01Jan2000, 05:09	2.15
1666	1.025	193.5	01Jan2000, 06:12	2.05
1667	0.698	119.2	01Jan2000, 05:02	1.40
1668	1.052	236.6	01Jan2000, 05:29	2.23
1669	0.386	52.4	01Jan2000, 04:56	0.99
1670	0.370	98.0	01Jan2000, 04:04	1.95
1671	0.802	222.1	01Jan2000, 04:41	2.32
CC01	19.043	2393.9	01Jan2000, 11:30	1.91
CC03	17.269	2367.6	01Jan2000, 10:21	1.92
CC04	16.200	2342.3	01Jan2000, 09:42	1.94
CC05	15.232	2308.5	01Jan2000, 09:16	1.98
CC06	14.589	2279.4	01Jan2000, 08:43	2.00
CC07	14.472	2277.4	01Jan2000, 08:30	2.01
CC08	12.821	2134.4	01Jan2000, 07:40	1.98
CC09D	11.934	2015.0	01Jan2000, 07:08	2.00
CC09U	8.771	1451.2	01Jan2000, 08:25	1.90
CC10	7.445	1358.7	01Jan2000, 06:58	1.94
CC11D	7.082	1333.1	01Jan2000, 06:04	1.97
CC11U	4.724	849.9	01Jan2000, 06:04	1.94
CC12D	4.390	812.7	01Jan2000, 05:36	1.95

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	494.2	01Jan2000, 05:16	2.45
CC13	1.413	351.1	01Jan2000, 04:50	2.15
CCR1	19.043	2393.9	01Jan2000, 12:39	1.91
CCR10	7.445	1358.7	01Jan2000, 08:39	1.94
CCR11	7.082	1333.1	01Jan2000, 07:02	1.97
CCR12	4.390	812.7	01Jan2000, 06:19	1.95
CCR13	1.413	351.1	01Jan2000, 06:24	2.15
CCR2	17.753	2373.1	01Jan2000, 11:35	1.92
CCR3	17.269	2367.6	01Jan2000, 10:59	1.92
CCR4	16.200	2342.3	01Jan2000, 10:26	1.94
CCR5	15.232	2308.5	01Jan2000, 09:46	1.98
CCR6	14.589	2279.4	01Jan2000, 09:21	2.00
CCR7	14.472	2277.4	01Jan2000, 08:43	2.01
CCR8	12.821	2134.4	01Jan2000, 08:52	1.98
CCR9	11.934	2015.0	01Jan2000, 07:49	2.00
Clay Creek	1.665	320.5	01Jan2000, 05:39	1.88
CLC01	1.438	287.3	01Jan2000, 05:21	1.90
CLCR1	1.438	287.3	01Jan2000, 05:56	1.90
Crooked Creek	19.959	2410.7	01Jan2000, 12:37	1.90
DC01	1.529	222.4	01Jan2000, 05:08	1.31
DCR1	1.529	222.4	01Jan2000, 06:32	1.31
Delaware Creek	2.181	323.5	01Jan2000, 05:53	1.44
HJC01	2.713	775.0	01Jan2000, 05:05	2.36
HJC02	1.658	541.8	01Jan2000, 04:27	2.61
HJC03	0.673	238.9	01Jan2000, 04:09	2.81
HJCR1	2.713	775.0	01Jan2000, 05:44	2.36
HJCR2	1.658	541.8	01Jan2000, 05:20	2.61
HJCR3	0.673	238.9	01Jan2000, 04:40	2.81
Howard Johnson Ditch	3.108	859.7	01Jan2000, 05:40	2.28
J1619	0.668	149.5	01Jan2000, 04:29	1.85
J1623	0.540	72.0	01Jan2000, 05:30	1.26
J1628	0.456	132.8	01Jan2000, 04:41	2.55
J1630	0.887	141.7	01Jan2000, 06:05	1.76
J1633	0.458	87.3	01Jan2000, 04:55	1.69
J1634	0.334	90.1	01Jan2000, 03:25	1.85
J1635	0.796	366.6	01Jan2000, 03:03	2.99
J1636	0.652	141.2	01Jan2000, 04:19	1.76
J1637	0.726	113.2	01Jan2000, 05:14	1.44

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak *	Volume (IN)
J1638	0.803	109.4	01Jan2000, 05:02	1.19
J1640	1.009	199.0	01Jan2000, 06:05	2.10
J1643	0.985	305.5	01Jan2000, 04:17	2.48
J1644	1.055	253.2	01Jan2000, 04:19	1.95
J1646	0.484	123.0	01Jan2000, 04:18	2.09
J1649	0.528	135.9	01Jan2000, 04:14	2.05
J1651	0.663	209.6	01Jan2000, 04:05	2.45
J1653	0.779	169.1	01Jan2000, 04:19	1.64
J1654	0.644	169.6	01Jan2000, 04:06	1.95
J1655	0.931	124.6	01Jan2000, 05:39	1.16
J1656	1.366	340.6	01Jan2000, 05:00	2.24
J1658	0.767	167.6	01Jan2000, 04:36	1.68
J1659	1.528	444.8	01Jan2000, 04:26	2.41
J1661	1.220	268.2	01Jan2000, 06:05	2.45
J1662	0.672	135.8	01Jan2000, 05:56	2.10
J1663	1.498	339.4	01Jan2000, 05:13	2.10
J1664	0.777	251.3	01Jan2000, 03:51	2.41
J1666	1.025	193.5	01Jan2000, 06:12	2.05
J1667	0.698	119.2	01Jan2000, 05:02	1.40
J1668	1.052	236.6	01Jan2000, 05:29	2.23
J1669	0.386	52.4	01Jan2000, 04:56	0.99
Payne Branch	2.358	483.2	01Jan2000, 06:04	2.04
PB01	1.900	407.3	01Jan2000, 05:19	2.12
PBR1	1.900	407.3	01Jan2000, 06:16	2.12
SMR01	1.723	302.5	01Jan2000, 05:41	1.79
SMRR1	1.723	302.5	01Jan2000, 08:49	1.79
Spring Mill Run	2.502	337.0	01Jan2000, 08:25	1.74
WC01	20.902	2623.1	01Jan2000, 12:14	2.04
WC02	19.885	2612.5	01Jan2000, 11:18	2.04
WC03	18.622	2605.4	01Jan2000, 09:50	2.06
WC04	17.512	2583.3	01Jan2000, 08:59	2.05
WC05D	16.497	2539.3	01Jan2000, 08:39	2.04
WC05U	13.995	2204.0	01Jan2000, 08:43	2.09
WC06	13.351	2178.0	01Jan2000, 08:06	2.10
WC07	11.054	1957.3	01Jan2000, 07:54	2.16
WC08D	10.684	1932.6	01Jan2000, 07:16	2.17
WC08U	9.019	1682.8	01Jan2000, 07:40	2.22
WC09	8.252	1614.8	01Jan2000, 06:50	2.27

Global Summary Results for Run "2008noDet 10 yr 12 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: 2008noDet 10 yr 12 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:45:39

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 10 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC07	11.054	1957.3	01Jan2000, 07:54	2.16
WC06D	10.684	1932.6	01Jan2000, 07:16	2.17
WC08U	9.019	1682.8	01Jan2000, 07:40	2.22
WC09	8.252	1614.8	01Jan2000, 06:50	2.27
WC10	6.710	1371.7	01Jan2000, 07:17	2.24
WC11	4.818	1017.9	01Jan2000, 06:21	2.21
WC12	2.543	622.5	01Jan2000, 05:28	2.20
WC13	0.802	222.1	01Jan2000, 04:41	2.32
WCR1	20.902	2623.1	01Jan2000, 12:57	2.04
WCR10	6.710	1371.7	01Jan2000, 07:23	2.24
WCR11	4.818	1017.9	01Jan2000, 07:38	2.21
WCR12	2.543	622.5	01Jan2000, 07:09	2.20
WCR13	0.802	222.1	01Jan2000, 05:51	2.32
WCR2	19.885	2612.5	01Jan2000, 12:15	2.04
WCR3	18.522	2605.4	01Jan2000, 11:19	2.06
WCR4	17.512	2583.3	01Jan2000, 09:55	2.05
WCR5	16.497	2539.3	01Jan2000, 09:06	2.04
WCR6	13.351	2178.0	01Jan2000, 08:50	2.10
WCR7	11.054	1957.3	01Jan2000, 08:44	2.16
WCR8	10.684	1932.6	01Jan2000, 07:59	2.17
WCR9	8.252	1614.8	01Jan2000, 07:53	2.27
Williams Creek	21.252	2623.5	01Jan2000, 12:57	2.03

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: 2008noDet 10 yr 24 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:45:59

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 10 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

10% · 24 hr.
Current. nodetention

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	2293.3	01Jan2000, 12:40	2.32
1617	0.350	51.0	01Jan2000, 05:21	1.94
1618	0.916	130.1	01Jan2000, 06:54	2.13
1619	0.668	110.7	01Jan2000, 05:45	2.24
1620	0.622	84.4	01Jan2000, 06:42	1.98
1621	0.643	77.9	01Jan2000, 06:37	1.74
1622	0.117	18.2	01Jan2000, 04:45	1.94
1623	0.540	57.4	01Jan2000, 07:18	1.59
1624	0.529	102.7	01Jan2000, 05:10	2.46
1625	0.716	76.5	01Jan2000, 07:15	1.59
1626	0.252	37.9	01Jan2000, 05:01	1.94
1627	0.484	76.7	01Jan2000, 05:29	2.13
1628	0.456	101.3	01Jan2000, 05:50	3.02
1629	1.195	213.4	01Jan2000, 05:59	2.49
1630	0.887	117.2	01Jan2000, 07:47	2.13
1631	1.326	190.7	01Jan2000, 06:19	2.02
1632	0.450	69.8	01Jan2000, 06:08	2.17
1633	0.458	66.8	01Jan2000, 06:25	2.06
1634	0.334	62.4	01Jan2000, 04:36	2.24
1635	0.796	250.3	01Jan2000, 04:10	3.49
1636	0.652	103.0	01Jan2000, 05:31	2.13
1637	0.726	88.5	01Jan2000, 06:53	1.78
1638	0.803	83.7	01Jan2000, 06:45	1.50
1639	0.891	172.6	01Jan2000, 06:02	2.59
1640	1.009	166.1	01Jan2000, 07:43	2.54
1641	1.413	269.6	01Jan2000, 06:12	2.59
1642	0.363	45.7	01Jan2000, 05:15	1.63
1643	0.985	227.0	01Jan2000, 05:21	2.95
1644	1.055	185.6	01Jan2000, 05:27	2.35
1645	0.673	177.3	01Jan2000, 05:06	3.30
1646	0.484	90.5	01Jan2000, 05:24	2.49

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	127.4	01Jan2000, 04:46	2.02
1648	1.017	176.4	01Jan2000, 05:53	2.39
1649	0.528	99.4	01Jan2000, 05:20	2.46
1650	0.582	118.4	01Jan2000, 04:46	2.53
1651	0.663	153.4	01Jan2000, 05:06	2.91
1652	0.352	69.1	01Jan2000, 04:56	2.49
1653	0.779	123.5	01Jan2000, 05:35	2.03
1654	0.644	123.0	01Jan2000, 05:12	2.37
1655	0.931	103.7	01Jan2000, 07:43	1.52
1656	1.366	265.0	01Jan2000, 06:22	2.69
1657	0.227	44.9	01Jan2000, 04:41	2.21
1658	0.767	126.1	01Jan2000, 06:04	2.10
1659	1.528	332.7	01Jan2000, 05:32	2.87
1660	0.014	2.3	01Jan2000, 04:15	1.59
1661	1.220	222.6	01Jan2000, 07:32	2.90
1662	0.672	112.3	01Jan2000, 07:32	2.54
1663	1.498	267.7	01Jan2000, 06:40	2.54
1664	0.777	181.4	01Jan2000, 04:53	2.87
1665	1.741	320.9	01Jan2000, 06:34	2.59
1666	1.025	162.7	01Jan2000, 07:53	2.48
1667	0.698	92.8	01Jan2000, 06:41	1.77
1668	1.052	189.5	01Jan2000, 06:54	2.67
1669	0.386	41.2	01Jan2000, 06:58	1.32
1670	0.370	71.0	01Jan2000, 05:10	2.37
1671	0.802	169.5	01Jan2000, 05:59	2.79
CC01	19.043	2356.9	01Jan2000, 13:10	2.30
CC03	17.269	2270.5	01Jan2000, 12:05	2.32
CC04	16.200	2206.5	01Jan2000, 11:27	2.34
CC05	15.232	2143.4	01Jan2000, 11:03	2.38
CC06	14.589	2095.6	01Jan2000, 10:30	2.41
CC07	14.472	2088.2	01Jan2000, 10:17	2.42
CC08	12.821	1901.6	01Jan2000, 09:31	2.39
CC09D	11.934	1793.5	01Jan2000, 08:59	2.41
CC09U	8.771	1284.1	01Jan2000, 09:52	2.30
CC10	7.445	1150.8	01Jan2000, 08:23	2.35
CC11D	7.082	1115.9	01Jan2000, 07:28	2.38
CC11U	4.724	724.0	01Jan2000, 07:25	2.34
CC12D	4.390	680.8	01Jan2000, 06:50	2.35

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	427.9	01Jan2000, 06:36	2.91
CC13	1.413	269.6	01Jan2000, 06:12	2.59
CCR1	19.043	2356.9	01Jan2000, 14:19	2.30
CCR10	7.445	1150.8	01Jan2000, 10:04	2.35
CCR11	7.082	1115.9	01Jan2000, 08:26	2.38
CCR12	4.390	680.8	01Jan2000, 07:33	2.35
CCR13	1.413	269.6	01Jan2000, 07:46	2.59
CCR2	17.753	2293.3	01Jan2000, 13:17	2.32
CCR3	17.269	2270.5	01Jan2000, 12:43	2.32
CCR4	16.200	2206.5	01Jan2000, 12:11	2.34
CCR5	15.232	2143.4	01Jan2000, 11:33	2.38
CCR6	14.589	2095.6	01Jan2000, 11:08	2.41
CCR7	14.472	2088.2	01Jan2000, 10:30	2.42
CCR8	12.821	1901.6	01Jan2000, 10:43	2.39
CCR9	11.934	1793.5	01Jan2000, 09:40	2.41
Clay Creek	1.665	263.7	01Jan2000, 07:05	2.29
CLC01	1.438	230.7	01Jan2000, 06:55	2.31
CLCR1	1.438	230.7	01Jan2000, 07:30	2.31
Crooked Creek	19.959	2399.8	01Jan2000, 14:15	2.29
DC01	1.529	172.2	01Jan2000, 06:49	1.63
DCR1	1.529	172.2	01Jan2000, 08:13	1.63
Delaware Creek	2.181	259.3	01Jan2000, 07:32	1.78
HJC01	2.713	584.7	01Jan2000, 06:09	2.80
HJC02	1.658	403.8	01Jan2000, 05:28	3.09
HJC03	0.673	177.3	01Jan2000, 05:06	3.30
HJCR1	2.713	584.7	01Jan2000, 06:48	2.80
HJCR2	1.658	403.8	01Jan2000, 06:21	3.09
HJCR3	0.673	177.3	01Jan2000, 05:37	3.30
Howard Johnson Ditch	3.165	653.2	01Jan2000, 06:45	2.71
J1619	0.668	110.7	01Jan2000, 05:45	2.24
J1623	0.540	57.4	01Jan2000, 07:18	1.59
J1628	0.456	101.3	01Jan2000, 05:50	3.02
J1630	0.887	117.2	01Jan2000, 07:47	2.13
J1633	0.458	66.8	01Jan2000, 06:25	2.06
J1634	0.334	62.4	01Jan2000, 04:36	2.24
J1635	0.796	250.3	01Jan2000, 04:10	3.49
J1636	0.652	103.0	01Jan2000, 05:31	2.13
J1637	0.726	88.5	01Jan2000, 06:53	1.78

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1638	0.803	83.7	01Jan2000, 06:45	1.50
J1640	1.009	166.1	01Jan2000, 07:43	2.54
J1643	0.985	227.0	01Jan2000, 05:21	2.95
J1644	1.055	185.6	01Jan2000, 05:27	2.35
J1646	0.484	90.5	01Jan2000, 05:24	2.49
J1649	0.528	99.4	01Jan2000, 05:20	2.46
J1651	0.663	153.4	01Jan2000, 05:06	2.91
J1653	0.779	123.5	01Jan2000, 05:35	2.03
J1654	0.644	123.0	01Jan2000, 05:12	2.37
J1655	0.931	103.7	01Jan2000, 07:43	1.52
J1656	1.366	265.0	01Jan2000, 06:22	2.69
J1658	0.767	126.1	01Jan2000, 06:04	2.10
J1659	1.528	332.7	01Jan2000, 05:32	2.87
J1661	1.220	222.6	01Jan2000, 07:32	2.90
J1662	0.672	112.3	01Jan2000, 07:32	2.54
J1663	1.498	267.7	01Jan2000, 06:40	2.54
J1664	0.777	181.4	01Jan2000, 04:53	2.87
J1666	1.025	162.7	01Jan2000, 07:53	2.48
J1667	0.698	92.8	01Jan2000, 06:41	1.77
J1668	1.052	189.5	01Jan2000, 06:54	2.67
J1669	0.386	41.2	01Jan2000, 06:58	1.32
Payne Branch	2.358	392.3	01Jan2000, 07:36	2.47
PB01	1.900	329.0	01Jan2000, 06:50	2.56
PBR1	1.900	329.0	01Jan2000, 07:47	2.56
SMR01	1.723	252.7	01Jan2000, 07:28	2.20
SMRR1	1.723	252.7	01Jan2000, 10:36	2.20
Spring Mill Run	2.502	322.0	01Jan2000, 09:44	2.14
WC01	20.902	2679.8	01Jan2000, 13:45	2.46
WC02	19.885	2636.4	01Jan2000, 12:55	2.47
WC03	18.622	2589.2	01Jan2000, 11:37	2.48
WC04	17.512	2519.4	01Jan2000, 10:54	2.48
WC05D	16.497	2431.2	01Jan2000, 10:37	2.47
WC05U	13.995	2116.6	01Jan2000, 10:45	2.52
WC06	13.351	2063.5	01Jan2000, 10:08	2.53
WC07	11.054	1803.5	01Jan2000, 09:40	2.60
WC08D	10.684	1764.5	01Jan2000, 09:02	2.61
WC08U	9.019	1529.7	01Jan2000, 09:15	2.66
WC09	8.252	1438.6	01Jan2000, 08:20	2.72

Global Summary Results for Run "2008noDet 10 yr 24 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: 2008noDet 10 yr 24 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:45:59

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 10 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC06	13.351	2063.5	01Jan2000, 10:08	2.53
WC07	11.054	1803.5	01Jan2000, 09:40	2.60
WC08D	10.684	1764.5	01Jan2000, 09:02	2.61
WC08U	9.019	1539.7	01Jan2000, 09:15	2.66
WC09	8.252	1438.6	01Jan2000, 08:20	2.72
WC10	6.710	1185.1	01Jan2000, 08:39	2.69
WC11	4.818	865.4	01Jan2000, 07:39	2.65
WC12	2.543	488.7	01Jan2000, 06:47	2.65
WC13	0.802	169.5	01Jan2000, 05:59	2.79
WCR1	20.902	2679.8	01Jan2000, 14:28	2.46
WCR10	6.710	1186.1	01Jan2000, 08:45	2.69
WCR11	4.818	865.4	01Jan2000, 08:56	2.65
WCR12	2.543	488.7	01Jan2000, 08:28	2.65
WCR13	0.802	169.5	01Jan2000, 07:09	2.79
WCR2	19.885	2636.4	01Jan2000, 13:53	2.47
WCR3	18.622	2589.2	01Jan2000, 13:06	2.48
WCR4	17.512	2519.4	01Jan2000, 11:50	2.48
WCR5	16.497	2431.2	01Jan2000, 11:04	2.47
WCR6	13.351	2063.5	01Jan2000, 10:52	2.53
WCR7	11.054	1803.5	01Jan2000, 10:30	2.60
WCR8	10.684	1764.5	01Jan2000, 09:45	2.61
WCR9	8.252	1438.6	01Jan2000, 09:23	2.72
Williams Creek	21.252	2687.2	01Jan2000, 14:27	2.45

Print Close

Current w/o Detention
50% - 6 hr.

Project: CBBEL Crooked& WilliamsSimulation Run: 2008noDet 2 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:47:22

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 2 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1288.7	01Jan2000, 10:12	0.91
1617	0.350	43.9	01Jan2000, 03:11	0.73
1618	0.916	96.0	01Jan2000, 04:20	0.84
1619	0.668	91.8	01Jan2000, 03:34	0.88
1620	0.622	61.8	01Jan2000, 04:05	0.74
1621	0.643	56.1	01Jan2000, 03:53	0.62
1622	0.117	17.0	01Jan2000, 02:44	0.73
1623	0.540	36.0	01Jan2000, 04:18	0.52
1624	0.529	89.9	01Jan2000, 03:15	0.97
1625	0.716	48.3	01Jan2000, 04:15	0.52
1626	0.252	33.9	01Jan2000, 02:58	0.73
1627	0.484	66.4	01Jan2000, 03:21	0.84
1628	0.456	85.9	01Jan2000, 03:53	1.31
1629	1.195	180.1	01Jan2000, 03:49	1.05
1630	0.887	79.5	01Jan2000, 05:01	0.84
1631	1.326	146.0	01Jan2000, 03:48	0.75
1632	0.450	56.2	01Jan2000, 03:45	0.85
1633	0.458	50.2	01Jan2000, 03:55	0.77
1634	0.334	60.7	01Jan2000, 02:41	0.88
1635	0.796	278.9	01Jan2000, 02:33	1.60
1636	0.652	88.8	01Jan2000, 03:22	0.84
1637	0.726	61.3	01Jan2000, 04:07	0.63
1638	0.803	57.3	01Jan2000, 03:47	0.49
1639	0.891	134.7	01Jan2000, 03:51	1.00
1640	1.009	105.7	01Jan2000, 05:10	0.95

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1641	1.413	206.0	01Jan2000, 03:59	1.00
1642	0.363	35.8	01Jan2000, 03:04	0.53
1643	0.985	197.6	01Jan2000, 03:31	1.23
1644	1.055	162.8	01Jan2000, 03:25	0.96
1645	0.673	163.1	01Jan2000, 03:26	1.48
1646	0.484	81.1	01Jan2000, 03:26	1.05
1647	0.779	117.1	01Jan2000, 02:47	0.75
1648	1.017	147.3	01Jan2000, 03:42	0.97
1649	0.528	87.4	01Jan2000, 03:22	1.00
1650	0.582	115.7	01Jan2000, 02:56	1.06
1651	0.663	139.7	01Jan2000, 03:19	1.24
1652	0.352	66.0	01Jan2000, 03:04	1.05
1653	0.779	93.4	01Jan2000, 03:26	0.68
1654	0.644	101.8	01Jan2000, 03:17	0.87
1655	0.931	44.5	01Jan2000, 04:44	0.33
1656	1.366	200.4	01Jan2000, 04:09	1.06
1657	0.227	37.4	01Jan2000, 02:52	0.72
1658	0.767	85.8	01Jan2000, 03:45	0.66
1659	1.528	287.5	01Jan2000, 03:38	1.21
1660	0.014	1.7	01Jan2000, 02:26	0.36
1661	1.220	160.0	01Jan2000, 05:11	1.26
1662	0.672	72.7	01Jan2000, 05:01	0.95
1663	1.498	193.1	01Jan2000, 04:19	0.98
1664	0.777	170.5	01Jan2000, 03:07	1.21
1665	1.741	234.6	01Jan2000, 04:16	1.00
1666	1.025	101.5	01Jan2000, 05:16	0.92
1667	0.698	54.8	01Jan2000, 04:04	0.51
1668	1.052	139.3	01Jan2000, 04:34	1.09
1669	0.386	17.9	01Jan2000, 04:01	0.25
1670	0.370	59.0	01Jan2000, 03:16	0.87
1671	0.802	132.4	01Jan2000, 03:54	1.09

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC01	19.043	1294.8	01Jan2000, 10:48	0.91
CC03	17.269	1287.4	01Jan2000, 09:34	0.91
CC04	16.200	1280.7	01Jan2000, 08:51	0.93
CC05	15.232	1271.0	01Jan2000, 08:22	0.95
CC06	14.589	1261.8	01Jan2000, 07:45	0.96
CC07	14.472	1261.6	01Jan2000, 07:33	0.97
CC08	12.821	1197.9	01Jan2000, 06:28	0.95
CC09D	11.934	1133.5	01Jan2000, 05:51	0.95
CC09U	8.771	749.1	01Jan2000, 07:16	0.89
CC10	7.445	714.8	01Jan2000, 05:57	0.91
CC11D	7.082	707.7	01Jan2000, 05:03	0.93
CC11U	4.724	451.5	01Jan2000, 03:48	0.93
CC12D	4.390	430.4	01Jan2000, 04:38	0.93
CC12U	2.209	295.4	01Jan2000, 02:46	1.22
CC13	1.413	206.0	01Jan2000, 03:59	1.00
CCR1	19.043	1294.8	01Jan2000, 11:57	0.91
CCR10	7.445	714.8	01Jan2000, 07:38	0.91
CCR11	7.082	707.7	01Jan2000, 06:01	0.93
CCR12	4.390	430.4	01Jan2000, 05:21	0.93
CCR13	1.413	206.0	01Jan2000, 05:33	1.00
CCR2	17.753	1288.7	01Jan2000, 10:49	0.91
CCR3	17.269	1287.4	01Jan2000, 10:12	0.91
CCR4	16.200	1280.7	01Jan2000, 09:35	0.93
CCR5	15.232	1271.0	01Jan2000, 08:52	0.95
CCR6	14.589	1261.8	01Jan2000, 08:23	0.96
CCR7	14.472	1261.6	01Jan2000, 07:46	0.97
CCR8	12.821	1197.9	01Jan2000, 07:40	0.95
CCR9	11.934	1133.5	01Jan2000, 06:32	0.95
Clay Creek	1.665	166.9	01Jan2000, 04:49	0.85
CLC01	1.438	155.9	01Jan2000, 04:28	0.87
CLCR1	1.438	155.9	01Jan2000, 05:03	0.87

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Crooked Creek	19.959	1300.5	01Jan2000, 11:57	0.90
DC01	1.529	118.1	01Jan2000, 03:57	0.56
DCR1	1.529	118.1	01Jan2000, 05:21	0.56
Delaware Creek	2.181	173.0	01Jan2000, 04:42	0.64
HJC01	2.713	488.6	01Jan2000, 04:20	1.19
HJC02	1.658	356.9	01Jan2000, 03:44	1.33
HJC03	0.673	163.1	01Jan2000, 03:26	1.48
HJCR1	2.713	488.6	01Jan2000, 04:59	1.19
HJCR2	1.658	356.9	01Jan2000, 04:37	1.33
HJCR3	0.673	163.1	01Jan2000, 03:57	1.48
Howard Johnson Ditch	3.168	533.1	01Jan2000, 04:55	1.14
J1619	0.668	91.8	01Jan2000, 03:34	0.88
J1623	0.540	36.0	01Jan2000, 04:18	0.52
J1628	0.456	85.9	01Jan2000, 03:53	1.31
J1630	0.887	79.5	01Jan2000, 05:01	0.84
J1633	0.458	50.2	01Jan2000, 03:55	0.77
J1634	0.334	60.7	01Jan2000, 02:41	0.88
J1635	0.796	278.9	01Jan2000, 02:33	1.60
J1636	0.652	88.8	01Jan2000, 03:22	0.84
J1637	0.726	61.3	01Jan2000, 04:07	0.63
J1638	0.803	57.3	01Jan2000, 03:47	0.49
J1640	1.009	105.7	01Jan2000, 05:10	0.95
J1643	0.985	197.6	01Jan2000, 03:31	1.23
J1644	1.055	162.8	01Jan2000, 03:25	0.96
J1646	0.484	81.1	01Jan2000, 03:26	1.05
J1649	0.528	87.4	01Jan2000, 03:22	1.00
J1651	0.663	139.7	01Jan2000, 03:19	1.24
J1653	0.779	93.4	01Jan2000, 03:26	0.68
J1654	0.644	101.8	01Jan2000, 03:17	0.87
J1655	0.931	44.5	01Jan2000, 04:44	0.33
J1656	1.366	200.4	01Jan2000, 04:09	1.06

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1658	0.767	85.8	01Jan2000, 03:45	0.66
J1659	1.528	287.5	01Jan2000, 03:38	1.21
J1661	1.220	160.0	01Jan2000, 05:11	1.26
J1662	0.672	72.7	01Jan2000, 05:01	0.95
J1663	1.498	193.1	01Jan2000, 04:19	0.98
J1664	0.777	170.5	01Jan2000, 03:07	1.21
J1666	1.025	101.5	01Jan2000, 05:16	0.92
J1667	0.698	54.8	01Jan2000, 04:04	0.51
J1668	1.052	139.3	01Jan2000, 04:34	1.09
J1669	0.386	17.9	01Jan2000, 04:01	0.25
Payne Branch	2.358	264.7	01Jan2000, 05:03	0.94
PB01	1.900	225.2	01Jan2000, 04:18	0.98
PBR1	1.900	225.2	01Jan2000, 05:15	0.98
SMR01	1.723	147.8	01Jan2000, 04:43	0.76
SMRR1	1.723	147.8	01Jan2000, 07:51	0.76
Spring Mill Run	2.502	156.0	01Jan2000, 07:42	0.73
WC01	20.902	1313.1	01Jan2000, 11:28	0.95
WC02	19.885	1309.8	01Jan2000, 10:30	0.95
WC03	18.622	1308.0	01Jan2000, 09:02	0.95
WC04	17.512	1302.6	01Jan2000, 08:07	0.95
WC05D	16.497	1289.0	01Jan2000, 07:43	0.94
WC05U	13.995	1133.0	01Jan2000, 07:44	0.97
WC06	13.351	1125.7	01Jan2000, 07:02	0.98
WC07	11.054	1032.2	01Jan2000, 06:30	1.02
WC08D	10.684	1022.0	01Jan2000, 05:50	1.03
WC08U	9.019	879.3	01Jan2000, 06:09	1.06
WC09	8.252	849.0	01Jan2000, 05:19	1.10
WC10	6.710	718.9	01Jan2000, 06:22	1.07
WC11	4.818	532.6	01Jan2000, 05:36	1.04
WC12	2.543	356.3	01Jan2000, 04:37	1.03
WC13	0.802	132.4	01Jan2000, 03:54	1.09

Global Summary Results for Run "2008noDet 2 yr 6 hr 10%"

Project: CBBEL Crooked& Williams Simulation Run: 2008noDet 2 yr 6 hr 10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2008CN-10NoDet
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 6 hr 10%
Compute Time: 11May2010, 15:47:22 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC10	6.710	718.9	01Jan2000, 06:22	1.07
WC11	4.818	532.6	01Jan2000, 05:36	1.04
WC12	2.543	356.3	01Jan2000, 04:37	1.03
WC13	0.802	132.4	01Jan2000, 03:54	1.09
WCR1	20.902	1313.1	01Jan2000, 12:11	0.95
WCR10	6.710	718.9	01Jan2000, 06:28	1.07
WCR11	4.818	532.6	01Jan2000, 06:53	1.04
WCR12	2.543	356.3	01Jan2000, 06:18	1.03
WCR13	0.802	132.4	01Jan2000, 05:04	1.09
WCR2	19.885	1309.8	01Jan2000, 11:28	0.95
WCR3	18.622	1303.0	01Jan2000, 10:31	0.95
WCR4	17.512	1302.6	01Jan2000, 09:03	0.95
WCR5	16.497	1289.0	01Jan2000, 08:10	0.94
WCR6	13.351	1125.7	01Jan2000, 07:46	0.98
WCR7	11.054	1032.2	01Jan2000, 07:20	1.02
WCR8	10.684	1022.0	01Jan2000, 06:33	1.03
WCR9	8.252	849.0	01Jan2000, 06:22	1.10
Williams Creek	21.252	1313.1	01Jan2000, 12:11	0.95

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: 2008noDet 2 yr 12 hr 10% Current with Detention 50% - 12hr

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:46:42

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 2 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1431.9	01Jan2000, 11:01	1.15
1617	0.350	39.9	01Jan2000, 04:05	0.92
1618	0.916	96.6	01Jan2000, 05:18	1.04
1619	0.668	87.0	01Jan2000, 04:27	1.10
1620	0.622	61.6	01Jan2000, 05:05	0.94
1621	0.643	55.2	01Jan2000, 04:55	0.79
1622	0.117	14.5	01Jan2000, 03:30	0.92
1623	0.540	37.3	01Jan2000, 05:26	0.68
1624	0.529	82.8	01Jan2000, 04:06	1.22
1625	0.716	49.8	01Jan2000, 05:24	0.68
1626	0.252	30.0	01Jan2000, 03:48	0.92
1627	0.484	61.3	01Jan2000, 04:13	1.04
1628	0.456	83.1	01Jan2000, 04:42	1.61
1629	1.195	172.7	01Jan2000, 04:39	1.29
1630	0.887	83.4	01Jan2000, 06:00	1.04
1631	1.326	142.1	01Jan2000, 04:46	0.96
1632	0.450	54.0	01Jan2000, 04:39	1.06
1633	0.458	49.4	01Jan2000, 04:53	0.98
1634	0.334	51.7	01Jan2000, 03:24	1.10
1635	0.796	236.3	01Jan2000, 03:07	1.94
1636	0.652	82.2	01Jan2000, 04:14	1.04
1637	0.726	61.7	01Jan2000, 05:10	0.81
1638	0.803	56.3	01Jan2000, 04:54	0.64
1639	0.891	132.7	01Jan2000, 04:45	1.27
1640	1.009	115.0	01Jan2000, 06:09	1.22
1641	1.413	205.2	01Jan2000, 04:54	1.27
1642	0.363	32.7	01Jan2000, 04:07	0.70
1643	0.985	186.9	01Jan2000, 04:20	1.53
1644	1.055	151.2	01Jan2000, 04:15	1.19
1645	0.673	152.0	01Jan2000, 04:11	1.80
1646	0.484	75.2	01Jan2000, 04:15	1.29

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	101.4	01Jan2000, 03:35	0.96
1648	1.017	140.6	01Jan2000, 04:34	1.21
1649	0.528	81.0	01Jan2000, 04:12	1.25
1650	0.582	101.7	01Jan2000, 03:38	1.31
1651	0.663	128.8	01Jan2000, 04:06	1.53
1652	0.352	58.8	01Jan2000, 03:48	1.29
1653	0.779	90.2	01Jan2000, 04:25	0.90
1654	0.644	95.4	01Jan2000, 04:11	1.12
1655	0.931	55.3	01Jan2000, 05:55	0.51
1656	1.366	201.7	01Jan2000, 05:04	1.34
1657	0.227	33.9	01Jan2000, 03:44	0.97
1658	0.767	87.9	01Jan2000, 04:46	0.89
1659	1.528	273.3	01Jan2000, 04:27	1.50
1660	0.014	1.5	01Jan2000, 03:19	0.55
1661	1.220	167.9	01Jan2000, 06:05	1.54
1662	0.672	78.5	01Jan2000, 06:01	1.22
1663	1.498	197.8	01Jan2000, 05:17	1.24
1664	0.777	153.9	01Jan2000, 03:52	1.50
1665	1.741	239.2	01Jan2000, 05:13	1.27
1666	1.025	111.2	01Jan2000, 06:16	1.19
1667	0.698	59.0	01Jan2000, 05:12	0.70
1668	1.052	142.9	01Jan2000, 05:30	1.36
1669	0.386	21.7	01Jan2000, 05:13	0.40
1670	0.370	55.1	01Jan2000, 04:10	1.12
1671	0.802	131.3	01Jan2000, 04:47	1.38
CC01	19.043	1443.4	01Jan2000, 11:34	1.14
CC03	17.269	1428.8	01Jan2000, 10:24	1.15
CC04	16.200	1415.2	01Jan2000, 09:43	1.16
CC05	15.232	1397.6	01Jan2000, 09:17	1.19
CC06	14.589	1381.7	01Jan2000, 08:42	1.21
CC07	14.472	1380.6	01Jan2000, 08:29	1.21
CC08	12.821	1290.9	01Jan2000, 07:37	1.19
CC09D	11.934	1220.3	01Jan2000, 07:03	1.20
CC09U	8.771	853.8	01Jan2000, 08:17	1.12
CC10	7.445	798.2	01Jan2000, 06:50	1.15
CC11D	7.082	783.8	01Jan2000, 05:56	1.17
CC11U	4.724	506.0	01Jan2000, 05:48	1.16
CC12D	4.390	480.5	01Jan2000, 05:17	1.17

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	303.2	01Jan2000, 05:03	1.51
CC13	1.413	205.2	01Jan2000, 04:54	1.27
CCR1	19.043	1443.4	01Jan2000, 12:43	1.14
CCR10	7.445	798.2	01Jan2000, 08:31	1.15
CCR11	7.082	783.8	01Jan2000, 06:54	1.17
CCR12	4.390	480.5	01Jan2000, 06:00	1.17
CCR13	1.413	205.2	01Jan2000, 06:28	1.27
CCR2	17.753	1431.9	01Jan2000, 11:38	1.15
CCR3	17.269	1428.8	01Jan2000, 11:02	1.15
CCR4	16.200	1415.2	01Jan2000, 10:27	1.16
CCR5	15.232	1397.6	01Jan2000, 09:47	1.19
CCR6	14.589	1381.7	01Jan2000, 09:20	1.21
CCR7	14.472	1380.6	01Jan2000, 08:42	1.21
CCR8	12.821	1290.9	01Jan2000, 08:49	1.19
CCR9	11.934	1220.3	01Jan2000, 07:44	1.20
Clay Creek	1.665	182.6	01Jan2000, 05:44	1.08
CLC01	1.438	164.4	01Jan2000, 05:26	1.10
CLCR1	1.438	164.4	01Jan2000, 06:01	1.10
Crooked Creek	19.959	1452.9	01Jan2000, 12:41	1.13
DC01	1.529	117.8	01Jan2000, 05:03	0.72
DCR1	1.529	117.8	01Jan2000, 06:27	0.72
Delaware Creek	2.181	179.5	01Jan2000, 05:37	0.82
HJC01	2.713	474.5	01Jan2000, 05:08	1.47
HJC02	1.658	337.2	01Jan2000, 04:30	1.64
HJC03	0.673	152.0	01Jan2000, 04:11	1.80
HJCR1	2.713	474.5	01Jan2000, 05:47	1.47
HJCR2	1.658	337.2	01Jan2000, 05:23	1.64
HJCR3	0.673	152.0	01Jan2000, 04:42	1.80
Howard Johnson Ditch	3.168	523.3	01Jan2000, 05:42	1.41
J1619	0.668	87.0	01Jan2000, 04:27	1.10
J1623	0.540	37.3	01Jan2000, 05:26	0.68
J1628	0.456	83.1	01Jan2000, 04:42	1.61
J1630	0.887	83.4	01Jan2000, 06:00	1.04
J1633	0.458	49.4	01Jan2000, 04:53	0.98
J1634	0.334	51.7	01Jan2000, 03:24	1.10
J1635	0.796	236.3	01Jan2000, 03:07	1.94
J1636	0.652	82.2	01Jan2000, 04:14	1.04
J1637	0.726	61.7	01Jan2000, 05:10	0.81

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1638	0.803	56.3	01Jan2000, 04:54	0.64
J1640	1.009	115.0	01Jan2000, 06:09	1.22
J1643	0.985	186.9	01Jan2000, 04:20	1.53
J1644	1.055	151.2	01Jan2000, 04:15	1.19
J1646	0.484	75.2	01Jan2000, 04:15	1.29
J1649	0.528	81.0	01Jan2000, 04:12	1.25
J1651	0.663	128.8	01Jan2000, 04:06	1.53
J1653	0.779	90.2	01Jan2000, 04:25	0.90
J1654	0.644	95.4	01Jan2000, 04:11	1.12
J1655	0.931	55.3	01Jan2000, 05:55	0.51
J1656	1.366	201.7	01Jan2000, 05:04	1.34
J1658	0.767	87.9	01Jan2000, 04:46	0.89
J1659	1.528	273.3	01Jan2000, 04:27	1.50
J1661	1.220	167.9	01Jan2000, 06:05	1.54
J1662	0.672	78.5	01Jan2000, 06:01	1.22
J1663	1.498	197.8	01Jan2000, 05:17	1.24
J1664	0.777	153.9	01Jan2000, 03:52	1.50
J1666	1.025	111.2	01Jan2000, 06:16	1.19
J1667	0.698	59.0	01Jan2000, 05:12	0.70
J1668	1.052	142.9	01Jan2000, 05:30	1.36
J1669	0.386	21.7	01Jan2000, 05:13	0.40
Payne Branch	2.358	279.3	01Jan2000, 06:08	1.19
PB01	1.900	236.9	01Jan2000, 05:23	1.25
PBR1	1.900	236.9	01Jan2000, 06:20	1.25
SMR01	1.723	165.6	01Jan2000, 05:50	0.99
SMRR1	1.723	165.6	01Jan2000, 08:58	0.99
Spring Mill Run	2.502	183.4	01Jan2000, 08:33	0.96
WC01	20.902	1540.1	01Jan2000, 12:19	1.20
WC02	19.885	1534.1	01Jan2000, 11:23	1.20
WC03	18.622	1530.1	01Jan2000, 09:55	1.21
WC04	17.512	1517.5	01Jan2000, 09:03	1.21
WC05D	16.497	1491.4	01Jan2000, 08:44	1.19
WC05U	13.995	1308.5	01Jan2000, 08:47	1.23
WC06	13.351	1293.7	01Jan2000, 08:09	1.24
WC07	11.054	1169.4	01Jan2000, 07:53	1.29
WC08D	10.684	1154.7	01Jan2000, 07:16	1.30
WC08U	9.019	1007.4	01Jan2000, 07:37	1.33
WC09	8.252	968.3	01Jan2000, 06:46	1.38

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC10	6.710	815.1	01Jan2000, 07:17	1.35
WC11	4.818	598.7	01Jan2000, 06:23	1.32
WC12	2.543	365.4	01Jan2000, 05:32	1.31
WC13	0.802	131.3	01Jan2000, 04:47	1.38
WCR1	20.902	1540.1	01Jan2000, 13:02	1.20
WCR10	6.710	815.1	01Jan2000, 07:23	1.35
WCR11	4.818	598.7	01Jan2000, 07:40	1.32
WCR12	2.543	365.4	01Jan2000, 07:13	1.31
WCR13	0.802	131.3	01Jan2000, 05:57	1.38
WCR2	19.885	1534.1	01Jan2000, 12:21	1.20
WCR3	18.622	1530.1	01Jan2000, 11:24	1.21
WCR4	17.512	1517.5	01Jan2000, 09:59	1.21
WCR5	16.497	1491.4	01Jan2000, 09:11	1.19
WCR6	13.351	1293.7	01Jan2000, 08:53	1.24
WCR7	11.054	1169.4	01Jan2000, 08:43	1.29
WCR8	10.684	1154.7	01Jan2000, 07:59	1.30
WCR9	8.252	968.3	01Jan2000, 07:49	1.38
Williams Creek	21.252	1540.3	01Jan2000, 13:02	1.20

Project: CBBEL Crooked& WilliamsSimulation Run: 2008noDet 2 yr 24 hr 10% Current w/o Detention 50% -24hr

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:47:01

Basin Model: CW 2008CN-10NoDet
Meteorologic Model: 2 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	1408.5	01Jan2000, 12:37	1.43
1617	0.350	29.2	01Jan2000, 05:14	1.16
1618	0.916	77.8	01Jan2000, 06:48	1.30
1619	0.668	65.8	01Jan2000, 05:43	1.38
1620	0.622	48.8	01Jan2000, 06:39	1.18
1621	0.643	43.0	01Jan2000, 06:35	1.01
1622	0.117	10.3	01Jan2000, 04:42	1.16
1623	0.540	30.4	01Jan2000, 07:23	0.88
1624	0.529	61.4	01Jan2000, 05:13	1.52
1625	0.716	40.5	01Jan2000, 07:20	0.88
1626	0.252	21.5	01Jan2000, 04:57	1.16
1627	0.484	46.5	01Jan2000, 05:21	1.30
1628	0.456	64.9	01Jan2000, 05:53	1.96
1629	1.195	133.5	01Jan2000, 05:50	1.59
1630	0.887	70.3	01Jan2000, 07:41	1.30
1631	1.326	109.9	01Jan2000, 06:18	1.21
1632	0.450	41.5	01Jan2000, 06:03	1.33
1633	0.458	38.6	01Jan2000, 06:26	1.23
1634	0.334	36.6	01Jan2000, 04:36	1.38
1635	0.796	166.0	01Jan2000, 04:15	2.34
1636	0.652	61.1	01Jan2000, 05:23	1.30
1637	0.726	49.1	01Jan2000, 06:52	1.03
1638	0.803	43.7	01Jan2000, 06:45	0.83
1639	0.891	103.9	01Jan2000, 06:11	1.59
1640	1.009	99.5	01Jan2000, 07:55	1.55
1641	1.413	162.4	01Jan2000, 06:21	1.59
1642	0.363	23.5	01Jan2000, 05:21	0.91
1643	0.985	142.4	01Jan2000, 05:27	1.89
1644	1.055	113.2	01Jan2000, 05:21	1.47
1645	0.673	115.5	01Jan2000, 05:11	2.18
1646	0.484	56.5	01Jan2000, 05:17	1.59

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	72.1	01Jan2000, 04:45	1.21
1648	1.017	107.7	01Jan2000, 05:49	1.49
1649	0.528	60.6	01Jan2000, 05:18	1.54
1650	0.582	73.5	01Jan2000, 04:42	1.61
1651	0.663	96.6	01Jan2000, 05:09	1.87
1652	0.352	43.0	01Jan2000, 04:50	1.59
1653	0.779	67.9	01Jan2000, 05:53	1.17
1654	0.644	71.2	01Jan2000, 05:21	1.42
1655	0.931	51.0	01Jan2000, 08:21	0.74
1656	1.366	161.7	01Jan2000, 06:30	1.67
1657	0.227	24.8	01Jan2000, 04:49	1.26
1658	0.767	69.4	01Jan2000, 06:28	1.18
1659	1.528	209.4	01Jan2000, 05:35	1.84
1660	0.014	1.1	01Jan2000, 04:20	0.78
1661	1.220	142.7	01Jan2000, 07:33	1.88
1662	0.672	67.3	01Jan2000, 07:44	1.55
1663	1.498	160.8	01Jan2000, 06:48	1.56
1664	0.777	113.8	01Jan2000, 04:56	1.84
1665	1.741	193.7	01Jan2000, 06:43	1.59
1666	1.025	97.0	01Jan2000, 08:05	1.50
1667	0.698	48.5	01Jan2000, 07:12	0.95
1668	1.052	117.4	01Jan2000, 06:58	1.68
1669	0.386	19.1	01Jan2000, 07:29	0.61
1670	0.370	41.0	01Jan2000, 05:19	1.42
1671	0.802	103.6	01Jan2000, 06:11	1.73
CC01	19.043	1447.3	01Jan2000, 13:08	1.42
CC03	17.269	1394.5	01Jan2000, 12:02	1.43
CC04	16.200	1356.2	01Jan2000, 11:23	1.45
CC05	15.232	1320.3	01Jan2000, 10:58	1.48
CC06	14.589	1292.7	01Jan2000, 10:23	1.50
CC07	14.472	1286.2	01Jan2000, 10:10	1.50
CC08	12.821	1166.1	01Jan2000, 09:17	1.48
CC09D	11.934	1100.1	01Jan2000, 08:42	1.49
CC09U	8.771	769.8	01Jan2000, 09:49	1.40
CC10	7.445	690.9	01Jan2000, 08:21	1.44
CC11D	7.082	671.8	01Jan2000, 07:25	1.47
CC11U	4.724	439.4	01Jan2000, 07:16	1.45

Hydrologic Element	Drainage Area (Mi2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12D	4.390	412.6	01Jan2000, 06:42	1.45
CC12U	2.209	268.9	01Jan2000, 06:35	1.86
CC13	1.413	162.4	01Jan2000, 06:21	1.59
CCR1	19.043	1447.3	01Jan2000, 14:17	1.42
CCR10	7.445	690.9	01Jan2000, 10:02	1.44
CCR11	7.082	671.8	01Jan2000, 08:23	1.47
CCR12	4.390	412.6	01Jan2000, 07:25	1.45
CCR13	1.413	162.4	01Jan2000, 07:55	1.59
CCR2	17.753	1408.5	01Jan2000, 13:14	1.43
CCR3	17.269	1394.5	01Jan2000, 12:40	1.43
CCR4	16.200	1356.2	01Jan2000, 12:07	1.45
CCR5	15.232	1320.3	01Jan2000, 11:28	1.48
CCR6	14.589	1292.7	01Jan2000, 11:01	1.50
CCR7	14.472	1288.2	01Jan2000, 10:23	1.50
CCR8	12.821	1166.1	01Jan2000, 10:29	1.48
CCR9	11.934	1100.1	01Jan2000, 09:23	1.49
Clay Creek	1.665	155.3	01Jan2000, 07:16	1.38
CLC01	1.438	136.3	01Jan2000, 07:05	1.39
CLCR1	1.438	136.3	01Jan2000, 07:40	1.39
Crooked Creek	19.959	1473.5	01Jan2000, 14:13	1.41
DC01	1.529	92.8	01Jan2000, 06:49	0.93
DCR1	1.529	92.8	01Jan2000, 08:13	0.93
Delaware Creek	2.181	145.2	01Jan2000, 07:19	1.04
HJC01	2.713	366.9	01Jan2000, 06:14	1.80
HJC02	1.658	257.6	01Jan2000, 05:34	2.01
HJC03	0.673	115.5	01Jan2000, 05:11	2.18
HJCR1	2.713	366.9	01Jan2000, 06:53	1.80
HJCR2	1.658	257.6	01Jan2000, 06:27	2.01
HJCR3	0.673	115.5	01Jan2000, 05:42	2.18
Howard Johnson Ditch	3.168	407.4	01Jan2000, 06:50	1.73
J1619	0.668	65.8	01Jan2000, 05:43	1.38
J1623	0.540	30.4	01Jan2000, 07:23	0.88
J1628	0.456	64.9	01Jan2000, 05:53	1.96
J1630	0.887	70.3	01Jan2000, 07:41	1.30
J1633	0.458	38.6	01Jan2000, 06:26	1.23
J1634	0.334	36.6	01Jan2000, 04:36	1.38
J1635	0.796	166.0	01Jan2000, 04:15	2.34

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1636	0.652	61.1	01Jan2000, 05:23	1.30
J1637	0.726	49.1	01Jan2000, 06:52	1.03
J1638	0.803	43.7	01Jan2000, 06:45	0.83
J1640	1.009	99.5	01Jan2000, 07:55	1.55
J1643	0.985	142.4	01Jan2000, 05:27	1.89
J1644	1.055	113.2	01Jan2000, 05:21	1.47
J1646	0.484	56.5	01Jan2000, 05:17	1.59
J1649	0.528	60.6	01Jan2000, 05:18	1.54
J1651	0.663	96.6	01Jan2000, 05:09	1.87
J1653	0.779	67.9	01Jan2000, 05:53	1.17
J1654	0.644	71.2	01Jan2000, 05:21	1.42
J1655	0.931	51.0	01Jan2000, 08:21	0.74
J1656	1.366	161.7	01Jan2000, 06:30	1.67
J1658	0.767	69.4	01Jan2000, 06:28	1.18
J1659	1.528	209.4	01Jan2000, 05:35	1.84
J1661	1.220	142.7	01Jan2000, 07:33	1.88
J1662	0.672	67.3	01Jan2000, 07:44	1.55
J1663	1.498	160.8	01Jan2000, 06:48	1.56
J1664	0.777	113.8	01Jan2000, 04:56	1.84
J1666	1.025	97.0	01Jan2000, 08:05	1.50
J1667	0.698	48.5	01Jan2000, 07:12	0.95
J1668	1.052	117.4	01Jan2000, 06:58	1.68
J1669	0.386	19.1	01Jan2000, 07:29	0.61
Payne Branch	2.358	233.9	01Jan2000, 07:46	1.50
PB01	1.900	197.6	01Jan2000, 07:03	1.57
PBR1	1.900	197.6	01Jan2000, 08:00	1.57
SMR01	1.723	144.6	01Jan2000, 07:46	1.28
SMRR1	1.723	144.6	01Jan2000, 10:54	1.28
Spring Mill Run	2.502	183.0	01Jan2000, 10:04	1.24
WC01	20.902	1622.7	01Jan2000, 13:51	1.51
WC02	19.885	1596.5	01Jan2000, 13:02	1.51
WC03	18.622	1568.6	01Jan2000, 11:44	1.52
WC04	17.512	1525.8	01Jan2000, 10:59	1.52
WC05D	16.497	1470.2	01Jan2000, 10:43	1.50
WC05U	13.995	1289.5	01Jan2000, 10:49	1.55
WC06	13.351	1257.0	01Jan2000, 10:13	1.56
WC07	11.054	1103.1	01Jan2000, 09:45	1.61

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC08D	10.684	1079.5	01Jan2000, 09:07	1.62
WC08U	9.019	938.9	01Jan2000, 09:20	1.66
WC09	8.252	885.7	01Jan2000, 08:24	1.71
WC10	6.710	726.1	01Jan2000, 08:46	1.68
WC11	4.818	525.7	01Jan2000, 07:50	1.65
WC12	2.543	296.0	01Jan2000, 06:57	1.64
WC13	0.802	103.6	01Jan2000, 06:11	1.73
WCR1	20.902	1622.7	01Jan2000, 14:34	1.51
WCR10	6.710	726.1	01Jan2000, 08:52	1.68
WCR11	4.818	525.7	01Jan2000, 09:07	1.65
WCR12	2.543	296.0	01Jan2000, 08:38	1.64
WCR13	0.802	103.6	01Jan2000, 07:21	1.73
WCR2	19.885	1596.5	01Jan2000, 14:00	1.51
WCR3	18.622	1568.6	01Jan2000, 13:13	1.52
WCR4	17.512	1525.8	01Jan2000, 11:55	1.52
WCR5	16.497	1470.2	01Jan2000, 11:10	1.50
WCR6	13.351	1257.0	01Jan2000, 10:57	1.56
WCR7	11.054	1103.1	01Jan2000, 10:35	1.61
WCR8	10.684	1079.5	01Jan2000, 09:50	1.62
WCR9	8.252	885.7	01Jan2000, 09:27	1.71
Williams Creek	21.252	1626.9	01Jan2000, 14:33	1.50

APPENDIX A4-9

HEC-HMS Output – Future Condition

Future 1% - 6hr.

Project: CBBEL Crooked& WilliamsSimulation Run: 100yr6HrFuture3RR10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:36:14

Basin Model: CW 2030CN & det.3
Meteorologic Model: 100 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	3602.2	01Jan2000, 09:51	2.93
1617	0.350	156.8	01Jan2000, 03:17	2.49
1618	0.916	315.5	01Jan2000, 04:27	2.71
1619	0.668	305.5	01Jan2000, 03:37	2.85
1620	0.622	217.5	01Jan2000, 04:12	2.54
1621	0.643	214.1	01Jan2000, 04:01	2.27
1622	0.117	61.9	01Jan2000, 02:48	2.49
1623	0.540	151.3	01Jan2000, 04:25	2.10
1624	0.529	296.4	01Jan2000, 03:14	3.10
1625	0.716	202.8	01Jan2000, 04:22	2.10
1626	0.252	122.2	01Jan2000, 03:03	2.49
1627	0.484	221.1	01Jan2000, 03:27	2.71
1628	0.456	245.7	01Jan2000, 03:52	3.72
1629	1.195	541.0	01Jan2000, 03:53	3.12
1630	0.887	259.9	01Jan2000, 05:08	2.71
1631	1.326	516.2	01Jan2000, 03:53	2.59
1632	0.450	186.3	01Jan2000, 03:50	2.75
1633	0.458	176.9	01Jan2000, 03:58	2.64
1634	0.334	206.7	01Jan2000, 02:42	2.85
1635	0.796	743.4	01Jan2000, 02:29	4.24
1636	0.652	295.7	01Jan2000, 03:28	2.71
1637	0.726	233.3	01Jan2000, 04:13	2.33
1638	0.803	242.7	01Jan2000, 03:57	1.99
1639	0.891	444.9	01Jan2000, 03:47	3.26
1640	1.009	359.0	01Jan2000, 05:05	3.22
1641	1.413	680.2	01Jan2000, 03:55	3.26
1642	0.363	156.4	01Jan2000, 03:06	2.16
1643	0.985	591.9	01Jan2000, 03:28	3.65
1644	1.055	514.6	01Jan2000, 03:29	2.96

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1645	0.673	449.7	01Jan2000, 03:23	4.04
1646	0.484	244.5	01Jan2000, 03:30	3.12
1647	0.779	426.2	01Jan2000, 02:49	2.59
1648	1.017	464.2	01Jan2000, 03:46	3.00
1649	0.528	276.6	01Jan2000, 03:24	3.10
1650	0.582	352.4	01Jan2000, 02:59	3.16
1651	0.663	413.7	01Jan2000, 03:17	3.60
1652	0.352	230.1	01Jan2000, 03:06	3.56
1653	0.779	394.3	01Jan2000, 03:20	2.79
1654	0.644	433.0	01Jan2000, 03:06	3.63
1655	0.931	293.3	01Jan2000, 04:22	2.24
1656	1.366	726.1	01Jan2000, 04:01	3.80
1657	0.227	156.0	01Jan2000, 02:41	3.02
1658	0.767	502.1	01Jan2000, 03:22	3.91
1659	1.528	877.6	01Jan2000, 03:36	3.65
1660	0.014	15.5	01Jan2000, 01:47	4.12
1661	1.220	403.5	01Jan2000, 05:18	3.14
1662	0.672	311.4	01Jan2000, 04:48	4.07
1663	1.498	680.2	01Jan2000, 04:15	3.39
1664	0.777	508.4	01Jan2000, 03:06	3.56
1665	1.741	885.9	01Jan2000, 04:08	3.75
1666	1.025	425.6	01Jan2000, 05:05	3.85
1667	0.698	299.2	01Jan2000, 03:50	2.73
1668	1.052	477.8	01Jan2000, 04:31	3.70
1669	0.386	138.0	01Jan2000, 03:38	2.01
1670	0.370	222.1	01Jan2000, 03:10	3.18
1671	0.802	493.7	01Jan2000, 03:42	4.07
CC01	19.043	3662.8	01Jan2000, 10:27	2.92
CC03	17.269	3596.2	01Jan2000, 09:13	2.94
CC04	16.200	3516.9	01Jan2000, 08:29	2.96
CC05	15.232	3467.8	01Jan2000, 08:00	3.01
CC06	14.589	3424.3	01Jan2000, 07:22	3.04
CC07	14.472	3422.8	01Jan2000, 07:10	3.05
CC08	12.821	3189.3	01Jan2000, 06:10	3.02
CC09D	11.934	2975.2	01Jan2000, 05:39	3.04

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC09U	8.771	2312.4	01Jan2000, 07:59	2.92
CC10	7.445	2222.3	01Jan2000, 06:26	2.97
CC11D	7.082	2202.4	01Jan2000, 05:30	3.02
CC11U	4.724	1385.7	01Jan2000, 05:53	2.96
CC12D	4.390	1334.8	01Jan2000, 05:13	2.97
CC12U	2.209	861.7	01Jan2000, 05:20	3.62
CC13	1.413	680.2	01Jan2000, 03:55	3.26
CCR1	19.043	3662.8	01Jan2000, 11:36	2.92
CCR10	7.445	2222.3	01Jan2000, 08:07	2.97
CCR11	7.082	2202.4	01Jan2000, 06:28	3.02
CCR12	4.390	1334.8	01Jan2000, 05:56	2.97
CCR13	1.413	680.2	01Jan2000, 05:29	3.26
CCR2	17.753	3602.2	01Jan2000, 10:28	2.93
CCR3	17.269	3596.2	01Jan2000, 09:51	2.94
CCR4	16.200	3516.9	01Jan2000, 09:13	2.96
CCR5	15.232	3467.8	01Jan2000, 08:30	3.01
CCR6	14.589	3424.3	01Jan2000, 08:00	3.04
CCR7	14.472	3422.8	01Jan2000, 07:23	3.05
CCR8	12.821	3189.3	01Jan2000, 07:22	3.02
CCR9	11.934	2975.2	01Jan2000, 06:20	3.04
Clay Creek	1.438	341.3	01Jan2000, 03:21	3.52
CLC01	1.438	299.2	01Jan2000, 04:19	3.25
CLCR1	1.438	299.2	01Jan2000, 04:54	3.25
Crooked Creek	19.959	3685.0	01Jan2000, 11:34	2.91
D1619	0.668	85.5	01Jan2000, 03:37	0.80
D1623	0.540	104.4	01Jan2000, 04:25	1.45
D1628	0.456	88.5	01Jan2000, 03:52	1.34
D1630	0.887	39.0	01Jan2000, 05:08	0.41
D1633	0.458	23.0	01Jan2000, 03:58	0.34
D1634	0.334	82.7	01Jan2000, 02:42	1.14
D1635	0.796	475.8	01Jan2000, 02:29	2.71
D1636	0.652	150.8	01Jan2000, 03:28	1.38
D1637	0.726	198.3	01Jan2000, 04:13	1.98
D1638	0.803	155.3	01Jan2000, 03:57	1.28
D1640	1.009	43.1	01Jan2000, 05:05	0.39

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1643	0.985	65.1	01Jan2000, 03:28	0.40
D1644	1.055	72.0	01Jan2000, 03:29	0.41
D1646	0.484	34.2	01Jan2000, 03:30	0.44
D1649	0.528	124.5	01Jan2000, 03:24	1.39
D1651	0.663	285.4	01Jan2000, 03:17	2.49
D1653	0.779	193.2	01Jan2000, 03:20	1.37
D1654	0.644	164.6	01Jan2000, 03:06	1.38
D1654F	0.000	134.2	01Jan2000, 03:06	
D1655	0.931	149.6	01Jan2000, 04:22	1.14
D1656	1.366	159.7	01Jan2000, 04:01	0.84
D1656F	0.000	218.0	01Jan2000, 04:01	
D1657F	0.227	67.5	01Jan2000, 02:41	1.31
D1658	0.767	100.4	01Jan2000, 03:22	0.78
D1658F	0.000	326.1	01Jan2000, 03:22	
D1659	1.528	596.8	01Jan2000, 03:36	2.48
D1659F	0.000	122.7	01Jan2000, 03:36	
D1661	1.220	137.2	01Jan2000, 05:18	1.07
D1661F	0.000	44.5	01Jan2000, 05:18	
D1662	0.672	127.7	01Jan2000, 04:48	1.67
D1663	1.498	299.3	01Jan2000, 04:15	1.49
D1663F	0.000	224.4	01Jan2000, 04:15	
D1664	0.777	462.6	01Jan2000, 03:06	3.24
D1665	1.741	487.3	01Jan2000, 04:08	2.06
D1665F	0.000	256.7	01Jan2000, 04:08	
D1666	1.025	217.0	01Jan2000, 05:05	1.97
D1666F	0.000	144.8	01Jan2000, 05:05	
D1667	0.698	224.4	01Jan2000, 03:50	2.05
d1668	1.052	348.8	01Jan2000, 04:31	2.70
D1668F	0.000	62.0	01Jan2000, 04:31	
D1669	0.386	118.7	01Jan2000, 03:38	1.73
D1670F	0.370	118.4	01Jan2000, 03:10	1.69
D1671	0.802	222.2	01Jan2000, 03:42	1.83
D1671F	0.000	256.9	01Jan2000, 03:42	
DC01	1.529	325.6	01Jan2000, 04:02	2.15
DCR1	1.529	325.6	01Jan2000, 05:26	2.15

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Delaware Creek	2.181	487.2	01Jan2000, 04:29	2.32
HJC01	2.713	1385.9	01Jan2000, 04:18	3.48
HJC02	1.658	987.8	01Jan2000, 03:41	3.81
HJC03	0.673	449.7	01Jan2000, 03:23	4.04
HJCR1	2.713	1385.9	01Jan2000, 04:57	3.48
HJCR2	1.658	987.8	01Jan2000, 04:34	3.81
HJCR3	0.673	449.7	01Jan2000, 03:54	4.04
Howard Johnson Ditch	3.168	1537.4	01Jan2000, 04:52	3.38
J1619	0.668	257.3	01Jan2000, 03:37	2.85
J1623	0.540	111.1	01Jan2000, 04:26	2.10
J1628	0.456	187.8	01Jan2000, 03:52	3.72
J1630	0.887	241.1	01Jan2000, 05:08	2.71
J1633	0.458	166.0	01Jan2000, 03:58	2.64
J1634	0.334	162.3	01Jan2000, 02:42	2.85
J1635	0.796	411.4	01Jan2000, 02:29	4.24
J1636	0.652	213.3	01Jan2000, 03:28	2.71
J1637	0.726	143.4	01Jan2000, 04:15	2.33
J1638	0.803	182.6	01Jan2000, 03:58	1.99
J1640	1.009	334.7	01Jan2000, 05:05	3.22
J1643	0.985	549.1	01Jan2000, 03:28	3.65
J1644	1.055	472.9	01Jan2000, 03:29	2.96
J1646	0.484	223.4	01Jan2000, 03:30	3.12
J1649	0.528	201.6	01Jan2000, 03:24	3.10
J1651	0.663	224.1	01Jan2000, 03:18	3.60
J1653	0.779	284.6	01Jan2000, 03:20	2.79
J1654	0.644	220.7	01Jan2000, 03:08	3.63
J1655	0.931	225.1	01Jan2000, 04:22	2.24
J1656	1.366	481.1	01Jan2000, 04:02	3.80
J1658	0.767	204.2	01Jan2000, 03:24	3.91
J1659	1.528	395.8	01Jan2000, 03:37	3.65
J1661	1.220	315.5	01Jan2000, 05:18	3.14
J1662	0.672	225.6	01Jan2000, 04:49	4.07
J1663	1.498	363.2	01Jan2000, 04:16	3.39
J1664	0.777	205.3	01Jan2000, 03:07	3.56
J1665	1.741	401.5	01Jan2000, 04:09	3.75

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1666	1.025	205.6	01Jan2000, 05:10	3.85
J1667	0.698	173.4	01Jan2000, 03:51	2.73
J1668	1.052	215.4	01Jan2000, 04:34	3.70
J1669	0.386	86.5	01Jan2000, 03:40	2.01
J1671	0.802	162.0	01Jan2000, 03:59	4.07
Payne Branch	2.358	868.8	01Jan2000, 04:58	3.12
PB01	1.900	731.0	01Jan2000, 04:13	3.24
PBR1	1.900	731.0	01Jan2000, 05:10	3.24
R1619	0.668	37.8	01Jan2000, 05:54	0.80
R1623	0.540	64.5	01Jan2000, 06:21	1.45
R1628	0.456	31.2	01Jan2000, 06:52	1.34
R1630	0.887	20.4	01Jan2000, 07:58	0.41
R1633	0.458	12.2	01Jan2000, 06:06	0.34
R1634	0.334	38.5	01Jan2000, 04:18	1.14
R1635	0.796	144.7	01Jan2000, 04:36	2.71
R1636	0.652	69.0	01Jan2000, 05:36	1.38
R1637	0.726	108.8	01Jan2000, 06:22	1.98
R1638	0.803	95.5	01Jan2000, 05:41	1.28
R1640	1.009	19.1	01Jan2000, 08:20	0.39
R1643	0.985	22.8	01Jan2000, 06:07	0.40
R1644	1.055	30.7	01Jan2000, 05:47	0.41
R1646	0.484	13.4	01Jan2000, 05:59	0.44
R1649	0.528	50.1	01Jan2000, 05:44	1.39
R1651	0.663	97.0	01Jan2000, 05:51	2.49
R1653	0.779	84.1	01Jan2000, 05:23	1.37
R1654	0.644	48.8	01Jan2000, 05:42	1.38
R1654F	0.000	39.6	01Jan2000, 05:43	
R1655	0.931	81.8	01Jan2000, 06:30	1.14
R1656	1.366	54.0	01Jan2000, 07:13	0.84
R1656F	0.000	81.0	01Jan2000, 07:01	
R1657F	0.227	19.7	01Jan2000, 04:47	1.31
R1658	0.767	32.3	01Jan2000, 06:07	0.78
R1658F	0.000	98.6	01Jan2000, 06:13	
R1659	1.528	197.1	01Jan2000, 06:29	2.48
R1659F	0.000	41.5	01Jan2000, 06:27	

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1660F	0.014	3.2	01Jan2000, 03:48	4.12
R1661	1.220	68.2	01Jan2000, 08:21	1.07
R1661F	0.000	26.4	01Jan2000, 07:49	
R1662	0.672	43.0	01Jan2000, 08:44	1.67
R1663	1.498	113.0	01Jan2000, 07:20	1.49
R1663F	0.000	95.6	01Jan2000, 07:04	
R1664	0.777	160.2	01Jan2000, 05:29	3.24
R1665	1.741	164.5	01Jan2000, 07:25	2.06
R1665F	0.000	97.0	01Jan2000, 07:11	
R1666	1.025	76.8	01Jan2000, 09:05	1.97
R1666F	0.000	67.4	01Jan2000, 08:17	
R1667	0.698	99.3	01Jan2000, 06:11	2.05
R1668	1.052	123.4	01Jan2000, 08:03	2.70
R1668F	0.000	26.8	01Jan2000, 07:33	
R1669	0.386	67.5	01Jan2000, 05:17	1.73
R1670F	0.370	36.3	01Jan2000, 05:40	1.69
R1671	0.802	68.5	01Jan2000, 06:50	1.83
R1671F	0.000	81.5	01Jan2000, 06:47	
SMR01	1.723	369.8	01Jan2000, 04:19	3.40
SMRR1	1.723	369.8	01Jan2000, 07:27	3.40
Spring Mill Run	2.502	478.6	01Jan2000, 06:54	3.21
WC01	20.902	3368.1	01Jan2000, 12:18	3.38
WC02	19.885	3362.9	01Jan2000, 11:21	3.40
WC03	18.622	3347.6	01Jan2000, 09:52	3.44
WC04	17.512	3293.4	01Jan2000, 08:56	3.46
WC05D	16.497	3186.2	01Jan2000, 08:29	3.46
WC05U	13.995	2758.7	01Jan2000, 09:15	3.50
WC06	13.351	2669.3	01Jan2000, 08:31	3.50
WC07	11.054	2359.9	01Jan2000, 07:42	3.56
WC08D	10.684	2317.0	01Jan2000, 06:59	3.58
WC08U	9.019	2027.5	01Jan2000, 06:59	3.64
WC09	8.252	1882.7	01Jan2000, 05:56	3.62
WC10	6.710	1570.8	01Jan2000, 05:51	3.61
WC11	4.818	1068.2	01Jan2000, 05:07	3.66
WC12	2.543	560.7	01Jan2000, 04:16	3.85

Global Summary Results for Run "100yr6HrFuture3RR10%"

Project: CBBEL Crooked& Williams Simulation Run: 100yr6HrFuture3RR10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:36:14

Basin Model: CW 2030CN & det.3
Meteorologic Model: 100 year / 6 hr 10%
Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC09	8.252	1682.7	01Jan2000, 05:56	3.62
WC10	6.710	1570.8	01Jan2000, 05:51	3.61
WC11	4.818	1068.2	01Jan2000, 05:07	3.66
WC12	2.543	560.7	01Jan2000, 04:16	3.85
WC13	0.802	162.0	01Jan2000, 03:59	4.07
WCR1	20.902	3368.1	01Jan2000, 13:01	3.38
WCR10	6.710	1570.8	01Jan2000, 05:57	3.61
WCR11	4.818	1068.2	01Jan2000, 06:24	3.66
WCR12	2.543	560.7	01Jan2000, 05:57	3.85
WCR13	0.802	162.0	01Jan2000, 05:09	4.07
WCR2	19.885	3362.9	01Jan2000, 12:19	3.40
WCR3	18.622	3347.6	01Jan2000, 11:21	3.44
WCR4	17.512	3293.4	01Jan2000, 09:52	3.46
WCR5	16.497	3186.2	01Jan2000, 08:56	3.46
WCR6	13.351	2669.3	01Jan2000, 09:15	3.50
WCR7	11.054	2359.9	01Jan2000, 08:32	3.56
WCR8	10.684	2317.0	01Jan2000, 07:42	3.58
WCR9	8.252	1682.7	01Jan2000, 06:59	3.62
Williams Creek	21.252	3368.1	01Jan2000, 13:01	3.37

Print Close

Future - 1% 12 hr

Project: CBBEL Crooked& WilliamsSimulation Run: 100yr12HrFuture3RR10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 27May2010, 10:25:12

Basin Model: CW 2030CN & det.3
Meteorologic Model: 100 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

03351310	17.753	3860.1	01Jan2000, 10:52	3.45
1617	0.350	137.0	01Jan2000, 04:08	2.97
1618	0.916	304.4	01Jan2000, 05:22	3.20
1619	0.668	275.6	01Jan2000, 04:26	3.36
1620	0.622	206.8	01Jan2000, 05:07	3.02
1621	0.643	201.7	01Jan2000, 04:57	2.73
1622	0.117	50.9	01Jan2000, 03:32	2.97
1623	0.540	148.3	01Jan2000, 05:25	2.55
1624	0.529	257.2	01Jan2000, 04:00	3.64
1625	0.716	198.1	01Jan2000, 05:22	2.55
1626	0.252	103.8	01Jan2000, 03:50	2.97
1627	0.484	196.2	01Jan2000, 04:16	3.20
1628	0.456	225.1	01Jan2000, 04:38	4.29
1629	1.195	497.3	01Jan2000, 04:42	3.64
1630	0.887	261.1	01Jan2000, 06:05	3.20
1631	1.326	478.3	01Jan2000, 04:46	3.08
1632	0.450	171.4	01Jan2000, 04:41	3.25
1633	0.458	165.2	01Jan2000, 04:52	3.14
1634	0.334	167.9	01Jan2000, 03:22	3.36
1635	0.796	598.2	01Jan2000, 02:58	4.85
1636	0.652	262.9	01Jan2000, 04:18	3.20
1637	0.726	223.5	01Jan2000, 05:11	2.79
1638	0.803	229.0	01Jan2000, 04:56	2.42
1639	0.891	407.8	01Jan2000, 04:36	3.82
1640	1.009	359.5	01Jan2000, 05:59	3.78

1641	1.413	629.9	01Jan2000, 04:44	3.82
1642	0.363	134.2	01Jan2000, 03:58	2.61
1643	0.985	525.6	01Jan2000, 04:13	4.23
1644	1.055	457.6	01Jan2000, 04:17	3.47
1645	0.673	395.7	01Jan2000, 04:06	4.64
1646	0.484	217.5	01Jan2000, 04:18	3.64
1647	0.779	351.7	01Jan2000, 03:33	3.08
1648	1.017	423.2	01Jan2000, 04:35	3.52
1649	0.528	244.0	01Jan2000, 04:11	3.62
1650	0.582	296.5	01Jan2000, 03:40	3.68
1651	0.663	360.7	01Jan2000, 04:01	4.17
1652	0.352	196.8	01Jan2000, 03:48	4.12
1653	0.779	347.7	01Jan2000, 04:09	3.32
1654	0.644	371.4	01Jan2000, 03:48	4.21
1655	0.931	289.4	01Jan2000, 05:21	2.74
1656	1.366	674.3	01Jan2000, 04:48	4.39
1657	0.227	127.3	01Jan2000, 03:20	3.57
1658	0.767	441.3	01Jan2000, 04:05	4.50
1659	1.528	788.1	01Jan2000, 04:22	4.23
1660	0.014	12.0	01Jan2000, 02:12	4.73
1661	1.220	408.0	01Jan2000, 06:12	3.69
1662	0.672	302.6	01Jan2000, 05:36	4.67
1663	1.498	645.4	01Jan2000, 05:06	3.96
1664	0.777	434.6	01Jan2000, 03:47	4.12
1665	1.741	828.0	01Jan2000, 04:55	4.33
1666	1.025	420.5	01Jan2000, 05:55	4.44
1667	0.698	278.4	01Jan2000, 04:42	3.26
1668	1.052	458.6	01Jan2000, 05:21	4.28
1669	0.386	128.2	01Jan2000, 04:35	2.48
1670	0.370	192.1	01Jan2000, 03:55	3.74
1671	0.802	446.3	01Jan2000, 04:26	4.67

CC01	19.043	3934.7	01Jan2000, 11:17	3.43
CC03	17.269	3849.7	01Jan2000, 10:20	3.45
CC04	16.200	3762.2	01Jan2000, 09:48	3.48
CC05	15.232	3702.4	01Jan2000, 09:35	3.53
CC06	14.589	3654.5	01Jan2000, 09:06	3.57
CC07	14.472	3651.9	01Jan2000, 08:55	3.57
CC08	12.821	3454.0	01Jan2000, 08:22	3.54
CC09D	11.934	3275.5	01Jan2000, 07:53	3.56
CC09U	8.771	2434.3	01Jan2000, 08:35	3.43
CC10	7.445	2277.1	01Jan2000, 07:10	3.50
CC11D	7.082	2232.8	01Jan2000, 06:17	3.54
CC11U	4.724	1396.9	01Jan2000, 06:32	3.48
CC12D	4.390	1327.1	01Jan2000, 05:55	3.49
CC12U	2.209	844.2	01Jan2000, 06:01	4.19
CC13	1.413	629.9	01Jan2000, 04:44	3.82
CCR1	19.043	3934.7	01Jan2000, 12:26	3.43
CCR10	7.445	2277.1	01Jan2000, 08:51	3.50
CCR11	7.082	2232.8	01Jan2000, 07:15	3.54
CCR12	4.390	1327.1	01Jan2000, 06:38	3.49
CCR13	1.413	629.9	01Jan2000, 06:18	3.82
CCR2	17.753	3860.1	01Jan2000, 11:29	3.45
CCR3	17.269	3849.7	01Jan2000, 10:58	3.45
CCR4	16.200	3762.2	01Jan2000, 10:32	3.48
CCR5	15.232	3702.4	01Jan2000, 10:05	3.53
CCR6	14.589	3654.5	01Jan2000, 09:44	3.57
CCR7	14.472	3651.9	01Jan2000, 09:08	3.57
CCR8	12.821	3454.0	01Jan2000, 09:34	3.54
CCR9	11.934	3275.5	01Jan2000, 08:34	3.56
Clay Creek	1.438	341.7	01Jan2000, 04:43	4.12
CLC01	1.438	297.1	01Jan2000, 05:13	3.80
CLCR1	1.438	297.1	01Jan2000, 05:48	3.80

Crooked Creek	19.959	3968.7	01Jan2000, 12:21	3.42
D1619	0.668	77.2	01Jan2000, 04:26	0.94
D1623	0.540	102.3	01Jan2000, 05:25	1.76
D1628	0.456	81.0	01Jan2000, 04:38	1.55
D1630	0.887	39.2	01Jan2000, 06:05	0.48
D1633	0.458	21.5	01Jan2000, 04:52	0.41
D1634	0.334	67.2	01Jan2000, 03:22	1.34
D1635	0.796	382.8	01Jan2000, 02:58	3.10
D1636	0.652	134.1	01Jan2000, 04:18	1.63
D1637	0.726	190.0	01Jan2000, 05:11	2.37
D1638	0.803	146.6	01Jan2000, 04:56	1.55
D1640	1.009	43.1	01Jan2000, 05:59	0.45
D1643	0.985	57.8	01Jan2000, 04:13	0.47
D1644	1.055	64.1	01Jan2000, 04:17	0.49
D1646	0.484	30.4	01Jan2000, 04:18	0.51
D1649	0.528	109.8	01Jan2000, 04:11	1.63
D1651	0.663	248.9	01Jan2000, 04:01	2.88
D1653	0.779	170.4	01Jan2000, 04:09	1.63
D1654	0.644	141.1	01Jan2000, 03:48	1.60
D1654F	0.000	115.1	01Jan2000, 03:48	
D1655	0.931	147.6	01Jan2000, 05:21	1.40
D1656	1.366	148.3	01Jan2000, 04:48	0.97
D1656F	0.000	202.5	01Jan2000, 04:48	
D1657F	0.227	55.1	01Jan2000, 03:20	1.54
D1658	0.767	88.3	01Jan2000, 04:05	0.90
D1658F	0.000	286.7	01Jan2000, 04:05	
D1659	1.528	535.9	01Jan2000, 04:22	2.87
D1659F	0.000	110.2	01Jan2000, 04:22	
D1661	1.220	138.7	01Jan2000, 06:12	1.25
D1661F	0.000	45.0	01Jan2000, 06:12	
D1662	0.672	124.1	01Jan2000, 05:36	1.91

D1663	1.498	284.0	01Jan2000, 05:06	1.74
D1663F	0.000	212.9	01Jan2000, 05:06	
D1664	0.777	395.5	01Jan2000, 03:47	3.75
D1665	1.741	455.4	01Jan2000, 04:55	2.38
D1665F	0.000	239.9	01Jan2000, 04:55	
D1666	1.025	214.4	01Jan2000, 05:55	2.27
D1666F	0.000	143.0	01Jan2000, 05:55	
D1667	0.698	208.8	01Jan2000, 04:42	2.44
d1668	1.052	334.8	01Jan2000, 05:21	3.12
D1668F	0.000	59.6	01Jan2000, 05:21	
D1669	0.386	110.3	01Jan2000, 04:35	2.14
D1670F	0.370	102.4	01Jan2000, 03:55	1.99
D1671	0.802	200.8	01Jan2000, 04:26	2.10
D1671F	0.000	232.3	01Jan2000, 04:26	
DC01	1.529	319.5	01Jan2000, 05:02	2.60
DCR1	1.529	319.5	01Jan2000, 06:26	2.60
Delaware Creek	2.181	486.8	01Jan2000, 05:30	2.78
HJC01	2.713	1275.5	01Jan2000, 05:02	4.04
HJC02	1.658	881.5	01Jan2000, 04:24	4.40
HJC03	0.673	395.7	01Jan2000, 04:06	4.64
HJCR1	2.713	1275.5	01Jan2000, 05:41	4.04
HJCR2	1.658	881.5	01Jan2000, 05:17	4.40
HJCR3	0.673	395.7	01Jan2000, 04:37	4.64
Howard Johnson Ditch	8.[illegible]	1432.7	01Jan2000, 05:36	3.92
J1619	0.668	235.8	01Jan2000, 04:26	3.36
J1623	0.540	110.2	01Jan2000, 05:26	2.55
J1628	0.456	174.6	01Jan2000, 04:39	4.29
J1630	0.887	242.2	01Jan2000, 06:05	3.20
J1633	0.458	155.9	01Jan2000, 04:52	3.14
J1634	0.334	138.9	01Jan2000, 03:22	3.36
J1635	0.796	359.0	01Jan2000, 02:59	4.85

J1636	0.652	197.3	01Jan2000, 04:18	3.20
J1637	0.726	142.0	01Jan2000, 05:13	2.79
J1638	0.803	177.7	01Jan2000, 04:57	2.42
J1640	1.009	335.1	01Jan2000, 05:59	3.78
J1643	0.985	490.2	01Jan2000, 04:13	4.23
J1644	1.055	423.8	01Jan2000, 04:17	3.47
J1646	0.484	200.2	01Jan2000, 04:18	3.64
J1649	0.528	183.7	01Jan2000, 04:12	3.62
J1651	0.663	207.7	01Jan2000, 04:03	4.17
J1653	0.779	260.8	01Jan2000, 04:09	3.32
J1654	0.644	201.6	01Jan2000, 03:50	4.21
J1655	0.931	223.2	01Jan2000, 05:22	2.74
J1656	1.366	456.4	01Jan2000, 04:49	4.39
J1658	0.767	195.2	01Jan2000, 04:09	4.50
J1659	1.528	379.7	01Jan2000, 04:22	4.23
J1661	1.220	318.2	01Jan2000, 06:13	3.69
J1662	0.672	220.6	01Jan2000, 05:38	4.67
J1663	1.498	355.4	01Jan2000, 05:08	3.96
J1664	0.777	198.6	01Jan2000, 03:49	4.12
J1665	1.741	392.4	01Jan2000, 04:58	4.33
J1666	1.025	205.2	01Jan2000, 06:02	4.44
J1667	0.698	168.2	01Jan2000, 04:44	3.26
J1668	1.052	212.9	01Jan2000, 05:26	4.28
J1669	0.386	85.2	01Jan2000, 04:38	2.48
J1671	0.802	160.8	01Jan2000, 04:58	4.67
Payne Branch	2.358	849.3	01Jan2000, 05:57	3.67
PB01	1.900	710.7	01Jan2000, 05:11	3.80
PBR1	1.900	710.7	01Jan2000, 06:08	3.80
R1619	0.668	37.8	01Jan2000, 07:21	0.94
R1623	0.540	64.6	01Jan2000, 07:54	1.76
R1628	0.456	31.3	01Jan2000, 08:21	1.55

R1630	0.887	20.5	01Jan2000, 09:36	0.48
R1633	0.458	12.2	01Jan2000, 07:33	0.41
R1634	0.334	38.4	01Jan2000, 05:29	1.34
R1635	0.796	144.6	01Jan2000, 05:54	3.10
R1636	0.652	69.0	01Jan2000, 07:01	1.63
R1637	0.726	108.9	01Jan2000, 07:55	2.37
R1638	0.803	95.6	01Jan2000, 07:08	1.55
R1640	1.009	19.2	01Jan2000, 09:58	0.45
R1643	0.985	22.9	01Jan2000, 07:34	0.47
R1644	1.055	30.7	01Jan2000, 07:12	0.49
R1646	0.484	13.4	01Jan2000, 07:27	0.51
R1649	0.528	50.2	01Jan2000, 07:10	1.63
R1651	0.663	97.2	01Jan2000, 07:18	2.88
R1653	0.779	84.2	01Jan2000, 06:49	1.63
R1654	0.644	48.9	01Jan2000, 07:11	1.60
R1654F	0.000	39.7	01Jan2000, 07:12	
R1655	0.931	82.0	01Jan2000, 08:08	1.40
R1656	1.366	54.2	01Jan2000, 08:45	0.97
R1656F	0.000	81.2	01Jan2000, 08:31	
R1657F	0.227	19.8	01Jan2000, 06:16	1.55
R1658	0.767	32.3	01Jan2000, 07:34	0.90
R1658F	0.000	98.8	01Jan2000, 07:42	
R1659	1.528	197.1	01Jan2000, 07:59	2.88
R1659F	0.000	41.6	01Jan2000, 07:56	
R1660F	0.014	3.2	01Jan2000, 05:21	4.73
R1661	1.220	68.5	01Jan2000, 09:59	1.25
R1661F	0.000	26.5	01Jan2000, 09:23	
R1662	0.672	43.4	01Jan2000, 10:16	1.91
R1663	1.498	113.4	01Jan2000, 08:54	1.74
R1663F	0.000	95.8	01Jan2000, 08:35	
R1664	0.777	160.2	01Jan2000, 06:53	3.75

Project: CBBEI. Crooked&Williams Simulation Run: 100yr12HrFuture3NR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.3
End of Run: 03Jan2000, 00:00 Meteorologic Model: 100 year / 12 hr 10%
Compute Time: 27May2010, 10:25:12 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1664	0.777	160.2	01Jan2000, 06:53	3.75
R1665	1.741	164.7	01Jan2000, 03:58	2.36
R1665F	0.000	97.3	01Jan2000, 08:40	
R1666	1.025	77.3	01Jan2000, 10:40	2.27
R1666F	0.000	67.7	01Jan2000, 09:48	
R1667	0.698	99.4	01Jan2000, 07:43	2.44
R1668	1.052	123.8	01Jan2000, 09:37	3.12
R1668F	0.000	26.9	01Jan2000, 09:03	
R1669	0.986	67.6	01Jan2000, 06:46	2.14
R1670F	0.370	36.4	01Jan2000, 07:12	1.99
R1671	0.802	63.7	01Jan2000, 08:19	2.10
R1671F	0.000	61.8	01Jan2000, 08:16	
SMR01	1.723	360.4	01Jan2000, 05:18	3.96
SMRR1	1.723	368.4	01Jan2000, 08:26	3.95
Spring Mill Run	2.502	507.0	01Jan2000, 06:52	3.76
WC01	20.902	3619.2	01Jan2000, 12:42	3.94
WC02	19.885	3605.5	01Jan2000, 11:43	3.96
WC03	18.622	3584.6	01Jan2000, 10:16	4.01
WC04	17.512	3515.0	01Jan2000, 09:20	4.03
WC05D	16.497	3397.1	01Jan2000, 09:34	4.02
WC05U	13.995	2959.5	01Jan2000, 09:35	4.07
WC06	13.351	2842.9	01Jan2000, 08:51	4.06
WC07	11.054	2453.2	01Jan2000, 08:03	4.13
WC08D	10.684	2397.2	01Jan2000, 07:20	4.15
WC08U	9.019	2081.0	01Jan2000, 07:20	4.22
WC09	3.252	1923.0	01Jan2000, 06:22	4.19
WC10	6.710	1587.2	01Jan2000, 06:34	4.18
WC11	4.818	1072.1	01Jan2000, 05:55	4.24
WC12	2.543	551.4	01Jan2000, 05:05	4.44
WC13	0.802	160.8	01Jan2000, 04:58	4.67
WCR1	20.902	3619.2	01Jan2000, 13:25	3.94
WCR10	6.710	1587.2	01Jan2000, 06:40	4.18
WCR11	4.818	1072.1	01Jan2000, 07:12	4.24
WCR12	2.543	551.4	01Jan2000, 06:46	4.44
WCR13	0.802	160.8	01Jan2000, 06:08	4.67
WCR2	19.885	3605.5	01Jan2000, 12:43	3.96
WCR3	18.622	3584.6	01Jan2000, 11:45	4.01
WCR4	17.512	3515.0	01Jan2000, 10:16	4.03
WCR5	16.497	3397.1	01Jan2000, 10:01	4.02
WCR6	13.351	2842.9	01Jan2000, 09:35	4.06
WCR7	11.054	2453.2	01Jan2000, 08:53	4.13
WCR8	10.684	2397.2	01Jan2000, 08:03	4.15
WCR9	3.252	1923.0	01Jan2000, 07:25	4.19
Williams Creek	21.252	3619.6	01Jan2000, 13:25	3.93

Project: CBBEL Crooked& WilliamsSimulation Run: 100yr24HrFuture3RR10% Future 1% - 24 hr.

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:22:41

Basin Model: CW 2030CN & det.3
Meteorologic Model: 100 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	3747.3	01Jan2000, 13:00	3.91
1617	0.350	93.3	01Jan2000, 05:16	3.39
1618	0.916	227.8	01Jan2000, 06:50	3.64
1619	0.668	193.6	01Jan2000, 05:38	3.81
1620	0.622	151.8	01Jan2000, 06:36	3.45
1621	0.643	145.7	01Jan2000, 06:29	3.14
1622	0.117	33.5	01Jan2000, 04:41	3.39
1623	0.540	110.6	01Jan2000, 07:04	2.95
1624	0.529	177.0	01Jan2000, 05:04	4.12
1625	0.716	147.3	01Jan2000, 07:01	2.95
1626	0.252	69.5	01Jan2000, 04:57	3.39
1627	0.484	135.6	01Jan2000, 05:25	3.64
1628	0.456	163.6	01Jan2000, 05:43	4.80
1629	1.195	358.3	01Jan2000, 05:57	4.10
1630	0.887	204.5	01Jan2000, 07:42	3.64
1631	1.326	342.6	01Jan2000, 06:11	3.52
1632	0.450	122.4	01Jan2000, 06:02	3.69
1633	0.458	119.4	01Jan2000, 06:17	3.58
1634	0.334	110.2	01Jan2000, 04:32	3.81
1635	0.796	390.3	01Jan2000, 03:13	5.38
1636	0.652	182.1	01Jan2000, 05:27	3.64
1637	0.726	164.3	01Jan2000, 06:43	3.21
1638	0.803	164.2	01Jan2000, 06:32	2.81
1639	0.891	293.1	01Jan2000, 05:48	4.31
1640	1.009	282.3	01Jan2000, 07:29	4.27
1641	1.413	457.3	01Jan2000, 06:00	4.31
1642	0.363	89.6	01Jan2000, 05:05	3.02
1643	0.985	371.7	01Jan2000, 05:13	4.74
1644	1.055	319.0	01Jan2000, 05:24	3.93
1645	0.673	280.4	01Jan2000, 05:00	5.16
1646	0.484	152.3	01Jan2000, 05:22	4.10

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	232.4	01Jan2000, 04:42	3.52
1648	1.017	301.6	01Jan2000, 05:48	3.98
1649	0.528	169.6	01Jan2000, 05:16	4.09
1650	0.582	199.9	01Jan2000, 04:44	4.15
1651	0.663	251.5	01Jan2000, 05:01	4.68
1652	0.352	135.2	01Jan2000, 04:48	4.62
1653	0.779	239.8	01Jan2000, 05:16	3.78
1654	0.644	256.1	01Jan2000, 04:48	4.72
1655	0.931	217.3	01Jan2000, 06:59	3.18
1656	1.366	496.9	01Jan2000, 05:57	4.91
1657	0.227	84.3	01Jan2000, 04:30	4.06
1658	0.767	311.6	01Jan2000, 05:02	5.02
1659	1.528	562.0	01Jan2000, 05:23	4.73
1660	0.014	7.7	01Jan2000, 02:17	5.25
1661	1.220	324.0	01Jan2000, 07:46	4.18
1662	0.672	234.9	01Jan2000, 06:49	5.19
1663	1.498	481.2	01Jan2000, 06:24	4.46
1664	0.777	298.6	01Jan2000, 04:48	4.62
1665	1.741	613.6	01Jan2000, 06:06	4.85
1666	1.025	330.6	01Jan2000, 07:14	4.96
1667	0.698	200.2	01Jan2000, 06:07	3.73
1668	1.052	348.6	01Jan2000, 06:36	4.79
1669	0.386	90.0	01Jan2000, 06:08	2.91
1670	0.370	132.3	01Jan2000, 04:59	4.23
1671	0.802	323.1	01Jan2000, 05:23	5.19
CC01	19.043	3869.4	01Jan2000, 13:27	3.89
CC03	17.269	3712.9	01Jan2000, 12:26	3.91
CC04	16.200	3587.4	01Jan2000, 11:49	3.94
CC05	15.232	3483.6	01Jan2000, 11:28	3.99
CC06	14.589	3406.1	01Jan2000, 10:57	4.03
CC07	14.472	3395.0	01Jan2000, 10:45	4.04
CC08	12.821	3119.0	01Jan2000, 09:53	4.00
CC09D	11.934	2945.0	01Jan2000, 09:17	4.03
CC09U	8.771	2142.0	01Jan2000, 09:52	3.89
CC10	7.445	1912.1	01Jan2000, 08:24	3.96
CC11D	7.082	1849.2	01Jan2000, 07:31	4.01
CC11U	4.724	1194.7	01Jan2000, 07:39	3.94
CC12D	4.390	1114.9	01Jan2000, 07:03	3.95

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	681.9	01Jan2000, 07:03	4.70
CC13	1.413	457.3	01Jan2000, 06:00	4.31
CCR1	19.043	3869.4	01Jan2000, 14:36	3.89
CCR10	7.445	1912.1	01Jan2000, 10:05	3.96
CCR11	7.082	1849.2	01Jan2000, 08:29	4.01
CCR12	4.390	1114.9	01Jan2000, 07:46	3.95
CCR13	1.413	457.3	01Jan2000, 07:34	4.31
CCR2	17.753	3747.3	01Jan2000, 13:37	3.91
CCR3	17.269	3712.9	01Jan2000, 13:04	3.91
CCR4	16.200	3587.4	01Jan2000, 12:33	3.94
CCR5	15.232	3483.6	01Jan2000, 11:58	3.99
CCR6	14.589	3406.1	01Jan2000, 11:35	4.03
CCR7	14.472	3395.0	01Jan2000, 10:58	4.04
CCR8	12.821	3119.0	01Jan2000, 11:05	4.00
CCR9	11.934	2945.0	01Jan2000, 09:58	4.03
Clay Creek	1.438	313.4	01Jan2000, 06:22	4.65
CLC01	1.438	276.7	01Jan2000, 06:39	4.28
CLCR1	1.438	276.7	01Jan2000, 07:14	4.28
Crooked Creek	19.959	3936.6	01Jan2000, 14:29	3.88
D1619	0.668	54.2	01Jan2000, 05:38	1.07
D1623	0.540	76.3	01Jan2000, 07:04	2.03
D1628	0.456	58.9	01Jan2000, 05:43	1.73
D1630	0.887	30.7	01Jan2000, 07:42	0.55
D1633	0.458	15.5	01Jan2000, 06:17	0.47
D1634	0.394	44.1	01Jan2000, 04:32	1.52
D1635	0.796	249.8	01Jan2000, 03:13	3.44
D1636	0.652	92.9	01Jan2000, 05:27	1.85
D1637	0.726	139.7	01Jan2000, 06:43	2.72
D1638	0.803	105.1	01Jan2000, 06:32	1.80
D1640	1.009	33.9	01Jan2000, 07:29	0.51
D1643	0.985	40.9	01Jan2000, 05:13	0.52
D1644	1.055	44.7	01Jan2000, 05:24	0.55
D1646	0.484	21.3	01Jan2000, 05:22	0.57
D1649	0.528	76.3	01Jan2000, 05:16	1.84
D1651	0.663	173.5	01Jan2000, 05:01	3.23
D1653	0.779	117.5	01Jan2000, 05:16	1.85
D1654	0.644	97.3	01Jan2000, 04:48	1.79
D1654F	0.000	79.4	01Jan2000, 04:48	

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1655	0.931	110.8	01Jan2000, 06:59	1.62
D1656	1.366	109.3	01Jan2000, 05:57	1.08
D1656F	0.000	149.2	01Jan2000, 05:57	
D1657F	0.227	36.5	01Jan2000, 04:30	1.76
D1658	0.767	62.3	01Jan2000, 05:02	1.00
D1658F	0.000	202.4	01Jan2000, 05:02	
D1659	1.528	382.2	01Jan2000, 05:23	3.22
D1659F	0.000	78.6	01Jan2000, 05:23	
D1661	1.220	110.1	01Jan2000, 07:46	1.42
D1661F	0.000	35.7	01Jan2000, 07:46	
D1662	0.672	96.3	01Jan2000, 06:49	2.13
D1663	1.498	211.7	01Jan2000, 06:24	1.96
D1663F	0.000	158.7	01Jan2000, 06:24	
D1664	0.777	271.7	01Jan2000, 04:48	4.21
D1665	1.741	337.5	01Jan2000, 06:06	2.67
D1665F	0.000	177.8	01Jan2000, 06:06	
D1666	1.025	168.6	01Jan2000, 07:14	2.53
D1666F	0.000	112.5	01Jan2000, 07:14	
D1667	0.698	150.2	01Jan2000, 06:07	2.80
d1668	1.052	254.5	01Jan2000, 06:36	3.50
D1668F	0.000	45.3	01Jan2000, 06:36	
D1669	0.386	77.4	01Jan2000, 06:08	2.50
D1670F	0.370	70.5	01Jan2000, 04:59	2.25
D1671	0.802	145.4	01Jan2000, 05:23	2.34
D1671F	0.000	168.3	01Jan2000, 05:23	
DC01	1.529	287.0	01Jan2000, 06:36	3.00
DCR1	1.529	287.0	01Jan2000, 08:00	3.00
Delaware Creek	2.181	433.0	01Jan2000, 07:03	3.19
HJC01	2.713	930.5	01Jan2000, 06:03	4.53
HJC02	1.658	632.6	01Jan2000, 05:21	4.91
HJC03	0.673	280.4	01Jan2000, 05:00	5.16
HJCR1	2.713	930.5	01Jan2000, 06:42	4.53
HJCR2	1.658	632.6	01Jan2000, 06:14	4.91
HJCR3	0.673	280.4	01Jan2000, 05:31	5.16
Howard Johnson Ditch	3.168	1050.8	01Jan2000, 06:38	4.41
J1619	0.668	176.6	01Jan2000, 05:39	3.81
J1623	0.540	98.4	01Jan2000, 07:06	2.95
J1628	0.456	135.1	01Jan2000, 05:45	4.80

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1630	0.887	194.0	01Jan2000, 07:43	3.64
J1633	0.458	115.9	01Jan2000, 06:18	3.58
J1634	0.334	104.1	01Jan2000, 04:32	3.81
J1635	0.796	283.8	01Jan2000, 03:14	5.38
J1636	0.652	157.4	01Jan2000, 05:28	3.64
J1637	0.726	132.8	01Jan2000, 06:47	3.21
J1638	0.803	154.2	01Jan2000, 06:32	2.81
J1640	1.009	267.2	01Jan2000, 07:30	4.27
J1643	0.985	353.1	01Jan2000, 05:14	4.74
J1644	1.055	304.5	01Jan2000, 05:24	3.93
J1646	0.484	144.1	01Jan2000, 05:23	4.10
J1649	0.528	142.6	01Jan2000, 05:16	4.09
J1651	0.663	173.6	01Jan2000, 05:02	4.68
J1653	0.779	205.5	01Jan2000, 05:17	3.78
J1654	0.644	165.5	01Jan2000, 04:51	4.72
J1655	0.931	187.7	01Jan2000, 07:00	3.18
J1656	1.366	370.8	01Jan2000, 05:59	4.91
J1658	0.767	175.1	01Jan2000, 05:08	5.02
J1659	1.528	338.7	01Jan2000, 05:25	4.73
J1661	1.220	271.7	01Jan2000, 07:48	4.18
J1662	0.672	180.4	01Jan2000, 06:51	5.19
J1663	1.498	317.1	01Jan2000, 06:28	4.46
J1664	0.777	186.2	01Jan2000, 04:51	4.62
J1665	1.741	357.6	01Jan2000, 06:11	4.85
J1666	1.025	191.3	01Jan2000, 07:27	4.96
J1667	0.698	148.4	01Jan2000, 06:09	3.73
J1668	1.052	197.1	01Jan2000, 06:45	4.79
J1669	0.386	79.7	01Jan2000, 06:10	2.91
J1671	0.802	156.5	01Jan2000, 06:26	5.19
Payne Branch	2.358	655.8	01Jan2000, 07:21	4.15
PB01	1.900	544.9	01Jan2000, 06:33	4.29
PBR1	1.900	544.9	01Jan2000, 07:30	4.29
R1619	0.668	37.4	01Jan2000, 09:13	1.07
R1623	0.540	64.2	01Jan2000, 09:36	2.03
R1628	0.456	31.0	01Jan2000, 10:45	1.73
R1630	0.887	20.4	01Jan2000, 12:05	0.55
R1633	0.458	12.1	01Jan2000, 09:11	0.47
R1634	0.334	38.1	01Jan2000, 05:50	1.52

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1635	0.796	143.9	01Jan2000, 07:17	3.44
R1636	0.652	68.4	01Jan2000, 08:37	1.85
R1637	0.726	108.4	01Jan2000, 09:47	2.72
R1638	0.803	95.1	01Jan2000, 08:20	1.80
R1640	1.009	19.1	01Jan2000, 12:42	0.51
R1643	0.985	22.6	01Jan2000, 09:45	0.52
R1644	1.055	30.4	01Jan2000, 09:00	0.55
R1646	0.484	13.3	01Jan2000, 09:28	0.57
R1649	0.528	49.6	01Jan2000, 09:02	1.84
R1651	0.663	96.4	01Jan2000, 09:24	3.23
R1653	0.779	83.5	01Jan2000, 08:29	1.85
R1654	0.644	48.4	01Jan2000, 09:29	1.79
R1654F	0.000	39.2	01Jan2000, 09:31	
R1655	0.931	81.5	01Jan2000, 10:22	1.62
R1656	1.366	53.8	01Jan2000, 11:18	1.08
R1656F	0.000	80.7	01Jan2000, 10:52	
R1657F	0.227	19.5	01Jan2000, 08:31	1.76
R1658	0.767	32.0	01Jan2000, 09:48	1.00
R1658F	0.000	98.1	01Jan2000, 10:03	
R1659	1.528	197.1	01Jan2000, 10:21	3.22
R1659F	0.000	41.2	01Jan2000, 10:17	
R1660F	0.014	3.1	01Jan2000, 07:11	5.25
R1661	1.220	68.2	01Jan2000, 12:34	1.42
R1661F	0.000	26.3	01Jan2000, 11:29	
R1662	0.672	43.1	01Jan2000, 13:06	2.13
R1663	1.498	112.8	01Jan2000, 11:29	1.96
R1663F	0.000	95.3	01Jan2000, 10:53	
R1664	0.777	159.7	01Jan2000, 08:45	4.21
R1665	1.741	164.4	01Jan2000, 11:34	2.67
R1665F	0.000	96.7	01Jan2000, 11:03	
R1666	1.025	76.9	01Jan2000, 13:34	2.53
R1666F	0.000	67.3	01Jan2000, 12:10	
R1667	0.698	98.8	01Jan2000, 09:53	2.80
R1668	1.052	123.4	01Jan2000, 12:21	3.50
R1668F	0.000	26.7	01Jan2000, 11:22	
R1669	0.386	67.1	01Jan2000, 08:08	2.50
R1670F	0.370	36.0	01Jan2000, 09:36	2.26
R1671	0.802	68.2	01Jan2000, 10:48	2.34

Global Summary Results for Run "100yr24HrFuture3RR10%"

Project: CBBEL Crooked& Williams Simulation Run: 100yr24HrFuture3RR10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 11May2010, 15:22:41

Basin Model: CW 2030CN & det.3
Meteorologic Model: 100 year / 24 hr 10%
Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC09	8.252	1773.2	01Jan2000, 07:46	4.70
WC10	6.710	1450.6	01Jan2000, 07:56	4.69
WC11	4.818	1005.8	01Jan2000, 07:06	4.75
WC12	2.543	513.4	01Jan2000, 06:19	4.96
WC13	0.802	156.5	01Jan2000, 06:26	5.19
WCR1	20.902	3877.1	01Jan2000, 14:09	4.43
WCR10	6.710	1450.6	01Jan2000, 08:02	4.69
WCR11	4.818	1005.8	01Jan2000, 08:23	4.75
WCR12	2.543	513.4	01Jan2000, 08:00	4.96
WCR13	0.802	156.5	01Jan2000, 07:36	5.19
WCR2	19.885	3802.0	01Jan2000, 13:55	4.46
WCR3	18.622	3715.2	01Jan2000, 13:00	4.51
WCR4	17.512	3573.4	01Jan2000, 11:31	4.53
WCR5	16.497	3392.2	01Jan2000, 10:37	4.52
WCR6	13.351	2788.6	01Jan2000, 10:10	4.56
WCR7	11.054	2321.8	01Jan2000, 09:54	4.64
WCR8	10.684	2250.5	01Jan2000, 09:13	4.65
WCR9	8.252	1773.2	01Jan2000, 08:49	4.70
Williams Creek	21.252	3891.3	01Jan2000, 14:09	4.42

Print Close

Future 10% - 6hr

Project: CBBEL Crooked& WilliamsSimulation Run: 10yr6HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10 year / 6 hr 10%
Compute Time: 11May2010, 15:42:30 Control Specifications: Frequency Control

Volume Units: IN

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	2056.0	01Jan2000, 09:57	1.57
1617	0.350	78.6	01Jan2000, 03:17	1.28
1618	0.916	165.3	01Jan2000, 04:26	1.43
1619	0.668	160.1	01Jan2000, 03:37	1.51
1620	0.622	110.2	01Jan2000, 04:11	1.30
1621	0.643	103.7	01Jan2000, 04:00	1.12
1622	0.117	30.8	01Jan2000, 02:49	1.28
1623	0.540	70.1	01Jan2000, 04:26	0.99
1624	0.529	157.5	01Jan2000, 03:16	1.67
1625	0.716	94.0	01Jan2000, 04:23	0.99
1626	0.252	61.1	01Jan2000, 03:04	1.28
1627	0.484	115.1	01Jan2000, 03:26	1.43
1628	0.456	140.4	01Jan2000, 03:53	2.13
1629	1.195	297.8	01Jan2000, 03:52	1.73
1630	0.887	136.5	01Jan2000, 05:06	1.43
1631	1.326	261.7	01Jan2000, 03:53	1.33
1632	0.450	97.4	01Jan2000, 03:50	1.46
1633	0.458	90.0	01Jan2000, 03:59	1.36
1634	0.334	107.4	01Jan2000, 02:43	1.51
1635	0.796	442.8	01Jan2000, 02:31	2.53
1636	0.652	153.9	01Jan2000, 03:28	1.43
1637	0.726	113.5	01Jan2000, 04:13	1.15
1638	0.803	111.0	01Jan2000, 03:57	0.93
1639	0.891	237.9	01Jan2000, 03:50	1.75
1640	1.009	189.8	01Jan2000, 05:08	1.71
1641	1.413	363.8	01Jan2000, 03:58	1.75
1642	0.363	71.9	01Jan2000, 03:08	1.02
1643	0.985	332.0	01Jan2000, 03:30	2.06
1644	1.055	276.1	01Jan2000, 03:29	1.61

Project: CBBEL Crooked& WilliamsSimulation Run: 10yr6HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10 year / 6 hr 10%
Compute Time: 23Jun2010, 14:25:05 Control Specifications: Frequency Control

Volume Units: IN

Future 10% - 6hr

03351310	17.753	2056.0	01Jan2000, 09:57	1.57
1617	0.350	78.6	01Jan2000, 03:17	1.28
1618	0.916	165.3	01Jan2000, 04:26	1.43
1619	0.668	160.1	01Jan2000, 03:37	1.51
1620	0.622	110.2	01Jan2000, 04:11	1.30
1621	0.643	103.7	01Jan2000, 04:00	1.12
1622	0.117	30.8	01Jan2000, 02:49	1.28
1623	0.540	70.1	01Jan2000, 04:26	0.99
1624	0.529	157.5	01Jan2000, 03:16	1.67
1625	0.716	94.0	01Jan2000, 04:23	0.99
1626	0.252	61.1	01Jan2000, 03:04	1.28
1627	0.484	115.1	01Jan2000, 03:26	1.43
1628	0.456	140.4	01Jan2000, 03:53	2.13
1629	1.195	297.8	01Jan2000, 03:52	1.73
1630	0.887	136.5	01Jan2000, 05:06	1.43
1631	1.326	261.7	01Jan2000, 03:53	1.33
1632	0.450	97.4	01Jan2000, 03:50	1.46
1633	0.458	90.0	01Jan2000, 03:59	1.36
1634	0.334	107.4	01Jan2000, 02:43	1.51
1635	0.796	442.8	01Jan2000, 02:31	2.53
1636	0.652	153.9	01Jan2000, 03:28	1.43
1637	0.726	113.5	01Jan2000, 04:13	1.15
1638	0.803	111.0	01Jan2000, 03:57	0.93
1639	0.891	237.9	01Jan2000, 03:50	1.75
1640	1.009	189.8	01Jan2000, 05:08	1.71
1641	1.413	363.8	01Jan2000, 03:58	1.75
1642	0.363	71.9	01Jan2000, 03:08	1.02
1643	0.985	332.0	01Jan2000, 03:30	2.06
1644	1.055	276.1	01Jan2000, 03:29	1.61
1645	0.673	262.9	01Jan2000, 03:25	2.37
1646	0.484	134.3	01Jan2000, 03:30	1.73

1647	0.779	213.7	01Jan2000, 02:51	1.33
1648	1.017	249.8	01Jan2000, 03:45	1.63
1649	0.528	149.1	01Jan2000, 03:24	1.69
1650	0.582	193.1	01Jan2000, 02:59	1.75
1651	0.663	232.5	01Jan2000, 03:19	2.04
1652	0.352	128.8	01Jan2000, 03:08	2.01
1653	0.779	196.8	01Jan2000, 03:23	1.40
1654	0.644	241.4	01Jan2000, 03:09	2.03
1655	0.931	127.7	01Jan2000, 04:30	0.97
1656	1.366	412.7	01Jan2000, 04:04	2.17
1657	0.227	79.6	01Jan2000, 02:46	1.54
1658	0.767	289.2	01Jan2000, 03:24	2.26
1659	1.528	495.4	01Jan2000, 03:38	2.07
1660	0.014	9.1	01Jan2000, 01:52	2.43
1661	1.220	213.9	01Jan2000, 05:20	1.67
1662	0.672	182.1	01Jan2000, 04:50	2.38
1663	1.498	368.4	01Jan2000, 04:18	1.84
1664	0.777	284.6	01Jan2000, 03:07	2.01
1665	1.741	504.2	01Jan2000, 04:09	2.14
1666	1.025	244.4	01Jan2000, 05:07	2.22
1667	0.698	145.6	01Jan2000, 03:55	1.33
1668	1.052	271.1	01Jan2000, 04:33	2.11
1669	0.386	57.2	01Jan2000, 03:46	0.83
1670	0.370	116.0	01Jan2000, 03:14	1.66
1671	0.802	288.6	01Jan2000, 03:44	2.38
CC01	19.043	2069.4	01Jan2000, 10:33	1.56
CC03	17.269	2053.2	01Jan2000, 09:19	1.57
CC04	16.200	2038.0	01Jan2000, 08:35	1.59
CC05	15.232	2016.2	01Jan2000, 08:12	1.62
CC06	14.589	1997.1	01Jan2000, 07:36	1.64
CC07	14.472	1996.6	01Jan2000, 07:23	1.65
CC08	12.821	1869.5	01Jan2000, 06:29	1.62
CC09D	11.934	1758.9	01Jan2000, 05:58	1.64
CC09U	8.771	1353.7	01Jan2000, 08:04	1.55
CC10	7.445	1309.0	01Jan2000, 06:29	1.58
CC11D	7.082	1299.8	01Jan2000, 05:33	1.61
CC11U	4.724	858.5	01Jan2000, 05:55	1.59
CC12D	4.390	843.0	01Jan2000, 05:12	1.60

CC12U	2.209	528.8	01Jan2000, 05:22	2.03
CC13	1.413	363.8	01Jan2000, 03:58	1.75
CCR1	19.043	2069.4	01Jan2000, 11:42	1.56
CCR10	7.445	1309.0	01Jan2000, 08:10	1.58
CCR11	7.082	1299.8	01Jan2000, 06:31	1.61
CCR12	4.390	843.0	01Jan2000, 05:55	1.60
CCR13	1.413	363.8	01Jan2000, 05:32	1.75
CCR2	17.753	2056.0	01Jan2000, 10:34	1.57
CCR3	17.269	2053.2	01Jan2000, 09:57	1.57
CCR4	16.200	2038.0	01Jan2000, 09:19	1.59
CCR5	15.232	2016.2	01Jan2000, 08:42	1.62
CCR6	14.589	1997.1	01Jan2000, 08:14	1.64
CCR7	14.472	1996.6	01Jan2000, 07:36	1.65
CCR8	12.821	1869.5	01Jan2000, 07:41	1.62
CCR9	11.934	1758.9	01Jan2000, 06:39	1.64
Clay Creek	1.438	183.9	01Jan2000, 03:34	1.90
CLC01	1.438	164.0	01Jan2000, 04:26	1.76
CLCR1	1.438	164.0	01Jan2000, 05:01	1.76
Crooked Creek	19.959	2080.5	01Jan2000, 11:42	1.55
D1619	0.668	44.8	01Jan2000, 03:37	0.42
D1623	0.540	48.4	01Jan2000, 04:26	0.68
D1628	0.456	50.5	01Jan2000, 03:53	0.77
D1630	0.887	20.5	01Jan2000, 05:06	0.21
D1633	0.458	11.7	01Jan2000, 03:59	0.18
D1634	0.334	43.0	01Jan2000, 02:43	0.60
D1635	0.796	283.4	01Jan2000, 02:31	1.62
D1636	0.652	78.5	01Jan2000, 03:28	0.73
D1637	0.726	96.5	01Jan2000, 04:13	0.98
D1638	0.803	71.1	01Jan2000, 03:57	0.60
D1640	1.009	22.8	01Jan2000, 05:08	0.20
D1643	0.985	36.5	01Jan2000, 03:30	0.23
D1644	1.055	38.7	01Jan2000, 03:29	0.22
D1646	0.484	18.8	01Jan2000, 03:30	0.24
D1649	0.528	67.1	01Jan2000, 03:24	0.76
D1651	0.663	160.4	01Jan2000, 03:19	1.41
D1653	0.779	96.4	01Jan2000, 03:23	0.69
D1654	0.644	91.7	01Jan2000, 03:09	0.77
D1654F	0.000	74.8	01Jan2000, 03:09	

D1655	0.931	65.1	01Jan2000, 04:30	0.50
D1656	1.366	90.8	01Jan2000, 04:04	0.48
D1656F	0.000	123.9	01Jan2000, 04:04	
D1657F	0.227	34.4	01Jan2000, 02:46	0.67
D1658	0.767	57.8	01Jan2000, 03:24	0.45
D1658F	0.000	187.8	01Jan2000, 03:24	
D1659	1.528	336.9	01Jan2000, 03:38	1.41
D1659F	0.000	69.3	01Jan2000, 03:38	
D1661	1.220	72.7	01Jan2000, 05:20	0.57
D1661F	0.000	23.6	01Jan2000, 05:20	
D1662	0.672	74.7	01Jan2000, 04:50	0.98
D1663	1.498	162.1	01Jan2000, 04:18	0.81
D1663F	0.000	121.5	01Jan2000, 04:18	
D1664	0.777	259.0	01Jan2000, 03:07	1.83
D1665	1.741	277.3	01Jan2000, 04:09	1.18
D1665F	0.000	146.1	01Jan2000, 04:09	
D1666	1.025	124.6	01Jan2000, 05:07	1.13
D1666F	0.000	83.1	01Jan2000, 05:07	
D1667	0.698	109.2	01Jan2000, 03:55	1.00
d1668	1.052	197.9	01Jan2000, 04:33	1.54
D1668F	0.000	35.2	01Jan2000, 04:33	
D1669	0.386	49.2	01Jan2000, 03:46	0.71
D1670F	0.370	61.8	01Jan2000, 03:14	0.89
D1671	0.802	129.9	01Jan2000, 03:44	1.07
D1671F	0.000	150.4	01Jan2000, 03:44	
DC01	1.529	208.2	01Jan2000, 04:09	1.04
DCR1	1.529	208.2	01Jan2000, 05:33	1.04
Delaware Creek	2.181	316.1	01Jan2000, 05:08	1.15
HJC01	2.713	799.0	01Jan2000, 04:21	1.96
HJC02	1.658	574.4	01Jan2000, 03:43	2.18
HJC03	0.673	262.9	01Jan2000, 03:25	2.37
HJCR1	2.713	799.0	01Jan2000, 05:00	1.96
HJCR2	1.658	574.4	01Jan2000, 04:36	2.18
HJCR3	0.673	262.9	01Jan2000, 03:56	2.37
Howard Johnson Ditch	3.083	877.1	01Jan2000, 04:55	1.89
J1619	0.668	152.3	01Jan2000, 03:37	1.51
J1623	0.540	70.1	01Jan2000, 04:26	0.99
J1628	0.456	120.0	01Jan2000, 03:53	2.13

J1630	0.887	136.0	01Jan2000, 05:06	1.43
J1633	0.458	90.0	01Jan2000, 03:59	1.36
J1634	0.334	102.5	01Jan2000, 02:43	1.51
J1635	0.796	302.7	01Jan2000, 02:32	2.53
J1636	0.652	143.4	01Jan2000, 03:28	1.43
J1637	0.726	113.5	01Jan2000, 04:13	1.15
J1638	0.803	95.0	01Jan2000, 03:58	0.93
J1640	1.009	185.5	01Jan2000, 05:08	1.71
J1643	0.985	317.6	01Jan2000, 03:30	2.06
J1644	1.055	267.5	01Jan2000, 03:29	1.61
J1646	0.484	128.5	01Jan2000, 03:30	1.73
J1649	0.528	131.1	01Jan2000, 03:25	1.69
J1651	0.663	167.3	01Jan2000, 03:19	2.04
J1653	0.779	183.4	01Jan2000, 03:23	1.40
J1654	0.644	104.1	01Jan2000, 03:11	2.03
J1655	0.931	127.7	01Jan2000, 04:30	0.97
J1656	1.366	277.3	01Jan2000, 04:05	2.17
J1658	0.767	109.1	01Jan2000, 03:28	2.26
J1659	1.528	217.7	01Jan2000, 03:40	2.07
J1661	1.220	159.9	01Jan2000, 05:20	1.67
J1662	0.672	148.7	01Jan2000, 04:51	2.38
J1663	1.498	227.9	01Jan2000, 04:19	1.84
J1664	0.777	184.7	01Jan2000, 03:08	2.01
J1665	1.741	209.1	01Jan2000, 04:13	2.14
J1666	1.025	133.7	01Jan2000, 05:11	2.22
J1667	0.698	134.4	01Jan2000, 03:55	1.33
J1668	1.052	118.0	01Jan2000, 04:38	2.11
J1669	0.386	47.0	01Jan2000, 03:47	0.83
J1671	0.802	74.6	01Jan2000, 04:11	2.38
Payne Branch	2.358	471.2	01Jan2000, 04:59	1.66
PB01	1.900	398.0	01Jan2000, 04:15	1.73
PBR1	1.900	398.0	01Jan2000, 05:12	1.73
R1619	0.668	37.1	01Jan2000, 04:36	0.42
R1623	0.540	48.4	01Jan2000, 04:26	0.68
R1628	0.456	30.3	01Jan2000, 05:47	0.77
R1630	0.887	20.0	01Jan2000, 05:34	0.21
R1633	0.458	11.7	01Jan2000, 04:00	0.18
R1634	0.334	38.0	01Jan2000, 03:18	0.61

R1635	0.796	143.6	01Jan2000, 04:01	1.62
R1636	0.652	68.1	01Jan2000, 04:16	0.73
R1637	0.726	96.5	01Jan2000, 04:13	0.98
R1638	0.803	55.1	01Jan2000, 05:09	0.60
R1640	1.009	18.6	01Jan2000, 06:31	0.20
R1643	0.985	22.2	01Jan2000, 05:09	0.23
R1644	1.055	30.1	01Jan2000, 04:36	0.23
R1646	0.484	13.1	01Jan2000, 04:54	0.24
R1649	0.528	49.2	01Jan2000, 04:38	0.76
R1651	0.663	95.5	01Jan2000, 04:56	1.41
R1653	0.779	83.1	01Jan2000, 04:09	0.69
R1654	0.644	16.6	01Jan2000, 06:25	0.77
R1654F	0.000	14.3	01Jan2000, 06:20	
R1655	0.931	65.1	01Jan2000, 04:30	0.50
R1656	1.366	52.5	01Jan2000, 06:06	0.48
R1656F	0.000	28.4	01Jan2000, 08:04	
R1657F	0.227	6.7	01Jan2000, 05:16	0.67
R1658	0.767	31.4	01Jan2000, 05:15	0.45
R1658F	0.000	36.2	01Jan2000, 06:58	
R1659	1.528	116.1	01Jan2000, 06:26	1.41
R1659F	0.000	14.4	01Jan2000, 07:19	
R1660F	0.014	1.1	01Jan2000, 04:11	2.43
R1661	1.220	33.9	01Jan2000, 08:35	0.57
R1661F	0.000	9.1	01Jan2000, 09:09	
R1662	0.672	41.6	01Jan2000, 07:23	0.98
R1663	1.498	111.4	01Jan2000, 05:58	0.81
R1663F	0.000	33.1	01Jan2000, 08:06	
R1664	0.777	159.3	01Jan2000, 04:36	1.83
R1665	1.741	96.4	01Jan2000, 07:23	1.18
R1665F	0.000	34.7	01Jan2000, 08:12	
R1666	1.025	74.7	01Jan2000, 07:33	1.13
R1666F	0.000	23.8	01Jan2000, 09:44	
R1667	0.698	98.0	01Jan2000, 04:38	1.00
R1668	1.052	72.2	01Jan2000, 08:00	1.54
R1668F	0.000	9.5	01Jan2000, 08:45	
R1669	0.386	39.1	01Jan2000, 04:44	0.71
R1670F	0.370	12.6	01Jan2000, 06:16	0.89
R1671	0.802	39.8	01Jan2000, 06:52	1.07

Global Summary Results for Run "10yr6HrFuture1RR10%"

Project: CBBEL Crooked & Williams Simulation Run: 10yr6HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10 year / 6 hr 10%
Compute Time: 23Jun2010, 14:23:05 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1668	1.052	72.2	01Jan2000, 08:00	1.54
R1668F	0.000	9.5	01Jan2000, 08:45	
R1669	0.286	39.1	01Jan2000, 04:44	0.71
R1670F	0.370	12.6	01Jan2000, 06:16	0.89
R1671	0.602	39.8	01Jan2000, 06:52	1.07
R1671F	0.000	28.9	01Jan2000, 07:45	
SMR01	1.723	263.5	01Jan2000, 04:25	1.86
SMRR1	1.723	263.5	01Jan2000, 07:33	1.86
Spring Mill Run	2.502	295.4	01Jan2000, 06:25	1.72
WC01	20.902	1853.7	01Jan2000, 12:15	1.87
WC02	19.885	1850.7	01Jan2000, 11:17	1.88
WC03	18.622	1849.2	01Jan2000, 09:48	1.90
WC04	17.512	1842.6	01Jan2000, 08:52	1.92
WC05D	16.497	1821.2	01Jan2000, 08:25	1.91
WC05U	13.995	1552.0	01Jan2000, 08:26	1.94
WC06	13.351	1519.3	01Jan2000, 08:03	1.94
WC07	11.054	1357.1	01Jan2000, 07:13	1.99
WC08D	10.684	1339.1	01Jan2000, 06:30	2.00
WC08U	9.019	1193.1	01Jan2000, 06:58	2.05

Print Close

Global Summary Results for Run "10yr6HrFuture1RR10%"

Project: CBBEL Crooked& Williams Simulation Run: 10yr6HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10 year / 6 hr 10%
Compute Time: 23Jun2010, 14:25:05 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC09	8.252	1117.4	01Jan2000, 05:55	2.04
WC10	6.710	945.7	01Jan2000, 05:51	2.03
WC11	4.818	659.6	01Jan2000, 05:12	2.07
WC12	2.543	281.7	01Jan2000, 04:21	2.22
WC13	0.802	74.6	01Jan2000, 04:11	2.38
WCR1	20.902	1853.7	01Jan2000, 12:53	1.87
WCR10	6.710	945.7	01Jan2000, 05:57	2.03
WCR11	4.818	659.6	01Jan2000, 06:29	2.07
WCR12	2.543	281.7	01Jan2000, 06:02	2.22
WCR13	0.802	74.6	01Jan2000, 05:21	2.38
WCR2	19.885	1850.7	01Jan2000, 12:15	1.88
WCR3	18.622	1849.2	01Jan2000, 11:17	1.90
WCR4	17.512	1842.6	01Jan2000, 09:48	1.92
WCR5	16.497	1821.2	01Jan2000, 08:52	1.91
WCR6	13.351	1519.3	01Jan2000, 08:47	1.94
WCR7	11.054	1357.1	01Jan2000, 08:03	1.99
WCR8	10.634	1339.1	01Jan2000, 07:13	2.00
WCR9	8.252	1117.4	01Jan2000, 06:58	2.04
Williams Creek	21.252	1853.7	01Jan2000, 12:58	1.86

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Project: CBBEL Crooked& WilliamsSimulation Run: 10yr12HrFuture1RR10%

Start of Run: 01Jan2000, 00:00
End of Run: 03Jan2000, 00:00
Compute Time: 23Jun2010, 13:50:01

Basin Model: CW 2030CN & det.1
Meteorologic Model: 10 year / 12 hr 10%
Control Specifications: Frequency Control

Volume Units: IN

Future 10% -12hr

03351310	17.753	2284.8	01Jan2000, 11:10	1.92
1617	0.350	71.1	01Jan2000, 04:11	1.58
1618	0.916	164.7	01Jan2000, 05:23	1.76
1619	0.668	149.5	01Jan2000, 04:29	1.85
1620	0.622	108.6	01Jan2000, 05:09	1.62
1621	0.643	101.5	01Jan2000, 05:01	1.41
1622	0.117	26.2	01Jan2000, 03:36	1.58
1623	0.540	72.0	01Jan2000, 05:30	1.26
1624	0.529	141.8	01Jan2000, 04:05	2.04
1625	0.716	96.1	01Jan2000, 05:27	1.26
1626	0.252	53.6	01Jan2000, 03:54	1.58
1627	0.484	105.3	01Jan2000, 04:18	1.76
1628	0.456	132.8	01Jan2000, 04:41	2.55
1629	1.195	281.8	01Jan2000, 04:43	2.09
1630	0.887	141.7	01Jan2000, 06:05	1.76
1631	1.326	251.5	01Jan2000, 04:49	1.65
1632	0.450	92.6	01Jan2000, 04:43	1.79
1633	0.458	87.3	01Jan2000, 04:55	1.69
1634	0.334	90.1	01Jan2000, 03:25	1.85
1635	0.796	366.6	01Jan2000, 03:03	2.99
1636	0.652	141.2	01Jan2000, 04:19	1.76
1637	0.726	113.2	01Jan2000, 05:14	1.44
1638	0.803	109.4	01Jan2000, 05:02	1.19
1639	0.891	227.2	01Jan2000, 04:41	2.15
1640	1.009	199.0	01Jan2000, 06:05	2.10
1641	1.413	351.1	01Jan2000, 04:50	2.15
1642	0.363	64.7	01Jan2000, 04:06	1.30
1643	0.985	305.5	01Jan2000, 04:17	2.48
1644	1.055	253.2	01Jan2000, 04:19	1.95
1645	0.673	238.9	01Jan2000, 04:09	2.81
1646	0.484	123.0	01Jan2000, 04:18	2.09

1647	0.779	182.6	01Jan2000, 03:38	1.65
1648	1.017	235.1	01Jan2000, 04:37	1.99
1649	0.528	135.9	01Jan2000, 04:14	2.05
1650	0.582	167.2	01Jan2000, 03:41	2.12
1651	0.663	209.6	01Jan2000, 04:05	2.45
1652	0.352	113.8	01Jan2000, 03:51	2.41
1653	0.779	182.1	01Jan2000, 04:17	1.76
1654	0.644	214.5	01Jan2000, 03:53	2.45
1655	0.931	136.9	01Jan2000, 05:34	1.29
1656	1.366	397.5	01Jan2000, 04:53	2.60
1657	0.227	68.0	01Jan2000, 03:31	1.92
1658	0.767	262.9	01Jan2000, 04:09	2.70
1659	1.528	460.1	01Jan2000, 04:25	2.49
1660	0.014	7.2	01Jan2000, 02:15	2.88
1661	1.220	225.8	01Jan2000, 06:17	2.05
1662	0.672	183.2	01Jan2000, 05:40	2.83
1663	1.498	364.5	01Jan2000, 05:11	2.25
1664	0.777	251.3	01Jan2000, 03:51	2.41
1665	1.741	487.9	01Jan2000, 04:59	2.57
1666	1.025	250.1	01Jan2000, 05:58	2.65
1667	0.698	143.5	01Jan2000, 04:53	1.69
1668	1.052	269.4	01Jan2000, 05:24	2.53
1669	0.386	58.1	01Jan2000, 04:50	1.12
1670	0.370	105.0	01Jan2000, 04:03	2.06
1671	0.802	269.8	01Jan2000, 04:29	2.83
CC01	19.043	2304.4	01Jan2000, 11:39	1.91
CC03	17.269	2280.1	01Jan2000, 10:35	1.92
CC04	16.200	2257.9	01Jan2000, 09:58	1.94
CC05	15.232	2228.8	01Jan2000, 09:37	1.98
CC06	14.589	2204.2	01Jan2000, 09:06	2.01
CC07	14.472	2202.8	01Jan2000, 08:55	2.01
CC08	12.821	2066.5	01Jan2000, 08:02	1.98
CC09D	11.934	1956.4	01Jan2000, 07:42	2.00
CC09U	8.771	1458.7	01Jan2000, 08:44	1.90
CC10	7.445	1378.8	01Jan2000, 07:17	1.94
CC11D	7.082	1357.4	01Jan2000, 06:23	1.97
CC11U	4.724	885.6	01Jan2000, 06:31	1.94
CC12D	4.390	854.9	01Jan2000, 05:48	1.95

CC12U	2.209	536.7	01Jan2000, 06:04	2.45
CC13	1.413	351.1	01Jan2000, 04:50	2.15
CCR1	19.043	2304.4	01Jan2000, 12:48	1.91
CCR10	7.445	1378.8	01Jan2000, 08:58	1.94
CCR11	7.082	1357.4	01Jan2000, 07:21	1.97
CCR12	4.390	854.9	01Jan2000, 06:31	1.95
CCR13	1.413	351.1	01Jan2000, 06:24	2.15
CCR2	17.753	2284.8	01Jan2000, 11:47	1.92
CCR3	17.269	2280.1	01Jan2000, 11:13	1.92
CCR4	16.200	2257.9	01Jan2000, 10:42	1.94
CCR5	15.232	2228.8	01Jan2000, 10:07	1.98
CCR6	14.589	2204.2	01Jan2000, 09:44	2.01
CCR7	14.472	2202.8	01Jan2000, 09:08	2.01
CCR8	12.821	2066.5	01Jan2000, 09:14	1.98
CCR9	11.934	1956.4	01Jan2000, 08:23	2.00
Clay Creek	1.438	188.6	01Jan2000, 04:52	2.32
CLC01	1.438	164.9	01Jan2000, 05:23	2.15
CLCR1	1.438	164.9	01Jan2000, 05:58	2.15
Crooked Creek	19.959	2320.3	01Jan2000, 12:44	1.90
D1619	0.668	41.8	01Jan2000, 04:29	0.52
D1623	0.540	49.7	01Jan2000, 05:30	0.87
D1628	0.456	47.8	01Jan2000, 04:41	0.92
D1630	0.887	21.3	01Jan2000, 06:05	0.26
D1633	0.458	11.3	01Jan2000, 04:55	0.22
D1634	0.334	36.0	01Jan2000, 03:25	0.74
D1635	0.796	234.6	01Jan2000, 03:03	1.91
D1636	0.652	72.0	01Jan2000, 04:19	0.90
D1637	0.726	96.3	01Jan2000, 05:14	1.23
D1638	0.803	70.0	01Jan2000, 05:02	0.76
D1640	1.009	23.9	01Jan2000, 06:05	0.25
D1643	0.985	33.6	01Jan2000, 04:17	0.27
D1644	1.055	35.4	01Jan2000, 04:19	0.27
D1646	0.484	17.2	01Jan2000, 04:18	0.29
D1649	0.528	61.2	01Jan2000, 04:14	0.92
D1651	0.663	144.6	01Jan2000, 04:05	1.69
D1653	0.779	89.2	01Jan2000, 04:17	0.86
D1654	0.644	81.5	01Jan2000, 03:53	0.93
D1654F	0.000	66.5	01Jan2000, 03:53	

D1655	0.931	69.8	01Jan2000, 05:34	0.66
D1656	1.366	87.4	01Jan2000, 04:53	0.57
D1656F	0.000	119.3	01Jan2000, 04:53	
D1657F	0.227	29.4	01Jan2000, 03:31	0.83
D1658	0.767	52.6	01Jan2000, 04:09	0.54
D1658F	0.000	170.7	01Jan2000, 04:09	
D1659	1.528	312.9	01Jan2000, 04:25	1.69
D1659F	0.000	64.4	01Jan2000, 04:25	
D1661	1.220	76.8	01Jan2000, 06:17	0.70
D1661F	0.000	24.9	01Jan2000, 06:17	
D1662	0.672	75.1	01Jan2000, 05:40	1.16
D1663	1.498	160.4	01Jan2000, 05:11	0.99
D1663F	0.000	120.2	01Jan2000, 05:11	
D1664	0.777	228.7	01Jan2000, 03:51	2.20
D1665	1.741	268.3	01Jan2000, 04:59	1.41
D1665F	0.000	141.4	01Jan2000, 04:59	
D1666	1.025	127.6	01Jan2000, 05:58	1.35
D1666F	0.000	85.1	01Jan2000, 05:58	
D1667	0.698	107.6	01Jan2000, 04:53	1.27
d1668	1.052	196.7	01Jan2000, 05:24	1.85
D1668F	0.000	35.0	01Jan2000, 05:24	
D1669	0.386	50.0	01Jan2000, 04:50	0.96
D1670F	0.370	56.0	01Jan2000, 04:03	1.10
D1671	0.802	121.4	01Jan2000, 04:29	1.27
D1671F	0.000	140.6	01Jan2000, 04:29	
DC01	1.529	207.6	01Jan2000, 05:11	1.31
DCR1	1.529	207.6	01Jan2000, 06:35	1.31
Delaware Creek	2.181	321.4	01Jan2000, 05:48	1.44
HJC01	2.713	760.3	01Jan2000, 05:07	2.36
HJC02	1.658	530.4	01Jan2000, 04:28	2.61
HJC03	0.673	238.9	01Jan2000, 04:09	2.81
HJCR1	2.713	760.3	01Jan2000, 05:46	2.36
HJCR2	1.658	530.4	01Jan2000, 05:21	2.61
HJCR3	0.673	238.9	01Jan2000, 04:40	2.81
Howard Johnson Ditch	3.[illegible]	844.7	01Jan2000, 05:41	2.28
J1619	0.668	144.6	01Jan2000, 04:29	1.85
J1623	0.540	72.0	01Jan2000, 05:30	1.26
J1628	0.456	115.1	01Jan2000, 04:41	2.55

J1630	0.887	140.4	01Jan2000, 06:05	1.76
J1633	0.458	87.3	01Jan2000, 04:55	1.69
J1634	0.334	90.1	01Jan2000, 03:25	1.85
J1635	0.796	275.2	01Jan2000, 03:03	2.99
J1636	0.652	137.2	01Jan2000, 04:19	1.76
J1637	0.726	113.2	01Jan2000, 05:14	1.44
J1638	0.803	94.5	01Jan2000, 05:02	1.19
J1640	1.009	193.7	01Jan2000, 06:05	2.10
J1643	0.985	294.0	01Jan2000, 04:17	2.48
J1644	1.055	247.7	01Jan2000, 04:19	1.95
J1646	0.484	118.8	01Jan2000, 04:18	2.09
J1649	0.528	123.8	01Jan2000, 04:14	2.05
J1651	0.663	160.2	01Jan2000, 04:05	2.45
J1653	0.779	175.9	01Jan2000, 04:17	1.76
J1654	0.644	96.0	01Jan2000, 03:56	2.45
J1655	0.931	136.9	01Jan2000, 05:34	1.29
J1656	1.366	270.2	01Jan2000, 04:54	2.60
J1658	0.767	105.3	01Jan2000, 04:15	2.70
J1659	1.528	211.6	01Jan2000, 04:28	2.49
J1661	1.220	166.6	01Jan2000, 06:18	2.05
J1662	0.672	149.4	01Jan2000, 05:41	2.83
J1663	1.498	227.2	01Jan2000, 05:14	2.25
J1664	0.777	181.7	01Jan2000, 03:52	2.41
J1665	1.741	206.9	01Jan2000, 05:05	2.57
J1666	1.025	134.9	01Jan2000, 06:06	2.65
J1667	0.698	133.9	01Jan2000, 04:53	1.69
J1668	1.052	118.1	01Jan2000, 05:32	2.53
J1669	0.386	47.2	01Jan2000, 04:52	1.12
J1671	0.802	74.6	01Jan2000, 05:22	2.83
Payne Branch	2.358	479.8	01Jan2000, 06:01	2.04
PB01	1.900	403.2	01Jan2000, 05:17	2.12
PBR1	1.900	403.2	01Jan2000, 06:14	2.12
R1619	0.668	37.0	01Jan2000, 05:35	0.52
R1623	0.540	49.7	01Jan2000, 05:30	0.87
R1628	0.456	30.3	01Jan2000, 07:05	0.92
R1630	0.887	20.0	01Jan2000, 07:02	0.26
R1633	0.458	11.3	01Jan2000, 04:56	0.22
R1634	0.334	36.0	01Jan2000, 03:25	0.74

R1635	0.796	143.5	01Jan2000, 05:00	1.91
R1636	0.652	68.0	01Jan2000, 05:03	0.90
R1637	0.726	96.3	01Jan2000, 05:14	1.23
R1638	0.803	55.2	01Jan2000, 06:37	0.76
R1640	1.009	18.6	01Jan2000, 08:04	0.25
R1643	0.985	22.2	01Jan2000, 06:23	0.27
R1644	1.055	30.1	01Jan2000, 05:35	0.27
R1646	0.484	13.1	01Jan2000, 06:01	0.29
R1649	0.528	49.1	01Jan2000, 05:41	0.92
R1651	0.663	95.5	01Jan2000, 06:07	1.69
R1653	0.779	83.0	01Jan2000, 05:02	0.86
R1654	0.644	16.9	01Jan2000, 08:10	0.93
R1654F	0.000	14.5	01Jan2000, 08:05	
R1655	0.931	69.8	01Jan2000, 05:34	0.66
R1656	1.366	52.6	01Jan2000, 07:29	0.57
R1656F	0.000	28.9	01Jan2000, 09:45	
R1657F	0.227	6.8	01Jan2000, 07:04	0.83
R1658	0.767	31.4	01Jan2000, 06:30	0.54
R1658F	0.000	36.7	01Jan2000, 08:40	
R1659	1.528	116.5	01Jan2000, 08:01	1.69
R1659F	0.000	14.6	01Jan2000, 09:02	
R1660F	0.014	1.2	01Jan2000, 06:03	2.88
R1661	1.220	34.2	01Jan2000, 10:24	0.70
R1661F	0.000	9.3	01Jan2000, 10:59	
R1662	0.672	41.8	01Jan2000, 08:54	1.16
R1663	1.498	111.4	01Jan2000, 07:23	0.99
R1663F	0.000	33.6	01Jan2000, 09:51	
R1664	0.777	159.2	01Jan2000, 05:42	2.20
R1665	1.741	97.0	01Jan2000, 09:01	1.41
R1665F	0.000	35.3	01Jan2000, 09:54	
R1666	1.025	74.9	01Jan2000, 09:07	1.35
R1666F	0.000	24.3	01Jan2000, 11:26	
R1667	0.698	98.0	01Jan2000, 05:49	1.27
R1668	1.052	72.8	01Jan2000, 09:40	1.85
R1668F	0.000	9.6	01Jan2000, 10:26	
R1669	0.386	39.1	01Jan2000, 06:17	0.96
R1670F	0.370	12.8	01Jan2000, 08:05	1.10
R1671	0.802	40.1	01Jan2000, 08:27	1.27

R1671F	0.000	29.5	01Jan2000, 09:26	
SMR01	1.723	266.3	01Jan2000, 05:26	2.26
SMRR1	1.723	266.3	01Jan2000, 08:34	2.26
Spring Mill Run	2.502	334.9	01Jan2000, 07:09	2.11
WC01	20.902	2138.7	01Jan2000, 12:17	2.26
WC02	19.885	2128.4	01Jan2000, 11:19	2.28
WC03	18.622	2121.0	01Jan2000, 09:50	2.31
WC04	17.512	2091.6	01Jan2000, 08:54	2.32
WC05D	16.497	1992.9	01Jan2000, 08:47	2.32
WC05U	13.995	1697.0	01Jan2000, 09:11	2.35
WC06	13.351	1658.7	01Jan2000, 08:27	2.35
WC07	11.054	1438.1	01Jan2000, 08:01	2.41
WC08D	10.684	1413.6	01Jan2000, 07:18	2.42
WC08U	9.019	1240.2	01Jan2000, 07:23	2.47
WC09	8.252	1156.3	01Jan2000, 06:27	2.45
WC10	6.710	970.0	01Jan2000, 06:39	2.44
WC11	4.818	668.9	01Jan2000, 06:02	2.49
WC12	2.543	280.0	01Jan2000, 05:14	2.65
WC13	0.802	74.6	01Jan2000, 05:22	2.83
WCR1	20.902	2138.7	01Jan2000, 13:00	2.26
WCR10	6.710	970.0	01Jan2000, 06:45	2.44
WCR11	4.818	668.9	01Jan2000, 07:19	2.49
WCR12	2.543	280.0	01Jan2000, 06:55	2.65
WCR13	0.802	74.6	01Jan2000, 06:32	2.83
WCR2	19.885	2128.4	01Jan2000, 12:17	2.28
WCR3	18.622	2121.0	01Jan2000, 11:19	2.31
WCR4	17.512	2091.6	01Jan2000, 09:50	2.32
WCR5	16.497	1992.9	01Jan2000, 09:14	2.32
WCR6	13.351	1658.7	01Jan2000, 09:11	2.35
WCR7	11.054	1438.1	01Jan2000, 08:51	2.41
WCR8	10.684	1413.6	01Jan2000, 08:01	2.42
WCR9	8.252	1156.3	01Jan2000, 07:30	2.45
Williams Creek	21.252	2139.1	01Jan2000, 13:00	2.25

Project: CBBEL Crooked& WilliamsSimulation Run: 10yr24HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10 year / 24 hr 10%
Compute Time: 23Jun2010, 14:20:29 Control Specifications: Frequency Control

Volume Units: IN

Future 10% - 24hr

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
03351310	17.753	2289.9	01Jan2000, 12:55	2.32
1617	0.350	51.0	01Jan2000, 05:21	1.94
1618	0.916	130.1	01Jan2000, 06:54	2.13
1619	0.668	110.7	01Jan2000, 05:45	2.24
1620	0.622	84.4	01Jan2000, 06:42	1.98
1621	0.643	77.9	01Jan2000, 06:37	1.74
1622	0.117	18.2	01Jan2000, 04:45	1.94
1623	0.540	57.4	01Jan2000, 07:18	1.59
1624	0.529	102.7	01Jan2000, 05:10	2.46
1625	0.716	76.5	01Jan2000, 07:15	1.59
1626	0.252	37.9	01Jan2000, 05:01	1.94
1627	0.484	76.7	01Jan2000, 05:29	2.13
1628	0.456	101.3	01Jan2000, 05:50	3.02
1629	1.195	213.4	01Jan2000, 05:59	2.49
1630	0.887	117.2	01Jan2000, 07:47	2.13
1631	1.326	190.7	01Jan2000, 06:19	2.02
1632	0.450	69.8	01Jan2000, 06:08	2.17
1633	0.458	66.8	01Jan2000, 06:25	2.06
1634	0.334	62.4	01Jan2000, 04:36	2.24
1635	0.796	250.3	01Jan2000, 04:10	3.49
1636	0.652	103.0	01Jan2000, 05:31	2.13
1637	0.726	88.5	01Jan2000, 06:53	1.78
1638	0.803	83.7	01Jan2000, 06:45	1.50
1639	0.891	172.6	01Jan2000, 06:02	2.59
1640	1.009	166.1	01Jan2000, 07:43	2.54
1641	1.413	269.6	01Jan2000, 06:12	2.59
1642	0.363	45.7	01Jan2000, 05:15	1.63
1643	0.985	227.0	01Jan2000, 05:21	2.95
1644	1.055	185.6	01Jan2000, 05:27	2.35
1645	0.673	177.3	01Jan2000, 05:06	3.30
1646	0.484	90.5	01Jan2000, 05:24	2.49

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
1647	0.779	127.4	01Jan2000, 04:46	2.02
1648	1.017	176.4	01Jan2000, 05:53	2.39
1649	0.528	99.4	01Jan2000, 05:20	2.46
1650	0.582	118.4	01Jan2000, 04:46	2.53
1651	0.663	153.4	01Jan2000, 05:06	2.91
1652	0.352	82.2	01Jan2000, 04:54	2.87
1653	0.779	133.0	01Jan2000, 05:29	2.16
1654	0.644	155.7	01Jan2000, 04:56	2.92
1655	0.931	112.3	01Jan2000, 07:30	1.66
1656	1.366	308.2	01Jan2000, 06:07	3.08
1657	0.227	47.9	01Jan2000, 04:37	2.36
1658	0.767	194.6	01Jan2000, 05:08	3.18
1659	1.528	344.5	01Jan2000, 05:30	2.95
1660	0.014	4.8	01Jan2000, 02:19	3.38
1661	1.220	190.3	01Jan2000, 07:58	2.48
1662	0.672	149.3	01Jan2000, 06:57	3.33
1663	1.498	287.3	01Jan2000, 06:35	2.70
1664	0.777	181.4	01Jan2000, 04:53	2.87
1665	1.741	380.1	01Jan2000, 06:14	3.04
1666	1.025	206.9	01Jan2000, 07:22	3.13
1667	0.698	110.5	01Jan2000, 06:25	2.10
1668	1.052	215.4	01Jan2000, 06:44	3.00
1669	0.386	44.9	01Jan2000, 06:47	1.46
1670	0.370	76.4	01Jan2000, 05:09	2.50
1671	0.802	204.7	01Jan2000, 05:31	3.33
CC01	19.043	2349.7	01Jan2000, 13:22	2.30
CC03	17.269	2268.8	01Jan2000, 12:20	2.32
CC04	16.200	2209.0	01Jan2000, 11:45	2.34
CC05	15.232	2150.2	01Jan2000, 11:24	2.38
CC06	14.589	2105.8	01Jan2000, 10:53	2.41
CC07	14.472	2099.1	01Jan2000, 10:41	2.42
CC08	12.821	1916.3	01Jan2000, 09:51	2.39
CC09D	11.934	1811.0	01Jan2000, 09:16	2.41
CC09U	8.771	1313.9	01Jan2000, 10:03	2.30
CC10	7.445	1185.4	01Jan2000, 08:34	2.35
CC11D	7.082	1151.3	01Jan2000, 07:36	2.38
CC11U	4.724	759.6	01Jan2000, 07:36	2.34
CC12D	4.390	717.5	01Jan2000, 06:53	2.35

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
CC12U	2.209	462.3	01Jan2000, 06:53	2.91
CC13	1.413	269.6	01Jan2000, 06:12	2.59
CCR1	19.043	2349.7	01Jan2000, 14:31	2.30
CCR10	7.445	1185.4	01Jan2000, 10:15	2.35
CCR11	7.082	1151.3	01Jan2000, 08:34	2.38
CCR12	4.390	717.5	01Jan2000, 07:36	2.35
CCR13	1.413	269.6	01Jan2000, 07:46	2.59
CCR2	17.753	2289.9	01Jan2000, 13:32	2.32
CCR3	17.269	2268.8	01Jan2000, 12:58	2.32
CCR4	16.200	2209.0	01Jan2000, 12:29	2.34
CCR5	15.232	2150.2	01Jan2000, 11:54	2.38
CCR6	14.589	2105.8	01Jan2000, 11:31	2.41
CCR7	14.472	2099.1	01Jan2000, 10:54	2.42
CCR8	12.821	1916.3	01Jan2000, 11:03	2.39
CCR9	11.934	1811.0	01Jan2000, 09:57	2.41
Clay Creek	1.438	175.8	01Jan2000, 06:48	2.80
CLC01	1.438	155.3	01Jan2000, 06:52	2.58
CLCR1	1.438	155.3	01Jan2000, 07:27	2.58
Crooked Creek	19.959	2390.6	01Jan2000, 14:25	2.29
D1619	0.668	31.0	01Jan2000, 05:45	0.63
D1623	0.540	39.6	01Jan2000, 07:18	1.09
D1628	0.456	36.5	01Jan2000, 05:50	1.09
D1630	0.887	17.6	01Jan2000, 07:47	0.32
D1633	0.458	8.7	01Jan2000, 06:25	0.27
D1634	0.334	25.0	01Jan2000, 04:36	0.90
D1635	0.796	160.2	01Jan2000, 04:10	2.23
D1636	0.652	52.5	01Jan2000, 05:31	1.08
D1637	0.726	75.2	01Jan2000, 06:53	1.52
D1638	0.803	53.6	01Jan2000, 06:45	0.96
D1640	1.009	19.9	01Jan2000, 07:43	0.30
D1643	0.985	25.0	01Jan2000, 05:21	0.32
D1644	1.055	26.0	01Jan2000, 05:27	0.33
D1646	0.484	12.7	01Jan2000, 05:24	0.35
D1649	0.528	44.7	01Jan2000, 05:20	1.11
D1651	0.663	105.9	01Jan2000, 05:06	2.01
D1653	0.779	65.2	01Jan2000, 05:29	1.06
D1654	0.644	59.2	01Jan2000, 04:56	1.11
D1654F	0.000	48.3	01Jan2000, 04:56	

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
D1655	0.931	57.3	01Jan2000, 07:30	0.85
D1656	1.366	67.8	01Jan2000, 06:07	0.68
D1656F	0.000	92.5	01Jan2000, 06:07	
D1657F	0.227	20.7	01Jan2000, 04:37	1.02
D1658	0.767	38.9	01Jan2000, 05:08	0.64
D1658F	0.000	126.4	01Jan2000, 05:08	
D1659	1.528	234.3	01Jan2000, 05:30	2.01
D1659F	0.000	48.2	01Jan2000, 05:30	
D1661	1.220	64.7	01Jan2000, 07:58	0.84
D1661F	0.000	21.0	01Jan2000, 07:58	
D1662	0.672	61.2	01Jan2000, 06:57	1.36
D1663	1.498	126.4	01Jan2000, 06:35	1.19
D1663F	0.000	94.8	01Jan2000, 06:35	
D1664	0.777	165.1	01Jan2000, 04:53	2.61
D1665	1.741	209.1	01Jan2000, 06:14	1.67
D1665F	0.000	110.1	01Jan2000, 06:14	
D1666	1.025	105.5	01Jan2000, 07:22	1.60
D1666F	0.000	70.4	01Jan2000, 07:22	
D1667	0.698	82.9	01Jan2000, 06:25	1.57
d1668	1.052	157.3	01Jan2000, 06:44	2.19
D1668F	0.000	28.0	01Jan2000, 06:44	
D1669	0.386	38.6	01Jan2000, 06:47	1.26
D1670F	0.370	40.7	01Jan2000, 05:09	1.33
D1671	0.802	92.1	01Jan2000, 05:31	1.50
D1671F	0.000	106.8	01Jan2000, 05:31	
DC01	1.529	172.2	01Jan2000, 06:49	1.63
DCR1	1.529	172.2	01Jan2000, 08:13	1.63
Delaware Creek	2.181	259.3	01Jan2000, 07:32	1.78
HJC01	2.713	581.8	01Jan2000, 06:09	2.80
HJC02	1.658	400.9	01Jan2000, 05:29	3.09
HJC03	0.673	177.3	01Jan2000, 05:06	3.30
HJCR1	2.713	581.8	01Jan2000, 06:48	2.80
HJCR2	1.658	400.9	01Jan2000, 06:22	3.09
HJCR3	0.673	177.3	01Jan2000, 05:37	3.30
Howard Johnson Ditch	3.663	650.3	01Jan2000, 06:45	2.71
J1619	0.668	110.7	01Jan2000, 05:45	2.24
J1623	0.540	57.4	01Jan2000, 07:18	1.59
J1628	0.456	94.9	01Jan2000, 05:50	3.02

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
J1630	0.887	117.2	01Jan2000, 07:47	2.13
J1633	0.458	66.8	01Jan2000, 06:25	2.06
J1634	0.334	62.4	01Jan2000, 04:36	2.24
J1635	0.796	233.2	01Jan2000, 04:10	3.49
J1636	0.652	103.0	01Jan2000, 05:31	2.13
J1637	0.726	88.5	01Jan2000, 06:53	1.78
J1638	0.803	83.7	01Jan2000, 06:45	1.50
J1640	1.009	164.7	01Jan2000, 07:43	2.54
J1643	0.985	224.0	01Jan2000, 05:21	2.95
J1644	1.055	185.6	01Jan2000, 05:27	2.35
J1646	0.484	90.5	01Jan2000, 05:24	2.49
J1649	0.528	99.4	01Jan2000, 05:20	2.46
J1651	0.663	142.6	01Jan2000, 05:06	2.91
J1653	0.779	133.0	01Jan2000, 05:29	2.16
J1654	0.644	77.6	01Jan2000, 05:00	2.92
J1655	0.931	112.3	01Jan2000, 07:30	1.66
J1656	1.366	227.2	01Jan2000, 06:10	3.08
J1658	0.767	94.8	01Jan2000, 05:19	3.18
J1659	1.528	190.5	01Jan2000, 05:37	2.95
J1661	1.220	147.1	01Jan2000, 08:01	2.48
J1662	0.672	129.4	01Jan2000, 06:58	3.33
J1663	1.498	209.3	01Jan2000, 06:40	2.70
J1664	0.777	175.3	01Jan2000, 04:53	2.87
J1665	1.741	189.5	01Jan2000, 06:26	3.04
J1666	1.025	128.3	01Jan2000, 07:37	3.13
J1667	0.698	110.5	01Jan2000, 06:25	2.10
J1668	1.052	110.5	01Jan2000, 07:00	3.00
J1669	0.386	44.9	01Jan2000, 06:47	1.46
J1671	0.802	72.7	01Jan2000, 07:46	3.33
Payne Branch	2.358	391.7	01Jan2000, 07:32	2.47
PB01	1.900	328.2	01Jan2000, 06:46	2.56
PBR1	1.900	328.2	01Jan2000, 07:43	2.56
R1619	0.668	31.0	01Jan2000, 05:45	0.63
R1623	0.540	39.6	01Jan2000, 07:19	1.09
R1628	0.456	30.1	01Jan2000, 08:17	1.09
R1630	0.887	17.6	01Jan2000, 07:47	0.32
R1633	0.458	8.7	01Jan2000, 06:25	0.27
R1634	0.334	25.0	01Jan2000, 04:35	0.90

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1635	0.796	143.1	01Jan2000, 05:09	2.23
R1636	0.652	52.5	01Jan2000, 05:31	1.08
R1637	0.726	75.2	01Jan2000, 06:53	1.52
R1638	0.803	53.6	01Jan2000, 06:45	0.96
R1640	1.009	18.5	01Jan2000, 09:22	0.30
R1643	0.985	22.0	01Jan2000, 07:09	0.32
R1644	1.055	26.0	01Jan2000, 05:27	0.33
R1646	0.484	12.7	01Jan2000, 05:24	0.35
R1649	0.528	44.7	01Jan2000, 05:20	1.11
R1651	0.663	95.1	01Jan2000, 06:39	2.01
R1653	0.779	65.2	01Jan2000, 05:29	1.06
R1654	0.644	16.9	01Jan2000, 11:49	1.11
R1654F	0.000	14.5	01Jan2000, 11:39	
R1655	0.931	57.3	01Jan2000, 07:30	0.85
R1656	1.366	52.3	01Jan2000, 09:02	0.68
R1656F	0.000	29.0	01Jan2000, 13:19	
R1657F	0.227	6.8	01Jan2000, 10:49	1.02
R1658	0.767	31.1	01Jan2000, 07:35	0.64
R1658F	0.000	36.8	01Jan2000, 12:12	
R1659	1.528	116.1	01Jan2000, 10:43	2.01
R1659F	0.000	14.6	01Jan2000, 12:37	
R1660F	0.014	1.1	01Jan2000, 10:04	3.38
R1661	1.220	34.2	01Jan2000, 13:38	0.84
R1661F	0.000	9.3	01Jan2000, 14:29	
R1662	0.672	41.6	01Jan2000, 11:02	1.36
R1663	1.498	111.1	01Jan2000, 08:38	1.19
R1663F	0.000	33.7	01Jan2000, 13:26	
R1664	0.777	159.0	01Jan2000, 05:36	2.61
R1665	1.741	96.7	01Jan2000, 11:58	1.67
R1665F	0.000	35.4	01Jan2000, 13:26	
R1666	1.025	74.7	01Jan2000, 11:18	1.60
R1666F	0.000	24.4	01Jan2000, 14:55	
R1667	0.698	82.9	01Jan2000, 06:25	1.57
R1668	1.052	72.7	01Jan2000, 12:44	2.19
R1668F	0.000	9.7	01Jan2000, 13:56	
R1669	0.386	38.6	01Jan2000, 06:48	1.26
R1670F	0.370	12.8	01Jan2000, 11:46	1.33
R1671	0.802	39.9	01Jan2000, 11:19	1.50

Global Summary Results for Run "10yr24HrFuture1RR10%"

Project: CBBEL Crocked& Williams Simulation Run: 10yr24HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10 year / 24 hr 10%
Compute Time: 23Jun2010, 14:20:29 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1667	0.698	82.9	01Jan2000, 06:25	1.57
R1668	1.052	72.7	01Jan2000, 12:44	2.19
R1668F	0.000	9.7	01Jan2000, 13:56	
R1669	0.386	38.6	01Jan2000, 06:48	1.26
R1670F	0.370	12.8	01Jan2000, 11:46	1.33
R1671	0.802	39.9	01Jan2000, 11:19	1.50
R1671F	0.000	29.6	01Jan2000, 13:01	
SMR01	1.723	237.6	01Jan2000, 06:37	2.71
SMRR1	1.723	237.6	01Jan2000, 09:45	2.71
Spring Mill Run	2.502	327.2	01Jan2000, 08:42	2.54
WC01	20.902	2336.8	01Jan2000, 13:16	2.71
WC02	19.885	2286.3	01Jan2000, 12:24	2.72
WC03	18.622	2228.7	01Jan2000, 10:55	2.76
WC04	17.512	2143.0	01Jan2000, 10:09	2.78
WC05D	16.497	2032.3	01Jan2000, 10:01	2.77
WC05U	13.995	1720.5	01Jan2000, 10:04	2.81
WC06	13.351	1667.3	01Jan2000, 09:20	2.80
WC07	11.054	1383.4	01Jan2000, 09:09	2.87
WC08D	10.684	1349.1	01Jan2000, 08:35	2.88
WC08U	9.019	1175.5	01Jan2000, 08:53	2.94

Print Close

Global Summary Results for Run "10yr24HrFuture1RR10%"

Project: CBBEL Crooked&Williams Simulation Run: 10yr24HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 10 year / 24 hr 10%
Compute Time: 23Jun2010, 14:20:29 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC08U	9.019	1176.5	01Jan2000, 08:53	2.94
WC09	3.252	1090.4	01Jan2000, 07:50	2.92
WC10	6.710	907.8	01Jan2000, 07:44	2.91
WC11	4.816	633.3	01Jan2000, 06:27	2.95
WC12	2.543	261.2	01Jan2000, 06:37	3.13
WC13	0.802	72.7	01Jan2000, 07:46	3.33
WCR1	20.902	2336.8	01Jan2000, 13:59	2.71
WCR10	6.710	907.8	01Jan2000, 07:50	2.91
WCR11	4.816	633.3	01Jan2000, 07:44	2.95
WCR12	2.543	261.2	01Jan2000, 08:18	3.13
WCR13	0.802	72.7	01Jan2000, 08:56	3.33
WCR2	19.885	2286.3	01Jan2000, 13:22	2.72
WCR3	18.622	2228.7	01Jan2000, 12:24	2.76
WCR4	17.512	2143.0	01Jan2000, 11:05	2.78
WCR5	16.497	2032.3	01Jan2000, 10:28	2.77
WCR6	13.351	1667.3	01Jan2000, 10:04	2.80
WCR7	11.054	1383.4	01Jan2000, 09:59	2.87
WCR8	10.684	1349.1	01Jan2000, 09:18	2.88
WCR9	8.252	1090.4	01Jan2000, 08:53	2.92
Williams Creek	21.252	2345.9	01Jan2000, 13:55	2.69

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: 2yr6HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 6 hr 10%
Compute Time: 23Jun2010, 14:41:26 Control Specifications: Frequency Control

Volume Units: IN

Future 50% - 6hr

03351310	17.753	1265.3	01Jan2000, 09:55	0.91
1617	0.350	43.9	01Jan2000, 03:11	0.73
1618	0.916	96.0	01Jan2000, 04:20	0.84
1619	0.668	91.8	01Jan2000, 03:34	0.88
1620	0.622	61.8	01Jan2000, 04:05	0.74
1621	0.643	56.1	01Jan2000, 03:53	0.62
1622	0.117	17.0	01Jan2000, 02:44	0.73
1623	0.540	36.0	01Jan2000, 04:18	0.52
1624	0.529	89.9	01Jan2000, 03:15	0.97
1625	0.716	48.3	01Jan2000, 04:15	0.52
1626	0.252	33.9	01Jan2000, 02:58	0.73
1627	0.484	66.4	01Jan2000, 03:21	0.84
1628	0.456	85.9	01Jan2000, 03:53	1.31
1629	1.195	180.1	01Jan2000, 03:49	1.05
1630	0.887	79.5	01Jan2000, 05:01	0.84
1631	1.326	146.0	01Jan2000, 03:48	0.75
1632	0.450	56.2	01Jan2000, 03:45	0.85
1633	0.458	50.2	01Jan2000, 03:55	0.77
1634	0.334	60.7	01Jan2000, 02:41	0.88
1635	0.796	278.9	01Jan2000, 02:33	1.60
1636	0.652	88.8	01Jan2000, 03:22	0.84
1637	0.726	61.3	01Jan2000, 04:07	0.63
1638	0.803	57.3	01Jan2000, 03:47	0.49
1639	0.891	134.7	01Jan2000, 03:51	1.00
1640	1.009	105.7	01Jan2000, 05:10	0.95
1641	1.413	206.0	01Jan2000, 03:59	1.00
1642	0.363	35.8	01Jan2000, 03:04	0.53
1643	0.985	197.6	01Jan2000, 03:31	1.23
1644	1.055	162.8	01Jan2000, 03:25	0.96
1645	0.673	163.1	01Jan2000, 03:26	1.48
1646	0.484	81.1	01Jan2000, 03:26	1.05

1647	0.779	117.1	01Jan2000, 02:47	0.75
1648	1.017	147.3	01Jan2000, 03:42	0.97
1649	0.528	87.4	01Jan2000, 03:22	1.00
1650	0.582	115.7	01Jan2000, 02:56	1.06
1651	0.663	139.7	01Jan2000, 03:19	1.24
1652	0.352	77.2	01Jan2000, 03:08	1.21
1653	0.779	103.1	01Jan2000, 03:25	0.75
1654	0.644	142.1	01Jan2000, 03:11	1.21
1655	0.931	54.3	01Jan2000, 04:38	0.41
1656	1.366	248.2	01Jan2000, 04:05	1.31
1657	0.227	41.9	01Jan2000, 02:49	0.82
1658	0.767	176.6	01Jan2000, 03:25	1.39
1659	1.528	298.5	01Jan2000, 03:38	1.26
1660	0.014	5.6	01Jan2000, 01:57	1.51
1661	1.220	120.8	01Jan2000, 05:19	0.95
1662	0.672	112.8	01Jan2000, 04:52	1.48
1663	1.498	210.7	01Jan2000, 04:19	1.06
1664	0.777	170.5	01Jan2000, 03:07	1.21
1665	1.741	305.6	01Jan2000, 04:10	1.30
1666	1.025	149.1	01Jan2000, 05:07	1.36
1667	0.698	72.9	01Jan2000, 03:59	0.67
1668	1.052	164.1	01Jan2000, 04:33	1.28
1669	0.386	22.7	01Jan2000, 03:54	0.33
1670	0.370	63.1	01Jan2000, 03:17	0.91
1671	0.802	178.5	01Jan2000, 03:46	1.48
CC01	19.043	1272.5	01Jan2000, 10:30	0.91
CC03	17.269	1263.7	01Jan2000, 09:19	0.91
CC04	16.200	1255.8	01Jan2000, 08:35	0.93
CC05	15.232	1244.9	01Jan2000, 08:07	0.95
CC06	14.589	1234.5	01Jan2000, 07:31	0.96
CC07	14.472	1234.2	01Jan2000, 07:20	0.97
CC08	12.821	1164.5	01Jan2000, 06:21	0.95
CC09D	11.934	1098.6	01Jan2000, 05:47	0.95
CC09U	8.771	816.1	01Jan2000, 07:41	0.89
CC10	7.445	785.2	01Jan2000, 06:00	0.91
CC11D	7.082	778.2	01Jan2000, 05:02	0.93
CC11U	4.724	513.6	01Jan2000, 05:02	0.93
CC12D	4.390	498.3	01Jan2000, 04:19	0.93

CC12U	2.209	328.5	01Jan2000, 04:19	1.22
CC13	1.413	206.0	01Jan2000, 03:59	1.00
CCR1	19.043	1272.5	01Jan2000, 11:39	0.91
CCR10	7.445	785.2	01Jan2000, 07:41	0.91
CCR11	7.082	778.2	01Jan2000, 06:00	0.93
CCR12	4.390	498.3	01Jan2000, 05:02	0.93
CCR13	1.413	206.0	01Jan2000, 05:33	1.00
CCR2	17.753	1265.3	01Jan2000, 10:32	0.91
CCR3	17.269	1263.7	01Jan2000, 09:57	0.91
CCR4	16.200	1255.8	01Jan2000, 09:19	0.93
CCR5	15.232	1244.9	01Jan2000, 08:37	0.95
CCR6	14.589	1234.5	01Jan2000, 08:09	0.96
CCR7	14.472	1234.2	01Jan2000, 07:33	0.97
CCR8	12.821	1164.5	01Jan2000, 07:39	0.95
CCR9	11.934	1098.6	01Jan2000, 06:28	0.95
Clay Creek	1.438	133.5	01Jan2000, 04:18	1.10
CLC01	1.438	123.7	01Jan2000, 04:09	1.03
CLCR1	1.438	123.7	01Jan2000, 04:44	1.03
Crooked Creek	19.959	1279.0	01Jan2000, 11:39	0.90
D1619	0.668	25.7	01Jan2000, 03:34	0.25
D1623	0.540	24.9	01Jan2000, 04:18	0.36
D1628	0.456	30.9	01Jan2000, 03:53	0.47
D1630	0.887	11.9	01Jan2000, 05:01	0.13
D1633	0.458	6.5	01Jan2000, 03:55	0.10
D1634	0.334	24.3	01Jan2000, 02:41	0.35
D1635	0.796	178.5	01Jan2000, 02:33	1.02
D1636	0.652	45.3	01Jan2000, 03:22	0.43
D1637	0.726	52.1	01Jan2000, 04:07	0.53
D1638	0.803	36.7	01Jan2000, 03:47	0.31
D1640	1.009	12.7	01Jan2000, 05:10	0.11
D1643	0.985	21.7	01Jan2000, 03:31	0.14
D1644	1.055	22.8	01Jan2000, 03:25	0.13
D1646	0.484	11.4	01Jan2000, 03:26	0.15
D1649	0.528	39.3	01Jan2000, 03:22	0.45
D1651	0.663	96.4	01Jan2000, 03:19	0.85
D1653	0.779	50.5	01Jan2000, 03:25	0.37
D1654	0.644	54.0	01Jan2000, 03:11	0.46
D1654F	0.000	44.1	01Jan2000, 03:11	

D1655	0.931	27.7	01Jan2000, 04:38	0.21
D1656	1.366	54.6	01Jan2000, 04:05	0.29
D1656F	0.000	74.5	01Jan2000, 04:05	
D1657F	0.227	18.1	01Jan2000, 02:49	0.35
D1658	0.767	35.3	01Jan2000, 03:25	0.28
D1658F	0.000	114.7	01Jan2000, 03:25	
D1659	1.528	203.0	01Jan2000, 03:38	0.85
D1659F	0.000	41.8	01Jan2000, 03:38	
D1661	1.220	41.1	01Jan2000, 05:19	0.32
D1661F	0.000	13.3	01Jan2000, 05:19	
D1662	0.672	46.2	01Jan2000, 04:52	0.61
D1663	1.498	92.7	01Jan2000, 04:19	0.47
D1663F	0.000	69.5	01Jan2000, 04:19	
D1664	0.777	155.2	01Jan2000, 03:07	1.10
D1665	1.741	168.1	01Jan2000, 04:10	0.72
D1665F	0.000	88.5	01Jan2000, 04:10	
D1666	1.025	76.1	01Jan2000, 05:07	0.69
D1666F	0.000	50.8	01Jan2000, 05:07	
D1667	0.698	54.7	01Jan2000, 03:59	0.50
d1668	1.052	119.8	01Jan2000, 04:33	0.93
D1668F	0.000	21.3	01Jan2000, 04:33	
D1669	0.386	19.5	01Jan2000, 03:54	0.28
D1670F	0.370	33.6	01Jan2000, 03:17	0.49
D1671	0.802	80.3	01Jan2000, 03:46	0.66
D1671F	0.000	93.2	01Jan2000, 03:46	
DC01	1.529	118.1	01Jan2000, 03:57	0.56
DCR1	1.529	118.1	01Jan2000, 05:21	0.56
Delaware Creek	2.181	173.0	01Jan2000, 04:42	0.64
HJC01	2.713	488.6	01Jan2000, 04:20	1.19
HJC02	1.658	356.9	01Jan2000, 03:44	1.33
HJC03	0.673	163.1	01Jan2000, 03:26	1.48
HJCR1	2.713	488.6	01Jan2000, 04:59	1.19
HJCR2	1.658	356.9	01Jan2000, 04:37	1.33
HJCR3	0.673	163.1	01Jan2000, 03:57	1.48
Howard Johnson Ditch	3.162	533.1	01Jan2000, 04:55	1.14
J1619	0.668	91.8	01Jan2000, 03:34	0.88
J1623	0.540	36.0	01Jan2000, 04:18	0.52
J1628	0.456	85.0	01Jan2000, 03:53	1.31

J1630	0.887	79.5	01Jan2000, 05:01	0.84
J1633	0.458	50.2	01Jan2000, 03:55	0.77
J1634	0.334	60.7	01Jan2000, 02:41	0.88
J1635	0.796	243.5	01Jan2000, 02:33	1.60
J1636	0.652	88.8	01Jan2000, 03:22	0.84
J1637	0.726	61.3	01Jan2000, 04:07	0.63
J1638	0.803	57.3	01Jan2000, 03:47	0.49
J1640	1.009	105.7	01Jan2000, 05:10	0.95
J1643	0.985	197.6	01Jan2000, 03:31	1.23
J1644	1.055	162.8	01Jan2000, 03:25	0.96
J1646	0.484	81.1	01Jan2000, 03:26	1.05
J1649	0.528	87.4	01Jan2000, 03:22	1.00
J1651	0.663	138.3	01Jan2000, 03:19	1.24
J1653	0.779	103.1	01Jan2000, 03:25	0.75
J1654	0.644	72.7	01Jan2000, 03:12	1.21
J1655	0.931	54.3	01Jan2000, 04:38	0.41
J1656	1.366	197.5	01Jan2000, 04:06	1.31
J1658	0.767	91.3	01Jan2000, 03:28	1.39
J1659	1.528	181.3	01Jan2000, 03:39	1.26
J1661	1.220	108.2	01Jan2000, 05:20	0.95
J1662	0.672	107.6	01Jan2000, 04:52	1.48
J1663	1.498	172.5	01Jan2000, 04:20	1.06
J1664	0.777	170.5	01Jan2000, 03:08	1.21
J1665	1.741	175.9	01Jan2000, 04:12	1.30
J1666	1.025	118.6	01Jan2000, 05:10	1.36
J1667	0.698	72.9	01Jan2000, 03:59	0.67
J1668	1.052	102.1	01Jan2000, 04:36	1.28
J1669	0.386	22.7	01Jan2000, 03:54	0.33
J1671	0.802	70.0	01Jan2000, 04:07	1.48
Payne Branch	2.358	264.7	01Jan2000, 05:03	0.94
PB01	1.900	225.2	01Jan2000, 04:18	0.98
PBR1	1.900	225.2	01Jan2000, 05:15	0.98
R1619	0.668	25.7	01Jan2000, 03:34	0.25
R1623	0.540	24.9	01Jan2000, 04:18	0.36
R1628	0.456	30.0	01Jan2000, 04:18	0.47
R1630	0.887	11.9	01Jan2000, 05:01	0.13
R1633	0.458	6.5	01Jan2000, 03:55	0.10
R1634	0.334	24.3	01Jan2000, 02:41	0.35

R1635	0.796	143.1	01Jan2000, 03:21	1.02
R1636	0.652	45.3	01Jan2000, 03:22	0.43
R1637	0.726	52.1	01Jan2000, 04:07	0.53
R1638	0.803	36.7	01Jan2000, 03:47	0.31
R1640	1.009	12.7	01Jan2000, 05:09	0.11
R1643	0.985	21.7	01Jan2000, 03:32	0.14
R1644	1.055	22.8	01Jan2000, 03:25	0.13
R1646	0.484	11.4	01Jan2000, 03:26	0.15
R1649	0.528	39.3	01Jan2000, 03:22	0.45
R1651	0.663	95.0	01Jan2000, 03:34	0.85
R1653	0.779	50.5	01Jan2000, 03:25	0.37
R1654	0.644	15.7	01Jan2000, 05:48	0.46
R1654F	0.000	13.6	01Jan2000, 05:43	
R1655	0.931	27.7	01Jan2000, 04:38	0.21
R1656	1.366	52.0	01Jan2000, 04:37	0.29
R1656F	0.000	27.0	01Jan2000, 07:08	
R1657F	0.227	6.4	01Jan2000, 04:42	0.35
R1658	0.767	31.0	01Jan2000, 04:12	0.28
R1658F	0.000	34.5	01Jan2000, 06:17	
R1659	1.528	114.7	01Jan2000, 05:31	0.86
R1659F	0.000	13.6	01Jan2000, 06:33	
R1660F	0.014	1.1	01Jan2000, 03:55	1.51
R1661	1.220	33.1	01Jan2000, 06:49	0.32
R1661F	0.000	8.8	01Jan2000, 07:32	
R1662	0.672	41.0	01Jan2000, 05:52	0.61
R1663	1.498	92.7	01Jan2000, 04:19	0.47
R1663F	0.000	31.7	01Jan2000, 06:59	
R1664	0.777	155.2	01Jan2000, 03:08	1.10
R1665	1.741	94.8	01Jan2000, 06:19	0.72
R1665F	0.000	33.2	01Jan2000, 07:14	
R1666	1.025	74.0	01Jan2000, 05:37	0.69
R1666F	0.000	22.7	01Jan2000, 08:27	
R1667	0.698	54.7	01Jan2000, 03:59	0.50
R1668	1.052	70.7	01Jan2000, 06:47	0.93
R1668F	0.000	9.0	01Jan2000, 07:39	
R1669	0.386	19.5	01Jan2000, 03:54	0.28
R1670F	0.370	12.0	01Jan2000, 05:33	0.49
R1671	0.802	38.7	01Jan2000, 06:02	0.67

Global Summary Results for Run: 2yr6HrFuture1RR10%

Project: CBBEL Crooked& Williams Simulation Run: 2yr6HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 203CCN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 6 hr 10%
Compute Time: 29Jun2010, 14:41:26 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1568	1.052	70.7	01Jan2000, 06:47	0.93
R1568F	0.000	9.0	01Jan2000, 07:39	
R1669	0.386	19.5	01Jan2000, 03:54	0.28
R1670F	0.370	12.0	01Jan2000, 05:33	0.49
R1671	0.302	38.7	01Jan2000, 06:02	0.67
R1671F	0.000	27.4	01Jan2000, 07:00	
SMR01	1.723	184.6	01Jan2000, 04:32	1.08
SMRR1	1.723	184.6	01Jan2000, 07:40	1.08
Spring Mill Run	2.502	195.0	01Jan2000, 07:29	0.98
WC01	20.902	1331.9	01Jan2000, 12:19	1.10
WC02	19.885	1330.3	01Jan2000, 11:21	1.11
WC03	18.622	1329.5	01Jan2000, 09:52	1.12
WC04	17.512	1326.9	01Jan2000, 08:56	1.13
WC05D	16.497	1320.3	01Jan2000, 08:29	1.12
WC05U	13.995	1151.6	01Jan2000, 08:55	1.15
WC06	13.351	1121.6	01Jan2000, 08:11	1.15
WC07	11.054	1038.0	01Jan2000, 07:21	1.19
WC08D	10.684	1023.3	01Jan2000, 06:38	1.20
WC08U	9.019	909.7	01Jan2000, 06:40	1.24

Print Close

Global Summary Results for Run: 2yr6HrFuture1RR10%

Project: CEBEL Crooked& Williams Simulation Run: 2yr6HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN (1 det.)
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 6 hr 10%
Compute Time: 23Jun2010, 14:41:26 Control Specifications: Frequency Control

Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC09	8.252	855.1	01Jan2000, 05:37	1.22
WC10	6.710	698.5	01Jan2000, 05:46	1.21
WC11	4.818	490.7	01Jan2000, 04:32	1.24
WC12	2.543	244.7	01Jan2000, 04:20	1.36
WC13	0.802	70.0	01Jan2000, 04:07	1.48
WCR1	20.902	1331.9	01Jan2000, 13:02	1.10
WCR10	6.710	698.5	01Jan2000, 05:52	1.21
WCR11	4.818	490.7	01Jan2000, 05:49	1.24
WCR12	2.543	244.7	01Jan2000, 05:01	1.36
WCR13	0.802	70.0	01Jan2000, 05:17	1.48
WCR2	19.685	1330.3	01Jan2000, 12:19	1.11
WCR3	18.622	1329.5	01Jan2000, 11:21	1.12
WCR4	17.512	1326.9	01Jan2000, 09:52	1.13
WCR5	16.497	1320.3	01Jan2000, 08:56	1.12
WCR6	13.351	1121.6	01Jan2000, 08:55	1.15
WCR7	11.084	1038.0	01Jan2000, 08:11	1.19
WCR8	10.684	1023.3	01Jan2000, 07:21	1.20
WCR9	8.252	855.1	01Jan2000, 06:40	1.22
Williams Creek	21.252	1331.9	01Jan2000, 13:02	1.09

Print Close

Project: CBBEL Crooked& WilliamsSimulation Run: 2yr12HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 12 hr 10%
Compute Time: 23Jun2010, 14:36:46 Control Specifications: Frequency Control

Volume Units: IN

Future 50% - 12hr

03351310	17.753	1423.9	01Jan2000, 10:58	1.15
1617	0.350	39.9	01Jan2000, 04:05	0.92
1618	0.916	96.6	01Jan2000, 05:18	1.04
1619	0.668	87.0	01Jan2000, 04:27	1.10
1620	0.622	61.6	01Jan2000, 05:05	0.94
1621	0.643	55.2	01Jan2000, 04:55	0.79
1622	0.117	14.5	01Jan2000, 03:30	0.92
1623	0.540	37.3	01Jan2000, 05:26	0.68
1624	0.529	82.8	01Jan2000, 04:06	1.22
1625	0.716	49.8	01Jan2000, 05:24	0.68
1626	0.252	30.0	01Jan2000, 03:48	0.92
1627	0.484	61.3	01Jan2000, 04:13	1.04
1628	0.456	83.1	01Jan2000, 04:42	1.61
1629	1.195	172.7	01Jan2000, 04:39	1.29
1630	0.887	83.4	01Jan2000, 06:00	1.04
1631	1.326	142.1	01Jan2000, 04:46	0.96
1632	0.450	54.0	01Jan2000, 04:39	1.06
1633	0.458	49.4	01Jan2000, 04:53	0.98
1634	0.334	51.7	01Jan2000, 03:24	1.10
1635	0.796	236.3	01Jan2000, 03:07	1.94
1636	0.652	82.2	01Jan2000, 04:14	1.04
1637	0.726	61.7	01Jan2000, 05:10	0.81
1638	0.803	56.3	01Jan2000, 04:54	0.64
1639	0.891	132.7	01Jan2000, 04:45	1.27
1640	1.009	115.0	01Jan2000, 06:09	1.22
1641	1.413	205.2	01Jan2000, 04:54	1.27
1642	0.363	32.7	01Jan2000, 04:07	0.70
1643	0.985	186.9	01Jan2000, 04:20	1.53
1644	1.055	151.2	01Jan2000, 04:15	1.19
1645	0.673	152.0	01Jan2000, 04:11	1.80
1646	0.484	75.2	01Jan2000, 04:15	1.29

1647	0.779	101.4	01Jan2000, 03:35	0.96
1648	1.017	140.6	01Jan2000, 04:34	1.21
1649	0.528	81.0	01Jan2000, 04:12	1.25
1650	0.582	101.7	01Jan2000, 03:38	1.31
1651	0.663	128.8	01Jan2000, 04:06	1.53
1652	0.352	69.7	01Jan2000, 03:53	1.50
1653	0.779	99.0	01Jan2000, 04:23	0.98
1654	0.644	130.0	01Jan2000, 03:58	1.51
1655	0.931	64.2	01Jan2000, 05:48	0.60
1656	1.366	246.1	01Jan2000, 04:56	1.62
1657	0.227	37.4	01Jan2000, 03:39	1.07
1658	0.767	164.8	01Jan2000, 04:12	1.70
1659	1.528	284.0	01Jan2000, 04:27	1.55
1660	0.014	4.6	01Jan2000, 02:17	1.85
1661	1.220	131.5	01Jan2000, 06:19	1.21
1662	0.672	116.6	01Jan2000, 05:43	1.81
1663	1.498	215.5	01Jan2000, 05:15	1.34
1664	0.777	153.9	01Jan2000, 03:52	1.50
1665	1.741	303.4	01Jan2000, 05:01	1.61
1666	1.025	156.8	01Jan2000, 06:01	1.67
1667	0.698	75.9	01Jan2000, 05:02	0.90
1668	1.052	167.3	01Jan2000, 05:26	1.58
1669	0.386	25.8	01Jan2000, 05:05	0.50
1670	0.370	59.5	01Jan2000, 04:11	1.18
1671	0.802	171.4	01Jan2000, 04:32	1.81
CC01	19.043	1435.9	01Jan2000, 11:29	1.14
CC03	17.269	1420.7	01Jan2000, 10:22	1.15
CC04	16.200	1407.0	01Jan2000, 09:44	1.16
CC05	15.232	1389.6	01Jan2000, 09:20	1.19
CC06	14.589	1374.3	01Jan2000, 08:48	1.21
CC07	14.472	1373.2	01Jan2000, 08:35	1.21
CC08	12.821	1290.5	01Jan2000, 07:53	1.19
CC09D	11.934	1224.1	01Jan2000, 07:24	1.20
CC09U	8.771	870.4	01Jan2000, 08:16	1.12
CC10	7.445	814.7	01Jan2000, 06:49	1.15
CC11D	7.082	800.2	01Jan2000, 05:55	1.17
CC11U	4.724	522.4	01Jan2000, 05:47	1.16
CC12D	4.390	496.7	01Jan2000, 05:16	1.17

CC12U	2.209	319.7	01Jan2000, 05:02	1.51
CC13	1.413	205.2	01Jan2000, 04:54	1.27
CCR1	19.043	1435.9	01Jan2000, 12:38	1.14
CCR10	7.445	814.7	01Jan2000, 08:30	1.15
CCR11	7.082	800.2	01Jan2000, 06:53	1.17
CCR12	4.390	496.7	01Jan2000, 05:59	1.17
CCR13	1.413	205.2	01Jan2000, 06:28	1.27
CCR2	17.753	1423.9	01Jan2000, 11:35	1.15
CCR3	17.269	1420.7	01Jan2000, 11:00	1.15
CCR4	16.200	1407.0	01Jan2000, 10:28	1.16
CCR5	15.232	1389.6	01Jan2000, 09:50	1.19
CCR6	14.589	1374.3	01Jan2000, 09:26	1.21
CCR7	14.472	1373.2	01Jan2000, 08:48	1.21
CCR8	12.821	1290.5	01Jan2000, 09:06	1.19
CCR9	11.934	1224.1	01Jan2000, 08:05	1.20
Clay Creek	1.438	141.0	01Jan2000, 05:20	1.39
CLC01	1.438	128.2	01Jan2000, 05:14	1.29
CLCR1	1.438	128.2	01Jan2000, 05:49	1.29
Crooked Creek	19.959	1445.8	01Jan2000, 12:34	1.13
D1619	0.668	24.3	01Jan2000, 04:27	0.31
D1623	0.540	25.7	01Jan2000, 05:26	0.47
D1628	0.456	29.9	01Jan2000, 04:42	0.58
D1630	0.887	12.5	01Jan2000, 06:00	0.16
D1633	0.458	6.4	01Jan2000, 04:53	0.13
D1634	0.334	20.7	01Jan2000, 03:24	0.44
D1635	0.796	151.2	01Jan2000, 03:07	1.24
D1636	0.652	41.9	01Jan2000, 04:14	0.53
D1637	0.726	52.4	01Jan2000, 05:10	0.69
D1638	0.803	36.0	01Jan2000, 04:54	0.41
D1640	1.009	13.8	01Jan2000, 06:09	0.15
D1643	0.985	20.6	01Jan2000, 04:20	0.17
D1644	1.055	21.2	01Jan2000, 04:15	0.17
D1646	0.484	10.5	01Jan2000, 04:15	0.18
D1649	0.528	36.5	01Jan2000, 04:12	0.56
D1651	0.663	88.9	01Jan2000, 04:06	1.05
D1653	0.779	48.5	01Jan2000, 04:23	0.48
D1654	0.644	49.4	01Jan2000, 03:58	0.57
D1654F	0.000	40.3	01Jan2000, 03:58	

D1655	0.931	32.7	01Jan2000, 05:48	0.31
D1656	1.366	54.1	01Jan2000, 04:56	0.36
D1656F	0.000	73.8	01Jan2000, 04:56	
D1657F	0.227	16.2	01Jan2000, 03:39	0.46
D1658	0.767	33.0	01Jan2000, 04:12	0.34
D1658F	0.000	107.0	01Jan2000, 04:12	
D1659	1.528	193.1	01Jan2000, 04:27	1.06
D1659F	0.000	39.7	01Jan2000, 04:27	
D1661	1.220	44.7	01Jan2000, 06:19	0.41
D1661F	0.000	14.5	01Jan2000, 06:19	
D1662	0.672	47.8	01Jan2000, 05:43	0.74
D1663	1.498	94.8	01Jan2000, 05:15	0.59
D1663F	0.000	71.1	01Jan2000, 05:15	
D1664	0.777	140.1	01Jan2000, 03:52	1.37
D1665	1.741	166.9	01Jan2000, 05:01	0.89
D1665F	0.000	87.9	01Jan2000, 05:01	
D1666	1.025	80.0	01Jan2000, 06:01	0.85
D1666F	0.000	53.4	01Jan2000, 06:01	
D1667	0.698	56.9	01Jan2000, 05:02	0.68
d1668	1.052	122.1	01Jan2000, 05:26	1.15
D1668F	0.000	21.7	01Jan2000, 05:26	
D1669	0.386	22.2	01Jan2000, 05:05	0.43
D1670F	0.370	31.7	01Jan2000, 04:11	0.63
D1671	0.802	77.1	01Jan2000, 04:32	0.81
D1671F	0.000	89.5	01Jan2000, 04:32	
DC01	1.529	117.8	01Jan2000, 05:03	0.72
DCR1	1.529	117.8	01Jan2000, 06:27	0.72
Delaware Creek	2.181	179.5	01Jan2000, 05:37	0.82
HJC01	2.713	474.5	01Jan2000, 05:08	1.47
HJC02	1.658	337.2	01Jan2000, 04:30	1.64
HJC03	0.673	152.0	01Jan2000, 04:11	1.80
HJCR1	2.713	474.5	01Jan2000, 05:47	1.47
HJCR2	1.658	337.2	01Jan2000, 05:23	1.64
HJCR3	0.673	152.0	01Jan2000, 04:42	1.80
Howard Johnson Branch	3.083	523.3	01Jan2000, 05:42	1.41
J1619	0.668	87.0	01Jan2000, 04:27	1.10
J1623	0.540	37.3	01Jan2000, 05:27	0.68
J1628	0.456	83.1	01Jan2000, 04:42	1.81

J1630	0.887	83.4	01Jan2000, 06:00	1.04
J1633	0.458	49.4	01Jan2000, 04:53	0.98
J1634	0.334	51.7	01Jan2000, 03:24	1.10
J1635	0.796	228.1	01Jan2000, 03:07	1.94
J1636	0.652	82.2	01Jan2000, 04:14	1.04
J1637	0.726	61.7	01Jan2000, 05:10	0.81
J1638	0.803	56.3	01Jan2000, 04:54	0.64
J1640	1.009	115.0	01Jan2000, 06:09	1.22
J1643	0.985	186.9	01Jan2000, 04:20	1.53
J1644	1.055	151.2	01Jan2000, 04:15	1.19
J1646	0.484	75.2	01Jan2000, 04:15	1.29
J1649	0.528	81.0	01Jan2000, 04:12	1.25
J1651	0.663	128.8	01Jan2000, 04:06	1.53
J1653	0.779	99.0	01Jan2000, 04:22	0.98
J1654	0.644	69.0	01Jan2000, 04:00	1.51
J1655	0.931	64.2	01Jan2000, 05:48	0.60
J1656	1.366	196.6	01Jan2000, 04:57	1.62
J1658	0.767	89.6	01Jan2000, 04:16	1.70
J1659	1.528	178.8	01Jan2000, 04:29	1.55
J1661	1.220	114.1	01Jan2000, 06:20	1.21
J1662	0.672	109.9	01Jan2000, 05:43	1.81
J1663	1.498	175.9	01Jan2000, 05:16	1.34
J1664	0.777	153.9	01Jan2000, 03:52	1.50
J1665	1.741	175.7	01Jan2000, 05:06	1.61
J1666	1.025	119.9	01Jan2000, 06:05	1.67
J1667	0.698	75.9	01Jan2000, 05:02	0.90
J1668	1.052	102.7	01Jan2000, 05:32	1.58
J1669	0.386	25.8	01Jan2000, 05:05	0.50
J1671	0.802	70.1	01Jan2000, 05:14	1.81
Payne Branch	2.358	279.3	01Jan2000, 06:08	1.19
PB01	1.900	236.9	01Jan2000, 05:23	1.25
PBR1	1.900	236.9	01Jan2000, 06:20	1.25
R1619	0.668	24.3	01Jan2000, 04:27	0.31
R1623	0.540	25.7	01Jan2000, 05:27	0.47
R1628	0.456	29.9	01Jan2000, 04:42	0.58
R1630	0.887	12.5	01Jan2000, 06:00	0.16
R1633	0.458	6.4	01Jan2000, 04:53	0.13
R1634	0.334	20.7	01Jan2000, 03:24	0.44

R1635	0.796	143.0	01Jan2000, 03:42	1.24
R1636	0.652	41.9	01Jan2000, 04:14	0.53
R1637	0.726	52.4	01Jan2000, 05:10	0.69
R1638	0.803	36.0	01Jan2000, 04:54	0.41
R1640	1.009	13.8	01Jan2000, 06:09	0.15
R1643	0.985	20.6	01Jan2000, 04:20	0.17
R1644	1.055	21.2	01Jan2000, 04:15	0.17
R1646	0.484	10.5	01Jan2000, 04:15	0.18
R1649	0.528	36.5	01Jan2000, 04:12	0.56
R1651	0.663	88.9	01Jan2000, 04:06	1.05
R1653	0.779	48.5	01Jan2000, 04:22	0.48
R1654	0.644	15.9	01Jan2000, 07:29	0.57
R1654F	0.000	13.7	01Jan2000, 07:22	
R1655	0.931	32.7	01Jan2000, 05:48	0.31
R1656	1.366	52.0	01Jan2000, 05:36	0.36
R1656F	0.000	27.3	01Jan2000, 08:50	
R1657F	0.227	6.4	01Jan2000, 06:21	0.46
R1658	0.767	31.0	01Jan2000, 04:56	0.34
R1658F	0.000	34.8	01Jan2000, 07:56	
R1659	1.528	114.8	01Jan2000, 06:56	1.06
R1659F	0.000	13.8	01Jan2000, 08:13	
R1660F	0.014	1.1	01Jan2000, 05:36	1.85
R1661	1.220	33.2	01Jan2000, 08:35	0.41
R1661F	0.000	8.9	01Jan2000, 09:23	
R1662	0.672	41.1	01Jan2000, 07:13	0.74
R1663	1.498	94.8	01Jan2000, 05:15	0.59
R1663F	0.000	32.0	01Jan2000, 08:44	
R1664	0.777	140.1	01Jan2000, 03:52	1.37
R1665	1.741	95.0	01Jan2000, 07:51	0.89
R1665F	0.000	33.5	01Jan2000, 08:56	
R1666	1.025	74.0	01Jan2000, 07:05	0.85
R1666F	0.000	23.0	01Jan2000, 10:13	
R1667	0.698	56.9	01Jan2000, 05:02	0.68
R1668	1.052	70.9	01Jan2000, 08:23	1.15
R1668F	0.000	9.1	01Jan2000, 09:21	
R1669	0.386	22.2	01Jan2000, 05:05	0.43
R1670F	0.370	12.1	01Jan2000, 07:17	0.63
R1671	0.802	38.8	01Jan2000, 07:31	0.81

Global Summary Results for Run "2yr12HrFuture1RR10%"

Project: CBBEL Crooked& Williams Simulation Run: 2yr12HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 12 hr 10%
Compute Time: 23Jun2010, 14:36:46 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1666F	0.000	23.0	01Jan2000, 10:13	
R1667	0.698	56.9	01Jan2000, 05:02	0.68
R1668	1.052	70.9	01Jan2000, 08:23	1.15
R1668F	0.000	9.1	01Jan2000, 09:21	
R1669	0.386	22.2	01Jan2000, 05:05	0.43
R1670F	0.370	12.1	01Jan2000, 07:17	0.63
R1671	0.802	38.8	01Jan2000, 07:31	0.81
R1671F	0.000	27.8	01Jan2000, 08:40	
SMR01	1.723	194.1	01Jan2000, 05:14	1.36
SMRR1	1.723	194.1	01Jan2000, 08:22	1.36
Spring Mill Run	2.502	220.6	01Jan2000, 08:12	1.24
WC01	20.902	1512.6	01Jan2000, 13:09	1.38
WC02	19.883	1509.2	01Jan2000, 12:11	1.39
WC03	18.622	1507.0	01Jan2000, 10:42	1.41
WC04	17.512	1499.9	01Jan2000, 09:46	1.41
WC05D	16.497	1482.4	01Jan2000, 09:21	1.41
WC05U	13.995	1284.0	01Jan2000, 09:21	1.44
WC06	13.351	1250.8	01Jan2000, 08:39	1.43
WC07	11.054	1120.5	01Jan2000, 07:57	1.48
WC08D	10.684	1101.1	01Jan2000, 07:14	1.49

Print Close

Global Summary Results for Run "2yr12HrFuture1RR10%"

Project: CBBEL Crooked & Williams Simulation Run: 2yr12HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 12 hr 10%
Compute Time: 23Jun2010, 14:36:46 Control Specifications: Frequency Control

Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC08U	9.019	970.7	01Jan2000, 07:22	1.53
WC09	8.252	912.3	01Jan2000, 06:31	1.52
WC10	6.710	748.7	01Jan2000, 06:35	1.51
WC11	4.818	528.8	01Jan2000, 05:20	1.54
WC12	2.543	245.0	01Jan2000, 05:14	1.67
WC13	0.802	70.1	01Jan2000, 05:14	1.81
WCR1	20.902	1512.6	01Jan2000, 13:52	1.38
WCR10	6.710	748.7	01Jan2000, 06:41	1.51
WCR11	4.818	528.8	01Jan2000, 06:37	1.54
WCR12	2.543	245.0	01Jan2000, 06:55	1.67
WCR13	0.802	70.1	01Jan2000, 06:24	1.81
WCR2	19.885	1509.2	01Jan2000, 13:09	1.39
WCR3	18.622	1507.0	01Jan2000, 12:11	1.41
WCR4	17.512	1499.9	01Jan2000, 10:42	1.41
WCR5	16.497	1482.4	01Jan2000, 09:48	1.41
WCR6	13.351	1250.8	01Jan2000, 09:23	1.43
WCR7	11.054	1120.5	01Jan2000, 08:47	1.48
WCR8	10.684	1101.1	01Jan2000, 07:57	1.49
WCR9	8.252	912.3	01Jan2000, 07:34	1.52
Williams Creek	21.252	1512.7	01Jan2000, 13:52	

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Time sent: 2:39:28 PM 6/23/
Total pages: 6

Project: CBBEL Crooked& WilliamsSimulation Run: 2yr24HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 24 hr 10%
Compute Time: 23Jun2010, 14:40:50 Control Specifications: Frequency Control

Volume Units: IN

Future 50% - 24hr.

03351310	17.753	1408.5	01Jan2000, 12:37	1.43
1617	0.350	29.2	01Jan2000, 05:14	1.16
1618	0.916	77.8	01Jan2000, 06:48	1.30
1619	0.668	65.8	01Jan2000, 05:43	1.38
1620	0.622	48.8	01Jan2000, 06:39	1.18
1621	0.643	43.0	01Jan2000, 06:35	1.01
1622	0.117	10.3	01Jan2000, 04:42	1.16
1623	0.540	30.4	01Jan2000, 07:23	0.88
1624	0.529	61.4	01Jan2000, 05:13	1.52
1625	0.716	40.5	01Jan2000, 07:20	0.88
1626	0.252	21.5	01Jan2000, 04:57	1.16
1627	0.484	45.5	01Jan2000, 05:21	1.30
1628	0.456	64.9	01Jan2000, 05:53	1.96
1629	1.195	133.5	01Jan2000, 05:50	1.59
1630	0.887	70.3	01Jan2000, 07:41	1.30
1631	1.326	109.9	01Jan2000, 06:18	1.21
1632	0.450	41.5	01Jan2000, 06:03	1.33
1633	0.458	38.6	01Jan2000, 06:26	1.23
1634	0.334	36.6	01Jan2000, 04:36	1.38
1635	0.796	166.0	01Jan2000, 04:15	2.34
1636	0.652	61.1	01Jan2000, 05:23	1.30
1637	0.726	49.1	01Jan2000, 06:52	1.03
1638	0.803	43.7	01Jan2000, 06:45	0.83
1639	0.891	103.9	01Jan2000, 06:11	1.59
1640	1.009	99.5	01Jan2000, 07:55	1.55
1641	1.413	162.4	01Jan2000, 06:21	1.59
1642	0.363	23.5	01Jan2000, 05:21	0.91
1643	0.985	142.4	01Jan2000, 05:27	1.89
1644	1.055	113.2	01Jan2000, 05:21	1.47
1645	0.673	115.5	01Jan2000, 05:11	2.18
1646	0.484	56.5	01Jan2000, 05:17	1.59

1647	0.779	72.1	01Jan2000, 04:45	1.21
1648	1.017	107.7	01Jan2000, 05:49	1.49
1649	0.528	60.6	01Jan2000, 05:18	1.54
1650	0.582	73.5	01Jan2000, 04:42	1.61
1651	0.663	96.6	01Jan2000, 05:09	1.87
1652	0.352	51.5	01Jan2000, 04:56	1.84
1653	0.779	74.6	01Jan2000, 05:43	1.26
1654	0.644	96.8	01Jan2000, 05:02	1.86
1655	0.931	57.2	01Jan2000, 08:07	0.85
1656	1.366	196.1	01Jan2000, 06:15	1.99
1657	0.227	27.2	01Jan2000, 04:44	1.39
1658	0.767	125.0	01Jan2000, 05:14	2.08
1659	1.528	217.9	01Jan2000, 05:34	1.90
1660	0.014	3.0	01Jan2000, 02:21	2.24
1661	1.220	114.4	01Jan2000, 08:07	1.52
1662	0.672	97.7	01Jan2000, 07:04	2.20
1663	1.498	175.3	01Jan2000, 06:44	1.68
1664	0.777	113.8	01Jan2000, 04:56	1.84
1665	1.741	242.6	01Jan2000, 06:19	1.97
1666	1.025	133.3	01Jan2000, 07:28	2.04
1667	0.698	61.2	01Jan2000, 06:43	1.19
1668	1.052	137.3	01Jan2000, 06:48	1.93
1669	0.386	21.8	01Jan2000, 07:15	0.72
1670	0.370	44.6	01Jan2000, 05:20	1.50
1671	0.802	133.4	01Jan2000, 05:38	2.20
CC01	19.043	1447.3	01Jan2000, 13:08	1.42
CC03	17.269	1394.5	01Jan2000, 12:02	1.43
CC04	16.200	1356.2	01Jan2000, 11:23	1.45
CC05	15.232	1320.3	01Jan2000, 10:58	1.48
CC06	14.589	1292.7	01Jan2000, 10:23	1.50
CC07	14.472	1288.2	01Jan2000, 10:10	1.50
CC08	12.821	1166.1	01Jan2000, 09:17	1.48
CC09D	11.934	1100.1	01Jan2000, 08:42	1.49
CC09U	8.771	769.8	01Jan2000, 09:49	1.40
CC10	7.445	690.9	01Jan2000, 08:21	1.44
CC11D	7.082	671.8	01Jan2000, 07:25	1.47
CC11U	4.724	439.4	01Jan2000, 07:16	1.45
CC12D	4.390	412.6	01Jan2000, 06:42	1.45

CC12U	2.209	268.9	01Jan2000, 06:35	1.86
CC13	1.413	162.4	01Jan2000, 06:21	1.59
CCR1	19.043	1447.3	01Jan2000, 14:17	1.42
CCR10	7.445	690.9	01Jan2000, 10:02	1.44
CCR11	7.082	671.8	01Jan2000, 08:23	1.47
CCR12	4.390	412.6	01Jan2000, 07:25	1.45
CCR13	1.413	162.4	01Jan2000, 07:55	1.59
CCR2	17.753	1408.5	01Jan2000, 13:14	1.43
CCR3	17.269	1394.5	01Jan2000, 12:40	1.43
CCR4	16.200	1356.2	01Jan2000, 12:07	1.45
CCR5	15.232	1320.3	01Jan2000, 11:28	1.48
CCR6	14.589	1292.7	01Jan2000, 11:01	1.50
CCR7	14.472	1288.2	01Jan2000, 10:23	1.50
CCR8	12.821	1166.1	01Jan2000, 10:29	1.48
CCR9	11.934	1100.1	01Jan2000, 09:23	1.49
Clay Creek	1.438	131.8	01Jan2000, 07:03	1.73
CLC01	1.438	120.2	01Jan2000, 07:10	1.61
CLCR1	1.438	120.2	01Jan2000, 07:45	1.61
Crooked Creek	19.959	1473.5	01Jan2000, 14:13	1.41
D1619	0.668	18.4	01Jan2000, 05:43	0.39
D1623	0.540	21.0	01Jan2000, 07:23	0.61
D1628	0.456	23.4	01Jan2000, 05:53	0.71
D1630	0.887	10.6	01Jan2000, 07:41	0.20
D1633	0.458	5.0	01Jan2000, 06:26	0.16
D1634	0.334	14.6	01Jan2000, 04:36	0.55
D1635	0.796	106.3	01Jan2000, 04:15	1.49
D1636	0.652	31.2	01Jan2000, 05:23	0.66
D1637	0.726	41.8	01Jan2000, 06:52	0.88
D1638	0.803	28.0	01Jan2000, 06:45	0.53
D1640	1.009	11.9	01Jan2000, 07:55	0.19
D1643	0.985	15.7	01Jan2000, 05:27	0.21
D1644	1.055	15.8	01Jan2000, 05:21	0.21
D1646	0.484	7.9	01Jan2000, 05:17	0.22
D1649	0.528	27.3	01Jan2000, 05:18	0.69
D1651	0.663	66.6	01Jan2000, 05:09	1.29
D1653	0.779	36.6	01Jan2000, 05:43	0.62
D1654	0.644	36.8	01Jan2000, 05:02	0.71
D1654F	0.000	30.0	01Jan2000, 05:02	

D1655	0.931	29.1	01Jan2000, 08:07	0.43
D1656	1.366	43.1	01Jan2000, 06:15	0.44
D1656F	0.000	58.9	01Jan2000, 06:15	
D1657F	0.227	11.8	01Jan2000, 04:44	0.60
D1658	0.767	25.0	01Jan2000, 05:14	0.42
D1658F	0.000	81.2	01Jan2000, 05:14	
D1659	1.528	148.2	01Jan2000, 05:34	1.29
D1659F	0.000	30.5	01Jan2000, 05:34	
D1661	1.220	38.9	01Jan2000, 08:07	0.52
D1661F	0.000	12.6	01Jan2000, 08:07	
D1662	0.672	40.0	01Jan2000, 07:04	0.90
D1663	1.498	77.1	01Jan2000, 06:44	0.74
D1663F	0.000	57.8	01Jan2000, 06:44	
D1664	0.777	103.5	01Jan2000, 04:56	1.67
D1665	1.741	133.4	01Jan2000, 06:19	1.08
D1665F	0.000	70.3	01Jan2000, 06:19	
D1666	1.025	68.0	01Jan2000, 07:28	1.04
D1666F	0.000	45.4	01Jan2000, 07:28	
D1667	0.698	45.9	01Jan2000, 06:43	0.89
d1668	1.052	100.2	01Jan2000, 06:48	1.41
D1668F	0.000	17.8	01Jan2000, 06:48	
D1669	0.386	18.8	01Jan2000, 07:15	0.62
D1670F	0.370	23.7	01Jan2000, 05:20	0.80
D1671	0.802	60.0	01Jan2000, 05:38	0.99
D1671F	0.000	69.8	01Jan2000, 05:38	
DC01	1.529	92.8	01Jan2000, 06:49	0.93
DCR1	1.529	92.8	01Jan2000, 08:13	0.93
Delaware Creek	2.181	145.2	01Jan2000, 07:19	1.04
HJC01	2.713	366.9	01Jan2000, 06:14	1.80
HJC02	1.658	257.6	01Jan2000, 05:34	2.01
HJC03	0.673	115.5	01Jan2000, 05:11	2.18
HJCR1	2.713	366.9	01Jan2000, 06:53	1.80
HJCR2	1.658	257.6	01Jan2000, 06:27	2.01
HJCR3	0.673	115.5	01Jan2000, 05:42	2.18
Howard Johnson Ditch	3.163	407.4	01Jan2000, 06:50	1.73
J1619	0.668	65.8	01Jan2000, 05:43	1.38
J1623	0.540	30.4	01Jan2000, 07:22	0.88
J1628	0.456	64.9	01Jan2000, 05:53	1.96

J1630	0.887	70.3	01Jan2000, 07:41	1.30
J1633	0.458	38.6	01Jan2000, 06:26	1.23
J1634	0.334	36.6	01Jan2000, 04:36	1.38
J1635	0.796	166.0	01Jan2000, 04:15	2.34
J1636	0.652	61.1	01Jan2000, 05:23	1.30
J1637	0.726	49.1	01Jan2000, 06:52	1.03
J1638	0.803	43.7	01Jan2000, 06:45	0.83
J1640	1.009	99.5	01Jan2000, 07:55	1.55
J1643	0.985	142.4	01Jan2000, 05:27	1.89
J1644	1.055	113.2	01Jan2000, 05:21	1.47
J1646	0.484	56.5	01Jan2000, 05:17	1.59
J1649	0.528	60.6	01Jan2000, 05:18	1.54
J1651	0.663	96.6	01Jan2000, 05:09	1.87
J1653	0.779	74.6	01Jan2000, 05:43	1.26
J1654	0.644	58.6	01Jan2000, 05:05	1.86
J1655	0.931	57.2	01Jan2000, 08:07	0.85
J1656	1.366	163.8	01Jan2000, 06:16	1.99
J1658	0.767	77.5	01Jan2000, 05:17	2.08
J1659	1.528	166.7	01Jan2000, 05:38	1.90
J1661	1.220	104.7	01Jan2000, 08:08	1.52
J1662	0.672	97.7	01Jan2000, 07:04	2.20
J1663	1.498	148.8	01Jan2000, 06:45	1.68
J1664	0.777	113.8	01Jan2000, 04:55	1.84
J1665	1.741	165.8	01Jan2000, 06:27	1.97
J1666	1.025	110.3	01Jan2000, 07:30	2.04
J1667	0.698	61.2	01Jan2000, 06:44	1.19
J1668	1.052	98.4	01Jan2000, 06:58	1.93
J1669	0.386	21.8	01Jan2000, 07:15	0.72
J1671	0.802	68.8	01Jan2000, 07:08	2.20
Payne Branch	2.358	233.9	01Jan2000, 07:46	1.50
PB01	1.900	197.6	01Jan2000, 07:03	1.57
PBR1	1.900	197.6	01Jan2000, 08:00	1.57
R1619	0.668	18.4	01Jan2000, 05:43	0.39
R1623	0.540	21.0	01Jan2000, 07:22	0.61
R1628	0.456	23.4	01Jan2000, 05:53	0.71
R1630	0.887	10.6	01Jan2000, 07:40	0.20
R1633	0.458	5.0	01Jan2000, 06:26	0.16
R1634	0.334	14.6	01Jan2000, 04:36	0.55

R1635	0.796	106.3	01Jan2000, 04:15	1.49
R1636	0.652	31.2	01Jan2000, 05:23	0.66
R1637	0.726	41.8	01Jan2000, 06:53	0.88
R1638	0.803	28.0	01Jan2000, 06:45	0.53
R1640	1.009	11.9	01Jan2000, 07:55	0.19
R1643	0.985	15.7	01Jan2000, 05:27	0.21
R1644	1.055	15.8	01Jan2000, 05:21	0.21
R1646	0.484	7.9	01Jan2000, 05:17	0.22
R1649	0.528	27.3	01Jan2000, 05:18	0.69
R1651	0.663	66.6	01Jan2000, 05:09	1.29
R1653	0.779	36.6	01Jan2000, 05:43	0.62
R1654	0.644	15.8	01Jan2000, 10:32	0.71
R1654F	0.000	13.6	01Jan2000, 10:18	
R1655	0.931	29.1	01Jan2000, 08:07	0.43
R1656	1.366	43.1	01Jan2000, 06:15	0.44
R1656F	0.000	27.3	01Jan2000, 11:56	
R1657F	0.227	6.4	01Jan2000, 09:08	0.60
R1658	0.767	25.0	01Jan2000, 05:13	0.42
R1658F	0.000	34.7	01Jan2000, 10:56	
R1659	1.528	114.4	01Jan2000, 08:29	1.29
R1659F	0.000	13.7	01Jan2000, 11:17	
R1660F	0.014	1.1	01Jan2000, 08:38	2.24
R1661	1.220	33.1	01Jan2000, 10:44	0.52
R1661F	0.000	8.8	01Jan2000, 12:14	
R1662	0.672	40.0	01Jan2000, 07:05	0.90
R1663	1.498	77.1	01Jan2000, 06:44	0.74
R1663F	0.000	31.9	01Jan2000, 11:46	
R1664	0.777	103.5	01Jan2000, 04:55	1.67
R1665	1.741	94.7	01Jan2000, 09:54	1.08
R1665F	0.000	33.4	01Jan2000, 11:59	
R1666	1.025	68.0	01Jan2000, 07:28	1.04
R1666F	0.000	23.0	01Jan2000, 13:21	
R1667	0.698	45.9	01Jan2000, 06:44	0.89
R1668	1.052	70.7	01Jan2000, 10:37	1.41
R1668F	0.000	9.1	01Jan2000, 12:23	
R1669	0.386	18.8	01Jan2000, 07:15	0.62
R1670F	0.370	12.0	01Jan2000, 10:18	0.80
R1671	0.802	38.6	01Jan2000, 09:35	0.99

Global Summary Results for Run "2yr24HrFuture1RR10%"

Project: CBBEL Crooked& Williams Simulation Run: 2yr24HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 24 hr 10%
Compute Time: 23Jun2010, 14:40:50 Control Specifications: Frequency Control

Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
R1668F	0.000	9.1	01Jan2000, 12:23	
R1669	0.386	18.8	01Jan2000, 07:15	0.62
R1670F	0.370	12.0	01Jan2000, 10:18	0.80
R1671	0.802	33.6	01Jan2000, 09:35	0.99
R1671F	0.000	27.7	01Jan2000, 11:51	
SMR01	1.723	170.8	01Jan2000, 07:12	1.69
SMRR2	1.723	170.8	01Jan2000, 10:20	1.69
Spring Mill Run	2.502	217.7	01Jan2000, 09:28	1.56
WC01	20.902	1661.5	01Jan2000, 13:47	1.70
WC02	19.885	1634.8	01Jan2000, 12:58	1.72
WC03	18.622	1605.8	01Jan2000, 11:35	1.74
WC04	17.512	1560.2	01Jan2000, 10:41	1.75
WC05D	16.497	1496.1	01Jan2000, 10:15	1.74
WC05U	13.995	1282.9	01Jan2000, 10:26	1.78
WC06	13.351	1240.3	01Jan2000, 09:46	1.77
WC07	11.054	1067.7	01Jan2000, 09:11	1.82
WC08D	10.684	1042.1	01Jan2000, 08:28	1.84
WC08U	9.019	906.5	01Jan2000, 08:29	1.88
WC09	8.252	841.4	01Jan2000, 07:38	1.87

Print Close

Global Summary Results for Run "2yr24HrFuture1RR10%"

Project: CBBEL Crooked& Williams Simulation Run: 2yr24HrFuture1RR10%

Start of Run: 01Jan2000, 00:00 Basin Model: CW 2030CN & det.1
End of Run: 03Jan2000, 00:00 Meteorologic Model: 2 year / 24 hr 10%
Compute Time: 28Jun2010, 14:40:50 Control Specifications: Frequency Control

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
WC09	8.252	841.4	01Jan2000, 07:38	1.87
WC10	6.710	678.7	01Jan2000, 07:40	1.86
WC11	4.818	478.0	01Jan2000, 06:30	1.89
WC12	2.543	234.2	01Jan2000, 06:37	2.04
WC13	0.802	68.8	01Jan2000, 07:08	2.20
WCR1	20.902	1661.5	01Jan2000, 14:30	1.70
WCR10	6.710	678.68.8	01Jan2000, 07:46	1.86
WCR11	4.818	478.0	01Jan2000, 07:47	1.89
WCR12	2.543	234.2	01Jan2000, 08:18	2.04
WCR13	0.802	68.8	01Jan2000, 08:18	2.20
WCR2	19.865	1534.8	01Jan2000, 13:56	1.72
WCR3	18.622	1605.8	01Jan2000, 13:04	1.74
WCR4	17.512	1560.2	01Jan2000, 11:37	1.75
WCR5	16.497	1496.1	01Jan2000, 10:42	1.74
WCR6	13.351	1240.3	01Jan2000, 10:30	1.77
WCR7	11.054	1067.7	01Jan2000, 10:01	1.82
WCR8	10.684	1042.1	01Jan2000, 09:11	1.84
WCR9	8.252	841.4	01Jan2000, 08:41	1.87
Williams Creek	21.252	1665.8	01Jan2000, 14:30	1.70

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APPENDIX 5

Digital Files

For a copy of the digital files contained in Appendix 5 please contact the Hamilton County Surveyor's Office:

Hamilton County Surveyor's Office
One Hamilton County Square, Suite 188
Noblesville, IN 46060
317-776-8495
surveyor@hamiltoncounty.in.gov

List of digital files:
- DNR Data
- HMS
- RAS_HusseyDr
- RAS_SMRoadTribVer4_0
- Shapefiles
- WCApprovedRAS

APPENDIX 6

Selected Pages from Culvert Design Report, West 146th Street Added Travel Lanes

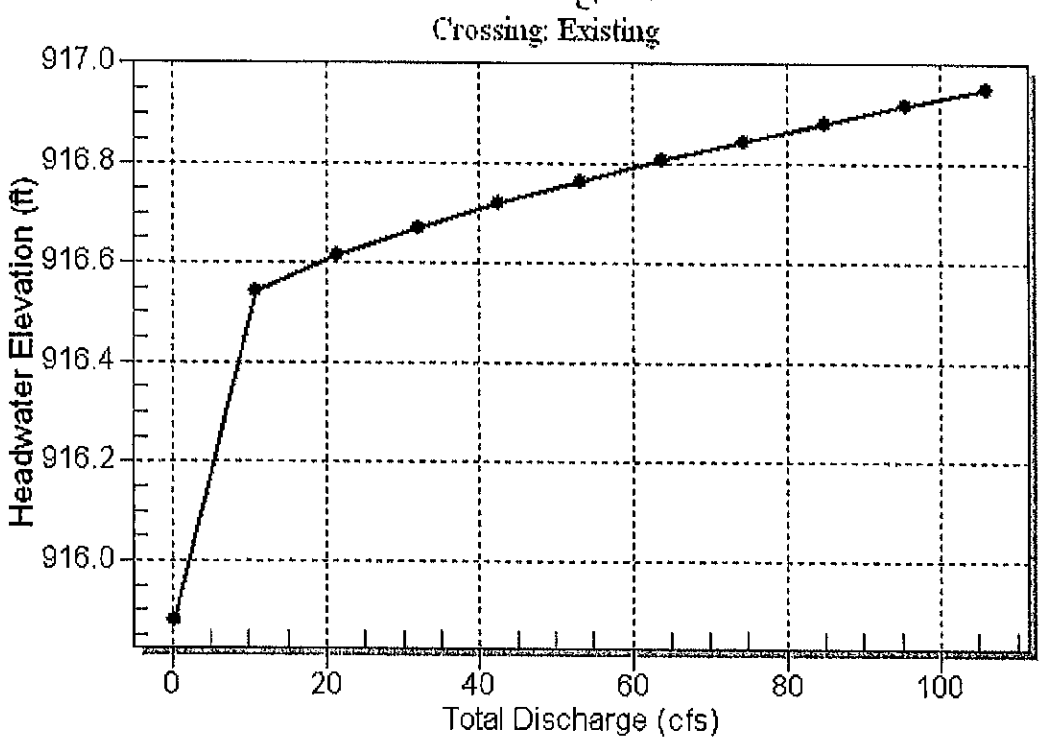
EXHIBIT 24
HY-8 REPORT
Existing Culvert 180+09 "A"

Designed: BSC 3/19/09
Checked: RAG 3/19/09

Table 1 - Summary of Culvert Flows at Crossing

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert Discharge (cfs)	Roadway Discharge (cfs)	Iterations
915.88	0.00	0.00	0.00	1
916.54	10.58	6.03	4.50	19
916.61	21.16	6.35	14.60	5
916.67	31.74	6.59	24.92	4
916.72	42.32	6.80	35.43	4
916.77	52.90	6.98	45.66	3
916.81	63.48	7.14	56.19	3
916.85	74.06	7.28	66.70	3
916.88	84.64	7.42	77.19	3
916.92	95.22	7.55	87.36	2
916.95	105.80	7.67	97.88	2
916.48	5.74	5.74	0.00	Overtopping

Rating Cnrve Plot for Crossing



Designed: BSC 3/9/09
Checked: RAG 3/9/09

DISCHARGES FOR NODE C1
CULVERT 222+08 "PR-A"

Distribution Type	Design Frequency (years)	Duration (hrs)	Rainfall Depth (in)	Discharge (cfs)	HydroCAD Name
Huff 2nd Quartile - Indianapolis	10	0.25	1.17	9.98	Huff2-010-15m
Huff 2nd Quartile - Indianapolis	10	0.50	1.63	24.55	Huff2-010-30m
Huff 2nd Quartile - Indianapolis	10	1.00	2.07	42.61	Huff2-010-01hr
Huff 2nd Quartile - Indianapolis	10	2.00	2.46	55.75	Huff2-010-02hr
Huff 2nd Quartile - Indianapolis	**10**	**3.00**	**2.62**	**58.39**	Huff2-010-03hr
Huff 2nd Quartile - Indianapolis	10	6.00	3.11	52.28	Huff2-010-06hr
Huff 2nd Quartile - Indianapolis	10	12.00	3.60	42.27	Huff2-010-12hr
Huff 2nd Quartile - Indianapolis	10	24.00	4.15	29.75	Huff2-010-24hr
Huff 2nd Quartile - Indianapolis	50	0.25	1.34	19.04	Huff2-050-15m
Huff 2nd Quartile - Indianapolis	50	0.50	1.89	45.40	Huff2-050-30m
Huff 2nd Quartile - Indianapolis	50	1.00	2.45	78.48	Huff2-050-01hr
Huff 2nd Quartile - Indianapolis	50	2.00	2.95	101.66	Huff2-050-02hr
Huff 2nd Quartile - Indianapolis	**50**	**3.00**	**3.16**	**104.59**	Huff2-050-03hr
Huff 2nd Quartile - Indianapolis	50	6.00	3.76	92.89	Huff2-050-06hr
Huff 2nd Quartile - Indianapolis	50	12.00	4.30	71.08	Huff2-050-12hr
Huff 2nd Quartile - Indianapolis	50	24.00	4.89	45.21	Huff2-050-24hr
Huff 2nd Quartile - Indianapolis	100	0.25	1.60	23.64	Huff2-100-15m
Huff 2nd Quartile - Indianapolis	100	0.50	2.31	55.94	Huff2-100-30m
Huff 2nd Quartile - Indianapolis	100	1.00	3.09	96.63	Huff2-100-01hr
Huff 2nd Quartile - Indianapolis	100	2.00	3.79	125.67	Huff2-100-02hr
Huff 2nd Quartile - Indianapolis	**100**	**3.00**	**4.09**	**128.87**	Huff2-100-03hr
Huff 2nd Quartile - Indianapolis	100	6.00	4.91	114.25	Huff2-100-06hr
Huff 2nd Quartile - Indianapolis	100	12.00	5.51	85.57	Huff2-100-12hr
Huff 2nd Quartile - Indianapolis	100	24.00	6.11	52.52	Huff2-100-24hr
SCS Type II	10	24.00	3.83	85.87	SCS-010
SCS Type II	50	24.00	5.52	157.54	SCS-050
SCS Type II	100	24.00	6.46	199.25	SCS-100

INDOT discharge peaks are shown in **bold**.

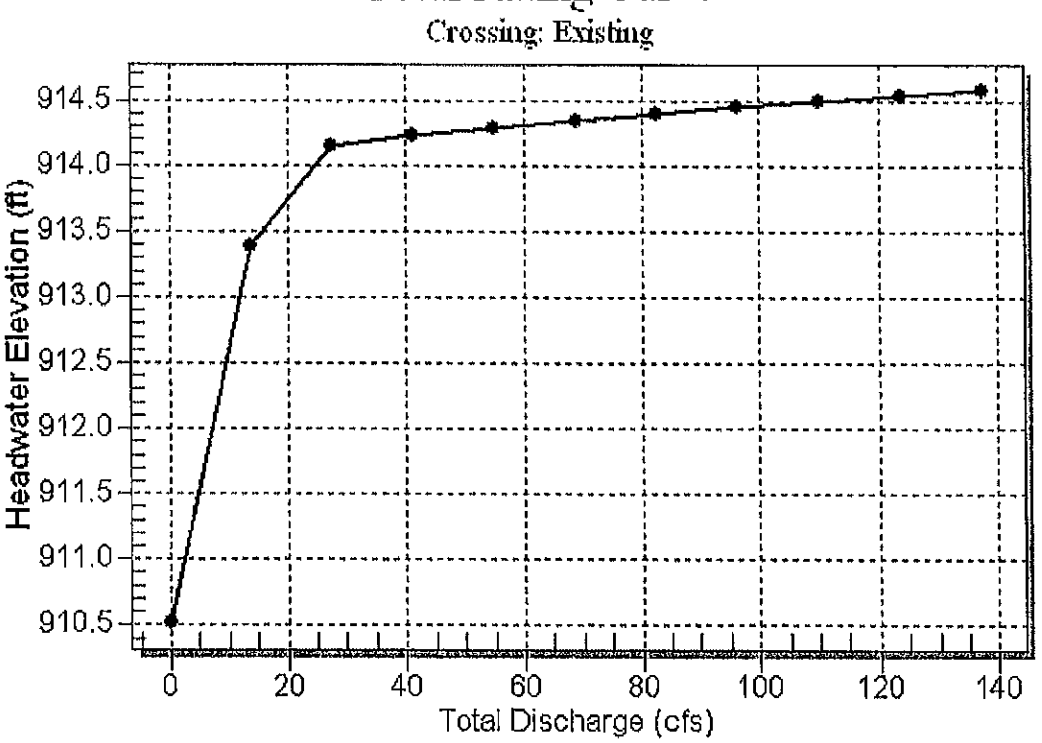
EXHIBIT 39
HY-8 REPORT
Drainage Basin D – Station 198+59"A"
Existing 21-inch C.M.P

Designed: BSC 2/21/09
Checked: RAG 2/21/09

Table 1 - Summary of Culvert Flows at Crossing

Headwater Elevation (ft)	Total Discharge (cfs)	21" CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
910.52	0.00	0.00	0.00	1
913.38	13.74	13.74	0.00	1
914.15	27.48	16.31	11.01	10
914.23	41.22	16.55	24.51	5
914.29	54.96	16.75	38.02	4
914.35	68.70	16.93	51.69	4
914.40	82.44	17.09	65.11	3
914.45	96.18	17.24	78.81	3
914.49	109.92	17.38	92.48	3
914.54	123.66	17.51	106.12	3
914.58	137.40	17.63	119.42	2
914.04	15.95	15.95	0.00	Overtopping

Rating Curve Plot for Crossing



Designed: BSC 3/11/09
Checked: RAG 3/11/09

DISCHARGES FOR NODE C6
CULVERT 205+60 "PR-A"

Distribution Type	Design Frequency (years)	Duration (hrs)	Rainfall Depth (in)	Discharge (cfs)	HydroCAD Name
Huff 2nd Quartile - Indianapolis	10	0.25	1.17	10.48	Huff2-010-15m
Huff 2nd Quartile - Indianapolis	10	0.50	1.63	23.53	Huff2-010-30m
Huff 2nd Quartile - Indianapolis	10	1.00	2.07	39.13	Huff2-010-01hr
Huff 2nd Quartile - Indianapolis	10	2.00	2.46	43.20	Huff2-010-02hr
Huff 2nd Quartile - Indianapolis	10	3.00	2.62	38.75	Huff2-010-03hr
Huff 2nd Quartile - Indianapolis	10	6.00	3.11	34.97	Huff2-010-06hr
Huff 2nd Quartile - Indianapolis	10	12.00	3.60	29.42	Huff2-010-12hr
Huff 2nd Quartile - Indianapolis	10	24.00	4.15	20.42	Huff2-010-24hr
Huff 2nd Quartile - Indianapolis	50	0.25	1.34	18.92	Huff2-050-15m
Huff 2nd Quartile - Indianapolis	50	0.50	1.89	44.00	Huff2-050-30m
Huff 2nd Quartile - Indianapolis	50	1.00	2.45	72.19	Huff2-050-01hr
Huff 2nd Quartile - Indianapolis	**50**	**2.00**	**2.95**	**77.56**	Huff2-050-02hr
Huff 2nd Quartile - Indianapolis	50	3.00	3.16	69.15	Huff2-050-03hr
Huff 2nd Quartile - Indianapolis	50	6.00	3.76	63.34	Huff2-050-06hr
Huff 2nd Quartile - Indianapolis	50	12.00	4.30	48.85	Huff2-050-12hr
Huff 2nd Quartile - Indianapolis	50	24.00	4.89	30.90	Huff2-050-24hr
Huff 2nd Quartile - Indianapolis	100	0.25	1.60	23.11	Huff2-100-15m
Huff 2nd Quartile - Indianapolis	100	0.50	2.31	54.37	Huff2-100-30m
Huff 2nd Quartile - Indianapolis	100	1.00	3.09	88.95	Huff2-100-01hr
Huff 2nd Quartile - Indianapolis	**100**	**2.00**	**3.79**	**95.67**	Huff2-100-02hr
Huff 2nd Quartile - Indianapolis	100	3.00	4.09	85.75	Huff2-100-03hr
Huff 2nd Quartile - Indianapolis	100	6.00	4.91	78.18	Huff2-100-06hr
Huff 2nd Quartile - Indianapolis	100	12.00	5.51	58.56	Huff2-100-12hr
Huff 2nd Quartile - Indianapolis	100	24.00	6.11	35.84	Huff2-100-24hr
SCS Type II	10	24.00	3.83	73.65	SCS-010
SCS Type II	25	24.00	4.72	106.28	SCS-025
SCS Type II	50	24.00	5.52	136.94	SCS-050
SCS Type II	100	24.00	6.46	173.93	SCS-100

INDOT discharge peaks are shown in **bold**.

Designed: BSC 1/19/09
Checked: PJG 1/19/09

EXHIBIT 1 - CULVERT SUMMARY SHEET

Culvert		Existing Structure							Proposed Structure									
Station	Line	Size and Type	Drainage Area acres	INDOT Q_{100} cfs	Headwater El. ft	Backwater HW ft	Overtopping cfs	Size and Type	Drainage Area acres	INDOT Q_{100} cfs	INDOT Headwater HW El.	INDOT Backwater HW ft	Hamilton County Design Storm Frequency	Hamilton County Q_{100} cfs	Hamilton County Headwater HW El.	Overtopping cfs	Notes
181+60	"PR-A"	-	-	-	-	-	-	4' x 7' Precast Box	137.77	112.78	913.88	See Notes	Q_{100}	111.85	913.88	375.51	BW stays within R/W
211+41	"S-3-A"	12" CMP	161.87	39.50	915.84	2.29	4.31	4' x 7' Precast Box	137.39	104.22	914.07	0.87	Q_{100}	179.29	916.10	180.33	
205+80	"PR-A"	-	-	-	-	-	-	3' x 9' Precast Box	116.17	95.87	914.90	See Notes	Q_{100}	173.93	916.18	250.19	BW stays within R/W
216+00	"PR-A"	12" CMP	4.75	11.90	916.75	2.35	122.93	18" Circular Pipe	4.75	4.16	916.47	0.87	Q_{100}	20.24	919.44	61.77	
30+21	"PR-B-S-2"	18" CMP	112.60	106.80	915.95	1.72	3.54	3' x 9' Precast Box	71.58	81.07	916.24	0.38	Q_{25}	96.70	917.16	241.10	
38+00	"S-2-A"	12" CMP	48.37	43.00	917.30	2.04	1.24	54" x 38" Deformed Pipe	47.67	31.65	917.34	0.85	Q_{25}	55.85	918.49	158.13	
12+00	"S-1-A"	-	-	-	-	-	-	18" x 29" Deformed Pipe	19.22	24.12	917.59	See Notes	Q_{25}	32.51	917.43	83.39	BW stays within R/W
222+08	"PR-A"	22" CMP	150.61	137.40	914.53	2.35	16.95	93" x 58" Deformed Pipe	175.94	138.57	915.28	1.15	Q_{100}	140.35	919.54	425.64	

Culverts and Ditches
At and West of OF Henley Drain

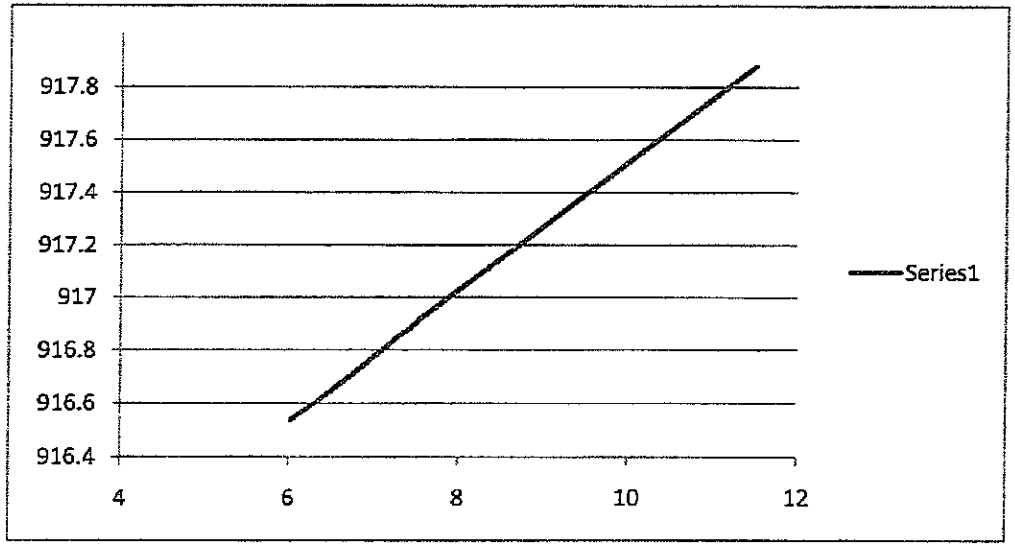
OF Henley Legal Drain crosses W. 146th Street at Station 222+08 "PR-A". As part of this project, Hamilton County plans to improve approximately 2,200 feet of OF Henley Drain south of the roadway to Saddle Creek Subdivision. Preliminary calculations for the channel size are provided to model the proposed culvert. Hamilton County will construct a storm sewer carrying the 10-year storm event to the detention basin in Saddle Creek subdivision with an overflow ditch to carry the 100-year storm event. Since Hamilton County will construct the legal drain according to the post detention amounts, those calculations will be submitted for review with the detention calculations at the Stage 2 plan submittal.

Existing Drainage Areas F & G (as shown in Exhibit 8) currently discharge into culverts that are either completely or partially buried at both ends, causing frequent flooding. These drainage areas enter OF Henley Drain south of 146th Street. Surrounding contours would require the road to be raised to replace these culverts in place. Hamilton County has directed BLN to route these watersheds in the roadside ditches to the culvert at Station 222+08 "PR-A". Because of the large acreage conveyed, a 100-year storm event will be used to design these ditches in accordance with the Hamilton County Stormwater Management Technical Standards Manual. Stability calculations for Q_{100} ditches are performed according to the requirements of the Indiana Design Manual (IDM) Section 38-5.05.

Station	DA, Ac.	culvert capacity just before overtopping	subwatershed Q10 (Huff)	subwatershed Q100 (Huff)	0-10-yr default release rate discharge	10-100-yr default release rate discharge
222+08 PR-A	175.9 (with addtl proposed road condition area added due to elimnating 2 other culverts	16 cfs	58 cfs	129 cfs	17.6 cfs	52.8 cfs
214+00 PR-A	4.75*					
205+60 PR-A	119.2	11 cfs (based on use of data for other 18" culvert calculations at 2 ft depth before overtops)	39 cfs	96 cfs	11.9	35.38

* small percent of DA so ignore for these purposes

915.88	0
916.54	6.03
916.61	6.35
916.67	6.59
916.72	6.8
916.77	6.98
916.81	7.14
916.85	7.28
916.88	7.42
916.92	7.55
917.88	11.5



11.5 found by trial until in line w/ other calculated values

APPENDIX 7

Williams Creek Hydraulic Analysis

WILLIAMS CREEK HYDRAULIC ANALYSIS

Prepared for:

Hamilton County Surveyors Office
1 Hamilton County Square Suite 188
Noblesville, IN 46060

January 2010

Prepared by

Christopher B. Burke Engineering, Ltd.
115 W. Washington St., Suite 1368-South
Indianapolis, Indiana 46204

CBBEL Project Number 07-760

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6. Location of Roads and Residences Impacted By The 1% Annual Chance Flood

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3. Existing Condition HEC-RAS Model Input/Output (Standard Table 1, Encroachment Table 1, Cross Section Plots)
4. Disc with Hydraulic Model
5. Check RAS Output, IDNR Project Evaluation Table and Hydraulic Modeling Checklist

1.0 INTRODUCTION

This report documents the results of a Christopher B. Burke Engineering, Ltd. (CBBEL) hydraulic analysis of Williams Creek, through Hamilton County, Indiana. The analysis was completed to determine base flood elevations (BFEs) and to delineate the floodway limits based on detailed-study methodology. The effective Special Flood Hazard Area for Williams Creek is currently shown as Zone AE and Unstudied on the Hamilton County Flood Insurance Rate Map (FIRM) which has a latest published date of February 19, 2003.

The study area is located in the southwest corner of Hamilton County, Indiana as shown on **Exhibit 1.** The study reach of Williams Creek begins at the Hamilton-Marion County line and extends approximately 9 miles to the downstream face of 156th Street.

This report presents the results of the CBBEL analysis and serves as support documentation for a Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS). The analysis was performed based on the "FEMA Guidelines and Specifications for Flood Hazard Mapping Partners" and also "General Guidelines for the Hydrologic-Hydraulic Assessment of Floodplains in Indiana" (Guidelines) published by the IDNR. The report also includes a revised delineation of flood hazard areas, proposed floodway data tables, and proposed flood profiles.

2.0 HYDRAULIC ANALYSIS

2.1 INTRODUCTION

This section of the report presents the modeling developed to support the floodplain and floodway delineation through the study reach. A copy of the Hamilton County 1-foot contour mapping showing Williams Creek and the location of model cross-sections is provided as **Exhibit 2.** The existing model of the studied portion of Williams Creek was developed using E-431. In order to maintain consistency in the data and modeling methodology, a completely new hydraulic model was developed to analyze the stream, as explained below.

2.2 HEC-RAS INPUT DATA

The hydraulic analysis developed for this FIS was completed using the U.S. Army Corps of Engineers' HEC-RAS computer program, version 3.1.3. The nature and source of information that was used to develop the model of this reach of Williams Creek is provided below.

2.2.1 Topographic Work Map

CBBEL used the 1-foot contour interval topographic map (2004) provided by Hamilton County as the base map for existing conditions. The vertical datum for the mapping is NAVD 1988. A copy of the map, showing the location and orientation of cross sections used in the hydraulic modeling is provided as Exhibit 2.

2.2.2 Study Reach

The study reach for Williams Creek starts at Model Section 0.030 (upstream face of 96th Street) and continues upstream approximately 9 miles to Model Section 9.022 (Downstream face of 156th Street). Due to the inability to accurately model drop inlet control structures in HEC-RAS, upstream of Model Section 8.551 was mapped using data from plans for the Centennial residential development provided by Schneider Corporation. Additional cross sections downstream of section 0.030 were imported from the Marion County model and were used to insure a smooth transition between the two models.

2.2.3 Flow Data

Flow data used for the simulation of the 10-, 50-, 100-, and 500-Year storm events were from the Coordinate Discharge Graph for Williams Creek provided by IDNR.

The discharge curve, dated April 2008, is presented in **Appendix 1**. **Table 1** summarizes the discharges used in this hydraulic model.

Table 1
Peak Discharges Used in the Williams Creek Hydraulic Model

			Recurrence Interval (Years)			
			10	50	100	500
HEC-RAS Cross Section Reach	Location	Drainage Area (mi^2)	Peak Discharge (cfs)			
9.022-8.744	156th Street	0.43	84	141	167	256
8.658-7.917	DS of Liberty Rd	0.80	140	240	292	433
7.797-7.325	US of 146th Street	1.78	270	466	570	841
7.288-5.470	US 141st Street	2.54	362	621	753	1110
5.422-3.977	Henley Creek	4.82	614	1050	1280	1890
3.871	Almond Ditch	6.71	807	1390	1690	2500
3.785-2.652	Elliot Creek	8.25	957	1650	2000	2960
2.584-1.277	Clay Creek	10.68	1180	2040	2480	3680
1.198-0.962	Simon Dam	12.36	1350	2300	2800	4150
0.856-0.110	Unnamed Tributary	14.54	1500	2550	3100	4600
0.030-0.0001	96th Street	16.50	1660	2860	3480	5160

2.2.4 Starting Water Surface Elevation

The starting water surface elevation for the 10-, 50-, 100-, and 500-year storm events were taken from the Marion County model of Williams Creek done by CBBEL and approved by IDNR in 2009. A copy of the output for the Marion County model that was used can be found in **Appendix 2**.

2.2.5 Cross Section Geometric Data

Cross-section geometric data was taken directly from the topographic base map described above. In-water channel inverts were estimated by field measurements and interpolated slopes between known elevations on the topographic base map. Full valley plots of the cross sections for Williams Creek are provided in **Appendix 3**. All cross sections were aligned to best represent a perpendicular orientation to flow.

2.2.6 Manning's Roughness Coefficients

Manning's roughness coefficients through the study reach range from 0.05 to 0.08 for the overbanks and 0.04 to 0.055 for the channel along Williams Creek. The Manning's roughness coefficients were determined from the color aerial photography and a site visit by CBBEL staff on April 22, 2009.

2.2.7 Calibration

There are high water marks for 1961 and 1969 storm events, but no associated flow data. The high water marks were mostly in the channel as well.

2.2.8 Ineffective Flow and Blocked Obstructions

Ineffective flow limits were added to model sections at appropriate locations based on contraction and expansion from flow obstructions such as upstream or downstream topography or bridges. Cross section-specific comments presenting justification for any ineffective flow limits and/or blocked obstructions are contained in the hydraulic model.

2.2.9 Bridges

Eleven bridges exist within the study reach limits.

2.2.10 Culverts

Eight culverts exist within the study reach limits.

2.2.11 Critical Depths

Three instances of BFEs with critical depths were calculated in the model. Cross sections 7.985 and 8.380 are both open channel spillways for ponds so the rapid elevation change and velocity change from broad lake to narrow channel causes the critical depth. Cross section 8.162 is an inlet into a pond. An attempt was made to mitigate this rapid change by increasing the Manning's N values for the impacted

cross sections but critical depth remained. Other variations in the Manning's N, interpolated cross sections and ineffective flow areas were also investigated but were unable to resolve the issue most likely due to the angle with which the stream enters the pond and the severity of the difference between the flow areas.

2.2.12 Floodway

A maximum of 0.14-foot surcharge floodway was determined for the 100-year profile in accordance with IDNR modeling guidelines. The floodway was defined using the equal conveyance option, Method 4, then importing to Method 1 and revised to obtain a reasonable floodway.

2.3 FINAL RESULTS OF HYDRAULIC ANALYSIS

Utilizing the input data described in Section 2.2, a HEC-RAS Existing Conditions Model of Williams Creek was developed using current topographic data. A copy of the Existing Conditions Model input/output is included as Appendix 3. A disc with digital copies of the model, cross sections, and the floodplain mapping shapefiles is provided as **Appendix 4.**

The CHECK-RAS program was run for the Existing Conditions HEC-RAS model. The CHECK-RAS output for the model is provided as **Appendix 5**. The output has been annotated with remarks to explain some of the messages. Additionally, a completed IDNR Project Evaluation Table and Hydraulic Modeling Checklist can also be found in Appendix 5.

The limits of the HEC-RAS floodplain and floodway were delineated on the base map (1" = 300') provided in Exhibit 2 and is also included on the annotated DFIRM map in **Exhibit 3.** A copy of the proposed FIS Flood Profile and Floodway Data Table are provided as **Exhibit 4** and **Exhibit 5**, respectively.

Roads that were found to overtop in the 1% annual chance flood and residences that would potentially be flooded, based on the Hamilton County one foot contour mapping, are shown in **Exhibit 6**. A shapefile of the impacted areas is located on the disc in Appendix 4 with the floodplain and floodway files.

3.0 REFERENCES

Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), Hamilton County, Indiana, effective date February 19, 2003.

Hamilton County. 1-foot contour interval topography and spot elevations. Dated 2004 NAVD 1988

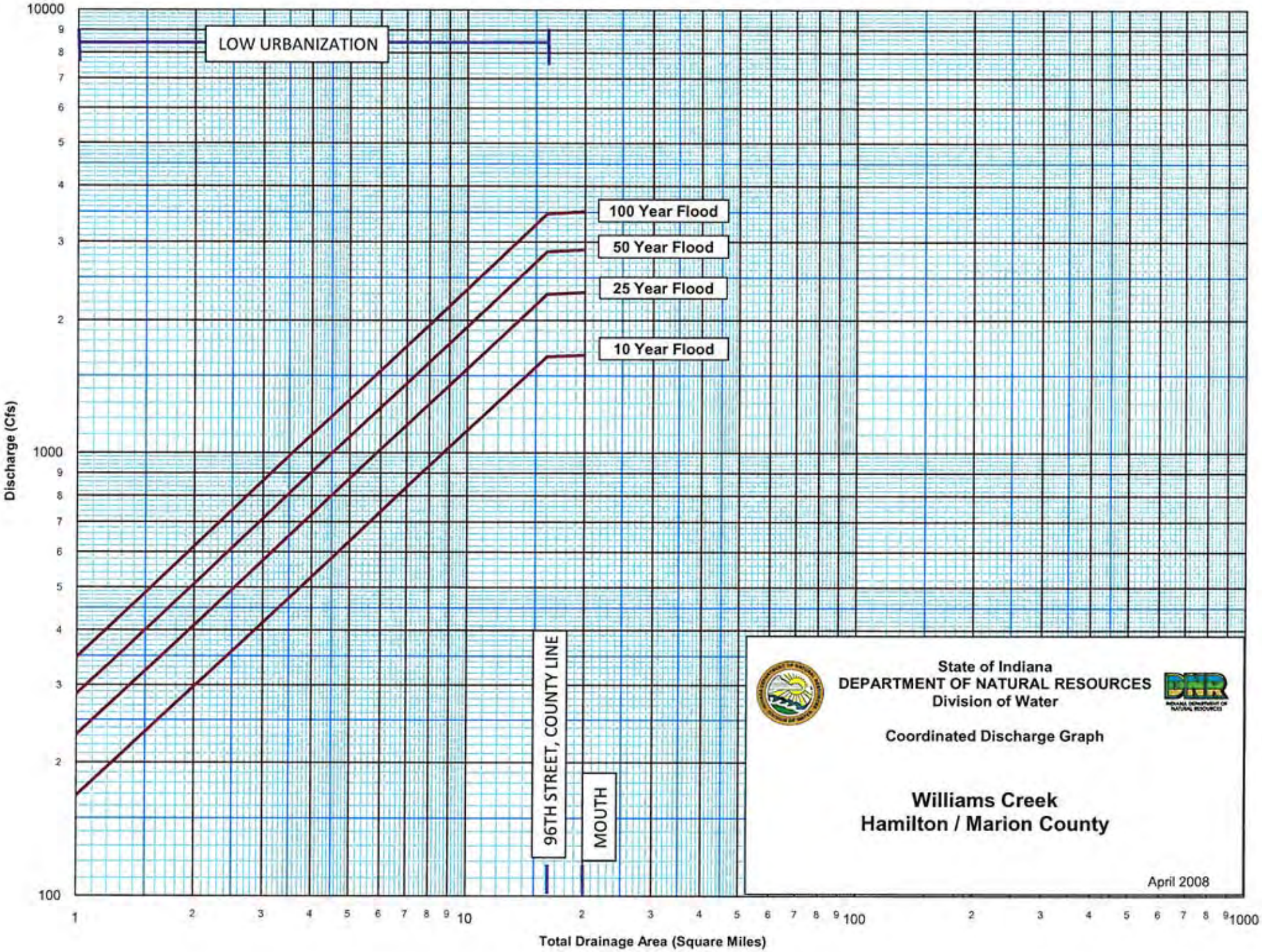
General Guidelines for the Hydrologic-Hydraulic Assessment of Floodplains in Indiana, IDNR 2002

Guidelines and Specifications for Flood Hazard Mapping Partners - Volume 1

Aerial Photography, 2005 Indiana Orthophotography (IndianaMap Framework Data, www.indianamap.org)

APPENDIX 1

IDNR Coordinated Curve


LOW URBANIZATION
100 Year Flood
50 Year Flood
25 Year Flood
10 Year Flood
96TH STREET, COUNTY LINE
MOUTH
Discharge (Cfs)
Total Drainage Area (Square Miles)
10000
1000
100
1
10
100
1000
State of Indiana
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Coordinated Discharge Graph
Williams Creek
Hamilton / Marion County
April 2008

APPENDIX 2

Starting Water Surface Elevations From Marion County Model

HEC-RAS Plan: WmsCrkFP-D08 River: River_wc Reach: Williams Cr

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Williams Cr	5.459	1660.00	784.28	791.73		791.92	0.001882	3.57	500.56	156.77	0.32
Williams Cr	5.459	2860.00	784.28	793.56		793.76	0.001523	3.80	906.76	360.76	0.30
Williams Cr	5.459	3470.00	784.28	794.32		794.51	0.001301	3.77	1342.85	670.26	0.28
Williams Cr	5.459	5160.00	784.28	796.09		796.20	0.000654	3.20	2595.19	745.71	0.21
Williams Cr	5.393	1660.00	783.44	791.17	787.45	791.34	0.001459	3.33	534.61	174.64	0.26
Williams Cr	5.393	2860.00	783.44	793.01	788.84	793.24	0.001401	4.01	824.59	274.19	0.27
Williams Cr	5.393	3480.00	783.44	793.75	789.42	794.01	0.001411	4.30	957.02	428.63	0.27
Williams Cr	5.393	5170.00	783.44	795.47	790.72	795.81	0.001435	4.96	1264.19	631.09	0.29
Williams Cr	5.382	Bridge									
Williams Cr	5.371	1660.00	783.10	790.64	787.36	790.90	0.002354	4.09	419.96	124.73	0.33
Williams Cr	5.371	2860.00	783.10	792.18	788.81	792.58	0.002624	5.18	613.47	380.12	0.36
Williams Cr	5.371	3480.00	783.10	792.73	789.44	793.21	0.002856	5.71	692.85	447.30	0.38
Williams Cr	5.371	5170.00	783.10	793.88	790.88	794.59	0.003539	7.03	859.01	550.98	0.43
Williams Cr	5.328	1660.00	782.45	789.85	787.51	790.18	0.004150	4.59	361.43	95.97	0.42
Williams Cr	5.328	2860.00	782.45	791.29	788.88	791.78	0.004493	5.62	516.75	138.58	0.45
Williams Cr	5.328	3480.00	782.45	791.76	789.45	792.35	0.004843	6.20	589.32	226.28	0.48
Williams Cr	5.328	5170.00	782.45	792.77	790.64	793.57	0.005425	7.38	847.54	448.41	0.52
Williams Cr	5.280	1660.00	781.72	789.13	786.53	789.38	0.002434	4.30	518.68	176.93	0.33
Williams Cr	5.280	2860.00	781.72	790.66	787.76	790.94	0.002336	4.85	903.24	419.26	0.34
Williams Cr	5.280	3480.00	781.72	791.19	788.70	791.47	0.002246	5.01	1104.74	490.31	0.34
Williams Cr	5.280	5170.00	781.72	792.34	789.73	792.63	0.002125	5.41	1546.11	515.90	0.34
Williams Cr	5.098	1660.00	778.93	786.86		787.12	0.002304	4.18	453.81	174.87	0.33
Williams Cr	5.098	2860.00	778.93	788.51		788.84	0.002153	4.87	809.51	292.31	0.33
Williams Cr	5.098	3480.00	778.93	789.07		789.41	0.002180	5.16	979.86	324.87	0.34
Williams Cr	5.098	5170.00	778.93	790.35		790.71	0.002071	5.60	1442.37	383.00	0.34
Williams Cr	4.974	1660.00	777.03	785.12	781.63	785.43	0.002919	4.50	369.08	75.65	0.36
Williams Cr	4.974	2860.00	777.03	786.51	783.31	787.02	0.003879	5.60	571.30	268.07	0.43
Williams Cr	4.974	3480.00	777.03	787.09	784.02	787.63	0.003812	6.13	723.54	289.32	0.43
Williams Cr	4.974	5170.00	777.03	788.26	785.58	788.97	0.004198	7.20	1081.33	473.22	0.46
Williams Cr	4.889	1670.00	775.73	783.30	780.78	783.80	0.004595	5.72	331.29	201.60	0.45
Williams Cr	4.889	2880.00	775.73	784.96	782.75	785.39	0.003369	5.93	742.28	238.29	0.41
Williams Cr	4.889	3510.00	775.73	785.64	783.65	786.07	0.003122	6.09	906.86	247.29	0.40
Williams Cr	4.889	5210.00	775.73	787.15	784.82	787.50	0.002320	5.95	1596.33	556.88	0.35
Williams Cr	4.731	1670.00	773.32	781.36	777.84	781.56	0.001594	3.60	487.24	126.68	0.27
Williams Cr	4.731	2880.00	773.32	783.24	779.13	783.52	0.001564	4.36	760.67	217.91	0.29
Williams Cr	4.731	3510.00	773.32	783.91	779.69	784.23	0.001645	4.74	904.38	240.58	0.30
Williams Cr	4.731	5210.00	773.32	785.46	780.96	785.87	0.001770	5.54	1213.16	561.45	0.32
Williams Cr	4.720	Bridge									
Williams Cr	4.708	1670.00	772.96	780.73	778.02	781.13	0.004751	5.05	330.63	83.30	0.45
Williams Cr	4.708	2880.00	772.96	782.52	779.70	783.01	0.004651	5.64	524.03	381.76	0.46
Williams Cr	4.708	3510.00	772.96	783.05	780.47	783.62	0.004781	6.13	607.55	458.12	0.47
Williams Cr	4.708	5210.00	772.96	784.15	781.97	784.95	0.005246	7.30	792.60	620.28	0.51
Williams Cr	4.628	1670.00	771.74	779.84	775.67	780.03	0.001415	3.54	489.46	104.30	0.26
Williams Cr	4.628	2880.00	771.74	781.49	777.10	781.81	0.001732	4.61	709.23	368.72	0.30
Williams Cr	4.628	3510.00	771.74	782.03	777.70	782.36	0.001751	4.86	1074.51	485.64	0.30
Williams Cr	4.628	5210.00	771.74	783.15	779.11	783.51	0.001849	5.45	1626.67	507.35	0.32
Williams Cr	4.510	1670.00	769.93	778.81		779.03	0.001861	3.92	525.46	153.40	0.29
Williams Cr	4.510	2880.00	769.93	780.34		780.65	0.002047	4.84	877.09	452.00	0.32
Williams Cr	4.510	3510.00	769.93	780.87		781.19	0.002083	5.13	1121.55	473.00	0.33
Williams Cr	4.510	5210.00	769.93	781.94		782.29	0.002206	5.76	1648.64	515.37	0.35
Williams Cr	4.317	1670.00	766.95	775.54		775.95	0.005578	5.15	324.15	89.08	0.48
Williams Cr	4.317	2880.00	766.95	777.23		777.66	0.004500	5.44	637.91	237.36	0.45
Williams Cr	4.317	3510.00	766.95	777.93		778.35	0.003920	5.46	812.68	256.97	0.42
Williams Cr	4.317	5210.00	766.95	779.83		780.11	0.002074	4.88	1617.74	439.39	0.32
Williams Cr	4.224	1670.00	765.52	774.53	771.47	774.64	0.001405	3.10	693.21	242.50	0.25

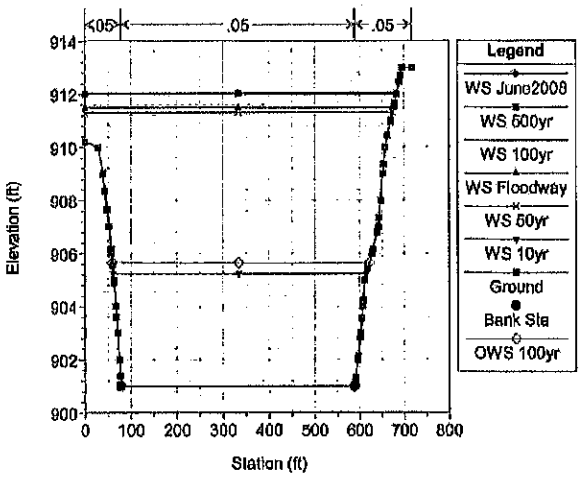
APPENDIX 3

EXISTING CONDITIONS HEC-RAS MODEL INPUT/OUTPUT

Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

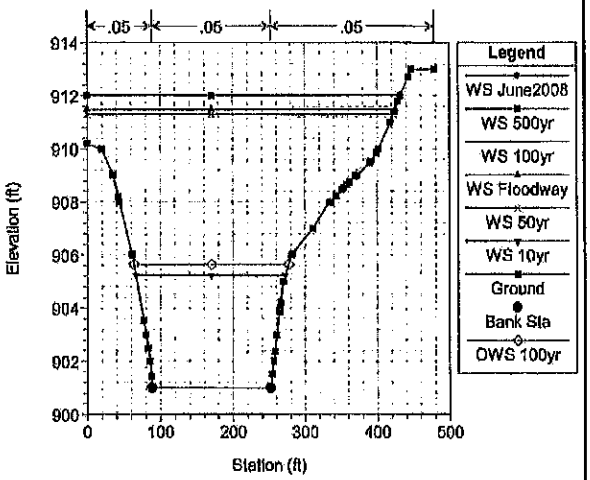
RS = 8.022



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

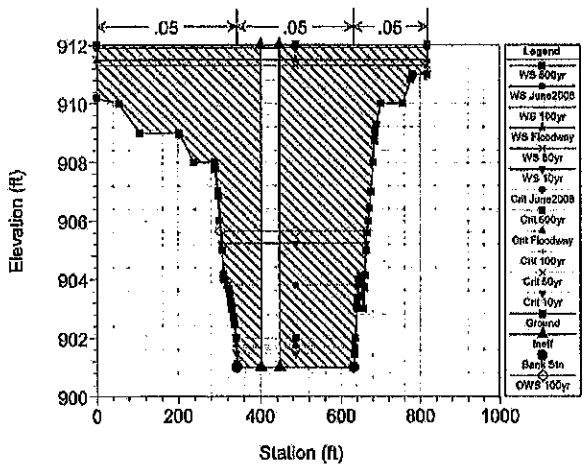
RS = 8.043



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

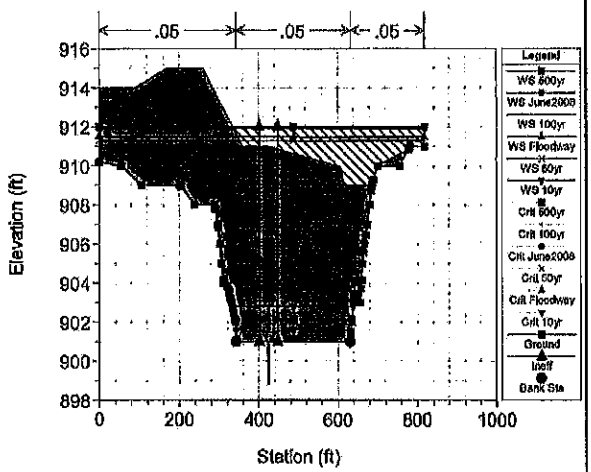
RS = 8.867



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

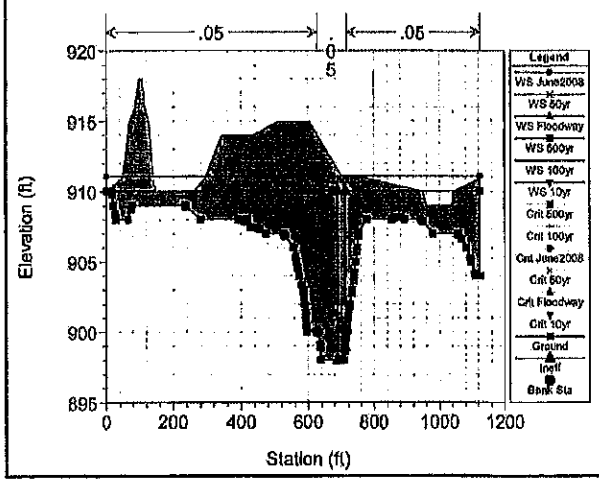
RS = 8.883 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

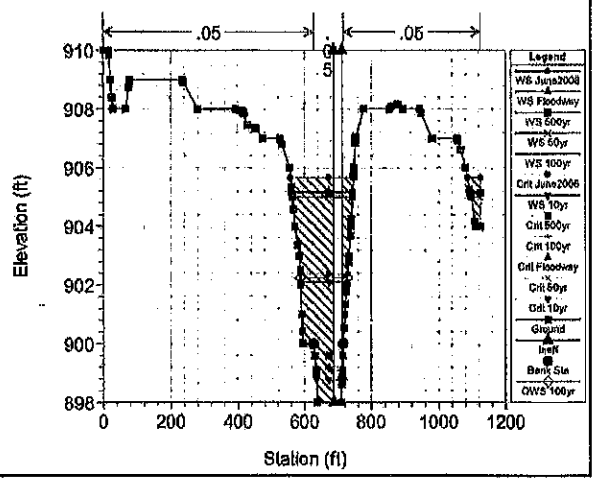
RS = 8.883 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

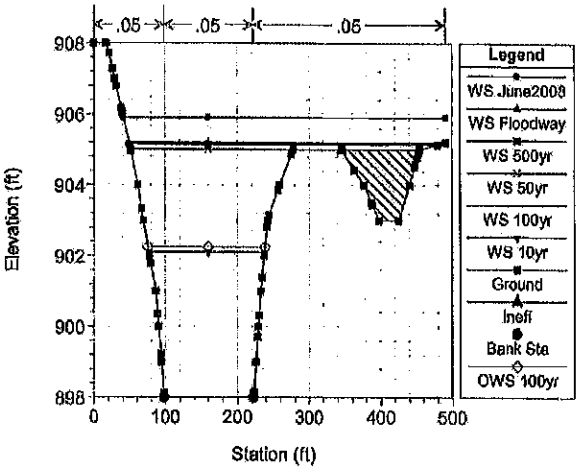
RS = 8.744



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

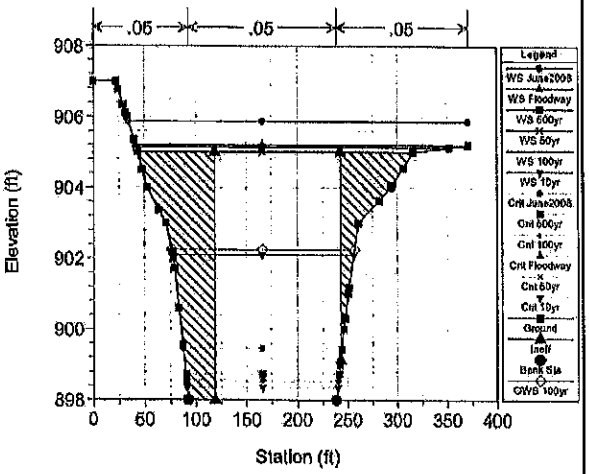
RS = 8.659



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

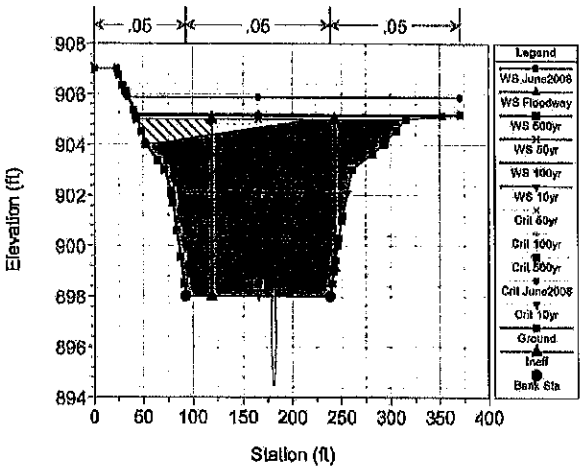
RS = 8.654



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

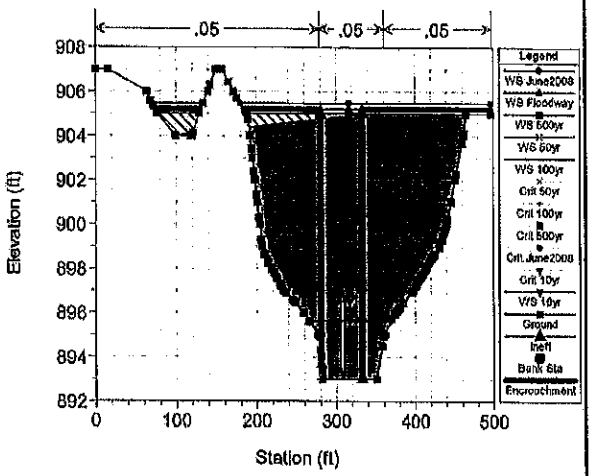
RS = 8.642 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

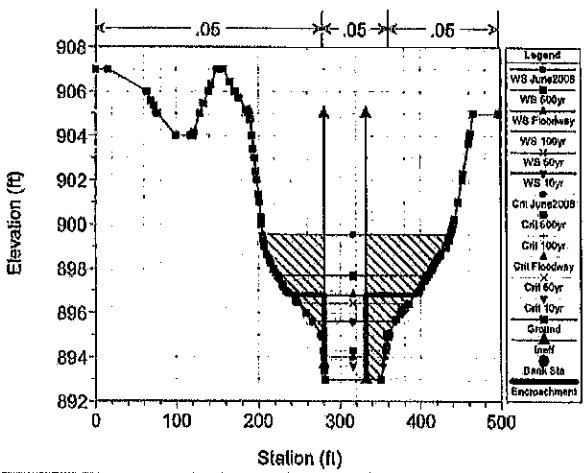
RS = 8.642 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

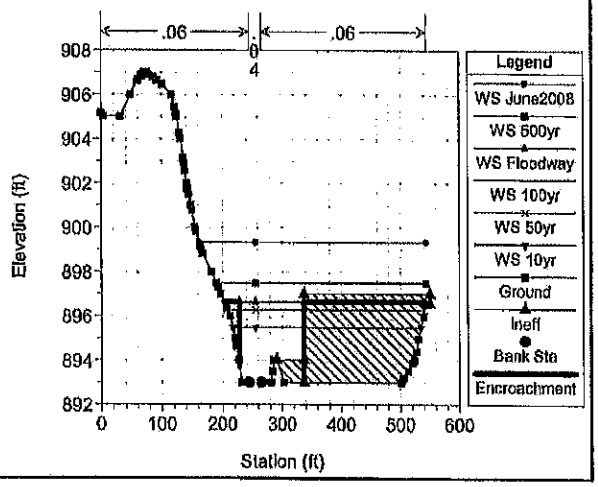
RS = 8.610



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

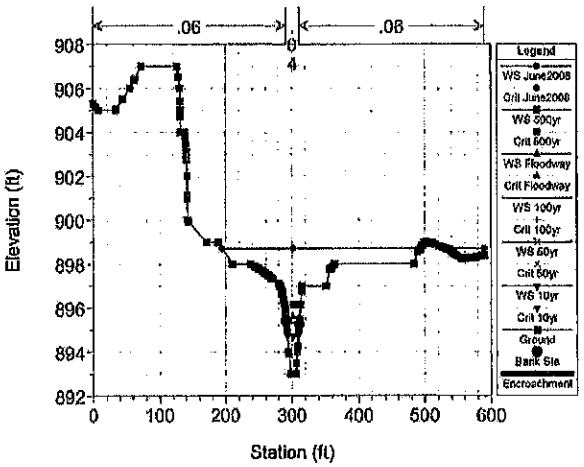
RS = 8.392



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

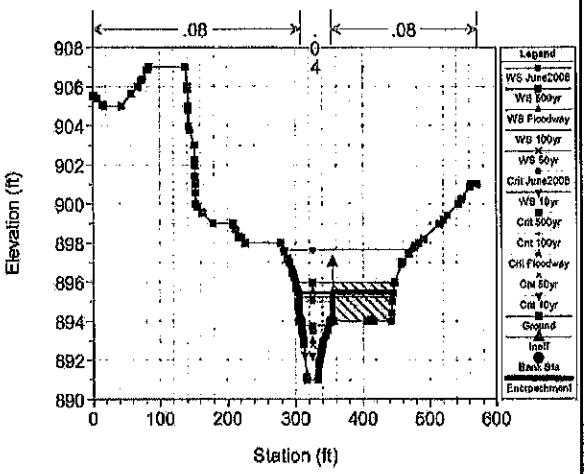
RS = 8.380



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

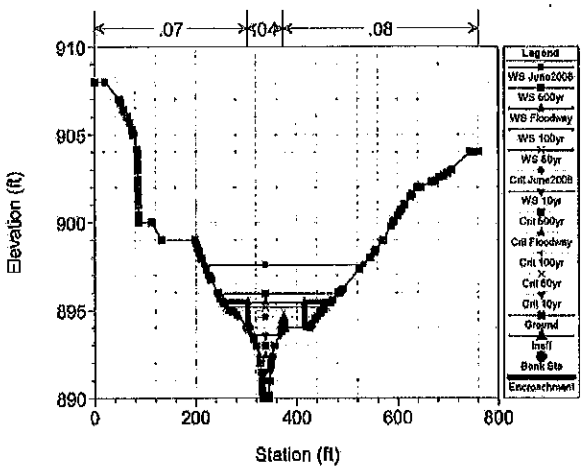
RS = 8.371



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

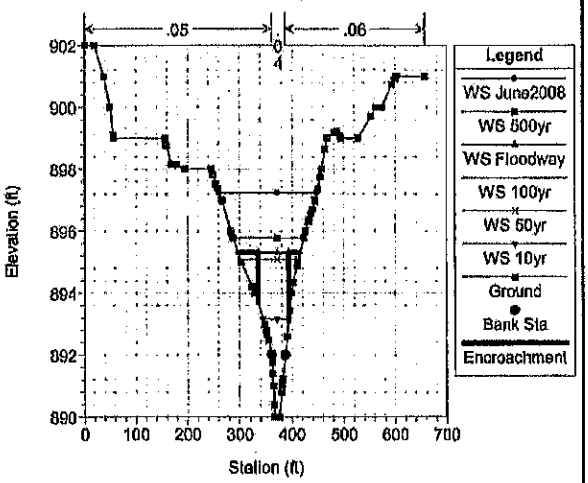
RS = 8.342



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

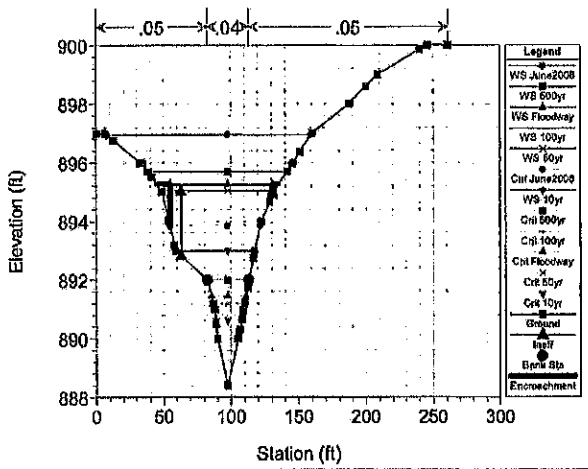
RS = 8.266



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

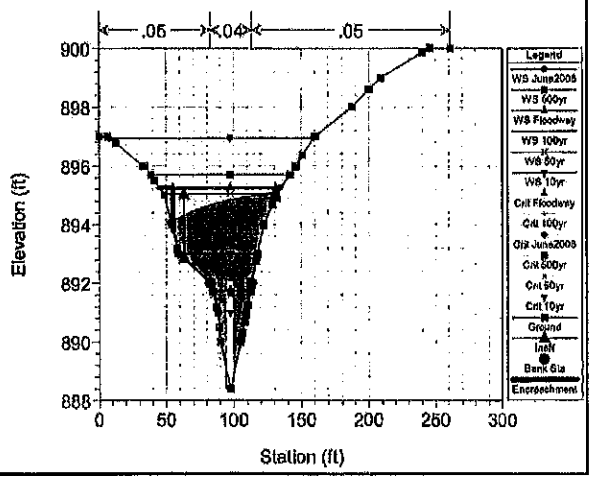
RS = 8.210



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

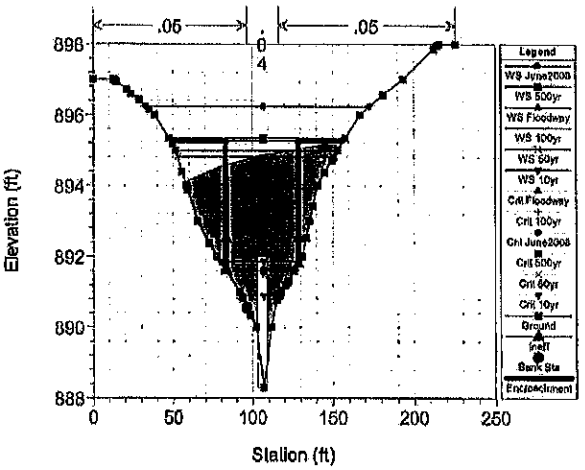
RS = 8.210 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

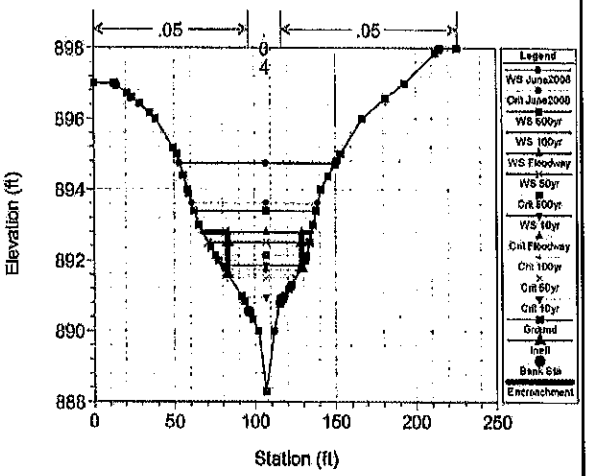
RS = 8.210 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

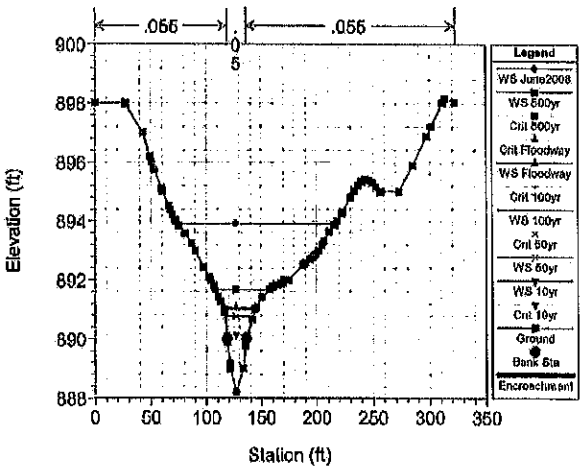
RS = 8.194



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

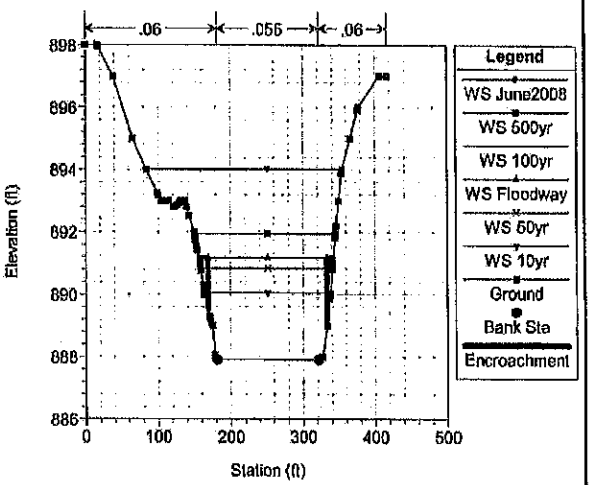
RS = 8.162



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

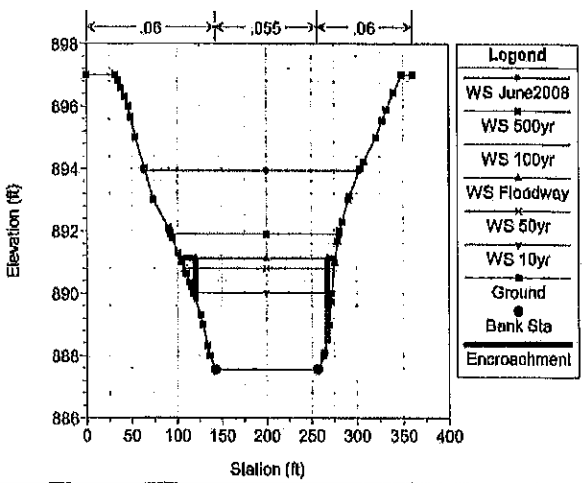
RS = 8.096



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

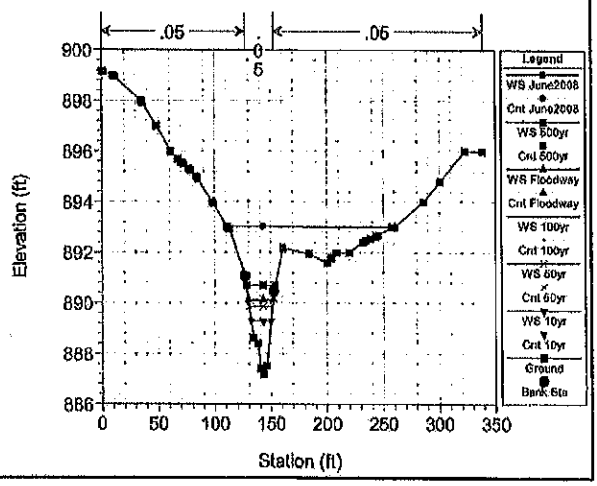
RS = 8.014



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

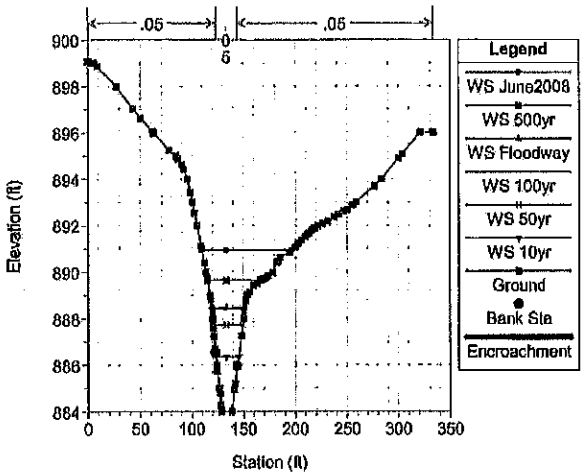
RS = 7.065



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

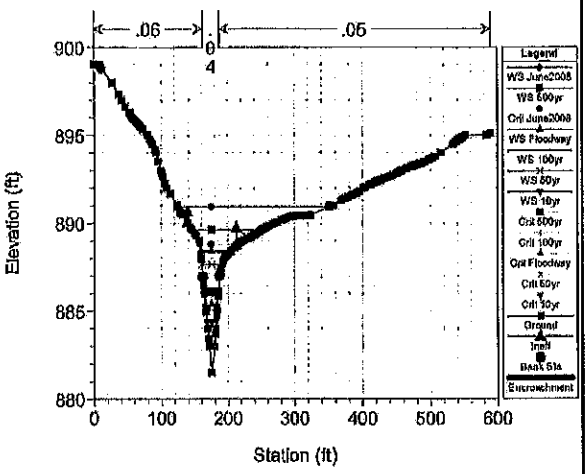
RS = 7 970



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

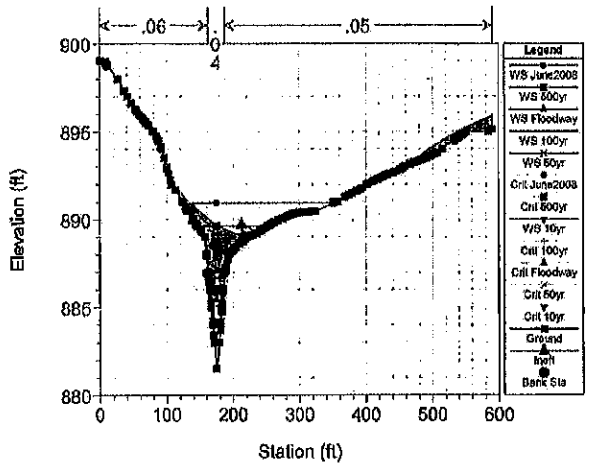
RS = 7 967



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

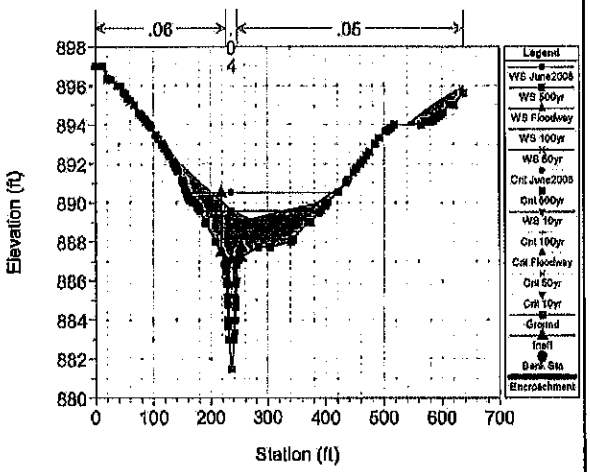
RS = 7 961 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

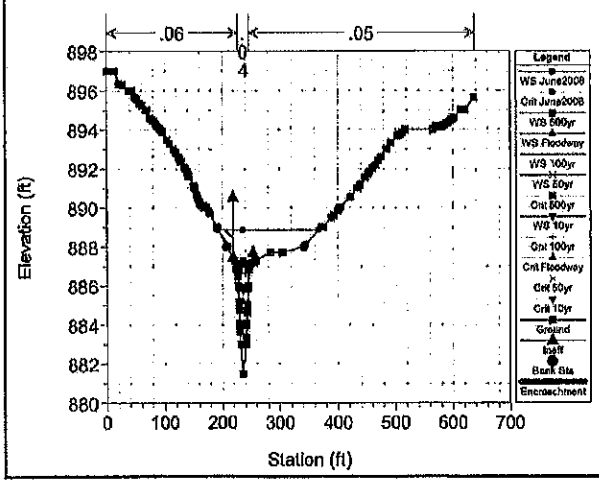
RS = 7 961 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

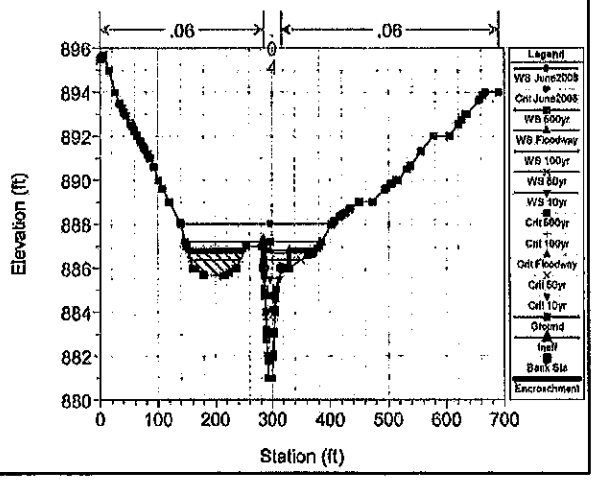
RS = 7 952



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

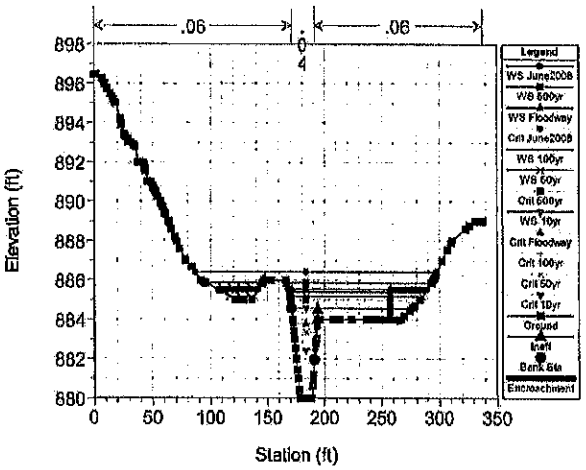
RS = 7 917



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

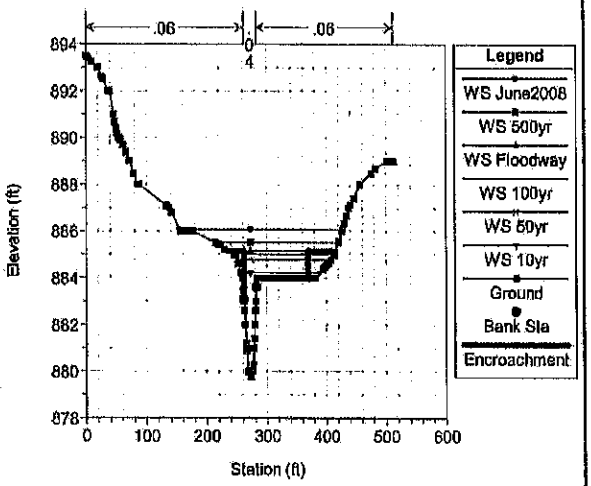
RS = 7 797



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

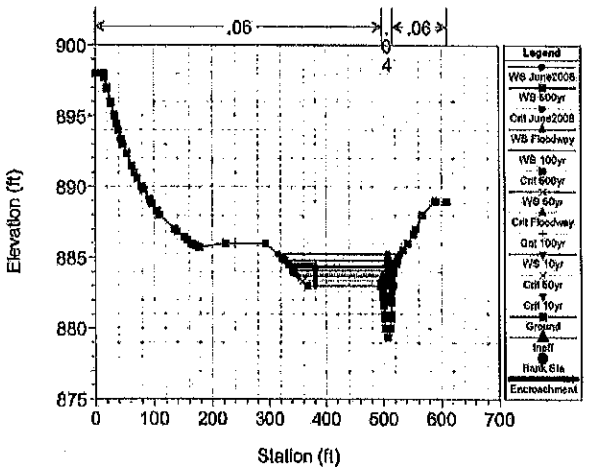
RS = 7 770



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

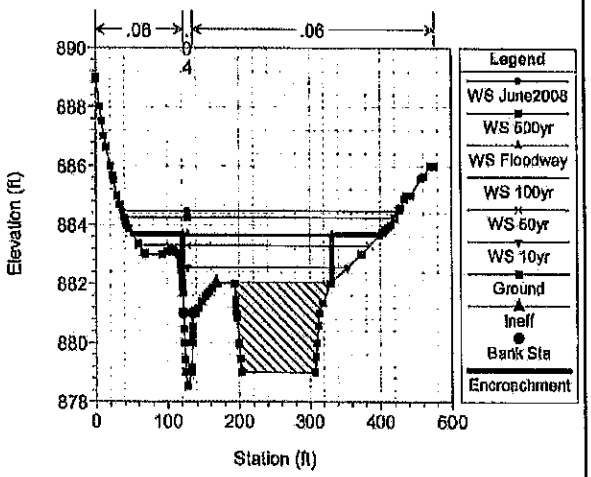
RS = 7 720



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

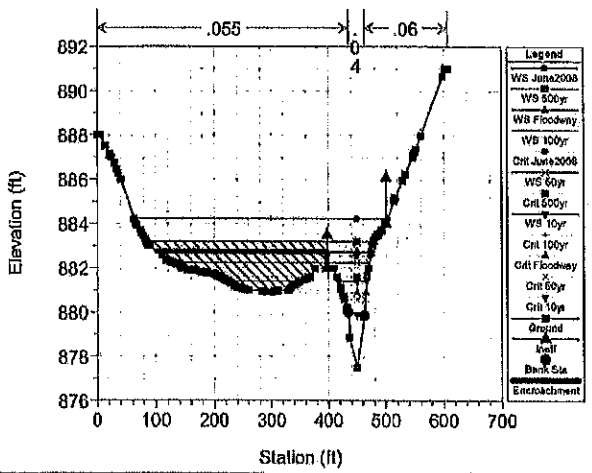
RS = 7 639



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

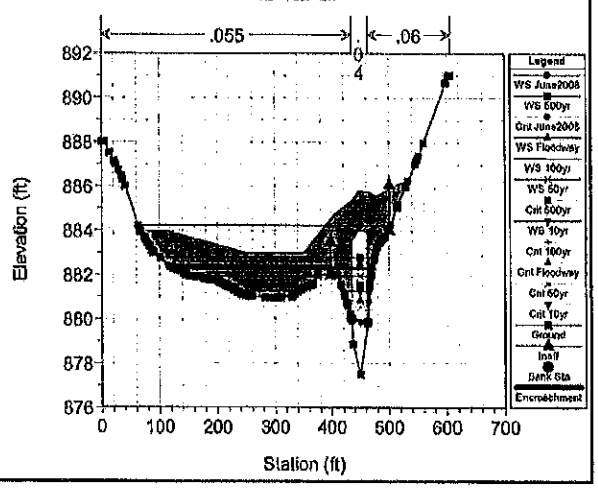
RS = 7 527



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

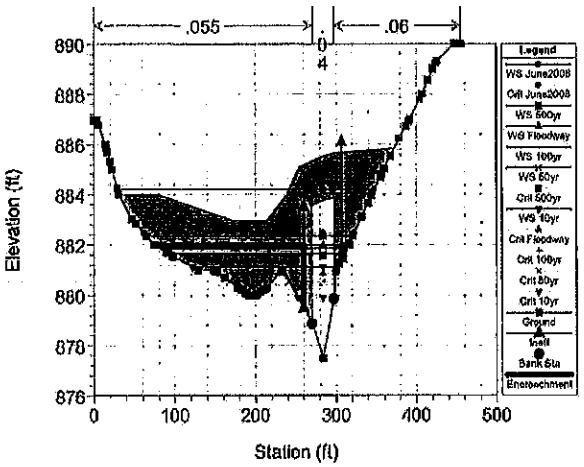
RS = 7 520 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

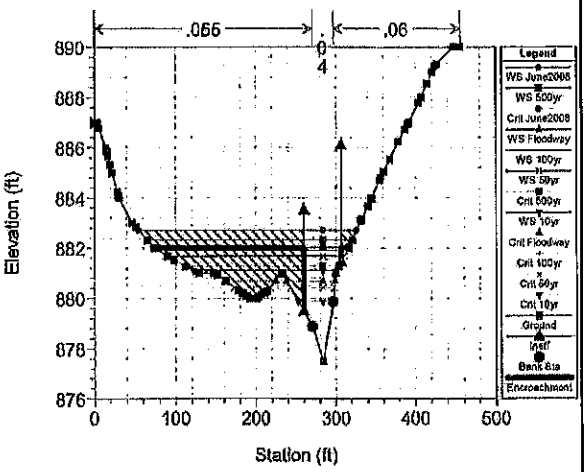
RS = 7.520 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

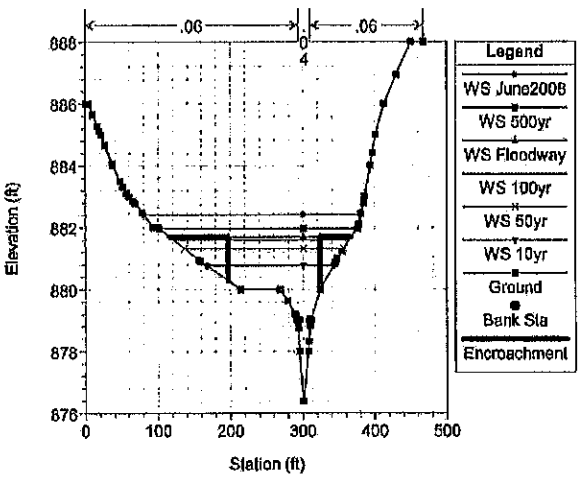
RS = 7.510



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

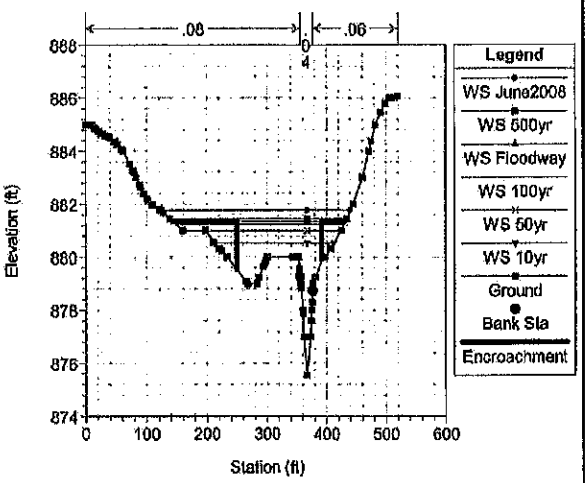
RS = 7.472



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

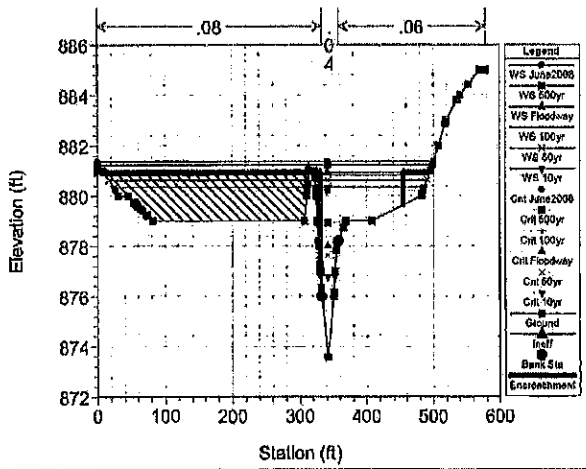
RS = 7.435



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

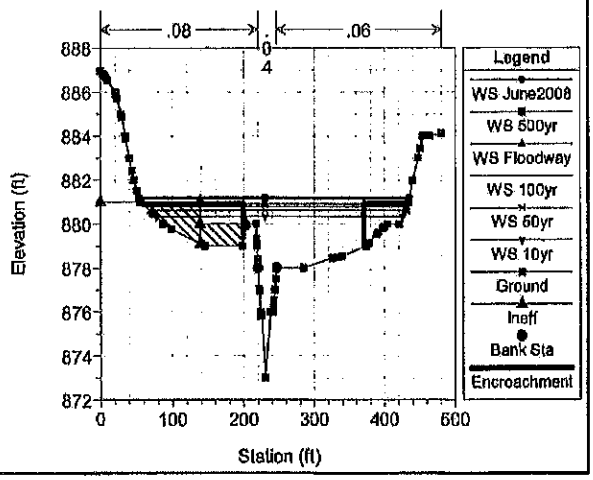
RS = 7.350



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

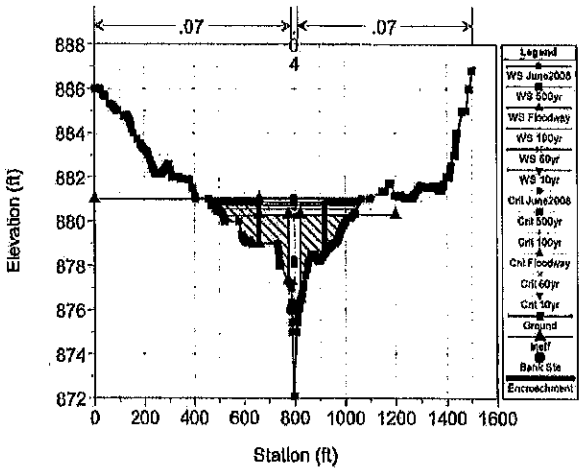
RS = 7.326



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(April 2008 curve)

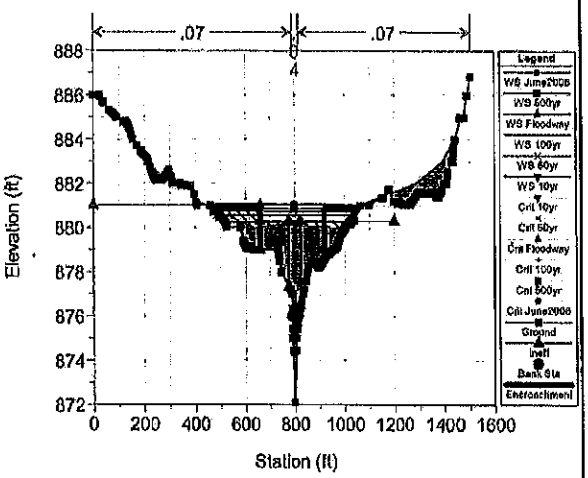
RS = 7.268



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(April 2008 curve)

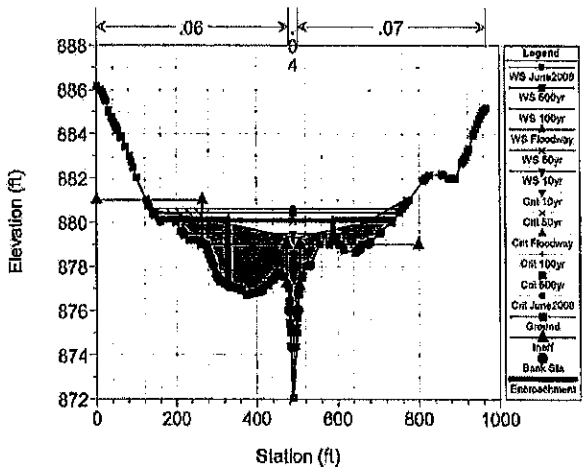
RS = 7.265 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(April 2008 curve)

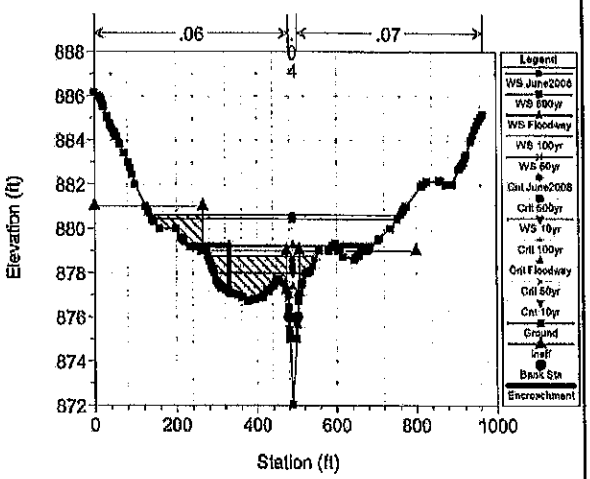
RS = 7.265 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(April 2008 curve)

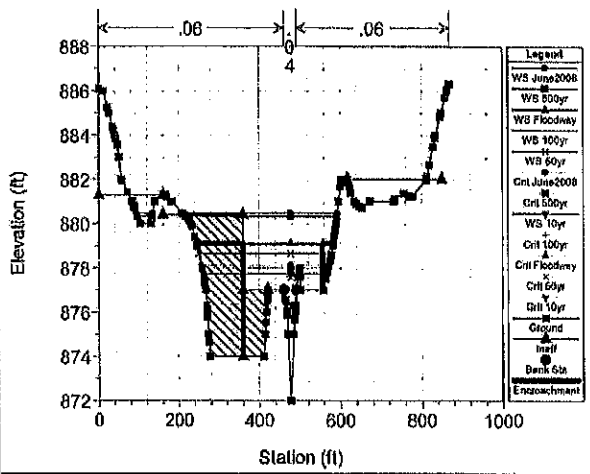
RS = 7.272



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(April 2008 curve)

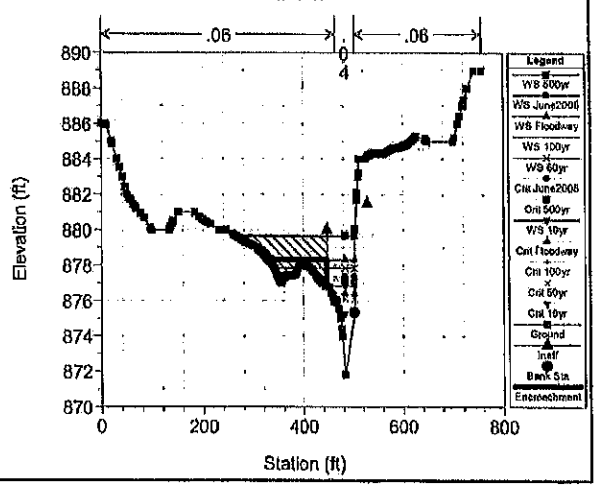
RS = 7.240

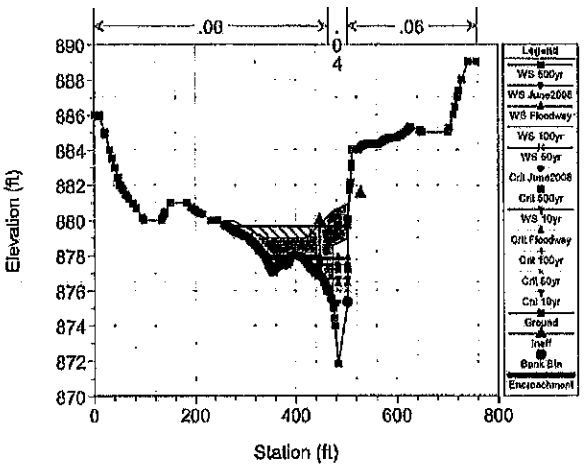


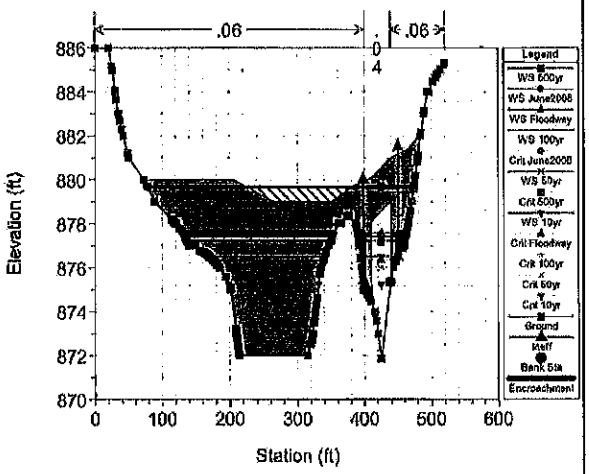
Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

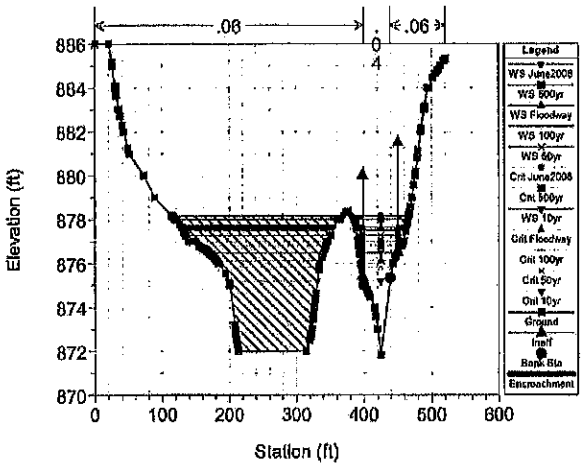
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(April 2008 curve)

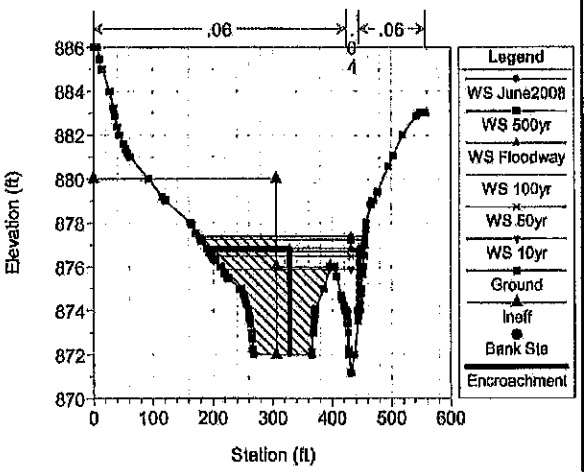
RS = 7.104

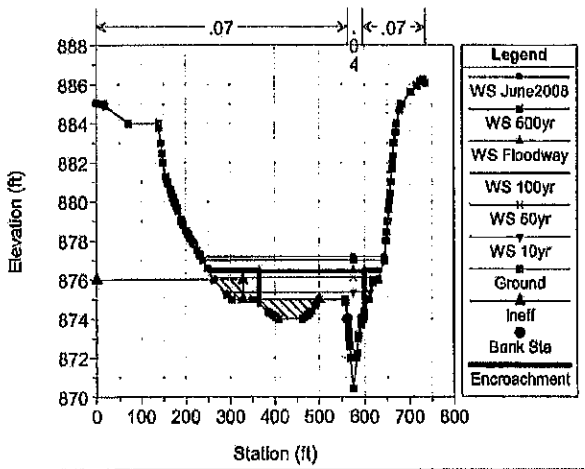


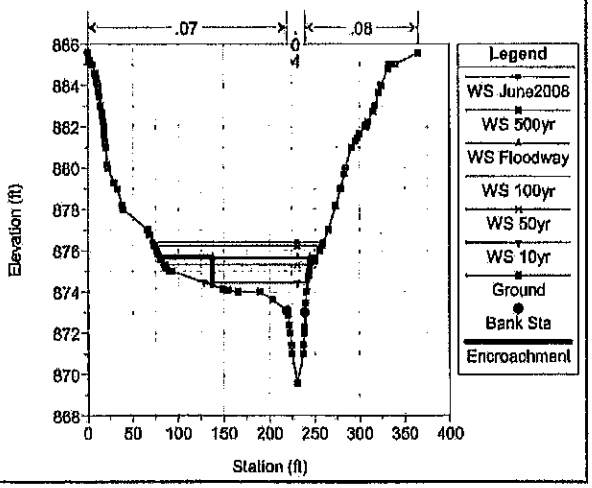

Elevation (ft)
Station (ft)
Legend
WS 500yr
WS June2008
WS Floodway
WS 100yr
WS 50yr
Crit June2008
Crit 500yr
WS 10yr
Crit Floodway
Crit 100yr
Crit 50yr
Crit 10yr
Ground
Ineff
Bank Sta
Encroachment

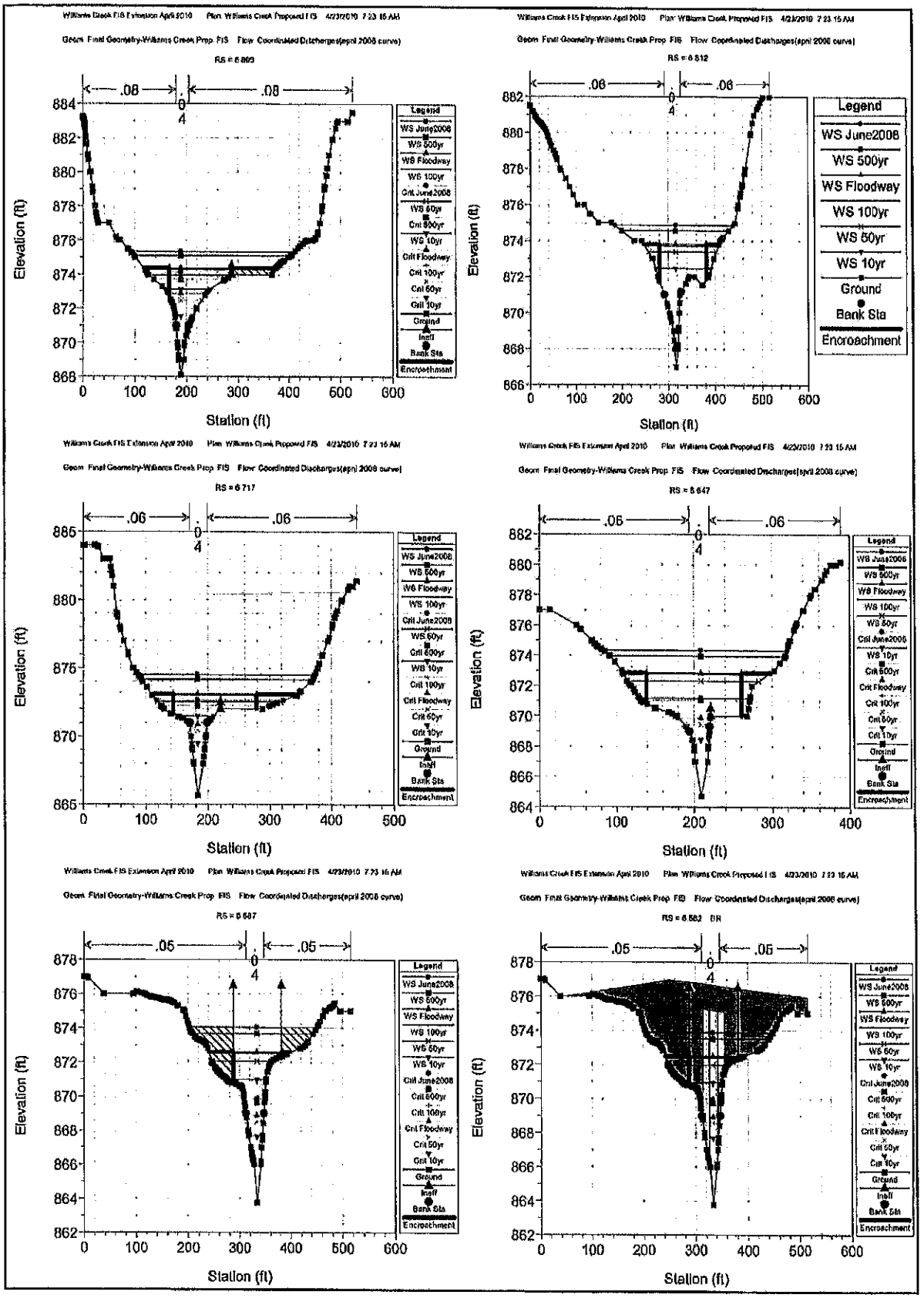

Elevation (ft)
Station (ft)
Legend
WS 500yr
WS June2008
WS Floodway
WS 100yr
Crit June2008
WS 50yr
Crit 500yr
WS 10yr
Crit Floodway
Crit 100yr
Crit 50yr
Crit 10yr
Ground
Ineff
Bank Sta
Encroachment


Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
Crit June2008
Crit 500yr
WS 10yr
Crit Floodway
Crit 100yr
Crit 50yr
Crit 10yr
Ground
Ineff
Bank Sta
Encroachment


Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
Ground
Ineff
Bank Sta
Encroachment


Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
Ground
Ineff
Bank Sta
Encroachment

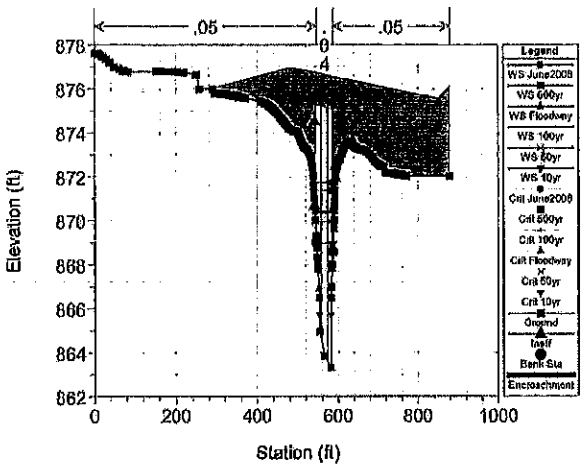

Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
Ground
Bank Sta
Encroachment


Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
Ground
Bank Sta
Encroachment

Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

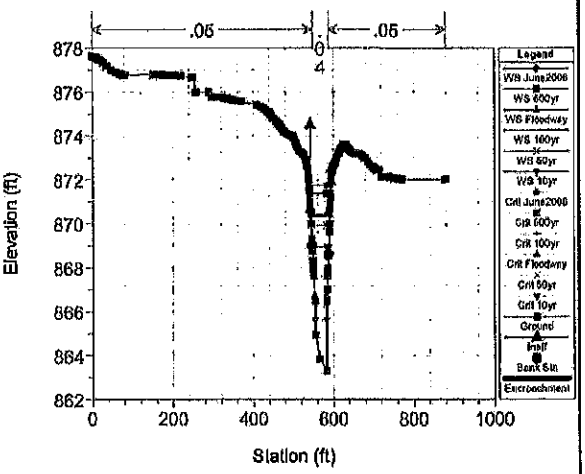
RS = 6 682 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

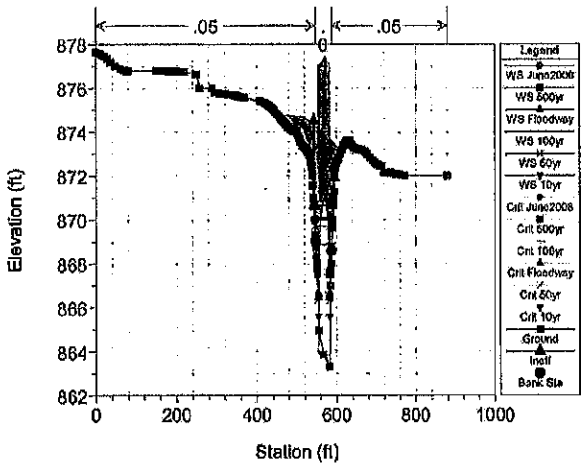
RS = 6 659



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

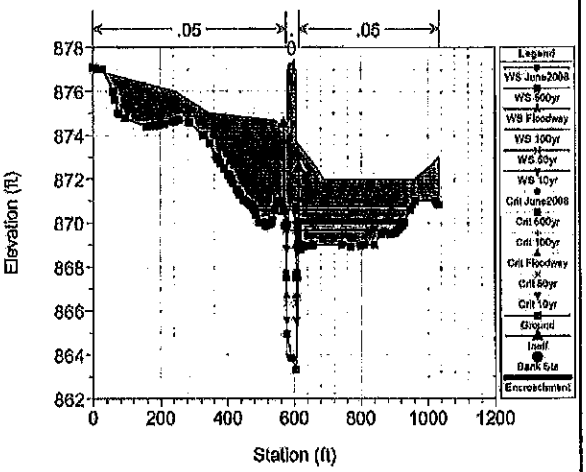
RS = 6 567 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

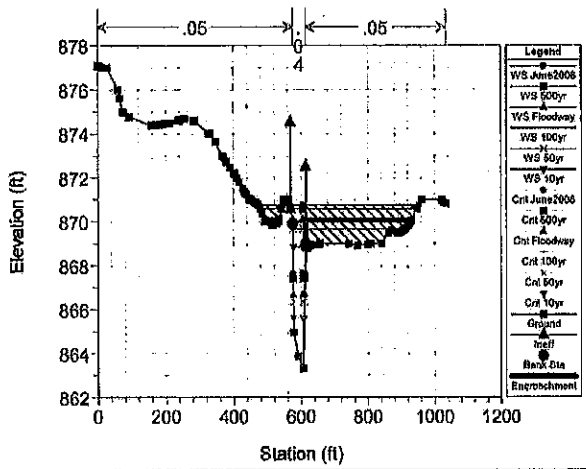
RS = 6 567 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

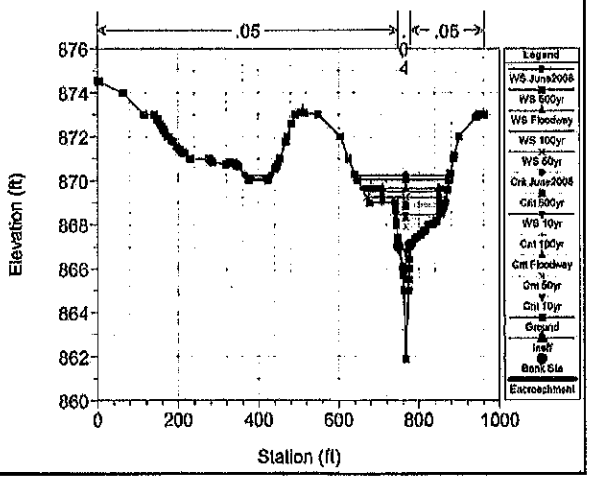
RS = 6 549



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

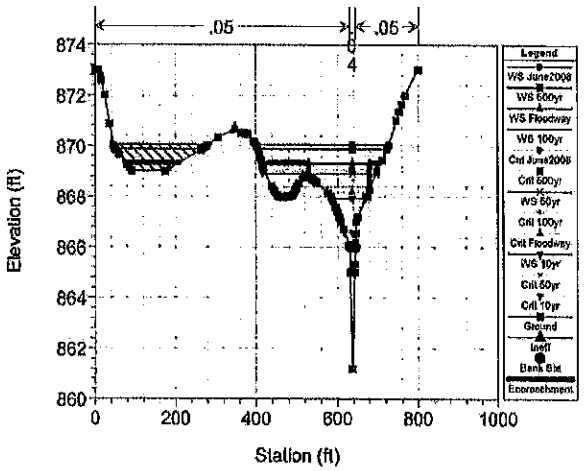
RS = 6 483



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

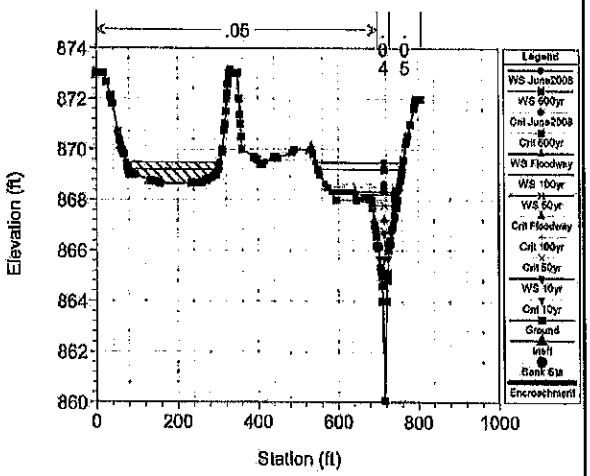
RS = 6.453



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

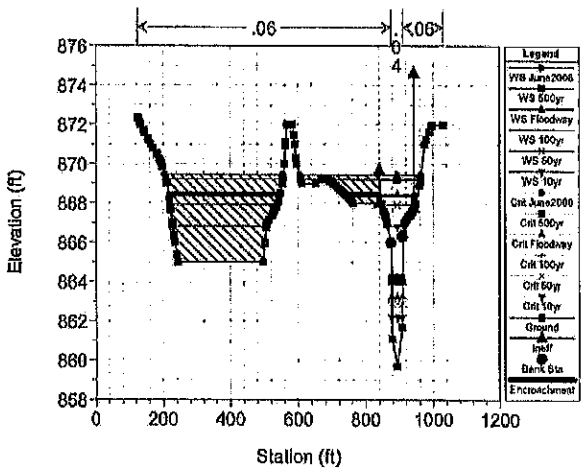
RS = 6.405



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

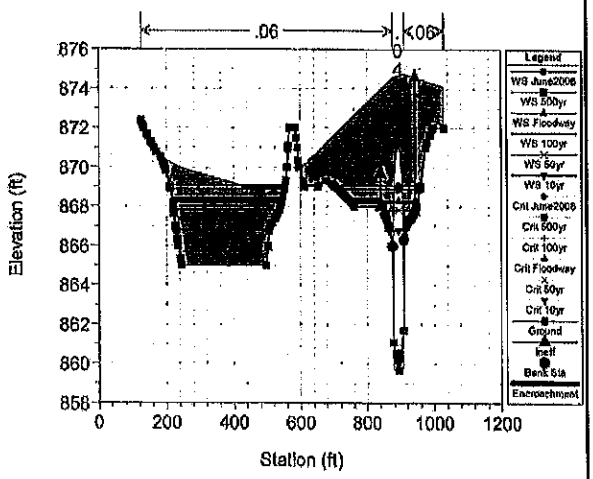
RS = 6.390



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

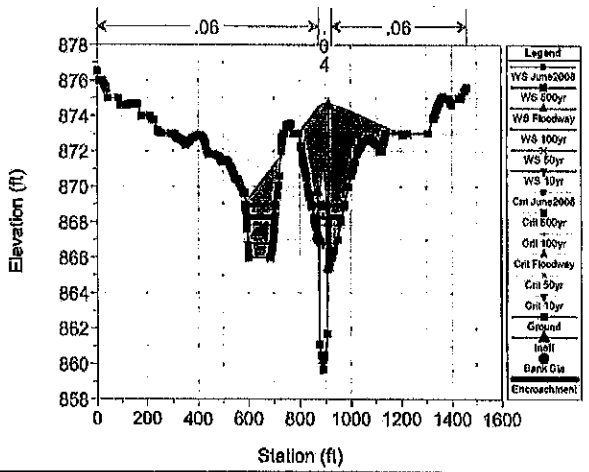
RS = 5.369 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

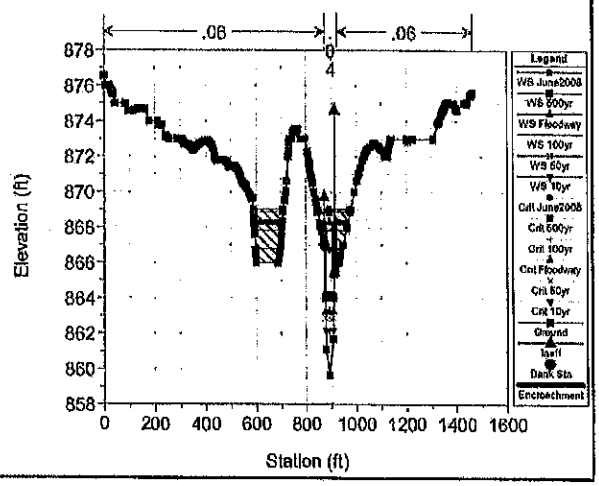
RS = 5.350 Culv



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)

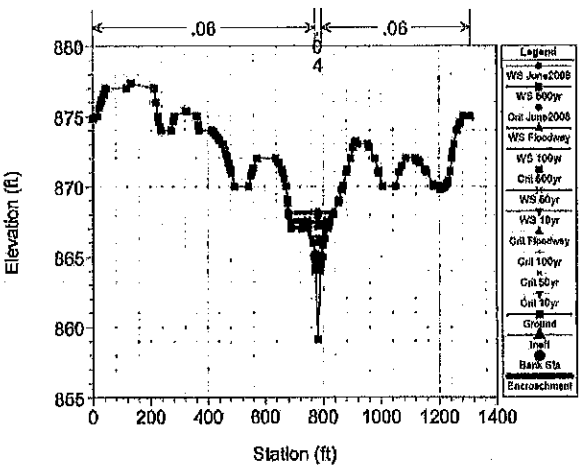
RS = 5.302



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

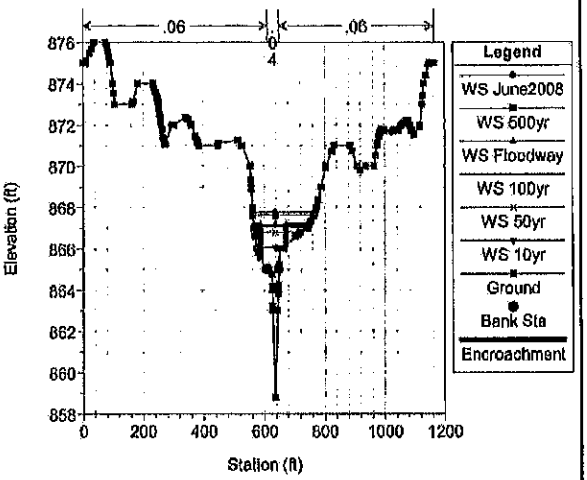
RS = 6.317



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

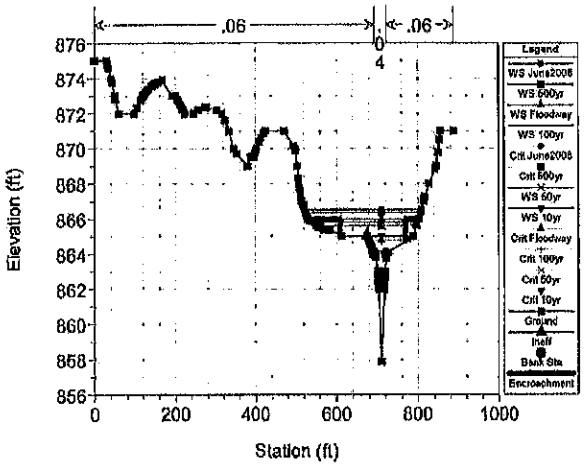
RS = 6.274



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

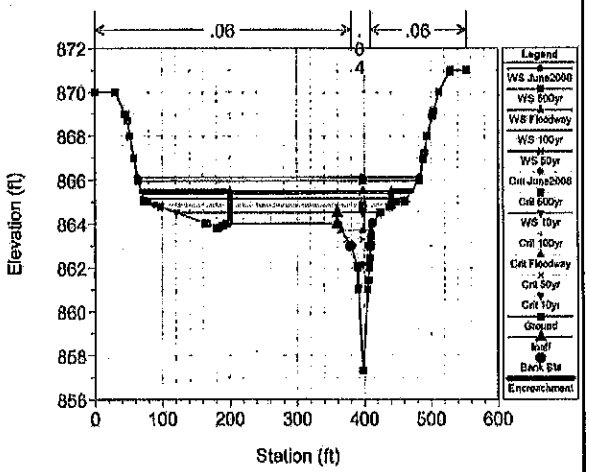
RS = 6.169



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

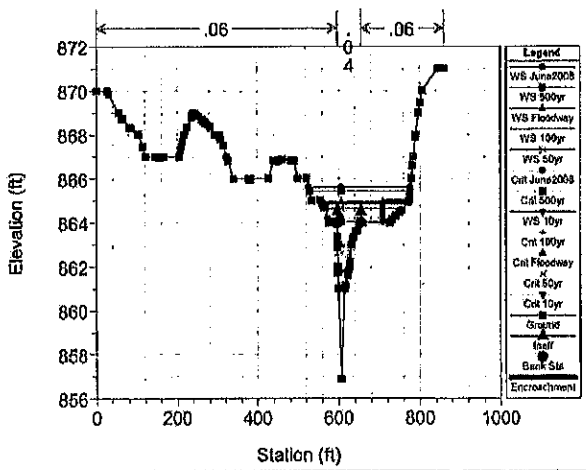
RS = 6.087



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

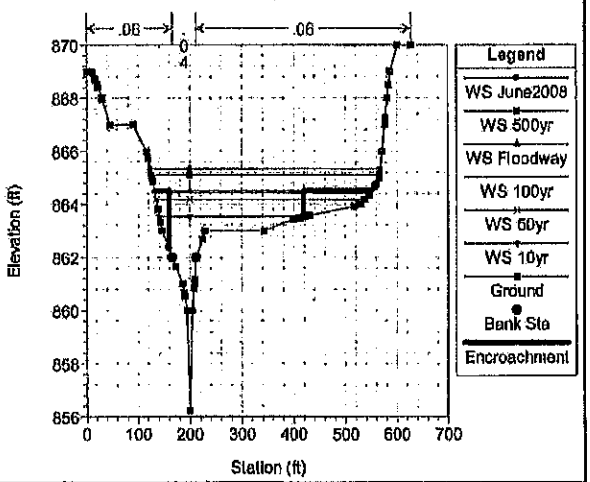
RS = 6.032

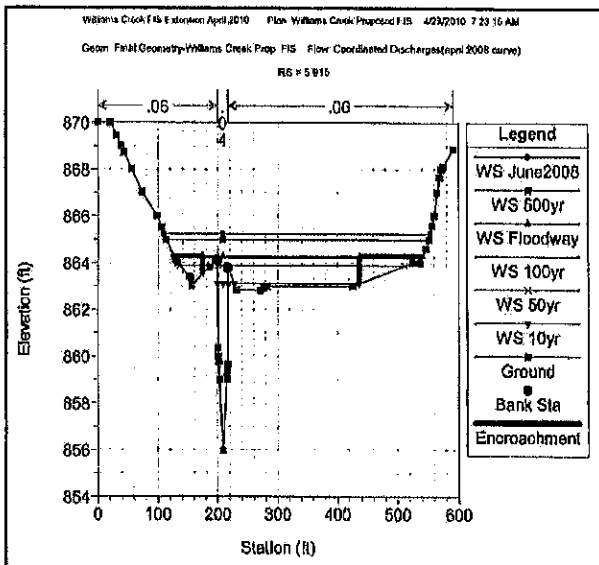


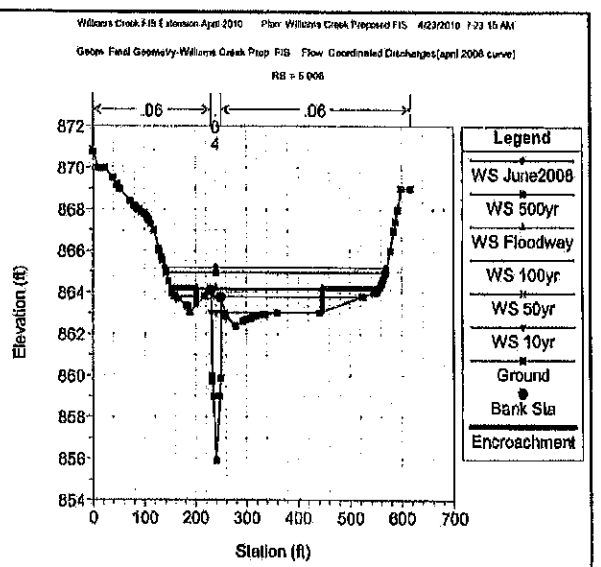
Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

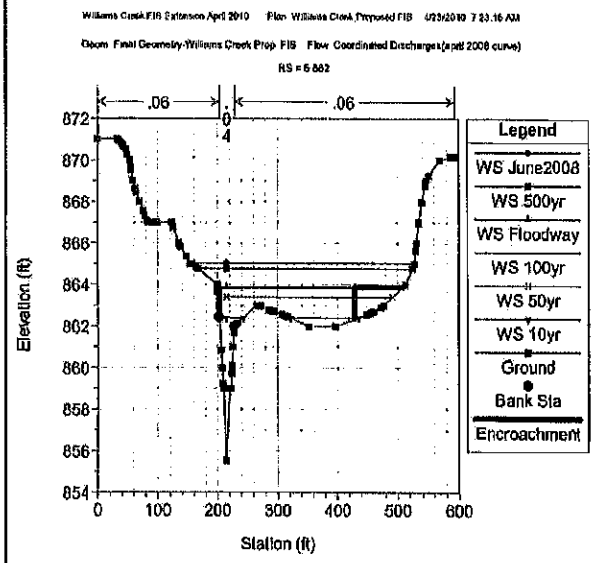
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

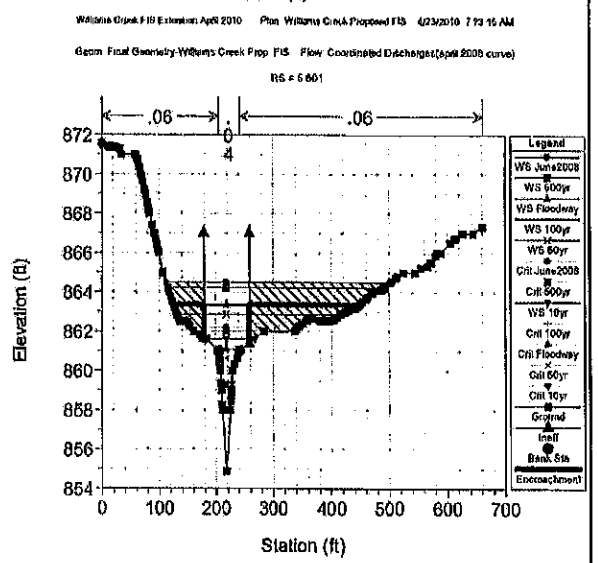
RS = 5.940

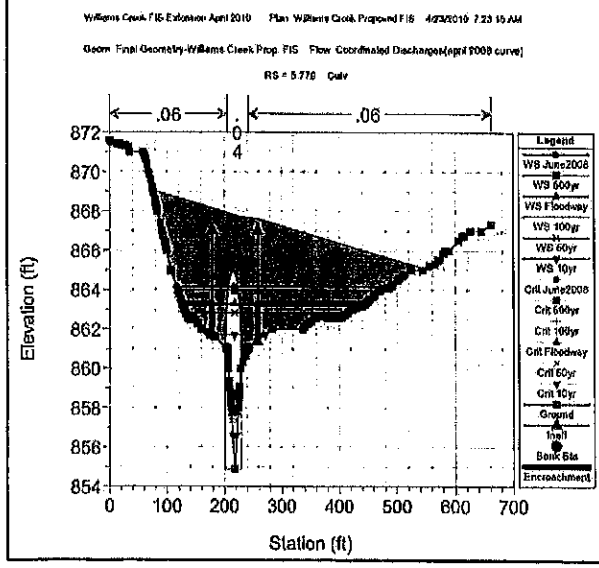


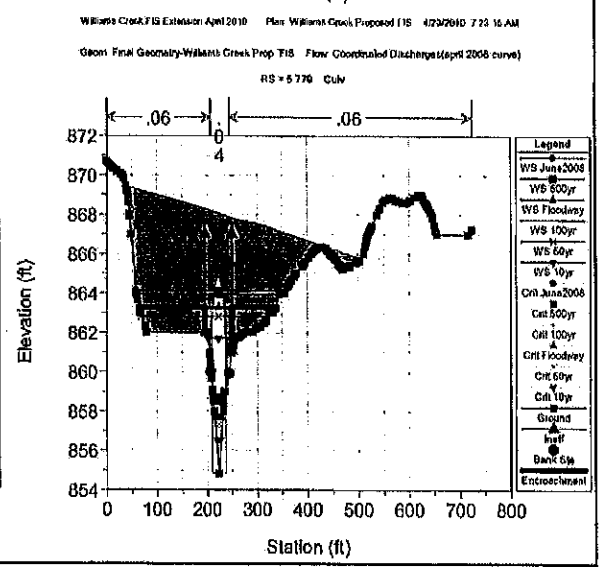

Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 915
.06
.06
0
4
Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
Ground
Bank Sta
Encroachment


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 906
.06
.06
0
4
Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
Ground
Bank Sta
Encroachment


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 862
.06
.06
0
4
Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
Ground
Bank Sta
Encroachment


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 861
.06
.06
0
4
Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
Crit June2008
Crit 500yr
WS 10yr
Crit 100yr
Crit Floodway
Crit 50yr
Crit 10yr
Ground
Ineff
Bank Sta
Encroachment

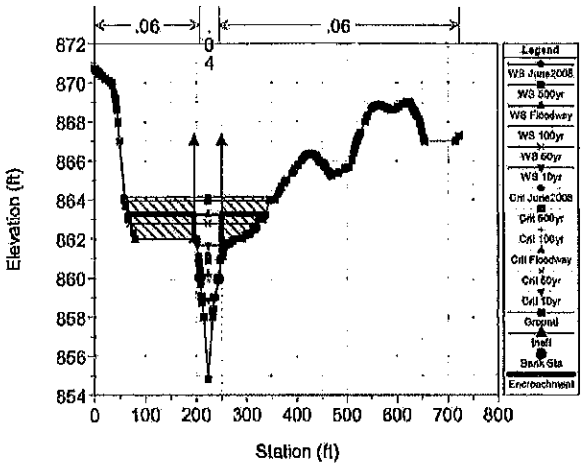

Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 770 Culv
.06
.06
0
4
Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
Crit June2008
Crit 500yr
Crit 100yr
Crit Floodway
Crit 50yr
Crit 10yr
Ground
Ineff
Bank Sta
Encroachment


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 770 Culv
.06
.06
0
4
Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
Crit June2008
Crit 500yr
Crit 100yr
Crit Floodway
Crit 50yr
Crit 10yr
Ground
Ineff
Bank Sta
Encroachment

Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

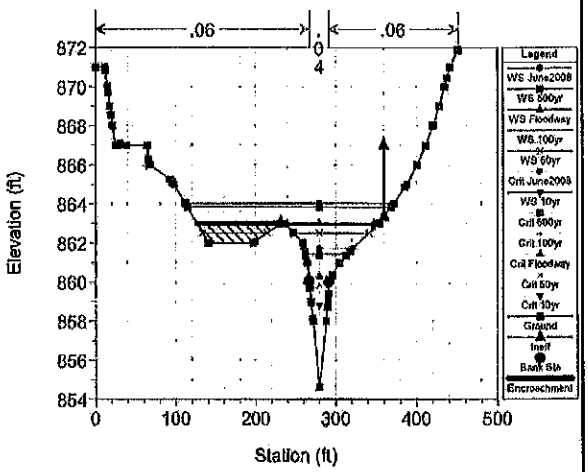
RS = 5.777



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

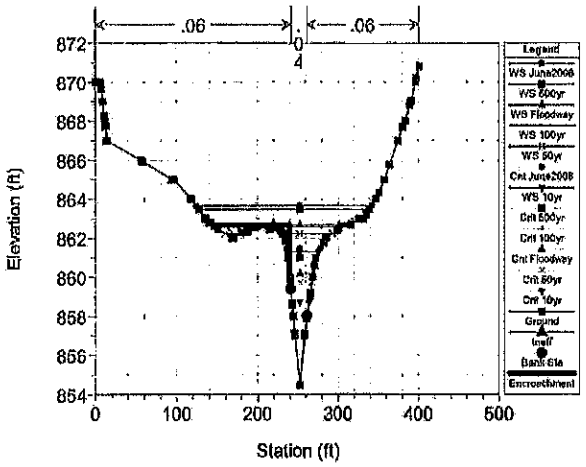
RS = 5.740



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

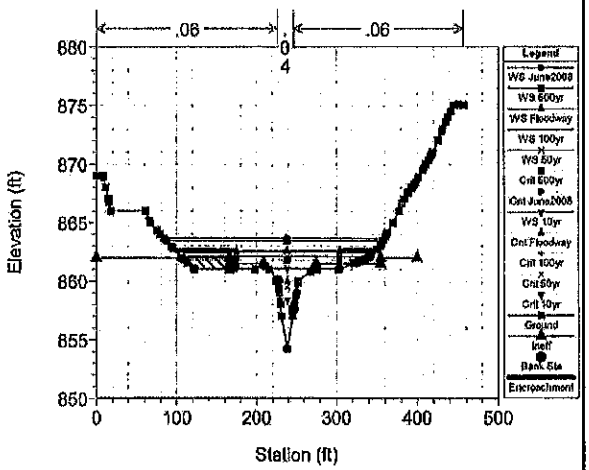
RS = 5.731



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

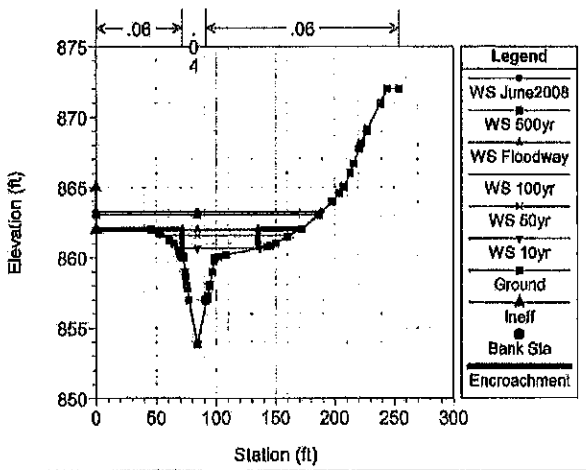
RS = 5.704



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

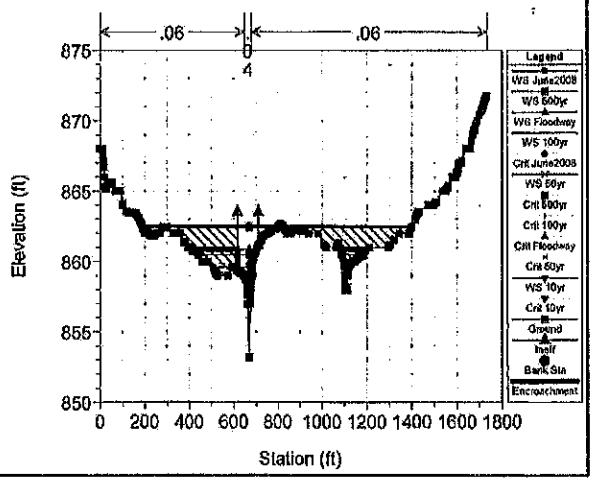
RS = 5.650

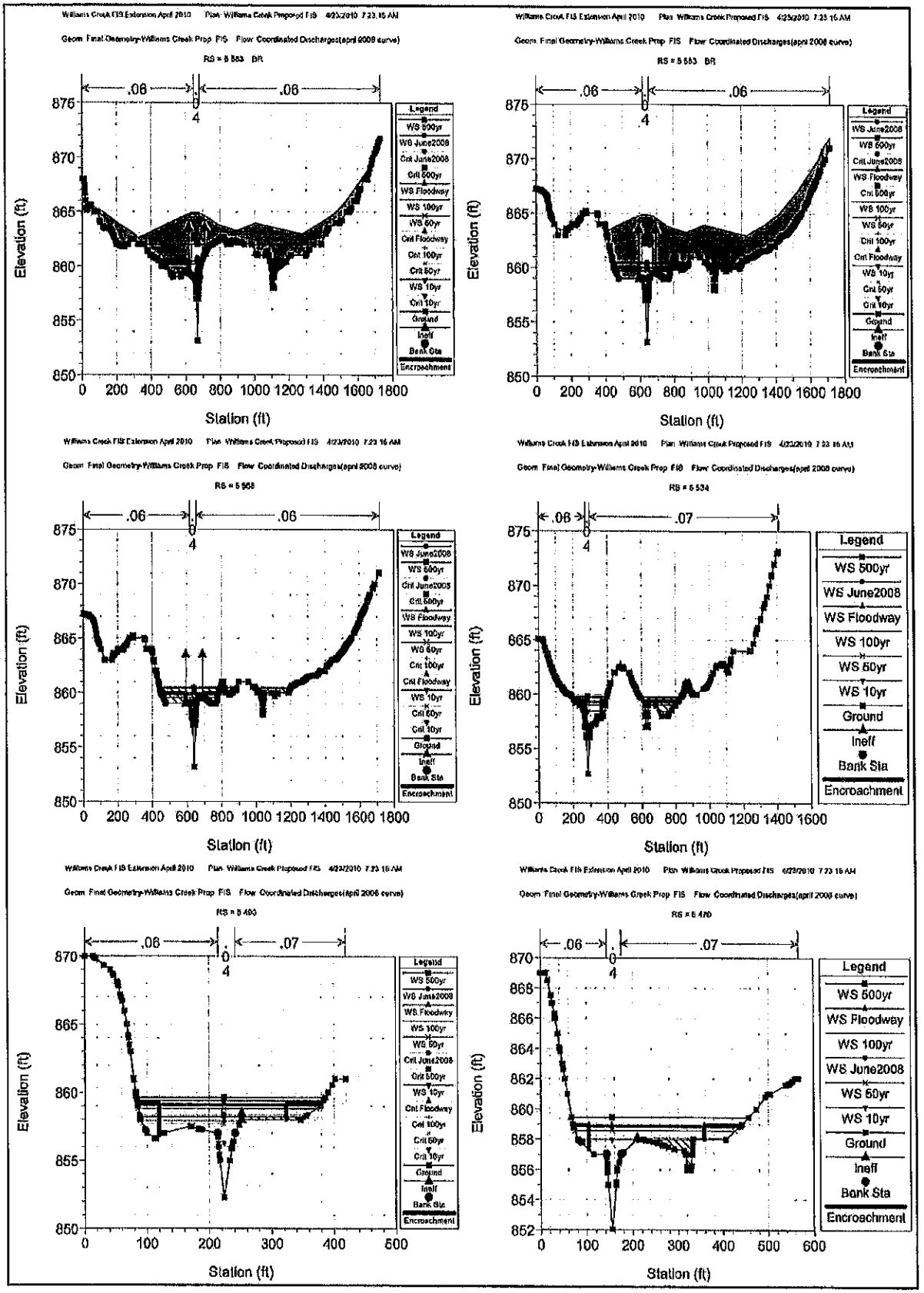


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

RS = 5.552

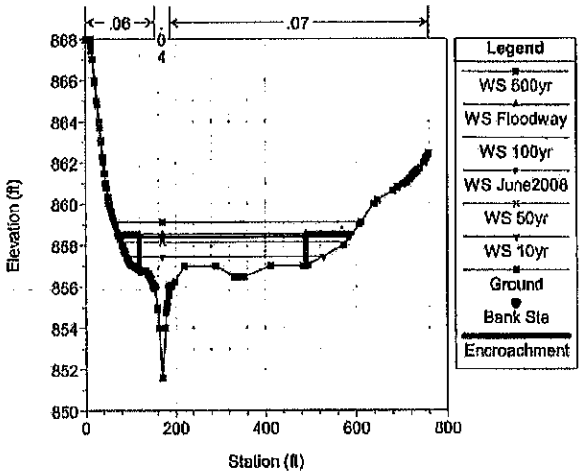



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 553 BR
.06
.06
Elevation (ft)
Station (ft)
Legend
WS 500yr
WS June2008
Crit June2008
Crit 500yr
WS Floodway
WS 100yr
WS 50yr
Crit Floodway
Crit 100yr
Crit 50yr
WS 10yr
Crit 10yr
Ground
Ineff
Bank Sta
Encroachment
Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 553 BR
.06
.06
Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
Crit June2008
Crit 500yr
WS Floodway
WS 100yr
WS 50yr
Crit 100yr
Crit Floodway
WS 10yr
Crit 50yr
Crit 10yr
Ground
Ineff
Bank Sta
Encroachment
Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 558
.06
.06
Elevation (ft)
Station (ft)
Legend
WS June2008
WS 500yr
Crit June2008
Crit 500yr
WS Floodway
WS 100yr
WS 50yr
Crit 100yr
Crit Floodway
WS 10yr
Crit 50yr
Crit 10yr
Ground
Ineff
Bank Sta
Encroachment
Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 534
.06
.07
Elevation (ft)
Station (ft)
Legend
WS 500yr
WS June2008
WS Floodway
WS 100yr
WS 50yr
WS 10yr
Ground
Ineff
Bank Sta
Encroachment
Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 400
.06
.07
Elevation (ft)
Station (ft)
Legend
WS 500yr
WS June2008
WS Floodway
WS 100yr
WS 50yr
Crit June2008
Crit 500yr
WS 10yr
Crit Floodway
Crit 100yr
Crit 50yr
Crit 10yr
Ground
Ineff
Bank Sta
Encroachment
Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 5 470
.06
.07
Elevation (ft)
Station (ft)
Legend
WS 500yr
WS Floodway
WS 100yr
WS June2008
WS 50yr
WS 10yr
Ground
Ineff
Bank Sta
Encroachment

Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

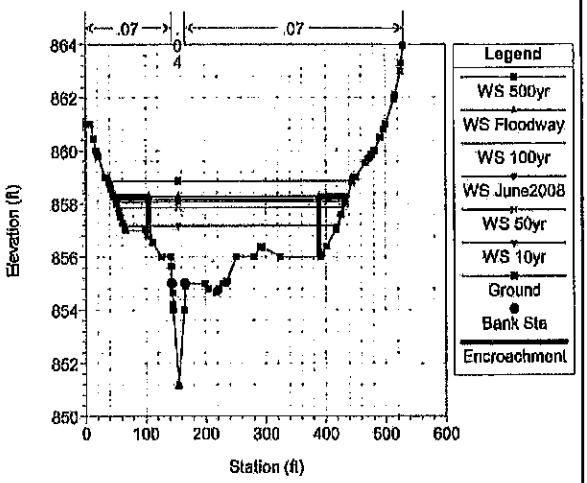
RS = 5.422



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

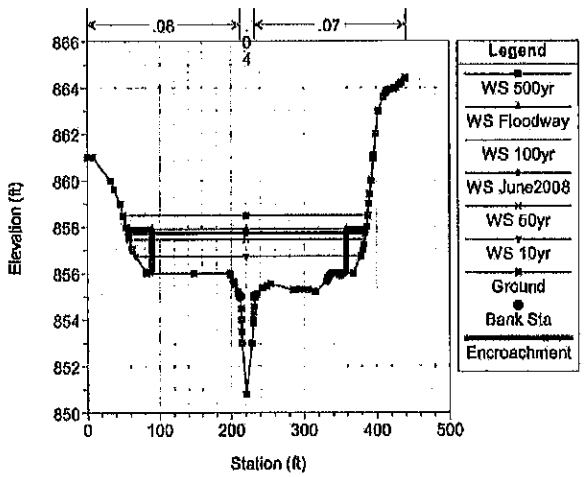
RS = 5.377



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

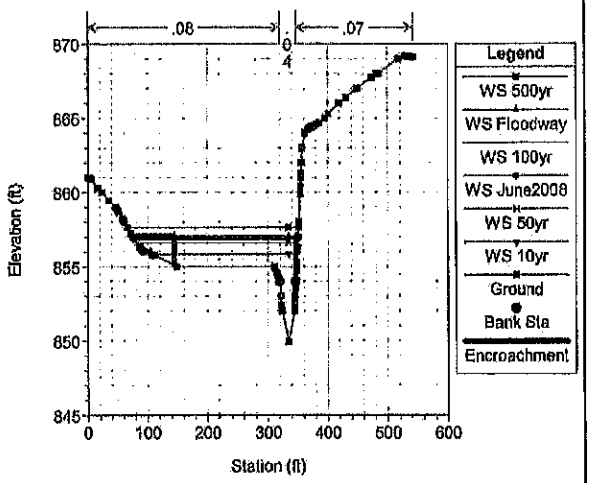
RS = 5.340



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

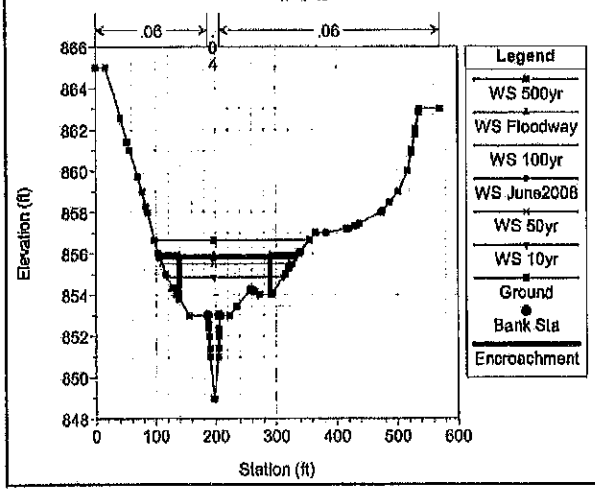
RS = 5.255



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

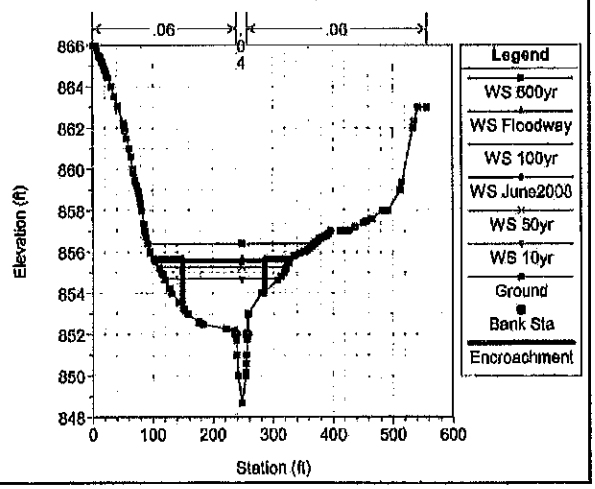
RS = 5.152



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

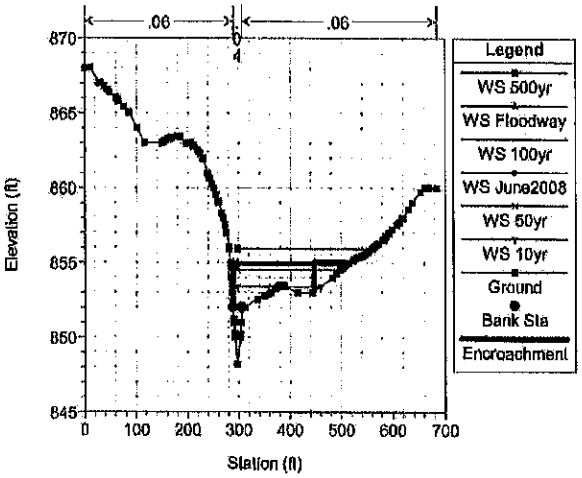
RS = 5.125



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

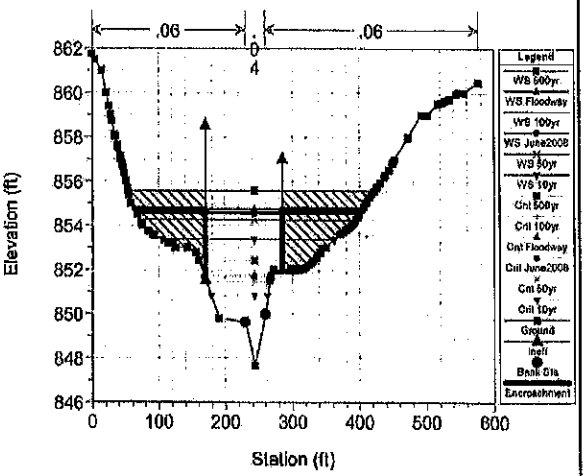
RS = 6 077



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

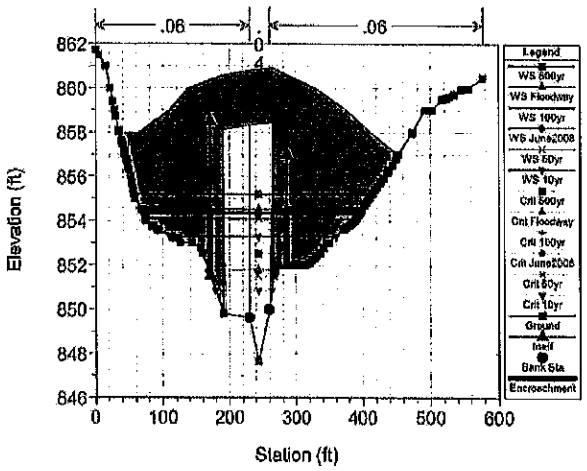
RS = 5 025



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

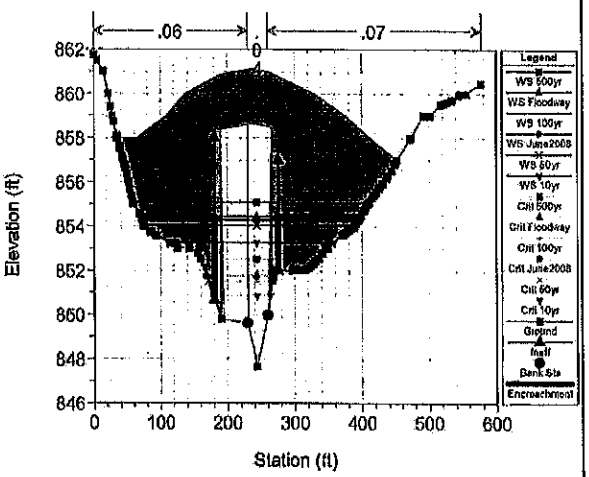
RS = 5 021 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

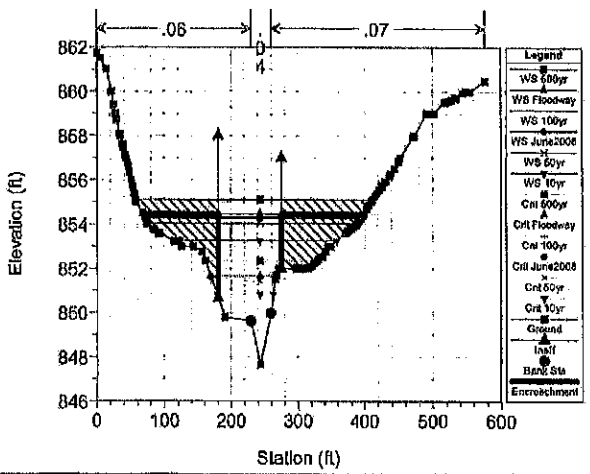
RS = 5 021 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

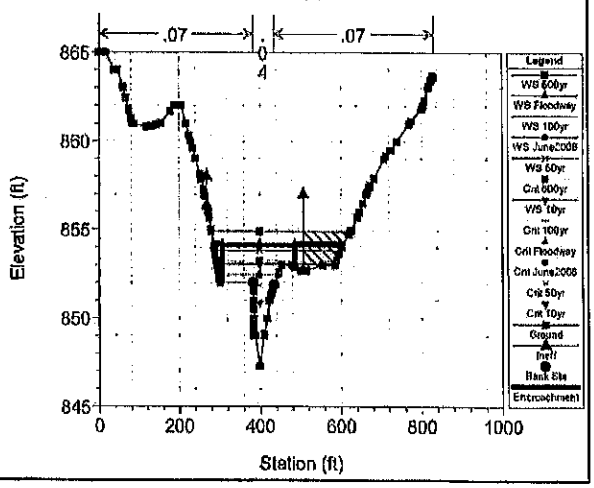
RS = 5 011



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

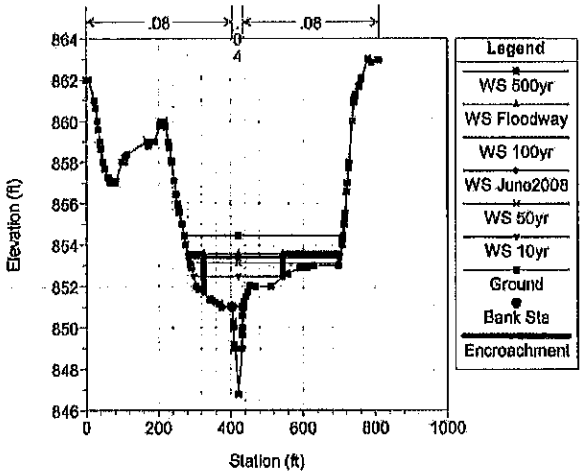
RS = 4 981



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

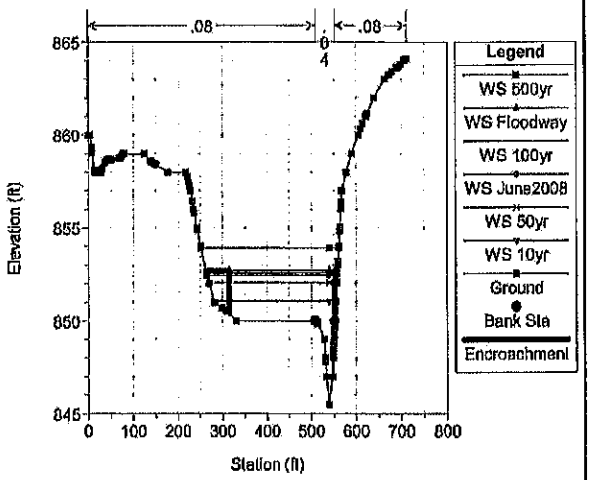
RS = 4.923



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

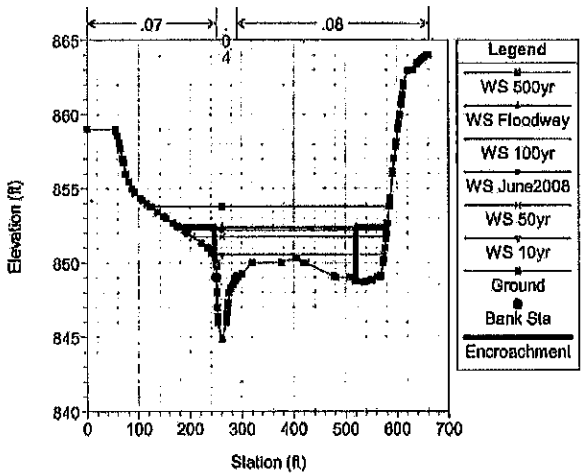
RS = 4.777



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

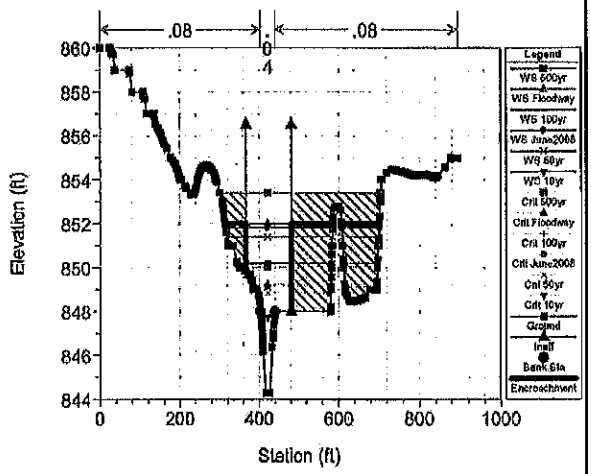
RS = 4.709



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

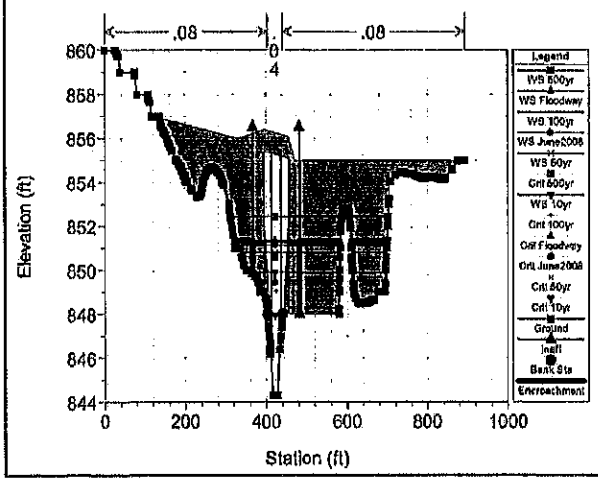
RS = 4.651



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

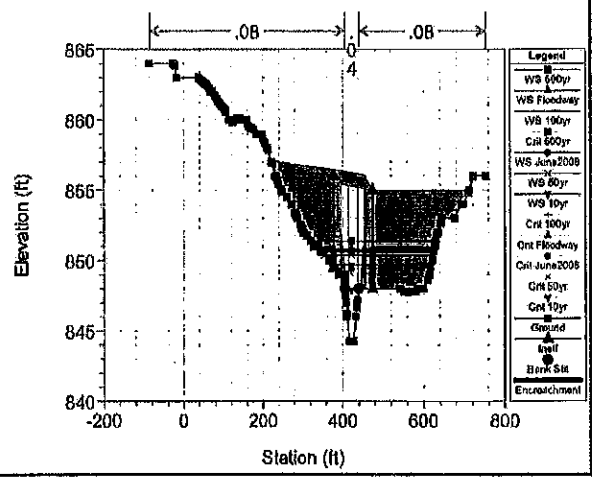
RS = 4.640 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

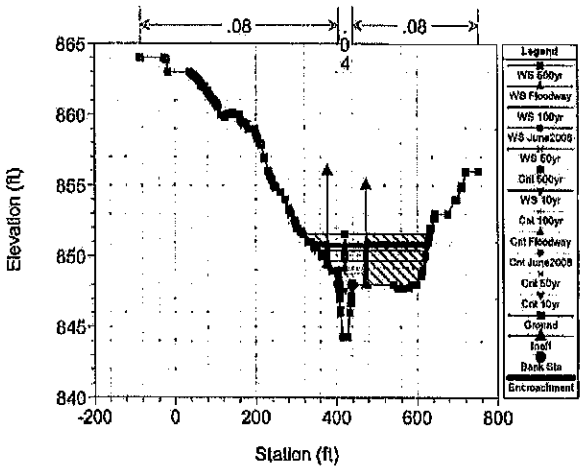
RS = 4.640 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

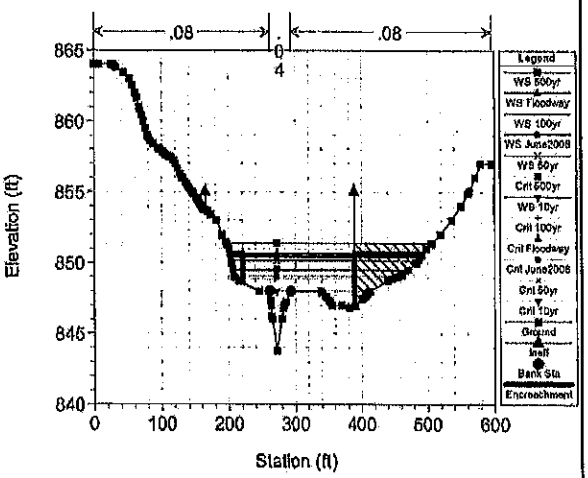
RS = 4.633



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

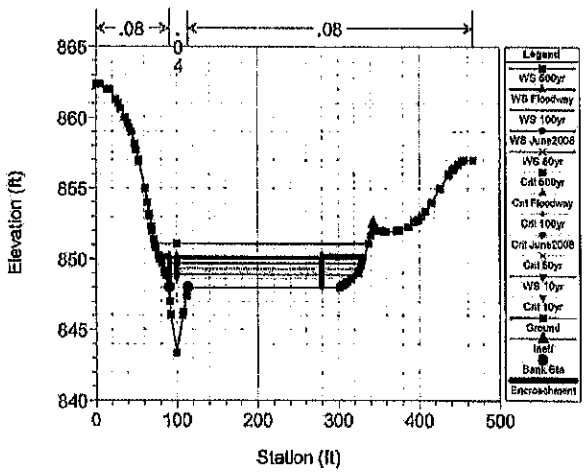
RS = 4.603



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

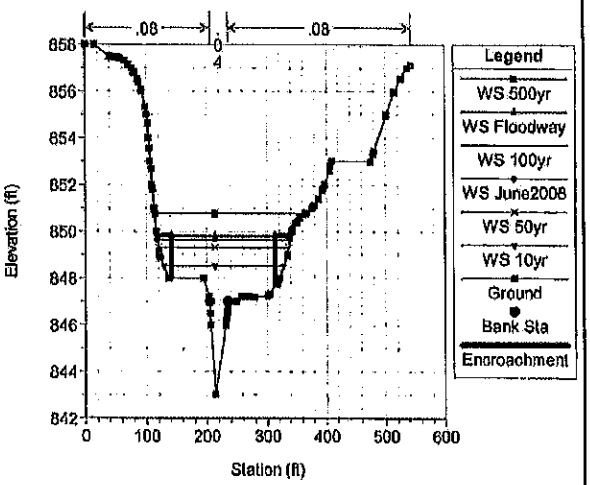
RS = 4.571



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

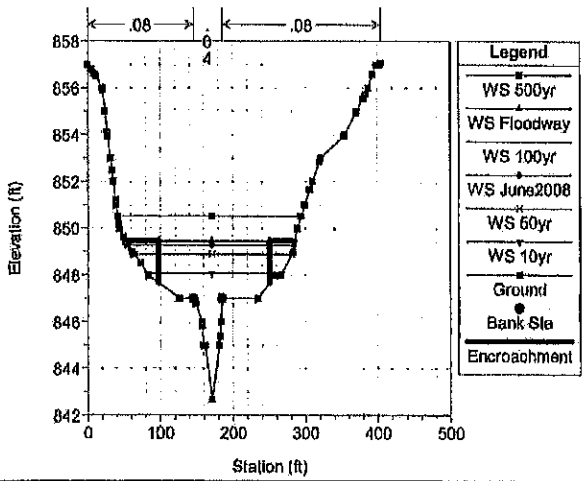
RS = 4.543



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

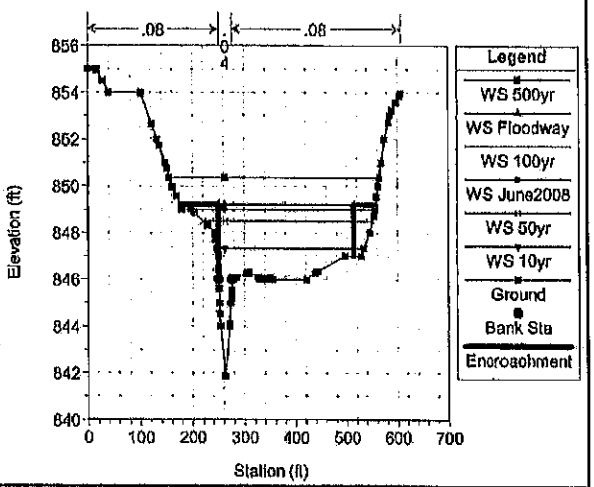
RS = 4.513



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

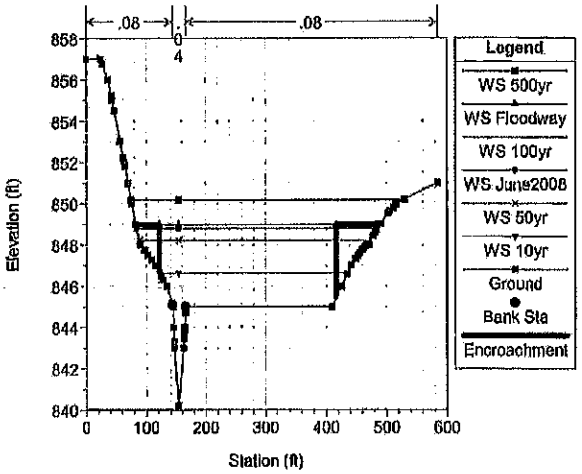
RS = 4.447



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

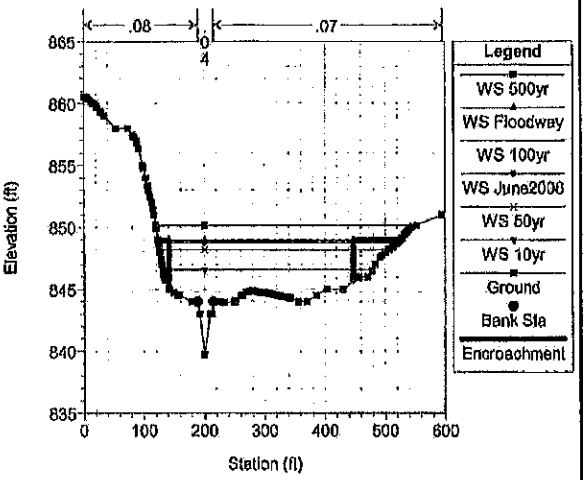
RS = 4.313



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

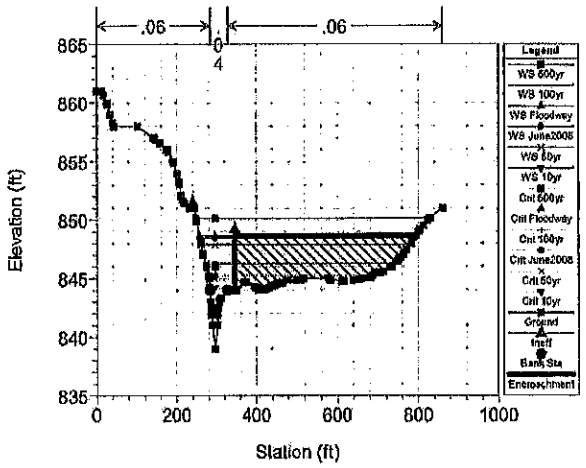
RS = 4.274



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

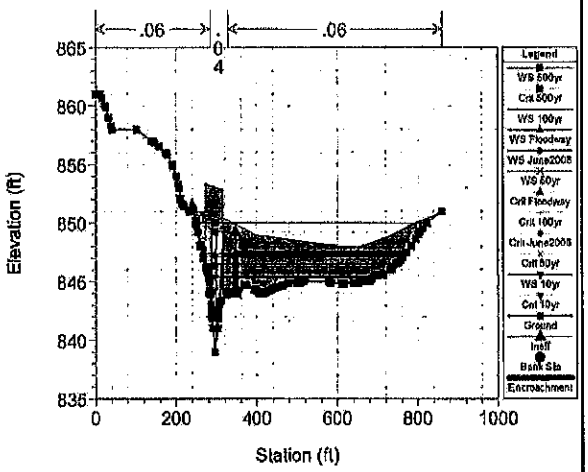
RS = 4.210



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

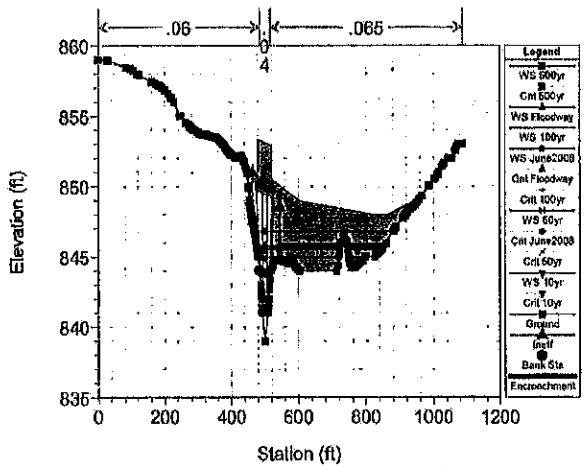
RS = 4.213 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

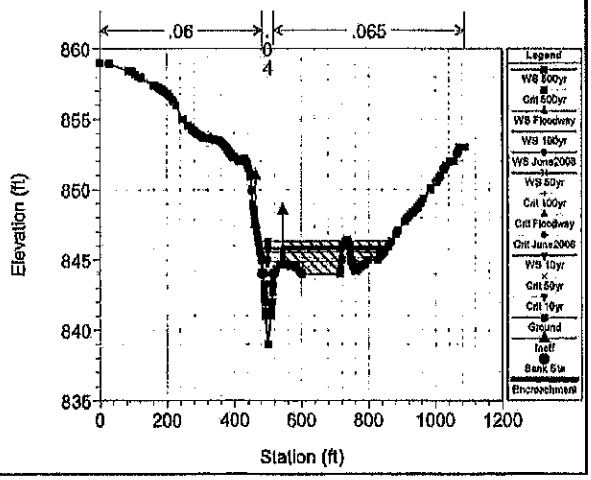
RS = 4.213 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

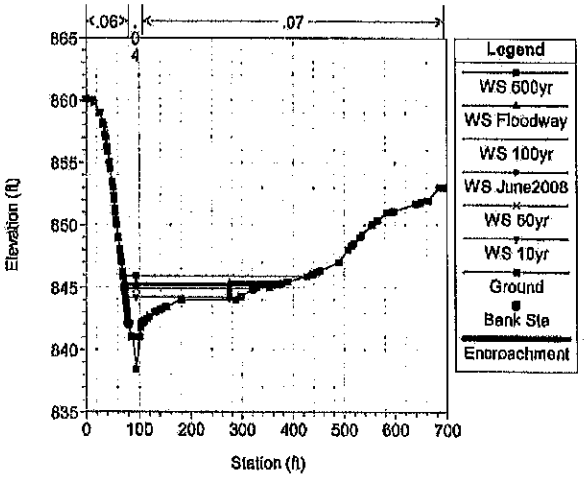
RS = 4.200



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

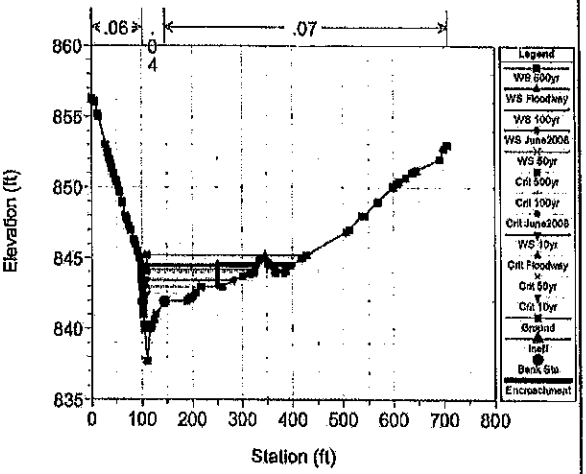
RS = 4.107



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

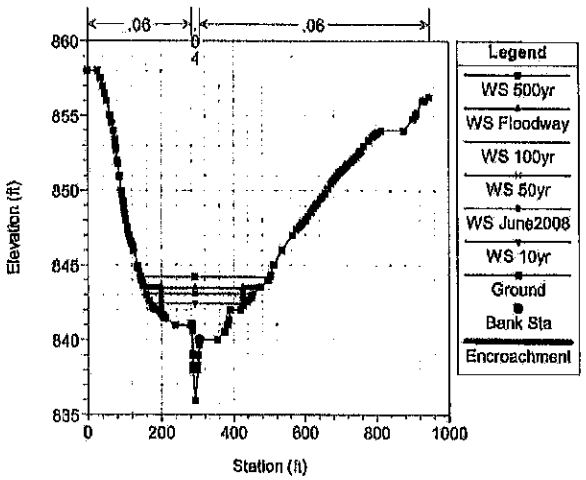
RS = 4.111



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

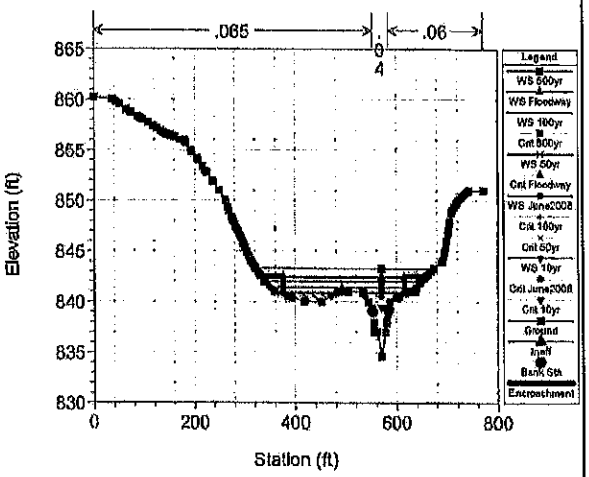
RS = 3.977



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

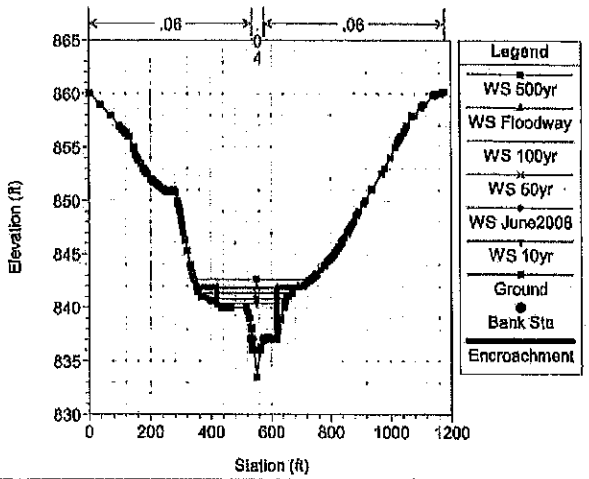
RS = 3.871



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

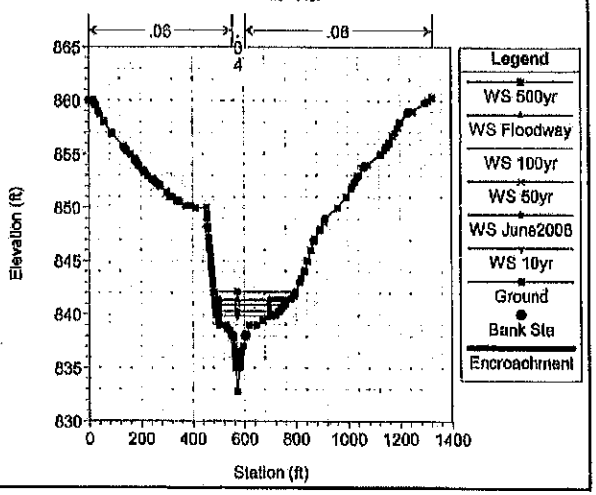
RS = 3.785



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

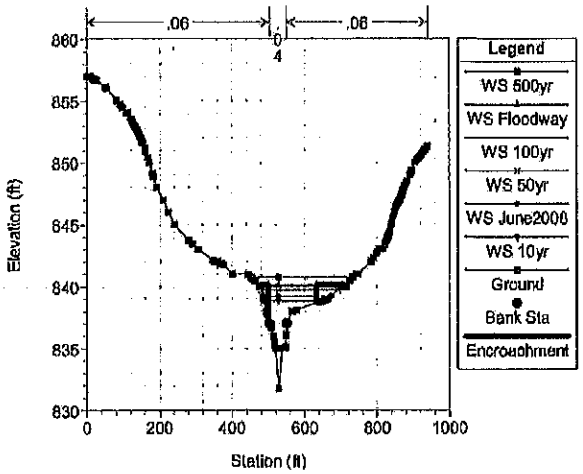
RS = 3.720



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

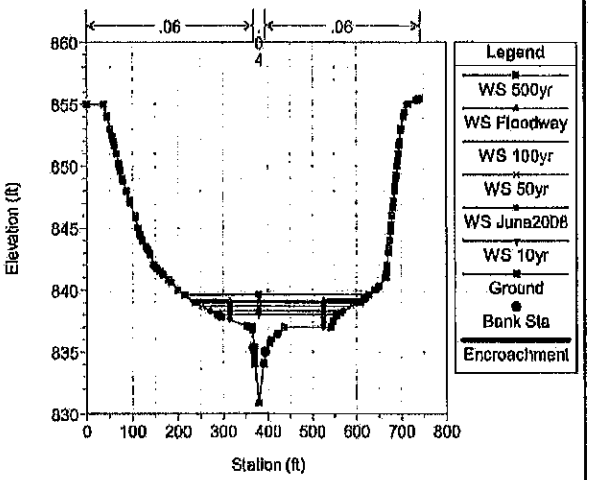
RS = 3.651



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

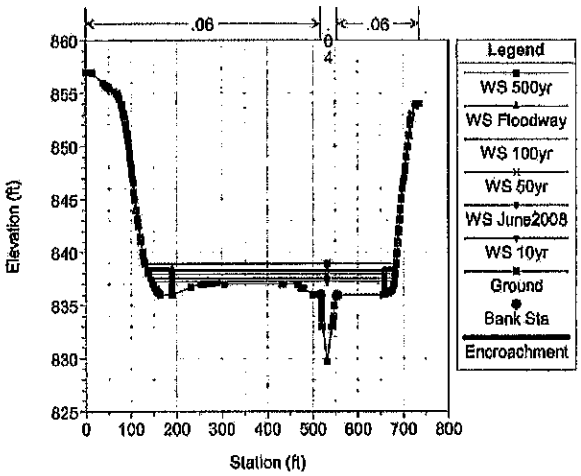
RS = 3.582



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

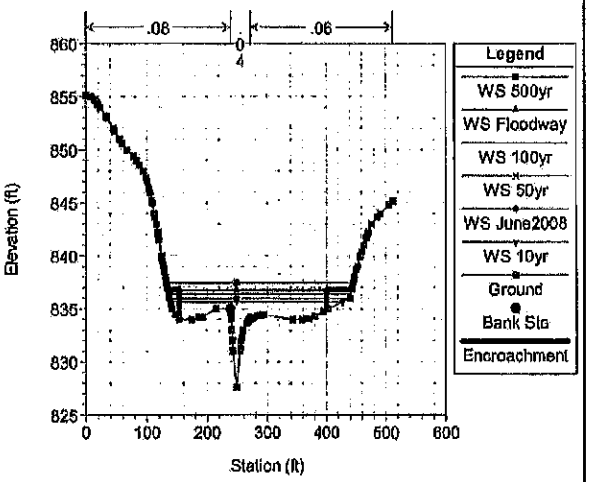
RS = 3.494



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

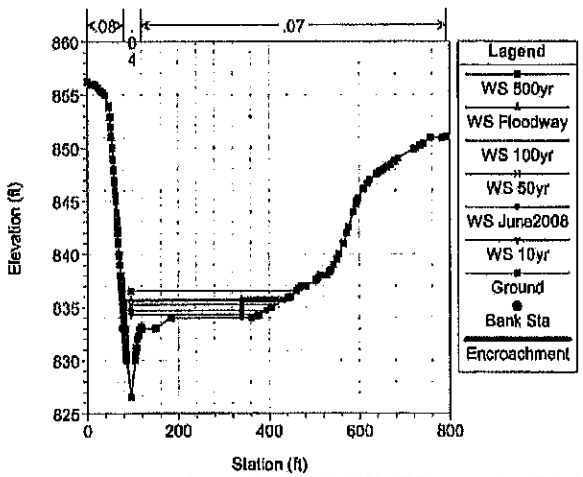
RS = 3.396



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

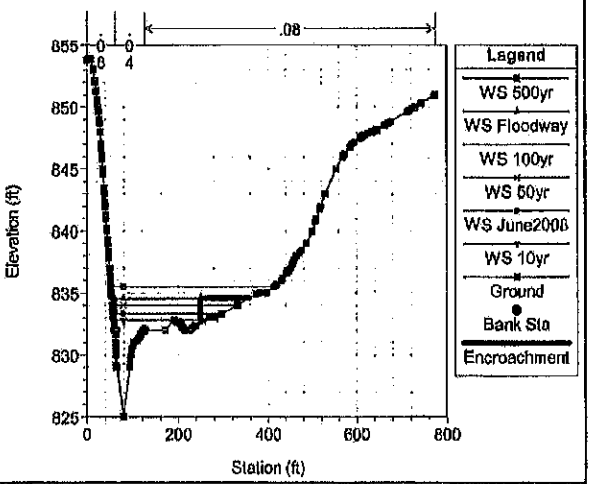
RS = 3.245



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

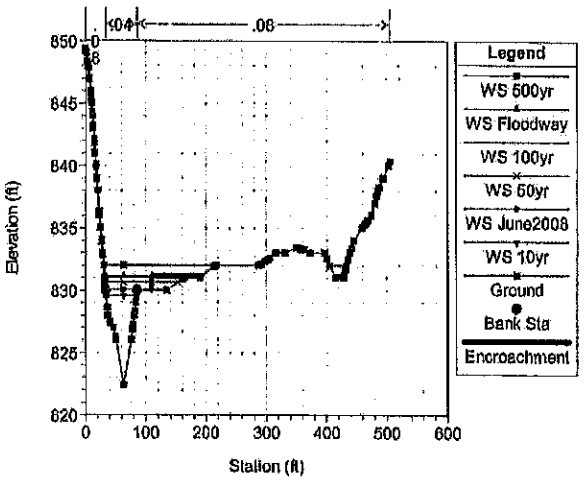
RS = 3.127



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

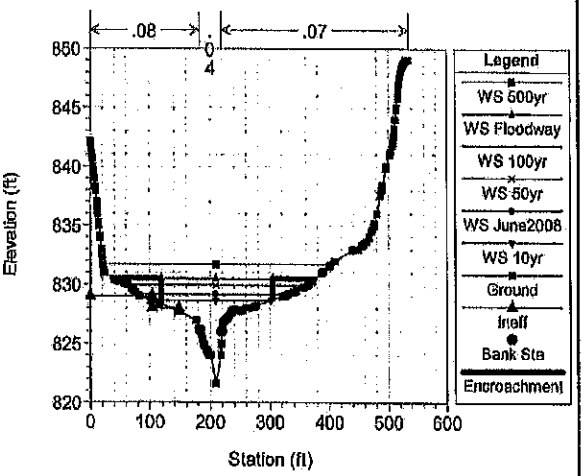
RS = 2 921



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

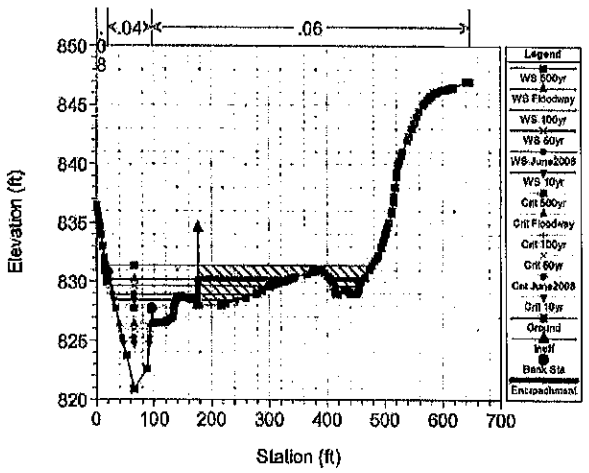
RS = 2 860



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

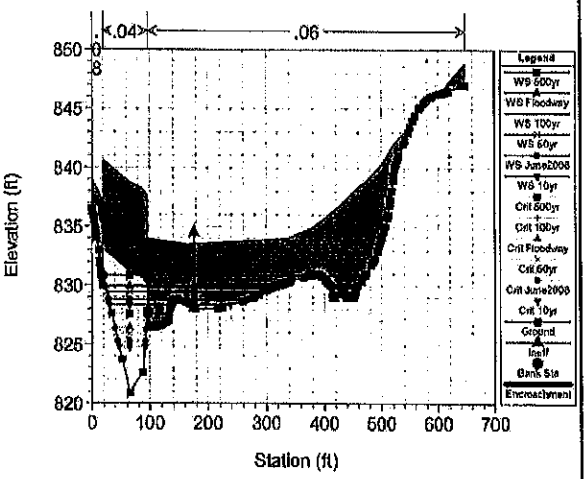
RS = 2 811



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

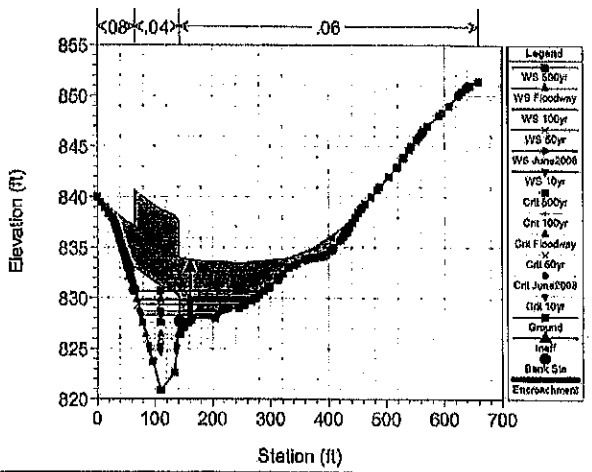
RS = 2 801 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

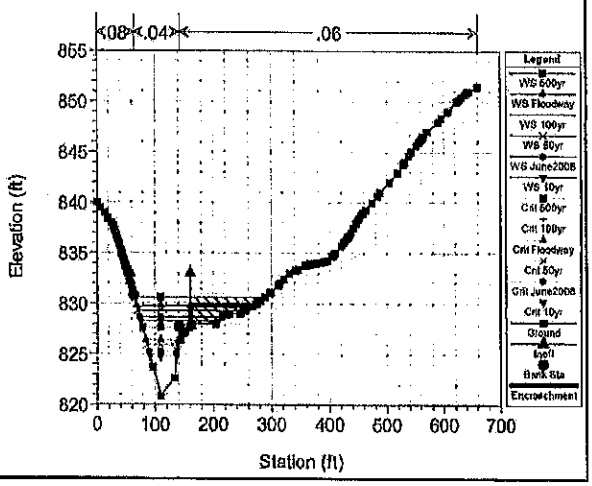
RS = 2 601 BR

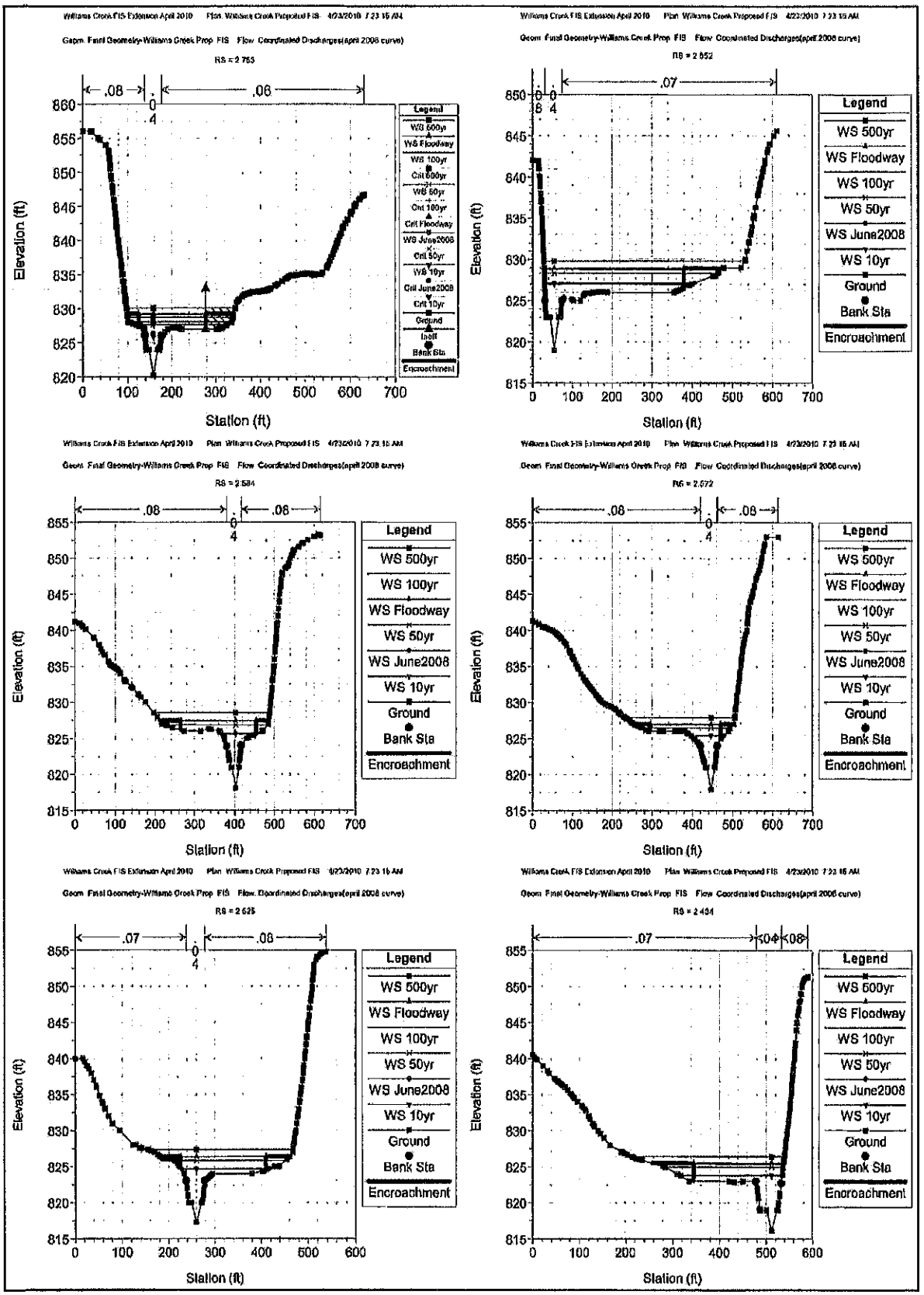


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

RS = 2 787

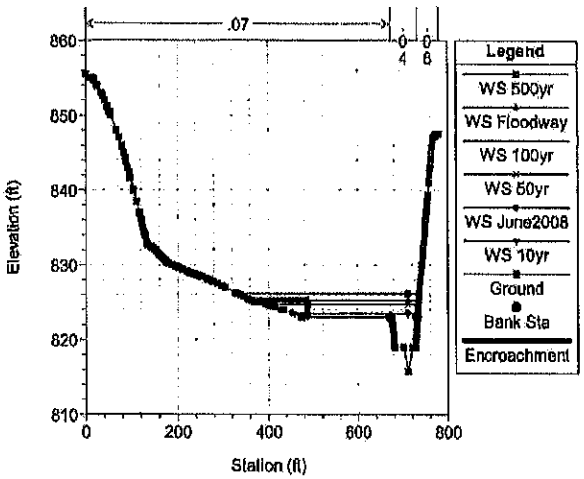



Elevation (ft)
Station (ft)
Legend
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS June2008
WS 10yr
Ground
Bank Sta
Encroachment

Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

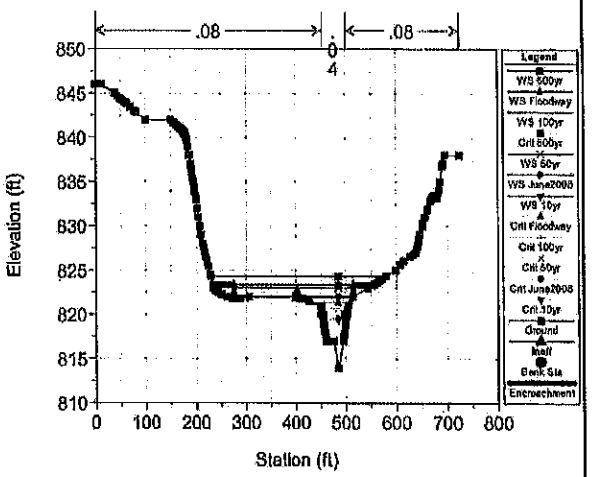
RS = 2.401



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

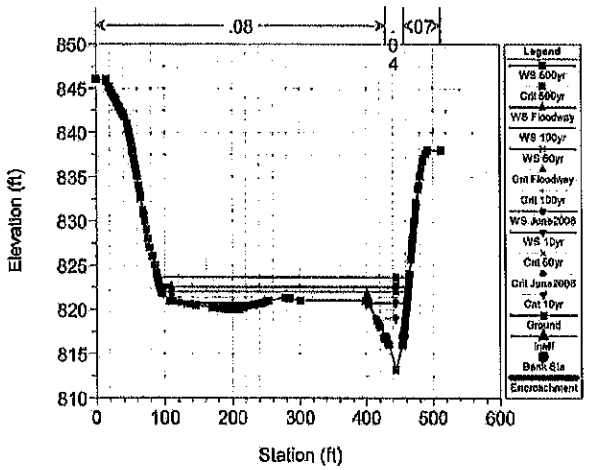
RS = 2.263



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

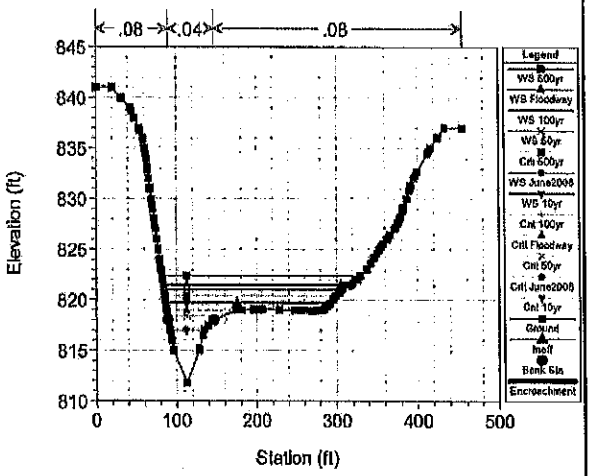
RS = 2.202



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

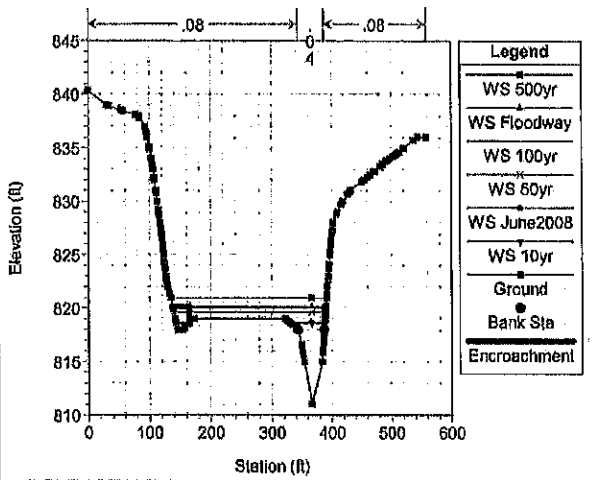
RS = 2.060



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

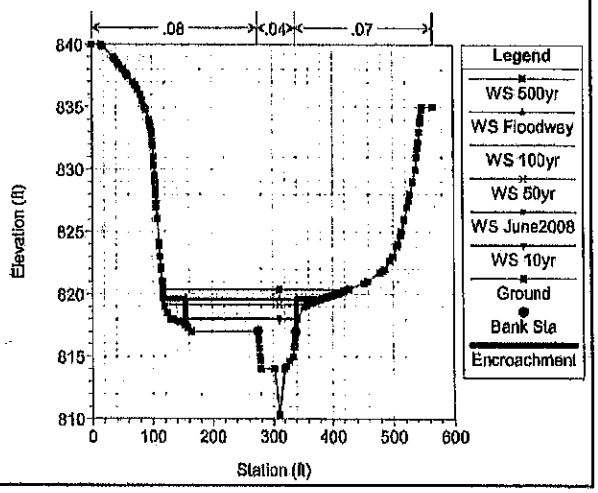
RS = 2.003



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

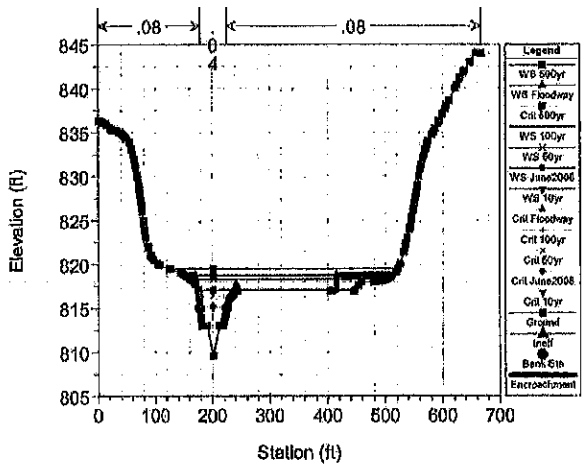
RS = 1.976



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

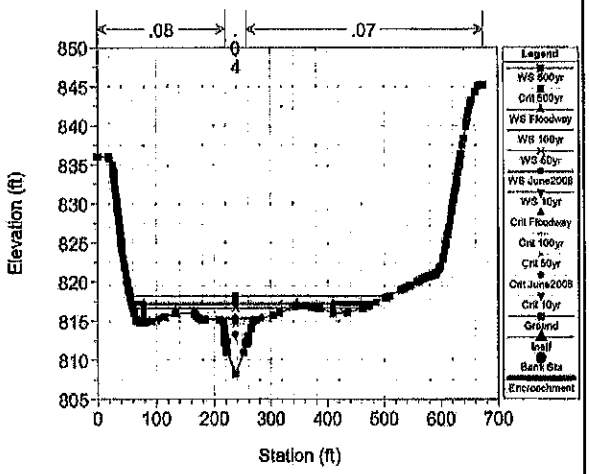
RS = 1.922



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

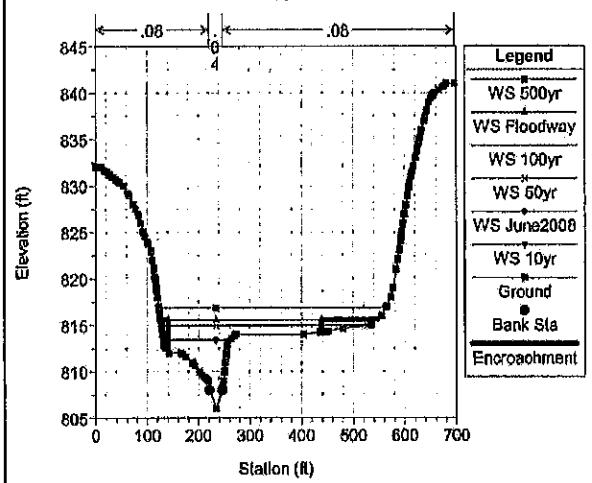
RS = 1.518



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

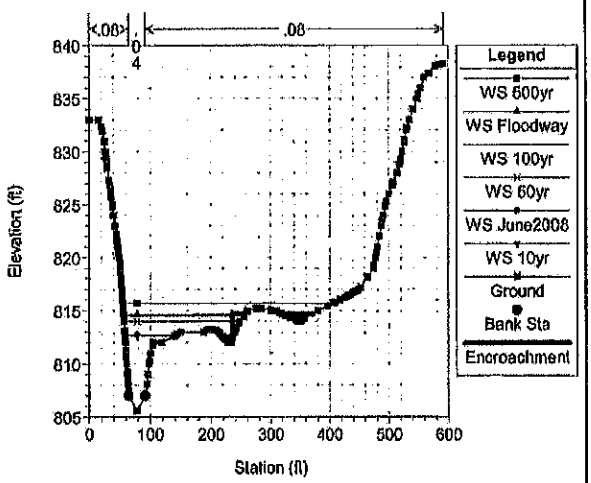
RS = 1.041



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

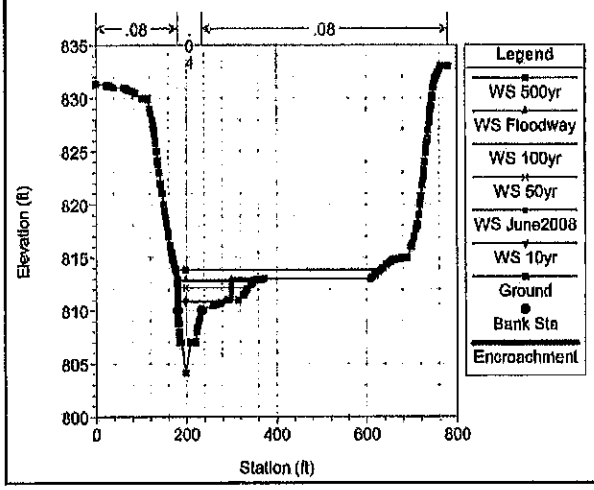
RS = 1.603



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

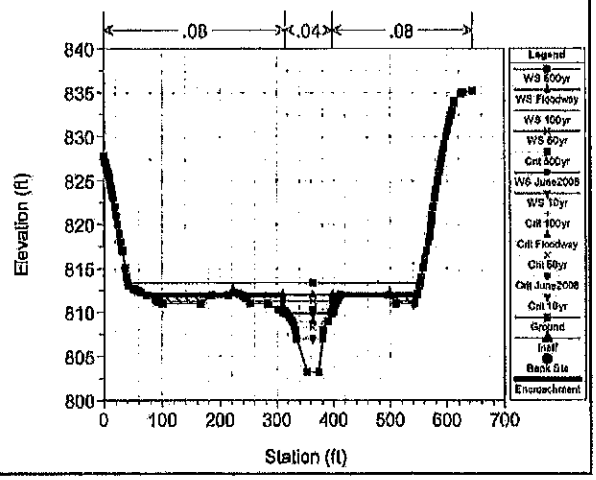
RS = 1.402



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

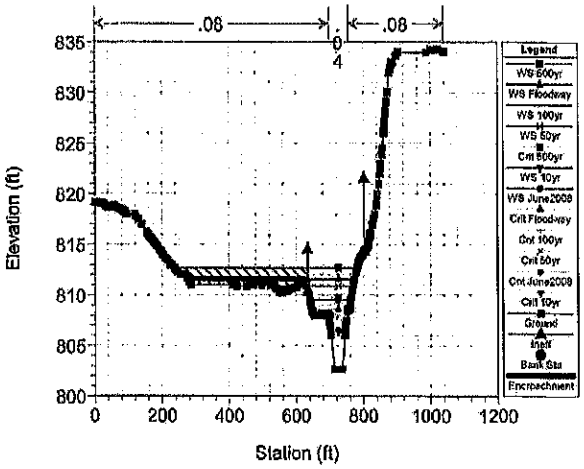
RS = 1.419



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

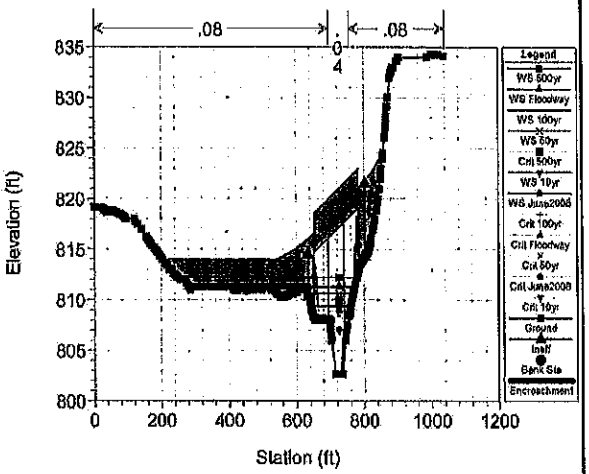
RS = 1 970



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

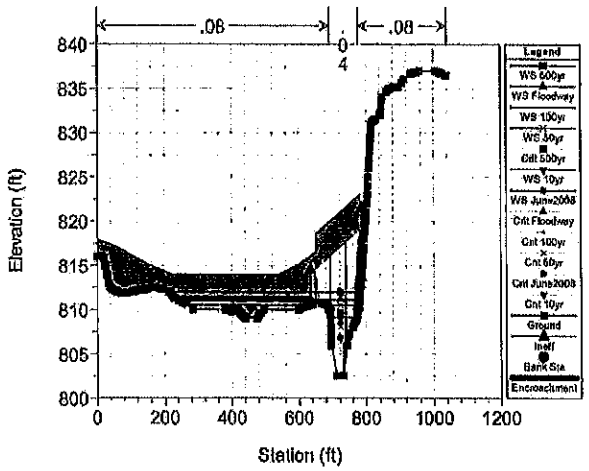
RS = 1 869 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

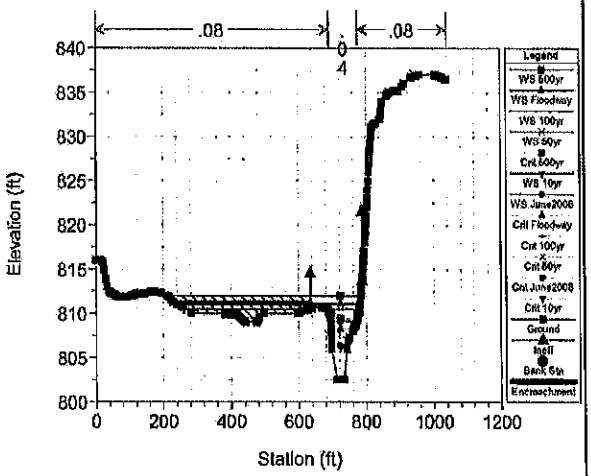
RS = 1 869 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

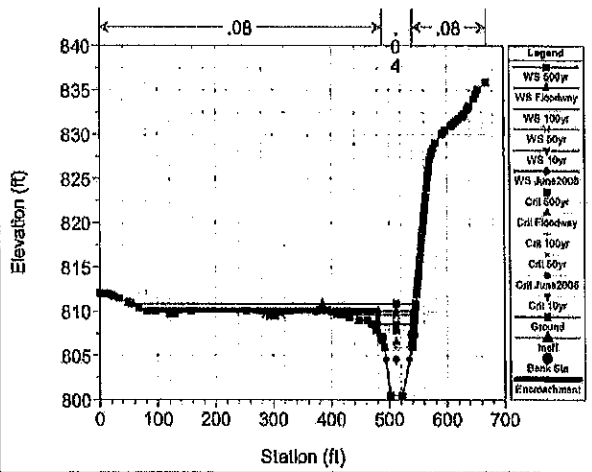
RS = 1 866



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

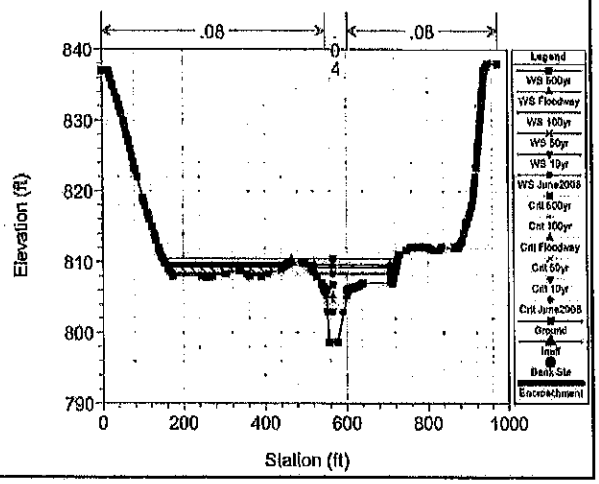
RS = 1 277



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

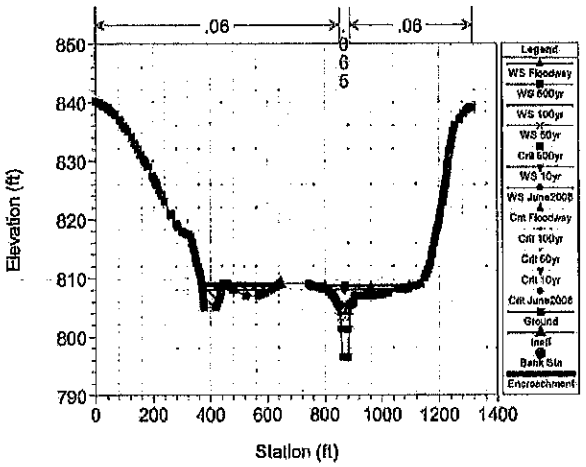
RS = 1 108



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

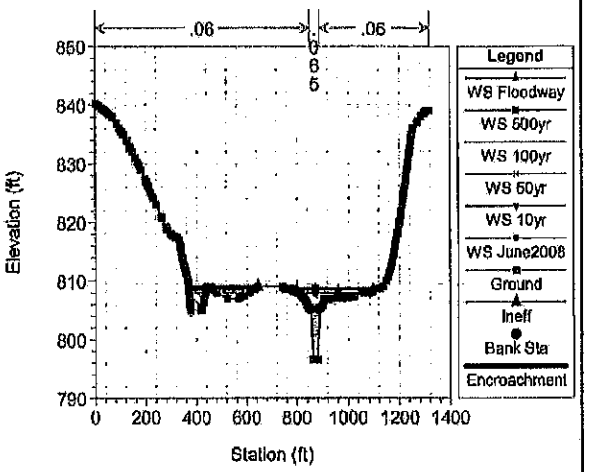
RS = 1.106



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

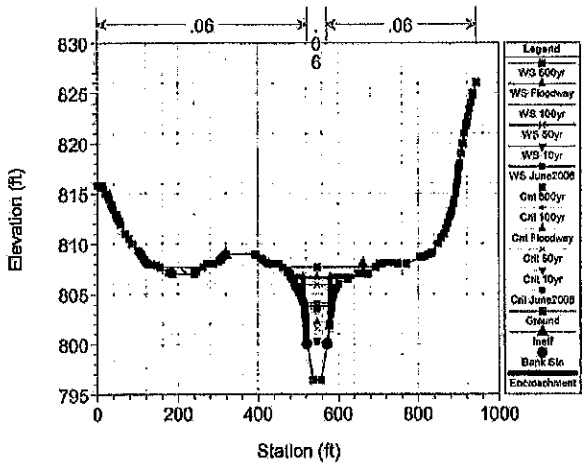
RS = 1.105 IS



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

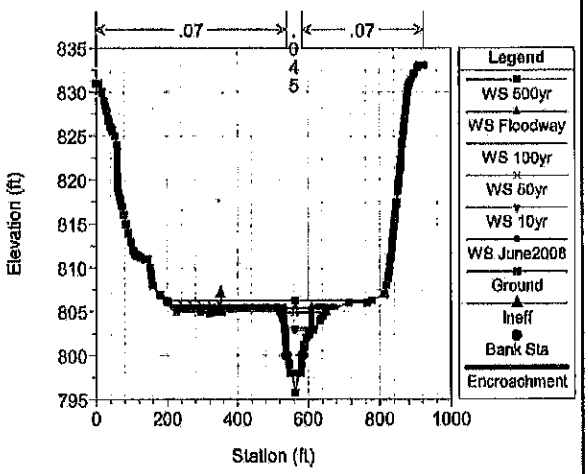
RS = 1.097



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

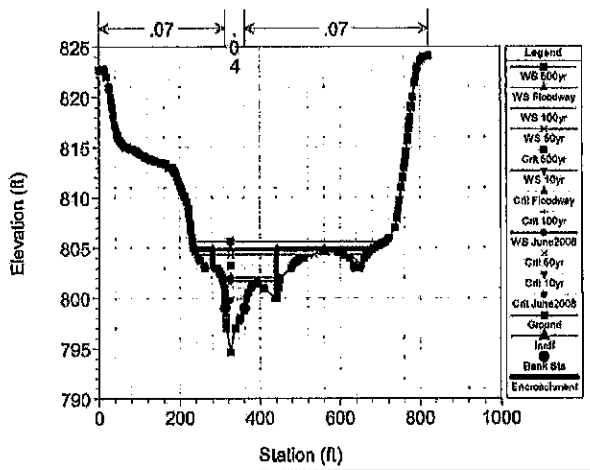
RS = 1.045



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

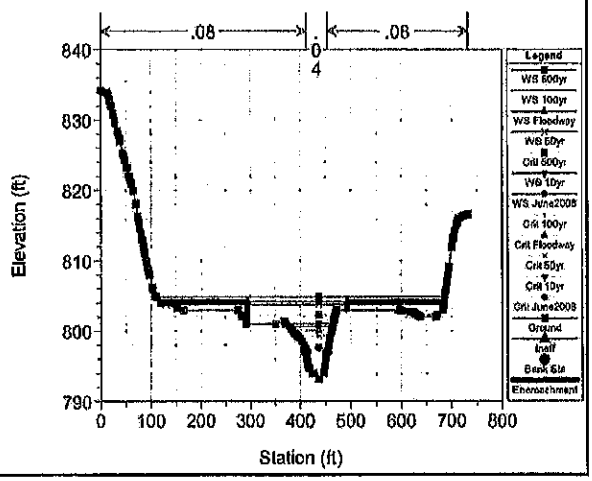
RS = 0.992

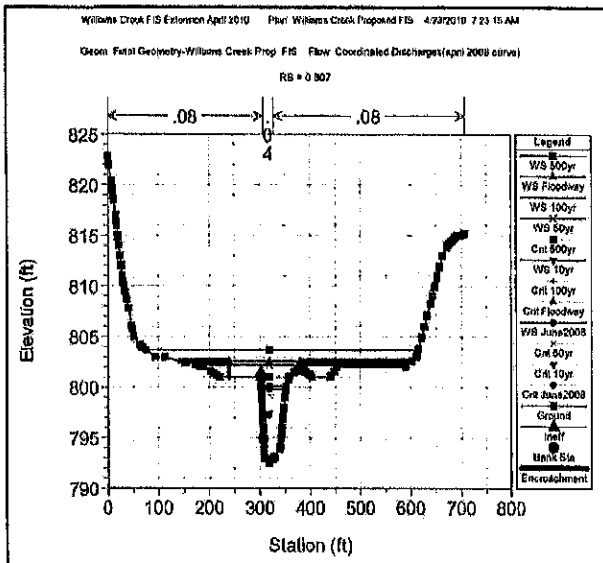


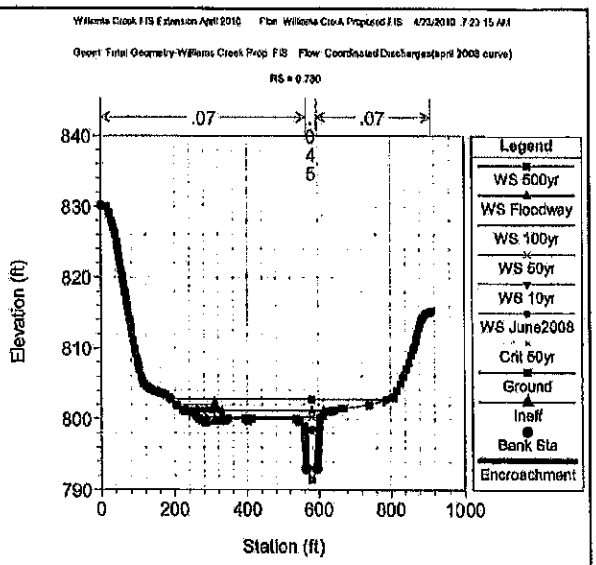
Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

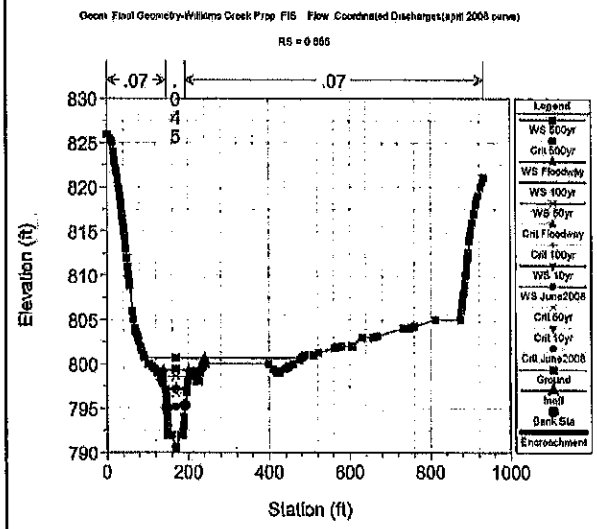
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

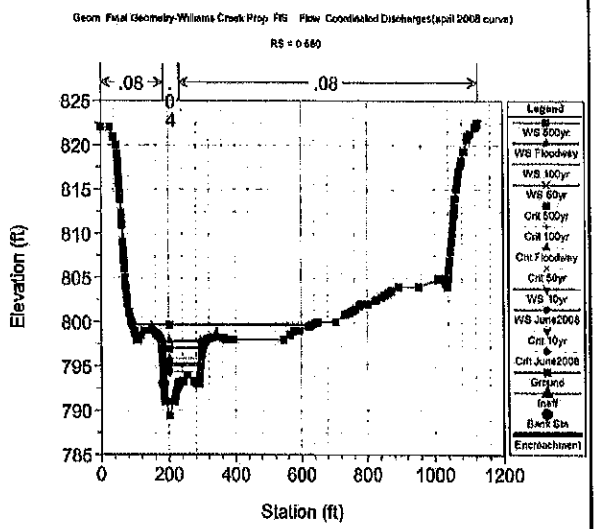
RS = 0.858

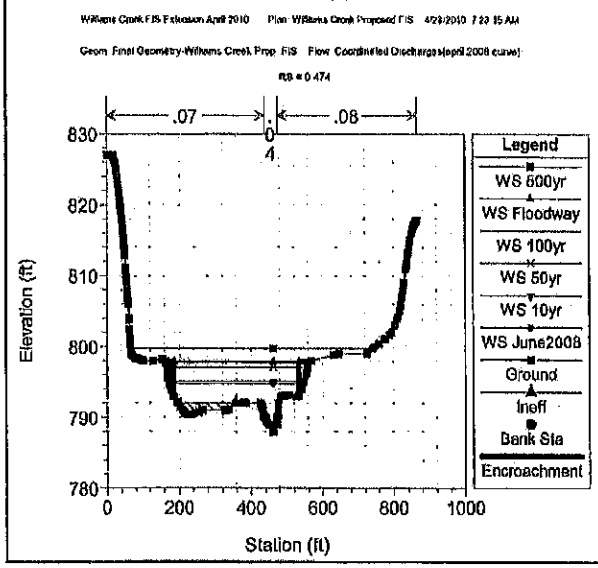


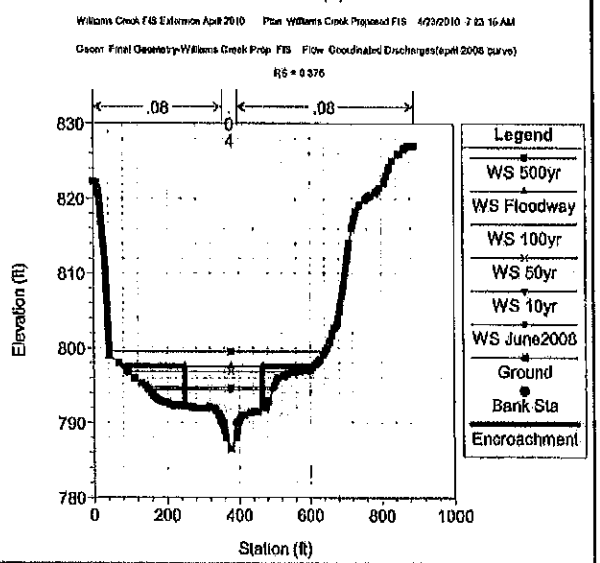

Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 0.807
.08
.08
.04
Elevation (ft)
Station (ft)
Legend
WS 500yr
WS Floodway
WS 100yr
WS 50yr
Crit 500yr
WS 10yr
Crit 100yr
Crit Floodway
WS June2008
Crit 50yr
Crit 10yr
Crit June2008
Ground
Ineff
Bank Sta
Encroachment


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 0.730
.07
.07
.045
Elevation (ft)
Station (ft)
Legend
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
WS June2008
Crit 50yr
Ground
Ineff
Bank Sta
Encroachment


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 0.666
.07
.07
.045
Elevation (ft)
Station (ft)
Legend
WS 500yr
Crit 500yr
WS Floodway
WS 100yr
WS 50yr
Crit Floodway
Crit 100yr
WS 10yr
WS June2008
Crit 50yr
Crit 10yr
Crit June2008
Ground
Ineff
Bank Sta
Encroachment


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 0.580
.08
.08
.04
Elevation (ft)
Station (ft)
Legend
WS 500yr
WS Floodway
WS 100yr
WS 50yr
Crit 500yr
Crit 100yr
Crit Floodway
Crit 50yr
WS 10yr
WS June2008
Crit 10yr
Crit June2008
Ground
Ineff
Bank Sta
Encroachment

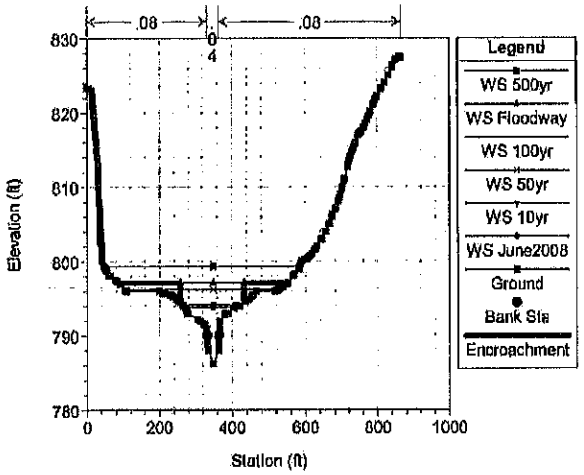

Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 0.474
.07
.08
.04
Elevation (ft)
Station (ft)
Legend
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
WS June2008
Ground
Ineff
Bank Sta
Encroachment


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)
RS = 0.376
.08
.08
.04
Elevation (ft)
Station (ft)
Legend
WS 500yr
WS Floodway
WS 100yr
WS 50yr
WS 10yr
WS June2008
Ground
Bank Sta
Encroachment

Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

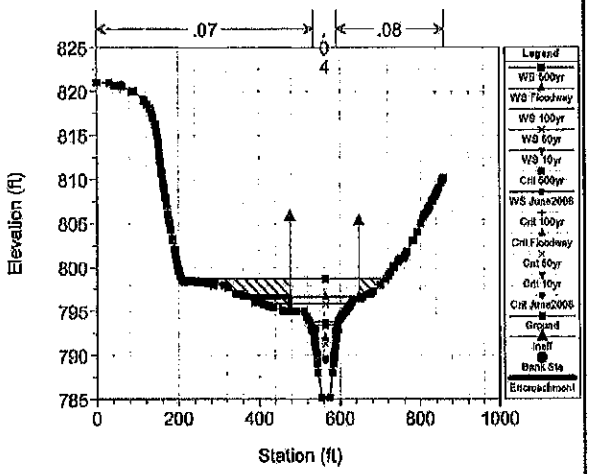
RS = 0.351



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

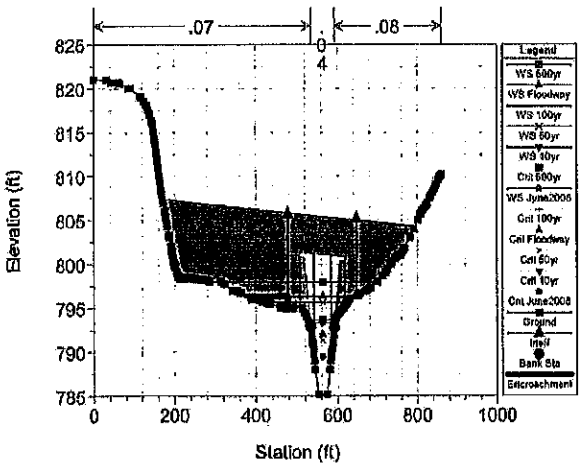
RS = 0.279



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

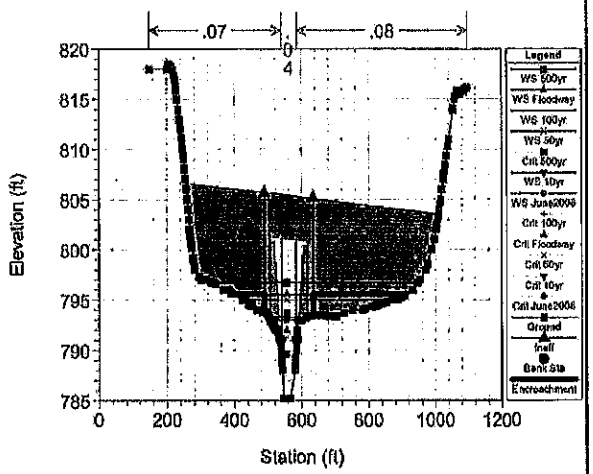
RS = 0.273 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

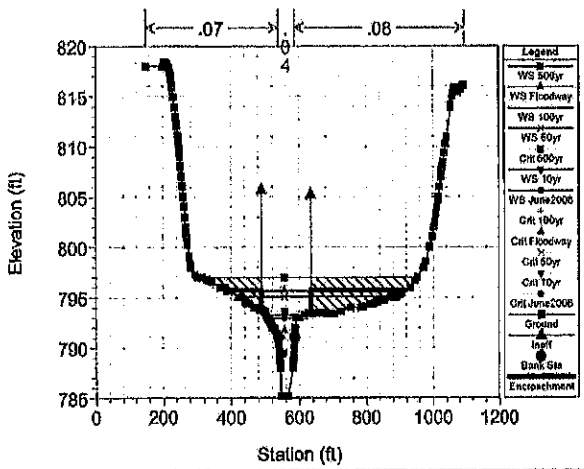
RS = 0.273 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

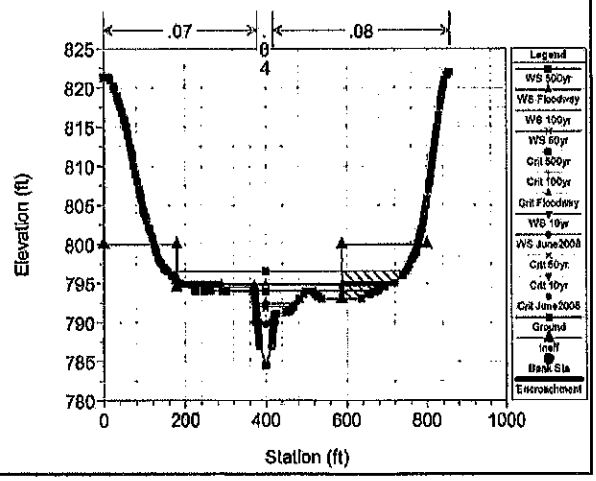
RS = 0.243



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:16 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

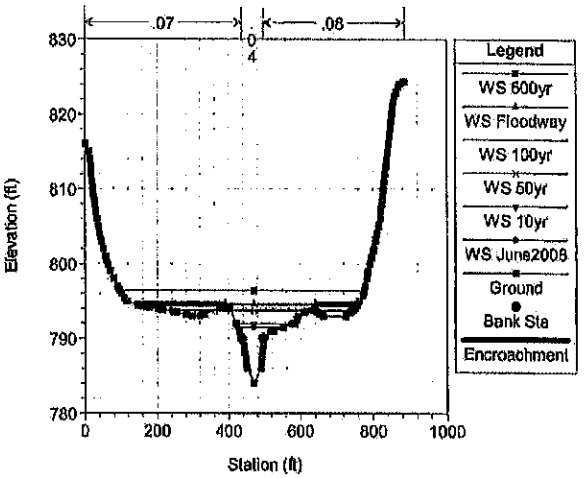
RS = 0.178



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

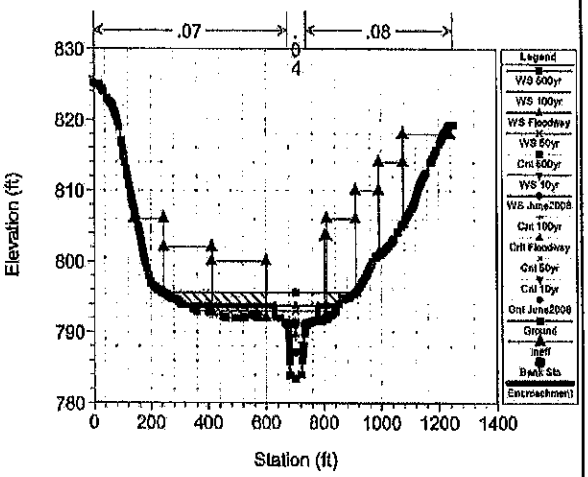
RS = 0.110



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

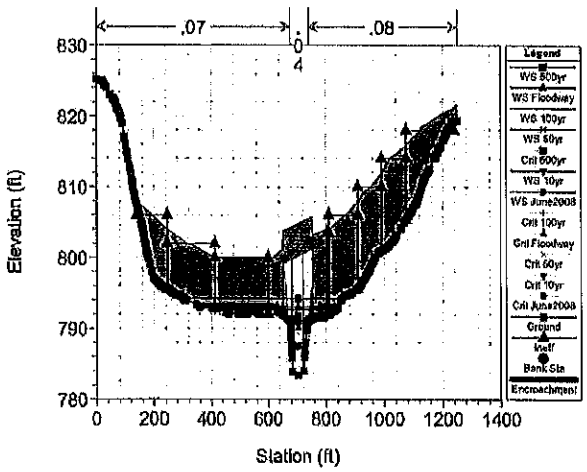
RS = 0.030



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

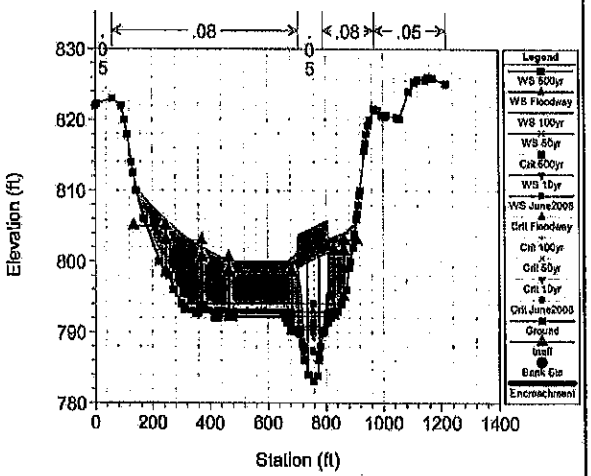
RS = 0.021 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

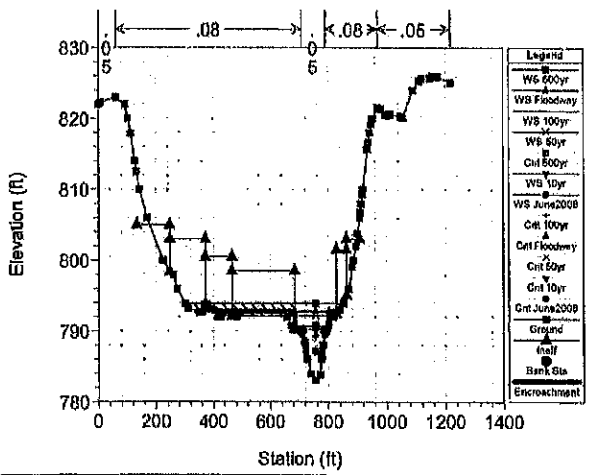
RS = 0.021 BR



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

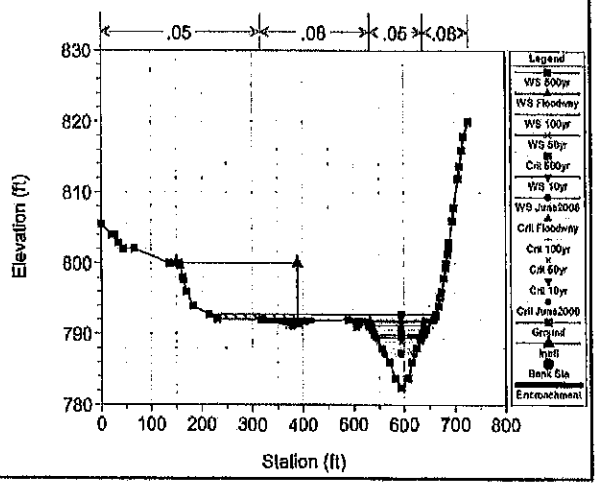
RS = 0.005



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

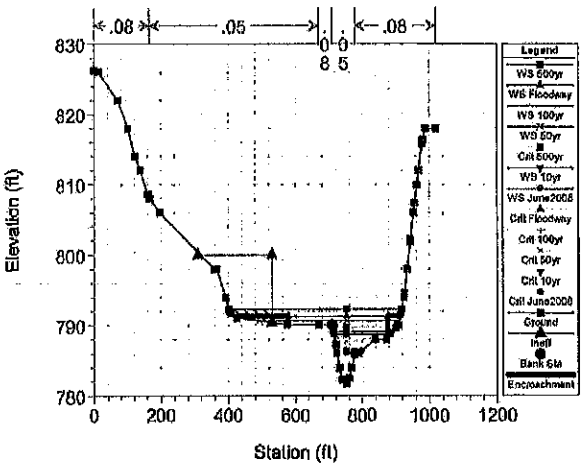
RS = 0.0004



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:21:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

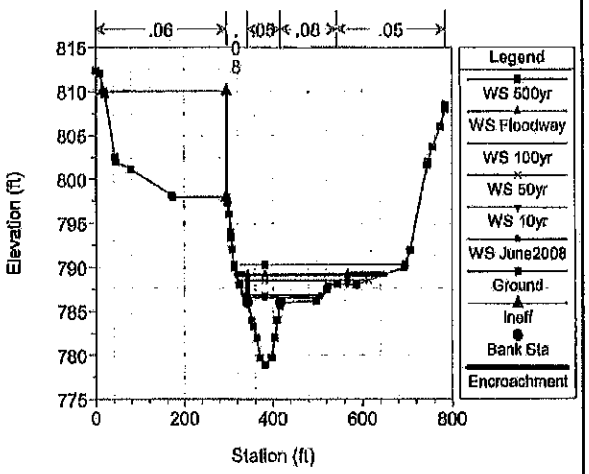
RS = 0.0003



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

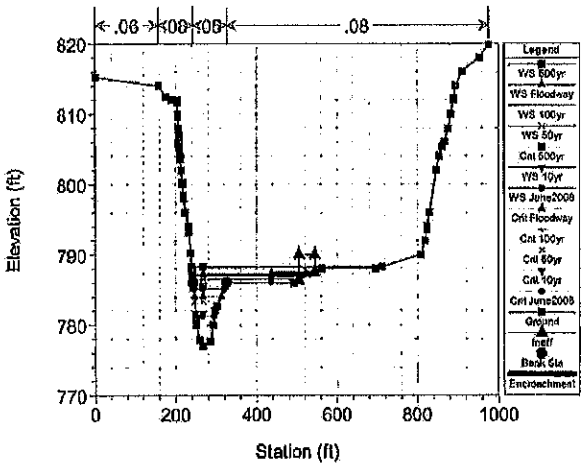
RS = 0.0002



Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM

Geom: Final Geometry-Williams Creek Prop FIS Flow: Coordinated Discharges(april 2008 curve)

RS = 0.0001



Encroachment Table 1

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP Profile: Floodway

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Width Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Hamilton Co CTP	9,022	Floodway	911.49	-0.01	911.49	676.16	4.82	155.36	7.33		78.26	588.45	
Hamilton Co CTP	8,943	Floodway	911.49	-0.01	911.49	424.56	14.82	127.80	24.38		68.68	252.17	
Hamilton Co CTP	8,867	Floodway	911.48	-0.01	911.49	46.00		167.00			343.05	692.04	
Hamilton Co CTP	8,663	Culvert											
Hamilton Co CTP	8,744	Floodway	905.20	0.19	905.21	24.00		167.00			627.80	716.18	
Hamilton Co CTP	8,658.66	Floodway	905.20	0.19	905.20	441.24	21.95	260.22	9.83		96.00	222.16	
Hamilton Co CTP	8,654	Floodway	905.19	0.20	905.20	328.14	16.62	261.18	14.20		92.76	238.81	
Hamilton Co CTP	8,542	Culvert											
Hamilton Co CTP	8,510	Floodway	896.82	0.02	896.86	52.00		292.00		281.00	276.58	360.43	383.00
Hamilton Co CTP	8,392	Floodway	896.64	0.00	896.85	108.16	44.91	98.97	148.12	225.84	245.15	296.98	337.00
Hamilton Co CTP	8,380	Floodway	895.68	0.01	896.51	19.69		292.00		291.27	291.27	311.26	311.26
Hamilton Co CTP	8,371	Floodway	895.40	0.06	895.65	47.29		291.53	0.47	307.71	307.71	364.02	365.00
Hamilton Co CTP	8,342	Floodway	895.46	0.05	895.48	112.87	0.14	269.25	22.61	303.40	303.93	374.76	415.27
Hamilton Co CTP	8,266	Floodway	895.32	0.05	895.36	56.17	00.20	220.06	11.74	335.46	362.06	367.71	393.63
Hamilton Co CTP	8,216	Floodway	895.26	0.05	895.29	76.05	53.16	224.52	14.32	55.00	82.60	113.36	180.95
Hamilton Co CTP	8,210	Culvert											
Hamilton Co CTP	8,194	Floodway	892.76	-0.02	892.95	45.62	41.39	219.73	30.88	83.19	96.83	116.64	128.81
Hamilton Co CTP	8,162	Floodway	891.07	0.06	891.87	28.91	3.99	275.32	12.69	116.29	119.07	136.13	144.30
Hamilton Co CTP	8,098	Floodway	891.17	0.00	891.17	164.44	13.01	264.12	14.07	189.20	192.00	322.00	333.64
Hamilton Co CTP	8,014	Floodway	891.13	0.00	891.13	145.72	24.36	252.42	16.22	120.96	143.00	257.00	267.66
Hamilton Co CTP	7,965	Floodway	890.13	0.02	890.99	22.57		292.00		127.00	127.00	153.00	153.00
Hamilton Co CTP	7,970	Floodway	886.46	0.06	888.63	30.00	4.66	272.25	15.09	120.41	128.11	144.19	150.41
Hamilton Co CTP	7,967	Floodway	886.41	0.07	888.52	43.87	1.46	265.25	4.29	159.02	162.33	187.45	202.89
Hamilton Co CTP	7,961	Culvert											
Hamilton Co CTP	7,952	Floodway	887.07	0.10	887.36	20.02		292.00		226.68	226.68	246.68	246.68
Hamilton Co CTP	7,917	Floodway	886.80	0.11	886.92	44.87		284.25	7.75	284.90	284.90	316.52	329.77
Hamilton Co CTP	7,797	Floodway	885.54	0.14	885.77	86.62		408.38	161.62	171.06	171.06	191.31	257.68
Hamilton Co CTP	7,770	Floodway	885.15	0.14	885.43	107.80		418.77	151.23	261.41	261.41	282.00	368.80
Hamilton Co CTP	7,726	Floodway	884.40	0.10	884.67	134.79	273.00	296.94		391.13	498.30	515.92	516.92
Hamilton Co CTP	7,633	Floodway	883.67	0.05	883.73	210.52	2.31	173.88	393.84	121.30	122.70	136.42	331.82
Hamilton Co CTP	7,527	Floodway	882.73	0.05	882.96	76.63	72.57	484.60	12.83	398.00	435.37	463.55	474.63
Hamilton Co CTP	7,520 BR U	Floodway	882.32	0.07	882.78	27.04		570.00		398.00	435.37	463.55	474.63
Hamilton Co CTP	7,520 BR D	Floodway	881.96	0.11	882.66	27.05	3.46	566.54	0.00	260.00	270.76	297.08	307.00
Hamilton Co CTP	7,510	Floodway	882.01	0.10	882.36	47.00	83.20	473.00	13.74	260.00	270.76	297.08	307.00
Hamilton Co CTP	7,472	Floodway	881.69	0.10	881.81	127.63	256.26	266.67	47.05	197.22	294.06	311.04	324.75
Hamilton Co CTP	7,435	Floodway	881.35	0.10	881.49	142.67	193.82	331.84	44.35	249.59	355.93	370.48	392.16
Hamilton Co CTP	7,350	Floodway	880.93	0.11	881.03	124.20	6.24	390.68	173.08	331.22	333.86	358.16	455.42
Hamilton Co CTP	7,326	Floodway	880.91	0.12	880.95	171.43	7.36	265.36	277.29	199.39	220.19	247.15	370.82
Hamilton Co CTP	7,268	Floodway	880.85	0.12	880.89	260.00	185.09	351.12	216.79	660.00	787.60	814.02	920.00
Hamilton Co CTP	7,265	Culvert											
Hamilton Co CTP	7,212	Floodway	879.23	0.05	879.31	258.59	362.73	351.72	38.55	330.00	480.25	502.44	588.69
Hamilton Co CTP	7,240	Floodway	879.10	0.04	879.17	196.41	250.88	352.11	150.30	360.00	481.47	491.36	556.41
Hamilton Co CTP	7,164	Floodway	878.39	0.06	878.61	55.24	54.18	698.73	0.09	447.98	466.30	503.00	503.22
Hamilton Co CTP	7,159 BR U	Floodway	877.85	0.09	878.44	29.00		755.00		447.98	466.30	503.00	503.22
Hamilton Co CTP	7,159 BR D	Floodway	877.57	0.14	878.23	29.00		753.00		398.48	400.38	439.10	450.52
Hamilton Co CTP	7,147	Floodway	877.64	0.13	877.90	52.04	6.57	715.34	31.09	398.48	400.38	439.10	450.52
Hamilton Co CTP	7,111	Floodway	876.63	0.13	877.20	117.41	170.44	582.56		328.00	423.52	445.41	445.41
Hamilton Co CTP	7,057	Floodway	876.49	0.09	876.59	235.00	291.79	462.13	9.08	365.00	582.38	596.05	600.00
Hamilton Co CTP	6,998	Floodway	876.67	0.06	876.98	107.49	243.00	503.14	6.85	137.51	219.45	230.82	245.00
Hamilton Co CTP	6,993	Floodway	874.37	0.09	874.68	121.57	44.50	564.79	143.71	166.15	180.16	204.22	267.78
Hamilton Co CTP	6,612	Floodway	873.81	0.09	873.96	100.69	38.73	553.52	160.76	261.30	292.11	327.93	362.19
Hamilton Co CTP	6,617	Floodway	873.08	0.07	873.29	134.09	64.25	579.25	109.49	144.25	170.73	196.61	279.24
Hamilton Co CTP	6,647	Floodway	872.85	0.07	872.93	121.63	170.62	449.30	133.08	139.05	194.39	220.41	260.68
Hamilton Co CTP	6,587	Floodway	872.59	0.08	872.73	94.00	63.87	670.96	16.15	268.00	312.33	347.46	382.00
Hamilton Co CTP	6,582 BR D	Floodway	872.49	0.09	872.71	38.46		724.86	28.14	268.00	312.33	347.45	382.00
Hamilton Co CTP	6,582 BR D	Floodway	870.42	0.09	870.63	38.83	2.17	750.83		543.91	547.52	597.97	601.65
Hamilton Co CTP	6,549	Floodway	870.42	0.09	870.60	47.74	2.08	747.95	3.02	543.91	547.52	597.97	601.65
Hamilton Co CTP	6,567	Culvert											
Hamilton Co CTP	6,549	Floodway	870.06	0.09	870.20	39.19		752.77	0.23	576.11	576.11	614.84	615.30
Hamilton Co CTP	6,463	Floodway	869.64	0.13	869.79	140.00	30.41	482.78	233.81	710.00	740.71	780.08	850.00
Hamilton Co CTP	6,453	Floodway	869.39	0.07	869.52	150.00	260.91	371.19	112.07	530.00	630.44	644.94	680.00
Hamilton Co CTP	6,405	Floodway	868.32	0.10	868.76	95.00	41.62	666.34	45.05	645.00	700.38	728.57	740.00
Hamilton Co CTP	6,396	Floodway	868.44	0.09	868.55	102.00	25.57	702.92	24.51	641.00	876.27	909.86	948.00
Hamilton Co CTP	6,389	Culvert											
Hamilton Co CTP	6,362	Floodway	868.29	0.09	868.41	42.00	1.63	751.37		871.00	873.75	924.57	913.00
Hamilton Co CTP	6,312	Floodway	867.61	0.09	868.02	52.02	56.95	656.76	99.28	754.35	774.66	795.72	806.37
Hamilton Co CTP	6,274	Floodway	867.14	0.08	867.56	65.12	70.69	643.42	30.89	587.30	611.91	649.07	672.42
Hamilton Co CTP	6,159	Floodway	866.96	0.14	866.17	160.00	105.57	632.71	114.72	610.00	693.70	723.50	770.00
Hamilton Co CTP	6,067	Floodway	865.47	0.09	865.57	240.00	295.28	430.27	27.45	200.00	379.92	409.02	440.00
Hamilton Co CTP	6,032	Floodway	864.94	0.08	865.12	149.29	25.23	671.51	50.26	660.00	597.67	655.90	709.29
Hamilton Co CTP	5,949	Floodway	864.61	0.08	864.58	259.33	14.23	473.42	266.35	160.35	166.45	212.23	419.72
Hamilton Co CTP	5,915	Floodway	864.27	0.07	864.41	262.60	6.75	407.67	338.58	174.00	199.29	217.00	436.60
Hamilton Co CTP	5,908	Floodway	864.20	0.07	864.35	244.75	7.70	434.60	310.50	202.00	231.00	250.00	446.75
Hamilton Co CTP	5,902	Floodway	863.89	0.05	863.99	226.08		393.67	356.33	203.05	203.06	228.29	420.09
Hamilton Co CTP	5,901	Floodway	863.36	0.05	863.54	79.00	75.10	627.00	60.00	170.00	205.21	241.63	258.00
Hamilton Co CTP	5,770	Culvert											
Hamilton Co CTP	5,777	Floodway	863.27	0.06	863.46	54.00	22.50	713.94	17.46	166.00	207.66	244.45	250.00
Hamilton Co CTP	5,749	Floodway	863.00	0.10	863.25	108.17	22.02	636.00	94.99	238.93	267.30	292.44	347.00
Hamilton Co CTP	5,731	Floodway	862.66	0.11	863.07	62.21	6.38	666.35	80.27	239.79	241.57	261.91	302.00
Hamilton Co CTP	5,704	Floodway	862.59	0.09	862.77	126.99	99.67	501.26	162.07	174.77	226.95	246.95	303.76
Hamilton Co CTP	5,658	Floodway	862.01	0.06	862.35	63.36		592.38	160.62	71.87	71.87	91.88	135.23
Hamilton Co CTP	5,589	Floodway	860.66	0.01	861.23	86.13	107.33	630.56	15.11	618.00	648.30	680.60	703.13
Hamilton Co CTP	5,583 BR U	Floodway	860.46	0.04	861.07	67.44	40.37	698.00	6.64	618.00	648.30	680.60	703.13
Hamilton Co CTP	5,583 BR D	Floodway	860.09	0.09	860.57	60.00	11.61	720.05	21.34	593.50	617.80	653.80	690.50
Hamilton Co CTP	5,560	Floodway	859.92	0.12	860.44	97.00	39.53	692.90	20.61	593.50	617.80	653.80	690.50
Hamilton Co CTP	5,534	Floodway	859.38	0.14	859.67	91.49	1.43	560.86	190.72	271.99	272.72	298.37	363.46
Hamilton Co CTP	5,493	Floodway	859.16	0.10	859.26	203.86	243.74	423.64	85.61	120.00	218.70	241.58	323.86

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HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP Profile: Floodway (Continued)

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Width Act	Q Left	Q Channel	Q Right	End Sta L	Ch Sta L	Ch Sta R	End Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Hamilton Co CTP	5.470	Floodway	858.93	0.11	859.09	254.12	109.19	502.65	142.26	104.53	142.95	176.46	359.65
Hamilton Co CTP	5.422	Floodway	858.65	0.11	858.86	370.12	95.26	560.30	615.42	116.94	151.77	187.25	489.06
Hamilton Co CTP	5.377	Floodway	858.28	0.12	858.36	284.44	89.59	427.72	782.69	105.29	144.21	166.49	389.73
Hamilton Co CTP	5.340	Floodway	857.91	0.13	858.05	288.63	302.49	480.82	496.69	99.81	213.05	232.92	359.44
Hamilton Co CTP	5.255	Floodway	857.06	0.14	857.30	202.62	518.01	761.99		144.65	319.65	347.07	347.07
Hamilton Co CTP	5.152	Floodway	855.93	0.09	856.17	151.36	320.34	553.65	399.81	136.90	187.37	206.36	200.26
Hamilton Co CTP	5.125	Floodway	855.66	0.09	855.87	136.57	536.63	585.95	105.22	160.10	236.98	267.43	260.07
Hamilton Co CTP	5.077	Floodway	855.09	0.11	855.31	168.62		525.33	754.67	286.81	286.81	306.05	447.33
Hamilton Co CTP	5.025	Floodway	854.72	0.11	854.84	114.50	538.17	592.78	111.05	171.00	230.00	260.00	265.50
Hamilton Co CTP	5.021	BR U	854.62	0.12	854.76	69.95	462.78	605.11	12.11	171.00	230.00	260.00	265.50
Hamilton Co CTP	5.021	BR D	854.45	0.13	854.71	69.87	462.20	807.56	10.24	151.00	230.00	260.00	275.50
Hamilton Co CTP	5.011		854.45	0.12	854.63	94.50	514.54	699.89	65.57	181.00	230.00	260.00	275.50
Hamilton Co CTP	4.981	Floodway	854.22	0.11	854.41	176.51	284.62	970.54	74.83	307.41	383.23	435.25	465.92
Hamilton Co CTP	4.923	Floodway	853.56	0.12	853.82	219.08	300.35	769.57	210.09	325.37	405.32	435.34	544.46
Hamilton Co CTP	4.777	Floodway	852.69	0.12	852.79	238.01	639.85	640.16		314.94	509.60	552.95	552.95
Hamilton Co CTP	4.709	Floodway	852.40	0.05	852.46	272.64	6.08	550.39	623.56	247.40	250.98	289.98	520.00
Hamilton Co CTP	4.651	Floodway	852.01	0.04	852.19	116.00	117.89	923.59	238.53	367.60	403.81	440.70	492.60
Hamilton Co CTP	4.646	BR U	851.89	0.07	851.99	51.46	6.76	1231.19	42.05	367.60	403.81	440.70	492.60
Hamilton Co CTP	4.646	BR D	850.80	0.13	851.68	48.24	7.94	1230.80	41.17	377.60	400.40	440.70	474.40
Hamilton Co CTP	4.633	Floodway	850.87	0.13	851.28	96.80	70.76	1034.42	174.82	377.60	400.40	440.70	474.40
Hamilton Co CTP	4.603	Floodway	850.65	0.14	850.81	168.66	146.71	526.61	504.48	220.34	261.82	293.43	389.00
Hamilton Co CTP	4.571	Floodway	850.19	0.08	850.44	189.42		600.07	670.93	90.56	90.56	114.22	280.00
Hamilton Co CTP	4.543	Floodway	849.82	0.07	850.06	171.16	163.80	772.61	343.58	142.05	205.27	235.56	313.21
Hamilton Co CTP	4.513	Floodway	849.47	0.04	849.73	152.18	170.60	857.97	251.35	98.45	146.64	185.10	280.64
Hamilton Co CTP	3.447	Floodway	849.20	0.03	849.27	283.16		466.59	810.41	250.67	250.67	276.65	513.73
Hamilton Co CTP	4.313		848.98	0.00	849.01	294.68	44.95	353.45	881.60	122.26	144.02	168.70	416.94
Hamilton Co CTP	4.274		848.95	0.00	848.97	306.14	146.90	320.22	812.89	141.77	189.28	214.68	447.91
Hamilton Co CTP	4.219	Floodway	848.65	-0.01	848.84	89.79	67.43	1063.34	149.23	256.14	263.05	326.21	346.00
Hamilton Co CTP	4.213	BR U	847.37	-0.01	848.49	37.08	84.87	1195.13		256.14	263.65	326.21	346.00
Hamilton Co CTP	4.213	BR D	846.78	0.02	847.50	31.70	1.83	1278.17		475.00	484.00	517.59	545.60
Hamilton Co CTP	4.200	Floodway	845.85	0.02	846.75	70.21	13.00	1181.49	85.51	475.00	484.89	517.59	545.60
Hamilton Co CTP	4.167	Floodway	845.29	0.10	845.66	200.00	26.84	766.90	486.47	76.00	89.45	107.65	275.00
Hamilton Co CTP	4.111	Floodway	844.55	0.05	844.81	148.98		862.35	417.65	101.44	101.44	145.40	250.42
Hamilton Co CTP	3.977	Floodway	843.51	0.08	843.81	227.25	289.22	458.44	532.34	199.76	283.03	305.78	427.00
Hamilton Co CTP	3.879	Floodway	842.51	0.11	842.77	238.64	602.01	961.61	126.49	370.88	552.57	584.12	615.72
Hamilton Co CTP	3.785	Floodway	841.89	0.11	842.19	200.09	330.99	1188.23	480.78	419.62	585.06	677.26	519.71
Hamilton Co CTP	3.729	Floodway	841.40	0.12	841.67	191.89	270.22	1352.97	376.81	605.09	655.72	605.75	695.98
Hamilton Co CTP	3.651	Floodway	840.12	0.10	840.87	132.59	21.87	1629.01	349.12	600.36	604.04	551.25	932.95
Hamilton Co CTP	3.582	Floodway	839.11	0.14	839.49	211.16	198.14	1073.68	726.18	314.44	367.30	394.10	526.60
Hamilton Co CTP	3.494	Floodway	838.37	0.14	838.52	468.14	672.14	907.07	420.76	190.00	517.73	554.91	556.14
Hamilton Co CTP	3.320	Floodway	836.82	0.10	837.06	247.57	927.90	859.23	781.97	153.60	238.75	272.33	401.37
Hamilton Co CTP	3.245	Floodway	835.71	0.09	836.08	260.00	3.66	1257.31	720.03	60.00	81.76	110.88	340.00
Hamilton Co CTP	3.127	Floodway	834.68	0.09	834.88	190.00	0.92	1590.55	405.50	60.00	61.98	125.82	250.00
Hamilton Co CTP	2.921	Floodway	831.12	0.09	831.93	75.86		1953.57	36.43	33.12	33.12	85.91	110.00
Hamilton Co CTP	2.860	Floodway	830.50	0.06	830.84	185.93	295.09	1330.41	374.50	115.85	183.33	219.45	304.76
Hamilton Co CTP	2.811	Floodway	830.21	0.08	830.41	164.30		1703.37	296.63	19.00	19.00	97.00	176.00
Hamilton Co CTP	2.801	BR U	829.94	0.09	830.30	74.08		2000.00		19.00	19.00	97.00	176.00
Hamilton Co CTP	2.801	BR D	829.88	0.09	830.23	72.79		2000.00		64.00	64.00	142.00	161.00
Hamilton Co CTP	2.787	Floodway	829.81	0.10	830.13	92.44		1913.18	86.82	64.00	64.00	142.00	161.00
Hamilton Co CTP	2.763	Floodway	829.26	0.10	829.72	162.83	41.47	1448.53	510.00	124.17	139.26	176.95	277.00
Hamilton Co CTP	2.652	Floodway	828.89	0.12	828.98	346.38		911.13	1088.87	31.62	31.62	74.17	380.00
Hamilton Co CTP	2.584	Floodway	827.40	-0.01	828.34	190.00	281.62	2003.07	195.31	265.00	380.62	417.94	455.00
Hamilton Co CTP	2.572	Floodway	828.99	0.05	828.03	175.13	245.22	2191.80	43.45	205.00	420.49	462.06	470.13
Hamilton Co CTP	2.525	Floodway	826.42	0.09	826.89	184.18	51.72	1884.80	563.47	226.00	238.31	278.79	410.18
Hamilton Co CTP	2.494	Floodway	826.51	0.08	825.87	190.88	561.65	1911.70	0.64	345.68	478.74	632.69	636.58
Hamilton Co CTP	2.401	Floodway	825.25	0.07	825.54	246.69	614.23	1863.79	1.98	407.61	672.23	731.95	734.30
Hamilton Co CTP	2.263	Floodway	823.39	0.01	823.96	239.05	360.45	2066.34	44.22	275.95	459.89	501.45	515.00
Hamilton Co CTP	2.202	Floodway	822.55	0.02	823.06	351.67	947.27	1492.80	39.94	110.00	428.64	456.00	461.87
Hamilton Co CTP	2.090	Floodway	821.54	0.11	821.67	220.00	12.16	1929.44	538.42	85.00	89.95	147.04	305.00
Hamilton Co CTP	2.033	Floodway	820.15	0.11	821.08	222.79	938.63	2144.37		105.00	344.67	367.79	367.79
Hamilton Co CTP	1.976	Floodway	819.63	0.10	820.00	105.00	511.22	1966.84	1.94	165.00	275.46	339.01	340.00
Hamilton Co CTP	1.922	Floodway	818.79	0.11	819.32	245.69	20.16	1937.41	522.43	170.00	178.98	225.29	416.69
Hamilton Co CTP	1.816	Floodway	817.24	0.09	817.85	331.87	366.36	1891.77	221.87	76.39	219.75	266.73	409.76
Hamilton Co CTP	1.641	Floodway	815.59	0.04	816.94	297.71	745.76	1371.53	382.71	141.02	221.37	247.26	438.73
Hamilton Co CTP	1.603	Floodway	814.67	0.12	815.48	176.00	68.40	1869.08	542.46	57.00	64.73	91.79	235.00
Hamilton Co CTP	1.492	Floodway	812.88	0.13	813.56	110.37		2187.47	292.53	181.63	181.63	235.27	300.00
Hamilton Co CTP	1.419	Floodway	812.00	0.07	812.43	97.55	9.04	2470.96		310.48	314.78	398.03	398.03
Hamilton Co CTP	1.373	Floodway	811.59	0.09	811.96	134.47	317.16	2136.23	26.61	635.00	697.74	756.15	769.47
Hamilton Co CTP	1.369	BR U	811.84	0.10	811.87	103.60	210.24	2243.52	26.23	635.00	697.74	756.15	769.47
Hamilton Co CTP	1.369	BR D	811.20	0.12	811.77	102.90	14.73	2485.27		635.00	692.02	777.06	777.06
Hamilton Co CTP	1.356		811.17	0.12	811.59	142.06	17.43	2482.57		635.00	692.02	777.06	777.06
Hamilton Co CTP	1.277	Floodway	810.07	0.03	810.65	59.90	25.31	2454.69		481.42	488.13	541.32	541.32
Hamilton Co CTP	1.195	Floodway	809.62	0.02	809.98	164.06	69.60	2379.92	350.48	522.00	549.62	604.49	706.06
Hamilton Co CTP	1.106	Floodway	808.61	0.14	809.14	296.03	191.07	1999.02	809.90	800.00	851.37	888.70	1096.03
Hamilton Co CTP	1.105		Inl Struct										
Hamilton Co CTP	1.097	Floodway	806.72	0.12	807.17	68.31	116.34	2559.85	123.82	512.27	522.60	572.85	580.69
Hamilton Co CTP	1.046	Floodway	805.48	0.10	806.26	75.39	62.85	2494.55	242.60	533.88	540.98	585.06	609.25
Hamilton Co CTP	0.962	Floodway	804.91	0.12	805.24	159.62	113.71	2052.76	633.53	282.01	313.38	352.65	441.63
Hamilton Co CTP	0.856	Floodway	804.20	-0.01	804.69	189.25	646.49	2343.21	110.30	293.75	412.30	454.10	493.00
Hamilton Co CTP	0.807	Floodway	802.86	0.01	803.97	139.97	214.55	2201.05	684.40	239.65	307.94	327.66	379.62
Hamilton Co CTP	0.730	Floodway	801.22	0.08	802.23	283.10	550.03	2460.92	90.05	330.16	565.50	585.96	613.26
Hamilton Co CTP	0.666	Floodway	799.34	0.10	800.60	60.00	40.91	3013.09	41.00	140.00	147.03	192.32	200.00
Hamilton Co CTP	0.580	Floodway	797.85	0.14	798.50	109.82		2302.39	797.61	185.11	185.11	231.76	295.00
Hamilton Co CTP	0.474	Floodway	797.88	0.10	797.93	349.64	1870.32	951.99	277.69	184.79	438.47	474.67	634.33
Hamilton Co CTP	0.376	Floodway	797.54	0.00	797.60	216.17	835.49	1623.55	640.96	250.00	355.65	396.74	456.17
Hamilton Co CTP	0.351	Floodway	797.11	0.00	797.56	175.19	649.54	2003.86	446.60	256.43	332.70	364.65	493.62
Hamilton Co CTP	0.270	Floodway	796.85	0.06	797.09	170.60	142.21	2895.25	62.54	477.01	535.08	592.84	647.51

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP Profile: Floodway (Continued)

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Width Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Hamilton Co CTP	0.273 BR U	Floodway	796.32	0.06	796.98	56.75	24.94	3066.45	6.62	477.01	535.08	592.84	647.51
Hamilton Co CTP	0.273 BR D	Floodway	795.59	0.09	796.45	63.69	56.08	3003.22	40.71	490.00	536.71	586.57	634.51
Hamilton Co CTP	0.243	Floodway	795.70	0.09	796.20	144.51	267.21	2657.67	164.93	490.00	536.71	586.57	634.51
Hamilton Co CTP	0.175	Floodway	794.94	0.12	795.56	299.50	101.95	2420.35	577.70	280.50	376.20	416.79	588.00
Hamilton Co CTP	0.110	Floodway	794.68	0.05	794.02	251.00	108.66	2566.62	424.82	301.00	437.95	496.88	642.00
Hamilton Co CTP	0.030	Floodway	793.73	-0.02	794.26	150.00	135.93	3222.63	121.44	630.00	677.40	740.76	780.00
Hamilton Co CTP	0.021 BR U	Floodway	793.12	0.06	794.01	76.02	40.48	3435.40	4.14	630.00	677.40	740.76	780.00
Hamilton Co CTP	0.021 BR D	Floodway	792.99	0.09	793.78	74.48	0.00	3459.81	20.19	664.66	708.77	791.64	803.33
Hamilton Co CTP	.0005	Floodway	792.62	0.09	793.80	118.67	117.27	3318.56	44.17	664.66	708.77	791.64	803.33
Hamilton Co CTP	0.0004	Floodway	791.59	0.13	792.46	105.68		3480.00		532.82	532.82	638.50	638.50
Hamilton Co CTP	0.0003	Floodway	791.33	0.14	791.62	298.00	224.29	2406.21	849.50	577.76	710.17	778.77	876.65
Hamilton Co CTP	0.0002	Floodway	789.21	0.14	789.66	223.68		2688.43	593.57	343.27	343.27	410.26	566.65
Hamilton Co CTP	0.0001	Floodway	787.49	0.10	787.76	194.92		3311.05	168.95	242.54	242.54	320.04	436.69

Standard Table 1

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	9.022	100yr	167.00	901.00	911.50		911.50	0.000000	0.03	6080.16	676.29	0.00
Hamilton Co CTP	9.022	Floodway	167.00	901.00	911.49		911.49	0.000000	0.03	6073.26	676.16	0.00
Hamilton Co CTP	9.022	10yr	84.00	901.00	905.24		905.24	0.000000	0.04	2252.11	554.50	0.00
Hamilton Co CTP	9.022	50yr	141.00	901.00	911.30		911.30	0.000000	0.03	5947.23	673.05	0.00
Hamilton Co CTP	9.022	500yr	256.00	901.00	912.00		912.00	0.000000	0.04	6422.20	682.60	0.00
Hamilton Co CTP	8.943	100yr	167.00	901.00	911.50		911.50	0.000000	0.07	2739.70	424.70	0.00
Hamilton Co CTP	8.943	Floodway	167.00	901.00	911.49		911.49	0.000000	0.07	2735.37	424.66	0.00
Hamilton Co CTP	8.943	10yr	84.00	901.00	905.23		905.24	0.000002	0.11	772.00	206.30	0.01
Hamilton Co CTP	8.943	50yr	141.00	901.00	911.30		911.30	0.000000	0.06	2656.37	421.96	0.00
Hamilton Co CTP	8.943	500yr	256.00	901.00	912.00		912.00	0.000001	0.11	2955.22	431.65	0.01
Hamilton Co CTP	8.867	100yr	167.00	901.00	911.49	901.75	911.50	0.000006	0.35	462.70	818.20	0.02
Hamilton Co CTP	8.867	Floodway	167.00	901.00	911.48	901.75	911.49	0.000006	0.35	462.29	818.20	0.02
Hamilton Co CTP	8.867	10yr	84.00	901.00	905.23	901.47	905.23	0.000031	0.43	194.64	358.84	0.04
Hamilton Co CTP	8.867	50yr	141.00	901.00	911.30	901.66	911.30	0.000004	0.30	473.73	818.20	0.02
Hamilton Co CTP	8.867	500yr	256.00	901.00	912.00	901.98	912.00	0.000012	0.61	505.78	818.20	0.03
Hamilton Co CTP	8.863		Culvert									
Hamilton Co CTP	8.744	100yr	167.00	896.00	905.00	899.20	905.02	0.000087	1.00	166.56	208.27	0.07
Hamilton Co CTP	8.744	Floodway	167.00	896.00	905.20	899.20	905.21	0.000079	0.98	171.23	213.93	0.06
Hamilton Co CTP	8.744	10yr	84.00	896.00	902.11	898.78	902.12	0.000133	0.87	97.03	139.18	0.08
Hamilton Co CTP	8.744	50yr	141.00	896.00	905.00	899.08	905.01	0.000062	0.85	166.57	208.28	0.06
Hamilton Co CTP	8.744	500yr	256.00	896.00	905.14	899.58	905.17	0.000191	1.51	169.81	212.26	0.10
Hamilton Co CTP	8.658	100yr	292.00	898.00	905.00		905.00	0.000008	0.30	1122.14	404.37	0.02
Hamilton Co CTP	8.658	Floodway	292.00	898.00	905.20		905.20	0.000007	0.29	1204.52	441.24	0.02
Hamilton Co CTP	8.658	10yr	140.00	898.00	902.10		902.10	0.000011	0.28	573.63	181.07	0.02
Hamilton Co CTP	8.658	50yr	240.00	898.00	905.00		905.00	0.000005	0.25	1122.22	404.41	0.02
Hamilton Co CTP	8.658	500yr	433.00	898.00	905.14		905.14	0.000016	0.44	1179.56	430.40	0.03
Hamilton Co CTP	8.654	100yr	292.00	898.00	905.00	898.57	905.00	0.000010	0.34	885.29	272.91	0.02
Hamilton Co CTP	8.654	Floodway	292.00	898.00	905.19	898.57	905.20	0.000005	0.25	1359.85	328.14	0.02
Hamilton Co CTP	8.654	10yr	140.00	898.00	902.09	898.35	902.09	0.000013	0.28	505.21	178.79	0.02
Hamilton Co CTP	8.654	50yr	240.00	898.00	905.00	898.60	905.00	0.000004	0.21	1301.37	273.20	0.01
Hamilton Co CTP	8.654	500yr	433.00	898.00	905.13	898.73	905.14	0.000011	0.37	1340.14	310.83	0.02
Hamilton Co CTP	8.542		Culvert									
Hamilton Co CTP	8.510	100yr	292.00	893.00	896.80	894.00	896.84	0.000421	1.48	197.25	154.38	0.13
Hamilton Co CTP	8.510	Floodway	292.00	893.00	896.82	894.00	896.86	0.000488	1.47	198.44	52.00	0.13
Hamilton Co CTP	8.510	10yr	140.00	893.00	895.64	893.61	896.65	0.000328	1.02	136.80	103.47	0.11
Hamilton Co CTP	8.510	50yr	240.00	893.00	896.45	893.88	896.47	0.000395	1.34	178.79	136.80	0.13
Hamilton Co CTP	8.510	500yr	433.00	893.00	897.69	894.30	897.74	0.000459	1.76	243.52	165.48	0.14
Hamilton Co CTP	8.392	100yr	292.00	893.00	896.63		896.65	0.000205	1.26	366.02	340.69	0.12
Hamilton Co CTP	8.392	Floodway	292.00	893.00	896.64		896.65	0.000222	1.31	330.01	108.16	0.12
Hamilton Co CTP	8.392	10yr	140.00	893.00	895.48		895.49	0.000212	0.99	222.76	316.69	0.11
Hamilton Co CTP	8.392	50yr	240.00	893.00	896.28		896.29	0.000206	1.16	321.59	332.74	0.11
Hamilton Co CTP	8.392	500yr	433.00	893.00	897.49		897.50	0.000280	1.69	587.92	353.53	0.14
Hamilton Co CTP	8.380	100yr	292.00	893.00	895.57	895.57	896.51	0.020224	7.80	37.59	21.18	1.00
Hamilton Co CTP	8.380	Floodway	292.00	893.00	895.58	895.58	896.51	0.020416	7.75	37.69	19.99	0.99
Hamilton Co CTP	8.380	10yr	140.00	893.00	894.74	894.74	895.38	0.022767	6.46	21.71	16.93	1.00
Hamilton Co CTP	8.380	50yr	240.00	893.00	895.39	895.33	896.17	0.021077	7.34	32.73	19.98	1.00
Hamilton Co CTP	8.380	500yr	433.00	893.00	896.16	896.16	897.34	0.017571	8.73	51.04	24.69	0.98
Hamilton Co CTP	8.371	100yr	292.00	891.00	895.43	892.97	895.49	0.000608	1.96	153.15	143.34	0.19
Hamilton Co CTP	8.371	Floodway	292.00	891.00	895.49	892.97	895.55	0.000603	1.94	151.88	47.29	0.19
Hamilton Co CTP	8.371	10yr	140.00	891.00	893.78	892.27	893.84	0.001429	1.96	71.39	42.49	0.27
Hamilton Co CTP	8.371	50yr	240.00	891.00	895.23	892.78	895.27	0.000514	1.73	142.42	141.91	0.18
Hamilton Co CTP	8.371	500yr	433.00	891.00	895.97	893.51	896.06	0.000791	2.48	181.78	147.15	0.23
Hamilton Co CTP	8.342	100yr	292.00	890.00	895.40	892.41	895.42	0.000249	1.20	340.09	209.39	0.12
Hamilton Co CTP	8.342	Floodway	292.00	890.00	895.46	892.41	895.48	0.000263	1.25	275.76	112.37	0.13
Hamilton Co CTP	8.342	10yr	140.00	890.00	893.59	891.62	893.64	0.001109	1.62	86.17	56.24	0.23
Hamilton Co CTP	8.342	50yr	240.00	890.00	895.20	892.11	895.22	0.000224	1.09	296.46	196.96	0.12
Hamilton Co CTP	8.342	500yr	433.00	890.00	895.95	892.99	895.97	0.000274	1.41	461.31	236.06	0.13
Hamilton Co CTP	8.266	100yr	292.00	890.00	895.27		895.31	0.000316	1.80	246.66	117.81	0.16
Hamilton Co CTP	8.266	Floodway	292.00	890.00	895.32		895.36	0.000331	1.85	199.66	58.17	0.16
Hamilton Co CTP	8.266	10yr	140.00	890.00	893.15		893.22	0.000976	2.09	76.30	46.69	0.23
Hamilton Co CTP	8.266	50yr	240.00	890.00	895.09		895.12	0.000260	1.59	224.55	111.46	0.13
Hamilton Co CTP	8.266	500yr	433.00	890.00	895.78		895.83	0.000414	2.21	310.32	135.45	0.17
Hamilton Co CTP	8.216	100yr	292.00	888.41	895.21	891.45	895.24	0.000188	1.47	259.26	89.23	0.12
Hamilton Co CTP	8.216	Floodway	292.00	888.41	895.26	891.45	895.29	0.000176	1.43	257.17	75.95	0.11
Hamilton Co CTP	8.216	10yr	140.00	888.41	893.00	890.63	893.04	0.000444	1.64	100.78	58.97	0.16

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	8.216	50yr	240.00	888.41	895.04	891.20	895.06	0.000146	1.26	244.38	84.18	0.10
Hamilton Co CTP	8.216	500yr	433.00	888.41	895.70	892.00	895.74	0.000285	1.99	305.80	103.28	0.14
Hamilton Co CTP	8.210		Culvert									
Hamilton Co CTP	8.194	100yr	292.00	888.30	892.80	891.72	892.84	0.002119	3.48	114.63	67.58	0.35
Hamilton Co CTP	8.194	Floodway	292.00	888.30	892.78	891.73	892.86	0.002306	3.62	100.36	45.62	0.37
Hamilton Co CTP	8.194	10yr	140.00	888.30	891.86	890.95	891.98	0.002430	2.91	58.29	50.20	0.36
Hamilton Co CTP	8.194	50yr	240.00	888.30	892.51	891.50	892.65	0.002250	3.35	95.65	62.73	0.36
Hamilton Co CTP	8.194	500yr	433.00	888.30	893.39	892.14	893.56	0.002056	3.87	167.46	75.65	0.36
Hamilton Co CTP	8.182	100yr	292.00	886.20	891.00	891.00	891.87	0.025141	7.65	41.74	28.01	0.92
Hamilton Co CTP	8.182	Floodway	292.00	886.20	891.07	891.07	891.87	0.022438	7.37	43.53	28.01	0.88
Hamilton Co CTP	8.182	10yr	140.00	886.20	890.16	890.16	890.79	0.034782	6.41	21.95	18.74	1.00
Hamilton Co CTP	8.182	50yr	240.00	886.20	890.77	890.77	891.65	0.026024	7.20	35.53	25.44	0.92
Hamilton Co CTP	8.182	500yr	433.00	886.20	891.67	891.67	892.56	0.019169	8.01	66.98	49.29	0.84
Hamilton Co CTP	8.096	100yr	292.00	887.91	891.17		891.17	0.000093	0.57	542.71	185.88	0.06
Hamilton Co CTP	8.096	Floodway	292.00	887.91	891.17		891.17	0.000095	0.58	522.17	164.44	0.06
Hamilton Co CTP	8.096	10yr	140.00	887.91	890.06		890.06	0.000090	0.43	342.76	173.43	0.05
Hamilton Co CTP	8.096	50yr	240.00	887.91	890.83		890.84	0.000091	0.53	481.02	182.13	0.05
Hamilton Co CTP	8.096	500yr	433.00	887.91	891.94		891.95	0.000097	0.67	689.84	194.96	0.06
Hamilton Co CTP	8.014	100yr	292.00	887.55	891.13		891.13	0.000094	0.61	520.10	172.96	0.06
Hamilton Co CTP	8.014	Floodway	292.00	887.55	891.13		891.13	0.000096	0.62	497.58	146.72	0.06
Hamilton Co CTP	8.014	10yr	140.00	887.55	890.02		890.02	0.000079	0.44	339.17	154.09	0.05
Hamilton Co CTP	8.014	50yr	240.00	887.55	890.79		890.80	0.000090	0.56	463.48	166.78	0.05
Hamilton Co CTP	8.014	500yr	433.00	887.55	891.90		891.90	0.000104	0.73	658.89	187.92	0.06
Hamilton Co CTP	7.985	100yr	292.00	887.20	890.11	890.11	890.99	0.032911	7.53	38.79	22.47	1.01
Hamilton Co CTP	7.985	Floodway	292.00	887.20	890.13	890.13	890.99	0.031885	7.44	39.23	22.57	0.99
Hamilton Co CTP	7.985	10yr	140.00	887.20	889.29	889.29	889.92	0.036938	6.34	22.09	18.18	1.01
Hamilton Co CTP	7.985	50yr	240.00	887.20	889.86	889.86	890.67	0.034007	7.20	33.31	21.16	1.01
Hamilton Co CTP	7.985	500yr	433.00	887.20	890.70	890.70	891.74	0.029990	8.21	52.65	26.06	1.00
Hamilton Co CTP	7.979	100yr	292.00	884.00	888.40		888.57	0.002358	3.42	92.53	32.42	0.31
Hamilton Co CTP	7.979	Floodway	292.00	884.00	888.46		888.63	0.002219	3.35	93.79	30.00	0.30
Hamilton Co CTP	7.979	10yr	140.00	884.00	886.30		886.58	0.007881	3.79	37.17	21.83	0.60
Hamilton Co CTP	7.979	50yr	240.00	884.00	887.73		887.91	0.003245	3.62	71.08	28.89	0.36
Hamilton Co CTP	7.979	500yr	433.00	884.00	889.65		889.83	0.001832	3.64	140.46	51.33	0.29
Hamilton Co CTP	7.967	100yr	292.00	881.51	888.35	885.38	888.40	0.000886	2.72	114.86	43.87	0.23
Hamilton Co CTP	7.967	Floodway	292.00	881.51	888.41	885.37	888.52	0.000837	2.67	117.71	43.87	0.23
Hamilton Co CTP	7.967	10yr	140.00	881.51	886.22	884.37	886.33	0.001698	2.62	53.44	21.91	0.30
Hamilton Co CTP	7.967	50yr	240.00	881.51	887.66	885.07	887.77	0.001120	2.71	90.09	30.85	0.25
Hamilton Co CTP	7.967	500yr	433.00	881.51	889.62	886.06	889.73	0.000678	2.84	166.21	105.98	0.21
Hamilton Co CTP	7.961		Culvert									
Hamilton Co CTP	7.952	100yr	292.00	881.51	886.97	885.21	887.29	0.003563	4.46	65.26	19.82	0.43
Hamilton Co CTP	7.952	Floodway	292.00	881.51	887.07	885.20	887.36	0.003356	4.34	67.24	20.02	0.42
Hamilton Co CTP	7.952	10yr	140.00	881.51	885.77	884.14	885.93	0.002509	3.22	43.43	18.69	0.35
Hamilton Co CTP	7.952	50yr	240.00	881.51	886.66	884.87	886.91	0.003167	4.05	59.25	19.00	0.40
Hamilton Co CTP	7.952	500yr	433.00	881.51	887.30	885.95	887.86	0.005781	6.01	73.80	38.63	0.56
Hamilton Co CTP	7.917	100yr	292.00	881.00	886.69	884.06	886.80	0.001530	2.79	123.42	182.74	0.28
Hamilton Co CTP	7.917	Floodway	292.00	881.00	886.80	884.06	886.92	0.001250	2.73	114.96	44.87	0.26
Hamilton Co CTP	7.917	10yr	140.00	881.00	885.52	883.05	885.59	0.001111	2.15	65.09	26.12	0.24
Hamilton Co CTP	7.917	50yr	240.00	881.00	886.37	883.76	886.46	0.001344	2.61	99.50	153.22	0.27
Hamilton Co CTP	7.917	500yr	433.00	881.00	887.20	884.74	887.27	0.000905	2.54	308.43	238.79	0.23
Hamilton Co CTP	7.797	100yr	570.00	880.00	885.40	883.78	885.63	0.002192	4.43	215.65	149.89	0.37
Hamilton Co CTP	7.797	Floodway	570.00	880.00	885.54	883.78	885.77	0.002192	4.39	198.02	96.62	0.36
Hamilton Co CTP	7.797	10yr	270.00	880.00	884.57	882.43	884.72	0.001639	3.23	122.23	105.16	0.30
Hamilton Co CTP	7.797	50yr	466.00	880.00	885.17	883.36	885.37	0.001972	4.05	188.57	137.05	0.35
Hamilton Co CTP	7.797	500yr	841.00	880.00	885.87	885.00	886.16	0.002747	5.29	273.18	176.88	0.42
Hamilton Co CTP	7.770	100yr	570.00	879.77	885.01		885.29	0.003038	4.94	210.77	169.66	0.43
Hamilton Co CTP	7.770	Floodway	570.00	879.77	885.15		885.43	0.003161	4.95	186.20	107.39	0.42
Hamilton Co CTP	7.770	10yr	270.00	879.77	884.22		884.44	0.002473	3.85	91.71	132.02	0.38
Hamilton Co CTP	7.770	50yr	466.00	879.77	884.78		885.05	0.002939	4.67	172.92	157.71	0.42
Hamilton Co CTP	7.770	500yr	841.00	879.77	885.52		885.81	0.003061	5.36	307.02	206.64	0.44
Hamilton Co CTP	7.726	100yr	570.00	879.37	884.30	883.79	884.47	0.002808	4.41	257.23	182.18	0.40
Hamilton Co CTP	7.726	Floodway	570.00	879.37	884.40	883.81	884.57	0.002942	4.39	231.61	134.79	0.39
Hamilton Co CTP	7.726	10yr	270.00	879.37	883.69	882.40	883.82	0.002098	3.39	162.17	168.18	0.34
Hamilton Co CTP	7.726	50yr	466.00	879.37	884.09	883.36	884.26	0.002730	4.19	220.70	176.53	0.39
Hamilton Co CTP	7.726	500yr	841.00	879.37	884.80	884.10	884.97	0.002746	4.74	351.67	196.53	0.41

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	7.633	100yr	570.00	876.53	883.62		883.67	0.001019	2.95	476.54	345.43	0.25
Hamilton Co CTP	7.633	Floodway	570.00	876.53	883.67		883.73	0.001100	3.08	396.58	210.62	0.26
Hamilton Co CTP	7.633	10yr	270.00	876.53	882.56		882.70	0.002581	3.89	166.59	234.84	0.36
Hamilton Co CTP	7.633	50yr	466.00	876.53	883.30		883.37	0.001281	3.14	369.27	324.67	0.27
Hamilton Co CTP	7.633	500yr	841.00	876.53	884.25		884.29	0.000787	2.83	705.94	380.95	0.22
Hamilton Co CTP	7.527	100yr	570.00	877.50	882.68	880.80	882.91	0.001879	4.12	170.46	370.57	0.35
Hamilton Co CTP	7.527	Floodway	570.00	877.50	882.73	880.88	882.95	0.001786	4.05	193.43	78.69	0.35
Hamilton Co CTP	7.527	10yr	270.00	877.50	881.41	879.91	881.55	0.001747	3.13	96.90	178.39	0.32
Hamilton Co CTP	7.527	50yr	466.00	877.50	882.24	880.57	882.47	0.002016	3.87	146.94	343.98	0.36
Hamilton Co CTP	7.527	500yr	841.00	877.50	883.20	881.60	883.63	0.002461	4.29	220.23	395.32	0.35
Hamilton Co CTP	7.520	Bridge										
Hamilton Co CTP	7.510	100yr	570.00	877.50	881.91	880.67	882.26	0.003576	5.07	130.14	236.35	0.46
Hamilton Co CTP	7.510	Floodway	570.00	877.50	882.01	880.68	882.35	0.003367	5.01	134.90	47.00	0.47
Hamilton Co CTP	7.510	10yr	270.00	877.50	881.11	879.88	881.25	0.002086	3.25	93.22	179.10	0.35
Hamilton Co CTP	7.510	50yr	466.00	877.50	881.67	880.42	881.95	0.003122	4.51	118.69	219.64	0.44
Hamilton Co CTP	7.510	500yr	841.00	877.50	882.32	881.20	882.90	0.005184	6.67	149.24	255.48	0.59
Hamilton Co CTP	7.472	100yr	570.00	876.40	881.59		881.70	0.001667	3.72	341.97	242.98	0.33
Hamilton Co CTP	7.472	Floodway	570.00	876.40	881.69		881.81	0.001668	3.79	273.84	127.53	0.33
Hamilton Co CTP	7.472	10yr	270.00	876.40	880.78		880.88	0.001626	3.17	172.28	175.73	0.31
Hamilton Co CTP	7.472	50yr	466.00	876.40	881.32		881.43	0.001759	3.65	279.06	220.34	0.33
Hamilton Co CTP	7.472	500yr	841.00	876.40	881.97		882.10	0.002030	4.36	439.44	274.40	0.38
Hamilton Co CTP	7.435	100yr	570.00	875.55	881.25		881.38	0.001656	3.75	375.99	282.00	0.32
Hamilton Co CTP	7.435	Floodway	570.00	875.55	881.35		881.49	0.001649	3.80	299.45	142.57	0.32
Hamilton Co CTP	7.435	10yr	270.00	875.55	880.53		880.61	0.001165	2.76	207.11	199.95	0.26
Hamilton Co CTP	7.435	50yr	466.00	875.55	881.00		881.11	0.001555	3.48	307.08	227.67	0.31
Hamilton Co CTP	7.435	500yr	841.00	875.55	881.45		881.65	0.002684	4.88	433.78	295.65	0.41
Hamilton Co CTP	7.350	100yr	570.00	873.59	880.82	878.06	880.91	0.000721	2.92	352.77	471.02	0.23
Hamilton Co CTP	7.350	Floodway	570.00	873.59	880.93	877.99	881.03	0.000712	2.95	319.43	124.20	0.22
Hamilton Co CTP	7.350	10yr	270.00	873.59	880.34	876.79	880.38	0.000280	1.71	274.11	451.58	0.14
Hamilton Co CTP	7.350	50yr	466.00	873.59	880.63	877.63	880.70	0.000596	2.59	320.92	463.25	0.20
Hamilton Co CTP	7.350	500yr	841.00	873.59	881.23	878.93	881.26	0.000367	2.19	1038.31	499.14	0.16
Hamilton Co CTP	7.325	100yr	570.00	873.02	880.79		880.83	0.000354	1.98	570.21	370.19	0.15
Hamilton Co CTP	7.325	Floodway	570.00	873.02	880.91		880.95	0.000349	2.00	485.65	171.48	0.15
Hamilton Co CTP	7.325	10yr	270.00	873.02	880.33		880.35	0.000144	1.19	442.42	346.68	0.10
Hamilton Co CTP	7.325	50yr	466.00	873.02	880.61		880.64	0.000299	1.76	521.69	361.66	0.14
Hamilton Co CTP	7.325	500yr	841.00	873.02	881.16		881.21	0.000518	2.51	695.58	381.31	0.19
Hamilton Co CTP	7.288	100yr	753.00	872.10	880.74	877.24	880.77	0.000254	1.99	922.90	585.34	0.14
Hamilton Co CTP	7.288	Floodway	753.00	872.10	880.86	877.24	880.89	0.000250	2.01	800.23	260.00	0.14
Hamilton Co CTP	7.288	10yr	362.00	872.10	880.25	876.03	880.30	0.000256	1.90	235.78	513.73	0.14
Hamilton Co CTP	7.288	50yr	621.00	872.10	880.56	876.68	880.59	0.000208	1.76	853.79	583.54	0.12
Hamilton Co CTP	7.288	500yr	1110.00	872.10	881.01	878.09	881.09	0.000576	3.09	1036.73	692.81	0.21
Hamilton Co CTP	7.285	Culvert										
Hamilton Co CTP	7.272	100yr	753.00	872.05	879.19	877.35	879.25	0.000685	2.92	610.46	425.22	0.22
Hamilton Co CTP	7.272	Floodway	753.00	872.05	879.23	877.35	879.31	0.000768	3.00	512.29	250.09	0.23
Hamilton Co CTP	7.272	10yr	362.00	872.05	877.97	876.97	878.20	0.001875	3.91	101.25	227.12	0.34
Hamilton Co CTP	7.272	50yr	621.00	872.05	878.73	876.87	879.18	0.002952	5.50	125.83	304.09	0.44
Hamilton Co CTP	7.272	500yr	1110.00	872.05	880.43	878.29	880.46	0.000314	2.20	1175.35	612.83	0.15
Hamilton Co CTP	7.240	100yr	753.00	872.01	879.06	877.72	879.12	0.000873	2.74	490.79	337.94	0.24
Hamilton Co CTP	7.240	Floodway	753.00	872.01	879.10	877.72	879.17	0.000896	2.79	459.93	196.41	0.24
Hamilton Co CTP	7.240	10yr	362.00	872.01	877.73	876.36	877.84	0.001837	3.08	205.47	301.72	0.32
Hamilton Co CTP	7.240	50yr	621.00	872.01	878.65	877.57	878.72	0.001048	2.80	400.05	328.16	0.25
Hamilton Co CTP	7.240	500yr	1110.00	872.01	880.34	878.00	880.39	0.000484	2.44	782.28	413.02	0.18
Hamilton Co CTP	7.164	100yr	753.00	871.85	878.27	876.41	878.55	0.002141	4.40	190.94	174.37	0.36
Hamilton Co CTP	7.164	Floodway	753.00	871.85	878.33	876.41	878.61	0.002050	4.35	194.13	55.24	0.37
Hamilton Co CTP	7.164	10yr	362.00	871.85	876.83	875.30	877.01	0.002289	3.44	111.08	83.94	0.38
Hamilton Co CTP	7.164	50yr	621.00	871.85	877.86	876.12	878.10	0.002131	4.10	167.83	138.86	0.37
Hamilton Co CTP	7.164	500yr	1110.00	871.85	879.69	877.16	880.00	0.001617	4.65	269.45	241.12	0.35
Hamilton Co CTP	7.159	Bridge										
Hamilton Co CTP	7.147	100yr	753.00	871.85	877.61	876.11	877.87	0.003211	4.97	164.33	298.55	0.46
Hamilton Co CTP	7.147	Floodway	753.00	871.85	877.64	876.11	877.99	0.002880	4.82	171.23	52.04	0.43
Hamilton Co CTP	7.147	10yr	362.00	871.85	876.48	875.20	876.66	0.002352	3.43	111.03	227.16	0.37
Hamilton Co CTP	7.147	50yr	621.00	871.85	877.28	875.83	877.57	0.002746	4.41	152.36	287.20	0.42
Hamilton Co CTP	7.147	500yr	1110.00	871.85	878.01	876.81	878.60	0.004431	6.36	190.50	325.31	0.55
Hamilton Co CTP	7.111	100yr	753.00	871.18	876.70		877.16	0.004205	6.18	209.78	260.98	0.53

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	7,111	Floodway	753.00	871.18	876.83		877.28	0.004580	6.07	197.44	117.41	0.51
Hamilton Co CTP	7,111	10yr	362.00	871.18	875.86		876.15	0.002810	4.36	100.66	225.39	0.41
Hamilton Co CTP	7,111	50yr	621.00	871.18	876.49		876.91	0.003928	5.76	177.68	264.24	0.50
Hamilton Co CTP	7,111	500yr	1110.00	871.18	877.23		877.74	0.004509	6.90	286.13	275.08	0.56
Hamilton Co CTP	7,057	100yr	753.00	870.43	876.40		876.50	0.001226	3.23	531.08	382.29	0.28
Hamilton Co CTP	7,057	Floodway	753.00	870.43	876.49		876.59	0.001259	3.32	442.67	235.00	0.29
Hamilton Co CTP	7,057	10yr	362.00	870.43	876.37		876.50	0.001723	3.14	200.97	325.34	0.32
Hamilton Co CTP	7,057	50yr	621.00	870.43	876.12		876.23	0.001353	3.23	426.64	371.56	0.29
Hamilton Co CTP	7,057	500yr	1110.00	870.43	877.01		877.10	0.001063	3.39	773.35	406.91	0.27
Hamilton Co CTP	6,998	100yr	753.00	869.60	875.62		875.90	0.002604	5.18	291.08	170.95	0.43
Hamilton Co CTP	6,998	Floodway	753.00	869.60	875.67		875.96	0.002687	5.30	247.87	107.49	0.43
Hamilton Co CTP	6,998	10yr	362.00	869.60	874.45		874.75	0.003306	4.63	110.23	113.70	0.44
Hamilton Co CTP	6,998	50yr	621.00	869.60	875.31		875.60	0.002856	5.00	240.82	162.60	0.43
Hamilton Co CTP	6,998	500yr	1110.00	869.60	876.23		876.53	0.002690	5.72	400.59	184.32	0.44
Hamilton Co CTP	6,893	100yr	753.00	868.13	874.28	872.65	874.57	0.002423	4.99	292.79	253.11	0.41
Hamilton Co CTP	6,893	Floodway	753.00	868.13	874.37	872.69	874.66	0.002307	4.93	270.13	121.57	0.40
Hamilton Co CTP	6,893	10yr	362.00	868.13	873.13	871.67	873.33	0.002073	3.81	137.00	86.87	0.36
Hamilton Co CTP	6,893	50yr	621.00	868.13	873.96	872.47	874.24	0.002425	4.76	239.30	159.16	0.40
Hamilton Co CTP	6,893	500yr	1110.00	868.13	875.09	873.71	875.34	0.002047	5.10	538.92	304.49	0.38
Hamilton Co CTP	6,812	100yr	753.00	867.00	873.71		873.85	0.001337	3.46	336.98	157.98	0.30
Hamilton Co CTP	6,812	Floodway	753.00	867.00	873.81		873.96	0.001344	3.54	294.88	100.89	0.30
Hamilton Co CTP	6,812	10yr	362.00	867.00	872.47		872.59	0.001600	2.93	166.93	119.46	0.30
Hamilton Co CTP	6,812	50yr	621.00	867.00	873.38		873.51	0.001319	3.27	286.93	145.98	0.29
Hamilton Co CTP	6,812	500yr	1110.00	867.00	874.57		874.72	0.001260	3.84	501.15	230.50	0.30
Hamilton Co CTP	6,717	100yr	753.00	865.68	873.02	870.87	873.21	0.001623	4.02	341.90	235.71	0.32
Hamilton Co CTP	6,717	Floodway	753.00	865.68	873.08	870.87	873.29	0.001577	4.13	285.17	134.99	0.32
Hamilton Co CTP	6,717	10yr	362.00	865.68	871.48	869.47	871.70	0.002181	3.76	102.36	58.62	0.36
Hamilton Co CTP	6,717	50yr	621.00	865.68	872.55	870.45	872.78	0.001881	4.18	240.07	199.33	0.35
Hamilton Co CTP	6,717	500yr	1110.00	865.68	874.16	872.23	874.27	0.000878	3.50	633.73	277.73	0.25
Hamilton Co CTP	6,647	100yr	753.00	864.70	872.78	869.87	872.86	0.000572	2.79	488.13	187.46	0.20
Hamilton Co CTP	6,647	Floodway	753.00	864.70	872.85	869.87	872.93	0.000586	2.85	422.94	121.83	0.20
Hamilton Co CTP	6,647	10yr	362.00	864.70	871.18	868.45	871.24	0.000704	2.51	229.46	141.34	0.21
Hamilton Co CTP	6,647	50yr	621.00	864.70	872.30	869.45	872.38	0.000598	2.70	403.03	168.81	0.20
Hamilton Co CTP	6,647	500yr	1110.00	864.70	873.96	871.06	874.03	0.000475	2.87	731.56	224.80	0.19
Hamilton Co CTP	6,587	100yr	753.00	863.79	872.61	868.87	872.65	0.000706	3.17	267.41	152.48	0.23
Hamilton Co CTP	6,587	Floodway	753.00	863.79	872.59	868.87	872.73	0.000670	3.12	295.27	94.00	0.22
Hamilton Co CTP	6,587	10yr	362.00	863.79	870.98	867.04	871.05	0.000516	2.23	175.01	76.37	0.19
Hamilton Co CTP	6,587	50yr	621.00	863.79	872.05	868.52	872.18	0.000660	2.91	248.18	117.14	0.22
Hamilton Co CTP	6,587	500yr	1110.00	863.79	873.67	869.63	873.83	0.000700	3.55	396.48	234.60	0.23
Hamilton Co CTP	6,582		Bridge									
Hamilton Co CTP	6,569	100yr	753.00	863.31	870.33	866.75	870.62	0.001076	3.46	221.72	47.73	0.26
Hamilton Co CTP	6,569	Floodway	753.00	863.31	870.42	866.74	870.60	0.001016	3.40	226.04	47.74	0.26
Hamilton Co CTP	6,569	10yr	362.00	863.31	868.95	865.62	869.03	0.000679	2.26	160.37	41.09	0.20
Hamilton Co CTP	6,569	50yr	621.00	863.31	869.92	866.38	870.07	0.000958	3.10	202.70	45.78	0.25
Hamilton Co CTP	6,569	500yr	1110.00	863.31	871.36	867.61	871.65	0.001254	4.22	273.89	52.85	0.29
Hamilton Co CTP	6,667		Culvert									
Hamilton Co CTP	6,649	100yr	753.00	863.31	869.97	866.64	870.17	0.001217	3.65	206.79	382.21	0.28
Hamilton Co CTP	6,649	Floodway	753.00	863.31	870.06	866.65	870.26	0.001156	3.59	210.46	39.19	0.27
Hamilton Co CTP	6,649	10yr	362.00	863.31	868.85	865.62	868.93	0.000587	2.22	163.40	41.42	0.19
Hamilton Co CTP	6,649	50yr	621.00	863.31	869.67	866.33	869.83	0.000905	3.19	195.19	334.58	0.25
Hamilton Co CTP	6,649	500yr	1110.00	863.31	870.58	867.41	870.94	0.001832	4.81	233.10	444.08	0.35
Hamilton Co CTP	6,483	100yr	753.00	861.90	869.51	868.27	869.66	0.001683	3.78	317.79	208.31	0.32
Hamilton Co CTP	6,483	Floodway	753.00	861.90	869.64	868.27	869.79	0.001512	3.66	309.21	140.00	0.31
Hamilton Co CTP	6,483	10yr	362.00	861.90	868.45	866.81	868.58	0.001791	3.21	161.06	110.36	0.32
Hamilton Co CTP	6,483	50yr	621.00	861.90	869.24	867.90	869.39	0.001695	3.63	269.22	198.29	0.32
Hamilton Co CTP	6,483	500yr	1110.00	861.90	870.07	868.02	870.24	0.001741	4.18	439.56	281.42	0.34
Hamilton Co CTP	6,453	100yr	753.00	861.20	869.27	868.39	869.40	0.001610	4.10	402.02	416.57	0.31
Hamilton Co CTP	6,453	Floodway	753.00	861.20	869.33	868.19	869.52	0.001947	4.55	297.08	150.00	0.34
Hamilton Co CTP	6,453	10yr	362.00	861.20	867.93	866.66	868.20	0.002976	4.65	115.36	83.14	0.40
Hamilton Co CTP	6,453	50yr	621.00	861.20	868.90	867.91	869.09	0.002146	4.53	299.07	273.89	0.35
Hamilton Co CTP	6,453	500yr	1110.00	861.20	869.87	869.02	869.98	0.001337	4.01	587.12	536.45	0.28
Hamilton Co CTP	6,405	100yr	753.00	860.07	868.22	867.16	868.71	0.004727	5.53	173.37	164.80	0.52
Hamilton Co CTP	6,405	Floodway	753.00	860.07	868.32	867.22	868.78	0.004320	5.77	164.98	65.00	0.50
Hamilton Co CTP	6,405	10yr	362.00	860.07	866.69	865.70	867.10	0.006646	5.17	71.90	37.99	0.58
Hamilton Co CTP	6,405	50yr	621.00	860.07	867.79	866.78	868.26	0.005049	5.69	127.00	61.08	0.53

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	6.405	500yr	1110.00	860.07	869.21	868.50	869.50	0.002841	5.14	361.66	435.02	0.41
Hamilton Co CTP	6.396	100yr	753.00	859.70	868.35	863.23	868.47	0.000511	2.63	326.23	636.66	0.18
Hamilton Co CTP	6.396	Floodway	753.00	859.70	868.44	863.24	868.55	0.000484	2.78	335.46	102.00	0.18
Hamilton Co CTP	6.396	10yr	362.00	859.70	866.83	862.20	866.88	0.000285	1.81	204.56	327.45	0.13
Hamilton Co CTP	6.396	50yr	621.00	859.70	867.93	862.91	868.03	0.000445	2.54	283.81	418.49	0.17
Hamilton Co CTP	6.396	500yr	1110.00	859.70	869.21	864.03	869.38	0.000672	3.49	414.05	679.05	0.21
Hamilton Co CTP	6.391		Culvert									
Hamilton Co CTP	6.382	100yr	753.00	859.65	866.19	863.22	866.32	0.000524	2.82	269.65	222.17	0.19
Hamilton Co CTP	6.382	Floodway	753.00	859.65	866.29	863.22	866.41	0.000545	2.78	273.46	42.00	0.19
Hamilton Co CTP	6.382	10yr	362.00	859.65	866.79	862.19	866.83	0.000262	1.71	211.52	169.04	0.13
Hamilton Co CTP	6.382	50yr	621.00	859.65	867.82	862.90	867.92	0.000431	2.46	254.05	206.71	0.17
Hamilton Co CTP	6.382	500yr	1110.00	859.65	868.87	864.00	869.09	0.000826	3.77	298.10	246.24	0.24
Hamilton Co CTP	6.317	100yr	753.00	859.13	867.42	865.96	867.93	0.003857	6.15	187.07	137.82	0.48
Hamilton Co CTP	6.317	Floodway	753.00	859.13	867.51	865.96	868.02	0.003680	6.08	157.28	52.02	0.47
Hamilton Co CTP	6.317	10yr	362.00	859.13	866.37	864.24	866.63	0.002415	4.16	96.96	47.30	0.37
Hamilton Co CTP	6.317	50yr	621.00	859.13	867.14	865.43	867.59	0.003477	5.62	145.02	117.13	0.45
Hamilton Co CTP	6.317	500yr	1110.00	859.13	868.03	867.17	868.61	0.004242	6.96	276.75	156.38	0.52
Hamilton Co CTP	6.274	100yr	753.00	858.79	867.07		867.27	0.001898	3.91	283.35	181.79	0.34
Hamilton Co CTP	6.274	Floodway	753.00	858.79	867.14		867.36	0.001802	4.01	235.66	85.12	0.34
Hamilton Co CTP	6.274	10yr	362.00	858.79	866.06		866.18	0.001433	2.87	146.92	93.37	0.28
Hamilton Co CTP	6.274	50yr	621.00	858.79	866.80		866.98	0.001702	3.61	238.68	155.45	0.32
Hamilton Co CTP	6.274	500yr	1110.00	858.79	867.62		867.87	0.002094	4.54	389.50	200.74	0.37
Hamilton Co CTP	6.159	100yr	753.00	857.88	865.83	864.73	866.04	0.002342	4.33	320.83	280.69	0.38
Hamilton Co CTP	6.159	Floodway	753.00	857.88	865.96	864.60	866.17	0.002125	4.21	290.30	160.00	0.36
Hamilton Co CTP	6.159	10yr	362.00	857.88	865.00	862.85	865.17	0.001963	3.41	139.08	176.04	0.33
Hamilton Co CTP	6.159	50yr	621.00	857.88	865.60	864.13	865.81	0.002284	4.12	263.82	245.08	0.37
Hamilton Co CTP	6.159	500yr	1110.00	857.88	866.35	865.63	866.56	0.002301	4.65	465.20	282.55	0.38
Hamilton Co CTP	6.087	100yr	753.00	857.32	865.38	863.70	865.46	0.000930	2.93	561.75	398.83	0.24
Hamilton Co CTP	6.087	Floodway	753.00	857.32	865.47	863.70	865.57	0.001074	3.19	443.25	240.00	0.26
Hamilton Co CTP	6.087	10yr	362.00	857.32	864.61	862.15	864.81	0.001056	2.71	247.16	303.35	0.25
Hamilton Co CTP	6.087	50yr	621.00	857.32	865.14	863.29	865.22	0.000975	2.89	465.78	390.88	0.25
Hamilton Co CTP	6.087	500yr	1110.00	857.32	865.95	864.78	866.01	0.000850	3.03	791.12	417.22	0.24
Hamilton Co CTP	6.032	100yr	753.00	856.89	864.85	862.98	865.04	0.002430	3.69	279.76	209.24	0.37
Hamilton Co CTP	6.032	Floodway	753.00	856.89	864.94	862.98	865.12	0.002313	3.67	259.68	149.29	0.36
Hamilton Co CTP	6.032	10yr	362.00	856.89	864.03	861.79	864.15	0.002082	2.78	130.40	162.38	0.33
Hamilton Co CTP	6.032	50yr	621.00	856.89	864.63	862.62	864.80	0.002317	3.43	235.34	189.90	0.36
Hamilton Co CTP	6.032	500yr	1110.00	856.89	865.42	864.04	865.62	0.002312	4.04	414.48	248.04	0.37
Hamilton Co CTP	5.949	100yr	753.00	856.23	864.43		864.49	0.000765	2.49	591.72	418.09	0.22
Hamilton Co CTP	5.949	Floodway	753.00	856.23	864.61		864.58	0.000786	2.65	500.03	259.33	0.22
Hamilton Co CTP	5.949	10yr	362.00	856.23	863.54		863.60	0.000815	2.19	262.02	281.86	0.22
Hamilton Co CTP	5.949	50yr	621.00	856.23	864.18		864.24	0.000795	2.42	488.78	401.97	0.22
Hamilton Co CTP	5.949	500yr	1110.00	856.23	865.11		865.16	0.000612	2.47	883.65	440.90	0.20
Hamilton Co CTP	5.915	100yr	753.00	855.96	864.20		864.32	0.001642	3.77	472.06	413.08	0.27
Hamilton Co CTP	5.915	Floodway	753.00	855.96	864.27		864.41	0.001675	3.84	400.75	262.60	0.28
Hamilton Co CTP	5.915	10yr	362.00	855.96	863.10		863.36	0.002359	4.12	114.51	229.05	0.33
Hamilton Co CTP	5.915	50yr	621.00	855.96	863.88		864.04	0.002021	4.05	343.20	366.10	0.30
Hamilton Co CTP	5.915	500yr	1110.00	855.96	864.99		865.05	0.000948	3.11	809.27	436.42	0.21
Hamilton Co CTP	5.908	100yr	753.00	855.91	864.13		864.26	0.001653	3.84	455.18	402.82	0.28
Hamilton Co CTP	5.908	Floodway	753.00	855.91	864.20		864.35	0.001692	3.91	380.70	244.75	0.29
Hamilton Co CTP	5.908	10yr	362.00	855.91	863.03		863.27	0.002096	3.95	118.45	204.06	0.32
Hamilton Co CTP	5.908	50yr	621.00	855.91	863.79		863.97	0.002027	4.11	325.34	348.27	0.31
Hamilton Co CTP	5.908	500yr	1110.00	855.91	864.85		865.02	0.000932	3.15	797.09	425.97	0.22
Hamilton Co CTP	5.862	100yr	753.00	855.54	863.84		863.93	0.001140	3.21	469.62	307.45	0.26
Hamilton Co CTP	5.862	Floodway	753.00	855.54	863.89		863.99	0.001263	3.30	427.77	226.03	0.27
Hamilton Co CTP	5.862	10yr	362.00	855.54	862.40		862.66	0.003129	4.18	116.30	152.89	0.41
Hamilton Co CTP	5.862	50yr	621.00	855.54	863.40		863.63	0.001684	3.55	359.46	290.71	0.30
Hamilton Co CTP	5.862	500yr	1110.00	855.54	864.77		864.83	0.000704	2.85	797.30	357.31	0.21
Hamilton Co CTP	5.801	100yr	753.00	854.89	863.31	861.09	863.49	0.001433	3.72	254.07	321.64	0.31
Hamilton Co CTP	5.801	Floodway	753.00	854.89	863.36	861.09	863.54	0.001403	3.70	257.72	79.00	0.30
Hamilton Co CTP	5.801	10yr	362.00	854.89	861.62	859.35	861.79	0.002112	3.33	120.75	85.44	0.34
Hamilton Co CTP	5.801	50yr	621.00	854.89	862.85	860.63	863.02	0.001492	3.54	218.03	285.07	0.31
Hamilton Co CTP	5.801	500yr	1110.00	854.89	864.22	862.02	864.46	0.001506	4.30	326.08	377.70	0.32
Hamilton Co CTP	5.779		Culvert									
Hamilton Co CTP	5.777	100yr	753.00	854.84	863.21	860.18	863.40	0.001042	3.58	232.77	272.59	0.27

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	5.777	Floodway	753.00	854.84	863.27	860.18	863.40	0.001018	3.56	236.81	54.00	0.27
Hamilton Co CTP	5.777	10yr	362.00	854.84	861.67	858.87	861.77	0.000806	2.51	151.37	58.57	0.23
Hamilton Co CTP	5.777	50yr	621.00	854.84	862.80	859.88	862.98	0.000947	3.23	210.53	253.30	0.26
Hamilton Co CTP	5.777	500yr	1110.00	854.84	863.96	860.91	864.26	0.001409	4.54	273.19	286.69	0.32
Hamilton Co CTP	5.749	100yr	753.00	854.63	862.60	860.27	863.18	0.001644	4.54	238.69	213.63	0.34
Hamilton Co CTP	5.749	Floodway	753.00	854.63	863.00	860.27	863.26	0.001495	4.38	248.72	108.17	0.32
Hamilton Co CTP	5.749	10yr	362.00	854.63	861.43	858.83	861.60	0.001309	3.32	122.17	52.19	0.28
Hamilton Co CTP	5.749	50yr	621.00	854.63	862.50	859.94	862.75	0.001558	4.21	197.42	174.15	0.32
Hamilton Co CTP	5.749	500yr	1110.00	854.63	863.84	861.36	864.01	0.001109	4.13	539.80	255.06	0.28
Hamilton Co CTP	5.731	100yr	753.00	854.47	862.55	860.18	862.99	0.002343	5.57	185.90	139.07	0.40
Hamilton Co CTP	5.731	Floodway	753.00	854.47	862.66	860.18	863.07	0.002175	5.43	183.78	82.21	0.39
Hamilton Co CTP	5.731	10yr	362.00	854.47	861.29	858.73	861.47	0.001324	3.57	118.15	38.98	0.29
Hamilton Co CTP	5.731	50yr	621.00	854.47	862.24	859.74	862.58	0.001969	4.92	183.38	81.51	0.37
Hamilton Co CTP	5.731	500yr	1110.00	854.47	863.47	861.00	863.85	0.002093	5.79	372.83	212.05	0.39
Hamilton Co CTP	5.704	100yr	753.00	854.24	862.50	859.96	862.67	0.001210	4.02	391.39	247.20	0.26
Hamilton Co CTP	5.704	Floodway	753.00	854.24	862.59	859.96	862.77	0.001221	4.07	321.48	128.99	0.29
Hamilton Co CTP	5.704	10yr	362.00	854.24	861.08	858.39	861.27	0.001404	3.62	124.55	170.70	0.30
Hamilton Co CTP	5.704	50yr	621.00	854.24	862.10	859.48	862.30	0.001390	4.11	294.02	235.02	0.30
Hamilton Co CTP	5.704	500yr	1110.00	854.24	863.47	861.83	863.58	0.000866	3.75	642.94	271.05	0.25
Hamilton Co CTP	5.658	100yr	753.00	853.84	861.95		862.27	0.002155	5.11	241.22	124.26	0.38
Hamilton Co CTP	5.658	Floodway	753.00	853.84	862.01		862.35	0.002424	5.17	200.60	63.36	0.38
Hamilton Co CTP	5.658	10yr	362.00	853.84	860.67		860.89	0.001749	3.88	116.82	69.33	0.33
Hamilton Co CTP	5.658	50yr	621.00	853.84	861.58		861.88	0.002098	4.82	198.15	107.54	0.37
Hamilton Co CTP	5.658	500yr	1110.00	853.84	863.06		863.30	0.001545	4.88	438.30	187.00	0.33
Hamilton Co CTP	5.589	100yr	753.00	853.19	860.85	859.86	861.21	0.003865	5.24	184.12	413.87	0.48
Hamilton Co CTP	5.589	Floodway	753.00	853.19	860.86	859.86	861.23	0.003840	5.23	185.31	85.13	0.48
Hamilton Co CTP	5.589	10yr	362.00	853.19	859.58	858.28	859.88	0.004775	4.42	92.33	187.81	0.50
Hamilton Co CTP	5.589	50yr	621.00	853.19	860.48	859.58	860.83	0.004022	4.99	154.63	351.46	0.48
Hamilton Co CTP	5.589	500yr	1110.00	853.19	862.42	860.46	862.67	0.001836	4.57	330.60	1167.96	0.35
Hamilton Co CTP	5.583	Bridge										
Hamilton Co CTP	5.568	100yr	753.00	853.19	859.80	859.26	860.36	0.006966	6.33	144.07	367.12	0.63
Hamilton Co CTP	5.568	Floodway	753.00	853.19	859.92	859.26	860.44	0.006933	6.99	155.79	97.00	0.59
Hamilton Co CTP	5.568	10yr	362.00	853.19	858.84	857.49	859.18	0.005771	4.70	77.08	45.39	0.55
Hamilton Co CTP	5.568	50yr	621.00	853.19	859.53	858.70	860.05	0.006804	5.69	119.58	306.94	0.62
Hamilton Co CTP	5.568	500yr	1110.00	853.19	860.39	860.05	861.09	0.007124	7.18	201.16	623.00	0.66
Hamilton Co CTP	5.534	100yr	753.00	852.71	859.24		859.52	0.002818	4.88	272.14	365.47	0.41
Hamilton Co CTP	5.534	Floodway	753.00	852.71	859.38		859.67	0.002511	4.88	237.26	91.49	0.41
Hamilton Co CTP	5.534	10yr	362.00	852.71	858.42		858.58	0.001713	3.43	160.36	205.00	0.32
Hamilton Co CTP	5.534	50yr	621.00	852.71	859.01		859.26	0.002385	4.49	234.77	332.21	0.39
Hamilton Co CTP	5.534	500yr	1110.00	852.71	859.80		860.12	0.002954	5.62	375.89	447.91	0.45
Hamilton Co CTP	5.493	100yr	753.00	852.30	859.05	857.87	859.13	0.001083	3.12	489.51	294.70	0.26
Hamilton Co CTP	5.493	Floodway	753.00	852.30	859.16	857.92	859.26	0.001283	3.44	403.49	203.86	0.29
Hamilton Co CTP	5.493	10yr	362.00	852.30	858.20	856.28	858.28	0.001034	2.63	232.17	265.00	0.25
Hamilton Co CTP	5.493	50yr	621.00	852.30	858.81	857.67	858.89	0.001061	2.97	416.92	296.97	0.26
Hamilton Co CTP	5.493	500yr	1110.00	852.30	859.63	858.27	859.72	0.001082	3.39	683.62	303.50	0.27
Hamilton Co CTP	5.470	100yr	753.00	852.07	858.83		858.97	0.001638	3.68	431.45	364.40	0.32
Hamilton Co CTP	5.470	Floodway	753.00	852.07	858.93		859.09	0.001626	3.73	361.07	254.12	0.32
Hamilton Co CTP	5.470	10yr	362.00	852.07	858.00		858.12	0.001530	3.05	166.32	239.04	0.30
Hamilton Co CTP	5.470	50yr	621.00	852.07	858.57		858.72	0.001758	3.64	337.90	352.13	0.33
Hamilton Co CTP	5.470	500yr	1110.00	852.07	859.46		859.57	0.001342	3.67	669.21	309.17	0.30
Hamilton Co CTP	5.422	100yr	1280.00	851.61	858.44		858.54	0.001517	3.68	829.66	513.68	0.32
Hamilton Co CTP	5.422	Floodway	1280.00	851.61	858.55		858.69	0.001491	3.71	741.16	370.12	0.31
Hamilton Co CTP	5.422	10yr	614.00	851.61	857.45		857.61	0.002304	3.76	355.23	437.27	0.37
Hamilton Co CTP	5.422	50yr	1050.00	851.61	858.14		858.25	0.001694	3.70	676.31	498.14	0.33
Hamilton Co CTP	5.422	500yr	1890.00	851.61	859.13		859.22	0.001248	3.69	1197.02	548.31	0.29
Hamilton Co CTP	5.377	100yr	1280.00	851.16	858.16		858.24	0.001100	3.57	862.99	386.64	0.28
Hamilton Co CTP	5.377	Floodway	1280.00	851.16	858.28		858.36	0.001077	3.59	782.44	284.44	0.27
Hamilton Co CTP	5.377	10yr	614.00	851.16	857.16		857.24	0.001066	3.05	482.42	356.63	0.28
Hamilton Co CTP	5.377	50yr	1050.00	851.16	857.86		857.93	0.001092	3.42	746.32	377.77	0.27
Hamilton Co CTP	5.377	500yr	1890.00	851.16	858.86		858.95	0.001104	3.89	1141.56	406.63	0.28
Hamilton Co CTP	5.340	100yr	1280.00	850.80	857.78		857.92	0.001906	4.67	696.92	328.70	0.35
Hamilton Co CTP	5.340	Floodway	1280.00	850.80	857.91		858.05	0.001851	4.67	652.92	268.63	0.35
Hamilton Co CTP	5.340	10yr	614.00	850.80	856.73		856.90	0.002245	4.27	358.72	310.69	0.37
Hamilton Co CTP	5.340	50yr	1050.00	850.80	857.47		857.61	0.001962	4.45	594.79	326.98	0.35
Hamilton Co CTP	5.340	500yr	1890.00	850.80	858.50		858.64	0.001823	4.67	935.66	338.01	0.35

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	5.255	100yr	1280.00	849.96	856.92		857.17	0.002143	5.12	569.28	273.91	0.39
Hamilton Co CTP	5.255	Floodway	1280.00	849.96	857.06		857.30	0.002226	4.97	510.41	202.52	0.37
Hamilton Co CTP	5.255	10yr	614.00	849.96	855.84		856.06	0.001902	4.17	286.85	242.06	0.35
Hamilton Co CTP	5.255	50yr	1050.00	849.96	856.60		856.84	0.002092	4.86	482.31	267.98	0.38
Hamilton Co CTP	5.255	500yr	1890.00	849.96	857.66		857.93	0.002106	5.63	777.09	285.21	0.40
Hamilton Co CTP	5.152	100yr	1280.00	848.95	855.63		856.05	0.002550	5.33	491.65	228.49	0.41
Hamilton Co CTP	5.152	Floodway	1280.00	848.95	855.93		856.17	0.002566	5.41	426.14	151.36	0.41
Hamilton Co CTP	5.152	10yr	614.00	848.95	854.86		855.03	0.002143	4.27	206.54	193.46	0.36
Hamilton Co CTP	5.152	50yr	1050.00	848.95	855.50		855.72	0.002561	5.12	418.33	216.67	0.40
Hamilton Co CTP	5.152	500yr	1890.00	848.95	856.65		856.87	0.002390	5.61	691.13	257.92	0.40
Hamilton Co CTP	5.125	100yr	1280.00	848.68	855.57		855.76	0.001901	4.92	528.95	226.08	0.36
Hamilton Co CTP	5.125	Floodway	1280.00	848.68	855.66		855.87	0.001914	4.99	448.67	138.67	0.36
Hamilton Co CTP	5.125	10yr	614.00	848.68	854.70		854.80	0.001171	3.46	347.58	189.80	0.28
Hamilton Co CTP	5.125	50yr	1050.00	848.68	855.25		855.42	0.001788	4.59	459.76	213.66	0.35
Hamilton Co CTP	5.125	500yr	1890.00	848.68	856.40		856.59	0.001880	5.35	736.47	278.57	0.37
Hamilton Co CTP	5.077	100yr	1280.00	848.21	854.93		855.21	0.003452	6.09	446.94	226.65	0.47
Hamilton Co CTP	5.077	Floodway	1280.00	848.21	855.03		855.31	0.003709	5.80	393.90	198.52	0.45
Hamilton Co CTP	5.077	10yr	614.00	848.21	853.40		854.14	0.008918	7.74	138.80	169.91	0.72
Hamilton Co CTP	5.077	50yr	1050.00	848.21	854.52		854.84	0.004025	6.23	357.37	214.12	0.50
Hamilton Co CTP	5.077	500yr	1890.00	848.21	855.93		856.15	0.002482	5.82	702.30	276.45	0.41
Hamilton Co CTP	5.026	100yr	1280.00	847.66	854.61	851.70	854.74	0.000069	3.54	521.95	386.22	0.26
Hamilton Co CTP	5.026	Floodway	1280.00	847.66	854.72	851.75	854.84	0.000843	3.53	534.01	114.50	0.25
Hamilton Co CTP	5.026	10yr	614.00	847.66	853.37	850.83	853.43	0.000531	2.36	379.63	267.46	0.19
Hamilton Co CTP	5.026	50yr	1050.00	847.66	854.26	851.44	854.38	0.000754	3.16	481.00	323.63	0.24
Hamilton Co CTP	5.026	500yr	1890.00	847.66	855.50	852.41	855.74	0.001043	4.29	630.75	368.14	0.29
Hamilton Co CTP	5.021	Bridge										
Hamilton Co CTP	5.011	100yr	1280.00	847.66	854.33	851.67	854.51	0.001240	4.09	433.77	325.99	0.31
Hamilton Co CTP	5.011	Floodway	1280.00	847.66	854.45	851.67	854.63	0.001169	4.08	446.56	94.50	0.30
Hamilton Co CTP	5.011	10yr	614.00	847.66	853.26	850.84	853.33	0.000651	2.67	332.56	246.63	0.21
Hamilton Co CTP	5.011	50yr	1050.00	847.66	854.04	851.43	854.18	0.001024	3.59	408.31	315.12	0.27
Hamilton Co CTP	5.011	500yr	1890.00	847.66	855.11	852.35	855.39	0.001643	5.14	607.86	354.07	0.38
Hamilton Co CTP	4.981	100yr	1280.00	847.30	854.10	852.48	854.29	0.001578	3.94	521.38	319.45	0.32
Hamilton Co CTP	4.981	Floodway	1280.00	847.30	854.22	852.48	854.41	0.001555	3.97	484.25	178.51	0.32
Hamilton Co CTP	4.981	10yr	614.00	847.30	853.06	850.86	853.18	0.001239	2.94	293.75	292.60	0.26
Hamilton Co CTP	4.981	50yr	1050.00	847.30	853.82	851.85	853.98	0.001436	3.60	469.06	311.76	0.31
Hamilton Co CTP	4.981	500yr	1890.00	847.30	854.89	853.24	855.10	0.001638	4.46	696.87	342.94	0.34
Hamilton Co CTP	4.923	100yr	1280.00	846.78	853.44		853.69	0.002459	5.12	619.73	419.59	0.41
Hamilton Co CTP	4.923	Floodway	1280.00	846.78	853.56		853.82	0.002401	5.14	510.55	219.06	0.41
Hamilton Co CTP	4.923	10yr	614.00	846.78	852.48		852.68	0.002120	4.10	297.74	251.28	0.37
Hamilton Co CTP	4.923	50yr	1050.00	846.78	853.12		853.39	0.002647	5.07	465.56	411.83	0.42
Hamilton Co CTP	4.923	500yr	1890.00	846.78	854.45		854.60	0.001550	4.60	1052.01	439.92	0.33
Hamilton Co CTP	4.777	100yr	1280.00	845.47	852.57		852.87	0.001177	3.33	770.80	294.40	0.26
Hamilton Co CTP	4.777	Floodway	1280.00	845.47	852.69		852.79	0.001196	3.29	715.60	238.01	0.27
Hamilton Co CTP	4.777	10yr	614.00	845.47	851.07		851.20	0.002230	3.46	342.78	275.20	0.36
Hamilton Co CTP	4.777	50yr	1050.00	845.47	852.05		852.15	0.001469	3.40	618.37	288.17	0.31
Hamilton Co CTP	4.777	500yr	1890.00	845.47	853.92		854.00	0.000759	3.20	1178.30	310.15	0.24
Hamilton Co CTP	4.709	100yr	1280.00	844.86	852.35		852.41	0.000549	2.69	1088.81	397.76	0.20
Hamilton Co CTP	4.709	Floodway	1280.00	844.86	852.40		852.48	0.000751	3.06	853.83	272.54	0.23
Hamilton Co CTP	4.709	10yr	614.00	844.86	850.55		850.64	0.001236	2.86	436.62	332.32	0.27
Hamilton Co CTP	4.709	50yr	1050.00	844.86	851.77		851.83	0.000883	2.67	852.95	373.56	0.21
Hamilton Co CTP	4.709	500yr	1890.00	844.86	853.79		853.83	0.000358	2.44	1706.47	460.89	0.16
Hamilton Co CTP	4.651	100yr	1280.00	844.30	851.97	849.22	852.16	0.001040	3.98	496.16	364.66	0.28
Hamilton Co CTP	4.651	Floodway	1280.00	844.30	852.01	849.22	852.19	0.001044	4.00	500.74	116.00	0.28
Hamilton Co CTP	4.651	10yr	614.00	844.30	850.18	847.76	850.31	0.000978	3.08	291.25	322.30	0.26
Hamilton Co CTP	4.651	50yr	1050.00	844.30	851.38	848.84	851.55	0.001051	3.74	428.87	356.16	0.28
Hamilton Co CTP	4.651	500yr	1890.00	844.30	853.40	850.03	853.62	0.000985	4.44	680.93	414.71	0.28
Hamilton Co CTP	4.646	Bridge										
Hamilton Co CTP	4.633	100yr	1280.00	844.30	850.74	849.21	851.17	0.002605	5.78	320.18	283.28	0.45
Hamilton Co CTP	4.633	Floodway	1280.00	844.30	850.87	849.19	851.28	0.002593	5.65	332.10	96.60	0.43
Hamilton Co CTP	4.633	10yr	614.00	844.30	849.68	847.62	849.68	0.001653	3.81	217.30	246.23	0.33
Hamilton Co CTP	4.633	50yr	1050.00	844.30	850.40	848.78	850.76	0.002499	5.21	286.66	271.25	0.42
Hamilton Co CTP	4.633	500yr	1890.00	844.30	851.68	850.08	852.17	0.003324	6.95	491.46	315.76	0.50
Hamilton Co CTP	4.603	100yr	1280.00	843.77	850.50	849.08	850.67	0.002102	4.41	544.96	289.32	0.37
Hamilton Co CTP	4.603	Floodway	1280.00	843.77	850.65	849.07	850.81	0.001956	4.35	542.44	168.66	0.36
Hamilton Co CTP	4.603	10yr	614.00	843.77	849.48	847.98	849.58	0.001625	3.26	355.46	263.84	0.31

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	4.603	50yr	1050.00	843.77	850.16	848.87	850.31	0.002037	4.11	460.69	282.82	0.36
Hamilton Co CTP	4.603	500yr	1890.00	843.77	851.38	849.54	851.68	0.002106	4.99	710.15	310.50	0.39
Hamilton Co CTP	4.571	100yr	1280.00	843.38	850.11	849.30	850.32	0.002944	5.26	556.79	253.47	0.43
Hamilton Co CTP	4.571	Floodway	1280.00	843.38	850.19	849.35	850.44	0.003543	5.52	473.39	189.42	0.45
Hamilton Co CTP	4.571	10yr	614.00	843.38	848.89	848.64	849.18	0.004462	5.28	257.02	235.98	0.50
Hamilton Co CTP	4.571	50yr	1050.00	843.38	849.70	849.12	849.93	0.003418	5.31	453.48	248.36	0.46
Hamilton Co CTP	4.571	500yr	1890.00	843.38	851.09	849.69	851.27	0.002243	5.21	811.37	265.17	0.39
Hamilton Co CTP	4.543	100yr	1280.00	843.04	849.76		850.00	0.002291	4.99	528.55	222.69	0.40
Hamilton Co CTP	4.543	Floodway	1280.00	843.04	849.82		850.06	0.002367	5.12	474.61	171.16	0.40
Hamilton Co CTP	4.543	10yr	614.00	843.04	846.51		848.73	0.002484	4.28	262.24	199.41	0.39
Hamilton Co CTP	4.543	50yr	1050.00	843.04	849.91		849.66	0.002657	4.95	429.49	217.18	0.41
Hamilton Co CTP	4.543	500yr	1890.00	843.04	850.76		851.01	0.002041	5.34	762.74	251.62	0.39
Hamilton Co CTP	4.513	100yr	1280.00	842.67	849.43		849.66	0.002322	4.76	519.05	232.05	0.40
Hamilton Co CTP	4.513	Floodway	1280.00	842.67	849.47		849.73	0.002449	4.92	440.43	162.18	0.41
Hamilton Co CTP	4.513	10yr	614.00	842.67	846.06		848.32	0.003009	4.26	234.97	184.96	0.42
Hamilton Co CTP	4.513	50yr	1050.00	842.67	848.88		849.15	0.002942	4.91	396.22	216.85	0.44
Hamilton Co CTP	4.513	500yr	1890.00	842.67	850.51		850.73	0.001777	4.81	783.66	252.33	0.36
Hamilton Co CTP	4.447	100yr	1280.00	841.86	849.17		849.25	0.000856	3.27	945.49	380.46	0.24
Hamilton Co CTP	4.447	Floodway	1280.00	841.86	849.20		849.27	0.000968	3.24	837.15	263.16	0.24
Hamilton Co CTP	4.447	10yr	614.00	841.86	847.33		847.50	0.002266	4.07	351.37	286.10	0.37
Hamilton Co CTP	4.447	50yr	1050.00	841.86	848.49		848.59	0.001229	3.58	704.09	329.72	0.29
Hamilton Co CTP	4.447	500yr	1890.00	841.86	850.35		850.41	0.000637	3.21	1410.05	408.17	0.22
Hamilton Co CTP	4.313	100yr	1280.00	840.22	848.98		849.00	0.000343	2.27	1380.95	405.27	0.16
Hamilton Co CTP	4.313	Floodway	1280.00	840.22	848.98		849.01	0.000369	2.36	1209.04	294.68	0.16
Hamilton Co CTP	4.313	10yr	614.00	840.22	846.63		846.69	0.000999	2.89	527.88	313.03	0.25
Hamilton Co CTP	4.313	50yr	1050.00	840.22	848.20		848.24	0.000463	2.43	1075.01	385.64	0.18
Hamilton Co CTP	4.313	500yr	1890.00	840.22	850.19		850.22	0.000322	2.46	1898.25	464.65	0.15
Hamilton Co CTP	4.274	100yr	1280.00	839.75	848.95		848.97	0.000160	1.75	1809.60	402.50	0.12
Hamilton Co CTP	4.274	Floodway	1280.00	839.75	848.95		848.97	0.000193	1.81	1427.37	306.14	0.12
Hamilton Co CTP	4.274	10yr	614.00	839.75	846.57		846.59	0.000401	1.97	724.16	347.78	0.16
Hamilton Co CTP	4.274	50yr	1050.00	839.75	848.17		848.19	0.000219	1.78	1304.46	379.52	0.13
Hamilton Co CTP	4.274	500yr	1890.00	839.75	850.16		850.18	0.000182	1.95	2111.49	432.86	0.12
Hamilton Co CTP	4.219	100yr	1280.00	839.00	848.66	845.26	848.84	0.000891	3.69	421.67	539.14	0.26
Hamilton Co CTP	4.219	Floodway	1280.00	839.00	848.65	845.27	848.84	0.000933	3.77	420.56	69.79	0.26
Hamilton Co CTP	4.219	10yr	614.00	839.00	846.27	844.20	846.41	0.001192	3.11	225.32	469.23	0.28
Hamilton Co CTP	4.219	50yr	1050.00	839.00	847.88	844.94	848.05	0.000881	3.55	353.40	520.18	0.27
Hamilton Co CTP	4.219	500yr	1890.00	839.00	850.15	846.03	850.16	0.000073	1.22	2832.46	580.71	0.08
Hamilton Co CTP	4.213		Bridge									
Hamilton Co CTP	4.200	100yr	1280.00	839.00	845.83	845.18	846.74	0.008418	7.92	194.97	359.86	0.65
Hamilton Co CTP	4.200	Floodway	1280.00	839.00	845.85	845.17	846.75	0.008332	7.88	196.35	70.21	0.65
Hamilton Co CTP	4.200	10yr	614.00	839.00	844.00	843.30	845.28	0.003663	5.12	131.19	284.08	0.47
Hamilton Co CTP	4.200	50yr	1050.00	839.00	845.65	844.53	846.28	0.005577	7.07	175.21	346.17	0.60
Hamilton Co CTP	4.200	500yr	1890.00	839.00	846.31	846.12	847.78	0.009378	10.23	229.51	390.59	0.80
Hamilton Co CTP	4.167	100yr	1280.00	838.41	845.20		845.59	0.004084	6.33	446.78	299.01	0.52
Hamilton Co CTP	4.167	Floodway	1280.00	838.41	845.26		845.66	0.003637	6.06	413.49	200.00	0.49
Hamilton Co CTP	4.167	10yr	614.00	838.41	844.20		844.58	0.004130	5.40	197.53	220.92	0.50
Hamilton Co CTP	4.167	50yr	1050.00	838.41	844.91		845.28	0.003961	5.96	364.94	252.74	0.51
Hamilton Co CTP	4.167	500yr	1890.00	838.41	845.89		846.25	0.003684	6.61	674.30	357.25	0.51
Hamilton Co CTP	4.111	100yr	1280.00	837.69	844.50	843.49	844.73	0.002816	4.70	478.79	277.86	0.41
Hamilton Co CTP	4.111	Floodway	1280.00	837.69	844.55	843.95	844.81	0.002908	4.81	402.22	146.98	0.42
Hamilton Co CTP	4.111	10yr	614.00	837.69	843.42	842.44	843.61	0.002696	3.88	245.19	185.55	0.40
Hamilton Co CTP	4.111	50yr	1050.00	837.69	844.18	842.91	844.41	0.002861	4.49	405.16	255.20	0.41
Hamilton Co CTP	4.111	500yr	1890.00	837.69	845.22	844.09	845.48	0.002601	5.24	715.61	334.85	0.42
Hamilton Co CTP	3.977	100yr	1280.00	835.97	843.42		843.53	0.001266	3.85	704.92	316.80	0.28
Hamilton Co CTP	3.977	Floodway	1280.00	835.97	843.51		843.61	0.001147	3.70	650.12	227.25	0.28
Hamilton Co CTP	3.977	10yr	614.00	835.97	842.44		842.52	0.001019	3.03	419.08	262.46	0.25
Hamilton Co CTP	3.977	50yr	1050.00	835.97	843.09		843.19	0.001263	3.67	602.49	297.98	0.28
Hamilton Co CTP	3.977	500yr	1890.00	835.97	844.20		844.31	0.001224	4.13	969.24	357.92	0.28
Hamilton Co CTP	3.871	100yr	1690.00	834.61	842.40	841.07	842.65	0.002103	5.21	674.99	322.63	0.39
Hamilton Co CTP	3.871	Floodway	1690.00	834.61	842.61	841.54	842.77	0.002098	5.26	611.74	238.84	0.39
Hamilton Co CTP	3.871	10yr	807.00	834.61	840.88	839.47	841.39	0.004017	5.86	164.08	203.62	0.51
Hamilton Co CTP	3.871	50yr	1390.00	834.61	842.00	840.91	842.27	0.002307	5.20	546.84	308.92	0.40
Hamilton Co CTP	3.871	500yr	2500.00	834.61	843.28	842.06	843.52	0.001666	5.41	972.70	362.63	0.37
Hamilton Co CTP	3.785	100yr	2000.00	833.51	841.78		841.97	0.001288	4.43	840.93	335.62	0.31
Hamilton Co CTP	3.785	Floodway	2000.00	833.51	841.89		842.10	0.001279	4.47	705.40	200.09	0.31

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	3.785	10yr	957.00	833.51	840.38		840.51	0.001008	3.30	440.06	231.84	0.27
Hamilton Co CTP	3.785	50yr	1650.00	833.51	841.38		841.56	0.001246	4.16	709.05	313.43	0.30
Hamilton Co CTP	3.785	500yr	2960.00	833.51	842.65		842.87	0.001408	5.05	1157.94	392.89	0.34
Hamilton Co CTP	3.729	100yr	2000.00	832.79	841.28		841.54	0.001894	4.88	696.00	289.64	0.37
Hamilton Co CTP	3.729	Floodway	2000.00	832.79	841.40		841.67	0.001866	4.91	617.61	191.89	0.37
Hamilton Co CTP	3.729	10yr	957.00	832.79	839.87		840.10	0.002061	4.16	332.13	221.93	0.37
Hamilton Co CTP	3.729	50yr	1650.00	832.79	840.87		841.12	0.001943	4.68	580.94	270.60	0.37
Hamilton Co CTP	3.729	500yr	2960.00	832.79	842.13		842.42	0.001931	5.43	955.83	319.82	0.38
Hamilton Co CTP	3.651	100yr	2000.00	831.79	840.02		840.63	0.003413	6.39	493.94	239.84	0.49
Hamilton Co CTP	3.651	Floodway	2000.00	831.79	840.12		840.67	0.003407	6.47	420.29	132.59	0.49
Hamilton Co CTP	3.651	10yr	957.00	831.79	838.84		839.16	0.002573	4.68	260.32	164.74	0.41
Hamilton Co CTP	3.651	50yr	1650.00	831.79	839.69		840.14	0.003126	5.85	422.14	209.34	0.47
Hamilton Co CTP	3.651	500yr	2960.00	831.79	840.72		841.35	0.003908	7.44	674.34	278.95	0.54
Hamilton Co CTP	3.582	100yr	2000.00	830.90	838.97		839.34	0.002999	6.51	677.58	364.62	0.47
Hamilton Co CTP	3.582	Floodway	2000.00	830.90	839.11		839.49	0.002803	6.48	577.14	211.16	0.46
Hamilton Co CTP	3.582	10yr	957.00	830.90	838.03		838.30	0.002124	4.90	379.13	270.76	0.38
Hamilton Co CTP	3.582	50yr	1650.00	830.90	838.69		839.04	0.002790	6.09	582.16	337.77	0.45
Hamilton Co CTP	3.582	500yr	2960.00	830.90	839.62		840.01	0.003204	7.20	932.67	413.63	0.49
Hamilton Co CTP	3.494	100yr	2000.00	829.77	838.23		838.37	0.001509	4.29	1041.22	546.60	0.32
Hamilton Co CTP	3.494	Floodway	2000.00	829.77	838.37		838.52	0.001554	4.30	966.98	468.14	0.32
Hamilton Co CTP	3.494	10yr	957.00	829.77	837.27		837.43	0.001658	3.90	517.80	535.40	0.32
Hamilton Co CTP	3.494	50yr	1650.00	829.77	837.95		838.09	0.001556	4.16	684.60	543.62	0.32
Hamilton Co CTP	3.494	500yr	2960.00	829.77	838.93		839.06	0.001398	4.41	1425.17	553.74	0.31
Hamilton Co CTP	3.326	100yr	2000.00	827.62	836.71		836.93	0.002662	6.17	757.83	306.23	0.41
Hamilton Co CTP	3.326	Floodway	2000.00	827.62	836.82		837.05	0.002661	6.24	698.84	247.57	0.41
Hamilton Co CTP	3.326	10yr	957.00	827.62	835.66		835.84	0.002552	4.31	437.23	289.33	0.38
Hamilton Co CTP	3.326	50yr	1650.00	827.62	836.40		836.61	0.002641	4.93	662.26	306.04	0.40
Hamilton Co CTP	3.326	500yr	2960.00	827.62	837.46		837.71	0.002687	5.71	990.94	313.57	0.42
Hamilton Co CTP	3.245	100yr	2000.00	826.68	835.62		835.97	0.002734	6.99	715.56	354.00	0.44
Hamilton Co CTP	3.245	Floodway	2000.00	826.68	835.71		836.08	0.002736	6.98	642.65	260.00	0.44
Hamilton Co CTP	3.245	10yr	957.00	826.68	834.31		834.72	0.003209	6.36	268.86	299.34	0.45
Hamilton Co CTP	3.245	50yr	1650.00	826.68	835.23		835.60	0.002911	5.60	590.27	337.13	0.45
Hamilton Co CTP	3.245	500yr	2960.00	826.68	836.54		836.85	0.002380	6.08	1055.60	389.84	0.42
Hamilton Co CTP	3.127	100yr	2000.00	825.06	834.49		834.76	0.001821	4.63	734.03	299.90	0.36
Hamilton Co CTP	3.127	Floodway	2000.00	825.06	834.56		834.86	0.001811	4.67	637.77	190.00	0.36
Hamilton Co CTP	3.127	10yr	957.00	825.06	832.79		833.03	0.002333	4.04	298.71	199.54	0.38
Hamilton Co CTP	3.127	50yr	1650.00	825.06	834.01		834.27	0.001930	4.47	604.29	276.49	0.36
Hamilton Co CTP	3.127	500yr	2960.00	825.06	835.51		835.80	0.001772	5.14	1071.29	360.37	0.36
Hamilton Co CTP	2.921	100yr	2000.00	822.42	831.04		831.84	0.004767	7.30	333.60	172.95	0.57
Hamilton Co CTP	2.921	Floodway	2000.00	822.42	831.12		831.93	0.004757	7.28	296.96	76.88	0.57
Hamilton Co CTP	2.921	10yr	957.00	822.42	829.54		829.95	0.003577	5.13	186.50	50.87	0.47
Hamilton Co CTP	2.921	50yr	1650.00	822.42	830.63		831.30	0.004425	6.65	280.37	120.81	0.55
Hamilton Co CTP	2.921	500yr	2960.00	822.42	831.96		832.97	0.005016	8.40	516.10	213.98	0.61
Hamilton Co CTP	2.860	100yr	2000.00	821.64	830.44		830.76	0.001869	5.45	785.43	334.96	0.38
Hamilton Co CTP	2.860	Floodway	2000.00	821.64	830.50		830.84	0.001926	5.57	641.25	185.93	0.38
Hamilton Co CTP	2.860	10yr	957.00	821.64	828.64		828.99	0.002392	4.98	296.66	196.90	0.40
Hamilton Co CTP	2.860	50yr	1650.00	821.64	829.93		830.25	0.002018	5.37	622.11	300.17	0.38
Hamilton Co CTP	2.860	500yr	2960.00	821.64	831.71		831.96	0.001444	5.39	1243.51	381.76	0.34
Hamilton Co CTP	2.811	100yr	2000.00	820.88	830.13	826.40	830.34	0.001112	3.92	630.49	361.93	0.29
Hamilton Co CTP	2.811	Floodway	2000.00	820.88	830.21	826.40	830.41	0.001084	3.86	642.82	154.30	0.28
Hamilton Co CTP	2.811	10yr	957.00	820.88	828.43	824.70	828.55	0.000778	2.84	381.47	183.86	0.23
Hamilton Co CTP	2.811	50yr	1650.00	820.88	829.64	825.92	829.82	0.001096	3.66	555.23	323.25	0.27
Hamilton Co CTP	2.811	500yr	2960.00	820.88	831.36	827.75	831.62	0.001169	4.47	825.64	463.19	0.30
Hamilton Co CTP	2.801		Bridge									
Hamilton Co CTP	2.787	100yr	2000.00	820.88	829.72	826.41	830.05	0.001716	4.72	452.60	198.30	0.35
Hamilton Co CTP	2.787	Floodway	2000.00	820.88	829.81	826.39	830.13	0.001638	4.65	461.45	92.44	0.35
Hamilton Co CTP	2.787	10yr	957.00	820.88	828.27	824.77	828.41	0.000951	3.10	324.27	133.23	0.25
Hamilton Co CTP	2.787	50yr	1650.00	820.88	829.32	825.91	829.59	0.001463	4.22	416.42	193.96	0.32
Hamilton Co CTP	2.787	500yr	2960.00	820.88	830.61	827.65	831.13	0.002332	5.90	536.05	223.31	0.42
Hamilton Co CTP	2.753	100yr	2000.00	820.27	829.16	826.15	829.62	0.002911	6.29	605.22	241.46	0.46
Hamilton Co CTP	2.753	Floodway	2000.00	820.27	829.26	826.10	829.72	0.002808	6.26	488.48	162.83	0.45
Hamilton Co CTP	2.753	10yr	957.00	820.27	827.70	825.91	828.07	0.002605	5.11	251.20	210.40	0.43
Hamilton Co CTP	2.753	50yr	1650.00	820.27	828.76	827.74	829.18	0.002853	5.94	433.05	238.95	0.45
Hamilton Co CTP	2.753	500yr	2960.00	820.27	830.11	828.88	830.65	0.003006	7.06	676.77	247.10	0.48
Hamilton Co CTP	2.652	100yr	2000.00	818.98	828.78		828.87	0.000716	3.35	1292.62	445.08	0.23

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	2.652	Floodway	2000.00	818.98	828.89		828.98	0.000709	3.19	1211.04	348.38	0.22
Hamilton Co CTP	2.652	10yr	957.00	818.98	826.99		827.12	0.001134	3.41	552.76	368.71	0.27
Hamilton Co CTP	2.652	50yr	1650.00	818.98	828.33		828.42	0.000743	3.26	1096.94	434.94	0.23
Hamilton Co CTP	2.652	500yr	2960.00	818.98	829.79		829.89	0.000705	3.65	1795.63	502.68	0.23
Hamilton Co CTP	2.584	100yr	2480.00	818.11	827.47		828.25	0.004138	8.01	580.88	275.03	0.56
Hamilton Co CTP	2.584	Floodway	2480.00	818.11	827.48		828.34	0.004478	8.32	504.64	190.00	0.58
Hamilton Co CTP	2.584	10yr	1180.00	818.11	825.58		826.28	0.004675	6.76	199.14	85.83	0.56
Hamilton Co CTP	2.584	50yr	2040.00	818.11	826.86		827.75	0.004816	8.09	420.30	257.04	0.59
Hamilton Co CTP	2.584	500yr	3680.00	818.11	828.54		829.30	0.003640	8.55	895.30	292.54	0.55
Hamilton Co CTP	2.572	100yr	2480.00	817.96	826.94		827.95	0.005223	8.61	474.60	244.42	0.62
Hamilton Co CTP	2.572	Floodway	2480.00	817.96	826.99		828.03	0.005246	8.68	430.41	175.13	0.62
Hamilton Co CTP	2.572	10yr	1180.00	817.96	825.39		825.98	0.004092	6.24	209.65	80.51	0.52
Hamilton Co CTP	2.572	50yr	2040.00	817.96	826.49		827.44	0.005174	8.13	368.89	221.46	0.61
Hamilton Co CTP	2.572	500yr	3680.00	817.96	827.93		828.01	0.005214	9.52	730.21	272.58	0.63
Hamilton Co CTP	2.525	100yr	2480.00	817.35	826.33		826.89	0.002943	6.86	677.86	275.93	0.47
Hamilton Co CTP	2.525	Floodway	2480.00	817.35	826.42		826.98	0.002859	6.84	618.92	184.18	0.46
Hamilton Co CTP	2.525	10yr	1180.00	817.35	824.66		825.11	0.002772	5.51	296.19	187.01	0.43
Hamilton Co CTP	2.525	50yr	2040.00	817.35	825.65		826.38	0.002924	6.52	553.93	240.39	0.46
Hamilton Co CTP	2.525	500yr	3680.00	817.35	827.38		827.97	0.002942	7.58	984.82	314.04	0.48
Hamilton Co CTP	2.434	100yr	2480.00	816.19	825.43		825.77	0.001845	5.36	781.35	276.62	0.37
Hamilton Co CTP	2.434	Floodway	2480.00	816.19	825.61		825.87	0.001864	5.43	693.88	190.88	0.37
Hamilton Co CTP	2.434	10yr	1180.00	816.19	823.78		824.04	0.001703	4.23	379.28	217.19	0.34
Hamilton Co CTP	2.434	50yr	2040.00	816.19	824.98		825.29	0.001754	4.98	682.13	252.71	0.36
Hamilton Co CTP	2.434	500yr	3680.00	816.19	826.40		826.82	0.002056	6.22	1075.77	325.73	0.40
Hamilton Co CTP	2.401	100yr	2480.00	815.77	825.18		825.45	0.001645	4.88	909.44	369.72	0.35
Hamilton Co CTP	2.401	Floodway	2480.00	815.77	825.25		825.54	0.001677	4.97	793.23	246.69	0.35
Hamilton Co CTP	2.401	10yr	1180.00	815.77	823.46		823.73	0.001675	4.20	364.25	276.09	0.35
Hamilton Co CTP	2.401	50yr	2040.00	815.77	824.72		824.99	0.001640	4.63	747.78	334.88	0.34
Hamilton Co CTP	2.401	500yr	3680.00	815.77	826.18		826.47	0.001628	5.36	1265.99	403.82	0.35
Hamilton Co CTP	2.263	100yr	2480.00	814.01	823.37	821.36	823.92	0.002694	6.53	689.34	321.60	0.45
Hamilton Co CTP	2.263	Floodway	2480.00	814.01	823.39	821.37	823.96	0.002798	6.66	619.01	239.05	0.46
Hamilton Co CTP	2.263	10yr	1180.00	814.01	821.05	819.49	822.30	0.002007	4.78	278.60	143.04	0.37
Hamilton Co CTP	2.263	50yr	2040.00	814.01	823.02	820.74	823.51	0.002465	6.02	577.51	309.91	0.43
Hamilton Co CTP	2.263	500yr	3680.00	814.01	824.32	823.30	824.92	0.002805	7.30	1008.76	350.74	0.47
Hamilton Co CTP	2.202	100yr	2480.00	813.23	822.53	821.40	823.04	0.002803	7.30	867.32	370.27	0.47
Hamilton Co CTP	2.202	Floodway	2480.00	813.23	822.55	822.00	823.06	0.002776	7.28	847.24	351.87	0.47
Hamilton Co CTP	2.202	10yr	1180.00	813.23	820.73	819.01	821.42	0.003671	6.95	214.46	174.62	0.52
Hamilton Co CTP	2.202	50yr	2040.00	813.23	822.02	820.61	822.62	0.003158	7.39	669.82	367.92	0.49
Hamilton Co CTP	2.202	500yr	3680.00	813.23	823.63	822.63	824.06	0.002410	7.42	1265.98	374.64	0.45
Hamilton Co CTP	2.090	100yr	2480.00	811.80	821.43	819.96	821.79	0.001763	5.31	760.30	233.88	0.37
Hamilton Co CTP	2.090	Floodway	2480.00	811.80	821.54	819.96	821.87	0.001610	5.14	780.99	220.00	0.35
Hamilton Co CTP	2.090	10yr	1180.00	811.80	819.67	818.95	819.92	0.001643	4.15	377.15	205.61	0.34
Hamilton Co CTP	2.090	50yr	2040.00	811.80	821.00	818.40	821.31	0.001614	4.86	661.90	221.47	0.35
Hamilton Co CTP	2.090	500yr	3680.00	811.80	822.37	820.39	822.84	0.002111	6.36	985.99	247.57	0.41
Hamilton Co CTP	2.033	100yr	2480.00	811.07	820.04		820.96	0.005085	8.32	501.82	252.54	0.60
Hamilton Co CTP	2.033	Floodway	2480.00	811.07	820.15		821.06	0.005238	8.29	478.40	222.79	0.60
Hamilton Co CTP	2.033	10yr	1180.00	811.07	818.68		819.16	0.004049	6.14	204.13	78.16	0.51
Hamilton Co CTP	2.033	50yr	2040.00	811.07	819.62		820.51	0.005045	7.89	396.47	250.54	0.59
Hamilton Co CTP	2.033	500yr	3680.00	811.07	820.97		821.97	0.005167	9.26	736.73	257.19	0.62
Hamilton Co CTP	1.976	100yr	2480.00	810.34	819.53		819.89	0.002216	5.38	737.72	259.96	0.40
Hamilton Co CTP	1.976	Floodway	2480.00	810.34	819.63		820.00	0.002182	5.40	690.94	185.00	0.40
Hamilton Co CTP	1.976	10yr	1180.00	810.34	817.97		818.22	0.002195	4.22	376.86	204.98	0.37
Hamilton Co CTP	1.976	50yr	2040.00	810.34	819.15		819.46	0.002064	4.95	641.05	240.20	0.38
Hamilton Co CTP	1.976	500yr	3680.00	810.34	820.36		820.83	0.002617	6.41	972.61	307.57	0.44
Hamilton Co CTP	1.922	100yr	2480.00	809.65	818.69	816.98	819.21	0.002884	6.57	738.99	358.80	0.46
Hamilton Co CTP	1.922	Floodway	2480.00	809.65	818.79	816.98	819.32	0.002821	6.58	663.53	245.69	0.46
Hamilton Co CTP	1.922	10yr	1180.00	809.65	817.04	815.14	817.50	0.003001	5.47	228.42	269.96	0.45
Hamilton Co CTP	1.922	50yr	2040.00	809.65	818.30	816.40	818.80	0.002793	6.20	604.23	342.19	0.45
Hamilton Co CTP	1.922	500yr	3680.00	809.65	819.49	818.69	820.08	0.003153	7.46	1045.03	397.23	0.49
Hamilton Co CTP	1.816	100yr	2480.00	808.30	817.15	814.97	817.73	0.002730	7.03	763.49	420.67	0.47
Hamilton Co CTP	1.816	Floodway	2480.00	808.30	817.24	814.97	817.85	0.002750	7.12	702.28	331.37	0.47
Hamilton Co CTP	1.816	10yr	1180.00	808.30	815.29	813.25	815.83	0.002933	5.96	224.85	141.68	0.46
Hamilton Co CTP	1.816	50yr	2040.00	808.30	816.70	814.68	817.29	0.002791	6.81	551.63	356.45	0.47
Hamilton Co CTP	1.816	500yr	3680.00	808.30	818.20	817.37	818.68	0.002355	7.16	1222.05	455.03	0.44
Hamilton Co CTP	1.641	100yr	2480.00	806.06	815.54		815.87	0.001647	6.05	1042.20	420.44	0.37
Hamilton Co CTP	1.641	Floodway	2480.00	806.06	815.59		815.94	0.001609	6.19	930.44	297.71	0.37

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	1.641	10yr	1180.00	806.06	813.34		813.69	0.001839	6.40	388.47	130.05	0.38
Hamilton Co CTP	1.641	50yr	2040.00	806.06	814.95		815.31	0.001698	6.04	796.86	400.32	0.38
Hamilton Co CTP	1.641	500yr	3680.00	806.06	816.86		817.13	0.001205	6.09	1612.63	440.95	0.34
Hamilton Co CTP	1.603	100yr	2480.00	805.58	814.55		815.40	0.003101	8.42	592.65	243.88	0.52
Hamilton Co CTP	1.603	Floodway	2480.00	805.58	814.67		815.48	0.002909	8.24	581.97	178.00	0.50
Hamilton Co CTP	1.603	10yr	1180.00	805.58	812.65		813.23	0.002522	6.38	250.42	100.79	0.46
Hamilton Co CTP	1.603	50yr	2040.00	805.58	814.02		814.83	0.003036	7.97	473.84	194.81	0.51
Hamilton Co CTP	1.603	500yr	3680.00	805.58	815.70		816.68	0.003419	9.65	939.53	360.07	0.55
Hamilton Co CTP	1.492	100yr	2480.00	804.16	812.76		813.43	0.003701	7.01	508.54	169.61	0.52
Hamilton Co CTP	1.492	Floodway	2480.00	804.16	812.88		813.56	0.003604	6.97	462.93	118.37	0.51
Hamilton Co CTP	1.492	10yr	1180.00	804.16	810.84		811.35	0.004235	5.71	223.65	102.20	0.52
Hamilton Co CTP	1.492	50yr	2040.00	804.16	812.18		812.81	0.003866	6.69	414.40	167.97	0.52
Hamilton Co CTP	1.492	500yr	3680.00	804.16	813.84		814.61	0.003758	7.92	921.77	464.61	0.54
Hamilton Co CTP	1.419	100yr	2480.00	803.23	811.93	808.96	812.33	0.002007	5.15	559.36	328.95	0.38
Hamilton Co CTP	1.419	Floodway	2480.00	803.23	812.00	808.96	812.43	0.002108	5.24	479.88	87.55	0.39
Hamilton Co CTP	1.419	10yr	1180.00	803.23	809.91	807.00	810.15	0.002112	3.98	296.62	81.35	0.37
Hamilton Co CTP	1.419	50yr	2040.00	803.23	811.30	808.31	811.67	0.002112	4.88	455.60	274.64	0.39
Hamilton Co CTP	1.419	500yr	3680.00	803.23	813.40	810.30	813.68	0.001312	4.87	1399.79	511.98	0.32
Hamilton Co CTP	1.373	100yr	2480.00	802.64	811.50	808.60	811.88	0.001589	5.28	629.06	495.81	0.35
Hamilton Co CTP	1.373	Floodway	2480.00	802.64	811.59	808.81	811.96	0.001514	5.20	639.60	134.47	0.35
Hamilton Co CTP	1.373	10yr	1180.00	802.64	809.61	806.40	809.73	0.001329	3.86	366.61	120.01	0.31
Hamilton Co CTP	1.373	50yr	2040.00	802.64	810.67	807.82	811.21	0.001567	4.92	542.14	237.26	0.35
Hamilton Co CTP	1.373	500yr	3680.00	802.64	812.69	809.72	813.23	0.001882	6.38	798.86	546.68	0.39
Hamilton Co CTP	1.369		Bridge									
Hamilton Co CTP	1.356	100yr	2480.00	802.59	811.05	808.25	811.49	0.002330	6.39	463.84	542.49	0.41
Hamilton Co CTP	1.356	Floodway	2480.00	802.59	811.17	808.27	811.59	0.002194	5.26	498.85	142.06	0.39
Hamilton Co CTP	1.356	10yr	1180.00	802.59	809.17	806.32	809.41	0.001984	3.92	300.84	121.10	0.36
Hamilton Co CTP	1.356	50yr	2040.00	802.59	810.48	807.69	810.86	0.002309	4.98	411.57	465.10	0.40
Hamilton Co CTP	1.356	500yr	3680.00	802.59	811.98	809.46	812.65	0.002684	6.66	620.79	611.37	0.47
Hamilton Co CTP	1.277	100yr	2480.00	800.49	810.04	806.54	810.58	0.001930	6.03	493.93	442.92	0.39
Hamilton Co CTP	1.277	Floodway	2480.00	800.49	810.07	806.55	810.65	0.002123	6.14	418.10	59.90	0.40
Hamilton Co CTP	1.277	10yr	1180.00	800.49	808.64	804.49	808.84	0.000915	3.62	340.06	73.96	0.26
Hamilton Co CTP	1.277	50yr	2040.00	800.49	809.61	805.93	810.05	0.001627	5.33	435.95	155.25	0.35
Hamilton Co CTP	1.277	500yr	3680.00	800.49	810.86	807.90	811.56	0.002416	7.23	934.93	491.74	0.44
Hamilton Co CTP	1.198	100yr	2800.00	798.70	809.60	805.22	809.93	0.001132	5.01	862.22	518.63	0.30
Hamilton Co CTP	1.198	Floodway	2800.00	798.70	809.62	805.22	809.96	0.001143	5.04	822.14	184.06	0.30
Hamilton Co CTP	1.198	10yr	1350.00	798.70	808.42	803.05	808.65	0.000506	3.04	616.17	396.91	0.20
Hamilton Co CTP	1.198	50yr	2300.00	798.70	809.25	804.55	809.61	0.000923	4.40	785.38	498.49	0.27
Hamilton Co CTP	1.198	500yr	4150.00	798.70	810.47	806.83	810.77	0.001136	5.95	1728.88	577.81	0.31
Hamilton Co CTP	1.106	100yr	2800.00	796.59	808.68	804.06	809.06	0.003617	5.64	776.98	602.68	0.31
Hamilton Co CTP	1.106	Floodway	2800.00	796.59	808.81	804.06	809.14	0.003122	5.29	798.12	296.03	0.29
Hamilton Co CTP	1.106	10yr	1350.00	796.59	808.03	801.38	808.18	0.001386	3.34	566.04	482.89	0.19
Hamilton Co CTP	1.106	50yr	2300.00	796.59	808.61	803.23	808.81	0.002801	4.91	716.55	574.67	0.28
Hamilton Co CTP	1.106	500yr	4150.00	796.59	808.69	808.22	809.52	0.007882	8.33	780.46	604.08	0.46
Hamilton Co CTP	1.105		Inl Struct									
Hamilton Co CTP	1.097	100yr	2800.00	796.47	806.59	802.20	807.03	0.002704	5.64	613.12	145.58	0.32
Hamilton Co CTP	1.097	Floodway	2800.00	796.47	806.72	802.20	807.17	0.002681	5.67	545.34	68.31	0.32
Hamilton Co CTP	1.097	10yr	1350.00	796.47	804.10	800.37	804.33	0.002041	3.69	371.49	71.67	0.27
Hamilton Co CTP	1.097	50yr	2300.00	796.47	805.94	801.62	806.30	0.002418	4.99	530.96	109.33	0.30
Hamilton Co CTP	1.097	500yr	4150.00	796.47	807.68	803.58	808.30	0.003508	6.60	809.14	341.30	0.38
Hamilton Co CTP	1.046	100yr	2800.00	795.77	805.38		806.12	0.003493	7.36	586.29	450.68	0.47
Hamilton Co CTP	1.046	Floodway	2800.00	795.77	805.48		806.26	0.003487	7.42	450.55	76.39	0.47
Hamilton Co CTP	1.046	10yr	1350.00	795.77	803.11		803.58	0.003249	5.59	274.07	81.45	0.43
Hamilton Co CTP	1.046	50yr	2300.00	795.77	804.89		805.60	0.003080	6.61	464.99	139.54	0.44
Hamilton Co CTP	1.046	500yr	4150.00	795.77	806.27		807.18	0.004179	8.88	910.98	580.64	0.53
Hamilton Co CTP	0.962	100yr	2800.00	794.62	804.79	802.00	805.11	0.001365	5.28	1073.49	443.36	0.33
Hamilton Co CTP	0.962	Floodway	2800.00	794.62	804.91	802.02	805.24	0.001352	5.31	796.43	159.62	0.33
Hamilton Co CTP	0.962	10yr	1350.00	794.62	802.04	799.92	802.39	0.002162	4.95	363.87	146.16	0.39
Hamilton Co CTP	0.962	50yr	2300.00	794.62	804.34	801.35	804.61	0.001209	4.77	851.25	356.25	0.31
Hamilton Co CTP	0.962	500yr	4150.00	794.62	805.64	803.25	806.01	0.001580	6.08	1465.96	482.26	0.37
Hamilton Co CTP	0.856	100yr	3100.00	793.17	804.21	800.09	804.51	0.000973	5.23	1440.73	566.77	0.29
Hamilton Co CTP	0.856	Floodway	3100.00	793.17	804.20	800.09	804.59	0.001150	5.68	948.57	199.25	0.32
Hamilton Co CTP	0.856	10yr	1500.00	793.17	801.04	797.77	801.41	0.001514	5.04	369.44	155.17	0.34
Hamilton Co CTP	0.856	50yr	2550.00	793.17	803.78	799.31	804.07	0.000899	4.68	1202.09	553.82	0.28
Hamilton Co CTP	0.856	500yr	4600.00	793.17	804.84	802.27	805.25	0.001373	6.47	1801.66	575.70	0.35

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	0.807	100yr	3100.00	792.50	802.55	800.00	803.94	0.004643	11.18	781.61	468.10	0.63
Hamilton Co CTP	0.807	Floodway	3100.00	792.50	802.56	800.00	803.97	0.004607	11.14	534.70	139.97	0.63
Hamilton Co CTP	0.807	10yr	1500.00	792.50	800.12	797.45	800.84	0.003194	7.65	290.14	49.35	0.50
Hamilton Co CTP	0.807	50yr	2550.00	792.50	802.19	799.24	803.53	0.004314	10.50	622.39	416.19	0.61
Hamilton Co CTP	0.807	500yr	4600.00	792.50	803.67	801.00	804.67	0.003814	10.90	1353.88	539.82	0.58
Hamilton Co CTP	0.730	100yr	3100.00	791.45	801.15		802.18	0.004124	9.09	661.44	412.55	0.54
Hamilton Co CTP	0.730	Floodway	3100.00	791.45	801.22		802.23	0.003972	8.97	647.57	283.10	0.53
Hamilton Co CTP	0.730	10yr	1500.00	791.45	798.67		799.99	0.004312	7.41	224.16	41.30	0.52
Hamilton Co CTP	0.730	50yr	2550.00	791.45	800.27	798.13	801.64	0.005432	9.73	388.60	347.20	0.60
Hamilton Co CTP	0.730	500yr	4600.00	791.45	802.76		803.40	0.002794	8.35	1405.70	597.80	0.45
Hamilton Co CTP	0.666	100yr	3100.00	790.58	799.24	797.34	800.50	0.005860	9.16	393.10	127.49	0.60
Hamilton Co CTP	0.666	Floodway	3100.00	790.58	799.34	797.34	800.60	0.005715	9.12	385.30	60.00	0.59
Hamilton Co CTP	0.666	10yr	1500.00	790.58	797.25	795.28	797.87	0.004306	6.32	242.86	53.44	0.49
Hamilton Co CTP	0.666	50yr	2550.00	790.58	798.02	796.69	798.69	0.005543	8.38	332.76	85.02	0.58
Hamilton Co CTP	0.666	500yr	4600.00	790.58	800.70	799.45	802.04	0.005502	10.02	778.36	388.15	0.60
Hamilton Co CTP	0.580	100yr	3100.00	789.40	797.79	795.88	798.41	0.003493	7.61	606.49	130.85	0.52
Hamilton Co CTP	0.580	Floodway	3100.00	789.40	797.85	795.88	798.50	0.003581	7.33	591.58	109.89	0.50
Hamilton Co CTP	0.580	10yr	1500.00	789.40	795.27	794.43	795.85	0.004835	6.59	312.90	114.55	0.57
Hamilton Co CTP	0.580	50yr	2550.00	789.40	797.07	795.44	797.69	0.003434	7.05	526.18	123.31	0.51
Hamilton Co CTP	0.500	500yr	4600.00	789.40	799.68	796.93	800.31	0.002523	7.70	1400.11	640.53	0.46
Hamilton Co CTP	0.474	100yr	3100.00	787.95	797.77		797.83	0.000337	2.90	2211.55	403.26	0.17
Hamilton Co CTP	0.474	Floodway	3100.00	787.95	797.88		797.93	0.000336	2.92	2116.45	349.54	0.17
Hamilton Co CTP	0.474	10yr	1500.00	787.95	795.05		795.11	0.000509	2.80	1155.78	375.26	0.20
Hamilton Co CTP	0.474	50yr	2550.00	787.95	797.08		797.13	0.000335	2.75	1938.63	393.25	0.17
Hamilton Co CTP	0.474	500yr	4600.00	787.95	799.73		799.79	0.000339	3.33	3313.37	674.55	0.18
Hamilton Co CTP	0.375	100yr	3100.00	786.60	797.54		797.62	0.000414	3.40	2269.82	531.32	0.19
Hamilton Co CTP	0.375	Floodway	3100.00	786.60	797.54		797.69	0.000589	4.05	1440.19	216.17	0.23
Hamilton Co CTP	0.375	10yr	1500.00	786.60	794.74		794.83	0.000519	3.04	1080.04	352.40	0.20
Hamilton Co CTP	0.375	50yr	2550.00	786.60	796.85		796.93	0.000410	3.22	1916.64	477.84	0.19
Hamilton Co CTP	0.375	500yr	4600.00	786.60	799.54		799.61	0.000322	3.40	3416.47	691.14	0.17
Hamilton Co CTP	0.351	100yr	3100.00	786.27	797.11		797.50	0.001491	6.30	1257.56	463.57	0.36
Hamilton Co CTP	0.351	Floodway	3100.00	786.27	797.11		797.55	0.001565	6.45	903.90	175.19	0.36
Hamilton Co CTP	0.351	10yr	1500.00	786.27	794.16		794.67	0.002203	6.03	392.10	162.16	0.41
Hamilton Co CTP	0.351	50yr	2550.00	786.27	796.26		796.79	0.001919	6.72	881.88	429.73	0.40
Hamilton Co CTP	0.351	500yr	4600.00	786.27	799.34		799.54	0.000777	5.22	2369.31	535.99	0.27
Hamilton Co CTP	0.279	100yr	3100.00	785.22	796.59	791.92	797.04	0.001294	5.58	709.05	286.53	0.33
Hamilton Co CTP	0.279	Floodway	3100.00	785.22	796.65	791.92	797.09	0.001260	5.53	719.41	170.50	0.32
Hamilton Co CTP	0.279	10yr	1500.00	785.22	793.77	789.65	794.04	0.001205	4.19	362.71	69.74	0.30
Hamilton Co CTP	0.279	50yr	2550.00	785.22	795.83	791.28	796.23	0.001249	5.16	566.76	217.23	0.32
Hamilton Co CTP	0.279	500yr	4600.00	785.22	798.65	793.44	799.15	0.001174	6.09	1061.37	505.29	0.32
Hamilton Co CTP	0.273		Bridge									
Hamilton Co CTP	0.243	100yr	3100.00	785.22	795.61	791.73	796.13	0.001611	6.19	700.05	621.30	0.36
Hamilton Co CTP	0.243	Floodway	3100.00	785.22	795.70	791.73	796.20	0.001558	6.12	712.44	144.51	0.36
Hamilton Co CTP	0.243	10yr	1500.00	785.22	793.28	789.56	793.60	0.001310	4.57	369.88	116.23	0.31
Hamilton Co CTP	0.243	50yr	2550.00	785.22	795.10	791.06	795.53	0.001408	5.56	625.49	471.28	0.34
Hamilton Co CTP	0.243	500yr	4600.00	785.22	796.98	793.64	797.69	0.001819	7.43	898.29	636.49	0.41
Hamilton Co CTP	0.178	100yr	3100.00	784.55	794.82	792.54	795.44	0.002312	7.13	856.30	514.62	0.43
Hamilton Co CTP	0.178	Floodway	3100.00	784.55	794.94	792.53	795.55	0.002205	7.02	827.93	299.50	0.42
Hamilton Co CTP	0.178	10yr	1500.00	784.55	792.39	789.94	792.92	0.002592	5.99	300.95	100.00	0.43
Hamilton Co CTP	0.178	50yr	2550.00	784.55	794.09	791.79	794.80	0.002072	7.20	566.05	464.28	0.46
Hamilton Co CTP	0.178	500yr	4600.00	784.55	796.55	793.94	796.96	0.001519	6.55	1559.80	590.54	0.36
Hamilton Co CTP	0.110	100yr	3100.00	784.07	794.63		794.82	0.001053	4.88	1301.28	613.28	0.30
Hamilton Co CTP	0.110	Floodway	3100.00	784.07	794.68		794.92	0.001166	5.16	957.14	251.00	0.31
Hamilton Co CTP	0.110	10yr	1500.00	784.07	791.94		792.21	0.001299	4.24	421.12	154.09	0.31
Hamilton Co CTP	0.110	50yr	2550.00	784.07	793.75		794.07	0.001207	4.69	869.03	463.10	0.31
Hamilton Co CTP	0.110	500yr	4600.00	784.07	796.41		796.57	0.000611	4.25	2533.47	679.09	0.23
Hamilton Co CTP	0.030	100yr	3480.00	783.44	793.75	789.66	794.22	0.001631	5.85	821.68	526.31	0.36
Hamilton Co CTP	0.030	Floodway	3480.00	783.44	793.73	789.66	794.26	0.001782	6.11	715.42	150.00	0.37
Hamilton Co CTP	0.030	10yr	1600.00	783.44	791.31	787.40	791.62	0.001479	4.43	378.44	87.72	0.32
Hamilton Co CTP	0.030	50yr	2860.00	783.44	792.98	788.97	793.44	0.001678	5.57	666.24	440.52	0.36
Hamilton Co CTP	0.030	500yr	5160.00	783.44	795.58	791.41	796.09	0.001484	6.37	1194.91	667.72	0.35
Hamilton Co CTP	0.0214		Bridge									
Hamilton Co CTP	.0005	100yr	3480.00	783.10	792.73	789.44	793.21	0.002856	5.71	692.84	447.28	0.38
Hamilton Co CTP	.0005	Floodway	3480.00	783.10	792.82	789.44	793.30	0.002773	5.67	678.80	118.67	0.38

HEC-RAS Plan: Prop FIS River: Williams Creek Reach: Hamilton Co CTP (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Hamilton Co CTP	.0005	10yr	1660.00	783.10	790.64	787.36	790.90	0.002354	4.09	419.94	124.73	0.33
Hamilton Co CTP	.0005	50yr	2860.00	783.10	792.18	788.81	792.58	0.002624	5.18	613.46	360.10	0.36
Hamilton Co CTP	.0005	500yr	5160.00	783.10	793.87	790.86	794.58	0.003535	7.03	866.20	550.83	0.43
Hamilton Co CTP	0.0004	100yr	3480.00	782.45	791.76	789.46	792.35	0.004844	6.20	589.29	226.25	0.48
Hamilton Co CTP	0.0004	Floodway	3480.00	782.45	791.89	789.45	792.46	0.004696	6.11	569.90	105.68	0.46
Hamilton Co CTP	0.0004	10yr	1660.00	782.45	789.85	787.61	790.16	0.004150	4.69	361.40	95.97	0.42
Hamilton Co CTP	0.0004	50yr	2860.00	782.45	791.29	788.88	791.78	0.004493	5.62	518.74	138.50	0.45
Hamilton Co CTP	0.0004	500yr	5160.00	782.45	792.75	790.63	793.57	0.005423	7.38	646.09	448.25	0.52
Hamilton Co CTP	0.0003	100yr	3480.00	781.72	791.19	788.70	791.47	0.002245	5.01	1104.77	490.31	0.34
Hamilton Co CTP	0.0003	Floodway	3480.00	781.72	791.33	788.70	791.62	0.002187	5.01	1036.41	296.50	0.33
Hamilton Co CTP	0.0003	10yr	1660.00	781.72	789.13	786.54	789.38	0.002434	4.30	516.73	176.93	0.33
Hamilton Co CTP	0.0003	50yr	2860.00	781.72	790.66	787.76	790.94	0.002336	4.85	903.30	419.25	0.34
Hamilton Co CTP	0.0003	500yr	5160.00	781.72	792.33	789.72	792.62	0.002126	5.40	1543.99	515.64	0.34
Hamilton Co CTP	0.0002	100yr	3480.00	778.93	789.06		789.41	0.002182	5.17	979.34	324.78	0.34
Hamilton Co CTP	0.0002	Floodway	3480.00	778.93	789.21		789.56	0.002225	5.14	919.09	223.58	0.33
Hamilton Co CTP	0.0002	10yr	1660.00	778.93	786.86		787.12	0.002302	4.16	453.96	174.90	0.33
Hamilton Co CTP	0.0002	50yr	2860.00	778.93	788.51		788.84	0.002163	4.67	809.61	292.31	0.33
Hamilton Co CTP	0.0002	500yr	5160.00	778.93	790.34		790.70	0.002072	5.60	1439.65	382.95	0.34
Hamilton Co CTP	0.0001	100yr	3480.00	777.03	787.09	784.02	787.64	0.003808	6.12	723.92	289.37	0.43
Hamilton Co CTP	0.0001	Floodway	3480.00	777.03	787.19	784.02	787.75	0.003827	6.15	670.49	194.32	0.43
Hamilton Co CTP	0.0001	10yr	1660.00	777.03	785.12	781.63	785.43	0.002916	4.50	369.23	75.66	0.36
Hamilton Co CTP	0.0001	50yr	2860.00	777.03	786.51	783.31	787.02	0.003803	5.60	670.86	268.01	0.43
Hamilton Co CTP	0.0001	500yr	5160.00	777.03	788.26	785.56	788.97	0.004190	7.19	1079.68	473.04	0.46

Appendix 4

Disc with Hydraulic Model

For a copy of the Hydraulic Model please contact the Hamilton County Surveyor's Office:

Hamilton County Surveyor's Office
One Hamilton County Square, Suite 188
Noblesville, IN 46060
317-776-8495
surveyor@hamiltoncounty.in.gov

APPENDIX 5

CheckRAS Output, IDNR Project Evaluation Table and Hydraulic Modeling Checklist

Division of Water
Indiana Department of Natural Resources
Hydraulic Modeling Checklist

This checklist will assist the staff at the Division of Water in the review of modeling for the definition of the floodway, for evaluation of a Construction in a Floodway permit application, for state concurrence of a Letter of Map Revision or a Flood Insurance Study or any other modeling that is submitted for review. The checklist items are based on the document "General Guidelines for the Hydrologic-Hydraulic Assessment of Floodplains in Indiana." The modeler should be familiar with this document and any discrepancies between the general guidelines and the submitted modeling should be discussed with the Division of Water Engineering Services staff prior to submittal.

This completed checklist must be submitted to the Division of Water along with your models. The Division of Water will not review any modeling submittal that is not accompanied by a completed checklist.

Please keep in mind that these questions were written primarily for the application of HEC-RAS computer models. HEC-RAS is preferred by the Division of Water, however, other modeling programs may be used provided their use has been discussed previously with Division of Water Staff. Should you have any questions, please contact Division of Water staff at (317) 232–4160 or toll free at (877) 928-3755.

1. **General Information**

   a. Preparer Name: Matt Mead
   (Name of individual who prepared the submitted modeling)

   b. Preparer Firm: Christopher B. Burke Engineering, Ltd.

   c. Date: August 19, 2009

2. **Project Location and Background Information**

   a. Waterbody Name: Williams Creek
   (Use name as shown on USGS 7 ½ minute quadrangle)

   b. Location Description: From the Hamilton - Marion County line to 156th St.
   (Example: Along the west bank of Blank Creek beginning at Culvert Avenue and extending upstream (north) approximately 2,000 feet to C.R. 700 North)

   c. Nearest Town/City: Carmel

   d. County: Hamilton

   e. Downstream End of Project Location:

   Section: 10 Township: 17N Range: 3E Quadrangle: Carmel
   (if the project is in a grant, reserve or donation, check here and give information below) ☐

Waterbody Name: _____
Preparer: _____
Date: _____

Upstream End of Project Location:

Section: 15 Township: 18N Range: 3E Quadrangle: Westfield
(if the project is in a grant, reserve or donation, check here and give information below) ☐

f. Study Reach Location: Downstream Limit 0.030 mi *(unit of distance)*

Upstream Limit 9.022 mi *(unit of distance)*

(Limits should be measured in miles from the mouth of the stream or use units of distance consistent with published flood study. The Division of Water has mileage on many streams.)

g. Type of Model

☒ HEC-RAS ☐ HEC-2 ☐ WSPRO ☐ WSP2 ☐ HY-8

Other _____

h. Published Flood Insurance model *(Name, Study Reach and Date)* FIS model

i. IDNR model *(Name, Study Reach and Date)* _____

j. Previous FARA / Floodway Permits within study reach *(Application Number and Approval Date)*

1. See Attached
2. _____
3. _____
4. _____
5. _____

3. Request Information

Please indicate for what purpose the models are submitted for review and approval:

☐ Floodway / Base Flood Elevation Determination (FARA)
☐ Construction in a Floodway Application
☐ Letter of Map Revision (LOMR)
☒ Flood Insurance Study modeling
☐ Other (please describe) _____

Permit Number	Approval Date
B-13441	6/3/1991
B-15242	4/30/1993
FW-15609	2/21/1994
FW-16072	12/30/1994
FW-17692	9/20/1996
FW-18732	2/25/1998
FW-18986	9/18/1998
FW-19495	7/16/1999
FW-20915	3/20/2001
FW-21260	12/27/2001
FW-21261	12/20/2001
FW-22907	10/19/2004
FW-22988	11/17/2004
FW-23055	2/11/2005
FW-24171	5/18/2007
FW-24360	11/21/2007

Waterbody Name: _____
Preparer: _____
Date: _____

4. Discharges

The source of the 100-year frequency flood discharges used in a hydraulic model need to be fully documented by completing the questions listed below.

It is strongly suggested that a preparer-determined 100-year discharge be submitted for approval prior to the submittal of hydraulic models. Discharge determinations and hydraulic models are considered to be separate items, each subject to review.

a. What is the source of the discharges used in the submitted model *(Please check one)*:

- [X] Discharges based on a curve published in "Coordinated Discharges of Selected Streams in Indiana"
  (Please attach copy of applicable graph)
- [ ] Discharges based on a determination from the Department of Natural Resources
  (Please attach copy of letter from IDNR)
- [ ] Discharges based on hydrologic analyses submitted with this model
  (Please attach a copy of the IDNR approval letter)
- [ ] Discharges from a Flood Insurance Study
- [ ] Discharges from other modeling *(Indicate source)* _____

b. Table of Discharges used in the model *(Expand table as needed)*

Drainage Area (sq. mi.)	Discharge (cfs)	Cross-Section / Location Where Discharge is Specified
see attached		

c. Comments regarding discharge determination:

IDNR discharges

Drainage Area (sq. mi.)	Discharge (cfs)	Cross-Section / Location Where Discharge is Specified
0.426	167	9.022
0.802	292	8.658
1.781	570	7.797
2.54	753	7.288
4.82	1280	5.422
6.71	1690	3.871
8.25	2000	3.785
10.68	2480	2.584
12.36	2800	1.198
14.54	3100	0.856
16.50	3480	0.03

Waterbody Name: _____
Preparer: _____
Date: _____

5. **Starting Elevation / Boundary Conditions**

Complete the following section fully to document the starting elevations and boundary conditions for starting the model:

a. Boundary condition used to derive starting elevations: *(Please check one)*

- [x] Known water surface *(Indicate source)*: Williams Creek Marion County (USGS 2004)
- [ ] Energy slope estimated from historic flood profile *(Indicate date)*: _____
- [ ] Energy slope estimated from stream thalweg *(Indicate mapping used)*: _____
- [ ] Other *(Please Describe)*: _____

b. Description (show any calculations):

_____

_____

6. **Manning's Roughness Coefficients ("n" Values)**

Complete the following section fully to document the Manning's roughness coefficients:

a. How were the roughness coefficients estimated? *(Check all that apply)*

- [ ] Flood Insurance Study
- [ ] Other modeling
- [x] Field inspection
- [x] Site photos
- [x] Aerial photography or mapping
- [ ] Calibration
- [ ] Other *(Describe)* _____

b. What is the range of the roughness coefficients?

Left Overbank	Minimum 0.05	Maximum 0.06
Channel	Minimum 0.04	Maximum 0.065
Right Overbank	Minimum 0.05	Maximum 0.08

c. Are proposed roughness coefficients different from the base roughness coefficients?

- [ ] Yes
- [x] No

Note: In most cases, the Department will not approve modeling based on an "improved" condition. If the "Yes" box is checked, you will need to justify the use of the modified roughness coefficients below. It is strongly suggested that these issues should be discussed with personnel at the Department prior to submittal.

Waterbody Name: _____
Preparer: _____
Date: _____

d. Description of "n" values

Please further describe the methods checked above that were used to estimate the roughness coefficients. If they are estimated from photos, please attach copies of the photos, along with an orientation map. If the roughness coefficients are estimated by calibration, please submit supporting documentation.

Mannings n values were determined based on 2005 aerial photos, site photos and site visits. The n values found in the HEC-RAS manual were used as a baseline.

e. Check-RAS

For HEC-RAS models, please run the "NT" report from Check-RAS and attach it to this checklist. List any comments in the model and justification for not correcting these comments (use additional sheets, if necessary):

See check RAS for comments

CHECK-RAS Program: NT Check
Manning's n Value and Transition Loss Coefficient Review

Project File: R:\2007\07-0760\Models\CEBEL Model\WC_may262009.prj
Plan File: R:\2007\07-0760\Models\CEBEL Model\WC_may262009.p05
Geometry File: R:\2007\07-0760\Models\CEBEL Model\WC_may262009.g05
Flow File: R:\2007\07-0760\Models\CEBEL Model\WC_may262009.f02
Report File: R:\2007\07-0760\Models\CEBEL Model\WC_may262009.nt
Selected profiles: 100yr;Floodway
Date: 6/20/2009
Time: 8:47:37 AM → No changes

SECNO	STRUCTURE	NLOB	NCHL	NROB	CNTR	EXP
Williams Creek,Hamilton Co CIP						
9.022		0.05	0.05	0.05	0.1	0.3
8.948		0.05	0.05	0.05	0.3	0.5
8.867		0.05	0.05	0.05	0.3	0.5
8.863	Culvert-Up	0.05	0.05	0.05	0.3	0.5
8.863	Culvert-Dn	0.05	0.05	0.05	0.3	0.5
8.744		0.05	0.05	0.05	0.3	0.5
8.658		0.05	0.05	0.05	0.3	0.5
8.554		0.05	0.05	0.05	0.3	0.5
8.542	Culvert-Up	0.05	0.05	0.05	0.3	0.5
8.542	Culvert-Dn	0.05	0.05	0.05	0.3	0.5
8.51		0.05	0.05	0.05	0.3	0.5
8.392		0.06	0.04	0.06	0.1	0.3
8.38		0.06	0.04	0.06	0.1	0.3
8.371		0.08	0.04	0.08	0.1	0.3
8.342		0.07	0.04	0.08	0.1	0.3
8.266		0.05	0.04	0.06	0.3	0.5
8.216		0.05	0.04	0.05	0.3	0.5
8.21	Culvert-Up	0.05	0.04	0.05	0.3	0.5
8.21	Culvert-Dn	0.05	0.04	0.05	0.3	0.5
8.194		0.05	0.04	0.05	0.3	0.5
8.162		0.055	0.05	0.055	0.1	0.3
8.096		0.06	0.055	0.06	0.1	0.3
8.014		0.06	0.055	0.06	0.1	0.3
7.985		0.05	0.05	0.05	0.3	0.5
7.979		0.05	0.05	0.05	0.3	0.5
7.967		0.06	0.04	0.05	0.3	0.5
7.961	Culvert-Up	0.06	0.04	0.05	0.3	0.5
7.961	Culvert-Dn	0.06	0.04	0.05	0.3	0.5
7.952		0.06	0.04	0.05	0.3	0.5
7.917		0.06	0.04	0.06	0.1	0.3
7.797		0.06	0.04	0.06	0.1	0.3
7.77		0.06	0.04	0.06	0.1	0.3
7.726		0.06	0.04	0.06	0.1	0.3
7.633		0.06	0.04	0.06	0.3	0.5
7.527		0.055	0.04	0.06	0.3	0.5
7.52	Bridge-Up	0.055	0.04	0.06	0.3	0.5
7.52	Bridge-Dn	0.055	0.04	0.06	0.3	0.5
7.51		0.055	0.04	0.06	0.3	0.5
7.472		0.06	0.04	0.06	0.1	0.3
7.435		0.08	0.04	0.06	0.1	0.3
7.36		0.08	0.04	0.06	0.1	0.3
7.325		0.08	0.04	0.06	0.3	0.5
7.288		0.07	0.04	0.07	0.3	0.5
7.285	Culvert-Up	0.07	0.04	0.07	0.3	0.5
7.285	Culvert-Dn	0.06	0.04	0.07	0.3	0.5
7.272		0.06	0.04	0.07	0.3	0.5
7.24		0.06	0.04	0.06	0.3	0.5
7.164		0.06	0.04	0.06	0.3	0.5
7.159	Bridge-Up	0.06	0.04	0.06	0.3	0.5
7.159	Bridge-Dn	0.06	0.04	0.06	0.3	0.5
7.147		0.06	0.04	0.06	0.3	0.5
7.111		0.06	0.04	0.06	0.1	0.3
7.057		0.07	0.04	0.07	0.1	0.3
6.998		0.07	0.04	0.06	0.1	0.3
6.893		0.08	0.04	0.06	0.1	0.3
6.812		0.06	0.04	0.06	0.1	0.3
6.717		0.06	0.04	0.06	0.1	0.3
6.647		0.06	0.04	0.06	0.3	0.5
6.587		0.05	0.04	0.05	0.3	0.5
6.582	Bridge-Up	0.05	0.04	0.05	0.3	0.5
6.582	Bridge-Dn	0.05	0.04	0.05	0.3	0.5
6.569		0.05	0.04	0.05	0.3	0.5
6.567	Culvert-Up	0.05	0.04	0.05	0.3	0.5
6.567	Culvert-Dn	0.05	0.04	0.05	0.3	0.5
6.549		0.05	0.04	0.05	0.3	0.5
6.483		0.05	0.04	0.05	0.1	0.3
6.483		0.05	0.04	0.05	0.1	0.3
6.405		0.05	0.04	0.05	0.3	0.5
6.396		0.06	0.04	0.05	0.3	0.5

6.389	Culvert-Up	0.06	0.04	0.06	0.3	0.5
6.389	Culvert-Dn	0.06	0.04	0.06	0.3	0.5
6.362		0.06	0.04	0.06	0.3	0.5
6.317		0.06	0.04	0.06	0.1	0.3
6.274		0.06	0.04	0.06	0.1	0.3
6.159		0.06	0.04	0.06	0.1	0.3
6.087		0.06	0.04	0.06	0.1	0.3
6.032		0.06	0.04	0.06	0.1	0.3
5.949		0.06	0.04	0.06	0.1	0.3
5.915		0.06	0.04	0.06	0.1	0.3
5.908		0.06	0.04	0.06	0.1	0.3
5.862		0.06	0.04	0.06	0.3	0.5
5.801		0.06	0.04	0.06	0.3	0.5
5.779	Culvert-Up	0.06	0.04	0.06	0.3	0.5
5.779	Culvert-Dn	0.06	0.04	0.06	0.3	0.5
5.777		0.06	0.04	0.06	0.3	0.5
5.749		0.06	0.04	0.06	0.1	0.3
5.731		0.06	0.04	0.06	0.1	0.3
5.704		0.06	0.04	0.06	0.1	0.3
5.658		0.06	0.04	0.06	0.3	0.5
5.589		0.06	0.04	0.06	0.3	0.5
5.583	Bridge-Up	0.06	0.04	0.06	0.3	0.5
5.583	Bridge-Dn	0.06	0.04	0.06	0.3	0.5
5.568		0.06	0.04	0.06	0.3	0.5
5.534		0.06	0.04	0.07	0.1	0.3
5.493		0.06	0.04	0.07	0.1	0.3
5.47		0.06	0.04	0.07	0.1	0.3
5.422		0.06	0.04	0.07	0.1	0.3
5.377		0.07	0.04	0.07	0.1	0.3
5.34		0.08	0.04	0.07	0.1	0.3
5.255		0.08	0.04	0.07	0.1	0.3
5.152		0.06	0.04	0.06	0.1	0.3
5.125		0.06	0.04	0.06	0.1	0.3
5.077		0.06	0.04	0.06	0.3	0.5
5.025		0.06	0.04	0.06	0.3	0.5
5.021	Bridge-Up	0.06	0.04	0.06	0.3	0.5
5.021	Bridge-Dn	0.06	0.04	0.07	0.3	0.5
5.011		0.06	0.04	0.07	0.3	0.5
4.981		0.07	0.04	0.07	0.1	0.3
4.923		0.08	0.04	0.08	0.1	0.3
4.777		0.08	0.04	0.08	0.1	0.3
4.709		0.07	0.04	0.08	0.3	0.5
4.651		0.08	0.04	0.08	0.3	0.5
4.646	Bridge-Up	0.08	0.04	0.08	0.3	0.5
4.646	Bridge-Dn	0.08	0.04	0.08	0.3	0.5
4.633		0.08	0.04	0.08	0.3	0.5
4.603		0.08	0.04	0.08	0.1	0.3
4.571		0.08	0.04	0.08	0.1	0.3
4.543		0.08	0.04	0.08	0.1	0.3
4.513		0.08	0.04	0.08	0.1	0.3
4.447		0.08	0.04	0.08	0.1	0.3
4.313		0.08	0.04	0.08	0.1	0.3
4.274		0.08	0.04	0.07	0.3	0.5
4.219		0.06	0.04	0.06	0.3	0.5
4.213	Bridge-Up	0.06	0.04	0.06	0.3	0.5
4.213	Bridge-Dn	0.06	0.04	0.065	0.3	0.5
4.2		0.06	0.04	0.065	0.3	0.5
4.167		0.06	0.04	0.07	0.1	0.3
4.111		0.06	0.04	0.07	0.1	0.3
3.977		0.06	0.04	0.06	0.1	0.3
3.871		0.065	0.04	0.06	0.1	0.3
3.785		0.06	0.04	0.06	0.1	0.3
3.729		0.06	0.04	0.06	0.1	0.3
3.651		0.06	0.04	0.06	0.1	0.3
3.582		0.06	0.04	0.06	0.1	0.3
3.494		0.06	0.04	0.06	0.1	0.3
3.326		0.08	0.04	0.06	0.1	0.3
3.246		0.08	0.04	0.07	0.1	0.3
3.127		0.08	0.04	0.08	0.1	0.3
2.921		0.08	0.04	0.08	0.1	0.3
2.86		0.08	0.04	0.07	0.3	0.5
2.811		0.08	0.04	0.06	0.3	0.5
2.801	Bridge-Up	0.08	0.04	0.06	0.3	0.5
2.801	Bridge-Dn	0.08	0.04	0.06	0.3	0.5
2.787		0.08	0.04	0.06	0.3	0.5
2.753		0.08	0.04	0.06	0.1	0.3
2.652		0.08	0.04	0.07	0.1	0.3
2.584		0.08	0.04	0.08	0.1	0.3
2.572		0.08	0.04	0.08	0.1	0.3
2.525		0.07	0.04	0.08	0.1	0.3
2.484		0.07	0.04	0.08	0.1	0.3
2.401		0.07	0.04	0.08	0.1	0.3
2.263		0.08	0.04	0.08	0.1	0.3
2.202		0.08	0.04	0.07	0.1	0.3
2.09		0.08	0.04	0.08	0.1	0.3

2.033		0.08	0.04	0.08	0.1	0.3
1.976		0.08	0.04	0.07	0.1	0.3
1.022		0.08	0.04	0.08	0.1	0.3
1.816		0.08	0.04	0.07	0.1	0.3
1.641		0.08	0.04	0.08	0.3	0.3
1.603		0.08	0.04	0.08	0.1	0.3
1.492		0.08	0.04	0.08	0.1	0.3
1.419		0.08	0.04	0.08	0.3	0.5
1.373		0.08	0.04	0.08	0.3	0.5
1.369	Bridge-Up	0.08	0.04	0.08	0.3	0.5
1.369	Bridge-Dn	0.08	0.04	0.08	0.3	0.5
1.356		0.08	0.04	0.08	0.3	0.5
1.277		0.08	0.04	0.08	0.1	0.3
1.198		0.08	0.04	0.08	0.3	0.5
1.106		0.06	0.065	0.06	0.3	0.5
1.105	Inline Weir-Up	0.06	0.065	0.06	0.3	0.5
1.105	Inline Weir-Dn	0.06	0.065	0.06	0.3	0.5
1.097		0.06	0.06	0.06	0.3	0.5
1.046		0.07	0.045	0.07	0.1	0.3
.962		0.07	0.04	0.07	0.1	0.3
.866		0.08	0.04	0.08	0.1	0.3
.807		0.08	0.04	0.08	0.1	0.3
.73		0.07	0.045	0.07	0.1	0.3
.666		0.07	0.045	0.07	0.1	0.3
.58		0.08	0.04	0.08	0.1	0.3
.474		0.07	0.04	0.08	0.1	0.3
.375		0.08	0.04	0.08	0.1	0.3
.351		0.08	0.04	0.08	0.3	0.5
.279		0.07	0.04	0.08	0.3	0.5
.273	Bridge-Up	0.07	0.04	0.08	0.3	0.5
.273	Bridge-Dn	0.07	0.04	0.08	0.3	0.5
.243		0.07	0.04	0.08	0.3	0.5
.178		0.07	0.04	0.08	0.1	0.3
.11		0.07	0.04	0.08	0.3	0.5
.03		0.07	0.04	0.08	0.3	0.5
.021	Bridge-Up	0.07	0.04	0.08	0.3	0.5
.021	Bridge-Dn	0.05	0.05	0.08	0.3	0.5
		0.08	-----	0.05		
.0005		0.05	0.05	0.08	0.3	0.5
		0.08	-----	0.05		
.0004		0.05	0.05	0.08	0.1	0.3
		0.08	-----	-----		
.0003		0.08	0.05	0.08	0.1	0.3
		0.05	-----	-----		
		0.08	-----	-----		
.0002		0.06	0.05	0.08	0.1	0.3
		0.08	-----	0.05		
.0001		0.06	0.05	0.08	0.1	0.3
		0.08	-----	-----		

---Summary of Statistics---

	Minimum	Maximum
Left Overbank n Value:	0.05	0.08
Right Overbank n Value:	0.05	0.08
Channel n Value:	0.04	0.065
Contraction Coefficient:	0.1	0.3
Expansion Coefficient:	0.3	0.5

ROUGHNESS COEFFICIENT CHECK

RS: 9.022
NT RC 05 The left overbank n value of 0.05 and the right overbank n value of 0.05 are less than or equal to the channel n value of 0.05
The overbank n values should be reevaluated.

RS: 8.943
NT RC 05 The left overbank n value of 0.05 and the right overbank n value of 0.05 are less than or equal to the channel n value of 0.05
The overbank n values should be reevaluated.

RS: 8.867
NT RC 05 The left overbank n value of 0.05 and the right overbank n value of 0.05 are less than or equal to the channel n value of 0.05
The overbank n values should be reevaluated.

RS: 8.863
NT RC 05 The left overbank n value of 0.05 and the right overbank n value of 0.05 are less than or equal to the channel n value of 0.05
The overbank n values should be reevaluated.

OK

RS: 8.863

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NT RC 05 The left overbank n value of 0.05 and the right overbank n value
         of 0.05 are less than or equal to the channel n value of 0.05
         The overbank n values should be reevaluated.

RS:      8.744
NT RC 05 The left overbank n value of 0.05 and the right overbank n value
         of 0.05 are less than or equal to the channel n value of 0.05
         The overbank n values should be reevaluated.

RS:      8.658
NT RC 05 The left overbank n value of 0.05 and the right overbank n value
         of 0.05 are less than or equal to the channel n value of 0.05
         The overbank n values should be reevaluated.

RS:      8.554
NT RC 05 The left overbank n value of 0.05 and the right overbank n value
         of 0.05 are less than or equal to the channel n value of 0.05
         The overbank n values should be reevaluated.

RS:      8.542
NT RC 05 The left overbank n value of 0.05 and the right overbank n value
         of 0.05 are less than or equal to the channel n value of 0.05
         The overbank n values should be reevaluated.

RS:      8.542
NT RC 05 The left overbank n value of 0.05 and the right overbank n value
         of 0.05 are less than or equal to the channel n value of 0.05
         The overbank n values should be reevaluated.

RS:      8.51
NT RC 05 The left overbank n value of 0.05 and the right overbank n value
         of 0.05 are less than or equal to the channel n value of 0.05
         The overbank n values should be reevaluated.

RS:      7.985
NT RC 05 The left overbank n value of 0.05 and the right overbank n value
         of 0.05 are less than or equal to the channel n value of 0.05
         The overbank n values should be reevaluated.

RS:      7.979
NT RC 05 The left overbank n value of 0.05 and the right overbank n value
         of 0.05 are less than or equal to the channel n value of 0.05
         The overbank n values should be reevaluated.

RS:      1.106
NT RC 05 The left overbank n value of 0.06 and the right overbank n value
         of 0.06 are less than or equal to the channel n value of 0.065
         The overbank n values should be reevaluated.

RS:      1.105
NT RC 05 The left overbank n value of 0.06 and the right overbank n value
         of 0.06 are less than or equal to the channel n value of 0.065
         The overbank n values should be reevaluated.

RS:      1.105
NT RC 05 The left overbank n value of 0.06 and the right overbank n value
         of 0.06 are less than or equal to the channel n value of 0.065
         The overbank n values should be reevaluated.

RS:      1.097
NT RC 05 The left overbank n value of 0.06 and the right overbank n value
         of 0.06 are less than or equal to the channel n value of 0.06
         The overbank n values should be reevaluated.
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OK

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TRANSITION LOSS COEFFICIENT CHECK
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RS:      7.985
NT TL 02 Contraction and expansion loss coefficients are 0.3 and 0.5
         respectively. However, this cross section is not at the structure.
         They should be equal to 0.1 and 0.3.
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Structure modeled as geometry as it is riprap

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ROUGHNESS COEFFICIENT AT STRUCTURES
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RS:      8.194
NT RS 01 This is Section 2.
         Channel n value of 0.04 is less than the channel n value of 0.05
         at Section 1.

RS:      7.967
NT RS 01 This is Section 3.
         Channel n value of 0.04 is less than the channel n value of 0.05
         at Section 4.
```

OK

RS: 7.52
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 3. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 3. The selection of the n value(s) should be reevaluated.

RS: 7.53
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 2 Usually, the channel n value of the bridge opening section is less than the channel n value of Section 2. The selection of the n value(s) should be reevaluated.

RS: 7.159
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 3. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 3. The selection of the n value(s) should be reevaluated.

RS: 7.159
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 2 Usually, the channel n value of the bridge opening section is less than the channel n value of Section 2. The selection of the n value(s) should be reevaluated.

RS: 5.582
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 3. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 3. The selection of the n value(s) should be reevaluated.

RS: 6.582
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 2 Usually, the channel n value of the bridge opening section is less than the channel n value of Section 2. The selection of the n value(s) should be reevaluated.

RS: 5.583
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 3. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 3. The selection of the n value(s) should be reevaluated.

RS: 5.583
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 2 Usually, the channel n value of the bridge opening section is less than the channel n value of Section 2. The selection of the n value(s) should be reevaluated.

RS: 5.021
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 3. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 3. The selection of the n value(s) should be reevaluated.

RS: 5.021
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 2 Usually, the channel n value of the bridge opening section is less than the channel n value of Section 2. The selection of the n value(s) should be reevaluated.

RS: 4.646
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 3. Usually, the channel n value of the bridge opening section is less than the channel n value of Section 3. The selection of the n value(s) should be reevaluated.

RS: 4.646
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening section is equal or larger than the channel n value of 0.04 at Section 2 Usually, the channel n value of the bridge opening section is less than the channel n value of Section 2. The selection of the n value(s) should be reevaluated.

RS: 4.213

OK

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NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening
         section is equal or larger than the channel n value of 0.04 at Section 3.
         Usually, the channel n value of the bridge opening section is
         less than the channel n value of Section 3.
         The selection of the n value(s) should be reevaluated.

RS:      4.213
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening
         section is equal or larger than the channel n value of 0.04 at Section 2
         Usually, the channel n value of the bridge opening section is
         less than the channel n value of Section 2.
         The selection of the n value(s) should be reevaluated.

RS:      2.601
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening
         section is equal or larger than the channel n value of 0.04 at Section 3.
         Usually, the channel n value of the bridge opening section is
         less than the channel n value of Section 3.
         The selection of the n value(s) should be reevaluated.

RS:      2.601
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening
         section is equal or larger than the channel n value of 0.04 at Section 2
         Usually, the channel n value of the bridge opening section is
         less than the channel n value of Section 2.
         The selection of the n value(s) should be reevaluated.

RS:      1.369
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening
         section is equal or larger than the channel n value of 0.04 at Section 3.
         Usually, the channel n value of the bridge opening section is
         less than the channel n value of Section 3.
         The selection of the n value(s) should be reevaluated.

RS:      1.369
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening
         section is equal or larger than the channel n value of 0.04 at Section 2
         Usually, the channel n value of the bridge opening section is
         less than the channel n value of Section 2.
         The selection of the n value(s) should be reevaluated.

RS:      0.273
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening
         section is equal or larger than the channel n value of 0.04 at Section 3.
         Usually, the channel n value of the bridge opening section is
         less than the channel n value of Section 3.
         The selection of the n value(s) should be reevaluated.

RS:      0.273
NT RS 02 The channel n value of 0.04 for the downstream internal bridge opening
         section is equal or larger than the channel n value of 0.04 at Section 2
         Usually, the channel n value of the bridge opening section is
         less than the channel n value of Section 2.
         The selection of the n value(s) should be reevaluated.

RS:      0.021
NT RS 02 The channel n value of 0.04 for the upstream internal bridge opening
         section is equal or larger than the channel n value of 0.04 at Section 3.
         Usually, the channel n value of the bridge opening section is
         less than the channel n value of Section 3.
         The selection of the n value(s) should be reevaluated.

RS:      0.021
NT RS 02 The channel n value of 0.05 for the downstream internal bridge opening
         section is equal or larger than the channel n value of 0.05 at Section 2
         Usually, the channel n value of the bridge opening section is
         less than the channel n value of Section 2.
         The selection of the n value(s) should be reevaluated.
```

--- END---

Waterbody Name: _____
Preparer: _____
Date: _____

7. Cross Sections

The following questions have to do with the cross section information that is the basis of the submitted modeling:

a. What is the source of the cross section information *(check all that apply)*:
- [ ] Flood Insurance Study
- [x] Field survey *(Date)* 4-22-04 bridge surveys
- [x] Detailed topographic mapping *(Date)* Hamilton County 1' contours, 2004
- [ ] Other modeling *(indicate source)* _____
- [ ] Other *(please specify)* _____

b. Are cross sections stationed increasing from left to right looking downstream?
[x] Yes [ ] No

c. How are sections labeled *(check one)* (Note: The following list is in order of preference)
- [x] Consistent with FIS / other studies
- [ ] Miles above mouth
- [ ] Feet above other landmark *(Please specify landmark)* _____
- [ ] Other *(Please specify)* _____

d. Are sections oriented perpendicular to flow at all portions of the cross section?
[x] Yes [ ] No

e. Are the full cross section extents shown on submitted mapping?
[x] Yes [ ] No

f. Do the cross sections extend fully across the floodplain *(above expected 100-year flood elevations)*?
[x] Yes [ ] No

g. Do the cross sections represent average conditions in the reach at which they are located?
[x] Yes [ ] No

h. Are areas of blocked or ineffective flow indicated on the submitted cross sections?
[x] Yes [ ] No

i. Are cross sections located at places where discharge values change along the stream reach?
[x] Yes [ ] No

Waterbody Name: _____
Preparer: _____
Date: _____

j. For any "No" answers above, please provide an explanation:

k. Are interpolated sections used anywhere in the model (if yes, state reasons for using interpolated sections)

☐ Yes ☒ No

Reason: _____

l. Check-RAS

For HEC-RAS models, please run the "XS" report from Check-RAS and attach it to this checklist. List any comments in the model and justification for not correcting these comments (use additional sheets, if necessary):

See check RAS for comments

CHECK-RAS Program, XS Check
Cross Section Location and Alignment Review

Project File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.prj
Plan File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.p05
Geometry File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.g05
Flow File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.f02
Report File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.xs
Selected profiles: 100yr;Floodway
Date: 8/20/2009
Time: 6:47:12 AM — No changes

SECNO	Len Lob	Len Chl	Len Rob	TopWdthAct	Q Total	Flow Code
Williams Creek,Hamilton Co OTP						
9.022	434.28	416.33	336.34	676.29	167	B
8.943	377.43	400.94	457.63	424.7	167	M
8.867	649.33	649.5	646.34	46	167	B
8.863	Culvert #1-Up					
8.863	Culvert #1-Dn					
8.744	456.59	454.74	444.71	24	167	B
8.650	547.43	549.24	557	404.37	292	
8.554	228.89	229.82	224	124	292	
8.542	Culvert #1-Up					
8.542	Culvert #1-Dn					
8.51	604.96	626.04	631.75	52	292	
8.392	62.93	60.55	62.41	134.25	292	M
8.38	11.18	47.45	62.38	21.18	292	C
8.371	132.24	156.22	186.27	52.75	292	
8.242	398.33	401.53	407.29	209.39	292	
8.266	250.41	261.88	267.88	117.81	292	
8.216	121.23	116.72	119.95	89.23	292	
8.21	Culvert #1-Up					
8.21	Culvert #1-Dn					
8.194	169.42	168.92	157.83	67.58	292	
8.162	392.96	345.76	325.96	28.01	292	C
8.096	437.17	433.23	430.19	185.88	292	
8.014	165.86	155.87	151.54	172.9	292	
7.985	31.08	31.52	13.76	22.47	292	C
7.979	40.49	60.17	70.49	32.42	292	
7.967	74.47	82.1	66.05	43.87	292	
7.961	Culvert #1-Up					
7.961	Culvert #1-Dn					
7.952	173.36	183.87	185.45	19.82	292	
7.917	817.43	632.31	673.51	86.63	292	
7.797	124	143.47	84.86	119.54	570	
7.77	408.51	295.23	182.28	169.66	570	
7.726	538.86	487.72	415.77	182.18	570	
7.633	363.19	362.92	513.99	345.43	570	
7.527	126.48	96.99	103.64	76.63	570	
7.52	Bridge #1-Up					
7.52	Bridge #1-Dn					
7.51	174.72	193.5	190.54	47	570	
7.472	188.47	196.1	199.32	242.98	570	
7.435	416.6	445.49	426.55	282	570	
7.35	136.59	130.28	116.07	179.6	570	
7.325	189.56	195.38	190.85	293.48	570	
7.288	85.78	87.88	84.36	394.05	753	
7.285	Culvert #1-Up					
7.285	Culvert #1-Dn					
7.285	Culvert #2-Up					
7.285	Culvert #2-Dn					
7.272	159.47	166.75	165.86	411.32	753	D
7.24	275.17	403.85	477.19	222.58	753	
7.164	109.07	89	92.68	58.24	753	
7.159	Bridge #1-Up					
7.159	Bridge #1-Dn					
7.147	137.86	193.07	192.78	52.04	753	
7.111	246.05	281.55	262.05	347.64	753	
7.057	353.89	311.96	324.66	382.28	753	
6.998	363.03	556.14	456.23	170.95	753	
6.893	425.1	426.03	214.45	169.12	753	
6.812	366.23	504.11	271.95	157.98	753	
6.717	329.6	365.71	354.72	236.71	753	
6.647	158.1	317.16	389.22	187.45	753	
6.587	93.36	93.92	90.08	94	753	
6.582	Bridge #1-Up					
6.582	Bridge #1-Dn					
6.569	107.43	106.53	116.3	47.73	753	
6.567	Culvert #1-Up					
6.567	Culvert #1-Dn					
6.549	445.06	347.57	283.98	39.4	753	
6.483	174.27	163.5	123.86	208.29	753	

6.453	253.13	253.26	265.87	292.02	753	
6.405	56.27	46.73	36.78	165.65	763	
6.396	231.84	178.72	197.64	58	753	
6.389	Culvert #2-Up					
6.389	Culvert #2-Dn					
6.389	Culvert #1-Up					
6.389	Culvert #1-Dn					
6.362	230.82	235.2	197.55	85.91	753	
6.317	223.31	223.89	214.84	137.82	753	
6.274	547.19	605.66	576.97	181.79	753	
6.159	390.64	363.58	357.61	260.69	753	
6.087	289.52	288.68	291.4	398.83	753	
6.032	480.35	440.41	272.11	209.24	753	
5.949	198.23	178.08	104.36	416.09	753	
5.915	40.75	38.17	34.58	413.08	753	
5.908	222.8	239	233.42	402.92	753	
5.862	332.6	324.75	303.07	307.45	753	
5.801	131.62	128.19	119.45	79	753	
5.779	Culvert #1-Up					
5.779	Culvert #1-Dn					
5.777	147.54	148.63	164.46	54	753	
5.745	91.52	92.23	90.18	112.43	753	
5.731	131.36	144.17	154.41	81.25	753	
5.704	250.07	243.86	240.80	247.2	753	
5.658	259.17	363.73	470.57	124.26	753	
5.589	126.39	111.04	113.69	85.13	753	
5.583	Bridge #1-Up					
5.583	Bridge #1-Dn					
5.568	184.91	176.4	180.22	97	753	
5.534	218.33	217.38	131.68	166.86	753	
5.493	118.29	122.89	123.74	294.7	753	
5.47	241.92	253.66	295.75	364.4	753	
5.422	331.64	374.75	226.85	513.58	1280	
5.377	140.81	196.96	260.54	386.64	1280	
5.34	207.84	446.94	426.91	329.7	1280	
5.255	426.14	347.01	343.96	273.91	1280	
5.152	135.83	142.59	101.41	228.5	1280	
5.125	271.89	249.95	135.57	226.09	1280	
5.077	287.13	274.07	202.24	228.66	1280	
5.025	60.72	76.64	69.77	114.5	1280	
5.021	Bridge #1-Up					
5.021	Bridge #1-Dn					
5.011	163.02	157.12	122.81	94.5	1280	
4.981	293.06	305.91	310.77	221.26	1280	
4.923	389.17	770.11	400.11	419.67	1280	
4.777	199.03	362.17	358.46	294.58	1280	
4.709	191.28	303.93	293.23	398.88	1280	
4.651	96.22	97.93	91.11	103	1280	
4.646	Bridge #1-Up					
4.646	Bridge #1-Dn					
4.633	161.14	157.97	139.6	89	1280	
4.603	233.63	169.86	97.45	187.31	1280	
4.571	163.47	143.65	92.9	253.47	1280	
4.543	151.6	163.01	92.39	222.69	1280	
4.513	327.17	344.25	104.09	232.05	1280	
4.447	358.58	707.81	319.85	380.46	1280	
4.313	263.76	207.27	89.26	405.27	1280	
4.274	218.93	288.41	129.05	402.5	1280	
4.219	104.03	100.25	104.81	89.86	1280	
4.213	Bridge #1-Up					
4.213	Bridge #1-Dn					
4.2	183.3	178.08	167.17	70.08	1280	
4.167	276.31	296.14	172.91	299.01	1280	
4.111	440.66	707.08	672.54	233.87	1280	
3.977	412.72	559.04	575.41	316.8	1280	
3.871	285.96	484.53	480.57	322.63	1680	
3.785	232.68	293.36	263.09	335.62	2000	
3.739	375.61	413.44	331.34	289.64	2000	
3.651	381.19	365.97	340.82	239.84	2000	
3.582	401.71	460.92	416.34	364.62	2000	
3.494	668.58	887.86	564.51	546.6	2000	
3.326	217.11	427.55	277.01	308.23	2000	
3.245	598.27	621.8	337.25	354	2000	
3.127	847.05	1068.62	615.57	299.9	2000	
2.931	237.84	323.57	458.72	172.95	2000	D
2.86	152.49	258.8	291.68	334.96	2000	
2.811	81.37	124.94	168.79	154.35	2000	D
2.801	Bridge #1-Up					
2.801	Bridge #1-Dn					
2.787	193.09	180.02	275.6	91.99	2000	
2.753	526.64	536.24	439.78	178.21	2000	
2.652	183.16	357.77	372.95	445.08	2000	
2.586	58.02	61.03	61.92	275.03	2480	
2.572	120.1	250.48	228.15	244.42	2480	
2.525	355.3	480.55	432.14	275.93	2480	

2.434	170.35	173.23	166.19	276.62	2480	
2.401	720.99	729.04	704.42	369.72	2480	
2.263	305.82	323.3	149.55	321.9	2480	
2.202	475.13	559.66	432.76	370.27	2480	
2.09	158.07	301.11	144.9	233.88	2480	
2.033	198.26	299.5	260.52	252.54	2480	
1.976	200.2	206.53	187.69	259.96	2480	
1.922	372.2	561.3	435.17	358.8	2480	
1.816	827.08	924.36	802.43	420.67	2480	
1.641	199.06	201.04	162.54	420.44	2480	
1.603	470.36	584.36	500.04	243.88	2480	D
1.492	413.7	384.89	314.47	169.61	2480	
1.419	260.47	245.16	242.1	172.26	2480	
1.373	67.31	86.44	87.23	138.89	2480	
1.369	Bridge #1-Up					
1.369	Bridge #1-Dn					
1.336	282.98	418.19	469.52	146.03	2480	
1.277	529.35	418.32	305.12	147.24	2480	
1.198	486.7	481.23	339.2	222.08	2800	
1.106	26.41	50.75	74.38	264.41	2800	
1.105	Inline Weir-Up					
1.105	Inline Weir-Dn					
1.097	263.96	267.54	264.56	145.58	2800	
1.046	361.08	447.86	341.48	322.25	2800	
.962	401.98	568.85	462.05	443.26	2800	
.856	278.4	258.72	189.55	566.77	3100	
.807	289.46	404.31	315.11	458.11	3100	
.73	320.43	338.97	386.53	328.25	3100	
.666	501.16	451.48	297.51	130.05	3100	
.58	393.45	559.99	442.74	130.85	3100	
.474	571.02	521.34	481.02	402.26	3100	
.375	99.53	128.49	167.44	531.31	3100	
.351	276.99	326.96	332.25	463.56	3100	
.279	190.6	189.81	201.44	170.5	3100	
.273	Bridge #1-Up					
.273	Bridge #1-Dn					
.243	349.84	342.84	330.06	144.51	3100	
.178	320.13	360.33	307.81	394.68	3100	
.11	367.67	418.55	394.91	613.07	3100	
.03	158.4	158.4	158.4	204	3480	
.021	Bridge #1-Up					
.021	Bridge #1-Dn					
.0006	234.95	227.29	260.24	168.05	3480	
.0004	246.85	250.67	218.09	172.35	3480	D
.0003	741.22	963.27	845.97	382.67	3480	
.0002	725.81	667.21	340.32	324.78	3480	
.0001	0	0	0	264.43	3480	

B=blocked obstruction XS SC 05
C=critial depth XS SC 03
D=divided flow XS SC 01
E=cross section extended XS SC 02
K=known water-surface XS SC 04

DISTANCE CHECK

SPACING CHECK

RS: 0.58
XS SP 01 Diff. HV = 0.65 ; Kratio = 3.22 ; Depth Ratio = 1.18.
TopWdthAct ratio = 3.08 ; Length Chl Up / 500 = 1.12
Change in HV > 0.5
K ratio < 0.7 or K ratio > 1.4
Depth ratio < 0.9 or Depth ratio > 1.1
TopWdthAct ratio < 0.5 or TopWdthAct ratio > 2.0
and Length Chnl up / 500 > 1.1
additional cross sections may need to be added between
river station up and river station dn.

Stream runs parallel to D/S XS for most of the distance, no realistic location to add new XS.

INEFFECTIVE FLOW CHECK

DISCHARGE CHECK

LOCATION CHECK

```
RS:        8.392
XS LC 01 Lenchl Up/TopwdthAct Dn = 2.86
         MaxChlDpth Up/MaxChlDpth Dn = 1.61
         TopwdthAct Up/TopwdthAct Dn = 6.34
         This cross section is located too far upstream from the
         critical depth cross section.

RS:        8.194
XS LC 01 Lenchl Up/TopwdthAct Dn = 6.03
         MaxChlDpth Up/MaxChlDpth Dn = 1.61
         TopwdthAct Up/TopwdthAct Dn = 2.41
         This cross section is located too far upstream from the
         critical depth cross section.

RS:        8.014
XS LC 01 Lenchl Up/TopwdthAct Dn = 6.94
         MaxChlDpth Up/MaxChlDpth Dn = 1.23
         TopwdthAct Up/TopwdthAct Dn = 7.69
         This cross section is located too far upstream from the
         critical depth cross section.

BOUNDARY CONDITION CHECK
------------------------

XS BC 02 The name of the stream is Williams Creek,Hamilton Co CTP
         Known WS = 787.09 is specified as the downstream boundary
         for profile 100yr

XS BC 02 The name of the stream is Williams Creek,Hamilton Co CTP
         Known WS = 787.19 is specified as the downstream boundary
         for profile Floodway

XS BC 03 Maximum number of iterations is 0
         It should not be less than 20.

LATERAL WEIRS CHECK
-------------------

---END---
```

8.392, placed to define transition without including high ground from embankment

8.194 placed to define transition.

critical depth caused by structure modeled as geometry in XS. 8.014 is placed to define the transition from structure to ponds/wetlands

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: 96th Street

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections)*:

Section 1 Cross-section number: 0.0004
Section 2 Cross-section number: 0.0005
Section 3 Cross-section number: 0.050
Section 4 Cross-section number: 0.110

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?
☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?
☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?
☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?
☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?
☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?
☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?
☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*
☒ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☐ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?
☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: I-465

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections)*:

Section 1 Cross-section number: 0.174
Section 2 Cross-section number: 0.243
Section 3 Cross-section number: 0.274
Section 4 Cross-section number: 0.351

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?
☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?
☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?
☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?
☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?
☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?
☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?
☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*
☒ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☐ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?
☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: 106th Street

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections):*

Section 1	Cross-section number: 1,277
Section 2	Cross-section number: 1,356
Section 3	Cross-section number: 1,373
Section 4	Cross-section number: 1,419

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?

☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?

☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?

☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?

☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*

- ☒ Energy (Low flow)
- ☐ Momentum (Low flow)
- ☐ WSPRO (Low flow)
- ☐ Energy (High flow)
- ☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?

☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: 116th Street

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections)*:

Section 1 Cross-section number: 2.753
Section 2 Cross-section number: 2.717
Section 3 Cross-section number: 2.44
Section 4 Cross-section number: 2.400

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?
☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?
☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?
☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?
☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?
☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?
☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?
☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*
☒ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☐ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?
☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: Springmill Road (North of N. Creekwood Lane)

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections)*:

Section 1 Cross-section number: 4,167
Section 2 Cross-section number: 4,000
Section 3 Cross-section number: 4,319
Section 4 Cross-section number: 4,274

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?

☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?

☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?

☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?

☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*

☒ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☐ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?

☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: Spring Mill Road Str. #31

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections):*

Section 1 Cross-section number: 4,603
Section 2 Cross-section number: 4,633
Section 3 Cross-section number: 4,651
Section 4 Cross-section number: 4,709

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?
☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?
☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?
☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?
☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?
☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?
☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?
☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*
☒ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☐ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?
☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: Dorset Dr.

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections)*:

Section 1 Cross-section number: 5.191
Section 2 Cross-section number: 5.011
Section 3 Cross-section number: 5.025
Section 4 Cross-section number: 5.077

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?

☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?

☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?

☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?

☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*

☒ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☐ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?

☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: 131st Street

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections)*:

Section 1 Cross-section number: 5,594
Section 2 Cross-section number: 5,566
Section 3 Cross-section number: 5,519
Section 4 Cross-section number: 5,059

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?
☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?
☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?
☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?
☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?
☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?
☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?
☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*
- ☒ Energy (Low flow)
- ☐ Momentum (Low flow)
- ☐ WSPRO (Low flow)
- ☐ Energy (High flow)
- ☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?
☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: Springmill Road STR # 546

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections)*:

Section 1 Cross-section number: 5,749
Section 2 Cross-section number: 5,777
Section 3 Cross-section number: 5,801
Section 4 Cross-section number: 5,862

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?
☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?
☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?
☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?
☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?
☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?
☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?
☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*
☒ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☐ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?
☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: Salsbury Creek Drive

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections)*:

Section 1 Cross-section number: _____
Section 2 Cross-section number: 6,568
Section 3 Cross-section number: 6,547
Section 4 Cross-section number: 6,447

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?
☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?
☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?
☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?
☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?
☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?
☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?
☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*
☒ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☐ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?
☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: Buckhorn Drive

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections)*:

Section 1 Cross-section number: 7.111
Section 2 Cross-section number: 7.147
Section 3 Cross-section number: 7.164
Section 4 Cross-section number: 7.240

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?

☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?

☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?

☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?

☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*

☐ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☒ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?

☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

8. Bridges

The following questions should be answered for each bridge in the model being submitted. Use a separate sheet for each bridge

a. Name of Bridge in model: Ponds Pointe Drive

b. Bridge cross-section locations *(See Section 8.9 of the Guidelines for location of bridge sections)*:

Section 1 Cross-section number: 7,472
Section 2 Cross-section number: 7,510
Section 3 Cross-section number: 7,527
Section 4 Cross-section number: 7,577

c. Is this model submitted in support of a Construction in a Floodway application for the bridge in question?
☐ Yes ☒ No

d. If the answer to c is "yes," then are the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?
☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?
☒ Yes ☐ No

f. Is cross section 1 located at a 2:1 flow expansion ratio downstream of the bridge face?
☒ Yes ☐ No

g. Is cross section 4 located at a 1:1 flow contraction ratio upstream of the bridge face?
☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the bridge?
☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?
☒ Yes ☐ No

j. What is the selected modeling method *(for the 100-year frequency flood only)*
☒ Energy (Low flow)
☐ Momentum (Low flow)
☐ WSPRO (Low flow)
☐ Energy (High flow)
☐ Pressure / Weir flow (High flow)

k. Does approach roadway profile data extend across the full valley cross section?
☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

l. Are bridge piers included in the model?

☒ Yes ☐ No

m. Were HEC-RAS default embankment side slopes applied at all bridge crossings in the model?

☒ Yes ☐ No

n. For all "No" answer above, please provide an explanation:

o. Check-RAS

For HEC-RAS models, please run the "Structure" report from Check-RAS and attach it to this checklist. List any comments in the model and justification for not correcting these comments (use additional sheets, if necessary):

See Check RAS for comments

Waterbody Name: _____
Preparer: _____
Date: _____

9. Culverts

The following questions should be answered for each culvert in the model being submitted. Use a separate sheet for each culvert:

a. Name of Culvert in model: Springmill Road STR # 546

b. Cross section locations (See Section 8.9 and 8.10 of the Guidelines for the location of culvert sections):

Section 1 Cross section number: 5,749
Section 2 Cross section number: 5,777
Section 3 Cross section number: 5,601
Section 4 Cross section number: 5,662

c. Is this model submitted in support of a Construction in a Floodway application for the culvert in question?

☐ Yes ☒ No

d. If the answer to c is "yes," then is the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☒ Yes ☐ No

f. Is cross-section 1 located at a 2:1 flow expansion ratio downstream of the culvert?

☒ Yes ☐ No

g. Is cross-section 4 located at a 1:1 flow contraction ratio upstream of the culvert?

☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the culvert?

☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☒ Yes ☐ No

j. Does approach roadway profile data extend across the full valley cross section?

☒ Yes ☐ No

k. Were HEC-RAS default embankment side slopes applied at all culvert crossings in the model?

☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

9. **Culverts**

The following questions should be answered for each culvert in the model being submitted. Use a separate sheet for each culvert:

a. Name of Culvert in model: 136th Street

b. Cross section locations (See Section 8.9 and 8.10 of the Guidelines for the location of culvert sections):

Section 1 Cross section number: 6,317
Section 2 Cross section number: 6,367
Section 3 Cross section number: 6,388
Section 4 Cross section number: 6,405

c. Is this model submitted in support of a Construction in a Floodway application for the culvert in question?

☐ Yes ☒ No

d. If the answer to c is "yes," then is the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☒ Yes ☐ No

f. Is cross-section 1 located at a 2:1 flow expansion ratio downstream of the culvert?

☒ Yes ☐ No

g. Is cross-section 4 located at a 1:1 flow contraction ratio upstream of the culvert?

☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the culvert?

☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☒ Yes ☐ No

j. Does approach roadway profile data extend across the full valley cross section?

☒ Yes ☐ No

k. Were HEC-RAS default embankment side slopes applied at all culvert crossings in the model?

☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

9. **Culverts**

The following questions should be answered for each culvert in the model being submitted. Use a separate sheet for each culvert:

a. Name of Culvert in model: Springmill Road St. #30

b. Cross section locations (See Section 8.9 and 8.10 of the Guidelines for the location of culvert sections):

Section 1 Cross section number: 6.4[illegible]
Section 2 Cross section number: 6.5[illegible]
Section 3 Cross section number: 6.56[illegible]
Section 4 Cross section number: _____

c. Is this model submitted in support of a Construction in a Floodway application for the culvert in question?
☐ Yes ☒ No

d. If the answer to c is "yes," then is the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?
☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?
☒ Yes ☐ No

f. Is cross-section 1 located at a 2:1 flow expansion ratio downstream of the culvert?
☒ Yes ☐ No

g. Is cross-section 4 located at a 1:1 flow contraction ratio upstream of the culvert?
☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the culvert?
☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?
☒ Yes ☐ No

j. Does approach roadway profile data extend across the full valley cross section?
☒ Yes ☐ No

k. Were HEC-RAS default embankment side slopes applied at all culvert crossings in the model?
☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

9. Culverts

The following questions should be answered for each culvert in the model being submitted. Use a separate sheet for each culvert:

a. Name of Culvert in model: Illot Street

b. Cross section locations (See Section 8.9 and 8.10 of the Guidelines for the location of culvert sections):

Section 1 Cross section number: 7,240
Section 2 Cross section number: 7,222
Section 3 Cross section number: 7,208
Section 4 Cross section number: 7,725

c. Is this model submitted in support of a Construction in a Floodway application for the culvert in question?
☐ Yes ☒ No

d. If the answer to c is "yes," then is the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?
☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?
☒ Yes ☐ No

f. Is cross-section 1 located at a 2:1 flow expansion ratio downstream of the culvert?
☒ Yes ☐ No

g. Is cross-section 4 located at a 1:1 flow contraction ratio upstream of the culvert?
☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the culvert?
☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?
☒ Yes ☐ No

j. Does approach roadway profile data extend across the full valley cross section?
☒ Yes ☐ No

k. Were HEC-RAS default embankment side slopes applied at all culvert crossings in the model?
☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

9. Culverts

The following questions should be answered for each culvert in the model being submitted. Use a separate sheet for each culvert:

a. Name of Culvert in model: 146th Street

b. Cross section locations (See Section 8.9 and 8.10 of the Guidelines for the location of culvert sections):

Section 1 Cross section number: 7.917
Section 2 Cross section number: 7.952
Section 3 Cross section number: 7.968
Section 4 Cross section number: 7.979

c. Is this model submitted in support of a Construction in a Floodway application for the culvert in question?

☐ Yes ☒ No

d. If the answer to c is "yes," then is the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☒ Yes ☐ No

f. Is cross-section 1 located at a 2:1 flow expansion ratio downstream of the culvert?

☒ Yes ☐ No

g. Is cross-section 4 located at a 1:1 flow contraction ratio upstream of the culvert?

☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the culvert?

☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☒ Yes ☐ No

j. Does approach roadway profile data extend across the full valley cross section?

☒ Yes ☐ No

k. Were HEC-RAS default embankment side slopes applied at all culvert crossings in the model?

☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

9. Culverts

The following questions should be answered for each culvert in the model being submitted. Use a separate sheet for each culvert:

a. Name of Culvert in model: Francis Ck.

b. Cross section locations (See Section 8.9 and 8.10 of the Guidelines for the location of culvert sections):

Section 1 Cross section number: 8,162
Section 2 Cross section number: 8,199
Section 3 Cross section number: 8,216
Section 4 Cross section number: 8,264

c. Is this model submitted in support of a Construction in a Floodway application for the culvert in question?

☐ Yes ☒ No

d. If the answer to c is "yes," then is the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☒ Yes ☐ No

f. Is cross-section 1 located at a 2:1 flow expansion ratio downstream of the culvert?

☒ Yes ☐ No

g. Is cross-section 4 located at a 1:1 flow contraction ratio upstream of the culvert?

☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the culvert?

☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☒ Yes ☐ No

j. Does approach roadway profile data extend across the full valley cross section?

☒ Yes ☐ No

k. Were HEC-RAS default embankment side slopes applied at all culvert crossings in the model?

☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

9. Culverts

The following questions should be answered for each culvert in the model being submitted. Use a separate sheet for each culvert:

a. Name of Culvert in model: Manassas Rd.

b. Cross section locations (See Section 8.9 and 8.10 of the Guidelines for the location of culvert sections):

Section 1 Cross section number: 8,392
Section 2 Cross section number: 8,510
Section 3 Cross section number: 8,559
Section 4 Cross section number: 8,658

c. Is this model submitted in support of a Construction in a Floodway application for the culvert in question?

☐ Yes ☒ No

d. If the answer to c is "yes," then is the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☒ Yes ☐ No

f. Is cross-section 1 located at a 2:1 flow expansion ratio downstream of the culvert?

☒ Yes ☐ No

g. Is cross-section 4 located at a 1:1 flow contraction ratio upstream of the culvert?

☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the culvert?

☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☒ Yes ☐ No

j. Does approach roadway profile data extend across the full valley cross section?

☒ Yes ☐ No

k. Were HEC-RAS default embankment side slopes applied at all culvert crossings in the model?

☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

9. **Culverts**

The following questions should be answered for each culvert in the model being submitted. Use a separate sheet for each culvert:

a. Name of Culvert in model: Liberty – Pawtucket Crossings

b. Cross section locations (See Section 8.9 and 8.10 of the Guidelines for the location of culvert sections):

Section 1 Cross section number: 8.658
Section 2 Cross section number: 8.744
Section 3 Cross section number: 8.867
Section 4 Cross section number: 8.941

c. Is this model submitted in support of a Construction in a Floodway application for the culvert in question?

☐ Yes ☒ No

d. If the answer to c is "yes," then is the same number of sections used in the existing (or pre-project) and proposed (or post-project) model?

☐ Yes ☐ No ☒ N/A

e. Do the cross sections extend across the entire valley to the 100-year frequency flood elevation?

☒ Yes ☐ No

f. Is cross-section 1 located at a 2:1 flow expansion ratio downstream of the culvert?

☒ Yes ☐ No

g. Is cross-section 4 located at a 1:1 flow contraction ratio upstream of the culvert?

☒ Yes ☐ No

h. Have the expansion / contraction coefficients been adjusted to reflect the effects of the culvert?

☒ Yes ☐ No

i. Were effective flow limits set at sections 2 and 3?

☒ Yes ☐ No

j. Does approach roadway profile data extend across the full valley cross section?

☒ Yes ☐ No

k. Were HEC-RAS default embankment side slopes applied at all culvert crossings in the model?

☒ Yes ☐ No

Waterbody Name: _____
Preparer: _____
Date: _____

l. For all "No" answer above, please provide an explanation:

m. Check-RAS

For HEC-RAS models, please run the "Structure" report from Check-RAS and attach it to this checklist. List any comments in the model and justification for not correcting these comments (use additional sheets, if necessary):

See checkRAS for comments

CHECK-RAS Program: Structure Check

Project File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.prj
Plan File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.p05
Geometry File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.g05
Flow File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.f02
Report File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.br
Selected profiles: 100yr;Floodway
Date: 6/19/2009
Time: 13:21:24 PM — No changes

RS	MaxLoChord	MnTpRd	EGEL	WSEL	MinChEl	Structure
Williams Creek,Hamilton Co CTP						
9.022			911.5	911.5	901	
8.943			911.5	911.5	901	
8.867			911.5	911.49	901	
8.863	902.8	909	0	902.8	898.8	Culvert #1-Up
8.863	902	909	0	902	898	Culvert #1-Dn
8.744			905.02	905	898	
8.658			905	905	898	
8.554			905	905	898	
8.542	898.5	904	0	898.5	894.5	Culvert #1-Up
8.542	897	904.01	0	897	893	Culvert #1-Dn
8.51			896.84	896.8	893	
8.392			896.65	896.63	893	
8.38			896.51	896.57	893	
8.371			895.49	895.43	891	
8.342			895.42	895.4	890	
8.266			895.31	895.27	890	
8.216			895.24	895.21	888.41	
8.21	892.11	894.13	0	892.11	888.41	Culvert #1-Up
8.21	892	894.13	0	892	888.3	Culvert #1-Dn
8.194			892.94	892.8	888.3	
8.162			891.87	891	888.2	
8.096			891.17	891.17	887.91	
8.014			891.13	891.13	887.55	
7.985			890.99	890.11	887.2	
7.979			888.57	888.4	884	
7.967			888.46	888.35	881.51	
7.961	887.72	889.18	0	886.98	881.72	Culvert #1-Up
7.961	887.51	889.18	0	886.97	881.51	Culvert #1-Dn
7.952			887.28	886.97	881.51	
7.917			886.8	886.69	881	
7.797			885.62	885.4	880	
7.77			885.29	885.01	879.77	
7.726			884.47	884.3	879.37	
7.633			883.67	883.62	878.53	
7.527			882.91	882.68	877.8	
7.52	884	883	882.73	882.26	877.8	Bridge #1-Up
7.52	883.86	883	882.47	881.87	877.5	Bridge #1-Dn
7.51			882.26	881.91	877.5	
7.472			881.7	881.59	876.4	
7.435			881.38	881.25	876.55	
7.35			880.91	880.82	873.59	
7.325			880.83	880.79	873.02	
7.288			880.77	880.74	872.1	
7.285	876.6	880	0	876.6	872.1	Culvert #1-Up
7.285	876.55	879.34	0	876.55	872.05	Culvert #1-Dn
7.285	877.08	880	0	877.08	872.68	Culvert #2-Up
7.285	877.08	879.34	0	877.08	872.68	Culvert #2-Dn
7.272			879.25	879.19	872.05	
7.24			879.12	879.06	872.01	
7.164			878.55	878.27	871.85	
7.159	878.94	879	878.38	877.76	871.85	Bridge #1-Up
7.159	879.01	879	878.14	877.43	871.85	Bridge #1-Dn
7.147			877.87	877.81	871.85	
7.111			877.16	876.7	871.18	
7.057			876.5	876.4	870.43	
6.998			875.9	875.62	869.6	
6.893			874.57	874.28	868.13	
6.812			873.88	873.71	867	
6.717			873.21	873.02	865.68	
6.647			872.86	872.78	864.7	
6.587			872.65	872.51	863.79	
6.582	875.26	875.95	872.63	872.4	863.79	Bridge #1-Up
6.582	875.26	875.56	870.55	870.33	863.31	Bridge #1-Dn
6.569			870.52	870.33	863.31	
6.567	870.97	872	0	870	863.87	Culvert #1-Up
6.567	870.97	872	0	869.97	863.87	Culvert #1-Dn
6.549			870.17	869.97	863.31	
6.483			869.66	869.51	861.9	
6.453			869.4	869.27	861.2	
6.405			868.72	868.24	860.07	

6.396			868.48	868.36	859.7	
6.389	861	869	0	861	869.7	Culvert #2-Up
6.389	860.95	869.19	0	860.95	859.65	Culvert #2-Dn
6.389	871	869	0	860.23	861	Culvert #1-Up
6.389	870.95	869.19	0	860.22	860.95	Culvert #1-Dn
6.362			868.31	868.22	859.65	
6.317			867.93	867.42	859.13	
6.274			867.27	867.07	858.79	
6.159			866.04	865.83	857.88	
6.087			865.46	865.38	857.32	
6.032			865.04	864.85	856.88	
5.949			864.49	864.43	856.23	
5.915			864.32	864.2	855.96	
5.908			864.26	864.13	855.91	
5.862			863.93	863.84	855.54	
5.801			863.49	863.31	854.89	
5.779	864.89	865.14	0	863.24	854.89	Culvert #1-Up
5.779	864.84	865.01	0	863.23	854.84	Culvert #1-Dn
5.777			863.4	863.21	854.84	
5.749			863.18	862.9	854.63	
5.731			862.99	862.55	854.47	
5.704			862.67	862.5	854.24	
5.658			862.27	861.95	853.84	
5.589			861.21	860.85	853.19	
5.583	861.98	862.59	861.05	860.41	853.19	Bridge #1-Up
5.583	861.98	863	860.52	859.95	853.19	Bridge #1-Dn
5.568			860.38	859.8	853.19	
5.534			859.52	859.24	852.71	
5.493			859.13	859.05	852.3	
5.47			858.97	858.83	852.07	
5.422			858.54	858.44	851.51	
5.377			858.24	858.16	851.16	
5.34			857.92	857.78	850.8	
5.255			857.17	856.92	849.96	
5.152			856.05	855.83	848.95	
5.125			855.75	855.57	848.68	
5.077			855.21	854.93	848.21	
5.025			854.74	854.61	847.66	
5.021	858.43	857.03	854.67	854.4	847.66	Bridge #1-Up
5.021	858.63	857.03	854.6	854.32	847.66	Bridge #1-Dn
5.011			854.51	854.33	847.66	
4.981			854.29	854.11	847.3	
4.973			853.69	853.45	846.78	
4.777			852.68	852.59	845.47	
4.709			852.42	852.37	844.86	
4.651			852.15	851.94	844.3	
4.646	855.4	855	851.95	851.27	844.3	Bridge #1-Up
4.646	855.4	855	851.61	850.68	844.3	Bridge #1-Dn
4.633			851.2	850.73	844.3	
4.603			850.67	850.5	843.77	
4.571			850.32	850.11	843.38	
4.543			850	849.76	843.04	
4.513			849.66	849.43	842.67	
4.447			848.25	849.17	841.86	
4.313			849	848.98	840.22	
4.274			848.97	848.95	839.75	
4.219			848.84	848.66	839	
4.213	849.67	848	848.49	847.38	839	Bridge #1-Up
4.213	849.67	848	847.49	845.76	839	Bridge #1-Dn
4.2			846.74	845.83	839	
4.167			845.59	845.2	838.41	
4.111			844.73	844.5	837.69	
3.977			843.53	843.42	835.97	
3.871			842.65	842.4	834.61	
3.785			841.97	841.78	833.51	
3.729			841.54	841.28	832.79	
3.651			840.53	840.02	831.79	
3.582			839.34	838.97	830.9	
3.494			838.37	838.23	829.77	
3.326			836.93	836.71	827.62	
3.245			836.97	835.62	826.58	
3.127			834.76	834.49	825.06	
2.921			831.84	831.04	822.42	
2.86			830.75	830.44	821.64	
2.811			830.34	830.13	820.88	
2.801	833.09	833.5	830.22	829.85	820.88	Bridge #1-Up
2.801	833.09	833.5	830.15	829.76	820.88	Bridge #1-Dn
2.787			830.05	829.72	820.89	
2.753			829.62	829.16	820.27	
2.652			828.87	828.78	818.98	
2.589			828.25	827.47	818.11	
2.572			827.95	826.94	817.96	
2.525			826.69	826.33	817.35	
2.434			825.77	825.43	816.19	
2.401			825.45	825.18	815.77	

2.263			823.92	823.37	814.01	
2.202			823.04	822.53	813.23	
2.09			821.79	821.43	811.8	
2.033			820.96	820.04	811.07	
1.976			819.89	819.53	810.34	
1.922			819.21	818.69	809.65	
1.816			817.73	817.15	808.3	
1.641			815.87	815.54	806.06	
1.603			815.4	814.55	805.58	
1.492			813.42	812.76	804.16	
1.419			812.33	811.93	803.23	
1.373			811.88	811.5	802.64	
1.369	819.09	814	811.79	811.24	802.64	Bridge #1-Up
1.369	819.09	814	811.68	811.08	802.59	Bridge #1-Dn
1.386			811.49	811.05	802.59	
1.277			810.58	810.04	800.49	
1.198			809.93	809.5	798.7	
1.106			809.06	808.68	796.59	
1.105		804.59	809.06	808.68	796.59	Inline-Up
1.105		804.59				Inline-Dn
1.097			807.03	806.59	796.47	
1.046			806.12	805.38	795.77	
0.962			805.11	804.79	794.62	
0.856			804.51	804.21	793.17	
0.807			803.94	802.55	792.5	
0.73			802.18	801.15	791.45	
0.666			800.5	799.24	790.58	
0.58			798.41	797.7	789.4	
0.474			797.83	797.77	787.95	
0.375			797.62	797.54	786.6	
0.351			797.5	797.11	786.27	
0.279			797.04	796.59	785.22	
0.273	801.32	804.32	796.92	796.26	785.22	Bridge #1-Up
0.273	801.32	803.57	796.39	795.5	785.22	Bridge #1-Dn
0.243			796.13	795.61	785.22	
0.178			795.44	794.82	784.55	
0.11			794.82	754.33	784.07	
0.03			794.22	793.74	783.44	
0.021	801.21	800	793.95	793.03	783.44	Bridge #1-Up
0.021	801.21	800	793.7	792.9	783.1	Bridge #1-Dn
0.0005			793.2	792.74	783.1	
0.0006			792.35	791.76	782.45	
0.0003			791.47	791.19	781.72	
0.0002			789.41	789.06	778.93	
0.0001			787.64	787.09	777.03	

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 8.863
TYPE OF STRUCTURE: Culvert

Description:	Liberty-Pawtucket Crossing
Distance from Upstream XS:	20
Deck/Roadway Width:	600
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	8.943	400.94	911.5	0	911.5	424.7	
4	8.943	400.94	911.49	0	911.49	424.65	
3	8.867	649.50	911.49	0	911.5	46	
3	8.867	649.50	911.49	0	911.49	46	
	8.863	610.00	902.0	0	0	0	Culvert #1-Up
	8.863	19.50	902	0	0	0	Culvert #1-Dn
	8.863	610.00	902.8	0	0	0	Culvert #1-Up
	8.863	19.50	902	0	0	0	Culvert #1-Dn
2	8.744	454.74	905	0	905.02	24	
2	8.744	454.74	905.19	0.19	905.21	24	
1	8.658	549.24	905	0	905	404.87	
1	8.658	549.24	905.19	0.19	905.19	441.61	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	402	912	0	688	910

```
 2        448        818.2      912                    712        1124.75   910
-------------------------------------------------------------------------------

Opening Type       StagStaL    StagStaR  EncStaL   EncStaR   LLfStaS   RLfStaS
-------------------------------------------------------------------------------
Culvert Group                                                 402       448    U
                                                              688       712    D
                                         0         0                           U
                                         0         0                           D
-------------------------------------------------------------------------------

CULVERT:
Culvert Name: Culvert #1
Shape:        Circular        Rise:       4        Span:            0        Barrels:        1
FHWA Chart #: # 1 - Concrete Pipe Culvert
FHWA Scale #: # 1 - Square edge entrance with headwall
Solution Crit:Highest U.S. EG

UpstrmDist:     20        Length:         610      n-Value:         0.013
EntLossCoef:    0.5       ExtLossCoef:    1        CulvInvElU       898.8     CulvInvElD      898
LCntStaU:       424       RCntStaU:       424      LCntStaD         700       RCntStaD        700
Culvert Depth Blocked:    0


-------------------------------------------------------------------------------
Culv Area:      12.57     CulvQ:          121.06   MinTopRd:        910.89
                12.57                     119.24                    910.89
-------------------------------------------------------------------------------

                    LAbutSt   RAbutSt   LMnTpRd   RMnTpRd   MnTpRd    NxLoCd
-------------------------------------------------------------------------------
Culvert #1          422       426       911       909       909       902.8    U
                    698       702       910       909       909       902      D
                    422       426       911       909       909       902.8    U
                    698       702       910       909       909       902      D
-------------------------------------------------------------------------------

Name            Q Total.  Q Struc   Q Weir    Selected Method      Flow Type
-------------------------------------------------------------------------------
Culvert #1                121.06    45.94     Highest U.S. EG      Pressure and Weir Flow
                          119.24    47.76     Highest U.S. EG      Pressure and Weir Flow
-------------------------------------------------------------------------------

GEOMETRIC CHECK
---------------

RS:        8.869
ST GD 03   The end station of 1132 from downstream road/weir data
           is greater than the end station of 1124.75 from downstream internal
           section.
           The high chord elevation of 911 for the end road/weir station is
           greater than the ground elevation of 904 for the end ground station.
           The EGEL at section 3 of 911.5 is greater than the ground elevation.
           The road/weir data should be included in the ground data

TYPE OF FLOW CHECK
------------------

RS:        8.869 This is Culvert #1
CV PW 01   Type of flow is pressure and weir flow because,
           1. EGEL 3 of 911.5 is greater than MinTopRd of 910.89.
           2. CulvWSIn of 902.80 is greater than or equal to NxLoCdU of 902.80.
           3. CulvWSOut of 902.00 is greater than or equal to NxLoCdD of 902.00.

RS:        8.869 This is Culvert #1.
CV PW 01   Type of flow is pressure and weir flow because,
           1. EGEL 3 of 911.49 is greater than MinTopRd of 910.89.
           2. CulvWSIn of 902.80 is greater than or equal to NxLoCdU of 902.80.
           3. CulvWSOut of 902.00 is greater than or equal to NxLoCdD of 902.00.

DISTANCE CHECK
--------------

CULVERT COEFFICIENT CHECK
-------------------------

CULVERT CRITERIA CHECK
----------------------

INEFFECTIVE FLOW CHECK
----------------------

RS:        8.867 This is Section 3
```

ok

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ST IF 02  Weir flow occurs at Culvert Group 1
          However, the ineffective flow elevation of 912 between stations 0
          and 492 is equal to or greater than the WSEL of 911.49
          The LMnTpRdU is 911
          The ineffective flow elevation should be equal to or lower than the MnTpRd
          It should also be less than the WSEL.

RS:       8.869 This is Section 3
ST IF 02  Weir flow occurs at Culvert Group 1
          However, the ineffective flow elevation of 912 between stations 448
          and 818.2 is equal to or greater than the WSEL of 911.49
          The RMnTpRdU is 909
          The ineffective flow elevation should be equal to or lower than the MnTpRd
          It should also be less than the WSEL.

RS:       8.744 This is Section 2
ST IF 02  Weir flow occurs at Culvert Group 1
          However, the ineffective flow elevation of 910 between stations 0
          and 588 is equal to or greater than the WSEL of 905
          The LMnTpRdD is 910 and the MxLoCdD is 902
          The ineffective flow elevation should be between the LMnTpRdD and the MxLoCdD
          if LMnTpRdD is greater than MxLoCdD. Otherwise, It should be equal to LMnTpRdD.
          It should also be less than the WSEL.

RS:       8.744 This is Section 2
ST IF 02  Weir flow occurs at Culvert Group 1
          However, the ineffective flow elevation of 910 between stations 712
          and 1124.75 is equal to or greater than the WSEL of 905
          The RMnTpRdD is 909 and the MxLoCdD is 902
          The ineffective flow elevation should be between the RMnTpRdD and the MxLoCdD
          if RMnTpRdD is greater than MxLoCdD. Otherwise, It should be equal to RMnTpRdD.
          It should also be less than the WSEL.

RS:       8.688 This is Section 1
ST IF 07  Ineffective flow option was considered at this section.
          However, it should be a fully expanded cross section.
          Ineffective flow stations and elevations should be cleared from
          this section, unless the area beyond the ineffective flow stations
          are not within the flow path of the stream.
          This message should be ignored if this section is Section 3 of the downstream
          structure.
```

OK

FLOODWAY CHECK

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 8.542
TYPE OF STRUCTURE: Culvert

Description:	Manassas Rd
Distance from Upstream XS:	60
Deck/Roadway Width:	69
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	8.658	549.24	905	0	905	404.87	
4	8.658	549.24	905.19	0.19	905.19	441.61	
3	8.854	229.82	905	0	905	124	
3	8.854	229.82	905.19	0.19	905.19	329.59	
	8.542	120.00	898.5	0	0	0	Culvert #1-Dn
	8.542	48.82	897	0	0	0	Culvert #1-Dn
	8.542	120.00	0	0	0	0	Culvert #1-Up
	8.542	49.82	0	0	0	0	Culvert #1-Dn
2	8.51	626.04	896.8	0	896.04	52	
2	8.51	626.04	896.82	0.02	896.86	52	
1	8.392	60.55	896.63	0	896.65	134.35	
1	8.392	60.55	896.64	0	896.65	108.16	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	119	905	0	281	905
2	243	370.71	905	333	496.98	905

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LfStaS	RfStaS	
Culvert Group					119	243	U
					281	333	D
			0	0			U
			0	0			D

CULVERT:
Culvert Name: Culvert #1
Shape: Circular Rise: 4 Span: 0 Barrels: 1
FHWA Chart #: # 1 - Concrete Pipe Culvert
FHWA Scale #: # 1 - Square edge entrance with headwall
Solution Crit:Highest U.S. EG

UpstrmDist:	60	Length:	120	n-Value:	0.013		
EntLossCoef:	0.5	ExtLossCoef:	1	CulvInvElU	894.5	CulvInvElD	893
LCntStaU:	181	RCntStaU:	181	LCntStaD	308	RCntStaD	308
Culvert Depth Blocked:	0						

Culv Area:	12.57	CulvQ:	197.22	MinTopRd:	904.78
	0		0		905.01

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Culvert #1	179	183	904	905	904	898.5	U
	306	310	904.01	905	904.01	897	D
	179	183	904	905	904	898.5	U
	306	310	904.01	905	904.01	897	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Culvert #1		197.22	42.47	Highest U.S. EG	Pressure and Weir Flow
		0	290.5	Highest U.S. EG	Pressure and Weir Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 8.542 This is Culvert #1
CV PW 01 Type of flow is pressure and weir flow because,
1. EGEL 3 of 905 is greater than MinTopRd of 904.78,
2. CulvWSIn of 898.50 is greater than or equal to MxLoCdU of 898.50.
3. CulvWSOut of 897.00 is greater than or equal to MxLoCdD of 897.00.

RS: 8.542 This is Culvert #2
CV PW 01 Type of flow is pressure and weir flow because,
1. EGEL 3 of 905.19 is greater than MinTopRd of 905.01,
2. CulvWSIn of 0.00 is less than MxLoCdU of 898.50.
3. CulvWSOut of 0.00 is less than MxLoCdD of 897.00.
4. (EGEL 3 - CulvInvUp) / Rise is greater than or equal to 1.2

DISTANCE CHECK

CULVERT COEFFICIENT CHECK

CULVERT CRITERIA CHECK

INEFFECTIVE FLOW CHECK

RS: 8.954 This is Section 3
ST IF 02 Weir flow occurs at Culvert Group 1
However, the ineffective flow elevation of 905 between stations 0
and 119 is equal to or greater than the WSEL of 905
The LMnTpRdU is 904.0016
The ineffective flow elevation should be equal to or lower than the MnTpRd
It should also be less than the WSEL.

OK

RS: 8.51 This is Section 2
ST IF 02 Weir flow occurs at Culvert Group 1
However, the ineffective flow elevation of 905 between stations 0

and 281 is equal to or greater than the WSEL of 896.8
The LMnTpRdD is 904.0082 and the MxLoCdD is 897
The ineffective flow elevation should be between the LMnTpRdD and the MxLoCdD
if LMnTpRdD is greater than MxLoCdD. Otherwise, it should be equal to LMnTpRdD.
It should also be less than the WSEL.

RS: 8.688 This is Section 4
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the areas beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 2 of
the upstream structure.

RS: 8.392 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the area beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure.

OR

FLOODWAY CHECK

RS: 8.542 This is Culvert
ST FW 01 Encroachment Method was not specified at this river station.
For flood insurance studies Encroachment Methods 4 and 1
should be used.

NA

RS: 8.542 This is Culvert
ST FW 09 The left most weir station of 42.28 for the floodway profile is equal
or less than the left most weir station of 119 for the natural
profile.
The floodway weir flow boundary is equal to or outside of the
natural profile weir flow boundary.
Encroachment computations should be investigated.

RS: 8.542 This is Culvert
ST FW 09 The right most weir station of 370.71 for the floodway profile is equal
or greater than the right most weir station of 218.88 for the natural
profile.
The floodway weir flow boundary is equal to or outside of the
natural profile weir flow boundary.
Encroachment computations should be investigated.

no encroachment calculated.

RS: 8.51 This is Section 2
ST FW 04 The left encroachment station of 281 is greater than the
left bank station of 278.58
The left encroachment station is within the channel.
The encroachment station and/or channel bank station should be reevaluated.

RS: 8.51 This is Section 2
ST FW 04 The right encroachment station of 333 is less than the
right bank station of 360.43
The encroachment station and/or channel bank station should be reevaluated.

W/S limit of Floodway mapped at banks.

RS: 8.554 This is Section 3
ST FW 01 Encroachment Method was not specified at this river station.
For flood insurance studies Encroachment Methods 4 and 1
should be used.

NA

RS: 8.554 This is Section 3
ST FW 07 Surcharge value is more than the allowable value of 0.14

no values assigned for encroachment.

RS: 8.554 This is Section 3
ST FW 10 Right encroachment station 0 is less than the right ineffective flow
station 243 and equal to or less than the left ineffective flow station 119
The effective flow area is totally blocked by the encroachment
stations.
The encroachment stations should be adjusted.

NA

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 8.21
TYPE OF STRUCTURE: Culvert

Description:	Francis St.
Distance from Upstream XS:	31
Deck/Roadway Width:	46
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95

Elevation at which weir flow begins: 0
Weir crest shape: Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	8.266	261.88	895.27	0	895.31	117.81	
4	8.266	261.88	895.33	0.06	895.37	58.17	
3	8.216	116.72	895.21	0	895.24	89.23	
3	8.216	116.72	895.26	0.07	895.3	75.85	
	8.21	75.00	892.11	0	0	0	Culvert #1-Up
	8.21	21.72	892	0	0	0	Culvert #1-Dn
	8.21	75.00	892.11	0	0	0	Culvert #1-Up
	8.21	21.72	892	0	0	0	Culvert #1-Dn
2	8.194	168.92	892.8	0	892.94	67.88	
2	8.194	168.92	892.81	0.01	892.97	45.62	
1	8.162	345.76	891	0	891.87	28.01	
1	8.162	345.76	891	0	891.87	27.92	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	63.05	895	0	83.13	892.5
2	130.95	261.04	895	128.81	225.7	892.5

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LIfStaS	RIfStaS	
Culvert Group					63.05	130.95	U
					83.13	128.81	D
			0	0			U
			0	0			D

CULVERT:
Culvert Name: Culvert #1
Shape: Box Rise: 3.7 Span: 5.9 Barrels: 1
FHWA Chart #: # 58- Rectangular concrete
FHWA Scale #: # 1 - Side tapered; Less favorable edges
Solution Crit:Highest U.S. EG

UpstrmDist: 20 Length: 76 n-Value: 0.013
BntLossCoef: 0.5 ExtLossCoef: 1 CulvInvElU 888.41 CulvInvElD 888.3
LCntStaU: 97 RCntStaU: 97 LCntStaD 106 RCntStaD 106
Culvert Depth Blocked: 0

Culv Area:	21.83	CulvQ:	203.47	MinTopRd:	894.33
	21.83		205.54		894.59

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Culvert #1	94.05	99.95	894.13	894.86	894.13	892.11	U
	103.05	108.95	894.13	894.86	894.13	892	D
	94.05	99.95	894.13	894.86	894.13	892.11	U
	103.05	108.95	894.13	894.86	894.13	892	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Culvert #1		203.47	80.53	Highest U.S. EG	Pressure and Weir Flow
		205.54	86.46	Highest U.S. EG	Pressure and Weir Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 8.21 This is Culvert #1
CV PW 01 Type of flow is pressure and weir flow because,
1. EGEL 3 of 895.24 is greater than MinTopRd of 894.33.
2. CulvWSIn of 892.11 is greater than or equal to MxLoCdU of 892.11.
3. CulvWSOut of 892.00 is greater than or equal to MxLoCdD of 892.00.

RS: 8.21 This is Culvert #1

CV PW 01 Type of flow is pressure and weir flow because,
1. EGEL 3 of 895.5 is greater than MinTopRd of 894.59.
2. CulvWSIn of 892.11 is greater than or equal to MxLoCdU of 892.11.
3. CulvWSOut of 892.00 is greater than or equal to MxLoCdD of 892.00.

DISTANCE CHECK

CULVERT COEFFICIENT CHECK

RS: 8.21 This is Culvert #1
CV CF 01 Culvert Chart # is 58 and Scale # is 1
Culvert entrance shape is Side tapered; Less favorable edges
Culvert entrance loss coefficient is 0.5 It should be equal to 0.2
Please refer to Table 6.3 on page 6-22 and Tabble 6.4 on page 6-23 of HEC-RAS Hydraulic Reference Manual, September 1998.

unable to set to existing crossing, Loss Coefficient is correct.

CULVERT CRITERIA CHECK

INEFFECTIVE FLOW CHECK

FLOODWAY CHECK

RS: 8.21 This is Culvert
ST FW 01 Encroachment Method was not specified at this river station. For flood insurance studies Encroachment Methods 4 and 1 should be used.

NA

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 7.961
TYPE OF STRUCTURE: Culvert

Description:	146th Street
Distance from Upstream XS:	32
Deck/Roadway Width:	24
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	7.979	60.17	888.4	0	888.57	32.42	
4	7.979	60.17	888.46	0.06	888.63	30	
3	7.967	82.10	888.35	0	888.46	43.87	
3	7.967	82.10	888.41	0.06	888.52	45.64	
	7.961	40.00	886.98	0	0	0	Culvert #1-Up
	7.961	18.10	886.97	0	0	0	Culvert #1-Dn
	7.961	40.00	887.08	0	0	0	Culvert #1-Up
	7.961	18.10	887.07	0	0	0	Culvert #1-Dn
2	7.952	183.87	886.97	0	887.28	19.82	
2	7.952	183.87	887.07	0.1	887.36	22.69	
1	7.917	632.31	886.69	0	886.8	86.63	
1	7.917	632.31	886.8	0.11	886.92	44.87	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	139.3	890.5	0	218.25	890.5
2	212.7	590.09	889.68	253.75	637.59	887.69

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LlfStaS	RlfStaS	
Culvert Group					139.3	212.7	U
					218.25	253.75	D
			0	0			U
			0	0			D

CULVERT:
Culvert Name: Culvert #1

Shape:	Ellipse	Rise:	6	Span:	9.4	Barrels:	1

FHWA Chart #: # 29- Horizontal Ellipse; Con
FHWA Scale #: # 3 - Grooved end projecting
Solution Crit:Highest U.S. EG

UpstrmDist:	24	Length:	40	n-Value:	0.013		
EntLossCoef:	0.9	ExtLossCoef:	1	CulvInvElU	881.72	CulvInvElD	881.51
LCntStaU:	176	RCntStaU:	176	LCntStaD	236	RCntStaD	236

Culvert Depth Blocked: 0

Culv Area:	177.19	CulvQ:	292	MinTopRd:	889.19
	177.19		292		889.41

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Culvert #1	171.3	180.7	889.57	889.18	889.18	887.72	U
	231.3	240.7	889.64	889.16	889.18	887.51	D
	171.3	180.7	889.57	889.18	889.18	887.72	U
	231.3	240.7	889.64	889.18	889.18	887.51	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Culvert #1		292	0	Highest U.S. EG	Low Flow
		292	0	Highest U.S. EG	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 7.961 This is Culvert #1
CV LF 01 Type of flow is low flow because,
1. EGEL 3 of 888.46 is less than or equal to MinTopRd of 889.19.
2. CulvWSIn of 886.98 is less than MxLoCdU of 887.72.
3. CulvWSout of 886.97 is less than MxLoCdD of 887.51.
4. Q/AD^0.5 of 0.67 is less than 4.0.

RS: 7.961 This is Culvert #1
CV LF 01 Type of flow is low flow because,
1. EGEL 3 of 888.52 is less than or equal to MinTopRd of 889.41.
2. CulvWSIn of 887.08 is less than MxLoCdU of 887.72.
3. CulvWSout of 887.07 is less than MxLoCdD of 887.51.
4. Q/AD^0.5 of 0.67 is less than 4.0.

DISTANCE CHECK

CULVERT COEFFICIENT CHECK

RS: 7.961 This is Culvert #1
CV CF 01 Culvert Chart # is 29 and Scale # is 3
Culvert entrance shape is Grooved end projecting
Culvert entrance loss coefficient is 0.9 It should be equal to 0.2
Please refer to Table 6.3 on page 6-22 and Tabble 6.4 on page 6-23 of HEC-RAS Hydraulic Reference Manual, September 1998.

culvert is corrugated metal not concrete. Metal not an option, RAS table has metal culvert projecting from fill as 0.9.

CULVERT CRITERIA CHECK

INEFFECTIVE FLOW CHECK

RS: 7.917 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from this section, unless the area beyond the ineffective flow stations are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream structure.

OK

FLOODWAY CHECK

RS: 7.961 This is Culvert
ST FW 01 Encroachment Method was not specified at this river station.

NA

For flood insurance studies Encroachment Methods 4 and 1
should be used.

RS: 7.952This is Section 2
ST FW 08 The left station effective of 226.49 for the natural profile.
is less than the left channel bank station of 226.66
The left encroachment station is outside the channel.
The left encroachment station of 218.25 is less than the left
station effective of 226.49 for the natural profile.
The left encroachment station should be adjusted.

RS: 7.967This is Section 3
ST FW 08 The left station effective of 159.02 for the natural profile.
is less than the left channel bank station of 162.33
The left encroachment station is outside the channel.
The left encroachment station of 139.3 is less than the left
station effective of 159.02 for the natural profile.
The left encroachment station should be adjusted.

RS: 7.967 This is Section 3
ST FW 08 The right station effective of 202.89 for the natural profile.
is greater than the right channel bank station of 187.45
The right encroachment station is outside the channel.
The right encroachment station of 240 is greater than the right
station effective of 202.89 for the natural profile.
The right encroachment station should be adjusted.

Fixed.

RIVER/REACH: Williams Creek, Hamilton Co OTP
RIVER STATION: 7.52
TYPE OF STRUCTURE: Bridge

Description:	Ponds Pointe Dr.
Distance from Upstream XS:	38
Deck/Roadway Width:	40
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	BGEL	TopWidth Actual	
4	7.633	562.92	883.62	0	883.67	345.43	
4	7.633	562.92	883.67	0.05	883.73	210.52	
3	7.527	96.99	882.68	0	882.91	76.63	
3	7.527	96.99	882.73	0.05	882.95	76.63	
	7.52	40.00	882.26	0	882.73	27.04	Bridge #1-Up
	7.52	18.99	881.87	0	882.47	27.06	Bridge #1-Dn
	7.52	40.00	882.32	0.07	882.78	27.04	Bridge #1-Up
	7.52	18.99	881.98	0.11	882.55	27.06	Bridge #1-Dn
2	7.51	193.50	881.91	0	882.26	47	
2	7.51	193.50	882.01	0.1	882.35	47	
1	7.472	196.10	881.59	0	881.7	242.98	
1	7.472	196.10	881.69	0.1	881.81	127.52	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	398	883.5	0	260	883.5
2	501	607.25	886.08	307	455.83	886.08

BRIDGE:
Bridge Name: Bridge #1
LowFlowMethod: Highest Energy Answer
Momentum Cd: 0
HighFlowMethod: Pressure and Weir flow
SluiceGate Cd: 0 Submerged Cd: 0.8

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

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MaxLowChord:	884	MinTopRd:	883.51	MinElPrs:	884
	884		885.2		884

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LIfStaS	RIfStaS	
Bridge					398	501	U
					260	307	D
			398	474.63			U
			398	474.63			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Bridge #1	435.06	463.08	883.00	885.37	883.00	884.00	U
	269.92	297.19	883.00	885.35	883.00	883.86	D
	435.86	463.08	884.52	885.37	884.52	884.00	U
	-9999.00	-9999.00	-9999.00	-9999.00	-9999.00	-9999.00	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	570	570	0	Energy only	Low Flow
	570	570	0	Energy only	UNKNOWN

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 7.52 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 882.91 is equal to or less than MinTopRd of 883.5.
2. EGEL 3 of 882.91 is less than MxLoCdU of 884.0.

RS: 7.52 This is Bridge #1
BR TF 01 Type of flow is UNKNOWN.
CHECKRAS can not find MxLoCd or MnTpRd elevation
or the given conditions do not satisfy the type of flow
specified in the CHECK-RAS program.
Please review the ground and road data, and encroachment stations,
or please review the messages, BR LF 01, BR PF 01, BR PF 02, BR LW 01
BR PW 01 for bridges to determine the type of flow.

Low flow

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 7.285
TYPE OF STRUCTURE: Culvert

Description:	141st Street
Distance from Upstream XS:	18
Deck/Roadway Width:	50
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	7.325	195.38	880.79	0	880.83	293.48	
4	7.325	195.38	880.91	0.12	880.95	171.43	
3	7.288	87.88	880.74	0	880.77	394.05	
3	7.288	87.88	880.86	0.12	880.89	360	
	7.285	54.00	876.6	0	0	0	Culvert #1-Up
	7.285	19.88	876.55	0	0	0	Culvert #1-Dn
	7.285	54.00	876.6	0	0	0	Culvert #1-Up
	7.285	19.88	876.55	0	0	0	Culvert #1-Dn
	7.285	54.00	877.08	0	0	0	Culvert #2-Up
	7.285	19.88	877.08	0	0	0	Culvert #2-Dn
	7.285	54.00	877.08	0	0	0	Culvert #2-Up
	7.285	19.88	877.08	0	0	0	Culvert #2-Dn
2	7.272	165.76	879.19	0	879.25	411.32	
2	7.272	165.75	879.23	0.05	879.31	258.89	
1	7.24	403.89	879.06	0	879.12	222.68	
1	7.24	403.89	879.1	0.04	879.17	196.41	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	660	881	0	265	881
2	660	774.2	880.3	265	474.26	879
3	822.8	1200	880.3	506.74	800	879

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LifStaS	RLfStaS	
Culvert Group					774.2	822.8	U
					474.26	506.74	D
			0	0			U
			0	0			D

CULVERT:
Culvert Name: Culvert #1
Shape: Ellipse Rise: 4.5 Span: 5.6 Barrels: 1
FHWA Chart #: # 29- Horizontal Ellipse; Con
FHWA Scale #: # 1 - Square edge with headwall
Solution Crit:Highest U.S. EG

UpstrmDist:	14	Length:	54	n-Value:	0.03		
EntLossCoef:	0.5	ExtLossCoef:	1	CulvInvElU	872.1	CulvInvElD	872.05
LCntStaU:	795	RCntStaU:	795	LCntStaD	487	RCntStaD	487

Culvert Depth Blocked: 0

Culv Area:	79.17	CulvQ:	125.43	MinTopRd:	880.1
	79.17		128.21		880.1

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Culvert #1	792.2	797.8	880	880	880	876.5	U
	484.2	489.8	879.36	879.34	879.34	876.55	D
	792.2	797.8	880	880	880	876.5	U
	484.2	489.8	879.36	879.34	879.34	876.55	D

CULVERT:
Culvert Name: Culvert #2
Shape: Ellipse Rise: 4.4 Span: 5.6 Barrels: 1
FHWA Chart #: # 29- Horizontal Ellipse; Con
FHWA Scale #: # 1 - Square edge with headwall
Solution Crit:Highest U.S. EG

UpstrmDist:	14	Length:	54	n-Value:	0.03		
EntLossCoef:	0.5	ExtLossCoef:	1	CulvInvElU	872.68	CulvInvElD	872.68
LCntStaU:	802	RCntStaU:	802	LCntStaD	494	RCntStaD	494

Culvert Depth Blocked: 0

Culv Area:	77.41	CulvQ:	121.17	MinTopRd:	880.1
	77.41		123.95		880.1

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Culvert #2	799.2	804.8	880	880	880	877.08	U
	491.2	496.8	879.34	879.35	879.34	877.08	D
	799.2	804.8	880	880	880	877.08	U
	491.2	496.8	879.34	879.35	879.34	877.08	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Culvert #1		125.43	506.4	Highest U.S. EG	Pressure and Weir Flow
		128.21	500.83	Highest U.S. EG	Pressure and Weir Flow
Culvert #2		121.17	506.4	Highest U.S. EG	Pressure and Weir Flow
		123.95	500.83	Highest U.S. EG	Pressure and Weir Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

```
RS:        7.285 This is Culvert #1
CV PW 01   Type of flow is pressure and weir flow because,
           1. EGEL 3 of 880.77 is greater than MinTopRd of 880.10.
           2. CulvWSIn of 876.60 is greater than or equal to MxLoCdU of 876.60.
           3. CulvWSOut of 876.55 is greater than or equal to MxLoCdD of 876.55.

RS:        7.285 This is Culvert #2
CV PW 01   Type of flow is pressure and weir flow because,
           1. EGEL 3 of 880.77 is greater than MinTopRd of 880.10.
           2. CulvWSIn of 877.08 is greater than or equal to MxLoCdU of 877.08.
           3. CulvWSOut of 877.08 is greater than or equal to MxLoCdD of 877.08.

RS:        7.285 This is Culvert #1
CV PW 01   Type of flow is pressure and weir flow because,
           1. EGEL 3 of 880.89 is greater than MinTopRd of 880.10.
           2. CulvWSIn of 876.60 is greater than or equal to MxLoCdU of 876.60.
           3. CulvWSOut of 876.55 is greater than or equal to MxLoCdD of 876.55.

RS:        7.285 This is Culvert #2
CV PW 01   Type of flow is pressure and weir flow because,
           1. EGEL 3 of 880.89 is greater than MinTopRd of 880.10.
           2. CulvWSIn of 877.08 is greater than or equal to MxLoCdU of 877.08.
           3. CulvWSOut of 877.08 is greater than or equal to MxLoCdD of 877.08.

DISTANCE CHECK
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CULVERT COEFFICIENT CHECK
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RS:        7.285 This is Culvert #1
CV CF 03   Type of material is Concrete. Culvert n-value is 0.03
           Culvert n-value is not within the recommended range.
           It should be within 0.011 and 0.017
           Please refer to Table 6.1 on page 6-20 and Table 6.2 on page 6-21
           of HEC-RAS Hydraulic Reference Manual, September 1998.

RS:        7.285 This is Culvert #2
CV CF 03   Type of material is Concrete. Culvert n-value is 0.03
           Culvert n-value is not within the recommended range.
           It should be within 0.011 and 0.017
           Please refer to Table 6.1 on page 6-20 and Table 6.2 on page 6-21
           of HEC-RAS Hydraulic Reference Manual, September 1998.
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Culverts are metal, meaning n is ok.

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CULVERT CRITERIA CHECK
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INEFFECTIVE FLOW CHECK
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RS:        7.260 This is Section 3
ST IF 02   Weir flow occurs at Culvert Group 1
           However, the ineffective flow elevation of 881 between stations 0
           and 660 is equal to or greater than the WSEL of 880.74
           The LMnTpRdU is 880
           The ineffective flow elevation should be equal to or lower than the MnTpRd
           It should also be less than the WSEL.

RS:        7.272 This is Section 2
ST IF 02   Weir flow occurs at Culvert Group 1
           However, the ineffective flow elevation of 881 between stations 0
           and 265 is equal to or greater than the WSEL of 879.19
           The LMnTpRdD is 879.3636 and the MxLoCdD is 876.55
           The ineffective flow elevation should be between the LMnTpRdD and the MxLoCdD
           if LMnTpRdD is greater than MxLoCdD. Otherwise, It should be equal to LMnTpRdD.
           It should also be less than the WSEL.

RS:        7.325 This is Section 4
ST IF 07   Ineffective flow option was considered at this section.
           However, it should be a fully expanded cross section.
           Ineffective flow stations and elevations should be cleared from
           this section, unless the areas beyond the ineffective flow stations
           are not within the flow path of the stream.
           This message should be ignored if this section is Section 2 of
           the upstream structure.

RS:        7.24 This is Section 1
ST IF 07   Ineffective flow option was considered at this section.
           However, it should be a fully expanded cross section.
           Ineffective flow stations and elevations should be cleared from
           this section, unless the area beyond the ineffective flow stations
           are not within the flow path of the stream.
           This message should be ignored if this section is Section 3 of the downstream
           structure.
```

ok

ok

ok

ok

RS: 7.288 This is Section 3
ST IF 09 'Permanent Ineffective Flow Areas' option is used.
HEC-RAS version 3.0.1 will compute higher water-surface elevation than it should be computed if weir flow occurs at the structure.
Please disable this option.

RS: 7.272 This is Section 2
ST IF 09 'Permanent Ineffective Flow Areas' option is used.
HEC-RAS version 3.0.1 will compute higher water-surface elevation than it should be computed if weir flow occurs at the structure.
Please disable this option.

OK

FLOODWAY CHECK

RS: 7.285 This is Culvert
ST FW 01 Encroachment Method was not specified at this river station.
For flood insurance studies Encroachment Methods 4 and 1 should be used.

NA

RS: 7.285 This is Culvert
ST FW 09 The left most weir station of 660 for the floodway profile is equal or less than the left most weir station of 660 for the natural profile.
The floodway weir flow boundary is equal to or outside of the natural profile weir flow boundary.
Encroachment computations should be investigated.

NA

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 7.159
TYPE OF STRUCTURE: Bridge

Description:	Buckhorn Drive
Distance from Upstream XS:	26
Deck/Roadway Width:	40
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	BGEL	TopWidth Actual	
4	7.24	403.89	879.06	0	879.12	222.69	
4	7.24	403.89	879.1	0.04	879.17	196.41	
3	7.164	89.00	878.27	0	878.55	55.24	
3	7.164	89.00	878.33	0.06	878.61	55.24	
	7.159	40.00	877.76	0	878.38	29	Bridge #1-Up
	7.159	23.00	877.43	0	878.14	29	Bridge #1-Dn
	7.159	40.00	877.85	0.09	878.44	29	Bridge #1-Up
	7.159	23.00	877.57	0.14	878.23	29	Bridge #1-Dn
2	7.147	193.07	877.51	0	877.87	52.04	
2	7.147	193.07	877.64	0.12	877.99	52.04	
1	7.111	281.55	876.7	0	877.16	147.64	
1	7.111	281.55	876.83	0.13	877.29	117.42	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	447.98	880	0	398.48	880
2	529.02	757	881.5	450.52	520.38	881.5

BRIDGE:
Bridge Name: Bridge #1
LowFlowMethod: Highest Energy Answer
Momentum Cd: 0
HighFlowMethod: Pressure and Weir flow
SluiceGate Cd: 0 Submerged Cd: 0.8

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord:	878.94	MinTopRd:	879.94	MinBlPrs:	879.94
	878.94		880.02		878.94

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LftStaS	RtStaS	
Bridge					447.98	529.02	U
					398.48	450.52	D
			447.98	503.22			U
			447.98	503.22			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Bridge #1	474.00	503.00	879.00	880.54	879.00	878.94	U
	410.00	439.00	879.00	880.09	879.00	879.01	D
	474.00	503.00	879.80	880.54	879.80	878.94	U
	-9999.00	-9999.00	-9999.00	-9999.00	-9999.00	-9999.00	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	753	753	0	Energy only	Low Flow
	753	753	0	Energy only	UNKNOWN

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 7.159 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 878.55 is equal to or less than MinTopRd of 879.9.
2. EGEL 3 of 878.55 is less than MxLoCdU of 878.9.

RS: 7.159 This is Bridge #1
BR TF 01 Type of flow is UNKNOWN.
CHECKRAS can not find MxLoCd or MnTpRd elevation
or the given conditions do not satisfy the type of flow
specified in the CHECK-RAS program.
Please review the ground and road data, and encroachment stations,
or please review the messages, BR LF 01, BR PF 01, BR PF 02, BR LW 01
BR PW 01 for bridges to determine the type of flow.

Low Flow

RIVER/REACH: Williams Creek, Hamilton Co OTP
RIVER STATION: 6.582
TYPE OF STRUCTURE: Bridge

Description:	Salsbury Creek Drive
Distance from Upstream XS:	27
Deck/Roadway Width:	46
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	6.647	317.16	872.78	0	872.86	187.45	
4	6.647	317.16	872.88	0.07	872.93	121.83	
3	6.587	93.92	872.51	0	872.65	94	
3	6.587	93.92	872.59	0.09	872.73	94	
	6.582	46.00	872.4	0	872.63	38.48	Bridge #1-Up
	6.582	20.92	870.33	0	870.55	38.84	Bridge #1-Dn
	6.582	46.00	872.49	0.09	872.71	38.46	Bridge #1-Up
	6.582	20.92	870.42	0.09	870.63	38.83	Bridge #1-Dn
2	6.569	106.53	870.33	0	870.52	47.73	
2	6.569	106.53	870.42	0.09	870.6	47.74	

Ineffective Flow, Section 3
Sta L Sta R Elev

Ineffective Flow, Section 2
Sta L Sta R Elev

1	0	288	876.5	0	543	874.5
2	382	515.66	876.5	595	879.08	872.6

BRIDGE:
Bridge Name: Bridge #1
LowFlowMethod: Highest Energy Answer
Momentum Cd: 1.2
HighFlowMethod: Energy Only
SluiceGate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
Add Friction component to Momentum
Do not add weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord: 875.26 MinTopRd: 876.47 MinElPrs: 875.26
875.26 876.55 875.26

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LftSteS	RtSteS	
Bridge					288	382	U
					543	595	D
			288	382			U
			288	382			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Bridge #1	314.49	356.04	876.00	875.95	875.95	875.26	U
	545.58	587.96	876.00	875.56	875.56	875.26	D
	-9999.00	-9999.00	-9999.00	-9999.00	-9999.00	-9999.00	U
	545.58	587.96	876.56	876.54	876.54	875.26	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	753	753	0	Momentum	Low Flow
	753	753	0	Momentum	UNKNOWN

GEOMETRIC CHECK

RS: 6.582
ST GO 03 The end station of 931 from downstream road/weir data
is greater than the end station of 879.08 from downstream internal
section.
The high chord elevation of 877.06 for the end road/weir station is OK
greater than the ground elevation of 872 for the end ground station.
The EGEL at section 3 of 872.65 is greater than the ground elevation.
The road/weir data should be included in the ground data

TYPE OF FLOW CHECK

RS: 6.582 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 872.65 is equal to or less than MinTopRd of 876.5,
2. EGEL 3 of 872.65 is less than MxLoCdU of 875.3,

RS: 6.582 This is Bridge #1
BR TF 01 Type of flow is UNKNOWN.
CHECKRAS can not find MxLoCd or MnTpRd elevation
or the given conditions do not satisfy the type of flow
specified in the CHECK-RAS program.
Please review the ground and road data, and encroachment stations.
or please review the messages, BR LF 01, BR PF 01, BR PF 02, BR LW 01
BR PW 01 for bridges to determine the type of flow.

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 6.567
TYPE OF STRUCTURE: Culvert

Description:	Springmill Road (Str. 30)
Distance from Upstream XS:	12
Deck/Roadway Width:	77
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest Shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
3	6.569	106.53	870.33	0	870.52	47.73	
3	6.569	106.53	870.42	0.09	870.5	47.74	
	6.567	77.00	870	0	0	0	Culvert #1-Up
	6.567	17.53	869.97	0	0	0	Culvert #1-Dn
	6.567	77.00	870.09	0	0	0	Culvert #1-Up
	6.567	17.53	870.06	0	0	0	Culvert #1-Dn
2	6.549	347.57	869.97	0	870.17	39.4	
2	6.549	347.57	870.06	0.1	870.26	39.19	
1	6.493	163.50	869.51	0	869.66	208.29	
1	6.493	163.50	869.64	0.14	869.79	140	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	543	874.5	0	569.3	874.5
2	595	879.08	872.5	615.3	1034.24	872.5

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LIfStaS	RIfStaS	
Culvert Group					543	595	U
					569.3	615.3	D
			0	0			U
			0	0			D

CULVERT:
Culvert Name: Culvert #1
Shape: Conspan Arch Rise: 7.1 Span: 28 Barrels: 1
FHWA Chart #: # 61- Span/Rise ratio approxi
FHWA Scale #: # 1 - 0 degree wing wall angle
Solution Crit: Highest U.S. EG

UpstrmDist:	12	Length:	77	n-Value:	0.013		
EntLossCoef:	0.5	ExtLossCoef:	1	CulvInvElU	863.87	CulvInvElD	863.87
LCntStaU:	569.01	RCntStaU:	569.01	LCntStaD	592.2	RCntStaD	592.3
Culvert Depth Blocked:	0						

Culv Area:	-9999	CulvQ:	753	MinTopRd:	872.51
	-9999		753		873.6

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxHoCd	
Culvert #1	555.01	583.01	873.71	872	872	870.97	U
	578.3	606.3	874.15	872	872	870.97	D
	555.01	583.01	873.71	872	872	870.97	U
	578.3	606.3	874.15	872	872	870.97	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Culvert #1		753	0	Highest U.S. EG	Low Flow
		753	0	Highest U.S. EG	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 6.567 This is Culvert #1
CV LF 01 Type of flow is low flow because,
1. EGEL # of 870.52 is less than or equal to MinTopRd of 872.51.

2. EGEL 3 of 870.52 is less than MxLoCdW of 870.97.

RS: 6.567 This is Culvert #1
CV LF 01 Type of flow is low flow because,
1. EGEL 3 of 870.5 is less than or equal to MinTopWd of 873.60.
2. EGEL 3 of 870.5 is less than MxLoCdW of 870.97.

DISTANCE CHECK

CULVERT COEFFICIENT CHECK

RS: 6.567 This is Culvert #3
CV CF 01 Culvert Chart # is 61 and Scale # is 1
Culvert entrance shape is 0 degree wing wall angle
Culvert entrance loss coefficient is 0.5 it should be equal to 0.7
Please refer to Table 6.3 on page 6-22 and Table 6.4 on page 6-23 of HEC-RAS Hydraulic Reference Manual, September 1995.

Conspan arch.
This is correct.

CULVERT CRITERIA CHECK

INEFFECTIVE FLOW CHECK

RS: 6.483 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from this section, unless the area beyond the ineffective flow stations are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream structure.

ok

FLOODWAY CHECK

RS: 6.567 This is Culvert
ST FW 01 Encroachment Method was not specified at this river station.
For flood insurance studies Encroachment Methods 4 and 1 should be used.

NA

RS: 6.549 This is Section 2
ST FW 10 Left encroachment station 576.11 is more than the left ineffective flow station 569.3 and less than the right ineffective flow station 615.3
Left encroachment station is within the effective flow area.
Left encroachment station should at least be equal to the left ineffective flow station.

RS: 6.569 This is Section 3
ST FW 10 Left encroachment station 543.91 is more than the left ineffective flow station 543 and less than the right ineffective flow station 595
Left encroachment station is within the effective flow area.
Left encroachment station should at least be equal to the left ineffective flow station.

RS: 6.569 This is Section 3
ST FW 10 Right encroachment station 591.65 is less than the right ineffective flow station 595 and greater than the left ineffective flow station 543
Right encroachment station is within the effective flow area.
Right encroachment station should at least be equal to the right ineffective flow station.

Set to banks

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 6.389
TYPE OF STRUCTURE: Culvert

Description:	136th Street (Str#43)
Distance from Upstream XS:	30
Deck/Roadway Width:	38
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual
4	6.405	46.73	868.24	0	868.72	165.65

4	6.405	46.73	868.37	0.13	868.81	95	
3	6.396	170.72	868.36	0	868.48	58	
3	6.396	170.72	868.48	0.12	868.6	58	
	6.389	127.45	861	0	0	0	Culvert #2-Up
	6.389	14.27	860.95	0	0	0	Culvert #2-Dn
	6.389	127.45	861	0	0	0	Culvert #2-Up
	6.389	14.27	860.95	0	0	0	Culvert #2-Dn
	6.389	127.45	868.23	0	0	0	Culvert #1-Up
	6.389	14.27	868.22	0	0	0	Culvert #1-Dn
	6.389	127.45	868.35	0	0	0	Culvert #1-Up
	6.389	14.27	868.34	0	0	0	Culvert #1-Dn
2	6.362	239.20	868.22	0	868.31	85.91	
2	6.362	239.20	868.34	0.12	868.42	85.91	
1	6.317	223.89	867.42	0	867.93	137.02	
1	6.317	223.89	867.49	0.07	868.05	42.03	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	129	869	869.7	0	843	869.7
2	921	1029.89	874.6	941	1462.22	874.6

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LIfStaS	RIfStaS	
Culvert Group					863	921	U
					843	941	D
			0	0			U
			0	0			D

CULVERT:
Culvert Name: Culvert #2
Shape: Box Rise: 1.3 Span: 28 Barrels: 1
FHWA Chart #: # 8 - flared wingwalls
FHWA Scale #: # 2 - Wingwall flared 90 or 15 deg.
Solution Crit:Highest U.S. EG

UpstrmDist: 37 Length: 127.45 n-Value: 0.013
EntLossCoef: 0.5 ExtLossCoef: 1 CulvInvElU 859.7 CulvInvElD 859.65
LCntStaU: 892 RCntStaU: 892 LCntStaD 892 RCntStaD 892
Culvert Depth Blocked: 0

Culv Area: 36.4 CulvQ: 90.65 MinTopRd: 869.71
36.4 89.73 874.36

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Culvert #2	878	906	869	874.1	869	861	U
	878	906	869.19	873	869.19	860.95	D
	878	906	869	874.1	869	861	U
	878	906	869.19	873	869.19	860.95	D

CULVERT:
Culvert Name: Culvert #1
Shape: Conspan Arch Rise: 10 Span: 28 Barrels: 1
FHWA Chart #: # 60- Span/Rise ratio approxi
FHWA Scale #: # 3 - 90 degree wing wall angle
Solution Crit:Highest U.S. EG

UpstrmDist: 37 Length: 127.45 n-Value: 0.013
EntLossCoef: 0.5 ExtLossCoef: 1 CulvInvElU 861 CulvInvElD 860.95
LCntStaU: 892 RCntStaU: 892 LCntStaD 892 RCntStaD 892
Culvert Depth Blocked: 0

Culv Area: -9999 CulvQ: 662.35 MinTopRd: 869.71
-9999 663.27 874.36

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Culvert #1	878	906	869	874.1	869	871	U
	878	906	869.19	873	869.19	870.95	D
	878	906	869	874.1	869	871	U
	878	906	869.19	873	869.19	870.95	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Culvert #2		90.65	0	Highest U.S. EG	Pressure Flow
		89.73	0	Highest U.S. EG	Pressure Flow
Culvert #1		662.35	0	Highest U.S. EG	Low Flow
		663.27	0	Highest U.S. EG	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 6.389 This is Culvert #2
CV PF 01 Type of flow is pressure flow because,
1. EGEL 3 of 868.48 is less than or equal to MinTopRd of 869.71.
2. CulvWSIn of 861.00 is greater than or equal to MxLoCdU of 861.00.
3. CulvWSOut of 860.95 is greater than or equal to MxLoCdD of 860.95.

RS: 6.389 This is Culvert #1
CV LF 01 Type of flow is low flow because,
1. EGEL 3 of 868.48 is less than or equal to MinTopRd of 869.71.
2. EGEL 3 of 868.48 is less than MxLoCdD of 871.00.

RS: 6.389 This is Culvert #2
CV PF 01 Type of flow is pressure flow because,
1. EGEL 3 of 868.6 is less than or equal to MinTopRd of 874.36.
2. CulvWSIn of 861.00 is greater than or equal to MxLoCdU of 861.00.
3. CulvWSOut of 860.95 is greater than or equal to MxLoCdD of 860.95.

RS: 6.389 This is Culvert #1
CV LF 01 Type of flow is low flow because,
1. EGEL 3 of 868.6 is less than or equal to MinTopRd of 874.36.
2. EGEL 3 of 868.6 is less than MxLoCdU of 871.00.

DISTANCE CHECK

COLVERT COEFFICIENT CHECK

CULVERT CRITERIA CHECK

INEFFECTIVE FLOW CHECK

RS: 6.405 This is Section 4
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the areas beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 2 of
the upstream structure.

ok

RS: 6.317 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the area beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure.

FLOODWAY CHECK

RS: 6.389 This is Culvert
ST FW 01 Encroachment Method was not specified at this river station. NA
For flood insurance studies Encroachment Methods 4 and 1
should be used.

RS: 6.362 This is Section 2
ST FW 10 Left encroachment station 855.09 is more than the left ineffective flow
station 843 and less than the right ineffective flow station 941
Left encroachment station is within the effective flow area.
Left encroachment station should at least be equal to the left
ineffective flow station.

set to natural profile

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 5.779
TYPE OF STRUCTURE: Culvert

Description:	Springmill Road (STR 546)
Distance from Upstream XS:	23
Deck/Roadway Width:	64.66
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.98
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	5.862	324.75	863.84	0	863.93	307.45	
4	5.862	324.75	863.94	0.1	864.03	226.03	
3	5.801	128.19	863.31	0	863.49	79	
3	5.801	128.19	863.44	0.13	863.61	79	
	5.779	64.66	863.24	0	0	0	Culvert #1-Up
	5.779	40.53	863.23	0	0	0	Culvert #1-Dn
	5.779	64.66	863.37	0	0	0	Culvert #1-Up
	5.779	40.53	863.36	0	0	0	Culvert #1-Dn
2	5.777	148.63	863.21	0	863.4	54	
2	5.777	148.63	863.35	0.13	863.53	54	
1	5.749	92.23	862.9	0	863.18	112.43	
1	5.749	92.23	862.98	0.08	863.3	64.2	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	179	867	0	196	867
2	258	661.55	867	250	722.49	867

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LIfStaS	RIfStaS	
Culvert Group					179	258	U
					196	250	D
			0	0			U
			0	0			D

CULVERT:
Culvert Name: Culvert #1
Shape: Conspan Arch Rise: 10 Span: 28 Barrels: 1
FHWA Chart #: # 60- Span/Rise ratio approxi
FHWA Scale #: # 3 - 90 degree wing wall angle
Solution Crit: Highest U.S. EG

UpstrmDist:	23	Length:	64.66	n-Value:	0.013		
EntLossCoef:	0.5	ExtLossCoef:	1	CulvInvElU	854.89	CulvInvElD	854.84
LCntStaU:	215.24	RCntStaU:	215.24	LCntStaD	223.09	RCntStaD	223.09
Culvert Depth Blocked:	0						

Culv Area:	-9999	CulvQ:	753	MinTopRd:	867.01
	-9999		753		867.87

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Culvert #1	201.24	229.24	867.76	865.14	865.14	864.89	U
	209.09	237.09	867.97	865.81	865.81	864.84	D
	201.24	229.24	867.76	865.14	865.14	864.89	U
	209.09	237.09	867.97	865.81	865.81	864.84	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Culvert #1		753	0	Highest U.S. EG	Low Flow
		753	0	Highest U.S. EG	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 5.779 This is Culvert #1
CV LF 01 Type of flow is low flow because,
1. EGEL 3 of 863.49 is less than or equal to MinTopRd of 867.01.
2. EGEL 3 of 863.49 is less than MxLoCdU of 864.89.

RS: 5.779 This is Culvert #1
CV LF 01 Type of flow is low flow because,
1. EGEL 3 of 863.61 is less than or equal to MinTopRd of 867.87.
2. EGEL 3 of 863.61 is less than MxLoCdU of 864.89.

DISTANCE CHECK

CULVERT COEFFICIENT CHECK

CULVERT CRITERIA CHECK

INEFFECTIVE FLOW CHECK

RS: 5.749 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section. ok
Ineffective flow stations and elevations should be cleared from
this section, unless the area beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure.

FLOODWAY CHECK

RS: 5.779 This is Culvert
ST FW 01 Encroachment Method was not specified at this river station.
For flood insurance studies Encroachment Methods 4 and 1
should be used. NA

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 5.589
TYPE OF STRUCTURE: Bridge

Description:	131st Street
Distance from Upstream XS:	17
Deck/Roadway Width:	73
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	5.658	363.73	861.95	0	862.27	124.26	
4	5.658	363.73	862.01	0.06	862.35	63.26	
3	5.589	111.04	860.85	0	861.21	85.13	
3	5.589	111.04	860.86	0.01	861.23	85.13	
	5.583	73.00	860.41	0	861.05	56.6	Bridge #1-Up
	5.583	21.04	859.95	0	860.52	60	Bridge #1-Dn
	5.583	73.00	860.45	0.04	861.07	57.44	Bridge #1-Up
	5.583	21.04	860.03	0.09	860.67	60	Bridge #1-Dn
2	5.568	176.40	859.8	0	860.38	97	
2	5.568	176.40	859.92	0.12	860.44	97	
1	5.534	217.38	859.24	0	859.52	166.86	
1	5.534	217.38	859.38	0.14	859.67	91.49	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	618	863.5	0	593.5	863.5
2	712	1732	863.5	690.5	1717.12	863.5

BRIDGE:
Bridge Name: Bridge #1

```
LowFlowMethod:  Highest Energy Answer
Momentum Cd:      0
HighFlowMethod: Pressure and Weir flow
SluiceGate Cd: 0          Submerged Cd:   0.8
```

```
Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line
```

MaxLowChord:	861.98	MinTopRd:	863.51	MinBlPrs:	861.98
	861.98		864.77		861.98

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LftStaS	RtStaS	
Bridge					618	712	U
					593.5	690.5	D
			618	703.13			U
			618	703.13			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Bridge #1	635.00	695.00	862.59	863.00	862.59	861.98	U
	612.00	672.00	863.35	863.00	863.00	861.98	D
	635.00	695.00	864.80	864.76	864.76	861.98	U
	618.00	672.00	864.84	864.51	864.51	861.98	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	753	753	0	Energy only	Low Flow
	753	753	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

```
RS:        5.583 This is Bridge #1
BR LF 01   Type of flow is low flow because,
           1. EGEL 3 of 861.21 is equal to or less than MinTopRd of 863.5.
           2. EGEL 3 of 861.21 is less than MxLoCdU of 862.0.

RS:        5.583 This is Bridge #1
BR LF 01   Type of flow is low flow because,
           1. EGEL 3 of 861.23 is equal to or less than MinTopRd of 864.8.
           2. EGEL 3 of 861.23 is less than MxLoCdU of 862.0.
```

DISTANCE CHECK

INEFFECTIVE FLOW CHECK

```
RS:        5.534 This is Section 1
ST IF 07   Ineffective flow option was considered at this section.
           However, it should be a fully expanded cross section.
           Ineffective flow stations and elevations should be cleared from
           this section, unless the area beyond the ineffective flow stations
           are not within the flow path of the stream.
           This message should be ignored if this section is Section 3 of the downstream
           structure.
```

OK

FLOODWAY CHECK

```
RS:        5.583 This is Bridge
ST FW 01   Encroachment Method was not specified at this river station.
           For flood insurance studies Encroachment Methods 4 and 1
           should be used.
```

NA

```
RS:        5.589 This is Section 3
ST FW 10   Right encroachment station 703.13 is less than the right ineffective flow
           station 712 and greater than the left ineffective flow station 618
```

Set to limit of natural profile

Right encroachment station is within the effective flow area.
Right encroachment station should at least be equal to the right ineffective flow station.

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 5.021
TYPE OF STRUCTURE: Bridge

Description:	Dorset Dr.
Distance from Upstream XS:	20
Deck/Roadway Width:	32
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	5.077	274.07	854.93	0	855.21	228.66	
4	5.077	274.07	855.04	0.11	855.31	158.52	
3	5.025	76.64	854.63	0	854.74	114.5	
3	5.025	76.64	854.72	0.11	854.84	114.5	
	5.021	32.00	854.4	0	854.57	69.82	Bridge #1-Up
	5.021	24.64	854.32	0	854.6	69.73	Bridge #1-Dn
	5.021	32.00	854.52	0.12	854.78	69.95	Bridge #1-Up
	5.021	24.64	854.45	0.13	854.71	69.87	Bridge #1-Dn
2	5.011	157.12	854.35	0	854.51	94.5	
2	5.011	157.12	854.46	0.13	854.63	94.5	
1	4.981	305.91	854.11	0	854.29	221.26	
1	4.981	305.91	854.22	0.11	854.41	178.51	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	171	858.5	0	181	858
2	285.5	576.45	857	275.5	576.45	857

BRIDGE:
Bridge Name: Bridge #1
LowFlowMethod: Highest Energy Answer
Momentum Cd: 1.3
HighFlowMethod: Energy Only
SluiceGate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

---

MaxLowChord:	858.43	MinTopRd:	857.03	MinElPrs:	858.43
	858.43		860.73		858.43

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LIfStaS	RIfStaS	
Bridge					171	285.5	U
					181	275.5	D
			171	285.5			U
			171	285.5			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Bridge #1	190.46	265.54	858.00	857.03	857.03	858.43	U
	190.46	265.55	858.00	857.03	857.03	858.63	D
	190.46	265.54	860.50	860.61	860.50	858.43	U
	190.46	265.55	860.72	860.81	860.72	858.63	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	1280	1280	0	Energy only	Low Flow
	1280	1280	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 5.021 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 854.74 is equal to or less than MinTopRd of 857.0.
2. EGEL 3 of 854.74 is less than MxLoCdU of 858.4.

RS: 5.021 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 854.84 is equal to or less than MinTopRd of 860.7.
2. EGEL 3 of 854.84 is less than MxLoCdU of 859.4.

DISTANCE CHECK

INEFFECTIVE FLOW CHECK

RS: 4.981 This is Section 1
ST IF 07 Ineffective flow option was considered at this section,
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the area beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure.

ok

FLOODWAY CHECK

RS: 5.021 This is Bridge
ST FW 01 Encroachment Method was not specified at this river station.
For flood insurance studies Encroachment Methods 4 and 1
should be used.

NA

RIVER/REACH: Williams Creek, Hamilton Co OTP
RIVER STATION: 4.646
TYPE OF STRUCTURE: Bridge

Description:	Springmill Road (Str# 31)
Distance from Upstream XS:	27.5
Deck/Roadway Width:	33.25
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	Topwidth Actual	
4	4.709	303.93	852.37	0	852.42	396.88	
4	4.709	303.93	852.43	0.05	852.53	272.54	
3	4.651	97.93	851.94	0	852.15	103	
3	4.651	97.93	851.98	0.04	852.2	103	
	4.646	33.25	851.27	0	851.96	51.09	Bridge #1-Up
	4.646	37.18	850.69	0	851.62	47.59	Bridge #1-Dn
	4.646	33.25	851.34	0.07	852	51.54	Bridge #1-Up
	4.646	37.18	850.82	0.13	851.69	49.38	Bridge #1-Dn
2	4.633	157.97	850.73	0	851.2	89	
2	4.633	157.97	850.86	0.13	851.31	89	
1	4.603	169.86	850.5	0	850.67	107.91	
1	4.603	169.86	850.65	0.14	850.81	168.66	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	372	856.5	-86.52	378.48	856
2	475	893.99	856.5	467.48	752.43	855

```
BRIDGE:
Bridge Name:     Bridge #1
LowFlowMethod:   Highest Energy Answer
Momentum Cd:       1.2
HighFlowMethod: Energy Only
SluiceGate Cd: 0          Submerged Cd:    0

-----------------------------------------------------------------------------
Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line
-----------------------------------------------------------------------------

-----------------------------------------------------------------------------
MaxLowChord:    855.4     MinTopRd:  855.01          MinElPrs:        855.4
                855.4                855.37                           855.4
-----------------------------------------------------------------------------

Opening Type        StagStaL    StagStaR  EncStaL    EncStaR    LIfStaS    RIfStaS
-----------------------------------------------------------------------------
Bridge                                                           372        475     U
                                                                 378.48     467.48  D
                                          372        475                           U
                                          372        475                           D
-----------------------------------------------------------------------------

                    LAbutSt     RAbutSt   LMnTpRd    RMnTpRd    MnTpRd     MxLoCd
-----------------------------------------------------------------------------
Bridge #1           395.01      454.99    856.00     855.00     856.00     855.40  U
                    396.01      455.99    856.10     855.00     855.00     855.40  D
                    395.01      454.99    856.10     855.29     855.29     855.40  U
                    396.01      455.99    856.10     855.36     855.36     855.40  D
-----------------------------------------------------------------------------

Name            Q Total.  Q Struc   Q Weir    Selected Method      Flow Type
-----------------------------------------------------------------------------
Bridge #1       1280      1280      0         Energy only          Low Flow
                1280      1280      0         Energy only          Low Flow
-----------------------------------------------------------------------------

GEOMETRIC CHECK
---------------

TYPE OF FLOW CHECK
------------------

RS:        4.646 This is Bridge #1
BR LF 01   Type of flow is low flow because,
           1. EGEL 3 of 852.15 is equal to or less than MinTopRd of 855.0.
           2. EGEL 3 of 852.15 is less than MxLoCdU of 855.4.

RS:        4.646 This is Bridge #1
BR LF 01   Type of flow is low flow because,
           1. EGEL 3 of 852.2 is equal to or less than MinTopRd of 855.4.
           2. EGEL 3 of 852.2 is less than MxLoCdU of 855.4.

DISTANCE CHECK
--------------

INEFFECTIVE FLOW CHECK
----------------------

RS:        4.693 This is Section 1
ST IF 07   Ineffective flow option was considered at this section.
           However, it should be a fully expanded cross section.
           Ineffective flow stations and elevations should be cleared from
           this section, unless the area beyond the ineffective flow stations
           are not within the flow path of the stream.
           This message should be ignored if this section is Section 3 of the downstream
           structure.

FLOODWAY CHECK
--------------

RS:        4.646 This is Bridge
ST FW 01   Encroachment Method was not specified at this river station.
           For flood insurance studies Encroachment Methods 4 and 1
           should be used.
```

ok

NA

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 4.213
TYPE OF STRUCTURE: Bridge

Description:	Springmill Road (North of N. Creekwood Lane, Str
Distance from Upstream XS:	30
Deck/Roadway Width:	40
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	4.274	288.41	848.95	0	848.97	402.5	
4	4.274	288.41	848.95	0	848.97	306.14	
3	4.219	100.25	848.66	0	848.84	89.86	
3	4.219	100.25	848.65	-0.01	848.84	89.79	
	4.213	40.00	847.38	0	848.49	37.7	Bridge #1-Up
	4.213	29.25	845.76	0	847.49	31.62	Bridge #1-Dn
	4.213	40.00	847.37	-0.02	848.49	37.64	Bridge #1-Up
	4.213	29.25	845.79	0.02	847.5	31.73	Bridge #1-Dn
2	4.2	178.08	845.03	0	846.74	70.00	
2	4.2	178.08	845.86	0.03	846.75	70.25	
1	4.167	296.14	845.2	0	845.59	299.01	
1	4.167	296.14	845.32	0.12	845.67	200	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	239.99	851.5	0	463.6	851
2	346	860.22	849.2	545.5	1088.83	848.5

BRIDGE:
Bridge Name: Bridge #1
LowFlowMethod: Highest Energy Answer
Momentum Cd: 0
HighFlowMethod: Energy Only
Sluicegate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord:	849.67	MinTopRd:	849.21	MinElPrs:	849.67
	849.67		850.08		849.67

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LIfStaS	RIfStaS	
Bridge					239.99	346	U
					463.5	545.5	D
			256.14	346			U
			256.14	346			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Bridge #1	271.00	315.00	851.00	848.00	848.00	849.67	U
	478.00	522.00	851.00	848.00	848.00	849.67	D
	-9999.00	-9999.00	-9999.00	-9999.00	-9999.00	-9999.00	U
	478.00	522.00	851.00	850.07	850.07	849.67	D

Name	Q Total	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	1280	1280	0	Energy only	Low Flow

1280	1280	0	Energy only	UNKNOWN

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 4.213 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 848.84 is equal to or less than MinTopRd of 849.2.
2. EGEL 3 of 848.84 is less than MxLoCdU of 849.7.

RS: 4.213 This is Bridge #1
BR TF 01 Type of flow is UNKNOWN.
CHECKRAS can not find MxLoCd or MnTpRd elevation
or the given conditions do not satisfy the type of flow
specified in the CHECK-RAS program.
Please review the ground and road data, and encroachment stations.
or please review the messages, BR LF 01, BR PF 01, BR PF 02, BR LW 01
BR PW 01 for bridges to determine the type of flow.

Low Flow

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 2.801
TYPE OF STRUCTURE: Bridge

Description:	116th
Distance from Upstream XS:	49
Deck/Roadway Width:	35
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	2.86	258.80	830.44	0	830.75	334.96	
4	2.86	258.80	830.51	0.06	830.84	185.93	
3	2.011	124.94	830.13	0	830.34	154.35	
3	2.011	124.94	830.22	0.09	830.42	154.33	
	2.801	35.00	829.85	0	830.22	73.62	Bridge #1-Up
	2.801	40.94	829.76	0	830.15	72.37	Bridge #1-Dn
	2.801	35.00	829.95	0.1	830.3	74.06	Bridge #1-Up
	2.801	40.94	829.86	0.1	830.24	72.82	Bridge #1-Dn
2	2.787	180.02	829.72	0	830.05	91.99	
2	2.787	180.02	829.82	0.1	830.14	91.99	
1	2.753	536.24	829.16	0	829.62	178.21	
1	2.753	536.24	829.27	0.12	829.73	152.83	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	176	646.879	834.5	0	58	833
				161	659.46	833

BRIDGE:
Bridge Name: Bridge #1
LowFlowMethod: Highest Energy Answer
Momentum Cd: 0
HighFlowMethod: Pressure and Weir flow
SluiceGate Cd: 0 Submerged Cd: 0.8

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord:	833.09	MinTopRd:	833.51	MinElPrs:	833.09
	833.09		833.81		833.09

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LlfStaS	RlfStaS	
Bridge						176	U
					58	161	D
			29	176			U
			29	176			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Bridge #1	19.00	97.00	837.09	839.50	833.50	833.09	U
	64.00	142.00	837.09	839.50	833.50	833.09	D
	69.01	97.00	837.59	838.53	833.53	830.62	U
	69.01	142.00	837.59	838.80	833.80	831.71	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	2000	2000	0	Energy only	Low Flow
	2000	2000	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 2.801 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 830.34 is equal to or less than MinTopRd of 833.5.
2. EGEL 3 of 830.34 is less than MxLoCdU of 833.1.

RS: 2.801 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 830.42 is equal to or less than MinTopRd of 833.8.
2. EGEL 3 of 830.42 is less than MxLoCdU of 830.6.

DISTANCE CHECK

INEFFECTIVE FLOW CHECK

RS: 2.811 This is Section 3
ST IF 01 Pressure or low flow occurs at Bridge
However, left ineffective flow station was not considered at Section 3.
The ineffective flow station(s) and elevations should be inserted.

ineffective would be located inside high ground in LOB.

RS: 2.86 This is Section 4
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the areas beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 2 of
the upstream structure.

JK

RS: 2.753 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the area beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure.

JK

FLOODWAY CHECK

RS: 2.801 This is Bridge
ST FW 01 Encroachment Method was not specified at this river station.
For flood insurance studies Encroachment Methods 4 and 1
should be used.

NA

RS: 2.787 This is Section 2
ST FW 04 The left encroachment station of 69.01 is greater than the
left bank station of 64
The left encroachment station is within the channel.
The encroachment station and/or channel bank station should be reevaluated.

Fixed

RS: 2.787 This is Section 2

ST FW 10 Left encroachment station 69.01 is more than the left ineffective flow station 58 and less than the right ineffective flow station 161
Left encroachment station is within the effective flow area.
Left encroachment station should at least be equal to the left ineffective flow station.

Set to banks

RS: 2.811 This is Section 3
ST FW 03 The left station effective of 18.02 for the natural profile is less than left most abutment station of 18.99898
The 1% annual chance floodplain is outside the structure opening area.
The left encroachment station of 19 is greater than the left abutment station of 18.99898
The encroachment station should be recomputed.

Set to banks

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 1.369
TYPE OF STRUCTURE: Bridge

Description:	106th Street
Distance from Upstream XS:	20
Deck/Roadway Width:	29
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir Crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	1.419	245.16	811.93	0	812.33	172.26	
4	1.419	245.16	812.01	0.08	812.43	87.58	
3	1.373	86.44	811.5	0	811.88	138.85	
3	1.373	86.44	811.61	0.1	811.97	134.47	
	1.369	29.00	811.24	0	811.79	103.12	Bridge #1-Up
	1.369	37.44	811.08	0	811.68	102.57	Bridge #1-Dn
	1.369	29.00	811.35	0.12	811.88	103.55	Bridge #1-Up
	1.369	37.44	811.21	0.13	811.78	103.03	Bridge #1-Dn
2	1.356	418.19	811.05	0	811.49	146.03	
2	1.356	418.19	811.18	0.13	811.6	142.06	
1	1.277	418.33	810.04	0	810.58	147.24	
1	1.277	418.33	810.09	0.05	810.67	59.9	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	595	814.5	0	635	814.5
2	802	1039.42	821.5	787	1039.42	821.5

BRIDGE:
Bridge Name: Bridge #1
LowFlowMethod: Highest Energy Answer
Momentum Cd: 1.2
HighFlowMethod: Pressure and Weir flow
SluiceGate Cd: 0 Submerged Cd: 0.8

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

---

MaxLowChord:	819.09	MinTopRd:	814.51	MinElPrs:	819.09
	819.09		816.16		819.09

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LlfStaS	RlfStaS	
Bridge					635	802	U
					635	787	D
			635	769.47			U
			635	769.47			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Bridge #1	651.83	784.18	814.00	816.59	814.00	819.09	U
	649.89	782.22	814.00	816.59	814.00	819.09	D
	651.83	777.06	816.09	816.59	816.09	818.76	U
	649.89	777.06	816.15	816.59	816.15	818.92	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	2480	2480	0	Energy only	Low Flow
	2480	2480	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 1.369 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 811.88 is equal to or less than MinTopRd of 814.5.
2. EGEL 3 of 811.88 is less than MxLoCdU of 819.1.

RS: 1.369 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 811.97 is equal to or less than MinTopRd of 816.2.
2. EGEL 3 of 811.97 is less than MxLoCdU of 818.8.

DISTANCE CHECK

INEFFECTIVE FLOW CHECK

RS: 1.419 This is Section 4
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the areas beyond the ineffective flow stations ok
are not within the flow path of the stream.
This message should be ignored if this section is Section 2 of
the upstream structure.

RS: 1.277 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the area beyond the ineffective flow stations ok
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure.

FLOODWAY CHECK

RS: 1.369 This is Bridge
ST FW 01 Encroachment Method was not specified at this river station. NA
For flood insurance studies Encroachment Methods 4 and 1
should be used.

RS: 1.356 This is Section 2
ST FW 10 Right encroachment station 777.06 is less than the right ineffective flow
station 787 and greater than the left ineffective flow station 635 set to banks
Right encroachment station is within the effective flow area.
Right encroachment station should at least be equal to the right
ineffective flow station.

RS: 1.373 This is Section 3
ST FW 10 Right encroachment station 769.47 is less than the right ineffective flow
station 802 and greater than the left ineffective flow station 635 ineffective on high ground
Right encroachment station is within the effective flow area.
Right encroachment station should at least be equal to the right
ineffective flow station.

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 1.105
TYPE OF STRUCTURE: Inline

Description: In line dam south of 106th St. "Dan Simons Dam"

Distance from Upstream XS:	9
Deck/Roadway Width:	30
Weir Coefficient:	2.7
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	1.198	481.23	809.6	0	809.03	222.08	
4	1.198	481.23	809.62	0.03	809.08	164.51	
3	1.106	50.76	808.68	0	809.06	364.41	
3	1.106	50.76	808.81	0.14	809.14	296.03	
	1.105	30.00	808.68		809.06	0	Inline Weir-Up
	1.105	9.00				0	Inline Weir-Dn
	1.105	30.00	808.81	0	809.14	0	Inline Weir-Up
	1.105	9.00		0		0	Inline Weir-Dn
2	1.097	267.54	806.59	0	807.03	145.58	
2	1.097	267.54	806.72	0.13	807.17	68.31	
1	1.046	447.86	805.38	0	806.12	322.25	
1	1.046	447.86	805.49	0.11	806.26	75.39	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	645.07	809	0	319	808.94
2	960	1315.13	808	663	944.62	808

INLINE WEIR:
Inline Weir Gate:

Dist IWD:	9	Height:	0	Width	0	Invert:	0
Gate Coeff:	0	GateType:		TrunExp	0	OpenExp:	0
HeadExp:	0	TrunHght:	0	Weir Coeff:	0	WeirShape:	
GateNumber:	0						
LCntStaU:	0	RCntStaU:	0	LCntStaD	0	RCntStaD	0

MinTopRd:	804.6
	804.6

Gate ID	Gate # Open	Open Hght	Gate Q	Q Weir	Q Total	Flow Type
	807	3	808.22	2800	2800	Weir Flow
	0	830.44	0	2800	2800	Weir Flow

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LIfStaS	RIfStaS	
Inline					645.07	960	U
					319	-9999	D
Inline			0.00	0.00			U
			0.00	0.00			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
	0.00	0.00	804.59	804.59	804.59	0.00	U
	0.00	0.00	804.59	804.59	804.59	0.00	D
	0.00	0.00	804.59	804.59	804.59	0.00	U
	0.00	0.00	804.59	804.59	804.59	0.00	D

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 1.105
IW TF 01 Type of flow is Weir Flow because,
1. Gate Flow discharge is equal to 808.22
2. Weir Flow discharge is equal to 2800

RS: 1.105
IW TF 01 Type of flow is Weir Flow because,
1. Gate Flow discharge is equal to 0

2. Weir Flow discharge is equal to 2800

DISTANCE CHECK

INEFFECTIVE FLOW CHECK

RS: 1.106 This is Section 3
ST IF 02 Weir flow occurs at Inline
However, the ineffective flow elevation of 809 between stations 0
and 645.07 is equal to or greater than the WSEL of 808.68
The LMnTpRdU is 804.59
The ineffective flow elevation should be equal to or lower than the MnTpRd
It should also be less than the WSEL.

RS: 1.097 This is Section 2
ST IF 02 Weir flow occurs at Inline
However, the ineffective flow elevation of 809.94 between stations 0
and 319 is equal to or greater than the WSEL of 806.59
The LMnTpRdD is 804.59 and the MxLoCdD is 0
The ineffective flow elevation should be between the LMnTpRdD and the MxLoCdD
if LMnTpRdD is greater than MxLoCdD. Otherwise, It should be equal to LMnTpRdD.
It should also be less than the WSEL.

RS: 1.198 This is Section 4
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the areas beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 2 of
the upstream structure.

OK

RS: 1.046 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the area beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure.

RS: 1.106 This is Section 3
ST IF 09 'Permanent Ineffective Flow Areas' option is used.
HEC-RAS version 3.0.1 will compute higher water-surface elevation
than it should be computed if weir flow occurs at the structure.
Please disable this option.

RS: 1.097 This is Section 2
ST IF 09 'Permanent Ineffective Flow Areas' option is used.
HEC-RAS version 3.0.1 will compute higher water-surface elevation
than it should be computed if weir flow occurs at the structure.
Please disable this option.

FLOODWAY CHECK

RS: 1.106 This is Inline
ST FW 01 Encroachment Method was not specified at this river station.
For flood insurance studies Encroachment Methods 4 and 1
should be used.

NA

RS: 1.097 This is Section 2
ST FW 10 Left encroachment station 512.27 is more than the left ineffective flow
station 319 and equal to or greater than the right ineffective flow station -9999
The effective flow area is totally blocked by the encroachment
stations.
The encroachment stations should be adjusted.

OK

RS: 1.106 This is Section 3
ST FW 10 Left encroachment station 800 is more than the left ineffective flow
station 645.07 and less than the right ineffective flow station 960
Left encroachment station is within the effective flow area.
Left encroachment station should at least be equal to the left
ineffective flow station.

OK

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 0.273
TYPE OF STRUCTURE: Bridge

Description: I-465: Bridge data from design plans provided by
Distance from Upstream XS: 30

Deck/Roadway Width:	130
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	0.351	326.96	797.11	0	797.8	463.56	
4	0.351	326.96	797.11	0	797.55	175.19	
3	0.279	189.81	796.59	0	797.04	170.5	
3	0.279	189.81	796.65	0.06	797.09	170.5	
	0.273	130.00	796.26	0	796.92	66.48	Bridge #1-Up
	0.273	29.81	795.8	0	796.39	63.33	Bridge #1-Dn
	0.273	130.00	796.32	0.06	796.98	66.75	Bridge #1-Up
	0.273	29.81	795.89	0.09	796.45	63.69	Bridge #1-Dn
2	0.243	342.84	795.61	0	796.13	144.51	
2	0.243	342.84	795.7	0.09	796.2	144.51	
1	0.178	360.33	794.82	0	795.44	394.68	
1	0.178	360.33	794.94	0.12	795.55	398.5	

	Ineffective Flow, Section 3			Ineffective Flow, Section 2		
	Sta L	Sta R	Elev	Sta L	Sta R	Elev
1	0	477.01	805.69	149	490	805.69
2	647.51	859.24	805.19	634.51	1095.58	805.19

BRIDGE:
Bridge Name: Bridge #1
LowFlowMethod: Highest Energy Answer
Momentum Cd: 1.2
HighFlowMethod: Energy Only
SluiceGate Cd: 0 Submerged Cd: 0

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

MaxLowChord:	801.32	MinTopRd:	805.13	MinElPrs:	801.32
	801.32		805.2		801.32

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LTfStaS	RTfStaS	
Bridge					477.01	647.51	U
					490	634.51	D
			477.01	647.51			U
			477.01	647.51			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Bridge #1	507.01	617.49	805.19	804.32	804.32	801.32	U
	507.01	617.49	805.19	803.57	803.57	801.32	D
	507.01	617.49	805.19	805.11	805.11	801.32	U
	507.01	617.49	805.19	805.12	805.12	801.32	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	3100	3100	0	Energy only	Low Flow
	3100	3100	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 0.273 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 797.04 is equal to or less than MinTopRd of 805.1.
2. EGEL 3 of 797.04 is less than MxLoCdU of 801.3.

RS: 0.273 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 797.09 is equal to or less than MinTopRd of 805.2.
2. EGEL 3 of 797.09 is less than MxLoCdU of 801.3.

DISTANCE CHECK

INEFFECTIVE FLOW CHECK

RS: 0.178 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the area beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure.

ok

FLOODWAY CHECK

RS: 0.273 This is Bridge
ST FW 01 Encroachment Method was not specified at this river station.
For flood insurance studies Encroachment Methods 4 and 1
should be used.

NA

RIVER/REACH: Williams Creek, Hamilton Co CTP
RIVER STATION: 0.021
TYPE OF STRUCTURE: Bridge

Description:	96th Street. Bridge data taken from Marion Count
Distance from Upstream XS:	51
Deck/Roadway Width:	30.4
Weir Coefficient:	2.6
Maximum allowable submergence for weir flow:	0.95
Elevation at which weir flow begins:	0
Weir crest shape:	Broad Crested

Sec	River Station	Length Channel	WSEL	Surch.	EGEL	TopWidth Actual	
4	0.11	410.55	794.53	0	794.82	613.07	
4	0.11	418.55	794.58	0.05	794.92	251	
3	0.03	158.40	793.74	0	794.22	204	
3	0.03	158.40	793.73	-0.02	794.26	150	
	0.021	30.40	793.03	0	793.95	74.65	Bridge #1-Up
	0.021	77.00	792.9	0	793.7	74.1	Bridge #1-Dn
	0.021	30.40	793.12	0.09	794.01	75.02	Bridge #1-Up
	0.021	77.00	792.99	0.1	793.78	74.48	Bridge #1-Dn
2	0.0005	227.25	792.74	0	793.2	168.05	
2	0.0005	227.25	792.82	0.08	793.3	118.67	
1	0.0004	250.67	791.76	0	792.35	172.35	
1	0.0004	250.67	791.89	0.13	792.46	105.68	

	Ineffective Flow, Section 3 Sta L	Sta R	Elev	Ineffective Flow, Section 2 Sta L	Sta R	Elev
1	141	245	806	135	247	808
2	245	412	802	247	372	803
3	412	600	800	372	466	800.5
4	804	811	803.5	466	667.5	798.6
5	811	911	806	846.5	864	801.5
6	911	992	810	864	910	803
7	992	1076	814			
8	1076	1240	818			

BRIDGE:
Bridge Name: Bridge #1
LowFlowMethod: Highest Energy Answer
Momentum Cd: 1.2

HighFlowMethod: Pressure and Weir flow
SluiceGate Cd: 0 Submerged Cd: 0.8

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

---

MaxLowChord:	801.21	MinTopRd:	800.01	MinElPrs:	801.21
	801.21		800.54		801.21

Opening Type	StagStaL	StagStaR	EncStaL	EncStaR	LIfStaS	RIfStaS	
Bridge					600	804	U
					667.5	846.5	D
			630	780			U
			630	780			D

	LAbutSt	RAbutSt	LMnTpRd	RMnTpRd	MnTpRd	MxLoCd	
Bridge #1	650.97	753.04	800.00	803.30	800.00	801.21	U
	705.97	808.04	800.00	803.30	800.00	801.21	D
	684.66	753.04	804.42	803.30	803.30	801.21	U
	705.97	803.33	800.53	803.74	800.53	800.88	D

Name	Q Total.	Q Struc	Q Weir	Selected Method	Flow Type
Bridge #1	3480	3480	0	Energy only	Low Flow
	3480	3480	0	Energy only	Low Flow

GEOMETRIC CHECK

TYPE OF FLOW CHECK

RS: 0.021 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 794.22 is equal to or less than MinTopRd of 800.0.
2. EGEL 3 of 794.22 is less than MxLoCdU of 801.2.

RS: 0.021 This is Bridge #1
BR LF 01 Type of flow is low flow because,
1. EGEL 3 of 794.26 is equal to or less than MinTopRd of 800.5.
2. EGEL 3 of 794.26 is less than MxLoCdU of 801.2.

DISTANCE CHECK

INEFFECTIVE FLOW CHECK

RS: 0.0004 This is Section 1
ST IF 07 Ineffective flow option was considered at this section.
However, it should be a fully expanded cross section.
Ineffective flow stations and elevations should be cleared from
this section, unless the area beyond the ineffective flow stations
are not within the flow path of the stream.
This message should be ignored if this section is Section 3 of the downstream
structure. NA

FLOODWAY CHECK

RS: 0.021 This is Bridge
ST FW 01 Encroachment Method was not specified at this river station. NA
For flood insurance studies Encroachment Methods 4 and 1
should be used.

RS: 0.0005 This is Section 2
ST FW 03 The right station effective of 835.55 for the natural profile is greater than
right most abutment station of 808.0374
The right encroachment station of 803.33 is less than the
The 1% annual chance floodplain is outside the structure opening area. From Aaron Co. model

```
          right abutment station of 808.0374
          The encroachment station should be recomputed.

RS:       0.0005 This is Section 2
ST FW 10  Left encroachment station 694.66 is more than the left ineffective flow
          station 667.5 and less than the right ineffective flow station 846.5
          Left encroachment station is within the effective flow area.
          Left encroachment station should at least be equal to the left
          ineffective flow station.

RS:       0.0005 This is Section 2
ST FW 10  Right encroachment station 803.33 is less than the right ineffective flow
          station 846.5 and greater than the left ineffective flow station 667.5
          Right encroachment station is within the effective flow area.
          Right encroachment station should at least be equal to the right
          ineffective flow station.

RS:       0.03 This is Section 3
ST FW 10  Left encroachment station 630 is more than the left ineffective flow
          station 600 and less than the right ineffective flow station 804
          Left encroachment station is within the effective flow area.
          Left encroachment station should at least be equal to the left
          ineffective flow station.

RS:       0.03 This is Section 3
ST FW 10  Right encroachment station 700 is less than the right ineffective flow
          station 804 and greater than the left ineffective flow station 600
          Right encroachment station is within the effective flow area.
          Right encroachment station should at least be equal to the right
          ineffective flow station.

---END
```

matches Marion Co. model

Waterbody Name: _____
Preparer: _____
Date: _____

10. Floodways

Has floodway determination been done in accordance with Section 8.12 of the Guidelines?

☒ Yes ☐ No ☐ N/A

11. Model Output

For all model outputs review the "errors and warnings" and address those comments not already addressed.

See errors and warnings for any comments.

12. Documentation

Submitted documentation *(Check all that apply)*:

- ☒ Narrative regarding modeling
- ☐ Application Forms and/or LOMR Application Forms
- ☐ Pictures of stream reach *(w/ orientation map)*
- ☐ FIS map / profile
- ☐ Previous FARA/Floodway permits in study reach *(Including maps)*
- ☒ Check-RAS output
- ☒ Cross Section plots
- ☒ HEC-RAS "Standard Table 1"
- ☒ HEC-RAS "Encroachment 1" table *(Show where the 0.14' surcharge occurs)*
- ☒ Profile plots
- ☒ Summary of Modeling and Project Evaluation Results *(Mandatory – See Figure 3.1)*
- ☒ Floodplain mapping including:
  - ☒ Stream in question *(Along with other hydrographic features)*
  - ☒ Roads *(With street names)*
  - ☐ Existing features *(Buildings, parking lots, woods, etc)*

Waterbody Name: _____
Preparer: _____
Date: _____

- [x] The full extent of each cross section included in the model, with each cross section clearly labeled *(Include the location of initial and end points as used in the model)*
- [x] Contour topographic data *(If available)*
- [ ] Property limits *(Approximate property limits are acceptable only if surcharges are 0.14' or less at all cross sections)*
- [x] North arrow
- [x] Scale *(Numerical and graphical)*
- [ ] Horizontal and vertical control benchmark used *(See Section 5.4 of the Guidelines for benchmark guidance.)*
- [ ] Horizontal and vertical datums
- [x] Delineated flood fringe and floodway limits

  (The flood fringe and floodway should be shaded so that it is obvious to the reviewer what areas are flood fringe and floodway, but not shaded so dark that other features are obscured. For multi-colored plans, the Division of Water convention is to shade the flood fringe blue and the floodway yellow. See Section 8.12 of the Guidelines for delineation guidance.)

- [x] Disk with input data and model output *(Check all that apply)*
  - [ ] Base Condition (FIS, IDNR Regulatory) File name: _____
  - [ ] Duplicate Effective File name: _____
  - [ ] Corrected Effective File name: _____
  - [x] Existing (Pre-project) File name: Williams Creek Proposed FIS (WC.prj)
  - [ ] Proposed (Post-project) File name: _____

Waterbody Name: _____
Preparer: _____
Date: _____

13. Affirmation

By signing this document you are indicating that the submitted models have been developed and reviewed in accordance with accepted Division of Water procedures, that should the Division of Water find inconsistencies between your submitted models and the checklist, you will be notified in writing of the deficiencies and given 90 days to correct these problems; and that if after 90 days these inconsistencies still exist, you will be notified that your model is unacceptable and the Department will take no further action if the request is for a FARA, or issue a denial notice if the request is associated with a permit application.

10/14/09
Date:

Signature

Matthew W Mead
Name

Christopher B. Burke Engineering, LLC
Firm

Division of Water Use Only

Date Received _____ File Number _____

Reviewer _____ Date reviewed _____

☐ Approved ☐ Rejected

Section Manager Review _____

CHECK-RAS Program: Floodway Check
Encroachment Method, Starting WSEL, Floodway Width, and Surcharge Review

Project File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.prj
Plan File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.p05
Geometry File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.g05
Flow File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.f02
Report File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.fw
Selected profiles: 100yr,Floodway
Date: 10/14/2009
Time: 2:22:05 PM

SECNO	Method	Surcharge	EncStaL	EncStaR	LStaEff	RStaEff	Structure
Williams Creek,Hamilton Co CFP							
9.022					0	676.29	
9.022	0	-0.01	0	0	0	676.16	
8.943					0	424.7	
8.943	0	-0.01	0	0	0	424.56	
8.867					402	448	
8.867	0	-0.01	0	0	402	448	
8.863					0	0	Culvert #1-Up
8.863					0	0	Culvert #1-Dn
8.863	0	0	0	0	0	0	Culvert #1-Up
8.863	0	0	0	0	0	0	Culvert #1-Dn
8.744					688	712	
8.744	0	0.19	0	0	688	712	
8.658					51.06	455.43	
8.658	0	0.19	0	0	48.99	490.22	
8.554					119	243	
8.554	0	0.2	0	0	41.08	369.22	
8.542					0	0	Culvert #1-Up
8.542					0	0	Culvert #1-Dn
8.542	0	0	0	0	0	0	Culvert #1-Up
8.542	0	0	0	0	0	0	Culvert #1-Dn
8.51					281	333	
8.51	1	0.02	280	333	281	333	
8.392					202.75	337	
8.392	1	0	228.84	337	228.84	337	
8.38					290.87	312.08	
8.38	1	0.01	291.27	311.26	291.27	311.26	
8.371					302.25	355	
8.371	1	0.06	307.71	355	307.71	355	
8.342					255.61	465	
8.342	1	0.05	303.4	415.77	303.4	415.77	
8.266					297.41	415.22	
8.266	1	0.05	336.46	393.63	336.46	393.63	
8.236					45.49	134.72	
8.236	1	0.05	55	130.95	55	130.95	
8.21					0	0	Culvert #1-Up
8.21					0	0	Culvert #1-Dn
8.21	0	0	0	0	0	0	Culvert #1-Up
8.21	0	0	0	0	0	0	Culvert #1-Dn
8.194					67.44	135.02	
8.194	1	-0.02	83.19	128.81	83.19	128.81	
8.162					116.29	144.3	
8.162	1	0.06	116.29	144.3	116.29	144.3	
8.096					156.36	342.24	
8.096	1	0	169.2	333.64	169.2	333.64	
8.014					102.99	275.89	
8.014	1	0	120.96	267.68	120.96	267.68	
7.985					129.71	152.18	
7.985	1	0.02	137	153	129.65	152.22	
7.979					119.13	151.55	
7.979	1	0.06	120.41	150.41	120.41	150.41	
7.967					159.02	202.89	
7.967	1	0.07	159.02	202.89	159.02	202.89	
7.961					0	0	Culvert #1-Up
7.961					0	0	Culvert #1-Dn
7.961	0	0	0	0	0	0	Culvert #1-Up
7.961	0	0	0	0	0	0	Culvert #1-Dn
7.952					225.49	246.3	
7.952	1	0.1	226.66	246.68	226.66	246.68	
7.917					283.94	370.57	
7.917	1	0.13	286.9	329.77	286.9	329.77	
7.797					168.54	286.08	
7.797	1	0.14	171.06	257.68	171.06	257.68	
7.77					244.41	414.06	
7.77	1	0.14	261.41	368.8	261.41	368.8	
7.726					237.42	519.6	
7.726	1	0.1	381.13	515.92	381.13	515.92	
7.633					52.43	397.86	
7.633	1	0.05	121.3	331.82	121.3	331.82	
7.529					398	474.63	

7.527	1	0.05	398	474.63	398	474.63	
7.52					435.93	463.04	Bridge #1-Up
7.52					269.96	297.09	Bridge #1-Dn
7.52	0	0.07	398	474.63	435.93	463.04	Bridge #1-Up
7.52	0	0.11	260	307	269.96	297.09	Bridge #1-Dn
7.51					260	307	
7.51	1	0.1	260	307	260	307	
7.472					121.85	364.83	
7.472	1	0.1	197.22	324.75	197.22	324.75	
7.435					147.84	428.84	
7.435	1	0.1	249.59	392.16	249.59	392.16	
7.35					323.34	493.94	
7.35	1	0.11	331.22	455.42	331.22	455.42	
7.325					139	432.48	
7.325	1	0.12	199.39	370.82	199.39	370.82	
7.288					860	1054.05	
7.288	1	0.12	660	920	660	920	
7.285					0	0	Culvert #1-Up
7.285					0	0	Culvert #1-Dn
7.285	0	0	0	0	0	0	Culvert #1-Up
7.285	0	0	0	0	0	0	Culvert #1-Dn
7.285					0	0	Culvert #2-Up
7.285					0	0	Culvert #2-Dn
7.285	0	0	0	0	0	0	Culvert #2-Up
7.285	0	0	0	0	0	0	Culvert #2-Dn
7.272					265	687.15	
7.272	1	0.05	330	588.89	330	588.89	
7.24					360	582.68	
7.24	1	0.04	360	556.41	360	556.41	
7.164					447.98	503.22	
7.164	1	0.06	447.98	503.22	447.98	503.22	
7.159					474	503	Bridge #1-Up
7.159					410	439	Bridge #1-Dn
7.159	0	0.09	447.98	503.22	474	503	Bridge #1-Up
7.159	0	0.14	398.48	450.52	410	439	Bridge #1-Dn
7.147					398.48	450.52	
7.147	1	0.13	398.48	450.52	398.48	450.52	
7.111					306	453.64	
7.111	1	0.13	328	445.41	328	445.41	
7.057					253.05	635.34	
7.057	1	0.09	365	600	365	600	
6.998					79.91	250.87	
6.998	1	0.06	137.51	245	137.51	245	
6.893					136.61	287.73	
6.893	1	0.09	166.16	287.73	166.16	287.73	
6.812					249.71	407.69	
6.812	1	0.1	281.3	382.19	281.3	382.19	
6.717					109.98	345.69	
6.717	1	0.07	144.25	279.24	144.25	279.24	
6.647					109.04	396.49	
6.647	1	0.07	139.05	260.88	139.05	260.88	
6.587					288	382	
6.587	1	0.09	288	382	288	382	
6.582					314.76	355.49	Bridge #1-Up
6.582					545.8	586.98	Bridge #1-Dn
6.582	0	0.09	288	382	314.76	355.49	Bridge #1-Up
6.582	0	0.09	543.91	591.65	545.8	586.98	Bridge #1-Dn
6.569					543.91	591.65	
6.569	1	0.09	543.91	591.65	543.91	591.65	
6.567					0	0	Culvert #1-Up
6.567					0	0	Culvert #1-Dn
6.567	0	0	0	0	0	0	Culvert #1-Up
6.567	0	0	0	0	0	0	Culvert #1-Dn
6.549					575.9	615.3	
6.549	1	0.1	576.11	615.3	576.11	615.3	
6.483					662.58	870.87	
6.483	1	0.14	710	850	710	850	
6.453					414.25	706.27	
6.453	1	0.08	530	680	530	680	
6.405					585.77	751.43	
6.405	1	0.13	645	740	645	740	
6.396					863	921	
6.396	1	0.12	863	921	863	921	
6.389					0	0	Culvert #2-Up
6.389					0	0	Culvert #2-Dn
6.389	0	0	0	0	0	0	Culvert #2-Up
6.389	0	0	0	0	0	0	Culvert #2-Dn
6.389					0	0	Culvert #1-Up
6.389					0	0	Culvert #1-Dn
6.389	0	0	0	0	0	0	Culvert #1-Up
6.389	0	0	0	0	0	0	Culvert #1-Dn
6.362					855.09	941	
6.362	1	0.12	855.09	941	855.09	941	
6.317					686.57	824.39	
6.317	1	0.07	759.35	801.37	759.35	801.37	

6.274					565.2	747	
6.274	1	0.08	587.3	672.42	587.3	672.42	
6.159					539.44	800.13	
6.159	1	0.14	610	770	610	770	
6.087					69.96	468.6	
6.087	1	0.09	200	440	200	440	
6.032					559.44	768.60	
6.032	1	0.08	560	709.29	560	709.29	
5.949					132.58	548.60	
5.949	1	0.08	160.39	419.72	160.39	419.72	
5.915					127.04	540.11	
5.915	1	0.07	174	436.6	174	436.6	
5.908					151.92	554.84	
5.908	1	0.07	202	446.75	202	446.75	
5.862					200.08	507.53	
5.862	1	0.05	203.06	429.09	203.06	429.09	
5.801					179	258	
5.801	1	0.05	179	258	179	258	
5.779					0	0	Culvert #1-Up
5.779					0	0	Culvert #1-Dn
5.779	0	0	0	0	0	0	Culvert #1-Up
5.779	0	0	0	0	0	0	Culvert #1-Dn
5.777					196	250	
5.777	1	0.06	196	250	196	250	
5.749					238.83	351.27	
5.749	1	0.1	238.83	347	238.83	347	
5.731					225.84	307.1	
5.731	1	0.11	239.79	302	239.79	302	
5.704					99.66	346.86	
5.704	1	0.09	174.77	303.76	174.77	303.76	
5.658					46.71	170.97	
5.658	1	0.06	71.67	135.23	71.67	135.23	
5.589					618	703.13	
5.589	1	0.01	618	703.13	618	703.13	
5.583					638	691.6	Bridge #1-Up
5.583					612	672	Bridge #1-Dn
5.583	0	0.04	618	703.13	635	692.44	Bridge #1-Up
5.583	0	0.09	593.5	690.5	612	672	Bridge #1-Dn
5.568					593.5	690.5	
5.568	1	0.12	593.5	690.5	593.5	690.5	
5.534					325.21	392.07	
5.534	1	0.14	271.99	363.48	271.99	363.48	
5.493					84.92	379.62	
5.493	1	0.1	120	323.86	120	323.86	
5.47					71.21	435.61	
5.47	1	0.11	104.53	358.65	104.53	358.65	
5.422					73.6	587.29	
5.422	1	0.13	110.94	489.06	110.94	489.06	
5.377					49.11	435.76	
5.377	1	0.12	105.29	389.73	105.29	389.73	
5.34					55.61	305.3	
5.34	1	0.13	89.61	358.44	89.61	358.44	
5.255					76.62	350.53	
5.255	1	0.14	144.55	347.07	144.55	347.07	
5.152					105.84	334.33	
5.152	1	0.09	138.9	290.26	138.9	290.26	
5.125					103.24	329.33	
5.125	1	0.09	150.1	286.67	150.1	286.67	
5.077					283.61	512.27	
5.077	1	0.11	288.81	447.33	288.81	447.33	
5.025					171	285.5	
5.025	1	0.11	171	285.5	171	285.5	
5.021					192.33	263.15	Bridge #1-Up
5.021					192.37	263.1	Bridge #1-Dn
5.021	0	0.12	171	285.5	192.27	263.22	Bridge #1-Up
5.021	0	0.13	181	275.5	192.31	263.18	Bridge #1-Dn
5.011					181	275.5	
5.011	1	0.13	181	275.5	181	275.5	
4.981					285.74	507	
4.981	1	0.11	307.41	485.92	307.41	485.92	
4.923					283.42	702.09	
4.923	1	0.12	325.37	544.45	325.37	544.45	
4.777					264.02	558.6	
4.777	1	0.12	314.94	552.95	314.94	552.95	
4.709					180.92	579.81	
4.709	1	0.05	247.46	520	247.46	520	
4.651					372	475	
4.651	1	0.04	372	475	372	475	
4.646					398.45	451.56	Bridge #1-Up
4.646					401.2	450.8	Bridge #1-Dn
4.646	0	0.07	372	475	398.23	451.77	Bridge #1-Up
4.646	0	0.13	378.48	467.48	400.81	451.19	Bridge #1-Dn
4.633					378.48	467.48	
4.633	1	0.13	378.48	467.48	378.48	467.48	
4.603					201.69	389	

4.603	1	0.14	220.39	389	220.34	389	
4.591					78.42	331.89	
4.571	1	0.08	90.58	280	90.58	280	
4.543					117.72	340.42	
4.543	1	0.07	142.05	313.21	142.05	313.21	
4.513					53.73	285.77	
4.513	1	0.04	98.46	250.64	90.46	250.64	
4.447					176.51	556.96	
4.447	1	0.03	250.57	513.73	250.57	513.73	
4.313					81.92	487.19	
4.313	1	0	122.26	416.94	122.26	416.94	
4.274					123.38	525.87	
4.274	1	0	141.77	447.91	141.77	447.91	
4.219					256.14	346	
4.219	1	-0.01	256.14	346	256.21	346	
4.213					273.14	312.85	Bridge #1-Up
4.213					483.18	516.8	Bridge #1-Dn
4.213	0	-0.01	266.14	346	273.17	312.82	Bridge #1-Up
4.213	0	0.02	475	545.5	483.14	516.84	Bridge #1-Dn
4.2					476.42	545.5	
4.2	1	0.02	475	545.5	475.29	645.5	
4.167					71.74	370.75	
4.167	1	0.1	75	275	75	275	
4.111					96.31	330.18	
4.111	1	0.08	101.44	250.42	101.44	250.42	
3.977					154.24	471.04	
3.977	1	0.08	199.75	427	199.75	427	
3.871					333.58	556.2	
3.871	1	0.11	376.88	615.72	376.88	615.72	
3.785					353.05	688.67	
3.785	1	0.11	419.62	619.71	419.62	619.71	
3.729					484.4	774.05	
3.729	1	0.12	505.09	696.98	505.09	696.98	
3.651					475.28	715.12	
3.651	1	0.1	500.36	632.95	500.36	632.95	
3.582					237.86	602.48	
3.582	1	0.14	314.44	525.6	314.44	525.6	
3.494					138.99	682.59	
3.494	1	0.14	190	658.14	190	658.14	
3.326					134.49	442.72	
3.326	1	0.1	153.8	401.37	153.8	401.37	
3.245					77.84	431.84	
3.245	1	0.09	80	340	80	340	
3.127					54.17	354.08	
3.127	1	0.09	60	250	60	250	
2.921					31.5	427.49	
2.921	1	0.09	33.12	110	33.12	110	
2.86					89.66	374.61	
2.86	1	0.06	118.85	304.78	118.85	304.78	
2.811					18.02	176	
2.811	1	0.08	19	176	21.7	176	
2.801					23.38	97	Bridge #1-Up
2.801					69.63	142	Bridge #1-Dn
2.801	0	0.09	19	176	22.97	97	Bridge #1-Up
2.801	0	0.09	64	161	69.21	142	Bridge #1-Dn
2.787					69.01	161	
2.787	1	0.1	64	161	68.56	161	
2.753					98.79	277	
2.753	1	0.1	124.17	277	124.17	277	
2.652					28.86	473.94	
2.652	1	0.12	31.62	380	31.62	380	
2.584					211.69	486.72	
2.584	1	-0.01	265	455	265	455	
2.572					257.83	502.25	
2.572	1	0.05	295	470.13	295	470.13	
2.525					183.84	459.77	
2.525	1	0.09	226	410.18	226	410.18	
2.434					261.13	537.75	
2.434	1	0.08	345.68	536.56	345.68	536.56	
2.401					364.83	734.55	
2.401	1	0.07	487.61	734.3	487.61	734.3	
2.263					233.27	555.17	
2.263	1	0.01	275.95	515	275.95	515	
2.202					92.96	463.22	
2.202	1	0.02	110	461.87	110	461.87	
2.09					83.46	317.34	
2.09	1	0.11	85	305	85	305	
2.033					137.09	390.44	
2.033	1	0.11	165	387.79	165	387.79	
1.976					118.5	378.46	
1.976	1	0.1	155	340	155	340	
1.922					153.05	511.85	
1.922	1	0.11	170	416.69	170	416.69	
1.816					58.33	479	
1.816	1	0.09	78.39	409.76	78.39	409.76	

1.641					125.72	546.15	
1.641	1	0.04	141.02	438.73	141.02	438.73	
1.603					56.24	368.01	
1.603	1	0.12	57	235	57	235	
1.492					179.56	349.18	
1.492	1	0.12	181.63	300	181.63	300	
1.419					239.71	411.98	
1.419	1	0.07	310.48	398.03	310.48	398.03	
1.373					635	773.89	
1.373	1	0.09	635	769.47	635	769.47	
1.369					651.93	766.06	Bridge #1-Up
1.369					649.96	763.77	Bridge #1-Dn
1.369	0	0.1	635	769.47	651.92	766.26	Bridge #1-Up
1.369	0	0.12	635	777.06	649.93	763.99	Bridge #1-Dn
1.356					635	781.03	
1.356	1	0.12	635	777.06	635	777.06	
1.277					397.59	544.84	
1.277	1	0.03	481.42	541.32	481.42	541.32	
1.198					501.57	723.65	
1.198	1	0.02	522	706.06	522	706.06	
1.106					754.72	1119.14	
1.106	1	0.14	800	1096.03	800	1096.03	
1.105					0	0	Inline Weir-Up
1.105					0	0	Inline Weir-Dn
1.105	0	0	0	0	0	0	Inline Weir-Up
1.105	0	0	0	0	0	0	Inline Weir-Dn
1.097					483.89	629.47	
1.097	1	0.12	512.27	580.58	512.27	580.58	
1.046					352	674.25	
1.046	1	0.1	533.86	609.25	533.86	609.25	
0.962					236.05	679.41	
0.962	1	0.12	282.01	441.63	282.01	441.63	
0.856					118.05	684.82	
0.856	1	-0.01	299.75	493	299.75	493	
0.807					142.31	600.41	
0.807	1	0.01	239.65	379.62	239.65	379.62	
0.73					310	638.25	
0.73	1	0.08	330.16	613.26	330.16	613.26	
0.666					122.18	232.92	
0.666	1	0.1	140	200	140	200	
0.58					177.57	308.42	
0.58	1	0.14	185.11	295	185.11	295	
0.474					163.81	567.07	
0.474	1	0.1	184.79	534.33	184.79	534.33	
0.375					78.52	609.83	
0.375	1	0	250	466.17	250	466.17	
0.351					88.92	552.49	
0.351	1	0	258.43	433.62	258.43	433.62	
0.279					477.01	647.51	
0.279	1	0.06	477.01	647.51	477.01	647.51	
0.273					527.31	597.79	Bridge #1-Up
0.273					528.97	596.19	Bridge #1-Dn
0.273	0	0.06	477.01	647.51	527.18	597.92	Bridge #1-Up
0.273	0	0.09	490	634.51	528.69	596.37	Bridge #1-Dn
0.243					490	634.51	
0.243	1	0.09	490	634.51	490	634.51	
0.178					193.22	588	
0.178	1	0.12	289.5	588	289.5	588	
0.11					143.64	756.92	
0.11	1	0.05	391	642	391	642	
0.03					600	804	
0.03	1	-0.02	630	780	630	780	
0.021					650.99	753.02	Bridge #1-Up
0.021					705.98	808.02	Bridge #1-Dn
0.021	0	0.08	630	780	650.99	753.02	Bridge #1-Up
0.021	0	0.09	684.66	803.33	705.98	798.63	Bridge #1-Dn
0.0005					684.66	829.34	
0.0005	1	0.09	684.66	803.33	684.66	803.33	
0.0004					390	656.3	
0.0004	1	0.13	532.82	638.5	532.82	638.5	
0.0003					930	912.67	
0.0003	1	0.14	577.75	876.65	577.75	876.65	
0.0002					318.47	643.25	
0.0002	1	0.14	343.27	566.85	343.27	566.85	
0.0001					240.57	605	
0.0001	1	0.1	242.54	436.86	242.54	436.86	

ENCROACHMENT METHOD CHECK

RS: 9.022
FW RM 01 Floodway encroachment method is not selected at this section. within 1 sq mi limits

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RS:        8.943
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        8.867
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        8.863
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        8.744
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        8.658
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        8.554
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        8.542
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        8.31
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        7.961
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        7.52
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        7.285
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        7.286
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        7.159
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        6.503
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        6.567
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        6.389
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        6.389
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        5.779
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        5.583
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        5.021
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        4.646
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        4.213
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        2.801
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        1.369
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        1.105
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        0.273
FW EM 01   Floodway encroachment method is not selected at this section.

RS:        0.021
FW EM 01   Floodway encroachment method is not selected at this section.
```

Less than 1 mi²

Not applicable

FLOODWAY WIDTH CHECK

RS: 9.022
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 9.022
FW FW 03 The right channel bank station may not be at the proper location.

RS: 8.943
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 8.943
FW FW 03 The right channel bank station may not be at the proper location.

RS: 8.867
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 8.867
FW FW 03 The right channel bank station may not be at the proper location.

RS: 8.744
FW FW 03 The right channel bank station may not be at the proper location.

RS: 8.650
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 8.688
FW FW 03 The right channel bank station may not be at the proper location.

RS: 8.554
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 8.554
FW FW 03 The right channel bank station may not be at the proper location.

RS: 8.392
FW FW 03 The right channel bank station may not be at the proper location.

RS: 8.38
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 8.38
FW FW 03 The right channel bank station may not be at the proper location.

RS: 8.371
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 8.266
FW FW 03 The right channel bank station may not be at the proper location.

RS: 8.194
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 8.096
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 8.096
FW FW 03 The right channel bank station may not be at the proper location.

RS: 8.014
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 8.014
FW FW 03 The right channel bank station may not be at the proper location.

RS: 7.979

OK

FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.967
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.952
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.917
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.797
FW FW 03 The right channel bank station may not be at the proper location.

RS: 7.633
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.527
FW FW 03 The right channel bank station may not be at the proper location.

RS: 7.51
FW FW 03 The right channel bank station may not be at the proper location.

RS: 7.435
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.35
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.35
FW FW 03 The right channel bank station may not be at the proper location.

RS: 7.325
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.285
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.164
FW FW 03 The right channel bank station may not be at the proper location.

RS: 7.147
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.111
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 7.111
FW FW 03 The right channel bank station may not be at the proper location.

RS: 6.812
FW FW 03 The right channel bank station may not be at the proper location.

RS: 6.587
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 6.587
FW FW 03 The right channel bank station may not be at the proper location.

RS: 6.569
FW FW 03 The right channel bank station may not be at the proper location.

RS: 6.483
FW FW 03 The Left channel bank station may not be at the proper

OK

location.

RS: 6.453
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 6.453
FW FW 03 The right channel bank station may not be at the proper location.

RS: 6.396
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 6.274
FW FW 03 The right channel bank station may not be at the proper location.

RS: 5.777
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 5.777
FW FW 03 The right channel bank station may not be at the proper location.

RS: 5.749
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 5.731
FW FW 03 The right channel bank station may not be at the proper location.

RS: 5.704
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 5.589
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 5.422
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 5.377
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 5.377
FW FW 03 The right channel bank station may not be at the proper location.

RS: 5.255
FW FW 03 The right channel bank station may not be at the proper location.

RS: 5.125
FW FW 03 The right channel bank station may not be at the proper location.

RS: 5.025
FW FW 03 The right channel bank station may not be at the proper location.

RS: 5.011
FW FW 03 The right channel bank station may not be at the proper location.

RS: 4.651
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 4.633
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 4.447
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 4.2
FW FW 03 The Left channel bank station may not be at the proper location.

Ok

RS: 4.167
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 4.167
FW FW 03 The right channel bank station may not be at the proper location.

RS: 4.111
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 3.671
FW FW 03 The right channel bank station may not be at the proper location.

RS: 3.729
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 3.651
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 3.494
FW FW 03 The right channel bank station may not be at the proper location.

RS: 3.245
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 2.921
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 2.86
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 2.811
FW FW 03 The right channel bank station may not be at the proper location.

RS: 2.787
FW FW 03 The right channel bank station may not be at the proper location.

RS: 2.753
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 2.652
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 2.584
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 2.263
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 2.202
FW FW 03 The right channel bank station may not be at the proper location.

RS: 2.09
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 2.033
FW FW 03 The right channel bank station may not be at the proper location.

RS: 1.976
FW FW 03 The right channel bank station may not be at the proper location.

RS: 1.816
FW FW 03 The Left channel bank station may not be at the proper location.

OK

RS: 1.641
FW FW 03 The right channel bank station may not be at the proper location.

RS: 1.603
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 1.492
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 1.419
FW FW 03 The right channel bank station may not be at the proper location.

RS: 1.356
FW FW 03 The right channel bank station may not be at the proper location.

RS: 1.106
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 1.097
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 1.097
FW FW 03 The right channel bank station may not be at the proper location.

RS: 1.046
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 0.962
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 0.962
FW FW 03 The right channel bank station may not be at the proper location.

RS: 0.856
FW FW 03 The right channel bank station may not be at the proper location.

RS: 0.807
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 0.73
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 0.73
FW FW 03 The right channel bank station may not be at the proper location.

RS: 0.666
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 0.666
FW FW 03 The right channel bank station may not be at the proper location.

RS: 0.474
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 0.375
FW FW 03 The Left channel bank station may not be at the proper location.

RS: 0.279
FW FW 03 The right channel bank station may not be at the proper location.

OK

SURCHARGE CHECK

RS: 8.744 see next page

```
FW SC 02  The surcharge value is greater than the maximum
          allowable value of 0.14

RS:       8.658
FW SC 02  The surcharge value is greater than the maximum
          allowable value of 0.14

AS:       8.554
FW SC 02  The surcharge value is greater than the maximum
          allowable value of 0.14
```

No encroachment station is set at these locations

DISCHARGE CHECK

STARTING WATER-SURFACE ELEVATION CHECK

---END---

CHECK-RAS Program: MULTIPLE PROFILE Check

Project File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.prj
Plan File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.p05
Geometry File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.g05
Flow File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.f02
Report File: R:\2007\07-0760\Models\CBBEL Model\WC_may262009.mp
Selected profiles: #10yr,#50yr,#100yr,#500yr
Date: 8/20/2009
Time: 8:48:23 AM No change

River Station	WSEL	Q Total	Top Width Act	Vel Head	Profile Number
Williams Creek,Hamilton Co CTP					
9.022	905.24	84	554.5	0	3
9.022	911.3	141	673.85	0	4
9.022	911.5	167	676.29	0	1
9.022	912	256	682.6	0	5
8.943	905.23	84	206.3	0	3
8.943	911.3	141	421.98	0	4
8.943	911.5	167	424.7	0	1
8.943	912	256	431.65	0	5
8.867	905.23	84	46	0	3
8.867	911.3	141	46	0	4
8.867	911.49	167	46	0	1
8.867	912	256	46	0	5
8.863	Culvert #1				
8.744	902.11	84	24	0.01	3
8.744	905	141	24	0.01	4
8.744	908	167	24	0.02	1
8.744	905.14	256	24	0.04	5
8.658	902.1	140	161.07	0	3
8.658	905	240	404.41	0	4
8.658	905	292	404.37	0	1
8.658	905.14	433	430.4	0	5
8.554	902.09	140	124	0	3
8.554	905	240	273.2	0	4
8.554	905	292	124	0	1
8.554	905.13	433	310.83	0	5
8.542	Culvert #1				
8.51	896.64	140	52	0.02	3
8.51	896.45	240	52	0.03	4
8.51	896.8	292	52	0.03	1
8.51	897.69	433	52	0.05	5
8.392	895.48	140	119.39	0.01	3
8.392	896.28	240	128.7	0.01	4
8.392	896.63	292	134.25	0.01	1
8.392	897.49	433	353.52	0.02	5
8.38	894.74	140	16.93	0.65	3
8.38	895.33	240	19.98	0.84	4
8.38	896.57	292	21.18	0.94	1
8.38	896.16	433	24.59	1.18	5
8.371	893.78	140	42.49	0.06	3
8.371	895.23	240	52.02	0.05	4
8.371	895.43	292	52.75	0.06	1
8.371	895.97	433	64.66	0.05	5
8.342	893.59	140	56.24	0.04	3
8.342	895.2	240	196.98	0.02	4
8.342	895.4	292	209.39	0.02	1
8.342	895.95	433	236.08	0.03	5
8.266	893.15	140	48.89	0.06	3
8.266	895.09	240	111.45	0.03	4
8.266	895.27	292	117.81	0.04	1
8.266	895.78	433	135.45	0.05	5
8.216	893	140	54.63	0.04	3
8.216	895.04	240	84.18	0.02	4
8.216	895.21	292	89.23	0.03	1
8.216	895.7	433	103.28	0.05	5
8.21	Culvert #1				
8.194	891.86	140	45.62	0.12	3
8.194	892.51	240	62.73	0.14	4
8.194	892.8	292	67.58	0.15	1
8.194	893.39	433	75.55	0.17	5
8.162	890.16	140	18.74	0.64	3
8.162	890.77	240	25.44	0.78	4
8.162	891	292	28.01	0.87	1
8.162	891.67	433	49.29	0.89	5
8.096	890.06	140	173.43	0	3
8.096	890.83	240	182.13	0	4
8.096	891.17	292	185.88	0	1
8.096	891.94	433	194.96	0.01	5
8.014	890.02	140	154.09	0	3
8.014	890.79	240	166.78	0	4
8.014	891.13	292	172.9	0.01	1

8.014	891.9	433	187.92	0.01	5
7.985	889.29	140	18.18	0.62	3
7.985	889.86	240	21.16	0.81	4
7.985	890.11	292	22.47	0.88	1
7.985	890.7	433	26.06	1.05	5
7.979	886.36	140	21.83	0.22	3
7.979	887.73	240	28.89	0.19	4
7.979	888.4	292	32.42	0.17	1
7.979	889.65	433	51.33	0.19	5
7.967	886.22	140	21.91	0.11	3
7.967	887.66	240	30.86	0.11	4
7.967	888.35	292	43.87	0.11	1
7.967	889.62	433	66.56	0.11	5
7.961	Culvert #1				
7.952	885.77	140	16.69	0.16	3
7.952	886.66	240	19	0.35	4
7.952	886.97	292	19.82	0.31	1
7.952	887.3	433	32.83	0.56	5
7.917	885.52	140	26.12	0.07	3
7.917	886.37	240	69.74	0.1	4
7.917	886.69	292	86.63	0.12	1
7.917	887.2	433	238.79	0.07	5
7.797	884.57	270	105.18	0.14	3
7.797	885.17	466	115.77	0.2	4
7.797	885.4	570	119.54	0.22	1
7.797	885.87	841	127.19	0.29	5
7.77	884.22	270	132.02	0.22	3
7.77	884.78	466	157.71	0.27	4
7.77	885.01	570	169.66	0.28	1
7.77	885.52	841	206.64	0.28	5
7.726	883.69	270	166.18	0.13	3
7.726	884.09	466	176.53	0.16	4
7.726	884.3	570	182.18	0.17	1
7.726	884.8	841	196.53	0.18	5
7.633	882.56	270	234.84	0.15	3
7.633	883.3	466	324.67	0.06	4
7.633	883.62	570	345.43	0.05	1
7.633	884.25	841	380.95	0.04	5
7.527	881.41	270	69.08	0.18	3
7.527	882.24	466	73.76	0.22	4
7.527	882.68	570	76.63	0.23	1
7.527	883.2	841	81.19	0.24	5
7.52	Bridge #1				
7.51	881.11	270	41.65	0.15	3
7.51	881.67	466	47	0.28	4
7.51	881.91	570	47	0.35	1
7.51	882.32	841	47	0.58	5
7.472	880.78	270	175.73	0.1	3
7.472	881.32	466	220.34	0.11	4
7.472	881.59	570	242.98	0.11	1
7.472	881.97	841	274.4	0.13	5
7.436	880.53	270	199.95	0.09	3
7.435	881	466	227.87	0.12	4
7.435	881.25	570	282	0.13	1
7.435	881.45	841	295.65	0.2	5
7.35	880.34	270	163.24	0.03	3
7.35	880.63	466	167.66	0.08	4
7.35	880.82	570	170.6	0.09	1
7.35	881.23	841	499.14	0.03	5
7.325	880.33	270	287.09	0.01	3
7.325	880.61	466	291.3	0.03	4
7.325	880.79	570	293.48	0.03	1
7.325	881.16	841	381.31	0.05	5
7.288	880.25	362	48.6	0.05	3
7.288	880.96	621	357.38	0.03	4
7.288	880.74	753	394.05	0.03	1
7.288	881.01	1110	692.81	0.08	5
7.285	Culvert #1				
7.272	877.97	362	52.48	0.23	3
7.272	878.73	621	52.48	0.45	4
7.272	879.19	753	411.32	0.06	1
7.272	880.43	1110	487.79	0.03	5
7.24	877.73	362	202.82	0.11	3
7.24	878.65	621	218.23	0.07	4
7.24	879.06	753	222.68	0.06	1
7.24	880.24	1110	231.88	0.05	5
7.164	876.83	362	53.94	0.18	3
7.164	877.86	621	55.21	0.25	4
7.164	878.27	753	55.24	0.28	1
7.164	879.69	1110	55.35	0.31	5
7.159	Bridge #1				
7.147	876.48	362	51.72	0.18	3
7.147	877.28	621	52.04	0.29	4
7.147	877.51	753	52.04	0.37	1
7.147	878.51	1110	52.04	0.59	5

7.111	875.88	362	46.09	0.27	3
7.111	876.49	621	147.08	0.43	4
7.111	876.7	753	147.64	0.46	1
7.111	877.23	1110	149.02	0.51	5
7.057	875.37	362	283.8	0.13	3
7.057	876.12	621	371.56	0.11	4
7.057	876.4	753	382.29	0.1	1
7.057	877.01	1110	406.91	0.09	5
6.998	874.45	362	113.7	0.3	3
6.998	875.31	621	162.6	0.28	4
6.998	875.62	753	170.95	0.28	1
6.998	876.23	1110	184.32	0.3	5
6.893	873.13	362	66.87	0.3	3
6.893	873.96	621	159.16	0.28	4
6.893	874.28	753	169.12	0.29	1
6.893	875.09	1110	304.52	0.25	5
6.812	872.47	362	119.46	0.12	3
6.812	873.38	621	145.98	0.13	4
6.812	873.71	753	157.98	0.14	1
6.812	874.57	1110	230.57	0.16	5
6.717	871.48	362	58.63	0.22	3
6.717	872.55	621	199.33	0.23	4
6.717	873.02	753	235.71	0.19	1
6.717	874.16	1110	277.76	0.21	5
6.647	871.16	362	141.34	0.08	3
6.647	872.3	621	168.82	0.08	4
6.647	872.78	753	187.45	0.08	1
6.647	873.96	1110	224.86	0.07	5
6.587	870.98	362	63.57	0.08	3
6.587	872.05	621	74.75	0.12	4
6.587	872.51	753	94	0.14	1
6.587	873.67	1110	94	0.17	5
6.582	Bridge #2				
6.569	868.95	362	41.09	0.08	3
6.569	869.92	621	45.78	0.15	4
6.569	870.33	753	47.73	0.19	1
6.569	871.38	1110	50.85	0.27	5
6.567	Culvert #1				
6.549	868.85	362	38.05	0.08	3
6.549	869.67	621	39.1	0.16	4
6.549	869.97	753	39.4	0.21	1
6.549	870.59	1110	46	0.36	5
6.483	868.45	362	110.37	0.14	3
6.483	869.24	621	198.31	0.15	4
6.483	869.51	753	208.29	0.16	1
6.483	870.07	1110	229.21	0.17	5
6.453	867.93	362	83.39	0.27	3
6.453	868.91	621	274.02	0.19	4
6.453	869.27	753	292.02	0.13	1
6.453	869.86	1110	319.38	0.1	5
6.405	866.71	362	38.39	0.41	3
6.405	867.81	621	61.36	0.46	4
6.405	868.24	753	165.65	0.48	1
6.405	869.23	1110	211.61	0.28	5
6.396	866.85	362	49.03	0.05	3
6.396	867.94	621	58	0.1	4
6.396	868.36	753	58	0.12	1
6.396	869.21	1110	58	0.2	5
6.389	Culvert #2				
6.362	866.81	362	67.11	0.04	3
6.362	867.84	621	78.95	0.07	4
6.362	868.22	753	85.91	0.09	1
6.362	868.91	1110	94.87	0.14	5
6.317	866.37	362	47.3	0.26	3
6.317	867.14	621	74.86	0.45	4
6.317	867.42	753	137.82	0.51	1
6.317	868.03	1110	156.38	0.57	5
6.274	866.06	362	93.37	0.12	3
6.274	866.8	621	155.45	0.18	4
6.274	867.07	753	181.79	0.2	1
6.274	867.62	1110	200.74	0.24	5
6.159	865	362	112.67	0.17	3
6.159	865.6	621	245.08	0.21	4
6.159	865.83	753	260.69	0.21	1
6.159	866.35	1110	282.55	0.21	5
6.087	864.51	362	303.35	0.09	3
6.087	865.14	621	390.88	0.08	4
6.087	865.38	753	398.88	0.07	1
6.087	865.95	1110	417.22	0.07	5
6.032	864.03	362	58.33	0.12	3
6.032	864.63	621	189.9	0.17	4
6.032	864.85	753	209.24	0.19	1
6.032	865.42	1110	248.04	0.2	5
5.949	862.54	362	281.86	0.06	3
5.949	864.18	621	401.97	0.06	4

5.949	864.43	753	416.09	0.06	1
5.949	865.11	1110	440.9	0.05	5
5.915	863.1	362	229.05	0.26	3
5.915	863.88	621	366.1	0.17	4
5.915	864.2	753	413.08	0.12	1
5.915	864.99	1110	438.42	0.06	5
5.908	863.03	362	204.06	0.24	3
5.908	863.79	621	348.27	0.18	4
5.908	864.13	753	402.52	0.13	1
5.908	864.95	1110	425.97	0.07	5
5.862	862.4	362	152.89	0.26	3
5.862	863.4	621	290.71	0.13	4
5.862	863.84	753	307.45	0.09	1
5.862	864.77	1110	357.31	0.06	5
5.801	861.62	362	75.54	0.17	3
5.801	862.85	621	79	0.17	4
5.801	863.31	753	79	0.16	1
5.801	864.22	1110	79	0.24	5
5.779	Culvert #1				
5.777	861.67	362	47.84	0.1	3
5.777	862.8	621	54	0.16	4
5.777	863.21	753	54	0.19	1
5.777	863.96	1110	54	0.3	5
5.749	861.43	362	52.19	0.17	3
5.749	862.5	621	93.01	0.25	4
5.749	862.9	753	112.43	0.28	1
5.749	863.84	1110	245.83	0.17	5
5.731	861.29	362	38.98	0.19	3
5.731	862.28	621	62.69	0.34	4
5.731	862.65	753	81.28	0.43	1
5.731	863.47	1110	212.05	0.39	5
5.704	861.08	362	60.24	0.19	3
5.704	862.1	621	238.82	0.2	4
5.704	862.5	753	247.2	0.17	1
5.704	863.47	1110	271.05	0.11	5
5.658	860.67	362	69.33	0.22	3
5.658	861.58	621	107.54	0.3	4
5.658	861.95	753	124.26	0.32	1
5.658	863.06	1110	187	0.23	5
5.589	859.58	362	65.52	0.29	3
5.589	860.48	621	76.19	0.34	4
5.589	860.85	753	85.13	0.37	1
5.589	862.42	1110	94	0.25	5
5.583	Bridge #1				
5.568	858.84	362	33.64	0.34	3
5.568	859.53	621	79.39	0.52	4
5.568	859.8	753	97	0.58	1
5.568	860.39	1110	97	0.7	5
5.534	858.42	362	118.54	0.16	3
5.534	859.01	621	151.96	0.24	4
5.534	859.24	753	166.86	0.27	1
5.534	859.8	1110	203.82	0.33	5
5.493	858.2	362	163.96	0.08	3
5.493	858.81	621	286.97	0.08	4
5.493	859.05	753	294.7	0.08	1
5.493	859.63	1110	303.5	0.09	5
5.47	860	362	129.19	0.13	3
5.47	858.57	621	352.13	0.15	4
5.47	858.83	753	364.4	0.14	1
5.47	859.46	1110	389.17	0.11	5
5.422	857.45	614	437.27	0.16	3
5.422	858.14	1050	498.14	0.11	4
5.422	858.44	1280	513.68	0.1	1
5.422	859.19	1890	548.31	0.09	5
5.377	857.16	614	356.63	0.07	3
5.377	857.86	1050	377.77	0.08	4
5.377	858.16	1280	386.64	0.08	1
5.377	858.86	1890	406.53	0.09	5
5.34	856.73	614	310.69	0.17	3
5.34	857.47	1050	325.88	0.14	4
5.34	857.78	1280	329.7	0.14	1
5.34	858.5	1890	338.01	0.14	5
5.255	855.84	614	242.06	0.23	3
5.255	856.6	1050	267.98	0.24	4
5.255	856.92	1280	273.50	0.25	1
5.255	857.66	1890	285.21	0.27	5
5.152	854.86	614	193.46	0.17	3
5.152	855.5	1050	216.67	0.21	4
5.152	855.83	1280	228.5	0.22	1
5.152	856.65	1890	257.95	0.22	5
5.125	854.7	614	189.81	0.11	3
5.125	855.25	1050	213.56	0.17	4
5.125	855.57	1280	225.09	0.18	1
5.125	856.4	1890	278.62	0.2	5
5.077	853.4	614	159.86	0.74	3

5.077	854.52	1050	214.13	0.32	4
5.077	854.93	1280	228.66	0.28	1
5.077	855.93	1890	278.59	0.22	5
5.025	853.37	614	114.5	0.06	3
5.025	854.26	1050	114.5	0.1	4
5.025	854.63	1280	114.5	0.12	1
5.025	855.57	1890	114.5	0.18	5
5.021	Bridge #1				
5.011	853.26	614	94.5	0.07	3
5.011	854.04	1050	94.5	0.14	4
5.011	854.33	1280	94.5	0.10	1
5.011	855.12	1890	94.5	0.28	5
4.981	853.06	614	213.74	0.12	3
4.981	853.82	1050	219.43	0.16	4
4.981	854.11	1280	221.26	0.18	1
4.981	854.89	1890	226.67	0.22	6
4.923	852.48	614	261.15	0.21	3
4.923	853.12	1050	411.83	0.27	4
4.923	853.45	1280	419.67	0.25	1
4.923	854.46	1890	440.05	0.15	5
4.777	851.07	614	275.26	0.13	3
4.777	852.06	1050	288.33	0.1	4
4.777	852.59	1280	294.58	0.09	1
4.777	853.93	1890	310.32	0.08	5
4.709	850.57	614	332.63	0.05	3
4.709	851.79	1050	374.43	0.06	4
4.709	852.37	1280	398.88	0.05	1
4.709	853.81	1890	461.53	0.04	5
4.651	850.18	614	103	0.13	3
4.651	851.36	1050	103	0.19	4
4.651	851.94	1280	103	0.21	1
4.651	853.36	1890	103	0.26	5
4.646	Bridge #1				
4.633	849.68	614	89	0.21	3
4.633	850.4	1050	89	0.39	4
4.633	850.73	1280	89	0.47	1
4.633	851.56	1890	89	0.66	5
4.603	849.48	614	183.28	0.1	3
4.603	850.16	1050	186.05	0.16	4
4.603	850.5	1280	187.21	0.17	1
4.603	851.38	1890	192.75	0.2	5
4.571	848.89	614	235.96	0.3	3
4.571	849.7	1050	248.35	0.24	4
4.571	850.11	1280	253.47	0.21	1
4.571	851.09	1890	266.17	0.18	5
4.543	848.51	614	199.41	0.22	3
4.543	849.31	1050	217.18	0.25	4
4.543	849.76	1280	222.69	0.24	1
4.543	850.76	1890	251.62	0.24	5
4.513	848.08	614	184.96	0.24	3
4.513	848.88	1050	216.85	0.27	4
4.513	849.48	1280	232.05	0.24	1
4.513	850.51	1890	252.33	0.21	5
4.447	847.33	614	286.1	0.17	3
4.447	848.49	1050	329.72	0.1	4
4.447	849.17	1280	380.46	0.07	1
4.447	850.35	1890	406.17	0.06	5
4.313	846.63	614	313.03	0.06	3
4.313	848.2	1050	385.64	0.03	4
4.313	848.98	1280	406.27	0.03	1
4.313	850.19	1890	454.65	0.03	5
4.274	846.57	614	347.78	0.03	3
4.274	848.17	1050	379.52	0.02	4
4.274	848.95	1280	402.5	0.02	1
4.274	850.16	1890	432.86	0.02	5
4.219	846.27	614	73.14	0.14	3
4.219	847.88	1050	85.46	0.17	4
4.219	848.66	1280	89.86	0.18	1
4.219	850.15	1890	580.71	0.01	5
4.213	Bridge #1				
4.2	844.88	614	64.16	0.8	3
4.2	845.55	1050	68.11	0.73	4
4.2	845.83	1280	70.08	0.9	1
4.2	846.31	1890	73.55	1.47	5
4.167	844.2	614	220.92	0.39	3
4.167	844.91	1050	252.74	0.38	4
4.167	845.2	1280	289.01	0.4	1
4.167	845.89	1890	357.25	0.36	5
4.111	843.42	614	185.56	0.19	3
4.111	844.18	1050	228.81	0.23	4
4.111	844.5	1280	233.87	0.24	1
4.111	845.22	1890	334.85	0.26	5
3.977	842.44	614	262.46	0.08	3
3.977	843.09	1050	297.96	0.1	4
3.977	843.42	1280	316.8	0.1	1

3.977	844.2	1890	357.92	0.11	5
3.871	840.88	807	87.64	0.51	3
3.871	842	1390	308.92	0.27	4
3.871	843.4	1690	322.63	0.25	1
3.871	843.28	2500	352.63	0.23	5
3.785	840.38	957	231.84	0.13	3
3.785	841.38	1650	313.43	0.18	4
3.785	841.78	2000	335.62	0.19	1
3.785	842.65	2960	392.89	0.22	5
3.729	839.87	957	221.33	0.23	3
3.729	840.87	1650	370.5	0.25	4
3.729	841.28	2000	289.64	0.26	1
3.729	842.13	2960	319.82	0.29	5
3.651	838.84	957	184.74	0.32	3
3.651	839.69	1650	209.34	0.44	4
3.651	840.02	2000	239.84	0.51	1
3.651	840.72	2960	278.95	0.63	5
3.582	838.03	957	270.78	0.27	3
3.582	838.69	1650	337.77	0.35	4
3.582	838.97	2000	364.62	0.37	1
3.582	839.62	2960	413.63	0.4	5
3.494	837.27	957	535.4	0.17	3
3.494	837.95	1650	543.62	0.14	4
3.494	838.23	2000	546.6	0.14	1
3.494	838.93	2960	553.74	0.13	5
3.326	835.66	957	289.33	0.18	3
3.326	836.4	1650	306.04	0.2	4
3.326	836.71	2000	308.23	0.23	1
3.326	837.46	2960	313.57	0.24	5
3.245	834.91	957	299.34	0.4	3
3.245	835.23	1650	337.13	0.37	4
3.245	838.62	2000	354	0.35	1
3.245	836.54	2960	383.84	0.31	5
3.127	832.79	957	199.54	0.24	3
3.127	834.01	1650	276.49	0.26	4
3.127	834.49	2000	299.9	0.26	1
3.127	835.51	2960	360.37	0.29	5
2.921	829.54	957	60.87	0.41	3
2.921	830.63	1650	120.81	0.67	4
2.921	831.04	2000	172.95	0.8	1
2.921	831.98	2960	213.98	0.98	5
2.86	828.64	957	196.96	0.34	3
2.86	829.93	1650	300.17	0.32	4
2.86	830.44	2000	334.95	0.31	1
2.86	831.71	2960	381.76	0.25	5
2.811	828.43	957	115.98	0.12	3
2.811	829.64	1650	151.63	0.18	4
2.811	830.13	2000	154.35	0.21	1
2.811	831.35	2960	161	0.26	5
2.801	Bridge #1				
2.787	828.27	957	85.24	0.15	3
2.787	829.32	1650	90.14	0.27	4
2.787	829.72	2000	91.99	0.33	1
2.787	830.61	2960	96.17	0.52	5
2.753	827.7	957	158.95	0.37	3
2.753	828.75	1650	177.97	0.43	4
2.753	829.16	2000	178.31	0.46	1
2.753	830.11	2960	180.09	0.53	5
2.652	826.99	957	368.71	0.13	3
2.652	828.33	1650	434.08	0.09	4
2.652	828.78	2000	445.08	0.09	1
2.652	829.79	2960	502.66	0.1	5
2.584	825.58	1180	85.83	0.7	3
2.584	826.86	2040	257.84	0.88	4
2.584	827.47	2480	275.03	0.78	1
2.584	828.54	3680	292.54	0.76	5
2.572	825.39	1180	80.51	0.59	3
2.572	826.49	2040	221.45	0.95	4
2.572	826.94	2480	244.42	1.01	1
2.572	827.93	3680	272.58	1.08	5
2.525	824.66	1180	187.01	0.44	3
2.525	825.85	2040	240.38	0.53	4
2.525	826.33	2480	275.93	0.56	1
2.525	827.38	3680	314.04	0.6	5
2.434	823.78	1180	217.18	0.26	3
2.434	824.98	2040	252.72	0.31	4
2.434	825.43	2480	276.62	0.34	1
2.434	826.4	3680	325.73	0.42	5
2.401	823.46	1180	276.09	0.26	3
2.401	824.72	2040	334.88	0.26	4
2.401	825.18	2480	369.72	0.28	1
2.401	826.18	3680	403.82	0.29	5
2.263	821.95	1180	106.72	0.35	3
2.263	823.02	2040	309.91	0.49	4
2.263	823.37	2400	321.9	0.54	1

2.263	824.32	3680	350.74	0.59	5
2.202	820.73	1180	56.04	0.69	3
2.202	822.02	2040	367.92	0.59	4
2.202	822.53	2480	370.27	0.51	1
2.202	823.63	3680	374.84	0.43	5
2.09	819.67	1180	205.61	0.25	3
2.09	821	2040	221.47	0.3	4
2.09	821.43	2480	233.88	0.35	1
2.09	822.37	3680	247.57	0.47	5
2.033	818.58	1180	78.16	0.58	3
2.033	819.62	2040	250.54	0.88	4
2.033	820.04	2480	252.54	0.92	1
2.033	820.97	3680	257.19	1	5
1.976	817.97	1180	204.98	0.26	3
1.976	819.15	2040	240.2	0.31	4
1.976	819.53	2480	259.96	0.36	1
1.976	820.36	3680	307.57	0.47	5
1.922	817.04	1180	65.02	0.46	3
1.922	818.3	2040	342.19	0.5	4
1.922	818.69	2480	358.8	0.52	1
1.922	819.49	3680	397.23	0.59	5
1.816	815.29	1180	103.04	0.84	3
1.816	816.7	2040	277	0.59	4
1.816	817.15	2480	420.67	0.88	1
1.816	818.2	3680	455.03	0.48	5
1.641	813.34	1180	130.05	0.35	3
1.641	814.95	2040	400.32	0.36	4
1.641	815.54	2480	420.44	0.32	1
1.641	816.86	3680	440.95	0.27	5
1.603	813.65	1180	100.79	0.59	3
1.603	814.02	2040	194.81	0.81	4
1.603	814.55	2480	243.88	0.85	1
1.603	815.7	3680	350.67	0.98	5
1.492	810.84	1180	102.2	0.5	3
1.492	812.10	2040	157.97	0.63	4
1.492	812.76	2480	169.61	0.67	1
1.492	813.84	3680	454.51	0.77	5
1.419	809.91	1180	81.35	0.25	3
1.419	811.3	2040	157.73	0.37	4
1.419	811.93	2480	172.26	0.4	1
1.419	813.4	3680	511.98	0.29	5
1.373	809.51	1180	120.01	0.22	3
1.373	810.87	2040	134.74	0.36	4
1.373	811.5	2480	138.89	0.38	1
1.373	812.69	3680	147.21	0.53	5
1.369	Bridge #1				
1.356	809.17	1180	79.61	0.24	3
1.356	810.48	2040	93.25	0.38	4
1.356	811.05	2480	146.03	0.45	1
1.356	811.98	3680	148.29	0.67	5
1.277	808.64	1180	73.96	0.2	3
1.277	809.61	2040	126.29	0.43	4
1.277	810.04	2480	147.24	0.55	1
1.277	810.86	3680	491.74	0.71	5
1.198	808.42	1350	197.48	0.13	3
1.198	809.25	2300	213.61	0.26	4
1.198	809.6	2800	222.08	0.33	1
1.198	810.47	4150	577.81	0.3	5
1.106	808.03	1350	281.98	0.15	3
1.106	808.51	2300	345.95	0.3	4
1.106	808.68	2800	364.41	0.30	1
1.106	808.69	4150	365.25	0.03	5
1.105	Inline Weir				
1.097	804.1	1350	71.67	0.22	3
1.097	805.94	2300	109.33	0.36	4
1.097	806.59	2800	145.58	0.43	1
1.097	807.68	4150	201.44	0.61	5
1.046	803.11	1350	81.45	0.47	3
1.046	804.89	2300	125.03	0.61	4
1.046	805.38	2800	322.25	0.70	1
1.046	806.27	4150	425.21	0.92	5
0.962	802.04	1350	165.16	0.34	3
0.962	804.34	2300	294.59	0.27	4
0.962	804.79	2800	443.36	0.32	1
0.962	805.64	4150	482.26	0.37	5
0.856	801.04	1500	155.17	0.37	3
0.856	803.78	2550	553.82	0.28	4
0.856	804.31	3100	566.77	0.3	1
0.856	804.84	4600	575.7	0.41	5
0.807	800.12	1500	49.35	0.72	3
0.807	802.19	2550	416.19	1.34	4
0.807	802.85	3100	458.11	1.39	1
0.807	803.67	4600	539.82	0.99	5
0.73	798.57	1500	41.3	0.82	3
0.73	800.27	2550	298.75	1.38	4

0.73	801.15	3100	320.25	1.03	1
0.73	802.75	4600	597.8	0.65	5
0.666	797.25	1500	53.44	0.82	3
0.666	798.62	2550	85.02	1.07	4
0.666	799.24	3100	110.05	1.26	1
0.666	800.7	4600	388.15	1.34	5
0.58	795.27	1500	114.55	0.58	3
0.58	797.07	2550	123.31	0.61	4
0.58	797.7	3100	130.85	0.7	1
0.58	799.68	4600	540.48	0.63	5
0.474	795.06	1500	375.26	0.06	3
0.474	797.08	2550	393.24	0.05	4
0.474	797.97	3100	403.25	0.08	1
0.474	799.73	4600	674.54	0.07	5
0.375	794.74	1500	352.1	0.09	3
0.375	796.85	2550	477.77	0.08	4
0.375	797.54	3100	531.31	0.09	1
0.375	799.54	4600	601.12	0.07	5
0.351	794.18	1500	162.15	0.49	3
0.351	796.26	2550	423.69	0.63	4
0.351	797.11	3100	453.56	0.4	1
0.351	799.34	4600	535.58	0.2	5
0.279	793.77	1500	69.74	0.27	3
0.279	795.83	2550	150.59	0.4	4
0.279	796.59	3100	170.5	0.45	1
0.279	798.65	4600	170.5	0.5	5
0.273	Bridge #1				
0.243	793.28	1500	116.24	0.32	3
0.243	795.09	2550	144.51	0.43	4
0.243	795.61	3100	144.51	0.92	1
0.243	796.98	4600	144.51	0.7	5
0.178	792.39	1500	100	0.54	3
0.178	794.08	2550	216.94	0.71	4
0.178	794.82	3100	394.68	0.62	1
0.178	796.55	4600	409	0.41	5
0.11	791.94	1500	154.09	0.27	3
0.11	793.76	2550	460.94	0.32	4
0.11	794.53	3100	613.07	0.29	1
0.11	796.4	4600	679.02	0.17	5
0.03	791.31	1660	87.74	0.3	3
0.03	792.97	2860	204	0.45	4
0.03	793.74	3480	204	0.48	1
0.03	795.57	5160	204	0.52	5
0.021	Bridge #1				
0.0008	790.64	1660	124.73	0.26	3
0.0005	792.18	2860	155.03	0.39	4
0.0005	792.74	3480	168.05	0.46	1
0.0005	793.92	5160	179	0.65	5
0.0004	789.85	1660	95.97	0.33	3
0.0004	791.29	2860	127.63	0.49	4
0.0004	791.76	3480	172.35	0.59	1
0.0004	792.76	5160	272.7	0.8	5
0.0003	789.13	1660	176.93	0.25	3
0.0003	790.66	2860	380.02	0.28	4
0.0003	791.19	3480	382.67	0.28	1
0.0003	792.33	5160	387.11	0.29	5
0.0003	786.86	1660	174.9	0.26	3
0.0002	788.51	2860	292.31	0.32	4
0.0002	789.06	3480	324.78	0.35	1
0.0002	790.34	5160	382.95	0.36	5
0.0001	785.12	1660	75.66	0.31	3
0.0001	786.51	2860	263.38	0.51	4
0.0001	787.09	3480	264.43	0.54	1
0.0001	788.26	5160	433.04	0.71	5

Boundary Condition Check

MP SW 01 The name of the stream is Williams Creek,Hamilton Co CTP (Known WS = 787.09) is specified as the downstream boundary for profile 100yr

MP SW 01 The name of the stream is Williams Creek,Hamilton Co CTP (Known WS = 785.12) is specified as the downstream boundary for profile 10yr

MP SW 01 The name of the stream is Williams Creek,Hamilton Co CTP (Known WS = 786.51) is specified as the downstream boundary for profile 50yr

MP SW 01 The name of the stream is Williams Creek,Hamilton Co CTP (Known WS = 788.26) is specified as the downstream boundary for profile 500yr

Discharge Check

Water Surface Elevation Check

Topwidth Check

---END---

Errors Warnings and Notes for Plan : 6509 inv. mp

Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 9.022 Profile: 100yr
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.943 Profile: 100yr
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.867 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.863 Profile: 100yr Culv: Culvert #1
Warning:	During the culvert inlet computations, the program could not balance the culvert/weir flow. The
	reported inlet energy grade answer may not be valid.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.744 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.554 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.542 Profile: 100yr
Warning:	During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a
	balance of energy within the specified tolerence and number of trials. The program used the solution
	with the minimum error.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.542 Profile: 100yr Culv: Culvert #1
Warning:	During the culvert inlet computations, the program could not balance the culvert/weir flow. The
	reported inlet energy grade answer may not be valid.
Warning:	During the culvert outlet computations, the program could not balance the culvert/weir flow. The
	reported outlet energy grade answer may not be valid.
Note:	The normal depth exceeds the height of the culvert. The program assumes that the normal depth is
	equal to the height of the culvert.
Note:	Culvert critical depth exceeds the height of the culvert.
Note:	During the supercritical calculations a hydraulic jump occurred inside of the culvert.
Note:	The culvert inlet is submerged and the culvert flows full over part or all of its length. Therefore, the
	culvert inlet equations are not valid and the supercritical result has been discarded. The outlet
	answer will be used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.510 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.392 Profile: 100yr
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.380 Profile: 100yr
Warning:	The energy equation could not be balanced within the specified number of iterations. The program

Errors Warnings and Notes for Plan : 6609 Inv. mo (Continued)

	used critical depth for the water surface and continued on with the calculations.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth,
	the calculated water surface came back below critical depth. This indicates that there is not a valid
	subcritical answer. The program defaulted to critical depth.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.371 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.342 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.216 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.210 Profile: 100yr Culv: Culvert #1
Note:	The normal depth exceeds the height of the culvert. The program assumes that the normal depth is
	equal to the height of the culvert.
Note:	During the supercritical calculations a hydraulic jump occurred inside of the culvert.
Note:	The culvert inlet is submerged and the culvert flows full over part or all of its length. Therefore, the
	culvert inlet equations are not valid and the supercritical result has been discarded. The outlet
	answer will be used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.194 Profile: 100yr
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.162 Profile: 100yr
Warning:	The energy equation could not be balanced within the specified number of iterations. The program
	used critical depth for the water surface and continued on with the calculations.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth,
	the calculated water surface came back below critical depth. This indicates that there is not a valid
	subcritical answer. The program defaulted to critical depth.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 8.014 Profile: 100yr
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.986 Profile: 100yr

Errors Warnings and Notes for Plan : 5509 inv. mo (Continued)

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.979 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.967 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.952 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.917 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.797 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.729 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.627 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.620 Profile: 100yr Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.620 Profile: 100yr Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.510 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

Errors Warnings and Notes for Plan : 6609 Inv. mp (Continued)

Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.435 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.350 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.326 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.286 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.272 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.240 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.164 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.159 Profile: 100yr Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.159 Profile: 100yr Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.147 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.111 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 7.067 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.998 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.717 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.647 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water

Errors Warnings and Notes for Plan : 5609 inv. mp (Continued)

	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.587 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.582 Profile: 100yr Upstream
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.582 Profile: 100yr Downstream
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.569 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.549 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.483 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.468 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.406 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.395 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.362 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.317 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.274 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section.

Errors Warnings and Notes for Plan : 5509 Inv. mo (Continued)

	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.159 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.087 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 6.032 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.949 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.801 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.779 Profile: 100yr Culv: Culvert #1
Warning:	During subcritical analysis, with the exit loss set =1.0, the projected WSEL in culvert has a lower
	energy than the downstream energy. Most likely, the downstream cross section blocks part of the
	culvert or the ineffective area is set too far in. Instead of projecting the WSEL, the program did an
	energy balance to get the WSEL inside the culvert at the downstream end.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.777 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.749 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.731 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.704 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.658 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.589 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.583 Profile: 100yr Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.583 Profile: 100yr Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.568 Profile: 100yr

Errors Warnings and Notes for Plan : 5509 Inv. mo (Continued)

Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.534 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.493 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.470 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.255 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.077 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.025 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.021 Profile: 100yr
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	energy inside of the bridge deck. This is not physically possible. Please review your bridge data and
	results for reasonableness.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.021 Profile: 100yr Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.021 Profile: 100yr Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 5.011 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.961 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.823 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.777 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.709 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.

Errors Warnings and Notes for Plan : 5509 Inv. mo (Continued)

Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.661 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.646 Profile: 100yr
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.646 Profile: 100yr Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.646 Profile: 100yr Downstream
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.633 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.603 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.513 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.447 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.274 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.219 Profile: 100yr
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.213 Profile: 100yr
Warning:	Pier drag coefficient of 2.0 assumed for Class B flow.
Note:	Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The
	momentum answer has been disregarded.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.213 Profile: 100yr Upstream
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.213 Profile: 100yr Downstream
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.

Errors Warnings and Notes for Plan : 5509 Inv. mo (Continued)

Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.200 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 4.111 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 3.871 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 3.729 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 3.651 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 3.494 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 3.245 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 3.127 Profile: 100yr
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2.921 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2.811 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2.601 Profile: 100yr Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.

Errors Warnings and Notes for Plan : 5509 Inv. mo (Continued)

Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,801 Profile: 100yr Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,787 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,753 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,652 Profile: 100yr
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,572 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,525 Profile: 100yr
Warning:	The energy lose was greater than 1.0 ft (0.3 m). between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,401 Profile: 100yr
Warning:	The energy lose was greater than 1.0 ft (0.3 m). between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,263 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,202 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
	This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,090 Profile: 100yr
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 2,033 Profile: 100yr
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1,922 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
	This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1,816 Profile: 100yr

Errors Warnings and Notes for Plan : 5509 inv. mo (Continued)

Error:	The elevation of the cross section needed to be extended. Doubling the height of the cross section
	four times was not sufficient. The cross section should be examined and coded to a new height
Warning:	The cross section had to be extended vertically during the critical depth calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.641 Profile: 100yr
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.603 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.482 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.419 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.373 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.369 Profile: 100yr Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.369 Profile: 100yr Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.356 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.277 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.190 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.106 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.106 Profile: 100yr

3 XS goes up to 936.00' which is significantly higher than 917.15' for the 100yr or 914.97 for the critical depth.

Errors Warnings and Notes for Plan : 5509 Inv. mo (Continued)

Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 1.046 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.962 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.856 Profile: 100yr
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.807 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.730 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.666 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section.
	This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.580 Profile: 100yr
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
	additional cross sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.375 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.279 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.273 Profile: 100yr Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.273 Profile: 100yr Downstream
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7

Errors Warnings and Notes for Plan : 550B Inv. mo (Continued)

	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.243 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.178 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.030 Profile: 100yr
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.021 Profile: 100yr Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.021 Profile: 100yr Downstream
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: .0005 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy
	was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.0004 Profile: 100yr
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.0003 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
	This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.0002 Profile: 100yr
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
	This may indicate the need for additional cross sections.
Location:	River: Williams Creek Reach: Hamilton Co CTP RS: 0.0001 Profile: 100yr
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.

PROJECT EVALUATION TABLE
HYDRAULIC MODELING RESULTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
LOCATION DESCRIPTION		PUBLISHED OR EFFECTIVE DATA (FL NGVD)	MODELING RESULTS				COMPARISONS			
Model Cross Section Station*	Location Description	(Based on FIS Table)	Duplicate effective Model (Ft., NAVD)	Corrected effective Model (Ft., NAVD)	Existing/Pre-project Model (Ft., NAVD) (Based on Existing Hydraulic Model)	Proposed/Post-project Model (Ft., NAVD) (Proposed Condition Model)	Cumulative Impacts w/o Project (8)	Cumulative Impacts with Project (9)	Project Impacts (10)	NOTES
							(8) - (5)	(9) - (6)	(9) - (8)	
0.20	Brevard-Orange County line				793.8					
0.60	115 A	794.2								
0.61	115 B	794.7								
0.94					794.6					A
0.98					795.8					
0.98	115 C	795.6								
0.98	115 D	796.5								
0.249					795.4					
0.280					795.8					
0.30	115 E	797.6								
0.32	115 F	798.0								
0.561					797.1					
0.575					797.6					B
0.26	115 G	798.6								
0.27	115 H	798.7								
0.35	115 I	798.7								
0.474					797.6					
0.38	115 J	798.7								
0.58					797.7					
0.585					799.2					
0.65	115 K	799.7								
0.75					801.8					C
0.807					802.6					
0.85	115 L	805								
0.858					804.9					
0.912					804.6					D
0.97	115 M	806.7								
1.040					805.4					
1.097					808.0					
1.100					808.7					
1.0	115 N	808.6								
1.01	115 O	808.9								
1.02	115 P	809.6								
1.09	115 Q	810								
1.100					809.8					E
1.09	115 R	811.2								
1.222					810.0					
1.250					811.4					
1.16	115 S	813.1								
1.275					811.8					
1.18	115 T	812.9								
1.412					811.9					F
1.27	115 U	814.5								
1.492					812.8					

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
LOCATION DESCRIPTION		PUBLISHED OR EFFECTIVE DATA (Ft. NGVD)	MODELING RESULTS				COMPARISONS			
Model Cross Section Station*	Location Description		Duplicate effective Model (Ft. NAVD)	Corrected effective Model (Ft. NAVD)	Existing/ Pre-project Model (Ft. NAVD)	Proposed/ Post-project Model (Ft. NAVD)	Cumulative Impacts with Project (8)	Cumulative Impacts with Project (6)	Project Impacts (9)	NOTES
0.32	[illegible]	815.4								
1.002					[illegible]					
1.041					815.6					G
0.49	[illegible]	816.5								
0.65	[illegible]	818.2								
1.055					817.2					
0.95	[illegible]	819.3								
1.087					818.7					
1.074					819.6					H
1.101					820.0					
2.00					821.9					
0.77	[illegible]	822.2								
2.907					822.5					I
0.85	[illegible]	824.0								
2.203					823.4					
0.35	[illegible]	825.6								
7.05	[illegible]	825.3								
2.401					825.2					
7.07	[illegible]	825.8								
2.434					825.6					J
2.525					826.3					
7.16	[illegible]	827.8								
2.575					826.8					
2.684					827.5					
2.604					828.3					K
7.27	[illegible]	829.0								
7.31	[illegible]	829.8								
2.762					830.2					
7.45	[illegible]	830.4								
2.787					830.7					
7.58	[illegible]	834.2								
2.811					830.4					
2.86					830.4					L
2.941					[illegible]					
7.6	[illegible]	834.7								
2.127					834.6					
7.86	[illegible]	835.4								
2.245					835.6					M
2.324					836.7					
7.8	[illegible]	836.9								
2.401					[illegible]					
7.92	[illegible]	839.8								
2.562					[illegible]					N
2.351					[illegible]					
0.01	[illegible]	841.5								

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
LOCATION DESCRIPTION		PUBLISHED OR EFFECTIVE DATA (Ft. NGVD)	MODELING RESULTS				COMPARISONS			
Model Cross Section Station*	Location Description		Duplicate effective Model (Ft., NAVD)	Corrected effective Model (Ft., NAVD)	Existing/ Pre-project Model (Ft., NAVD)	Proposed/ Post-project Model (Ft., NAVD)	Cumulative Impacts w/o Project (ft)	Cumulative Impacts w/ Project (ft)	Project Impacts (ft)	NOTES
0.729					844.8					
3.785					841.8					O
3.10	HS Ar1	843.5								
3.884					842.8					
3.97	HS AF	844.7								
3.977					843.4					
3.98	HS Ap	845.9								
4.111					844.5					P
4.167					1-845.7					
4.175	HS AE	847.3								
4.2					846.8					
4.210					848.7					
4.40	HS AS	848.6								
4.274					849.0					Q
4.25	HS AI	849.9								
4.315					850.0					
4.0	HS AU	850.5								
4.447					852.2					
4.84	HS AV	851								
5.3	HS AW	851.6								
4.815					849.4					R
4.74	HS AX	852.1								
4.848					549.8					
4.871					550.4					
4.895					850.8					S
4.70	HS AY	853.9								
4.931					850.7					
4.961					852.0					
4.97	HS AZ	854.2								
4.999					852.4					T
5.01	HS BA	854.4								
4.777					852.8					
5.98	HS BB	855.5								
6.09	HS BC	855.9								
4.825					853.2					
4.081					854.1					U
5.00	HS BD	855.7								
5.021					854.3					
5.024					854.6					
5.15	HS BE	857.2								
5.077					854.8					V
5.155					855.6					
5.24	HS BF	857.9								
5.252					856.8					
5.285					857.0					W

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
LOCATION DESCRIPTION		PUBLISHED FIS EFFECTIVE DATA (Ft. NGVD)	MODELING RESULTS				COMPARISONS			
Model Cross Section Station[a]	Specific Description	(Rounded to nearest foot)	Duplicate effective Model (Ft. NAVD)	Corrected effective Model (Ft. NAVD)	Existing Pre-project Model (Ft. NAVD)	Proposed Post-project Model (Ft. NAVD)	Cumulative Impacts w/o Project (8)	Cumulative Impacts w/o Project (9)	Project Impacts (10)	NOTES
							(6) – (5)	(7) – (5)	(9) – (8)	
6.28	FS 91	858.0								
6.34					857.8					
6.47	FS 92	859.6								
6.877					859.2					
6.929					860.0					X
6.87					860.6					
6.915					861.1					
6.61	FS 93	861.1								
6.934					859.9					Y
6.908					859.0					
6.28	FS 10	861.7								
6.919					860.9					
6.965					862.0					Z
6.304					862.6					
6.731					862.8					
6.736					862.9					AA
6.777					863.2					
6.891					863.9					
6.902					863.0					AB
6.965					864.1					
6.919					864.2					
6.948					864.4					AC
6.982					864.0					
6.997					865.4					
7.109					866.0					AD
6.974					867.1					
6.917					867.4					AE
7.302					868.2					
7.390					868.4					
7.395					868.2					AF
7.408					869.0					
7.489					870.6					AG
7.502					870.9					
7.903					870.9					
7.987					872.6					
8.067					872.8					AH
8.217					873.0					
8.619					873.7					
8.809					874.1					AI
8.900					874.6					
7.457					876.4					
7.116					876.7					AJ
7.147					877.6					
7.164					878.8					
7.24					879.1					AK

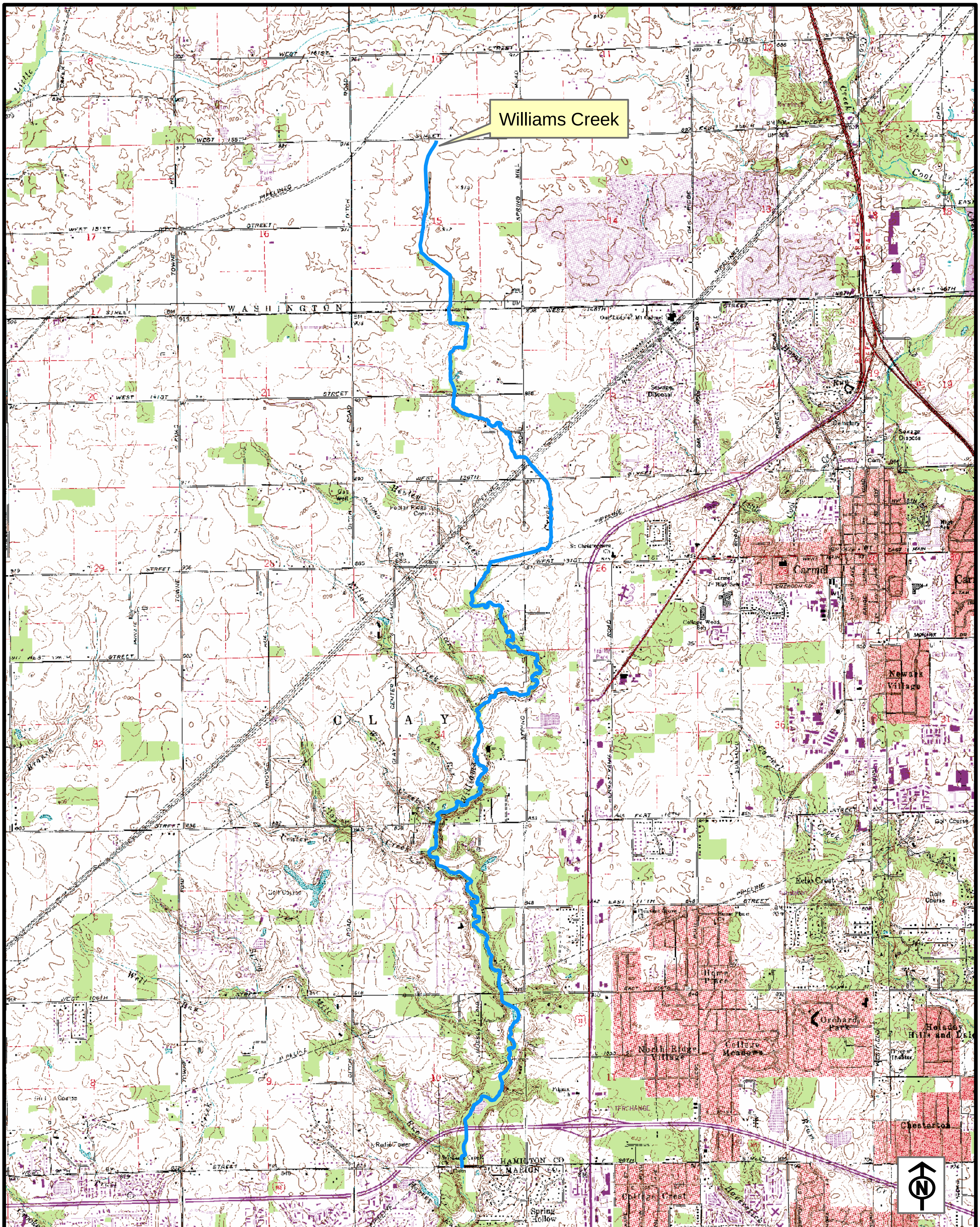
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
LOCATION DESCRIPTION		PUBLISHED OR EFFECTIVE DATA (Ft, NGVD) (Based on FIS Table)	MODELING RESULTS				COMPARISONS			NOTES
Model Cross Section Station*	Location Description		Duplicate effective Model (Ft., NAVD)	Corrected effective Model (Ft., NAVD)	Existing/ Pre-project Model (Ft., NAVD) (Existing Conditions Model)	Proposed/ Post-project Model (Ft., NAVD) (Proposed Conditions Model)	Cumulative Impacts w/o Project (11) (8) – (4)	Cumulative Impacts with Project (8) (7) – (5)	Project Impacts (6) (7) – (6)	
7.372					872.2					
7.359					863.7					
7.629					863.8					AL
7.56					860.8					
7.495					856.0					
7.472					851.8					AM
7.41					851.0					
7.477					852.7					
7.429					855.8					AN
7.720					854.2					
7.57					853.2					
7.737					845.4					
7.817					500.7					AO
7.832					567.0					
7.867					868.4					
7.919					860.4					AP
7.966					860.1					
8.014					861.1					
8.050					861.2					AQ
8.102					861.9					
8.156					862.9					
8.214					865.2					
8.268					866.8					AR
8.342					865.9					
8.371					868.6					
8.33					865.9					AS
8.562					868.6					
8.61					868.5					
8.654					868.0					
8.655					869.0					
8.744					868.0					
8.887					871.6					
8.943					871.6					
9.092					871.5					

NOTES:

* FIS River Stations are based on distance above the confluence with West Fork White River. Newmodeling is based on the distance from county line.

APPENDIX 7

Exhibit 1



0 4,000 8,000 Feet

Christopher B. Burke Engineering, Ltd.
National City Center, Suite 1368 South
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Indianapolis, Indiana 46204
(t) 317.266.8000 (f) 317.632.3306

PROJECT:	PROJECT NO.	APPROX. SCALE
Williams Creek Hydraulic Analysis	07-760	1"=4,000'
TITLE: Site Location Map		DATE: 10/09
Base Map Source: USGS Carmel, Fishers, Noblesville and Westfield Quadrangles		EXHIBIT 1

APPENDIX 7

Exhibit 2

Sources of Data:

1. Marion County Williams Creek Floodplain and Floodway CBBEL, Approved by IDNR 2009
2. Hamilton County 1' contours, NAVD 88

Legend

- CBBEL Cross Sections
- Preliminary Floodway
- Preliminary 100-Year Floodplain
- Preliminary 500-Year Floodplain
- Marion County Floodway
- Marion County 100-Year Floodplain
- Marion County 500-Year Floodplain

RS 2.584
RS 2.572
RS 2.525
RS 2.434
RS 2.401
RS 2.263
RS 2.202
RS 2.09
RS 2.033
RS 1.976
RS 1.922
RS 1.816
RS 1.641
RS 1.603
RS 1.492
RS 1.419
RS 1.373
RS 1.356
RS 1.277
RS 1.198
RS 1.106
RS 1.097
RS 1.046
RS 0.962
RS 0.856
RS 0.807
RS 0.73
RS 0.666
RS 0.58
RS 0.474
RS 0.375
RS 0.351
RS 0.289
RS 0.233
RS 0.178
RS 0.11
RS 0.03

QUEENS WAY
QUEENS WAY CIR
ROYAL DR
REGAL DR
ESTANCIA WAY
WINTERWOOD DR
BURLINGTON LN
VALESIDE CRES
MCLAREN LN
PARKSIDE CRES
111TH ST
SPRINGMILL RD
SPRINGMILL LN
SPRINGMILL CT
SPRING RIDGE DR
SPRING RIDGE CT
LIVERPOOL DR
MERSEY CT
HUMBER CT
TOTTENHAM DR
MANCHESTER CT
SPRINGWOOD DR
107TH ST
106TH ST
JUMPER LN
HUSSEY LN
LAURELWOOD DR
SANNER CT
MILLRIDGE DR
MILLRIDGE RD
SPRING HIGHLAND DR
COLMERY DR
ILLINOIS ST
103RD ST
VENTANA CT
SUPERIOR ST
CEDAR PL
CEDAR RIDGE RD
MILL RUN RD
CEDAR WOOD CT
MILL CREEK PL
CEDAR POINT DR
COPLEY DR
96TH ST
I 465
US 31

Limit of current Study
Hamilton-Marion County Line

0 300 600 Feet

N

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PROJECT:	PROJECT NO.	APPROX. SCALE
Williams Creek Hydraulic Analysis	07-760	1"= 300'
TITLE: Topographic Workmap		DATE: 10/09 Revised: 7/10
		Exhibit: 2 Panel: 1

Sources of Data:

1. Hamilton County 1' contours, NAVD 1988

Legend

- Preliminary Floodway
- CBBEL Cross Sections
- Preliminary 100-Year Floodplain
- Preliminary 500-Year Floodplain

RS 6.032
RS 5.949
RS 5.908
RS 5.915
RS 5.862
RS 5.801
RS 5.777
RS 5.749
RS 5.731
RS 5.704
RS 5.658
RS 5.586
RS 5.568
RS 5.534
RS 5.493
RS 5.47
RS 5.422
RS 5.377
RS 5.34
RS 5.255
RS 5.225
RS 5.152
RS 5.077
RS 5.038
RS 5.002
RS 4.981
RS 4.923
RS 4.777
RS 4.709
RS 4.651
RS 4.633
RS 4.603
RS 4.571
RS 4.543
RS 4.513
RS 4.447
RS 4.313
RS 4.274
RS 4.219
RS 4.2
RS 4.167
RS 4.111
RS 3.977
RS 3.871
RS 3.785
RS 3.729
RS 3.651
RS 3.582
RS 3.494
RS 3.326
RS 3.245
RS 3.127
RS 2.921
RS 2.86
RS 2.811
RS 2.787
RS 2.753
RS 2.652
RS 2.584
RS 2.572
RS 2.525
RS 2.434
RS 2.401

SIX POINTS RD
SHOEMAKER DR
IRWIN WAY
KINGSBURY DR
SHAKAMAC DR
MAIN ST
131ST ST
CARDIF DR
FLEETWOOD CT
FLEETWOOD DR
TERRENTS CT
MERIDIAN CORNERS BLVD
NOTTINGHAM CT
SOUTHAMPTON CT
LEEDS CIR
PORTSMOUTH DR
PORTSMOUTH CT
BOLIN CT
HAMILTON CROSSING BLVD
DORSET BLVD
BAILEY CIR
SHEFFIELD BLVD
CLIFFORD CIR
BRIGHTON LN
BRIGHTON CIR
REGENT CIR
BRIGHTON CT
BRIGHTON AVE
TENNYSON LN
KEATS CT
CARMEL DR
HAMPSHIRE CT
CORNWALL CT
NORTHANTS CIR
DEVON LN
NORFOLK CIR
MAYFAIR LN
CLARIDGE WAY
KENT CT
NORFOLK LN
SUFFOLK LN
GLENDURGAN DR
CLAY CENTER RD
HELFORD LN
CREEKWOOD LN
FRONTAGE RD
OLD MERIDIAN ST
PINTAIL CT
TEAL LN
ANGELIQUE CT
CLAY SPRINGS DR
MALLARD CT
US 31
SPRINGMILL RD
WILLIAMS CREEK DR
116TH ST

0 300 600 Feet

N

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PROJECT:	PROJECT NO.	APPROX. SCALE
Williams Creek Hydraulic Analysis	07-760	1"= 300'
TITLE: Topographic Workmap		DATE: 10/09 Revised: 4/10
		Exhibit: 2 Panel: 2

Sources of Data:

1. Hamilton County 1' contours, NAVD 1988

Legend

- Preliminary Floodway
- CBBEL Cross Sections
- Preliminary 100-Year Floodplain
- Preliminary 500-Year Floodplain

RS 8.392
RS 8.38
RS 8.371
RS 8.342
RS 8.266
RS 8.216
RS 8.162
RS 8.096
RS 8.014
RS 7.985
RS 7.967
RS 7.952
RS 7.917
RS 7.797
RS 7.77
RS 7.726
RS 7.633
RS 7.527
RS 7.5
RS 7.472
RS 7.435
RS 7.35
RS 7.325
RS 7.288
RS 7.272
RS 7.24
RS 7.147
RS 7.111
RS 7.057
RS 7.164
RS 6.998
RS 6.893
RS 6.812
RS 6.717
RS 6.647
RS 6.587
RS 6.569
RS 6.549
RS 6.483
RS 6.453
RS 6.405
RS 6.396
RS 6.362
RS 6.317
RS 6.274
RS 6.159
RS 6.087
RS 6.032
RS 5.949
RS 5.908
RS 5.862
RS 5.915
RS 5.801
RS 5.777
RS 5.731
RS 5.749
RS 5.704
RS 5.659
RS 5.586
RS 5.568
RS 5.534

0 300 600 Feet

N

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PROJECT:	PROJECT NO.	APPROX. SCALE
Williams Creek Hydraulic Analysis	07-760	1"= 300'
TITLE: Topographic Workmap		DATE: 10/09 Revised: 7/10
		Exhibit: 2 Panel: 3

Sources of Data:

1. Hamilton County 1' contours, NAVD 1988

Legend

- Preliminary Floodway
- CBBEL Cross Sections
- Preliminary 100-Year Floodplain
- Preliminary 500-Year Floodplain

Mapped based on data provided by others

Mapped based on data provided by others

RS 9.022
RS 8.943
RS 8.867
RS 8.744
RS 8.658
RS 8.554
RS 8.51
RS 8.392
RS 8.38
RS 8.371
RS 8.342
RS 8.266
RS 8.216
RS 8.162
RS 8.096
RS 8.014
RS 7.985
RS 7.967
RS 7.952
RS 7.917
RS 7.797
RS 7.771
RS 7.726
RS 7.633
RS 7.527
RS 7.5
RS 7.472
RS 7.435
RS 7.35
RS 7.325
RS 7.288
RS 7.272
RS 7.24
RS 7.164
RS 7.147
RS 7.111
RS 7.057

0 300 600 Feet

N

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115 West Washington Street
Indianapolis, Indiana 46204
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PROJECT: Williams Creek Hydraulic Analysis

PROJECT NO. 07-760

APPROX. SCALE 1"= 300'

DATE: 10/09

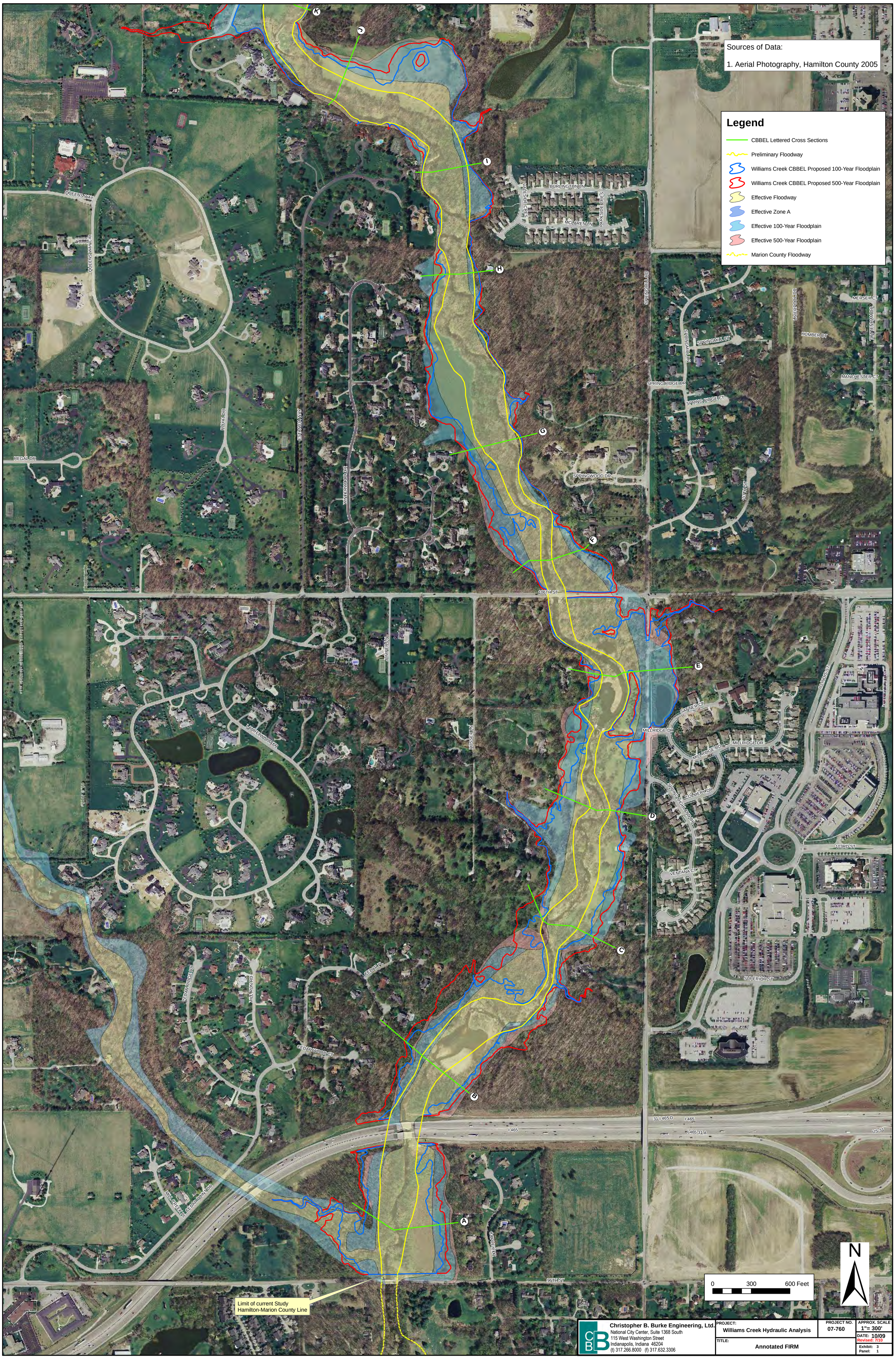
Revised: 4/10

TITLE: Topographic Workmap

Exhibit: 2
Panel: 4

APPENDIX 7

Exhibit 3


Sources of Data:
1. Aerial Photography, Hamilton County 2005
Legend
CBBEL Lettered Cross Sections
Preliminary Floodway
Williams Creek CBBEL Proposed 100-Year Floodplain
Williams Creek CBBEL Proposed 500-Year Floodplain
Effective Floodway
Effective Zone A
Effective 100-Year Floodplain
Effective 500-Year Floodplain
Marion County Floodway
A
B
C
D
E
F
G
H
I
J
K
QUEENS WAY
QUEENS WAY CIR
ROYAL DR
ESTANCIA WAY
REGAL DR
WINTERWOOD DR
BURLINGTON LN
VALESIDE CRES
MCLAREN LN
PARKSIDE CRES
SPRINGMILL RD
SPRINGMILL CT
SPRINGMILL LN
LIVERPOOL DR
MERSEY CT
HUMBER CT
TOTTENHAM DR
MANCHESTER CT
SPRING RIDGE DR
SPRING RIDGE CT
SPRINGWOOD DR
107TH ST
106TH ST
JUMPER LN
LAURELWOOD DR
HUSSEY LN
SANNER CT
MILLRIDGE DR
MILLRIDGE RD
COLMERY DR
SPRING HIGHLAND DR
ILLINOIS ST
103RD ST
VENTANA CT
SUPERIOR ST
CEDAR PL
CEDAR RIDGE RD
MILL RUN RD
CEDAR WOOD CT
I 465
31 I 465 D
I 465 31 A
US 31
MILL CREEK PL
CEDAR POINT DR
COPLEY DR
96TH ST
Limit of current Study
Hamilton-Marion County Line
0
300
600 Feet
N
Christopher B. Burke Engineering, Ltd.
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Indianapolis, Indiana 46204
(t) 317.266.8000 (f) 317.632.3306
PROJECT:
Williams Creek Hydraulic Analysis
PROJECT NO.
07-760
APPROX. SCALE
1"= 300'
DATE: 10/09
Revised: 7/10
TITLE:
Annotated FIRM
Exhibit: 3
Panel: 1

Sources of Data:
1. Aerial Photography, Hamilton County 2005
Legend
CBBEL Lettered Cross Sections
Preliminary Floodway
CBBEL Proposed 100-Year Floodplain
CBBEL Proposed 500-Year Floodplain
Effective Floodway
Effective Zone A
Effective 100-Year Floodplain
Effective 500-Year Floodplain
SIX POINTS RD
SHOEMAKER DR
IRWIN WAY
KINGSBURY DR
SHAKAMAC DR
MAIN ST
131ST ST
CARDIF DR
FLEETWOOD CT
FLEETWOOD DR
TIERRENTS CT
MERIDIAN CORNERS BLVD
SOUTHAMPTON CT
PORTSMOUTH DR
LEEDS CIR
PORTSMOUTH CT
BOLIN CT
HAMILTON CROSSING BLVD
NOTTINGHAM CT
DORSET BLVD
BAILEY CIR
BRIGHTON CIR
BRIGHTON LN
REGENT CIR
BRIGHTON CT
BRIGHTON AVE
SHEFFIELD BLVD
CLIFFORD CIR
HAMPSHIRE CT
CORNWALL CT
TENNYSON LN
KEATS CT
CARMEL DR
NORTHANTS CIR
DEVON LN
NORFOLK CIR
MAYFAIR LN
CLARIDGE WAY
NORFOLK LN
KENT CT
SUFFOLK LN
GLENDURGAN DR
CREEKWOOD LN
FRONTAGE RD
OLD MERIDIAN ST
CLAY CENTER RD
HELFORD LN
PINTAIL CT
TEAL LN
ANGELIQUE CT
CLAY SPRINGS DR
MALLARD CT
US 31
SPRINGMILL RD
WILLIAMS CREEK DR
116TH ST
0 300 600 Feet
N
Christopher B. Burke Engineering, Ltd.
National City Center, Suite 1368 South
115 West Washington Street
Indianapolis, Indiana 46204
(t) 317.266.8000 (f) 317.632.3306
PROJECT:
Williams Creek Hydraulic Analysis
PROJECT NO.
07-760
APPROX. SCALE
1"= 300'
DATE: 10/09
Revised: 4/10
TITLE:
Annotated FIRM
Exhibit: 3
Panel: 2

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(t) 317.266.8000 (f) 317.632.3306

PROJECT:	PROJECT NO.	APPROX. SCALE
Williams Creek Hydraulic Analysis	07-760	1"= 300'
TITLE: Annotated FIRM		DATE: 10/09 Revised: 7/10
		Exhibit: 3 Panel: 3

Sources of Data:

1. Aerial Photography, Hamilton County 2005

Legend

- CBBEL Lettered Cross Sections
- Preliminary Floodway
- CBBEL Proposed 100-Year Floodplain
- CBBEL Proposed 500-Year Floodplain

0 300 600 Feet

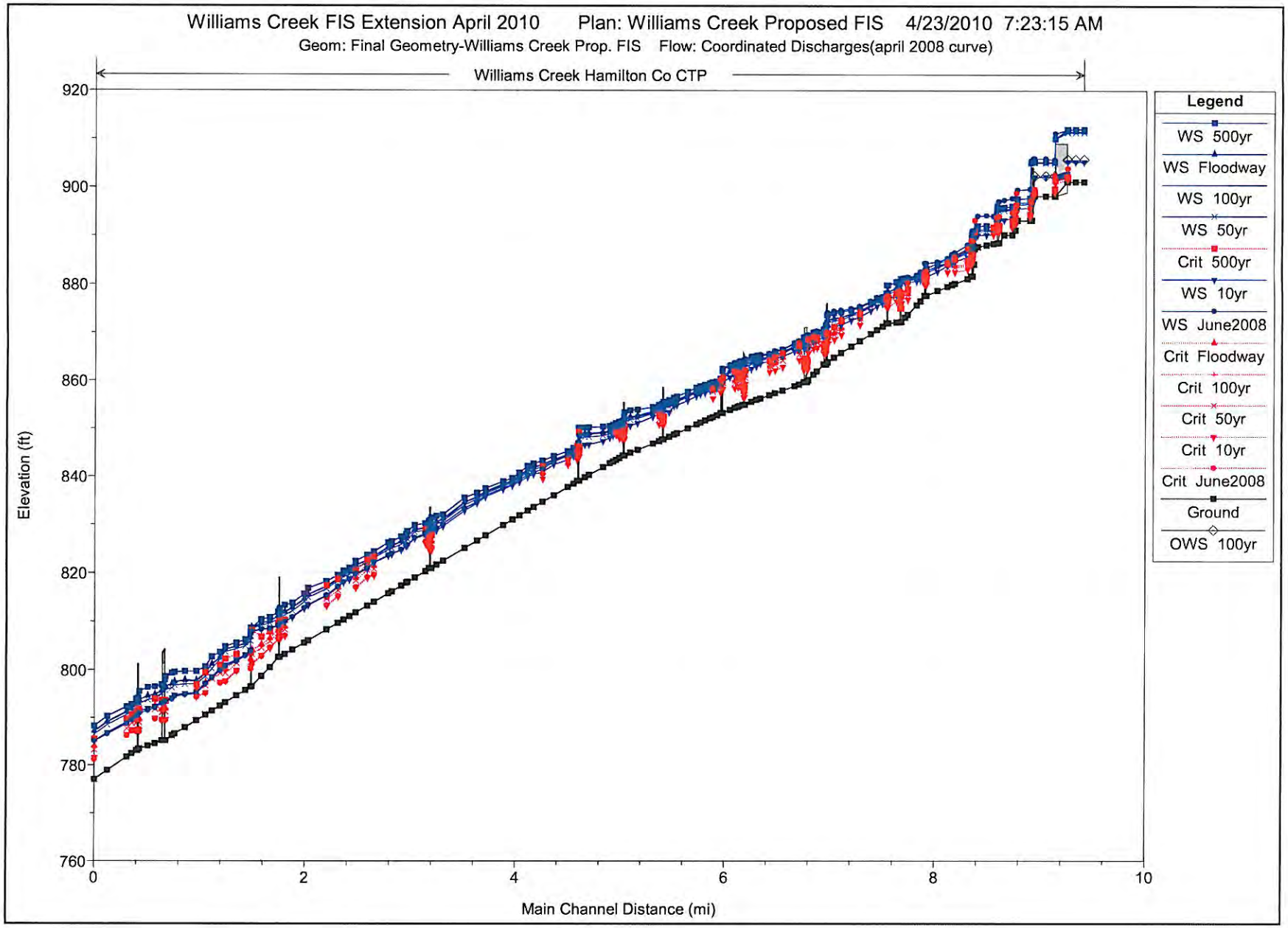
N

Christopher B. Burke Engineering, Ltd.
National City Center, Suite 1368 South
115 West Washington Street
Indianapolis, Indiana 46204
(t) 317.266.8000 (f) 317.632.3306

PROJECT: Williams Creek Hydraulic Analysis	PROJECT NO. 07-760	APPROX. SCALE 1"= 300'
TITLE: Annotated FIRM		DATE: 10/09 Revised: 4/10
		Exhibit: 3 Panel: 4

APPENDIX 7

Exhibit 4


Williams Creek FIS Extension April 2010 Plan: Williams Creek Proposed FIS 4/23/2010 7:23:15 AM
Geom: Final Geometry-Williams Creek Prop. FIS Flow: Coordinated Discharges(april 2008 curve)
Williams Creek Hamilton Co CTP
Elevation (ft)
920
900
880
860
840
820
800
780
760
0
2
4
6
8
10
Main Channel Distance (mi)
Legend
WS 500yr
WS Floodway
WS 100yr
WS 50yr
Crit 500yr
WS 10yr
WS June2008
Crit Floodway
Crit 100yr
Crit 50yr
Crit 10yr
Crit June2008
Ground
OWS 100yr

APPENDIX 7

Exhibit 5

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Williams Creek								
A	0.110	251	957	3.2	794.5	794.5	794.6	0.1
B	0.375	216	1440	2.2	797.5	797.5	797.5	0.0
C	0.730	283	648	4.8	801.2	801.2	801.2	0.0
D	0.962	160	796	3.5	804.8	804.8	804.9	0.1
E	1.198	184	822	3.4	809.6	809.6	809.6	0.0
F	1.419	88	480	5.2	811.9	811.9	812.0	0.1
G	1.641	298	930	2.7	815.5	815.5	815.6	0.1
H	1.976	185	681	3.6	819.5	819.5	819.6	0.1
I	2.202	352	847	2.9	822.5	822.5	822.6	0.1
J	2.434	191	694	3.6	825.4	825.4	825.5	0.1
K	2.652	348	1211	1.7	828.8	828.8	828.9	0.1
L	2.860	186	646	3.1	830.4	830.4	830.5	0.1
M	3.245	260	643	3.1	835.6	835.6	835.7	0.1
N	3.582	211	577	3.5	839.0	839.0	839.1	0.1
O	3.785	200	705	2.8	841.8	841.8	841.9	0.1
P	4.111	149	402	3.2	844.5	844.5	844.6	0.1
Q	4.274	306	1427	0.9	849.0	849.0	849.0	0.0
R	4.513	152	440	2.9	849.4	849.4	849.5	0.1
S	4.603	169	542	2.4	850.5	850.5	850.6	0.1
T	4.709	273	854	1.5	852.4	852.4	852.4	0.0

[1] Miles above Hamilton-Marion County Line

TABLE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, IN
(ALL JURISDICTIONS)

FLOODWAY DATA

WILLIAMS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Williams Creek								
U	4.981	179	484	2.6	854.1	854.1	854.2	0.1
V	5.077	159	394	3.3	854.9	854.9	855.0	0.1
W	5.255	203	518	2.5	856.9	856.9	857.0	0.1
X	5.422	370	741	1.7	858.4	858.4	858.5	0.1
Y	5.534	91	237	3.2	859.2	859.2	589.3	0.1
Z	5.658	63	201	3.8	862.0	862.0	862.0	0.0
AA	5.749	108	249	3.0	862.9	862.9	863.0	0.1
AB	5.862	226	428	1.8	863.8	863.8	863.9	0.1
AC	5.949	259	500	1.5	864.4	864.4	864.5	0.1
AD	6.159	160	290	2.6	865.8	865.8	865.9	0.1
AE	6.317	52	157	4.8	867.4	867.4	867.5	0.1
AF	6.405	95	165	4.6	868.2	868.2	868.3	0.1
AG	6.483	140	300	2.5	869.5	869.5	869.6	0.1
AH	6.647	122	423	1.8	872.8	872.8	872.9	0.1
AI	6.893	122	270	2.8	874.3	874.3	874.4	0.1
AJ	7.111	117	391	3.8	876.7	876.7	876.8	0.1
AK	7.240	196	639	1.6	879.1	879.1	879.1	0.0
AL	7.325	171	487	1.2	880.8	880.8	880.9	0.1
AM	7.472	128	274	2.1	881.6	881.6	881.7	0.1
AN	7.633	211	752	1.4	883.6	883.6	883.7	0.1

[1] Miles above Hamilton-Marion County Line

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARION COUNTY, IN
(ALL JURISDICTIONS)

FLOODWAY DATA

WILLIAMS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Williams Creek								
AO	7.917	45	115	2.5	886.7	886.7	886.8	0.1
AP	7.979	30	94	3.1	888.4	888.4	888.5	0.1
AQ	8.096	164	522	0.6	891.2	891.2	891.2	0.0
AR	8.266	58	200	1.5	895.3	895.3	895.3	0.0
AS	8.380	20	38	7.8	895.6	895.6	895.6	0.0

[1] Miles above Hamilton-Marion County Line

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

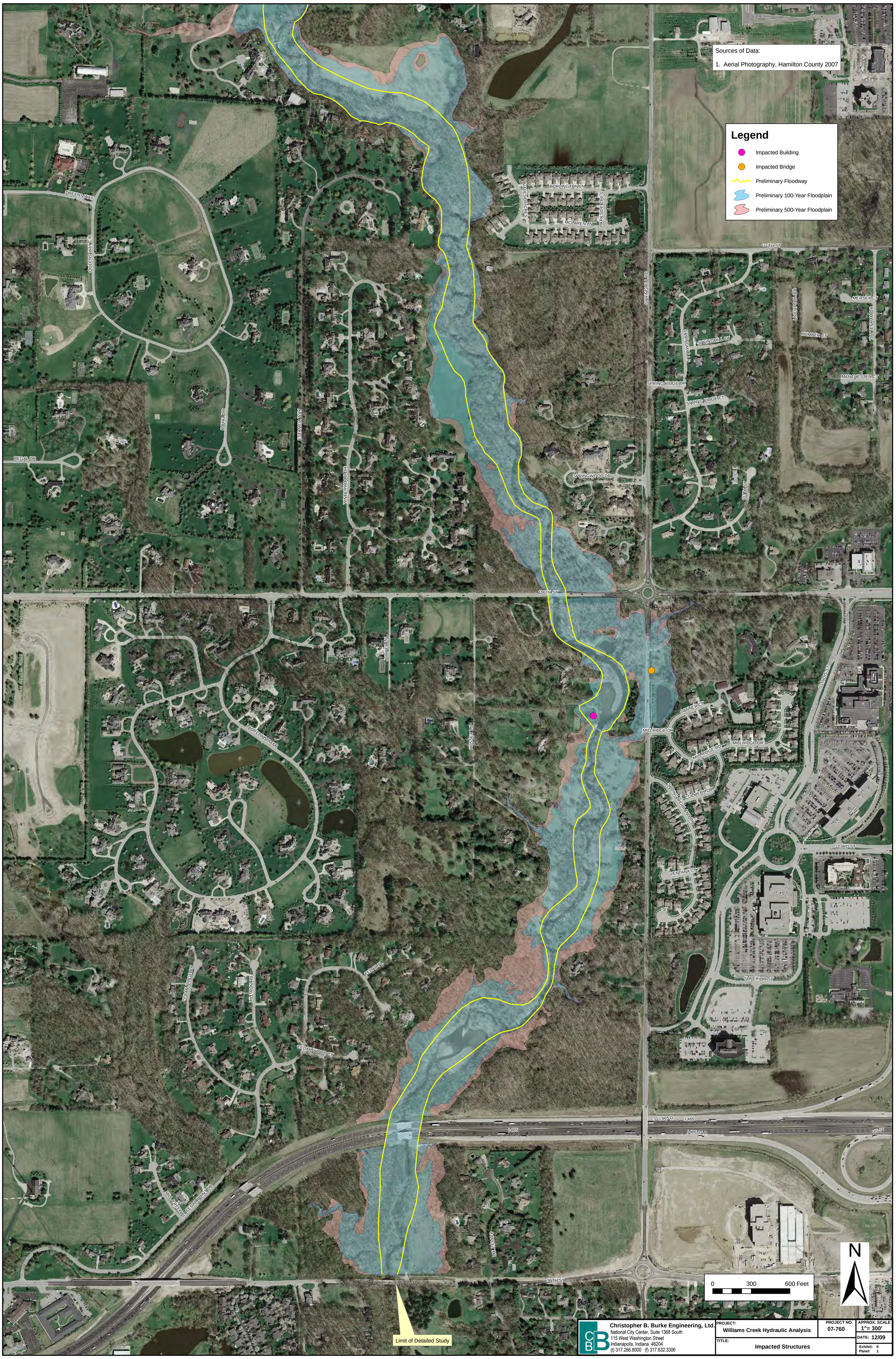
MARION COUNTY, IN
(ALL JURISDICTIONS)

FLOODWAY DATA

WILLIAMS CREEK

APPENDIX 7

Exhibit 6



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Indianapolis, Indiana 46204
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PROJECT:	PROJECT NO.	APPROX. SCALE
Williams Creek Hydraulic Analysis	07-760	1"= 300'
TITLE: Impacted Structures		DATE: 12/09
		Exhibit: 6 Panel: 1

Sources of Data:

1. Aerial Photography, Hamilton County 2007

Legend

- Impacted Building
- Impacted Bridge
- Preliminary Floodway
- Preliminary 100-Year Floodplain
- Preliminary 500-Year Floodplain

0 300 600 Feet

N

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(t) 317.266.8000 (f) 317.632.3306

PROJECT:	PROJECT NO.	APPROX. SCALE
Williams Creek Hydraulic Analysis	07-760	1"= 300'
TITLE: Impacted Structures		DATE: 12/09
		Exhibit: 6 Panel: 2

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PROJECT:	PROJECT NO.	APPROX. SCALE
Williams Creek Hydraulic Analysis	07-760	1"= 300'
TITLE: Impacted Structures		DATE: 12/09
		Exhibit: 6 Panel: 3

Sources of Data:

1. Aerial Photography, Hamilton County 2007

Legend

- Impacted Building
- Impacted Bridge
- Preliminary Floodway
- Preliminary 100-Year Floodplain
- Preliminary 500-Year Floodplain

0 300 600 Feet

N

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PROJECT:	PROJECT NO.	APPROX. SCALE
Williams Creek Hydraulic Analysis	07-760	1"= 300'
		DATE: 12/09
TITLE: Impacted Structures		Exhibit: 6 Panel: 4

APPENDIX 8

Thomas Hussey Drain Hydraulic Analysis

THOMAS HUSSEY DRAIN
HYDRAULIC ANALYSIS

Hamilton County, Indiana

(Williams Creek Master Plan Appendix 8)

Prepared for

Hamilton County Drainage Board
One Hamilton County Square
Noblesville, Indiana 46060

June 2010

Prepared by

Christopher B. Burke Engineering, Ltd.
115 West Washington Street, Suite 1368 South
Indianapolis, Indiana 46204

CBBEL Project No. 07-0760

INTRODUCTION

One of the areas identified by Hamilton County as having flooded was the 106th Street crossing of the Thomas Hussey Drain, a tributary to Williams Creek. The location of this point of interest within the watershed is shown below in **Figure A8-1**. A hydraulic model of a surrounding portion of the stream was created in order to determine the capacity of the existing crossing and whether the wall constructed downstream of the road would impact flood elevations. A description of this model is provided in this report.

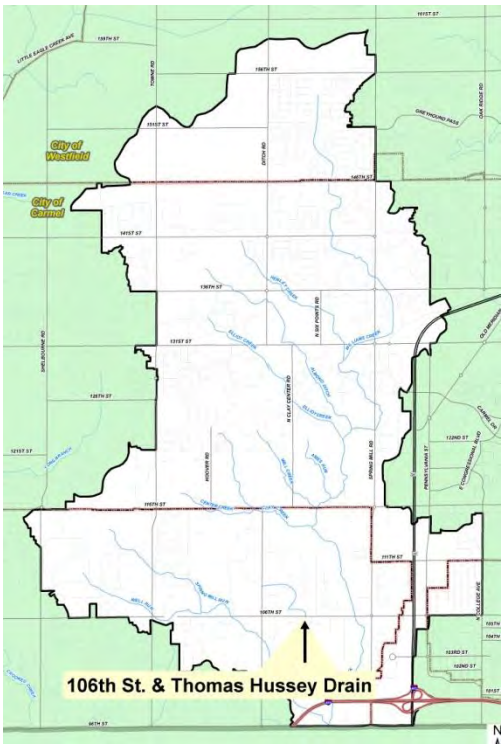

Figure A8-1: Watershed Location Map

HYDRAULIC MODEL

The hydraulic analysis was performed using the U.S. Army Corps of Engineers HEC-RAS model (version 3.1.3). Cross sections were taken from the Hamilton County 1 foot contour interval mapping (2004). The culvert was measured by CBBEL on April 22, 2009. The culvert is a 4 foot circular pipe that projects from the road embankment. Cross section locations for the model are shown on the topography below in **Figure A8-2**.

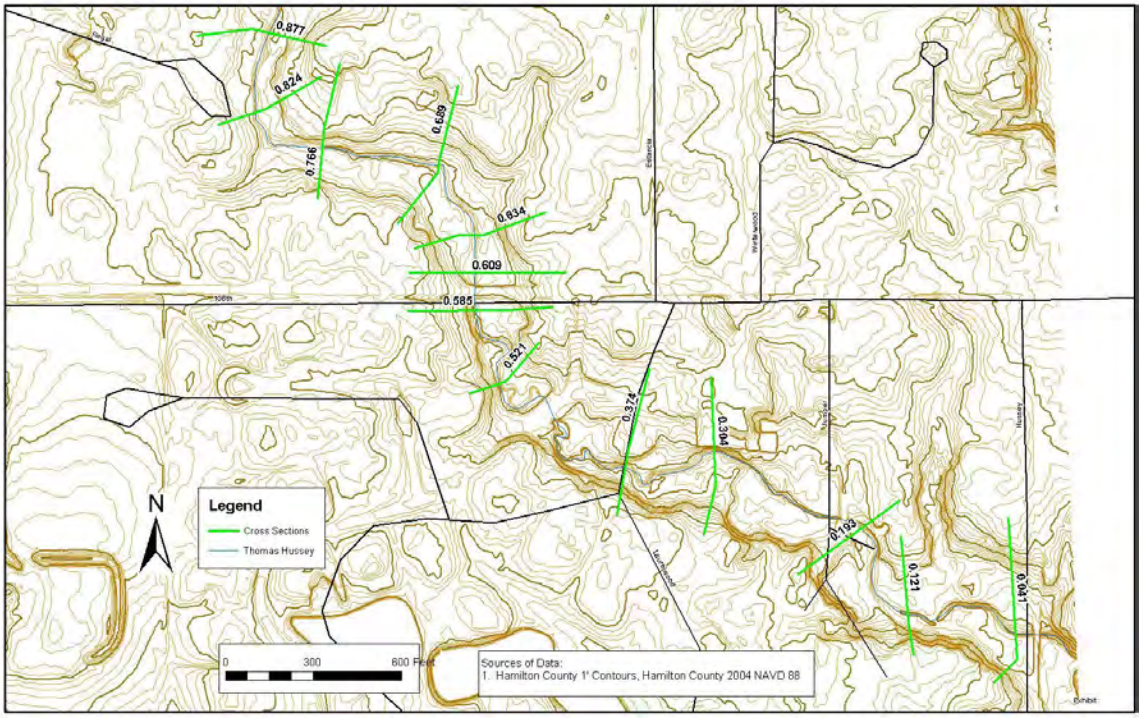

Figure A8-2: Model Cross Section Locations

The starting water surface elevation was determined by the normal depth method. Mannings N values were based on the site visit. Ineffective flow limits were based on flow contraction and expansion widths. No calibration of the model was done other than confirming that it showed road overtopping for the 2003 flood discharge.

To determine the capacity of the structure, a range of discharges were run in the model, including the frequency discharges determined for the drain at the mouth in the CBBEL version of the hydrology model for the existing condition of Williams Creek. The discharges determined at the drain's mouth were adjusted to this location by the relationship of respective drainage areas to the 0.6 power.

The model showed a culvert capacity of around 80 to 85 cfs before overtopping. Based on the HEC-HMS model, this is approximately equivalent to a 10% (10-year) annual chance storm. The 1% (100-year) annual chance flood discharge from the HEC-HMS model adjusted to this location is about 225 cfs. Based on the HEC-HMS calibrated model results adjusted to the site, the 2003 storm produced about 270 cfs at this site. While the 2003 discharge at this site exceeded the 1% (100-year) annual chance discharge, the culvert is not large enough to pass more than about 40% of the 1% (100-year) annual chance discharge. The presence of the wall therefore prevents water that flows over the road in the 1% (100-year) annual chance flood from continuing downstream and therefore increases upstream water surface elevations to some extent. The presence of storage upstream of the culvert was not included in the model. Therefore, the amount of water surface increase due

to the wall was not quantified. If storage volume upstream is encroached upon, the increase in water surface elevation will be even more. A copy of the HEC-RAS output follows. A digital copy of the model is located in Appendix 5 of the Master Plan.

HEC-RAS River: Thomas Hussey Reach: Study Reach

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Study Reach	0.876999	PF 1	PLS Cap Test	50.00	837.00	838.94		839.02	0.001941	2.23	28.09	28.48	0.31
Study Reach	0.876999	PF 1	PLS no ROF	50.00	837.00	838.94		839.02	0.001941	2.23	28.09	28.48	0.31
Study Reach	0.876999	PF 1	PLSnewCulv	50.00	837.00	838.96		839.03	0.001883	2.21	28.46	28.69	0.30
Study Reach	0.876999	PF 2	PLS Cap Test	60.00	837.00	839.08		839.16	0.002057	2.42	32.18	31.38	0.32
Study Reach	0.876999	PF 2	PLS no ROF	60.00	837.00	839.08		839.16	0.002057	2.42	32.18	31.38	0.32
Study Reach	0.876999	PF 2	PLSnewCulv	60.00	837.00	839.09		839.17	0.002016	2.40	32.48	31.61	0.32
Study Reach	0.876999	PF 3	PLS Cap Test	70.00	837.00	839.20		839.30	0.002161	2.60	36.22	34.40	0.33
Study Reach	0.876999	PF 3	PLS no ROF	70.00	837.00	839.20		839.30	0.002161	2.60	36.22	34.40	0.33
Study Reach	0.876999	PF 3	PLSnewCulv	70.00	837.00	839.21		839.31	0.002110	2.58	36.58	34.67	0.33
Study Reach	0.876999	PF 4	PLS Cap Test	80.00	837.00	839.32		839.42	0.002251	2.75	40.24	37.24	0.34
Study Reach	0.876999	PF 4	PLS no ROF	80.00	837.00	839.32		839.42	0.002251	2.75	40.24	37.24	0.34
Study Reach	0.876999	PF 4	PLSnewCulv	80.00	837.00	839.33		839.43	0.002211	2.74	40.58	37.47	0.34
Study Reach	0.876999	PF 5	PLS Cap Test	90.00	837.00	839.42		839.53	0.002330	2.90	44.20	39.75	0.35
Study Reach	0.876999	PF 5	PLS no ROF	90.00	837.00	839.42		839.53	0.002330	2.90	44.20	39.75	0.35
Study Reach	0.876999	PF 5	PLSnewCulv	90.00	837.00	839.43		839.54	0.002293	2.88	44.53	39.95	0.35
Study Reach	0.876999	PF 6	PLS Cap Test	100.00	837.00	839.51		839.64	0.002403	3.03	48.11	42.19	0.36
Study Reach	0.876999	PF 6	PLS no ROF	100.00	837.00	839.51		839.64	0.002403	3.03	48.11	42.19	0.36
Study Reach	0.876999	PF 6	PLSnewCulv	100.00	837.00	839.52		839.64	0.002366	3.02	48.47	42.42	0.36
Study Reach	0.876999	PF 7	PLS Cap Test	200.00	837.00	840.21		840.41	0.003047	4.11	91.85	107.21	0.43
Study Reach	0.876999	PF 7	PLS no ROF	200.00	837.00	847.67		847.67	0.000002	0.24	2105.18	388.83	0.01
Study Reach	0.876999	PF 7	PLSnewCulv	200.00	837.00	840.23		840.42	0.002982	4.07	93.40	109.38	0.42
Study Reach	0.876999	PF 8	PLS Cap Test	250.00	837.00	840.46		840.66	0.003182	4.43	121.48	127.01	0.44
Study Reach	0.876999	PF 8	PLS no ROF	250.00	837.00	850.09		850.09	0.000001	0.20	3067.62	406.97	0.01
Study Reach	0.876999	PF 8	PLSnewCulv	250.00	837.00	840.46		840.68	0.003189	4.43	121.44	126.99	0.44
Study Reach	0.876999	PF 9	PLS Cap Test	300.00	837.00	840.67		840.88	0.003134	4.59	148.60	138.21	0.44
Study Reach	0.876999	PF 9	PLS no ROF	300.00	837.00	850.15		850.15	0.000001	0.24	3092.10	408.09	0.01
Study Reach	0.876999	PF 9	PLSnewCulv	300.00	837.00	840.67		840.88	0.003134	4.59	148.60	138.21	0.44
Study Reach	0.876999	PF 10	PLS Cap Test	400.00	837.00	841.00		841.22	0.003085	4.85	197.40	153.37	0.45
Study Reach	0.876999	PF 10	PLS no ROF	400.00	837.00	850.26		850.26	0.000002	0.31	3135.09	410.13	0.02
Study Reach	0.876999	PF 10	PLSnewCulv	400.00	837.00	841.00		841.22	0.003085	4.85	197.40	153.37	0.45
Study Reach	0.876999	PF 11	PLS Cap Test	260.00	837.00	840.50		840.73	0.003179	4.47	127.05	130.05	0.44
Study Reach	0.876999	PF 11	PLS no ROF	260.00	837.00	850.10		850.10	0.000001	0.21	3069.21	407.04	0.01
Study Reach	0.876999	PF 11	PLSnewCulv	260.00	837.00	840.50		840.73	0.003179	4.47	127.03	130.05	0.44
Study Reach	0.876999	PF 12	PLS Cap Test	270.00	837.00	840.55		840.77	0.003162	4.50	132.52	131.79	0.44
Study Reach	0.876999	PF 12	PLS no ROF	270.00	837.00	850.11		850.11	0.000001	0.21	3075.50	407.33	0.01
Study Reach	0.876999	PF 12	PLSnewCulv	270.00	837.00	840.55		840.77	0.003162	4.50	132.52	131.79	0.44
Study Reach	0.876999	PF 13	PLS Cap Test	280.00	837.00	840.59		840.81	0.003157	4.53	137.83	133.95	0.44
Study Reach	0.876999	PF 13	PLS no ROF	280.00	837.00	850.13		850.13	0.000001	0.22	3084.23	407.73	0.01
Study Reach	0.876999	PF 13	PLSnewCulv	280.00	837.00	840.59		840.81	0.003157	4.53	137.83	133.95	0.44
Study Reach	0.876999	PF 14	PLS Cap Test	290.00	837.00	840.63		840.85	0.003149	4.56	143.26	135.44	0.44
Study Reach	0.876999	PF 14	PLS no ROF	290.00	837.00	850.16		850.16	0.000001	0.23	3096.11	408.27	0.01
Study Reach	0.876999	PF 14	PLSnewCulv	290.00	837.00	840.63		840.85	0.003149	4.56	143.26	135.44	0.44
Study Reach	0.876999	PF 15	PLS Cap Test	85.00	837.00	839.37		839.48	0.002291	2.83	42.23	38.52	0.35
Study Reach	0.876999	PF 15	PLS no ROF	85.00	837.00	839.37		839.48	0.002291	2.83	42.23	38.52	0.35
Study Reach	0.876999	PF 15	PLSnewCulv	85.00	837.00	839.38		839.49	0.002253	2.81	42.56	38.73	0.35
Study Reach	0.824000	PF 1	PLS Cap Test	50.00	837.00	838.38		838.43	0.002294	2.06	34.38	43.85	0.32
Study Reach	0.824000	PF 1	PLS no ROF	50.00	837.00	838.38		838.43	0.002294	2.06	34.38	43.85	0.32
Study Reach	0.824000	PF 1	PLSnewCulv	50.00	837.00	838.16		838.25	0.004681	2.57	25.62	36.47	0.46
Study Reach	0.824000	PF 2	PLS Cap Test	60.00	837.00	838.49		838.56	0.002366	2.21	39.61	47.77	0.33
Study Reach	0.824000	PF 2	PLS no ROF	60.00	837.00	838.49		838.56	0.002366	2.21	39.61	47.77	0.33
Study Reach	0.824000	PF 2	PLSnewCulv	60.00	837.00	838.26		838.36	0.004857	2.78	29.28	39.65	0.46
Study Reach	0.824000	PF 3	PLS Cap Test	70.00	837.00	838.59		838.66	0.002448	2.35	44.60	51.66	0.34
Study Reach	0.824000	PF 3	PLS no ROF	70.00	837.00	838.59		838.66	0.002448	2.35	44.60	51.66	0.34
Study Reach	0.824000	PF 3	PLSnewCulv	70.00	837.00	838.35		838.46	0.004910	2.95	33.14	42.90	0.47
Study Reach	0.824000	PF 4	PLS Cap Test	80.00	837.00	838.69		838.76	0.002519	2.49	49.67	55.45	0.35
Study Reach	0.824000	PF 4	PLS no ROF	80.00	837.00	838.69		838.76	0.002519	2.49	49.67	55.45	0.35
Study Reach	0.824000	PF 4	PLSnewCulv	80.00	837.00	838.44		838.56	0.004933	3.10	37.00	45.78	0.48
Study Reach	0.824000	PF 5	PLS Cap Test	90.00	837.00	838.77		838.86	0.002590	2.61	54.46	59.44	0.36
Study Reach	0.824000	PF 5	PLS no ROF	90.00	837.00	838.77		838.86	0.002590	2.61	54.46	59.44	0.36
Study Reach	0.824000	PF 5	PLSnewCulv	90.00	837.00	838.52		838.65	0.004965	3.23	40.81	48.68	0.48
Study Reach	0.824000	PF 6	PLS Cap Test	100.00	837.00	838.85	838.11	838.94	0.002624	2.72	59.57	63.29	0.37
Study Reach	0.824000	PF 6	PLS no ROF	100.00	837.00	838.85	838.11	838.94	0.002624	2.72	59.57	63.29	0.37
Study Reach	0.824000	PF 6	PLSnewCulv	100.00	837.00	838.59		838.73	0.005056	3.37	44.37	51.37	0.49
Study Reach	0.824000	PF 7	PLS Cap Test	200.00	837.00	839.44	838.62	839.58	0.003003	3.54	105.19	91.71	0.41
Study Reach	0.824000	PF 7	PLS no ROF	200.00	837.00	847.67		847.67	0.000002	0.28	1891.82	358.49	0.01
Study Reach	0.824000	PF 7	PLSnewCulv	200.00	837.00	839.18		839.39	0.005055	4.24	83.17	79.65	0.52
Study Reach	0.824000	PF 8	PLS Cap Test	250.00	837.00	839.66	838.85	839.81	0.003134	3.84	126.05	101.72	0.43
Study Reach	0.824000	PF 8	PLS no ROF	250.00	837.00	850.09		850.09	0.000001	0.23	2789.09	388.69	0.01
Study Reach	0.824000	PF 8	PLSnewCulv	250.00	837.00	839.65		839.81	0.003161	3.85	125.57	101.50	0.43
Study Reach	0.824000	PF 9	PLS Cap Test	300.00	837.00	839.83	839.01	840.00	0.003315	4.13	144.65	109.87	0.44
Study Reach	0.824000	PF 9	PLS no ROF	300.00	837.00	850.15		850.15	0.000002	0.27	2812.37	388.69	0.01
Study Reach	0.824000	PF 9	PLSnewCulv	300.00	837.00	839.83	839.01	840.00	0.003315	4.13	144.65	109.87	0.44
Study Reach	0.824000	PF 10	PLS Cap Test	400.00	837.00	840.14	839.35	840.34	0.003506	4.66	180.71	122.33	0.46
Study Reach	0.824000	PF 10	PLS no ROF	400.00	837.00	850.26		850.26	0.000003	0.35	2853.08	388.69	0.02
Study Reach	0.824000	PF 10	PLSnewCulv	400.00	837.00	840.14	839.35	840.34	0.003506	4.50	180.71	122.33	0.46
Study Reach	0.824000	PF 11	PLS Cap Test	260.00	837.00	839.69	838.89	839.85	0.003188	3.90	129.57	103.31	0.43
Study Reach	0.824000	PF 11	PLS no ROF	260.00	837.00	850.10		850.10	0.000001	0.24	2790.59	388.69	0.01
Study Reach	0.824000	PF 11	PLSnewCulv	260.00	837.00	839.69		839.85	0.003198	3.91	129.36	103.22	0.43
Study Reach	0.824000	PF 12	PLS Cap Test	270.00	837.00	839.73	838.92	839.89	0.003204	3.95	133.71	105.15	0.43
Study Reach	0.824000	PF 12	PLS no ROF	270.00	837.00	850.11		850.11	0.000001	0.24	2796.59	388.69	0.01
Study Reach	0.824000	PF 12	PLSnewCulv	270.00	837.00	839.73	838.92	839.89	0.003204	3.95	133.71	105.15	0.43
Study Reach	0.824000	PF 13	PLS Cap Test	280.00	837.00	839.76	838.95	839.93	0.003272	4.02	136.83	106.52	0.44
Study Reach	0.824000	PF 13	PLS no ROF	280.00	837.00	850.13		850.13	0.000002	0.25	2804.89	388.69	0.01

HEC-RAS River: Thomas Hussey Reach: Study Reach (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Study Reach	0.824000	PF 13	PLSnewCulv	280.00	837.00	839.70	838 95	839.93	0.003272	4 02	136.83	106.52	0.44
Study Reach	0.824000	PF 14	PLS Cap Test	290.00	837.00	839.80	838.99	839.96	0.003304	4.08	140.56	108.14	0.44
Study Reach	0.824000	PF 14	PLS no ROF	290.00	837.00	850.16		850.16	0.000002	0.26	2816.21	388.69	0.01
Study Reach	0.824000	PF 14	PLSnewCulv	290.00	837.00	839.80	838.99	839.96	0.003304	4 08	140.56	108.14	0.44
Study Reach	0.824000	PF 15	PLS Cap Test	85.00	837.00	838.73		838.81	0.002560	2.55	51.97	57.43	0.36
Study Reach	0.824000	PF 15	PLS no ROF	85.00	837.00	838.73		838.81	0.002560	2.55	51.97	57.43	0.36
Study Reach	0 824000	PF 15	PLSnewCulv	85.00	837.00	838.48		838.61	0.004946	3.17	38.92	47.25	0 48
Study Reach	0.765999	PF 1	PLS Cap Test	50.00	835.80	836 57	836.57	836.82	0.024951	4.10	13.67	30 62	0.94
Study Reach	0.765999	PF 1	PLS no ROF	50.00	835.80	836.57	836.57	836.82	0.024951	4.10	13.67	30 62	0.94
Study Reach	0.765999	PF 1	PLSnewCulv	50.00	835.80	837.01		837.07	0.003272	2.05	30.54	45.78	0.37
Study Reach	0.765999	PF 2	PLS Cap Test	60.00	835.80	836.64	836.64	836.91	0.024199	4.31	15.94	33 01	0.94
Study Reach	0.765999	PF 2	PLS no ROF	60 00	835.80	836.64	836.64	836.91	0 024199	4.31	15.94	33.01	0.94
Study Reach	0.765999	PF 2	PLSnewCulv	60.00	835.80	837.12		837.18	0.003160	2.16	35 78	51.11	0.37
Study Reach	0.765999	PF 3	PLS Cap Test	70.00	835.80	836.71	836.71	836 99	0.023947	4.47	18.25	35 27	0.94
Study Reach	0.765999	PF 3	PLS no ROF	70.00	835.80	836.71	836.71	836.99	0.023947	4.47	18 25	35.27	0.94
Study Reach	0.765999	PF 3	PLSnewCulv	70.00	835.80	837.21		837.28	0.003198	2.29	40.34	65.33	0.38
Study Reach	0.765999	PF 4	PLS Cap Test	80.00	835.80	836.77	836.77	837.07	0.022741	4.63	20.49	37.34	0.94
Study Reach	0 765999	PF 4	PLS no ROF	80.00	835.80	836.77	836 77	837.07	0.022741	4.63	20.49	37.34	0.94
Study Reach	0.765999	PF 4	PLSnewCulv	80.00	835.80	837.28		837.36	0.003266	2.41	44.61	59.01	0.39
Study Reach	0.765999	PF 5	PLS Cap Test	90.00	835.80	836.83	836.83	837.14	0.021983	4.74	22.81	39.31	0.93
Study Reach	0.765999	PF 5	PLS no ROF	90.00	835.80	836.83	836.83	837.14	0.021983	4.74	22.81	39.31	0.93
Study Reach	0.765999	PF 5	PLSnewCulv	90.00	835.80	837.35		837.43	0.003327	2.53	48.82	62.42	0.39
Study Reach	0.765999	PF 6	PLS Cap Test	100.00	835.80	836.88	836.88	837.21	0.022171	4.91	24.72	40.84	0.94
Study Reach	0.765999	PF 6	PLS no ROF	100.00	835.80	836.88	836.88	837.21	0.022171	4 91	24.72	40.84	0.94
Study Reach	0.765999	PF 6	PLSnewCulv	100.00	835.80	837.42		837.50	0.003383	2.63	52.93	65.58	0 40
Study Reach	0.765999	PF 7	PLS Cap Test	200.00	835.80	837.30	837.30	837.75	0.018987	5.69	45.98	60.14	0.93
Study Reach	0.765999	PF 7	PLS no ROF	200.00	835.80	847.67		847.67	0.000001	0.21	1952.73	350.74	0.01
Study Reach	0.765999	PF 7	PLSnewCulv	200.00	835.80	837.83		837 98	0.004431	3.60	84.28	84 67	0 48
Study Reach	0.765999	PF 8	PLS Cap Test	250.00	835.80	837.47	837.47	837.95	0.018176	6.26	56.38	68.13	0 93
Study Reach	0.765999	PF 8	PLS no ROF	250.00	835.80	850.09		850.09	0.000001	0.18	2886.44	424.83	0.01
Study Reach	0.765999	PF 8	PLSnewCulv	250.00	835.80	837.47	837.47	837.95	0 018055	6.24	56.54	68.24	0.93
Study Reach	0.765999	PF 9	PLS Cap Test	300.00	835.80	837.63	837.63	838.13	0.016565	6.43	68.33	76.30	0 90
Study Reach	0.765999	PF 9	PLS no ROF	300.00	835.80	850.15		850.15	0.000001	0.21	2911.86	425.26	0.01
Study Reach	0.765999	PF 9	PLSnewCulv	300.00	835 80	837.63	837.63	838.13	0.018565	6.43	68.33	76.30	0.90
Study Reach	0.765999	PF 10	PLS Cap Test	400.00	835.80	837.88	837.88	838.42	0.015896	6.94	88.12	86.45	0.91
Study Reach	0.765999	PF 10	PLS no ROF	400.00	835 80	850.26		850.26	0.000002	0.26	2956.34	426 01	0.01
Study Reach	0.765999	PF 10	PLSnewCulv	400.00	835.80	837.88	837 88	838.42	0.015896	6.94	88.12	86.45	0 91
Study Reach	0.765999	PF 11	PLS Cap Test	260.00	835.80	837.50	837 50	837.99	0.017526	6.27	59.02	70.01	0 92
Study Reach	0.765999	PF 11	PLS no ROF	260 00	835.80	850.10		850.10	0.000001	0.18	2888 07	424.86	0 01
Study Reach	0.765999	PF 11	PLSnewCulv	260.00	835.80	837.50	837.50	837.99	0.017526	6.27	59.02	70.01	0 92
Study Reach	0.765999	PF 12	PLS Cap Test	270.00	835.80	837.53	837.53	838.02	0.017636	6.35	60.90	71.32	0.92
Study Reach	0.765999	PF 12	PLS no ROF	270.00	835.80	850.11		850.11	0.000001	0.19	2894 64	424.97	0.01
Study Reach	0.765999	PF 12	PLSnewCulv	270 00	835.80	837.53	837.53	838.02	0.017636	6.35	60 90	71.32	0 92
Study Reach	0.765999	PF 13	PLS Cap Test	280.00	835.80	837.58	837.58	838 06	0.016849	6.33	64.05	73.66	0.91
Study Reach	0.765999	PF 13	PLS no ROF	280 00	835.80	850.13		850.13	0.000001	0.20	2903.69	425.12	0.01
Study Reach	0.765999	PF 13	PLSnewCulv	280.00	835.80	837.58	837.58	838 06	0.016849	6.33	64.05	73.66	0.91
Study Reach	0.765999	PF 14	PLS Cap Test	290.00	835.80	837.61	837.61	838.09	0.016489	6.36	66 57	75.31	0.90
Study Reach	0.765999	PF 14	PLS no ROF	290.00	835.80	850.16		850.16	0.000001	0.20	2916.07	425.33	0.01
Study Reach	0.765999	PF 14	PLSnewCulv	290 00	835.80	837.61	837.61	838.09	0.016489	6.35	66.57	75.31	0.90
Study Reach	0.765999	PF 15	PLS Cap Test	85 00	835.80	836.80	836.80	837.11	0.022208	4.68	21.71	38.39	0.93
Study Reach	0.765999	PF 15	PLS no ROF	85.00	835.80	836.80	836.80	837.11	0.022208	4.68	21.71	38.39	0.93
Study Reach	0.765999	PF 15	PLSnewCulv	85 00	835.80	837.32		837.39	0.003304	2.47	46.59	60.72	0.39
Study Reach	0.689000	PF 1	PLS Cap Test	50.00	833.00	834.62		834.66	0 001640	1.77	34.03	44.56	0.27
Study Reach	0.689000	PF 1	PLS no ROF	50.00	833.00	834.62		834.66	0.001640	1.77	34.03	44.56	0.27
Study Reach	0.689000	PF 1	PLSnewCulv	50.00	833.00	833.91	833.89	834.19	0.025410	4.22	11.85	19.55	0.96
Study Reach	0.689000	PF 2	PLS Cap Test	60.00	833.00	835.02		835 05	0.000899	1.57	55.73	121.33	0.21
Study Reach	0.689000	PF 2	PLS no ROF	60.00	833.00	835.02		835.05	0.000899	1.57	55.73	121.33	0.21
Study Reach	0.689000	PF 2	PLSnewCulv	60.00	833.00	833.97	833 97	834 30	0.027798	4.62	13.00	20.42	1.01
Study Reach	0.689000	PF 3	PLS Cap Test	70 00	833.00	835.42		835.44	0 000363	1.15	107.50	135.34	0.14
Study Reach	0.689000	PF 3	PLS no ROF	70.00	833.00	835.42		835 44	0.000363	1.15	107.50	135.34	0 14
Study Reach	0.689000	PF 3	PLSnewCulv	70.00	833.00	834.05	834 05	834.41	0 026637	4.81	14 63	22.37	1.00
Study Reach	0.689000	PF 4	PLS Cap Test	80.00	833.00	835.83		835.84	0.000174	0.90	165.11	149 35	0.10
Study Reach	0.689000	PF 4	PLS no ROF	80.00	833.00	835.83		835 84	0.000174	0.90	165.11	149 35	0.10
Study Reach	0.689000	PF 4	PLSnewCulv	80.00	833.00	834.12	834 12	834.50	0.024879	4.97	16.39	25.12	0.99
Study Reach	0.689000	PF 5	PLS Cap Test	90.00	833.00	836.11		836.12	0.000122	0.81	209.04	160 80	0.09
Study Reach	0.689000	PF 5	PLS no ROF	90.00	833.00	836.27		836.27	0.000092	0.72	234 33	168.75	0.07
Study Reach	0.689000	PF 5	PLSnewCulv	90.00	833.00	834.20	834.20	834.59	0.022968	5.07	18 40	28.29	0.96
Study Reach	0.689000	PF 6	PLS Cap Test	100.00	833.00	836.24		836.24	0.000120	0.82	229.19	165 49	0.09
Study Reach	0 689000	PF 6	PLS no ROF	100.00	833.00	836.81		836.81	0.000046	0.56	329.46	185 40	0.05
Study Reach	0.689000	PF 6	PLSnewCulv	100.00	833.00	834.27	834 27	834.68	0.021689	5.19	20.45	31.27	0 95
Study Reach	0 689000	PF 7	PLS Cap Test	200.00	833.00	836.56		836.58	0.000272	1.33	285.02	177.18	0.13
Study Reach	0.689000	PF 7	PLS no ROF	200.00	833.00	847.67		847.67	0.000000	0.11	3631.32	436.83	0.01
Study Reach	0.689000	PF 7	PLSnewCulv	200.00	833.00	834.93		835.31	0.010973	5.29	49.50	54.33	0.74
Study Reach	0.689000	PF 8	PLS Cap Test	250.00	833.00	836.68		836.70	0.000348	1.54	307.31	181.37	0.15
Study Reach	0.689000	PF 8	PLS no ROF	250.00	833.00	850.09		850.09	0.000000	0.10	4720.92	460.73	0.00
Study Reach	0.689000	PF 8	PLSnewCulv	250.00	833.00	835.67		835.78	0.002446	3.22	142.00	143 89	0.37
Study Reach	0.689000	PF 9	PLS Cap Test	300.00	833.00	836.82		836.84	0.000408	1.72	332.11	185.82	0.16
Study Reach	0.689000	PF 9	PLS no ROF	300.00	833.00	850.15		850.15	0.000000	0.12	4748 47	461.22	0.01
Study Reach	0.689000	PF 9	PLSnewCulv	300.00	833.00	836.21		836.26	0.001138	2 52	224 33	164 46	0.26
Study Reach	0.689000	PF 10	PLS Cap Test	400.00	833.00	836.99		837.02	0.000569	2.09	383.38	190 80	0.19
Study Reach	0.689000	PF 10	PLS no ROF	400.00	833.00	850.26		850.26	0.000000	0.16	4796.71	462.08	0.01
Study Reach	0.689000	PF 10	PLSnewCulv	400.00	833.00	836.54		836.60	0.001118	2.69	282 21	176.67	0.26

HEC-RAS River: Thomas Hussey Reach: Study Reach (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Study Reach	0.689000	PF 11	PLS Cap Test	260.00	833.00	836.72		836.74	0.000358	1.56	313.17	182.54	0.15
Study Reach	0.689000	PF 11	PLS no ROF	260.00	833.00	850.10		850.10	0.000000	0.11	4722.70	460.76	0.00
Study Reach	0.689000	PF 11	PLSnewCulv	260.00	833.00	835.60		835.88	0.001972	2.99	160.33	148.24	0.34
Study Reach	0.689000	PF 12	PLS Cap Test	270.00	833.00	836.74		836.76	0.000372	1.61	317.77	183.46	0.15
Study Reach	0.689000	PF 12	PLS no ROF	270.00	833.00	850.11		850.11	0.000000	0.11	4729.76	460.88	0.00
Study Reach	0.689000	PF 12	PLSnewCulv	270.00	833.00	835.92		835.99	0.001626	2.81	178.73	152.56	0.31
Study Reach	0.689000	PF 13	PLS Cap Test	280.00	833.00	836.75		836.77	0.000393	1.66	319.76	183.83	0.16
Study Reach	0.689000	PF 13	PLS no ROF	280.00	833.00	850.13		850.13	0.000000	0.11	4739.60	461.08	0.00
Study Reach	0.689000	PF 13	PLSnewCulv	280.00	833.00	836.04		836.10	0.001369	2.65	197.28	157.59	0.28
Study Reach	0.689000	PF 14	PLS Cap Test	290.00	833.00	836.81		836.83	0.000389	1.67	329.56	186.41	0.16
Study Reach	0.689000	PF 14	PLS no ROF	290.00	833.00	850.16		850.16	0.000000	0.12	4753.03	461.30	0.01
Study Reach	0.689000	PF 14	PLSnewCulv	290.00	833.00	836.16		836.21	0.001170	2.52	216.14	162.75	0.26
Study Reach	0.689000	PF 15	PLS Cap Test	85.00	833.00	836.03		836.03	0.000129	0.81	195.57	167.15	0.09
Study Reach	0.689000	PF 15	PLS no ROF	85.00	833.00	836.04		836.06	0.000126	0.80	197.88	157.70	0.09
Study Reach	0.689000	PF 15	PLSnewCulv	85.00	833.00	834.16	834.16	834.55	0.023650	6.01	17.44	26.64	0.97
Study Reach	0.634000	PF 1	PLS Cap Test	50.00	831.00	834.63		834.63	0.000024	0.38	245.55	176.75	0.04
Study Reach	0.634000	PF 1	PLS no ROF	50.00	831.00	834.63		834.63	0.000024	0.38	245.55	176.75	0.04
Study Reach	0.634000	PF 1	PLSnewCulv	50.00	831.00	832.69		832.74	0.001908	1.83	28.60	28.82	0.29
Study Reach	0.634000	PF 2	PLS Cap Test	60.00	831.00	835.03		835.03	0.000018	0.36	319.71	193.08	0.03
Study Reach	0.634000	PF 2	PLS no ROF	60.00	831.00	835.03		835.03	0.000018	0.36	319.71	193.08	0.03
Study Reach	0.634000	PF 2	PLSnewCulv	60.00	831.00	832.87		832.93	0.001694	1.89	34.00	31.47	0.28
Study Reach	0.634000	PF 3	PLS Cap Test	70.00	831.00	835.42		835.42	0.000013	0.34	397.76	202.42	0.03
Study Reach	0.634000	PF 3	PLS no ROF	70.00	831.00	835.42		835.42	0.000013	0.34	397.76	202.42	0.03
Study Reach	0.634000	PF 3	PLSnewCulv	70.00	831.00	833.05		833.10	0.001555	1.96	40.19	49.00	0.28
Study Reach	0.634000	PF 4	PLS Cap Test	80.00	831.00	835.83		835.83	0.000010	0.32	481.03	210.15	0.03
Study Reach	0.634000	PF 4	PLS no ROF	80.00	831.00	835.83		835.83	0.000010	0.32	481.03	210.15	0.03
Study Reach	0.634000	PF 4	PLSnewCulv	80.00	831.00	833.22		833.27	0.001351	1.96	50.62	69.59	0.26
Study Reach	0.634000	PF 5	PLS Cap Test	90.00	831.00	836.11		836.11	0.000009	0.31	541.27	214.31	0.03
Study Reach	0.634000	PF 5	PLS no ROF	90.00	831.00	836.26		836.26	0.000008	0.29	574.55	216.15	0.02
Study Reach	0.634000	PF 5	PLSnewCulv	90.00	831.00	833.38		833.44	0.001181	1.93	64.09	96.01	0.25
Study Reach	0.634000	PF 6	PLS Cap Test	100.00	831.00	836.23		836.23	0.000010	0.33	567.74	215.78	0.03
Study Reach	0.634000	PF 6	PLS no ROF	100.00	831.00	836.80		836.80	0.000008	0.27	693.00	222.82	0.02
Study Reach	0.634000	PF 6	PLSnewCulv	100.00	831.00	833.55		833.60	0.000984	1.88	81.31	113.78	0.23
Study Reach	0.634000	PF 7	PLS Cap Test	200.00	831.00	836.55		836.55	0.000029	0.59	637.24	219.57	0.05
Study Reach	0.634000	PF 7	PLS no ROF	200.00	831.00	847.67		847.67	0.000000	0.10	4214.34	467.11	0.00
Study Reach	0.634000	PF 7	PLSnewCulv	200.00	831.00	835.01		835.02	0.000201	1.21	316.01	192.66	0.11
Study Reach	0.634000	PF 8	PLS Cap Test	250.00	831.00	836.67		836.68	0.000040	0.70	663.85	221.03	0.05
Study Reach	0.634000	PF 8	PLS no ROF	250.00	831.00	850.09		850.09	0.000000	0.09	5346.79	467.11	0.00
Study Reach	0.634000	PF 8	PLSnewCulv	250.00	831.00	835.65		835.66	0.000126	1.07	449.80	207.13	0.09
Study Reach	0.634000	PF 9	PLS Cap Test	300.00	831.00	836.80		836.81	0.000051	0.80	693.01	222.62	0.06
Study Reach	0.634000	PF 9	PLS no ROF	300.00	831.00	850.15		850.15	0.000000	0.11	5374.68	467.11	0.00
Study Reach	0.634000	PF 9	PLSnewCulv	300.00	831.00	836.18		836.19	0.000098	1.02	556.13	215.14	0.08
Study Reach	0.634000	PF 10	PLS Cap Test	400.00	831.00	836.96		836.97	0.000078	1.02	728.18	224.52	0.08
Study Reach	0.634000	PF 10	PLS no ROF	400.00	831.00	850.26		850.26	0.000000	0.14	5423.49	467.11	0.01
Study Reach	0.634000	PF 10	PLSnewCulv	400.00	831.00	836.51		836.52	0.000121	1.19	627.51	219.04	0.09
Study Reach	0.634000	PF 11	PLS Cap Test	260.00	831.00	836.70		836.71	0.000042	0.72	670.83	221.41	0.06
Study Reach	0.634000	PF 11	PLS no ROF	260.00	831.00	850.10		850.10	0.000000	0.09	5348.56	467.11	0.00
Study Reach	0.634000	PF 11	PLSnewCulv	260.00	831.00	835.77		835.78	0.000117	1.05	469.36	209.22	0.09
Study Reach	0.634000	PF 12	PLS Cap Test	270.00	831.00	836.73		836.73	0.000044	0.74	676.25	221.71	0.06
Study Reach	0.634000	PF 12	PLS no ROF	270.00	831.00	850.11		850.11	0.000000	0.10	5355.75	467.11	0.00
Study Reach	0.634000	PF 12	PLSnewCulv	270.00	831.00	835.89		835.90	0.000109	1.03	494.85	211.25	0.09
Study Reach	0.634000	PF 13	PLS Cap Test	280.00	831.00	836.74		836.74	0.000047	0.77	678.44	221.83	0.06
Study Reach	0.634000	PF 13	PLS no ROF	280.00	831.00	850.13		850.13	0.000000	0.10	5365.70	467.11	0.00
Study Reach	0.634000	PF 13	PLSnewCulv	280.00	831.00	836.01		836.02	0.000101	1.02	520.25	213.17	0.08
Study Reach	0.634000	PF 14	PLS Cap Test	290.00	831.00	836.79		836.80	0.000048	0.78	690.18	222.47	0.06
Study Reach	0.634000	PF 14	PLS no ROF	290.00	831.00	850.16		850.16	0.000000	0.11	5379.30	467.11	0.00
Study Reach	0.634000	PF 14	PLSnewCulv	290.00	831.00	836.13		836.14	0.000095	1.00	545.56	214.55	0.08
Study Reach	0.634000	PF 15	PLS Cap Test	85.00	831.00	836.02		836.03	0.000009	0.31	523.16	213.33	0.03
Study Reach	0.634000	PF 15	PLS no ROF	85.00	831.00	836.04		836.04	0.000009	0.31	526.04	213.48	0.03
Study Reach	0.634000	PF 15	PLSnewCulv	85.00	831.00	833.30		833.36	0.001249	1.94	56.85	78.57	0.25
Study Reach	0.609000	PF 1	PLS Cap Test	50.00	831.00	834.63	831.70	834.63	0.000012	0.30	255.76	181.41	0.03
Study Reach	0.609000	PF 1	PLS no ROF	50.00	831.00	834.63	831.70	834.63	0.000012	0.30	255.76	181.41	0.03
Study Reach	0.609000	PF 1	PLSnewCulv	50.00	831.00	832.57	831.70	832.59	0.000692	1.25	61.02	81.43	0.18
Study Reach	0.609000	PF 2	PLS Cap Test	60.00	831.00	835.03	831.77	835.03	0.000011	0.31	294.29	193.55	0.03
Study Reach	0.609000	PF 2	PLS no ROF	60.00	831.00	835.03	831.77	835.03	0.000011	0.31	294.29	193.55	0.03
Study Reach	0.609000	PF 2	PLSnewCulv	60.00	831.00	832.78	831.77	832.79	0.000541	1.20	79.03	92.41	0.17
Study Reach	0.609000	PF 3	PLS Cap Test	70.00	831.00	835.42	831.84	835.42	0.000010	0.32	332.20	203.25	0.03
Study Reach	0.609000	PF 3	PLS no ROF	70.00	831.00	835.42	831.84	835.42	0.000010	0.32	332.20	203.25	0.03
Study Reach	0.609000	PF 3	PLSnewCulv	70.00	831.00	832.97	831.84	832.99	0.000431	1.16	97.26	102.37	0.15
Study Reach	0.609000	PF 4	PLS Cap Test	80.00	831.00	835.82	831.90	835.83	0.000009	0.32	370.90	214.32	0.03
Study Reach	0.609000	PF 4	PLS no ROF	80.00	831.00	835.82	831.90	835.83	0.000009	0.32	370.90	214.32	0.03
Study Reach	0.609000	PF 4	PLSnewCulv	80.00	831.00	833.16	831.90	833.17	0.000355	1.12	114.97	130.04	0.14
Study Reach	0.609000	PF 5	PLS Cap Test	90.00	831.00	836.11	831.96	836.11	0.000010	0.33	398.11	222.88	0.03
Study Reach	0.609000	PF 5	PLS no ROF	90.00	831.00	836.26	831.96	836.26	0.000008	0.32	412.97	226.10	0.02
Study Reach	0.609000	PF 5	PLSnewCulv	90.00	831.00	833.34	831.96	833.35	0.000301	1.09	132.09	137.05	0.13
Study Reach	0.609000	PF 6	PLS Cap Test	100.00	831.00	836.23	832.00	836.23	0.000011	0.36	409.91	225.46	0.03
Study Reach	0.609000	PF 6	PLS no ROF	100.00	831.00	836.80	832.00	836.80	0.000004	0.23	812.14	237.10	0.02
Study Reach	0.609000	PF 6	PLSnewCulv	100.00	831.00	833.51	832.00	833.52	0.000262	1.07	148.57	143.79	0.12
Study Reach	0.609000	PF 7	PLS Cap Test	200.00	831.00	836.55	832.46	836.55	0.000019	0.50	752.52	231.89	0.04
Study Reach	0.609000	PF 7	PLS no ROF	200.00	831.00	847.67	832.46	847.67	0.000000	0.08	4980.46	531.87	0.00
Study Reach	0.609000	PF 7	PLSnewCulv	200.00	831.00	834.99	832.46	835.00	0.000129	1.04	290.76	192.59	0.09
Study Reach	0.609000	PF 8	PLS Cap Test	250.00	831.00	836.67	832.81	836.67	0.000027	0.60	780.42	234.33	0.05

HEC-RAS River: Thomas Hussey Reach: Study Reach (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Study Reach	0.609000	PF 8	PLS no ROF	250.00	831.00	850.09	832.61	850.09	0.000000	0.08	6269.45	531.67	0.00
Study Reach	0.609000	PF 8	PLSnewCulv	250.00	831.00	835.63	832.61	835.64	0.000109	1.06	352.31	208.81	0.09
Study Reach	0.609000	PF 9	PLS Cap Test	300.00	831.00	836.80	832.73	836.80	0.000035	0.69	811.16	237.01	0.05
Study Reach	0.609000	PF 9	PLS no ROF	300.00	831.00	850.15	832.73	850.15	0.000000	0.09	6301.19	531.67	0.00
Study Reach	0.609000	PF 9	PLSnewCulv	300.00	831.00	836.16	832.73	836.17	0.000101	1.10	403.27	224.06	0.09
Study Reach	0.609000	PF 10	PLS Cap Test	400.00	831.00	836.95	832.95	836.96	0.000054	0.88	648.06	240.22	0.06
Study Reach	0.609000	PF 10	PLS no ROF	400.00	831.00	850.26	832.95	850.26	0.000000	0.12	6358.74	531.67	0.00
Study Reach	0.609000	PF 10	PLSnewCulv	400.00	831.00	836.48	832.95	836.50	0.000142	1.35	434.07	230.54	0.10
Study Reach	0.609000	PF 11	PLS Cap Test	260.00	831.00	836.70	832.64	836.70	0.000028	0.62	787.78	234.97	0.05
Study Reach	0.609000	PF 11	PLS no ROF	260.00	831.00	850.10	832.64	850.10	0.000000	0.08	6271.46	531.67	0.00
Study Reach	0.609000	PF 11	PLSnewCulv	260.00	831.00	835.75	832.64	835.76	0.000106	1.06	364.10	212.47	0.09
Study Reach	0.609000	PF 12	PLS Cap Test	270.00	831.00	836.72	832.67	836.73	0.000030	0.64	793.50	235.47	0.05
Study Reach	0.609000	PF 12	PLS no ROF	270.00	831.00	850.11	832.67	850.11	0.000000	0.08	6279.84	531.67	0.00
Study Reach	0.609000	PF 12	PLSnewCulv	270.00	831.00	835.87	832.67	835.89	0.000103	1.07	375.75	215.64	0.09
Study Reach	0.609000	PF 13	PLS Cap Test	280.00	831.00	836.73	832.69	836.74	0.000032	0.66	795.75	235.66	0.05
Study Reach	0.609000	PF 13	PLS no ROF	280.00	831.00	850.13	832.69	850.13	0.000000	0.09	6290.96	531.67	0.00
Study Reach	0.609000	PF 13	PLSnewCulv	280.00	831.00	835.99	832.69	836.00	0.000101	1.07	387.25	218.76	0.09
Study Reach	0.609000	PF 14	PLS Cap Test	290.00	831.00	836.79	832.71	836.79	0.000033	0.67	808.21	236.76	0.05
Study Reach	0.609000	PF 14	PLS no ROF	290.00	831.00	850.16	832.71	850.16	0.000000	0.09	6306.44	531.67	0.00
Study Reach	0.609000	PF 14	PLSnewCulv	290.00	831.00	836.11	832.71	836.12	0.000098	1.07	398.61	222.99	0.08
Study Reach	0.609000	PF 15	PLS Cap Test	85.00	831.00	836.02	831.93	836.02	0.000009	0.32	390.00	220.91	0.03
Study Reach	0.609000	PF 15	PLS no ROF	85.00	831.00	836.04	831.93	836.04	0.000009	0.32	391.29	221.28	0.03
Study Reach	0.609000	PF 15	PLSnewCulv	85.00	831.00	833.25	831.93	833.26	0.000326	1.11	123.62	133.59	0.13
Study Reach	0.600			Culvert									
Study Reach	0.584999	PF 1	PLS Cap Test	50.00	830.00	831.15	830.84	831.27	0.006661	2.77	18.10	31.78	0.52
Study Reach	0.584999	PF 1	PLS no ROF	50.00	830.00	831.15	830.84	831.27	0.006661	2.77	18.10	31.78	0.52
Study Reach	0.584999	PF 1	PLSnewCulv	50.00	830.00	831.15	830.84	831.27	0.006661	2.77	18.10	31.78	0.52
Study Reach	0.584999	PF 2	PLS Cap Test	60.00	830.00	831.28	830.92	831.40	0.006521	2.96	20.41	35.04	0.53
Study Reach	0.584999	PF 2	PLS no ROF	60.00	830.00	831.28	830.92	831.40	0.006521	2.96	20.41	35.04	0.53
Study Reach	0.584999	PF 2	PLSnewCulv	60.00	830.00	831.28	830.92	831.40	0.006521	2.96	20.41	35.04	0.53
Study Reach	0.584999	PF 3	PLS Cap Test	70.00	830.00	831.37	830.99	831.52	0.006320	3.12	22.71	46.15	0.53
Study Reach	0.584999	PF 3	PLS no ROF	70.00	830.00	831.37	830.99	831.52	0.006320	3.12	22.71	46.15	0.53
Study Reach	0.584999	PF 3	PLSnewCulv	70.00	830.00	831.37	830.99	831.52	0.006320	3.12	22.71	46.15	0.53
Study Reach	0.584999	PF 4	PLS Cap Test	80.00	830.00	831.46	831.05	831.63	0.006249	3.27	24.81	52.61	0.53
Study Reach	0.584999	PF 4	PLS no ROF	80.00	830.00	831.46	831.05	831.63	0.006249	3.27	24.81	52.61	0.53
Study Reach	0.584999	PF 4	PLSnewCulv	80.00	830.00	831.46	831.05	831.63	0.006249	3.27	24.81	52.61	0.53
Study Reach	0.584999	PF 5	PLS Cap Test	90.00	830.00	831.55	831.12	831.73	0.006233	3.43	26.79	58.56	0.54
Study Reach	0.584999	PF 5	PLS no ROF	90.00	830.00	831.55	831.12	831.73	0.006233	3.43	26.79	58.56	0.54
Study Reach	0.584999	PF 5	PLSnewCulv	90.00	830.00	831.55	831.12	831.73	0.006233	3.43	26.79	58.56	0.54
Study Reach	0.584999	PF 6	PLS Cap Test	100.00	830.00	831.71	831.19	831.82	0.003626	2.70	48.37	69.67	0.41
Study Reach	0.584999	PF 6	PLS no ROF	100.00	830.00	831.63	831.18	831.83	0.006205	3.57	28.72	64.29	0.54
Study Reach	0.584999	PF 6	PLSnewCulv	100.00	830.00	831.63	831.18	831.83	0.006205	3.57	28.72	64.29	0.54
Study Reach	0.584999	PF 7	PLS Cap Test	200.00	830.00	832.10	831.67	832.30	0.005288	3.67	87.27	154.44	0.52
Study Reach	0.584999	PF 7	PLS no ROF	200.00	830.00	832.10	831.72	832.30	0.005288	3.87	87.27	154.44	0.52
Study Reach	0.584999	PF 7	PLSnewCulv	200.00	830.00	832.25	831.72	832.61	0.006936	4.84	43.88	156.49	0.61
Study Reach	0.584999	PF 8	PLS Cap Test	250.00	830.00	832.26	831.85	832.47	0.005171	4.07	112.28	156.71	0.52
Study Reach	0.584999	PF 8	PLS no ROF	250.00	830.00	832.26	831.95	832.47	0.005171	4.07	112.28	156.71	0.52
Study Reach	0.584999	PF 8	PLSnewCulv	250.00	830.00	832.47	831.95	832.92	0.007486	5.41	49.80	159.69	0.64
Study Reach	0.584999	PF 9	PLS Cap Test	300.00	830.00	832.41	831.94	832.62	0.005041	4.22	135.14	158.77	0.52
Study Reach	0.584999	PF 9	PLS no ROF	300.00	830.00	832.41	832.17	832.62	0.005041	4.22	135.14	158.77	0.52
Study Reach	0.584999	PF 9	PLSnewCulv	300.00	830.00	832.67	832.17	833.20	0.007981	5.91	55.13	162.55	0.67
Study Reach	0.584999	PF 10	PLS Cap Test	400.00	830.00	832.66	832.35	832.87	0.004902	4.49	175.34	162.41	0.52
Study Reach	0.584999	PF 10	PLS no ROF	400.00	830.00	832.66	832.36	832.87	0.004902	4.49	175.34	162.41	0.52
Study Reach	0.584999	PF 10	PLSnewCulv	400.00	830.00	833.00	832.58	833.70	0.009014	6.85	64.08	167.60	0.73
Study Reach	0.584999	PF 11	PLS Cap Test	260.00	830.00	832.29	831.89	832.50	0.005140	4.10	117.05	157.14	0.52
Study Reach	0.584999	PF 11	PLS no ROF	260.00	830.00	832.29	831.99	832.50	0.005140	4.10	117.05	157.14	0.52
Study Reach	0.584999	PF 11	PLSnewCulv	260.00	830.00	832.52	831.99	832.97	0.007565	5.51	50.97	160.32	0.65
Study Reach	0.584999	PF 12	PLS Cap Test	270.00	830.00	832.33	832.11	832.53	0.005095	4.12	121.91	157.58	0.52
Study Reach	0.584999	PF 12	PLS no ROF	270.00	830.00	832.33	832.11	832.53	0.005095	4.12	121.91	157.58	0.52
Study Reach	0.584999	PF 12	PLSnewCulv	270.00	830.00	832.55	832.03	833.03	0.007692	5.61	52.00	160.88	0.66
Study Reach	0.584999	PF 13	PLS Cap Test	280.00	830.00	832.35	832.13	832.56	0.005087	4.16	126.27	157.97	0.52
Study Reach	0.584999	PF 13	PLS no ROF	280.00	830.00	832.35	832.13	832.56	0.005087	4.16	126.27	157.97	0.52
Study Reach	0.584999	PF 13	PLSnewCulv	280.00	830.00	832.59	832.08	833.09	0.007802	5.72	53.03	161.44	0.66
Study Reach	0.584999	PF 14	PLS Cap Test	290.00	830.00	832.38	831.97	832.59	0.005068	4.19	130.69	158.37	0.52
Study Reach	0.584999	PF 14	PLS no ROF	290.00	830.00	832.38	832.15	832.59	0.005068	4.19	130.69	158.37	0.52
Study Reach	0.584999	PF 14	PLSnewCulv	290.00	830.00	832.63	832.11	833.14	0.007896	5.82	54.08	162.00	0.67
Study Reach	0.584999	PF 15	PLS Cap Test	85.00	830.00	831.51	831.08	831.68	0.006231	3.36	25.82	55.66	0.53
Study Reach	0.584999	PF 15	PLS no ROF	85.00	830.00	831.51	831.09	831.68	0.006231	3.36	25.82	55.66	0.53
Study Reach	0.584999	PF 15	PLSnewCulv	85.00	830.00	831.51	831.09	831.68	0.006231	3.36	25.82	55.66	0.53
Study Reach	0.521000	PF 1	PLS Cap Test	50.00	827.00	828.84	828.45	829.03	0.006642	3.69	17.18	20.72	0.55
Study Reach	0.521000	PF 1	PLS no ROF	50.00	827.00	828.84	828.45	829.03	0.006642	3.69	17.18	20.72	0.55
Study Reach	0.521000	PF 1	PLSnewCulv	50.00	827.00	828.84	828.45	829.03	0.006642	3.69	17.18	20.72	0.55
Study Reach	0.521000	PF 2	PLS Cap Test	60.00	827.00	828.98	828.59	829.20	0.006585	3.92	20.28	22.82	0.56
Study Reach	0.521000	PF 2	PLS no ROF	60.00	827.00	828.98	828.59	829.20	0.006585	3.92	20.28	22.82	0.56
Study Reach	0.521000	PF 2	PLSnewCulv	60.00	827.00	828.98	828.59	829.20	0.006585	3.92	20.28	22.82	0.56
Study Reach	0.521000	PF 3	PLS Cap Test	70.00	827.00	829.12	828.70	829.36	0.006577	4.15	24.18	31.76	0.57
Study Reach	0.521000	PF 3	PLS no ROF	70.00	827.00	829.12	828.70	829.36	0.006577	4.15	24.18	31.76	0.57
Study Reach	0.521000	PF 3	PLSnewCulv	70.00	827.00	829.12	828.70	829.36	0.006577	4.15	24.18	31.76	0.57
Study Reach	0.521000	PF 4	PLS Cap Test	80.00	827.00	829.22	828.85	829.48	0.006629	4.34	27.84	35.98	0.57
Study Reach	0.521000	PF 4	PLS no ROF	80.00	827.00	829.22	828.85	829.48	0.006629	4.34	27.84	35.98	0.57
Study Reach	0.521000	PF 4	PLSnewCulv	80.00	827.00	829.22	828.85	829.48	0.006629	4.34	27.84	35.98	0.57

HEC-RAS River: Thomas Hussey Reach: Study Reach (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Study Reach	0.521000	PF 5	PLS Cap Test	90.00	827.00	829.32	828.91	829.59	0.006681	4.51	31.53	39.78	0.58
Study Reach	0.521000	PF 5	PLS no ROF	90.00	827.00	829.32	828.91	829.59	0.006681	4.51	31.53	39.78	0.58
Study Reach	0.521000	PF 5	PLSnewCulv	90.00	827.00	829.32	828.91	829.59	0.006681	4.51	31.53	39.78	0.58
Study Reach	0.521000	PF 6	PLS Cap Test	100.00	827.00	829.41	828.96	829.69	0.006738	4.68	35.20	43.24	0.59
Study Reach	0.521000	PF 6	PLS no ROF	100.00	827.00	829.41	828.96	829.69	0.006738	4.68	35.20	43.24	0.59
Study Reach	0.521000	PF 6	PLSnewCulv	100.00	827.00	829.41	828.96	829.69	0.006738	4.68	35.20	43.24	0.59
Study Reach	0.521000	PF 7	PLS Cap Test	200.00	827.00	830.07	829.81	830.42	0.006783	5.69	73.72	73.09	0.62
Study Reach	0.521000	PF 7	PLS no ROF	200.00	827.00	830.07	829.81	830.42	0.006783	5.69	73.72	73.09	0.62
Study Reach	0.521000	PF 7	PLSnewCulv	200.00	827.00	830.07	829.81	830.42	0.006783	5.69	73.72	73.09	0.62
Study Reach	0.521000	PF 8	PLS Cap Test	250.00	827.00	830.33	830.03	830.68	0.006556	5.96	93.79	84.37	0.62
Study Reach	0.521000	PF 8	PLS no ROF	250.00	827.00	830.33	830.03	830.68	0.006556	5.96	93.79	84.37	0.62
Study Reach	0.521000	PF 8	PLSnewCulv	250.00	827.00	830.33	830.03	830.68	0.006556	5.96	93.79	84.37	0.62
Study Reach	0.521000	PF 9	PLS Cap Test	300.00	827.00	830.54	830.23	830.90	0.006464	6.20	112.75	93.77	0.62
Study Reach	0.521000	PF 9	PLS no ROF	300.00	827.00	830.54	830.23	830.90	0.006464	6.20	112.75	93.77	0.62
Study Reach	0.521000	PF 9	PLSnewCulv	300.00	827.00	830.54	830.23	830.90	0.006464	6.20	112.75	93.77	0.62
Study Reach	0.521000	PF 10	PLS Cap Test	400.00	827.00	830.92	830.55	831.28	0.006170	6.54	151.10	110.48	0.62
Study Reach	0.521000	PF 10	PLS no ROF	400.00	827.00	830.92	830.55	831.28	0.006170	6.54	151.10	110.48	0.62
Study Reach	0.521000	PF 10	PLSnewCulv	400.00	827.00	830.92	830.55	831.28	0.006170	6.54	151.10	110.48	0.62
Study Reach	0.521000	PF 11	PLS Cap Test	260.00	827.00	830.37	830.07	830.73	0.006542	6.01	97.58	86.33	0.62
Study Reach	0.521000	PF 11	PLS no ROF	260.00	827.00	830.37	830.07	830.73	0.006542	6.01	97.58	86.33	0.62
Study Reach	0.521000	PF 11	PLSnewCulv	260.00	827.00	830.37	830.07	830.73	0.006542	6.01	97.58	86.33	0.62
Study Reach	0.521000	PF 12	PLS Cap Test	270.00	827.00	830.41	830.11	830.77	0.006558	6.07	101.12	88.12	0.62
Study Reach	0.521000	PF 12	PLS no ROF	270.00	827.00	830.41	830.11	830.77	0.006558	6.07	101.12	88.12	0.62
Study Reach	0.521000	PF 12	PLSnewCulv	270.00	827.00	830.41	830.11	830.77	0.006558	6.07	101.12	88.12	0.62
Study Reach	0.521000	PF 13	PLS Cap Test	280.00	827.00	830.46	830.15	830.81	0.006505	6.11	105.16	90.13	0.62
Study Reach	0.521000	PF 13	PLS no ROF	280.00	827.00	830.46	830.15	830.81	0.006505	6.11	105.16	90.13	0.62
Study Reach	0.521000	PF 13	PLSnewCulv	280.00	827.00	830.46	830.15	830.81	0.006505	6.11	105.16	90.13	0.62
Study Reach	0.521000	PF 14	PLS Cap Test	290.00	827.00	830.50	830.18	830.86	0.006475	6.15	109.04	92.01	0.62
Study Reach	0.521000	PF 14	PLS no ROF	290.00	827.00	830.50	830.18	830.86	0.006475	6.15	109.04	92.01	0.62
Study Reach	0.521000	PF 14	PLSnewCulv	290.00	827.00	830.50	830.18	830.86	0.006475	6.15	109.04	92.01	0.62
Study Reach	0.521000	PF 15	PLS Cap Test	85.00	827.00	829.27	828.87	829.54	0.006662	4.43	29.67	37.91	0.58
Study Reach	0.521000	PF 15	PLS no ROF	85.00	827.00	829.27	828.87	829.54	0.006662	4.43	29.67	37.91	0.58
Study Reach	0.521000	PF 15	PLSnewCulv	85.00	827.00	829.27	828.87	829.54	0.006662	4.43	29.67	37.91	0.58
Study Reach	0.374000	PF 1	PLS Cap Test	50.00	823.00	824.65		824.76	0.004763	2.65	20.38	20.48	0.46
Study Reach	0.374000	PF 1	PLS no ROF	50.00	823.00	824.65		824.76	0.004763	2.65	20.38	20.48	0.46
Study Reach	0.374000	PF 1	PLSnewCulv	50.00	823.00	824.65		824.76	0.004763	2.65	20.38	20.48	0.46
Study Reach	0.374000	PF 2	PLS Cap Test	60.00	823.00	824.79		824.91	0.004859	2.79	23.38	22.09	0.46
Study Reach	0.374000	PF 2	PLS no ROF	60.00	823.00	824.79		824.91	0.004859	2.79	23.38	22.09	0.46
Study Reach	0.374000	PF 2	PLSnewCulv	60.00	823.00	824.79		824.91	0.004859	2.79	23.38	22.09	0.46
Study Reach	0.374000	PF 3	PLS Cap Test	70.00	823.00	824.92		825.04	0.004917	2.91	26.24	23.51	0.47
Study Reach	0.374000	PF 3	PLS no ROF	70.00	823.00	824.92		825.04	0.004917	2.91	26.24	23.51	0.47
Study Reach	0.374000	PF 3	PLSnewCulv	70.00	823.00	824.92		825.04	0.004917	2.91	26.24	23.51	0.47
Study Reach	0.374000	PF 4	PLS Cap Test	80.00	823.00	825.02		825.15	0.004951	3.07	28.54	24.64	0.48
Study Reach	0.374000	PF 4	PLS no ROF	80.00	823.00	825.02		825.15	0.004951	3.07	28.54	24.64	0.48
Study Reach	0.374000	PF 4	PLSnewCulv	80.00	823.00	825.02		825.15	0.004951	3.07	28.54	24.64	0.48
Study Reach	0.374000	PF 5	PLS Cap Test	90.00	823.00	825.11		825.26	0.004987	3.22	30.82	26.11	0.48
Study Reach	0.374000	PF 5	PLS no ROF	90.00	823.00	825.11		825.26	0.004987	3.22	30.82	26.11	0.48
Study Reach	0.374000	PF 5	PLSnewCulv	90.00	823.00	825.11		825.26	0.004987	3.22	30.82	26.11	0.48
Study Reach	0.374000	PF 6	PLS Cap Test	100.00	823.00	825.19		825.36	0.005016	3.37	33.12	27.51	0.49
Study Reach	0.374000	PF 6	PLS no ROF	100.00	823.00	825.19		825.36	0.005016	3.37	33.12	27.51	0.49
Study Reach	0.374000	PF 6	PLSnewCulv	100.00	823.00	825.19		825.36	0.005016	3.37	33.12	27.51	0.49
Study Reach	0.374000	PF 7	PLS Cap Test	200.00	823.00	825.88		826.16	0.005207	4.43	56.01	39.62	0.53
Study Reach	0.374000	PF 7	PLS no ROF	200.00	823.00	825.88		826.16	0.005207	4.43	56.01	39.62	0.53
Study Reach	0.374000	PF 7	PLSnewCulv	200.00	823.00	825.88		826.16	0.005207	4.43	56.01	39.62	0.53
Study Reach	0.374000	PF 8	PLS Cap Test	250.00	823.00	826.13		826.46	0.005424	4.87	67.82	52.96	0.55
Study Reach	0.374000	PF 8	PLS no ROF	250.00	823.00	826.13		826.46	0.005424	4.87	67.82	52.96	0.55
Study Reach	0.374000	PF 8	PLSnewCulv	250.00	823.00	826.13		826.46	0.005424	4.87	67.82	52.96	0.55
Study Reach	0.374000	PF 9	PLS Cap Test	300.00	823.00	826.35		826.72	0.005534	5.22	79.92	57.10	0.57
Study Reach	0.374000	PF 9	PLS no ROF	300.00	823.00	826.35		826.72	0.005534	5.22	79.92	57.10	0.57
Study Reach	0.374000	PF 9	PLSnewCulv	300.00	823.00	826.35		826.72	0.005534	5.22	79.92	57.10	0.57
Study Reach	0.374000	PF 10	PLS Cap Test	400.00	823.00	826.72		827.16	0.005805	5.83	102.27	63.98	0.59
Study Reach	0.374000	PF 10	PLS no ROF	400.00	823.00	826.72		827.16	0.005805	5.83	102.27	63.98	0.59
Study Reach	0.374000	PF 10	PLSnewCulv	400.00	823.00	826.72		827.16	0.005805	5.83	102.27	63.98	0.59
Study Reach	0.374000	PF 11	PLS Cap Test	260.00	823.00	826.18		826.52	0.005445	4.94	70.30	53.83	0.56
Study Reach	0.374000	PF 11	PLS no ROF	260.00	823.00	826.18		826.52	0.005445	4.94	70.30	53.83	0.56
Study Reach	0.374000	PF 11	PLSnewCulv	260.00	823.00	826.18		826.52	0.005445	4.94	70.30	53.83	0.56
Study Reach	0.374000	PF 12	PLS Cap Test	270.00	823.00	826.23		826.57	0.005430	5.00	72.98	54.76	0.56
Study Reach	0.374000	PF 12	PLS no ROF	270.00	823.00	826.23		826.57	0.005430	5.00	72.98	54.76	0.56
Study Reach	0.374000	PF 12	PLSnewCulv	270.00	823.00	826.23		826.57	0.005430	5.00	72.98	54.76	0.56
Study Reach	0.374000	PF 13	PLS Cap Test	280.00	823.00	826.27		826.62	0.005498	5.09	75.11	55.49	0.56
Study Reach	0.374000	PF 13	PLS no ROF	280.00	823.00	826.27		826.62	0.005498	5.09	75.11	55.49	0.56
Study Reach	0.374000	PF 13	PLSnewCulv	280.00	823.00	826.27		826.62	0.005498	5.09	75.11	55.49	0.56
Study Reach	0.374000	PF 14	PLS Cap Test	290.00	823.00	826.31		826.67	0.005540	5.16	77.37	56.25	0.57
Study Reach	0.374000	PF 14	PLS no ROF	290.00	823.00	826.31		826.67	0.005540	5.16	77.37	56.25	0.57
Study Reach	0.374000	PF 14	PLSnewCulv	290.00	823.00	826.31		826.67	0.005540	5.16	77.37	56.25	0.57
Study Reach	0.374000	PF 15	PLS Cap Test	85.00	823.00	825.06		825.21	0.004969	3.15	29.68	25.38	0.48
Study Reach	0.374000	PF 15	PLS no ROF	85.00	823.00	825.06		825.21	0.004969	3.15	29.68	25.38	0.48
Study Reach	0.374000	PF 15	PLSnewCulv	85.00	823.00	825.06		825.21	0.004969	3.15	29.68	25.38	0.48
Study Reach	0.303999	PF 1	PLS Cap Test	50.00	821.00	822.30	821.97	822.46	0.008623	3.17	15.79	17.52	0.59
Study Reach	0.303999	PF 1	PLS no ROF	50.00	821.00	822.30	821.97	822.46	0.008623	3.17	15.79	17.52	0.59
Study Reach	0.303999	PF 1	PLSnewCulv	50.00	821.00	822.30	821.97	822.46	0.008623	3.17	15.79	17.52	0.59
Study Reach	0.303999	PF 2	PLS Cap Test	60.00	821.00	822.43	822.07	822.60	0.008447	3.30	18.16	18.80	0.59

HEC-RAS River: Thomas Hussey Reach: Study Reach (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Study Reach	0.303999	PF 2	PLS no ROF	60.00	821.00	822.43	822.07	822.60	0.008447	3.30	18.16	18.60	0.59
Study Reach	0.303999	PF 2	PLSnewCulv	60.00	821.00	822.43	822.07	822.60	0.008447	3.30	18.16	18.60	0.59
Study Reach	0.303999	PF 3	PLS Cap Test	70.00	821.00	822.65	822.17	822.73	0.008372	3.43	20.38	19.56	0.59
Study Reach	0.303999	PF 3	PLS no ROF	70.00	821.00	822.65	822.17	822.73	0.008372	3.43	20.38	19.56	0.59
Study Reach	0.303999	PF 3	PLSnewCulv	70.00	821.00	822.65	822.17	822.73	0.008372	3.43	20.38	19.56	0.59
Study Reach	0.303999	PF 4	PLS Cap Test	80.00	821.00	822.65	822.26	822.85	0.008258	3.57	22.42	20.49	0.60
Study Reach	0.303999	PF 4	PLS no ROF	80.00	821.00	822.65	822.26	822.85	0.008258	3.57	22.42	20.49	0.60
Study Reach	0.303999	PF 4	PLSnewCulv	80.00	821.00	822.65	822.26	822.85	0.008258	3.57	22.42	20.49	0.60
Study Reach	0.303999	PF 5	PLS Cap Test	90.00	821.00	822.74	822.34	822.95	0.008176	3.72	24.29	21.39	0.60
Study Reach	0.303999	PF 5	PLS no ROF	90.00	821.00	822.74	822.34	822.95	0.008176	3.72	24.29	21.39	0.60
Study Reach	0.303999	PF 5	PLSnewCulv	90.00	821.00	822.74	822.34	822.95	0.008176	3.72	24.29	21.39	0.60
Study Reach	0.303999	PF 6	PLS Cap Test	100.00	821.00	822.83	822.42	823.06	0.008090	3.85	26.16	22.25	0.60
Study Reach	0.303999	PF 6	PLS no ROF	100.00	821.00	822.83	822.42	823.06	0.008090	3.85	26.16	22.25	0.60
Study Reach	0.303999	PF 6	PLSnewCulv	100.00	821.00	822.83	822.42	823.06	0.008090	3.85	26.16	22.25	0.60
Study Reach	0.303999	PF 7	PLS Cap Test	200.00	821.00	823.46	823.00	823.83	0.007930	4.95	47.45	45.39	0.64
Study Reach	0.303999	PF 7	PLS no ROF	200.00	821.00	823.46	823.00	823.83	0.007930	4.95	47.45	45.39	0.64
Study Reach	0.303999	PF 7	PLSnewCulv	200.00	821.00	823.46	823.00	823.83	0.007930	4.95	47.45	45.39	0.64
Study Reach	0.303999	PF 8	PLS Cap Test	250.00	821.00	823.71	823.30	824.12	0.007773	5.32	59.85	53.76	0.64
Study Reach	0.303999	PF 8	PLS no ROF	250.00	821.00	823.71	823.30	824.12	0.007773	5.32	59.85	53.76	0.64
Study Reach	0.303999	PF 8	PLSnewCulv	250.00	821.00	823.71	823.30	824.12	0.007773	5.32	59.85	53.76	0.64
Study Reach	0.303999	PF 9	PLS Cap Test	300.00	821.00	823.92	823.53	824.37	0.007712	5.64	71.80	61.09	0.65
Study Reach	0.303999	PF 9	PLS no ROF	300.00	821.00	823.92	823.53	824.37	0.007712	5.64	71.80	61.09	0.65
Study Reach	0.303999	PF 9	PLSnewCulv	300.00	821.00	823.92	823.53	824.37	0.007712	5.64	71.80	61.09	0.65
Study Reach	0.303999	PF 10	PLS Cap Test	400.00	821.00	824.28	823.93	824.79	0.007627	6.17	95.45	70.25	0.66
Study Reach	0.303999	PF 10	PLS no ROF	400.00	821.00	824.28	823.93	824.79	0.007627	6.17	95.45	70.25	0.66
Study Reach	0.303999	PF 10	PLSnewCulv	400.00	821.00	824.28	823.93	824.79	0.007627	6.17	95.45	70.25	0.66
Study Reach	0.303999	PF 11	PLS Cap Test	260.00	821.00	823.75	823.35	824.17	0.007765	5.39	62.04	55.26	0.64
Study Reach	0.303999	PF 11	PLS no ROF	260.00	821.00	823.75	823.35	824.17	0.007765	5.39	62.04	55.26	0.64
Study Reach	0.303999	PF 11	PLSnewCulv	260.00	821.00	823.75	823.35	824.17	0.007765	5.39	62.04	55.26	0.64
Study Reach	0.303999	PF 12	PLS Cap Test	270.00	821.00	823.79	823.40	824.22	0.007845	5.47	64.09	56.61	0.65
Study Reach	0.303999	PF 12	PLS no ROF	270.00	821.00	823.79	823.40	824.22	0.007845	5.47	64.09	56.61	0.65
Study Reach	0.303999	PF 12	PLSnewCulv	270.00	821.00	823.79	823.40	824.22	0.007845	5.47	64.09	56.51	0.65
Study Reach	0.303999	PF 13	PLS Cap Test	280.00	821.00	823.84	823.45	824.27	0.007716	5.51	67.00	58.24	0.65
Study Reach	0.303999	PF 13	PLS no ROF	280.00	821.00	823.84	823.45	824.27	0.007716	5.51	67.00	58.24	0.65
Study Reach	0.303999	PF 13	PLSnewCulv	280.00	821.00	823.84	823.45	824.27	0.007716	5.51	67.00	58.24	0.65
Study Reach	0.303999	PF 14	PLS Cap Test	290.00	821.00	823.88	823.49	824.32	0.007653	5.56	69.67	59.82	0.65
Study Reach	0.303999	PF 14	PLS no ROF	290.00	821.00	823.88	823.49	824.32	0.007653	5.56	69.67	59.82	0.65
Study Reach	0.303999	PF 14	PLSnewCulv	290.00	821.00	823.88	823.49	824.32	0.007653	5.56	69.67	59.82	0.65
Study Reach	0.303999	PF 15	PLS Cap Test	85.00	821.00	822.70	822.30	822.90	0.008222	3.65	23.35	20.94	0.60
Study Reach	0.303999	PF 15	PLS no ROF	85.00	821.00	822.70	822.30	822.90	0.008222	3.65	23.35	20.94	0.60
Study Reach	0.303999	PF 15	PLSnewCulv	85.00	821.00	822.70	822.30	822.90	0.008222	3.65	23.35	20.94	0.60
Study Reach	0.193000	PF 1	PLS Cap Test	50.00	817.00	818.94	818.33	819.04	0.004169	2.58	19.90	18.99	0.43
Study Reach	0.193000	PF 1	PLS no ROF	50.00	817.00	818.94	818.33	819.04	0.004169	2.58	19.90	18.99	0.43
Study Reach	0.193000	PF 1	PLSnewCulv	50.00	817.00	818.94	818.33	819.04	0.004169	2.58	19.90	18.99	0.43
Study Reach	0.193000	PF 2	PLS Cap Test	60.00	817.00	819.07	818.44	819.18	0.004248	2.76	22.55	22.54	0.44
Study Reach	0.193000	PF 2	PLS no ROF	60.00	817.00	819.07	818.44	819.18	0.004248	2.76	22.55	22.54	0.44
Study Reach	0.193000	PF 2	PLSnewCulv	60.00	817.00	819.07	818.44	819.18	0.004248	2.76	22.55	22.54	0.44
Study Reach	0.193000	PF 3	PLS Cap Test	70.00	817.00	819.18	818.54	819.31	0.004293	2.94	25.37	27.29	0.45
Study Reach	0.193000	PF 3	PLS no ROF	70.00	817.00	819.18	818.54	819.31	0.004293	2.94	25.37	27.29	0.45
Study Reach	0.193000	PF 3	PLSnewCulv	70.00	817.00	819.18	818.54	819.31	0.004293	2.94	25.37	27.29	0.45
Study Reach	0.193000	PF 4	PLS Cap Test	80.00	817.00	819.28	818.63	819.43	0.004329	3.11	28.42	31.60	0.45
Study Reach	0.193000	PF 4	PLS no ROF	80.00	817.00	819.28	818.63	819.43	0.004329	3.11	28.42	31.60	0.45
Study Reach	0.193000	PF 4	PLSnewCulv	80.00	817.00	819.28	818.63	819.43	0.004329	3.11	28.42	31.60	0.45
Study Reach	0.193000	PF 5	PLS Cap Test	90.00	817.00	819.38	818.72	819.54	0.004355	3.25	31.66	35.77	0.46
Study Reach	0.193000	PF 5	PLS no ROF	90.00	817.00	819.38	818.72	819.54	0.004355	3.25	31.66	35.77	0.46
Study Reach	0.193000	PF 5	PLSnewCulv	90.00	817.00	819.38	818.72	819.54	0.004355	3.25	31.66	35.77	0.46
Study Reach	0.193000	PF 6	PLS Cap Test	100.00	817.00	819.47	818.80	819.64	0.004371	3.38	35.06	39.68	0.46
Study Reach	0.193000	PF 6	PLS no ROF	100.00	817.00	819.47	818.80	819.64	0.004371	3.38	35.06	39.68	0.46
Study Reach	0.193000	PF 6	PLSnewCulv	100.00	817.00	819.47	818.80	819.64	0.004371	3.38	35.06	39.68	0.46
Study Reach	0.193000	PF 7	PLS Cap Test	200.00	817.00	820.12		820.38	0.004625	4.34	68.46	60.25	0.50
Study Reach	0.193000	PF 7	PLS no ROF	200.00	817.00	820.12		820.38	0.004625	4.34	68.46	60.25	0.50
Study Reach	0.193000	PF 7	PLSnewCulv	200.00	817.00	820.12		820.38	0.004625	4.34	68.46	60.25	0.50
Study Reach	0.193000	PF 8	PLS Cap Test	250.00	817.00	820.35		820.63	0.004835	4.72	82.39	63.82	0.52
Study Reach	0.193000	PF 8	PLS no ROF	250.00	817.00	820.35		820.63	0.004835	4.72	82.39	63.82	0.52
Study Reach	0.193000	PF 8	PLSnewCulv	250.00	817.00	820.35		820.63	0.004835	4.72	82.39	63.82	0.52
Study Reach	0.193000	PF 9	PLS Cap Test	300.00	817.00	820.55		820.87	0.004957	5.04	95.77	67.07	0.54
Study Reach	0.193000	PF 9	PLS no ROF	300.00	817.00	820.55		820.87	0.004957	5.04	95.77	67.07	0.54
Study Reach	0.193000	PF 9	PLSnewCulv	300.00	817.00	820.55		820.87	0.004957	5.04	95.77	67.07	0.54
Study Reach	0.193000	PF 10	PLS Cap Test	400.00	817.00	820.91		821.28	0.005121	5.56	120.93	72.88	0.56
Study Reach	0.193000	PF 10	PLS no ROF	400.00	817.00	820.91		821.28	0.005121	5.56	120.93	72.88	0.56
Study Reach	0.193000	PF 10	PLSnewCulv	400.00	817.00	820.91		821.28	0.005121	5.56	120.93	72.88	0.56
Study Reach	0.193000	PF 11	PLS Cap Test	260.00	817.00	820.39		820.66	0.004847	4.79	85.24	64.53	0.53
Study Reach	0.193000	PF 11	PLS no ROF	260.00	817.00	820.39		820.66	0.004847	4.79	85.24	64.53	0.53
Study Reach	0.193000	PF 11	PLSnewCulv	260.00	817.00	820.39		820.66	0.004847	4.79	85.24	64.53	0.53
Study Reach	0.193000	PF 12	PLS Cap Test	270.00	817.00	820.44		820.74	0.004806	4.83	88.49	65.32	0.53
Study Reach	0.193000	PF 12	PLS no ROF	270.00	817.00	820.44		820.74	0.004806	4.83	88.49	65.32	0.53
Study Reach	0.193000	PF 12	PLSnewCulv	270.00	817.00	820.44		820.74	0.004806	4.83	88.49	65.32	0.53
Study Reach	0.193000	PF 13	PLS Cap Test	280.00	817.00	820.47		820.78	0.004921	4.92	90.43	65.79	0.53
Study Reach	0.193000	PF 13	PLS no ROF	280.00	817.00	820.47		820.78	0.004921	4.92	90.43	65.79	0.53
Study Reach	0.193000	PF 13	PLSnewCulv	280.00	817.00	820.47		820.78	0.004921	4.92	90.43	65.79	0.53
Study Reach	0.193000	PF 14	PLS Cap Test	290.00	817.00	820.50		820.82	0.004988	5.00	92.71	66.34	0.54
Study Reach	0.193000	PF 14	PLS no ROF	290.00	817.00	820.50		820.82	0.004988	5.00	92.71	66.34	0.54
Study Reach	0.193000	PF 14	PLSnewCulv	290.00	817.00	820.50		820.82	0.004988	5.00	92.71	66.34	0.54

HEC-RAS River Thomas Hussey Reach: Study Reach (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Study Reach	0.193000	PF 15	PLS Cap Test	85.00	817.00	819.33	818.68	819.49	0.004336	3.18	30.04	33.75	0.46
Study Reach	0.193000	PF 15	PLS no ROF	85.00	817.00	819.33	818.68	819.49	0.004336	3.18	30.04	33.75	0.46
Study Reach	0.193000	PF 15	PLSnewCulv	85.00	817.00	819.33	818.68	819.49	0.004336	3.18	30.04	33.75	0.46
Study Reach	0.120999	PF 1	PLS Cap Test	50.00	815.00	816.03	815.90	816.27	0.015876	3.89	12.87	17.19	0.78
Study Reach	0.120999	PF 1	PLS no ROF	50.00	815.00	816.03	815.90	816.27	0.015876	3.89	12.87	17.19	0.78
Study Reach	0.120999	PF 1	PLSnewCulv	50.00	815.00	816.03	815.90	816.27	0.015876	3.89	12.87	17.19	0.78
Study Reach	0.120999	PF 2	PLS Cap Test	60.00	815.00	816.13	815.99	816.40	0.015702	4.13	14.62	19.14	0.79
Study Reach	0.120999	PF 2	PLS no ROF	60.00	815.00	816.13	815.99	816.40	0.015702	4.13	14.62	19.14	0.79
Study Reach	0.120999	PF 2	PLSnewCulv	60.00	815.00	816.13	815.99	816.40	0.015702	4.13	14.62	19.14	0.79
Study Reach	0.120999	PF 3	PLS Cap Test	70.00	815.00	816.21	816.08	816.51	0.015514	4.38	16.31	20.85	0.80
Study Reach	0.120999	PF 3	PLS no ROF	70.00	815.00	816.21	816.08	816.51	0.015514	4.38	16.31	20.85	0.80
Study Reach	0.120999	PF 3	PLSnewCulv	70.00	815.00	816.21	816.08	816.51	0.015514	4.38	16.31	20.85	0.80
Study Reach	0.120999	PF 4	PLS Cap Test	80.00	815.00	816.29	816.16	816.62	0.015390	4.60	18.01	22.35	0.81
Study Reach	0.120999	PF 4	PLS no ROF	80.00	815.00	816.29	816.16	816.62	0.015390	4.60	18.01	22.35	0.81
Study Reach	0.120999	PF 4	PLSnewCulv	80.00	815.00	816.29	816.16	816.62	0.015390	4.60	18.01	22.35	0.81
Study Reach	0.120999	PF 5	PLS Cap Test	90.00	815.00	816.37	816.24	816.72	0.015262	4.81	19.72	23.83	0.81
Study Reach	0.120999	PF 5	PLS no ROF	90.00	815.00	816.37	816.24	816.72	0.015262	4.81	19.72	23.83	0.81
Study Reach	0.120999	PF 5	PLSnewCulv	90.00	815.00	816.37	816.24	816.72	0.015262	4.81	19.72	23.83	0.81
Study Reach	0.120999	PF 6	PLS Cap Test	100.00	815.00	816.44	816.32	816.82	0.015211	5.00	21.53	27.81	0.82
Study Reach	0.120999	PF 6	PLS no ROF	100.00	815.00	816.44	816.32	816.82	0.015211	5.00	21.53	27.81	0.82
Study Reach	0.120999	PF 6	PLSnewCulv	100.00	815.00	816.44	816.32	816.82	0.015211	5.00	21.53	27.81	0.82
Study Reach	0.120999	PF 7	PLS Cap Test	200.00	815.00	817.00	817.00	817.53	0.013638	6.16	45.82	58.16	0.83
Study Reach	0.120999	PF 7	PLS no ROF	200.00	815.00	817.00	817.00	817.53	0.013638	6.16	45.82	58.16	0.83
Study Reach	0.120999	PF 7	PLSnewCulv	200.00	815.00	817.00	817.00	817.53	0.013638	6.16	45.82	58.16	0.83
Study Reach	0.120999	PF 8	PLS Cap Test	250.00	815.00	817.21	817.21	817.77	0.012801	6.46	59.19	65.61	0.82
Study Reach	0.120999	PF 8	PLS no ROF	250.00	815.00	817.21	817.21	817.77	0.012801	6.46	59.19	65.51	0.82
Study Reach	0.120999	PF 8	PLSnewCulv	250.00	815.00	817.21	817.21	817.77	0.012801	6.46	59.19	65.51	0.82
Study Reach	0.120999	PF 9	PLS Cap Test	300.00	815.00	817.39	817.39	817.98	0.012601	6.79	71.26	73.30	0.82
Study Reach	0.120999	PF 9	PLS no ROF	300.00	815.00	817.39	817.39	817.98	0.012601	6.79	71.26	73.30	0.82
Study Reach	0.120999	PF 9	PLSnewCulv	300.00	815.00	817.39	817.39	817.98	0.012601	6.79	71.26	73.30	0.82
Study Reach	0.120999	PF 10	PLS Cap Test	400.00	815.00	817.68	817.68	818.33	0.012467	7.36	94.53	86.96	0.84
Study Reach	0.120999	PF 10	PLS no ROF	400.00	815.00	817.68	817.68	818.33	0.012467	7.36	94.53	86.96	0.84
Study Reach	0.120999	PF 10	PLSnewCulv	400.00	815.00	817.68	817.68	818.33	0.012467	7.36	94.53	86.96	0.84
Study Reach	0.120999	PF 11	PLS Cap Test	260.00	815.00	817.25	817.25	817.81	0.012801	6.54	61.49	66.67	0.82
Study Reach	0.120999	PF 11	PLS no ROF	260.00	815.00	817.25	817.25	817.81	0.012801	6.54	61.49	66.67	0.82
Study Reach	0.120999	PF 11	PLSnewCulv	260.00	815.00	817.25	817.25	817.81	0.012801	6.54	61.49	66.67	0.82
Study Reach	0.120999	PF 12	PLS Cap Test	270.00	815.00	817.27	817.27	817.85	0.013069	6.66	63.14	67.52	0.83
Study Reach	0.120999	PF 12	PLS no ROF	270.00	815.00	817.27	817.27	817.85	0.013069	6.66	63.14	67.52	0.83
Study Reach	0.120999	PF 12	PLSnewCulv	270.00	815.00	817.27	817.27	817.85	0.013069	6.66	63.14	67.52	0.83
Study Reach	0.120999	PF 13	PLS Cap Test	280.00	815.00	817.32	817.32	817.90	0.012582	6.85	66.67	70.25	0.82
Study Reach	0.120999	PF 13	PLS no ROF	280.00	815.00	817.32	817.32	817.90	0.012582	6.85	66.67	70.25	0.82
Study Reach	0.120999	PF 13	PLSnewCulv	280.00	815.00	817.32	817.32	817.90	0.012582	6.85	66.67	70.25	0.82
Study Reach	0.120999	PF 14	PLS Cap Test	290.00	815.00	817.36	817.36	817.94	0.012394	6.68	69.53	72.42	0.82
Study Reach	0.120999	PF 14	PLS no ROF	290.00	815.00	817.36	817.36	817.94	0.012394	6.68	69.53	72.42	0.82
Study Reach	0.120999	PF 14	PLSnewCulv	290.00	815.00	817.36	817.36	817.94	0.012394	6.68	69.53	72.42	0.82
Study Reach	0.120999	PF 15	PLS Cap Test	85.00	815.00	816.33	816.20	816.67	0.015343	4.71	18.86	23.10	0.81
Study Reach	0.120999	PF 15	PLS no ROF	85.00	815.00	816.33	816.20	816.67	0.015343	4.71	18.86	23.10	0.81
Study Reach	0.120999	PF 15	PLSnewCulv	85.00	815.00	816.33	816.20	816.67	0.015343	4.71	18.86	23.10	0.81
Study Reach	0.041000	PF 1	PLS Cap Test	50.00	810.00	811.90	811.48	812.04	0.006672	2.99	16.65	18.24	0.52
Study Reach	0.041000	PF 1	PLS no ROF	50.00	810.00	811.90	811.48	812.04	0.006672	2.99	16.65	18.24	0.52
Study Reach	0.041000	PF 1	PLSnewCulv	50.00	810.00	811.90	811.48	812.04	0.006672	2.99	16.65	18.24	0.52
Study Reach	0.041000	PF 2	PLS Cap Test	60.00	810.00	812.03	811.59	812.18	0.006667	3.19	19.19	19.74	0.53
Study Reach	0.041000	PF 2	PLS no ROF	60.00	810.00	812.03	811.59	812.18	0.006667	3.19	19.19	19.74	0.53
Study Reach	0.041000	PF 2	PLSnewCulv	60.00	810.00	812.03	811.59	812.18	0.006667	3.19	19.19	19.74	0.53
Study Reach	0.041000	PF 3	PLS Cap Test	70.00	810.00	812.14	811.70	812.31	0.006664	3.37	21.52	21.41	0.54
Study Reach	0.041000	PF 3	PLS no ROF	70.00	810.00	812.14	811.70	812.31	0.006664	3.37	21.52	21.41	0.54
Study Reach	0.041000	PF 3	PLSnewCulv	70.00	810.00	812.14	811.70	812.31	0.006664	3.37	21.52	21.41	0.54
Study Reach	0.041000	PF 4	PLS Cap Test	80.00	810.00	812.25	811.77	812.44	0.006662	3.53	23.87	23.01	0.54
Study Reach	0.041000	PF 4	PLS no ROF	80.00	810.00	812.25	811.77	812.44	0.006662	3.53	23.87	23.01	0.54
Study Reach	0.041000	PF 4	PLSnewCulv	80.00	810.00	812.25	811.78	812.44	0.006662	3.53	23.87	23.01	0.54
Study Reach	0.041000	PF 5	PLS Cap Test	90.00	810.00	812.34	811.85	812.55	0.006662	3.67	26.21	24.52	0.55
Study Reach	0.041000	PF 5	PLS no ROF	90.00	810.00	812.34	811.85	812.55	0.006662	3.67	26.21	24.52	0.55
Study Reach	0.041000	PF 5	PLSnewCulv	90.00	810.00	812.34	811.86	812.55	0.006662	3.67	26.21	24.52	0.55
Study Reach	0.041000	PF 6	PLS Cap Test	100.00	810.00	812.44	811.93	812.66	0.006661	3.80	28.56	26.13	0.55
Study Reach	0.041000	PF 6	PLS no ROF	100.00	810.00	812.44	811.93	812.66	0.006661	3.80	28.56	26.13	0.55
Study Reach	0.041000	PF 6	PLSnewCulv	100.00	810.00	812.44	811.93	812.66	0.006661	3.80	28.56	26.13	0.55
Study Reach	0.041000	PF 7	PLS Cap Test	200.00	810.00	813.18	812.59	813.50	0.006666	4.65	51.86	36.70	0.58
Study Reach	0.041000	PF 7	PLS no ROF	200.00	810.00	813.18	812.59	813.50	0.006666	4.65	51.86	36.70	0.58
Study Reach	0.041000	PF 7	PLSnewCulv	200.00	810.00	813.18	812.60	813.50	0.006666	4.65	51.86	36.70	0.58
Study Reach	0.041000	PF 8	PLS Cap Test	250.00	810.00	813.44	812.85	813.80	0.006663	5.04	61.84	41.38	0.59
Study Reach	0.041000	PF 8	PLS no ROF	250.00	810.00	813.44	812.85	813.80	0.006663	5.04	61.84	41.38	0.59
Study Reach	0.041000	PF 8	PLSnewCulv	250.00	810.00	813.44	812.85	813.80	0.006663	5.04	61.84	41.38	0.59
Study Reach	0.041000	PF 9	PLS Cap Test	300.00	810.00	813.67	813.11	814.07	0.006662	5.38	71.83	45.55	0.60
Study Reach	0.041000	PF 9	PLS no ROF	300.00	810.00	813.67	813.10	814.07	0.006662	5.38	71.83	45.65	0.60
Study Reach	0.041000	PF 9	PLSnewCulv	300.00	810.00	813.67	813.11	814.07	0.006662	5.38	71.83	45.55	0.60
Study Reach	0.041000	PF 10	PLS Cap Test	400.00	810.00	814.08	813.46	814.56	0.006661	5.96	98.06	132.80	0.62
Study Reach	0.041000	PF 10	PLS no ROF	400.00	810.00	814.08	813.46	814.56	0.006661	5.96	98.06	132.80	0.62
Study Reach	0.041000	PF 10	PLSnewCulv	400.00	810.00	814.08	813.46	814.56	0.006661	5.96	98.06	132.80	0.62
Study Reach	0.041000	PF 11	PLS Cap Test	260.00	810.00	813.49	812.91	813.86	0.006663	5.11	83.84	42.25	0.60
Study Reach	0.041000	PF 11	PLS no ROF	260.00	810.00	813.49	812.91	813.86	0.006663	5.11	83.84	42.25	0.60
Study Reach	0.041000	PF 11	PLSnewCulv	260.00	810.00	813.49	812.91	813.86	0.006663	5.11	83.84	42.25	0.60
Study Reach	0.041000	PF 12	PLS Cap Test	270.00	810.00	813.53	812.98	813.91	0.006665	5.18	85.83	43.09	0.60

HEC-RAS River: Thomas Hussey Reach: Study Reach (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Study Reach	0.041000	PF 12	PLS no ROF	270.00	810.00	813.53	812.98	813.91	0.006665	5.18	65.83	43.09	0.60
Study Reach	0.041000	PF 12	PLSnewCulv	270.00	810.00	813.53	812.98	813.91	0.006665	5.18	65.83	43.09	0.60
Study Reach	0.041000	PF 13	PLS Cap Test	280.00	810.00	813.58	813.02	813.97	0.006664	5.25	67.83	43.93	0.60
Study Reach	0.041000	PF 13	PLS no ROF	280.00	810.00	813.58	813.02	813.97	0.006664	5.25	67.83	43.93	0.60
Study Reach	0.041000	PF 13	PLSnewCulv	280.00	810.00	813.58	813.02	813.97	0.006664	5.25	67.83	43.93	0.60
Study Reach	0.041000	PF 14	PLS Cap Test	290.00	810.00	813.63	813.07	814.02	0.006663	5.31	69.83	44.74	0.60
Study Reach	0.041000	PF 14	PLS no ROF	290.00	810.00	813.63	813.07	814.02	0.006663	5.31	69.83	44.74	0.60
Study Reach	0.041000	PF 14	PLSnewCulv	290.00	810.00	813.63	813.07	814.02	0.006663	5.31	69.83	44.74	0.60
Study Reach	0.041000	PF 15	PLS Cap Test	85.00	810.00	812.30	811.82	812.49	0.006683	3.60	25.04	23.76	0.55
Study Reach	0.041000	PF 15	PLS no ROF	85.00	810.00	812.30	811.81	812.49	0.006683	3.60	25.04	23.76	0.55
Study Reach	0.041000	PF 15	PLSnewCulv	85.00	810.00	812.30	811.82	812.49	0.006683	3.60	25.04	23.76	0.55

APPENDIX 9

Williams Creek & Unnamed Tributary South of 106th Street, Analysis of Alternative Solutions

WILLIAMS CREEK & UNNAMED TRIBUTARY SOUTH OF 106th STREET

Analysis of Alternative Solutions
Hamilton County, Indiana

(Williams Creek Master Plan Appendix 9)

Prepared for

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One Hamilton County Square
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June 2010

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CBBEL Project No. 07-0760

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INTRODUCTION

This report is a part of the Williams Creek Master Plan that provides the detailed information for the analysis of the current flooding issue along Williams Creek on Spring Mill Road south of 106th Street. Several potential solutions were determined and then evaluated according to the criteria provided in Chapter 4 of the Master Plan. This report discusses the potential solutions, the evaluation of those solutions, and the selection of a recommended plan.

The main flooding problem along Williams Creek is located along Spring Mill Road just south of the intersection with 106th Street as shown in **Figure A9-1**. This reach of Spring Mill Road floods approximately once every year from the overflow of the unnamed tributary. The 10% annual chance flood from Williams Creek can also cause flooding of this reach of Spring Mill Road.

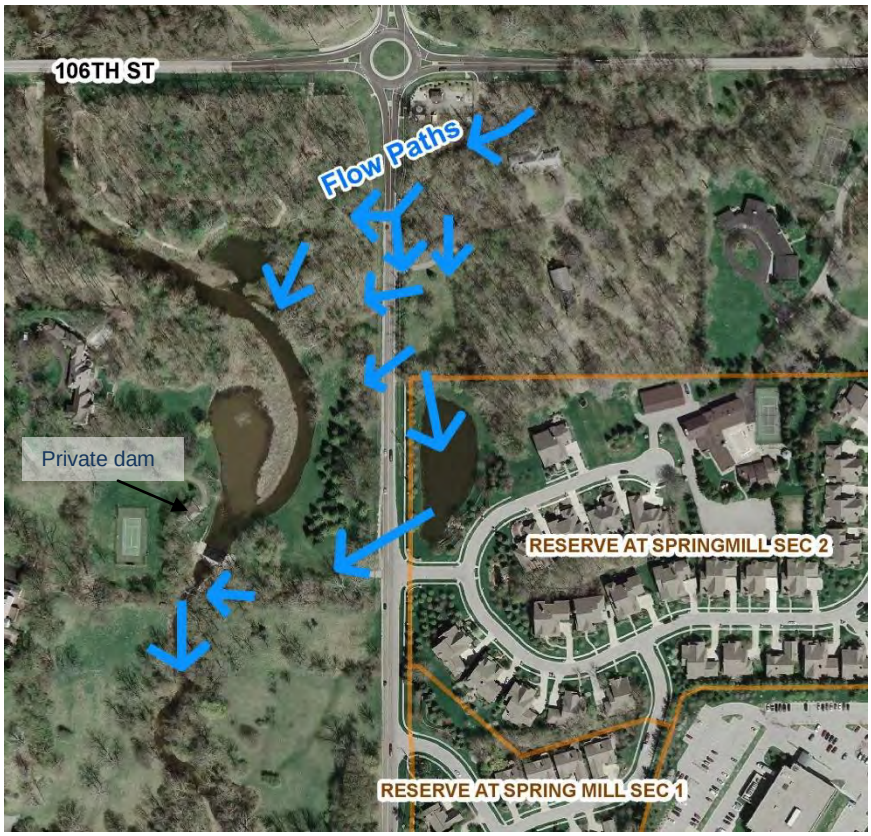

Figure A9-1: Spring Mill Road south of 106th Street – Flood Prone Area

COMPUTER MODELING

In order to evaluate potential solutions, various computer models were used. For the analysis of impacts from Williams Creek, the modeling of the existing conditions and the existing conditions with the private dam removed as described in Chapter 2 of the Master Plan were used.

A separate HECRAS model was generated for the unnamed tributary using the Hamilton County 1 foot contour interval mapping, field measurements of the existing culverts at Spring Mill Road, and the discharges resulting from the calibrated HECHMS model described in Chapter 2 of the Master Plan. Various starting water surface elevations were used in order to determine the impact of potential downstream

conditions. They were found to have negligible impact on the analysis. This model was used to evaluate upstream elevations for different culvert options under Spring Mill Road. It was not used to determine existing elevations for specific frequency storms due to the different directions (under Spring Mill Road, out of the tributary and south through the Reserves Subdivision pond and over Spring Mill Road) that water flows.

Output from the Williams Creek modeling can be found in Appendix 7 of the Master Plan and output from the tributary model is provided in **Appendix A9-1** following this report. A digital copy of all of the related modeling is included in Appendix 5 of the Williams Creek Master Plan.

INITIAL SCREENING OF POTENTIAL ALTERNATIVE SOLUTIONS

This chapter presents the preliminary screening of suggested alternatives identified during CBBEL's analysis. A listing of the noted alternatives and the preliminary screening of results are presented in **Table A9-1** for Williams Creek. Flooding of Spring Mill Road was found to potentially be from two sources, the tributary from the east and Williams Creek itself. Reducing the flooding from one source will not eliminate the flood risk from the other so both must be addressed. Options for reducing the flooding from each source are listed by source in order to select the most appropriate combination of alternative components to address each source. An alternative that includes components that address each source must be selected in order to sufficiently reduce the flood risk.

Table A9-1
Initial Screening of Potential Alternative Components

ID	Potential Alternative Component	Remarks	Benefit	Carry to shortlist of promising components?
Williams Creek				
A	Remove private dam	• Reconstruction of dam appears to have added significant wetland areas just upstream of dam • Dam is on private property and appears to provide an amenity for the property.	• Reduces Williams Creek 1% annual chance flood elevations upstream by up to 1.6 ft which is enough to reduce flooding on Spring Mill Road to a few inches • Does not reduce flooding from the unnamed tributary	Yes

ID	Potential Alternative Component	Remarks	Benefit	Carry to shortlist of promising components?
B	Lower crest of private dam	• Calculations show that removing the dam does not quite eliminate 1% annual chance flooding of Spring Mill Road so setting the crest at an elevation higher than the stream invert would not meet the established criteria	• Lowering the crest instead of removing the dam may be more agreeable to owner	No
C	Increase storage behind the dam and keep the existing dam crest elevation	• Significant excavation of private property would be required in order to provide enough storage to prevent raising elevations upstream along Williams Creek	• Could lower elevations upstream of the dam without reconstruction or removal of the dam	No
D	Provide off-line detention upstream of 106th Street	• The volume of the 24 hour - 1% annual chance flood runoff above the 10% annual chance runoff would need to be stored. This is 1,000 Ac-feet and would require about 167 Acres at a maximum depth of about 6 ft. of effective storage. No sites close enough to the problem area exist for this much detention.	• Would reduce the flow coming to the dam to a level that would not flood Spring Mill Road	No
E	Construct a 2-stage ditch channel improvement upstream of the dam to lower flood elevations	• The maximum reduction that could be achieved would be to the frequency elevations at the dam. Lowering the water surface profile to that at the dam would still impact Spring Mill Road	• Negligible reduction in flood elevations at Spring Mill Road	No
F	Raise Spring Mill Road between private drive and dam above the 1% annual chance flood elevation	• Would potentially need to provide compensatory storage to offset the storage presently used east of Spring Mill Road • Would require raising Spring Mill Road by over 2 ft • Would increase flood elevations upstream along the unnamed tributary and cause the flooding to last longer.	• Spring Mill Road would be protected from the 1% annual chance flood	Yes

ID	Potential Alternative Component	Remarks	Benefit	Carry to shortlist of promising components?
Tributary				
G	Raise Spring Mill Road near the tributary and increase the size of the culverts, raise Private Drive to act as a levee	• Raising Spring Mill Road to allow for larger culverts to be placed at Tributary Crossing. • Removes some of the storage presently occurring east of Spring Mill Road	• Reduce flooding of Spring Mill Road .	Yes
H	Construct detention ponds upstream of impacted area, improve culverts under Spring Mill Road, raise private drive to act as a levee	• Very expensive. • Could reduce flooding • Requires multiple detention basins due to topography and size of the watershed.	• Potentially could detain enough runoff to allow improved Spring Mill Road crossing to pass 1% annual chance flood. • The benefit/cost ratio is expected to be very low due to high costs of excavation and land purchases.	No
I	Increase the size of the Spring Mill Road culverts, install a by-pass culvert to route tributary flow south of private dam, raise Spring Mill Road	• Provides path to replace flow over Spring Mill Road • More expensive than raising Spring Mill Road instead • Potential maintenance issues with such a long buried pipe.	• Reduces flooding of Spring Mill Road	No
J	Increase the size of the Reserves subdivision pond	• Increasing the size of the Reserves Detention Pond to contain the overflow from the tributary. • Would require purchasing the land north of the pond. • Added liability for county for pond.	• Would require 20 Ac-ft of volume to contain all the runoff above 250 cfs that an enlarged pipe could potentially convey under Spring Mill Road. There is not enough area to create a pond of this volume with the available effective depth.	No
K	Install underground storage in upstream portions of tributary watershed	• Install underground storage under parking lots and other large flat areas • Potentially expensive and a maintenance issue. • Must be installed prior to construction	• Potentially could reduce flooding. • Does not require surface lands.	No

ID	Potential Alternative Component	Remarks	Benefit	Carry to shortlist of promising components?
L	Install rain gardens throughout tributary watershed to help slow runoff	• Would require purchasing land at numerous sites or depending on property owners to donate and maintain • The expected benefits would be small in comparison to the expense of land acquisition costs on top of construction costs.	• Has water quality benefits as well as provides for runoff reduction. • Could be used in conjunction with other alternatives	No
M	Add detention under proposed Meridian St improvements	• Could potentially require a redesign on an expensive project • Does not require surface lands.	• Could potentially detain runoff from north of 106th Street and East of Meridian St. but would not be a significant enough portion	No
N	Convert upstream portion of tributary to two stage ditch to improve temporary storage	• Could be done in the existing right-of-way	• Provides only slight increases in the temporary storage in the channel	No

Based on the screening process, a short-list of promising alternative components was compiled as listed in **Table A9-2**.

Table A9-2
Short List of Promising Alternative Components

Component ID	Description
Williams Creek	
A	Remove private dam
F	Raise Spring Mill Road between private drive and dam above the 1% annual chance flood elevation
Tributary	
G	Raise Spring Mill Road only near the tributary and increase the size of the culverts, raise Private Drive to act as a levee

DETAILED EVALUATION OF ALTERNATIVES

Each promising alternative component presented in Table A9-2 was evaluated in more detail either alone or combined with other appropriate components to create potential alternatives. **Table A9-3** below provides a summary of the component combinations (alternatives) that were evaluated.

Table A9-3
Summary of Components in Each Alternative

Alternative	Component ID	Component Description		
		Remove private dam	Raise Spring Mill Road to above 1% annual chance flood between private drive & dam	Raise Spring Mill Road near the tributary & increase size of culverts, raise Private Drive to act as a levee
0	None			
1	A, G	X		X
2	F, G		X	X

Each alternative presented in Table A9-3 was evaluated in more detail to determine effectiveness, economics, social and institutional impacts, and environmental feasibility. The results of the analyses are summarized in the following paragraphs. A Do-Nothing Alternative was added for comparison purposes. The analyses completed for each alternative were conceptual rather than design-level. In addition, the conceptual opinion of probable cost presented for each alternative in this report is based on limited information and a conceptual layout of the alternative and would, therefore, be subject to modification during the detailed design phase. A comparison of the advantages and disadvantages associated with each alternative, and whether the alternative is recommended for implementation, is provided at the end of the chapter in **Table A9-4**.

ALTERNATIVE 0 – DO NOTHING

This alternative was included as the base-condition scenario for evaluating the other two short-listed alternatives. The hydraulic evaluation of this alternative was completed by developing the existing-condition hydraulic model of Williams Creek as described in Appendix 7 and of the tributary as described earlier in this appendix.

If nothing is done to reduce the peak and duration of flooding along Spring Mill Road, the potential for damage remains high. The culvert for the tributary under Spring Mill Road would continue to clog, Spring Mill Road would continue to degrade from the water flowing over it, and traffic interruptions on Spring Mill Road as well as the entrance to the Reserves subdivision would continue.

ALTERNATIVE 1 – REMOVE PRIVATE DAM, RAISE SPRING MILL ROAD NEAR THE TRIBUTARY AND INCREASE THE SIZE OF THE CULVERTS, RAISE PRIVATE DRIVE TO ACT AS A LEVEE

The first component of this alternative is to remove the private dam on Williams Creek. Removal would include restoring the channel and overbank cross sectional area in the reach to that which currently exists downstream of the dam. Results of this alternative make the 1% annual chance flood along Williams Creek equal to or less than the Spring Mill Road profile.

The second component of this alternative addresses the existing structure conveying the unnamed tributary of Williams Creek under Spring Mill Road. These culverts are undersized and heavily damaged. By raising a 280 foot stretch of Spring Mill Road to be a maximum of 814 feet, NAVD '88 from north of the tributary to the private drive, then sloping to the existing road profile south of that, sufficient cover is then available to allow two 8X6 foot box culverts (or the equivalent) to be placed to pass the 1% annual chance flood without overtopping the road. To prevent flow to the south into the Reserves pond and across Spring Mill Road, about 200 feet of the private driveway just south of the tributary will also need to be raised to at least 812.3 feet NAVD '88. The components of this alternative are shown in **Figure A9-2**.

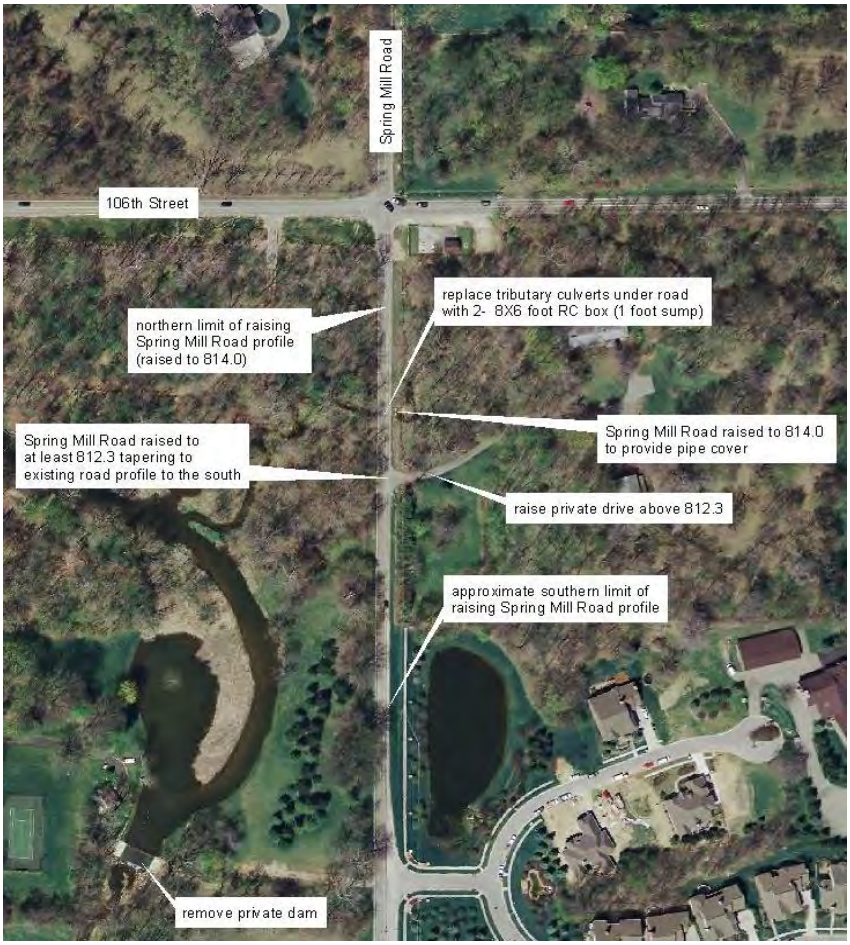

Figure A9-2: Components of Alternative 1

This alternative raises stages along the unnamed tributary upstream of Spring Mill Road. Therefore, this alternative must also include flood easements in the approximate area noted in **Figure A9-3**. No buildings or other manmade features appear to be impacted by this increase in the 1% annual chance flood elevations.

Figure A9-3: Area of increased 1% annual chance flood elevation increases

Output from the computer models of Williams Creek and the tributary for this alternative are provided in Appendix A9-1. The models are provided in digital form in Appendix 5.

The estimated cost of this alternative is $515,000. Details of the cost estimate are provided in **Appendix A9-2**.

ALTERNATIVE 2 – RAISE SPRING MILL ROAD BETWEEN PRIVATE DRIVE AND DAM, RAISE SPRING MILL ROAD NEAR THE TRIBUTARY AND INCREASE THE SIZE OF THE CULVERTS, RAISE PRIVATE DRIVE TO ACT AS A LEVEE

This alternative is the same as Alternative 1 except that instead of removing the private dam, an additional 200 feet of Spring Mill Road is raised to prevent Williams Creek from flooding the road. The components are shown in **Figure A9-4**.

Figure A9-4: Components of Alternative 2

The results of the analysis of the tributary for this alternative are the same as for Alternative 1. The output is included as described for Alternative 1. The differences are that Spring Mill Road would be elevated for approximately an additional 200 feet. The low point in this reach of Spring Mill Road would be raised from about 807.2 feet to at least 808.7 feet, NAVD '88. Model outputs are in Appendix A9-1. A digital copy is provided in Appendix 5.

Some impact on floodplain storage capabilities would result from raising Spring Mill Road and cutting off some of the Williams Creek floodplain. The portion of the Williams Creek floodplain that would be cut off is not effective flow area so no impact on conveyance area would result. The impact is therefore minimal on Williams Creek elevations. The tributary floodplain storage area that is removed by raising the private drive is at least partially replaced by the increase in elevations. There is also no effective increase in discharges downstream of the project because all the flow was going there before anyway.

The estimated cost of this alternative is $575,000. This estimate does not include the potential costs associated with potentially providing compensatory storage. Details of the cost estimate are provided in Appendix A9-2.

COMPARISON OF SHORT-LISTED ALTERNATIVES

Table A9-4 below provides a comparison of the advantages and disadvantages for each of the alternatives included on the short list in Table A9-3 and described above.

Table A9-4
Comparison of Short-Listed Alternatives

ID	DESCRIPTION	ADVANTAGES	DISADVANTAGES	RECOMMEND?
1	Remove private dam, raise Spring Mill Road near the tributary & increase size of the culverts, raise private drive to act as a levee	• Prevents flooding of Spring Mill Road due to both Williams Creek and its unnamed tributary • Insures all weather access to the Reserves development.	• Requires removal of a dam on private property which appears to provide amenities to the property owner. • Increases flood stages upstream of Spring Mill Road so flood easements would be required	YES (if removal of private dam is acceptable)
2	Raise Spring Mill Road near the dam, raise Spring Mill Road near the tributary and increase size of the culverts, raise private drive to act as a levee	• Prevents flooding of Spring Mill Road due to both Williams Creek and its unnamed tributary • Insures all weather access to the Reserves development	• Requires more road fill than Alternative 1 • Increases flood stages upstream of Spring Mill Road so flood easements would be required • May require additional compensatory floodplain storage	YES (if removal of private dam is NOT acceptable)

FORMULATION OF A RECOMMENDED PLAN

Based on a comparison of cost, feasibility, local acceptance, and benefits of the various options, alternative 1 is recommended if the removal of the private dam is acceptable. If the removal of the private dam is NOT acceptable, then alternative 2 is recommended. Both alternatives fail to meet the criteria of no increase in water surface elevations. However, the owners of the properties where flood stages will increase are some of the same properties that are now affected negatively by the flooding of Spring Mill Road. The increased water surface elevations do not impact any structures and occur in a wooded area that currently floods to a slightly lower elevation anyway. Flood easements may need to be purchased to offset the increase in water surface elevations. However, the cost associated with such potential easement acquisition has not been included in the cost estimates provided earlier.

Figure A9-5 shows the approximate area that is currently flood prone but would be protected from floods up to the 1% annual chance flood if Alternative 1 or 2 were implemented.

Figure A9-5: Area Protected From 1% Annual Chance Flooding By Alternative 1 or 2

APPENDIX A9-1

HEC-RAS MODEL SUMMARY OUTPUT

HEC-RAS Plan: alt 1 River: Unnamed Trib Reach: Unnamed Trib

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Unnamed Trib	0.337000	100yr-no dam	345.00	815.00	819.03		819.13	0.001482	2.70	203.35	116.82	0.25
Unnamed Trib	0.337000	100y-existing	345.00	815.00	819.03		819.13	0.001482	2.70	203.35	116.82	0.25
Unnamed Trib	0.337000	PF 3	50.00	815.00	816.21		816.26	0.003640	1.84	27.16	25.02	0.31
Unnamed Trib	0.337000	PF 4	100.00	815.00	816.98		817.05	0.002571	2.10	47.67	28.16	0.28
Unnamed Trib	0.337000	PF 5	150.00	815.00	817.54		817.62	0.002202	2.35	67.80	45.76	0.28
Unnamed Trib	0.337000	PF 6	200.00	815.00	818.00		818.09	0.001954	2.50	99.80	83.21	0.27
Unnamed Trib	0.337000	PF 7	250.00	815.00	818.41		818.50	0.001722	2.58	136.08	96.16	0.26
Unnamed Trib	0.337000	PF 8	300.00	815.00	818.75		818.85	0.001581	2.65	171.50	107.93	0.25
Unnamed Trib	0.337000	PF 9	350.00	815.00	819.07		819.16	0.001471	2.71	206.95	117.65	0.25
Unnamed Trib	0.337000	PF 10	400.00	815.00	819.35		819.45	0.001390	2.76	242.11	127.57	0.24
Unnamed Trib	0.324999	100yr-no dam	345.00	814.00	818.86	816.79	819.01	0.002094	3.49	175.13	145.37	0.29
Unnamed Trib	0.324999	100y-existing	345.00	814.00	818.86	816.79	819.01	0.002094	3.49	175.13	145.37	0.29
Unnamed Trib	0.324999	PF 3	50.00	814.00	816.04	814.84	816.09	0.001963	1.74	28.75	39.17	0.24
Unnamed Trib	0.324999	PF 4	100.00	814.00	816.81	815.31	816.89	0.002109	2.33	47.50	54.23	0.26
Unnamed Trib	0.324999	PF 5	150.00	814.00	817.36	815.67	817.48	0.002246	2.76	66.57	69.83	0.28
Unnamed Trib	0.324999	PF 6	200.00	814.00	817.82	815.99	817.95	0.002318	3.08	89.02	92.53	0.29
Unnamed Trib	0.324999	PF 7	250.00	814.00	818.21	816.28	818.36	0.002344	3.33	114.50	118.86	0.30
Unnamed Trib	0.324999	PF 8	300.00	814.00	818.56	816.53	818.72	0.002251	3.46	145.68	138.63	0.30
Unnamed Trib	0.324999	PF 9	350.00	814.00	818.89	816.81	819.04	0.002077	3.50	178.45	146.09	0.29
Unnamed Trib	0.324999	PF 10	400.00	814.00	819.19	817.04	819.34	0.001967	3.55	223.36	222.47	0.29
Unnamed Trib	0.305999	100yr-no dam	345.00	813.00	817.30	817.27	818.39	0.029589	8.37	41.63	21.03	0.97
Unnamed Trib	0.305999	100y-existing	345.00	813.00	817.30	817.27	818.39	0.029589	8.37	41.63	21.03	0.97
Unnamed Trib	0.305999	PF 3	50.00	813.00	815.51		815.70	0.010765	3.45	14.49	11.12	0.53
Unnamed Trib	0.305999	PF 4	100.00	813.00	816.11		816.44	0.014315	4.57	21.90	13.66	0.64
Unnamed Trib	0.305999	PF 5	150.00	813.00	816.49	816.04	816.96	0.017770	5.47	27.43	15.35	0.72
Unnamed Trib	0.305999	PF 6	200.00	813.00	816.77	816.43	817.38	0.021377	6.29	31.79	16.57	0.80
Unnamed Trib	0.305999	PF 7	250.00	813.00	817.00	816.77	817.76	0.024353	6.98	35.84	17.68	0.86
Unnamed Trib	0.305999	PF 8	300.00	813.00	817.17	817.04	818.10	0.027069	7.71	39.04	19.61	0.92
Unnamed Trib	0.305999	PF 9	350.00	813.00	817.32	817.30	818.42	0.029855	8.44	41.92	21.18	0.98
Unnamed Trib	0.305999	PF 10	400.00	813.00	817.53	817.53	818.73	0.028751	8.80	46.80	23.62	0.97
Unnamed Trib	0.259999	100yr-no dam	345.00	812.00	815.79		815.98	0.004310	3.95	142.94	94.77	0.41
Unnamed Trib	0.259999	100y-existing	345.00	812.00	815.79		815.98	0.004310	3.95	142.94	94.77	0.41
Unnamed Trib	0.259999	PF 3	50.00	812.00	813.84		813.91	0.005180	2.19	22.85	21.68	0.38
Unnamed Trib	0.259999	PF 4	100.00	812.00	814.42		814.53	0.004749	2.72	40.39	43.16	0.38
Unnamed Trib	0.259999	PF 5	150.00	812.00	814.83		814.97	0.004407	3.07	62.80	65.37	0.38
Unnamed Trib	0.259999	PF 6	200.00	812.00	815.16		815.31	0.004219	3.32	86.98	81.08	0.39
Unnamed Trib	0.259999	PF 7	250.00	812.00	815.40		815.57	0.004245	3.56	107.54	86.80	0.39
Unnamed Trib	0.259999	PF 8	300.00	812.00	815.62		815.80	0.004272	3.77	126.73	91.20	0.40
Unnamed Trib	0.259999	PF 9	350.00	812.00	815.81		816.00	0.004316	3.97	144.67	95.14	0.41
Unnamed Trib	0.259999	PF 10	400.00	812.00	816.02		816.22	0.004194	4.09	165.04	100.90	0.41
Unnamed Trib	0.194000	100yr-no dam	345.00	810.00	813.87		814.17	0.006619	4.98	117.09	83.97	0.50
Unnamed Trib	0.194000	100y-existing	345.00	810.00	813.87		814.17	0.006619	4.98	117.09	83.97	0.50
Unnamed Trib	0.194000	PF 3	50.00	810.00	812.00		812.08	0.005263	2.36	21.18	17.95	0.38
Unnamed Trib	0.194000	PF 4	100.00	810.00	812.54		812.70	0.005786	3.19	33.39	26.75	0.43
Unnamed Trib	0.194000	PF 5	150.00	810.00	812.95		813.16	0.006179	3.79	45.48	33.38	0.46
Unnamed Trib	0.194000	PF 6	200.00	810.00	813.25		813.51	0.006466	4.24	66.98	79.33	0.48
Unnamed Trib	0.194000	PF 7	250.00	810.00	813.49		813.77	0.006465	4.52	86.48	81.17	0.49
Unnamed Trib	0.194000	PF 8	300.00	810.00	813.70		814.00	0.006493	4.76	103.66	82.75	0.49
Unnamed Trib	0.194000	PF 9	350.00	810.00	813.88		814.19	0.006639	5.01	119.46	84.09	0.50
Unnamed Trib	0.194000	PF 10	400.00	810.00	814.05		814.39	0.006970	5.32	133.07	94.51	0.52
Unnamed Trib	0.150000	100yr-no dam	345.00	809.00	812.29		812.51	0.007444	5.10	144.04	91.83	0.53
Unnamed Trib	0.150000	100y-existing	345.00	809.00	812.29		812.51	0.007444	5.10	144.04	91.83	0.53
Unnamed Trib	0.150000	PF 3	50.00	809.00	810.97	810.27	811.05	0.003785	2.42	34.32	67.06	0.34
Unnamed Trib	0.150000	PF 4	100.00	809.00	811.35	810.73	811.46	0.004797	3.15	63.25	80.19	0.40
Unnamed Trib	0.150000	PF 5	150.00	809.00	811.56		811.73	0.005985	3.79	81.77	83.49	0.45
Unnamed Trib	0.150000	PF 6	200.00	809.00	811.78		811.95	0.006754	4.26	98.40	86.02	0.49
Unnamed Trib	0.150000	PF 7	250.00	809.00	811.95		812.15	0.007288	4.65	113.83	88.30	0.51
Unnamed Trib	0.150000	PF 8	300.00	809.00	812.13		812.34	0.007526	4.94	129.22	90.17	0.53
Unnamed Trib	0.150000	PF 9	350.00	809.00	812.31		812.53	0.007405	5.11	145.86	92.03	0.53
Unnamed Trib	0.150000	PF 10	400.00	809.00	812.53		812.74	0.006771	5.14	166.33	94.23	0.51
Unnamed Trib	0.128999	100yr-no dam	345.00	809.00	811.71	810.95	811.85	0.004921	3.64	156.30	179.68	0.42
Unnamed Trib	0.128999	100y-existing	345.00	809.00	811.71	810.95	811.85	0.004921	3.64	156.30	179.68	0.42
Unnamed Trib	0.128999	PF 3	50.00	809.00	809.91	809.84	810.12	0.032627	3.65	13.72	24.42	0.86
Unnamed Trib	0.128999	PF 4	100.00	809.00	810.30	810.21	810.52	0.019521	3.90	33.16	69.27	0.72
Unnamed Trib	0.128999	PF 5	150.00	809.00	810.64	810.43	810.83	0.012127	3.79	59.04	103.62	0.60
Unnamed Trib	0.128999	PF 6	200.00	809.00	810.92	810.58	811.10	0.009399	3.82	83.00	145.80	0.54
Unnamed Trib	0.128999	PF 7	250.00	809.00	811.18	810.73	811.34	0.007617	3.81	106.71	169.72	0.50
Unnamed Trib	0.128999	PF 8	300.00	809.00	811.44	810.85	811.59	0.006143	3.75	131.33	174.53	0.46
Unnamed Trib	0.128999	PF 9	350.00	809.00	811.74	810.95	811.86	0.004760	3.62	159.43	180.33	0.42
Unnamed Trib	0.128999	PF 10	400.00	809.00	812.08	811.08	812.20	0.003637	3.46	191.47	185.62	0.37
Unnamed Trib	0.101000	100yr-no dam	345.00	807.00	811.16	809.77	811.33	0.003349	4.21	141.10	286.45	0.37
Unnamed Trib	0.101000	100y-existing	345.00	807.00	811.16	809.77	811.33	0.003349	4.21	141.10	286.45	0.37
Unnamed Trib	0.101000	PF 3	50.00	807.00	809.83	808.08	809.84	0.000409	1.12	76.87	133.79	0.12

HEC-RAS Plan: alt 1 River: Unnamed Trib Reach: Unnamed Trib (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Unnamed Trib	0.101000	PF 4	100.00	807.00	809.91	808.55	809.96	0.001422	2.13	80.90	147.63	0.23
Unnamed Trib	0.101000	PF 5	150.00	807.00	810.06	808.66	810.16	0.002543	2.95	67.85	227.41	0.31
Unnamed Trib	0.101000	PF 6	200.00	807.00	810.27	809.21	810.39	0.003322	3.53	97.90	230.68	0.35
Unnamed Trib	0.101000	PF 7	250.00	807.00	810.53	809.46	810.68	0.003627	3.90	110.75	239.20	0.38
Unnamed Trib	0.101000	PF 8	300.00	807.00	810.84	809.62	811.01	0.003598	4.12	125.59	247.63	0.38
Unnamed Trib	0.101000	PF 9	350.00	807.00	811.21	809.78	811.37	0.003300	4.20	143.14	286.66	0.37
Unnamed Trib	0.101000	PF 10	400.00	807.00	811.62	809.92	811.78	0.002896	4.20	162.97	288.65	0.35
Unnamed Trib	0.096		Culvert									
Unnamed Trib	0.086000	100yr-no dam	345.00	807.00	809.94	809.56	810.40	0.012032	6.21	63.97	316.42	0.67
Unnamed Trib	0.086000	100y-existing	345.00	807.00	810.04	809.56	810.45	0.010288	5.89	68.72	332.57	0.62
Unnamed Trib	0.086000	PF 3	50.00	807.00	809.81	807.95	809.82	0.000310	0.96	78.08	309.58	0.11
Unnamed Trib	0.086000	PF 4	100.00	807.00	809.83	808.41	809.87	0.001203	1.91	78.94	310.58	0.21
Unnamed Trib	0.086000	PF 5	150.00	807.00	809.86	808.76	809.95	0.002579	2.81	80.31	312.17	0.31
Unnamed Trib	0.086000	PF 6	200.00	807.00	809.90	809.05	810.06	0.004307	3.68	82.12	314.26	0.40
Unnamed Trib	0.086000	PF 7	250.00	807.00	809.94	809.24	810.18	0.006263	4.48	84.23	316.72	0.48
Unnamed Trib	0.086000	PF 8	300.00	807.00	810.00	809.42	810.32	0.008343	5.24	86.57	319.44	0.56
Unnamed Trib	0.086000	PF 9	350.00	807.00	810.05	809.58	810.47	0.010506	5.96	88.97	332.64	0.63
Unnamed Trib	0.086000	PF 10	400.00	807.00	810.10	809.72	810.62	0.012703	6.64	91.39	333.29	0.69
Unnamed Trib	0.068999	100yr-no dam	345.00	807.00	809.58	808.96	809.64	0.003641	3.14	298.97	314.69	0.36
Unnamed Trib	0.068999	100y-existing	345.00	807.00	809.95	808.96	809.97	0.001517	2.23	405.85	321.80	0.24
Unnamed Trib	0.068999	PF 3	50.00	807.00	809.80	807.88	809.80	0.000044	0.37	363.46	319.00	0.04
Unnamed Trib	0.068999	PF 4	100.00	807.00	809.81	808.36	809.82	0.000172	0.73	366.36	319.19	0.08
Unnamed Trib	0.068999	PF 5	150.00	807.00	809.83	808.54	809.84	0.000372	1.07	371.16	319.51	0.12
Unnamed Trib	0.068999	PF 6	200.00	807.00	809.85	808.67	809.86	0.000628	1.40	377.73	319.95	0.15
Unnamed Trib	0.068999	PF 7	250.00	807.00	809.88	808.78	809.90	0.000922	1.71	386.01	320.49	0.18
Unnamed Trib	0.068999	PF 8	300.00	807.00	809.91	808.88	809.93	0.001234	2.00	395.83	321.14	0.21
Unnamed Trib	0.068999	PF 9	350.00	807.00	809.95	808.97	809.98	0.001548	2.26	407.03	321.88	0.24
Unnamed Trib	0.068999	PF 10	400.00	807.00	809.99	809.00	810.03	0.001852	2.49	419.45	322.69	0.26
Unnamed Trib	0.048	100yr-no dam	345.00	806.00	808.44	808.44	808.95	0.019671	6.95	99.13	119.25	0.83
Unnamed Trib	0.048	100y-existing	345.00	806.00	809.80	808.44	809.85	0.001443	2.60	369.75	346.00	0.24
Unnamed Trib	0.048	PF 3	50.00	806.00	809.80	806.94	809.80	0.000030	0.38	369.75	346.00	0.04
Unnamed Trib	0.048	PF 4	100.00	806.00	809.80	807.39	809.80	0.000121	0.75	369.75	346.00	0.07
Unnamed Trib	0.048	PF 5	150.00	806.00	809.80	807.65	809.81	0.000273	1.13	369.75	346.00	0.11
Unnamed Trib	0.048	PF 6	200.00	806.00	809.80	807.87	809.82	0.000485	1.51	369.75	346.00	0.14
Unnamed Trib	0.048	PF 7	250.00	806.00	809.80	808.20	809.82	0.000758	1.88	369.75	346.00	0.18
Unnamed Trib	0.048	PF 8	300.00	806.00	809.80	808.33	809.84	0.001091	2.26	369.75	346.00	0.21
Unnamed Trib	0.048	PF 9	350.00	806.00	809.80	808.45	809.85	0.001485	2.64	369.75	346.00	0.25
Unnamed Trib	0.048	PF 10	400.00	806.00	809.80	808.56	809.86	0.001940	3.01	369.75	346.00	0.28

APPENDIX A9-2

COST ESTIMATE CALCULATIONS

PRELIMINARY ESTIMATE OF COST OF CONSTRUCTION
FOR
WILLIAMS CREEK
SPRING MILL ROAD IMPROVEMENTS
ALTERNATIVE 1
CARMEL-HAMILTON COUNTY, IN
CBBEL Project Number: 07-0760
21-May-10

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
	ALTERNATIVE 1				
1	MOBILIZATION	LS	1	$30,000.00	$30,000.00
2	EROSION CONTROL MEASURES	LS	1	$15,000.00	$15,000.00
3	PAVEMENT REMOVAL	SY	1,880	$5.00	$9,400.00
4	STRUCTURE REMOVAL (ex. DBL 48" CMP)	LF	72	$50.00	$3,600.00
5	EXCAVATION	CY	170	$20.00	$3,400.00
6	BEDDING	CY	35	$65.00	$2,275.00
7	CULVERT - TWIN 8-FT BY 6-FT	LF	36	$1,200.00	$43,200.00
8	FILL	CY	1,980	$20.00	$39,600.00
9	CONCRETE HEADWALL	EA	2	$10,000.00	$20,000.00
10	GEOTEXTILE	SY	125	$10.00	$1,250.00
11	AGGREGATE SUBBASE, 7" DEPTH	SY	2,100	$15.00	$31,500.00
12	ASPHALT PAVEMENT, 6.5" DEPTH	SY	1,900	$30.00	$57,000.00
13	SITE RESTORATION	SY	1,250	$25.00	$31,250.00
14	GUARDRAIL	LF	100	$25.00	$2,500.00
15	PAVEMENT STRIPING	LF	705	$10.00	$7,050.00
16	MAINTENANCE OF TRAFFIC	LS	1	$15,000.00	$15,000.00
17	PRIVATE DAM REMOVAL	LS	1	$25,000.00	$25,000.00
				CONSTRUCTION COSTS	$337,025.00
				POLE ADJUSTMENT - $50,000 TO $100,000 (USE $75,000)	$75,000.00
				CONSTRUCTION COSTS + ESTIMATED 30% NON-CONSTRUCTION COSTS	$513,132.50

Notes:

1) Used Pavement Width of 24 ft based on 2009 Aerial Photograph.

2) Alternative 1 Length of Roadway Fill/Replacement is approximately 705 feet, which is from approx. 100 feet south of 106th Street to approx. 250 feet north of Millridge Drive

3) Private Road replacement was assumed to be 8-inches of gravel (aggregate subbase).

PRELIMINARY ESTIMATE OF COST OF CONSTRUCTION
FOR
WILLIAMS CREEK
SPRING MILL ROAD IMPROVEMENTS
ALTERNATIVE 2
CARMEL-HAMILTON COUNTY, IN
CBBEL Project Number: 07-0760
21-May-10

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
	ALTERNATIVE 2				
1	MOBILIZATION	LS	1	$35,000.00	$35,000.00
2	EROSION CONTROL MEASURES	LS	1	$17,000.00	$17,000.00
3	PAVEMENT REMOVAL	SY	2,430	$5.00	$12,150.00
4	STRUCTURE REMOVAL (ex. DBL 48" CMP)	LF	72	$50.00	$3,600.00
5	EXCAVATION	CY	170	$20.00	$3,400.00
6	BEDDING	CY	35	$65.00	$2,275.00
7	CULVERT - TWIN 8-FT BY 6-FT	LF	36	$1,200.00	$43,200.00
8	FILL	CY	3,230	$20.00	$64,600.00
9	CONCRETE HEADWALL	EA	2	$10,000.00	$20,000.00
10	GEOTEXTILE	SY	125	$10.00	$1,250.00
11	PAVEMENT SUBBASE, 7" DEPTH	SY	2,700	$15.00	$40,500.00
12	ASPHALT PAVEMENT, 6.5" DEPTH	SY	2,500	$30.00	$75,000.00
13	SITE RESTORATION	SY	1,600	$25.00	$40,000.00
14	GUARDRAIL	LF	100	$25.00	$2,500.00
15	PAVEMENT STRIPING	LF	910	$10.00	$9,100.00
16	MAINTENANCE OF TRAFFIC	LS	1	$15,000.00	$15,000.00
				CONSTRUCTION COSTS	$384,575.00
				POLE ADJUSTMENT - $50,000 TO $100,000 (USE $75,000)	$75,000.00
				CONSTRUCTION COSTS + ESTIMATED 30% NON-CONSTRUCTION COSTS	$574,947.50

Notes:

1) Used Pavement Width of 24 ft based on 2009 Aerial Photograph.

2) Alternative 2 Length of Roadway Fill/Replacement is approximately 910 feet, which is from approx. 100 feet south of 106th Street to approx. 50 feet north of Millridge Drive.

3) Private Road replacement was assumed to be 8-inches of gravel (aggregate subbase).

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JOB 07-0760 WILLIAMS CREEK
SHEET NO. 1 OF 6
CALCULATED BY ASD DATE 5/11/10
CHECKED BY DATE
SCALE COST ESTIMATE

COST ESTIMATE

- MOBILIZATION
  - USE 10% OF TOTAL CONSTRUCTION COST

- EROSION CONTROL MEASURES
  - USE 5% OF TOTAL CONSTRUCTION COST

- PAVEMENT REMOVAL
  - WIDTH OF ROADWAY = 24

ALTERNATIVE 1:

LENGTH OF ROADWAY = (BET. 814.0 to 808.0) = 705 LF (FROM 1-FT TOPO)

AREA = 705 LF X 24 LF = 16,920 SF = 1880 SY

ALTERNATIVE 2:

LENGTH OF ROADWAY = (BET. 814.0 to 808.7) = [illegible] (FROM 1-FT TOPO)

AREA = 910 X 24 LF = 21,840 SF = 2,426.7 SY

- STRUCTURE REMOVAL

FROM INDOT = $10/LF OF PIPE
2 PIPES @ 36 FT = 2 X 36 X 10 = $720 ≈ ROUND TO $1000

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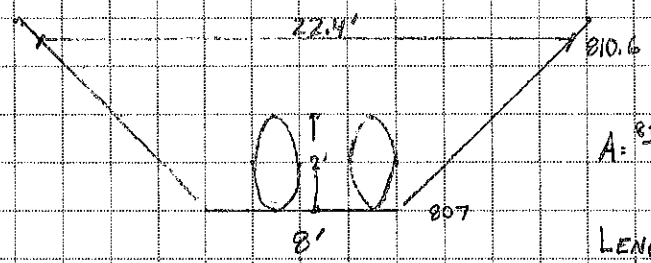
JOB 07-0760 WILLIAMS CREEK
SHEET NO. 2 OF 6
CALCULATED BY ASD DATE 5/11/10
CHECKED BY DATE
SCALE COST ESTIMATE

COST ESTIMATE

- EXCAVATION

ALTERNATIVE 1&2: CULVERT: 36 LF OF 2 - 8 X 6-FT RCBC (1 FT SUMP)

EXCAVATION FOR EXISTING CULVERTS - TOP OF ROAD = 810.6 INV. = 807

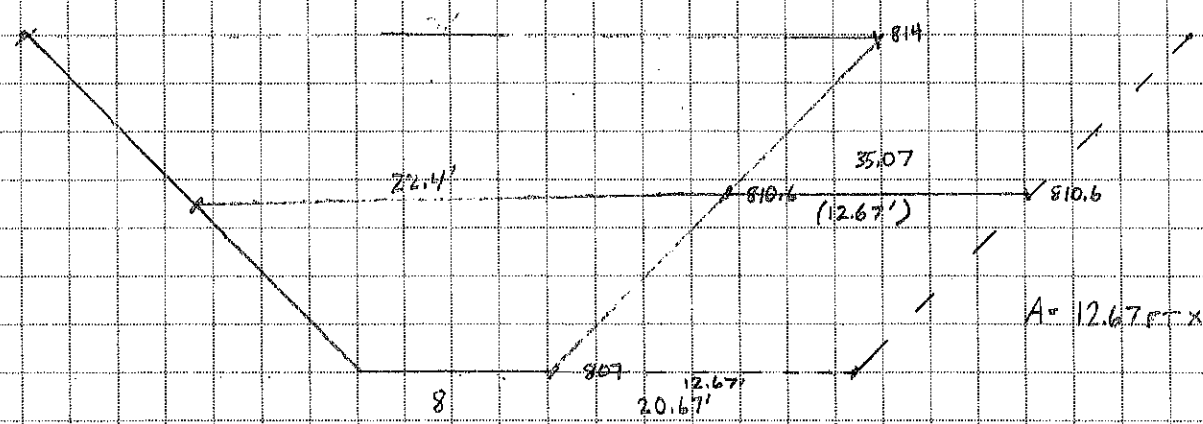


$A = \frac{8+22.4}{2}(3.6) - 2 \times \frac{\pi}{4}(2)^2 = 48.4$ SF

LENGTH = 36 LF

VOLUME = 48.4 SF X 36 LF = 1,742.4 CF ≈ 64.5 CY

WALL THICKNESS OF 8X6 FT RCBC = 8 INCHES



A = 12.67 FT X 3.6 FT = 45.6 SF

BEDDING & 1' SUMP: ASSUME BEDDING IS 1-FT DEEP & EXTEND 12-INCH PAST CULVERT

CULVERT = 1' X 20.67' X 38' = 785.5 CF = 29.1 CY
BEDDING = 1' X 20.67' X 38' = 785.5 CF = 29.1 CY.
TOTAL = 64.5 + 45.6 + 29.1 + 29.1 = 168.3 CY

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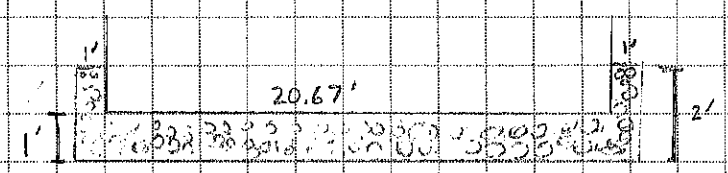
JOB 07-0760 WILLIAMS CREEK
SHEET NO. 3 OF 6
CALCULATED BY ASD DATE 5/11/10
CHECKED BY _____ DATE _____
SCALE COST ESTIMATE

COST ESTIMATE

- BEDDING

BEDDING - 12-INCHES & EXTEND 12-INCHES PAST CULVERT



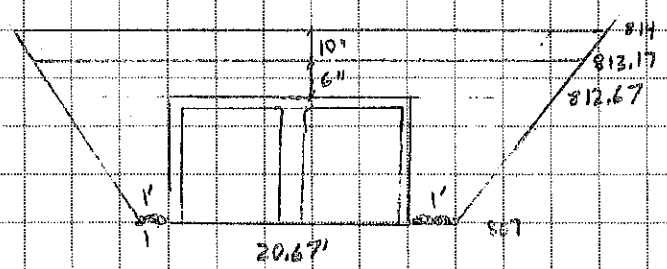
BEDDING = 38 FT x [(20.67 x 1) + 2 x (1 x 1)] = 38 FT x 22.67 = 861.5 CF = 31.9 CY

- CULVERT

- 36 LF OF 2 - 8-FT BY 6-FT RCBC

- FILL

FOR THE PROPOSED CULVERT, (SEE EXCAVATED AREA)



AREA = $\frac{20.67 + 20.67}{2}$ (7) = 170.3 SF

AREA CULVERT = $(5 + 8/12) \times (8 + \frac{8}{12} + \frac{8}{12}) \times 2$
= 5.67' x 18.67 = 105.8 SF

FILL = 36 LF x (170.3 - 105.8) = 2,322 CF = 86 CY

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JOB 07-0760 WILLIAMS CREEK
SHEET NO. 4 OF 6
CALCULATED BY ASD DATE 5/11/10
CHECKED BY DATE
SCALE COST ESTIMATE

COST ESTIMATE

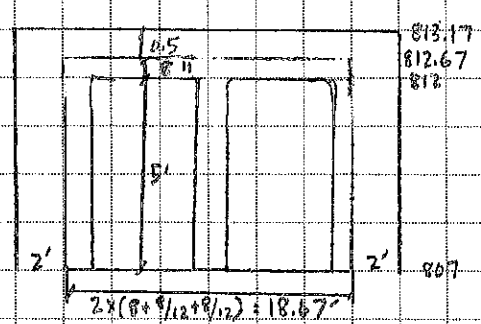
- FILL

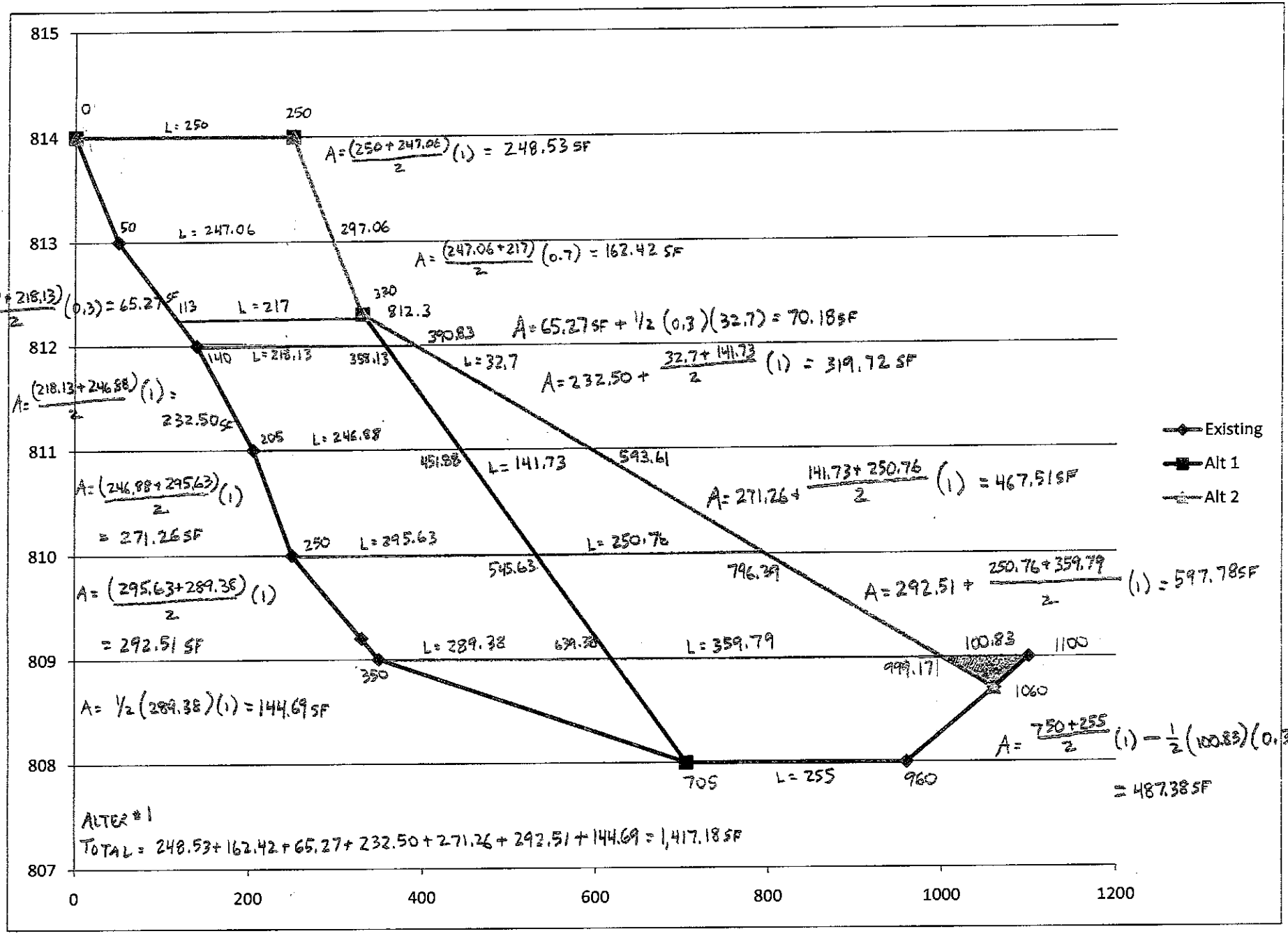
  - ALTERNATIVE 1: LENGTH OF FILL = 36 LF
    AREA OF FILL = (SEE ATTACHED WORKSHEET) = 1,417.18 SF
    VOLUME = 86.0 CY + (36 x 1417.18 SF)/27 = 1975.6 CY

  - ALTERNATIVE 2: LENGTH OF FILL = 36 LF
    AREA OF FILL = (SEE ATTACHED WORKSHEET) = 2,353.52 SF
    VOLUME 186 CY + (36 x 2,353.52 SF)/27 = 3224 CY

- CONCRETE HEADWALL:
  ASSUME HEADWALL EXTENDS 2-FT ON EACH SIDE AND IS 24-INCHES THICK

  AREA = 2 x (5 + 8/12 + 6/12) + 18.67 x 0.5 + 2 (5 + 8/12 + 6/12) = 34.0 SF
  VOLUME = 2 x 34.0 SF = 68 CF = 2.5 CY x 2 HEADWALLS = 5.0 CY





ALTER # 2

TOTAL 248.53 + 162.42 + 70.18 + 319.72 + 467.51 + 597.78 + 487.38 = 2,353.52 SF

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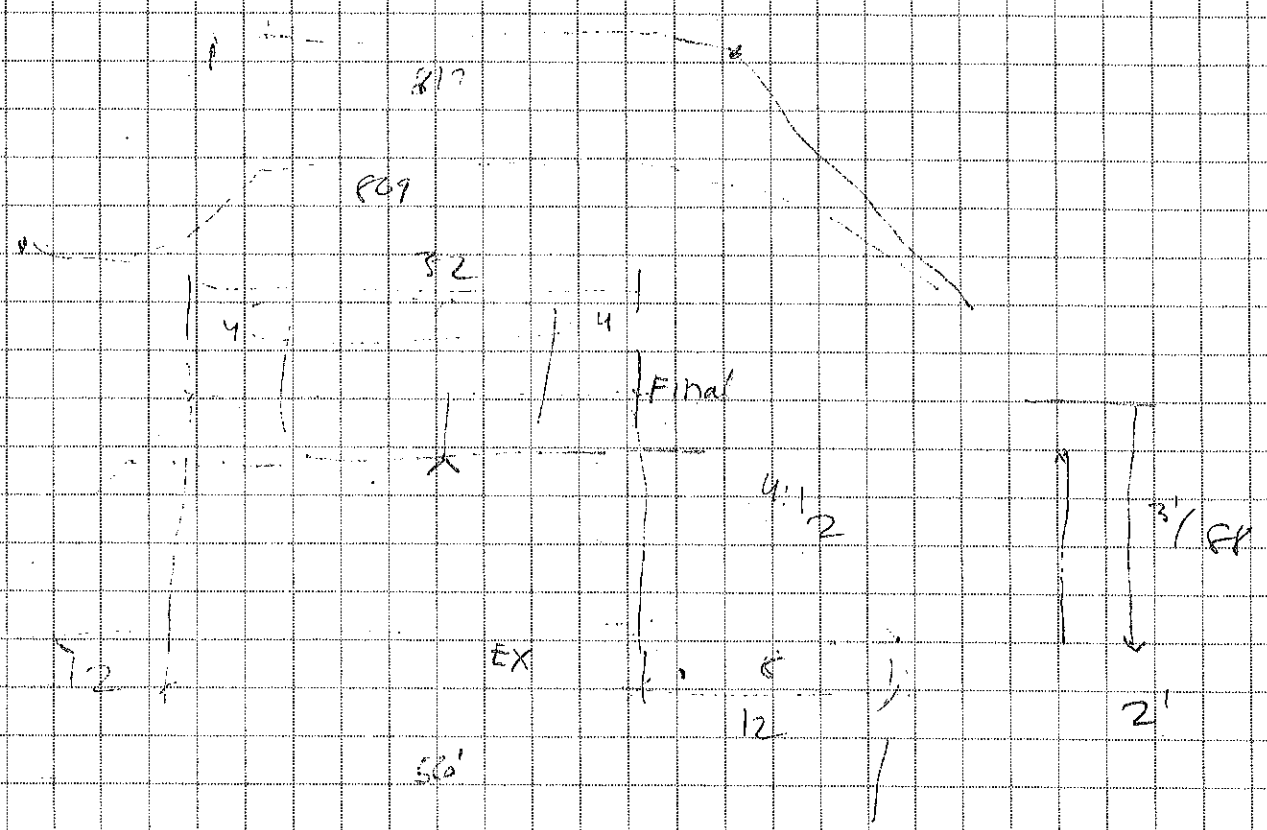
JOB 07-0760
SHEET NO. 1 OF 1
CALCULATED BY ASD DATE 5/12/10
CHECKED BY _____ DATE _____
SCALE FILL FOR ROADWAY

EXIST. ROADWAY		ALTERNATIVE 1		ALTERNATIVE 2	
X (ft)	Y (ft)	X (ft)	Y (ft)	X (ft)	Y (ft)
0	814	0	814	0	814
50	813	250	814	250	814
140	812	330	812.3	330	812.3
205	811	705	808	1060	808.7
* 250	810				
330	℄ ROADWAY				
350	809				
705	808				
960	808				
1060	808.7				
1100	809				



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JOB 07-0760 WILLIAMS CREEK
SHEET NO. 5 OF 6
CALCULATED BY ASD DATE 5/11/10
CHECKED BY DATE
SCALE COST ESTIMATE

COST ESTIMATE

- GEOTEXTILE (UNDER THE BEDDING): 36 LF OF 2 - 8-FT BY 6-FT
  + ALONG BOTH SIDES OF CULVERT ALONG BEDDING AND FILL

AREA = 38 x 20.67 + 38 x 3 x 2 = 1,013.5 SF ≈ 112.6 SY
= 1.10 x 112.6 = 123.9 SY (ADD 10%)

- PAVEMENT SUBBASE

  - ASSUME PAVEMENT SUBBASE = 7-INCHES

  - ALTERNATIVE 1: LENGTH = 705 LF (BET. 814 to 808)
    WIDTH = 24 FT
    VOLUME = 7/12 x 705 x 24 = 9,870 CF
    WEIGHT = 150#/CF

    TONS = 150#/CF x 9870 CF x TON/2000# = 740.3 TONS

  - ALTERNATIVE 2: LENGTH = 1060 FT (BET. 814 to 808.7)
    WIDTH = 24 FT
    VOLUME = 7/12 x 910 x 24 = 12,740 CF
    WEIGHT = 150#/CF

    TONS = 150#/CF x 12,740 CF x TON/2000# = 955.5 TONS

  - DRIVEWAY = 8"

    190 LF x 12 FT x 8/12 x 150#/CF x TON/2000# = 114 TON

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JOB 07-0760 WILLIAMS CREEK
SHEET NO. 6 OF 6
CALCULATED BY ASD DATE 5/11/10
CHECKED BY DATE
SCALE COST ESTIMATE

COST ESTIMATE

- ASPHALT PAVEMENT

  - ASSUME ASPHALT PAVEMENT = 6.5 INCHES

- ALTERNATIVE 1: LENGTH = 705 LF (BET. 814 to 808)
  WIDTH 24 LF

  VOLUME = 6.5/12 x 705 x 24 = 9165

  WEIGHT = 110#/INCH OF SY : $1\,\text{inch} \cdot \frac{1\,\text{ft}}{12\,\text{inches}} \cdot \left(\frac{3\,\text{ft}}{\text{yd}}\right)^2 = 0.75\,\text{CF} = \frac{110\#}{0.75\,\text{CF}} = 146.67\#/\text{CF}$

  TONS = 146.67#/CF x 9165 CF x $\frac{\text{TONS}}{2000\#}$ = 672.1 TONS ≈ 680 tons

- ALTERNATIVE 2: LENGTH = 910 FT (BET. 814 to 808.7)
  WIDTH = 24 FT

  VOLUME = 6.5/12 x 910 x 24 = 11,830 CF

  WEIGHT = 146.67#/CF

  TONS = 146.67#/CF x 11,830 CF x $\frac{\text{TONS}}{2000\#}$ = 867.6 TONS ≈ 870 tons

- SITE RESTORATION

  - ALTERNATIVE 1: ASSUME WIDTH OF CULVERT - ROAD
    WIDTH = 38 - 30 = 8 FT
    LENGTH OF ROADWAY = 705 LF

    AREA = 8 x 705 = 5,640 SF / 43,560 SF = 0.13 ACRES

  - ALTERNATIVE 2: ASSUME WIDTH OF CULVERT - ROAD
    WIDTH = 38 - 30 = 8 FT
    LENGTH OF ROADWAY = 1060 LF

    AREA = 8 x 1060 = 8,480 SF / 43,560 SF = 0.19 ACRES

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JOB 07-0760 WILLIAMS CREEK
SHEET NO. 1 OF 1
CALCULATED BY ASD DATE 5/12/10
CHECKED BY DATE
SCALE COST ESTIMATE - DAM REMOVAL

DAM REMOVAL - ALTER # 1

HEIGHT = 815 - 809 = 6 FT
WIDTH = 25 FT
LENGTH = 80 FT

VOLUME OF EXCAVATION = (6)(25)(80) = 12,000 CF ≈ 444.4 CY

CONCRETE REMOVAL = (6)(25)(30) = 4500 CF ≈ 166.7 CY

COST OF WATERWAY EX. = $20/CY + $12/CY = $32/CY

COST OF CONCRETE REMOVAL = $250/LF (INDOT CONCRETE WALL REMOVAL)

TOTAL COST = 450 x $32 + 30 x $250 = $21,900 ≈ $25,000