# WAKE FOREST-FALCONHURST ENGINEERING STUDY
# WAKE FOREST, NORTH CAROLINA

Falconhurst Drive. February 14, 2023

**FINAL REPORT SEPTEMBER 1, 2023**

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# 1 Background

The Town of Wake Forest has documented heavy sediment deposition within culverts crossing Falconhurst Drive that convey baseflow and stormwater runoff to Tom's Creek, a FEMA-regulated stream. The principal concern of this analysis was evaluating the potential sources of the sediment transport issues the site is experiencing. The principal culvert to be evaluated in this study is located on Falconhurst Drive, approximately 200 feet west of Hampton Chase Court. The tributary that conveys baseflow to the principal culvert with be referred to as Tributary A. Another culvert further east of the principal culvert will be evaluated, including its contributing drainage area and pipe system on the property located at 3205 Falconhurst Drive. The tributary conveying flow to the secondary culvert crossing will be referred to as Tributary B. Location map included in **Appendix A**.

Tom's Creek is located on the east side of the Neuse River and runs parallel to Falconhurst Drive in the project area. Tributary A and B run north to south crossing Falconhurst Drive and conveying flow to Tom's Creek. The 0.21 $mi^2$ watershed contributing to the two tributaries to Tom's Creek across Falconhurst Dive is zoned as GR-3 and GR-5 residential and is nearly built out. The watershed is bounded by Ligon Mill Road to the north and west, Reindeer Moss Drive to the east, and Falconhurst Drive to the south. The topography in the watershed consists of steep slopes to the south of Tom's Creek. To the north of Tom's Creek in the project area, the topography is flatter, with a slope in the range of 5-10%. The north side of Tom's Creek is zoned for GR-3 residential, and the south side is not zoned.

Tom's Creek is a Federal Emergency Management Agency (FEMA) regulated stream located on Flood Insurance Rate Map (FIRM) panel 1748, map number 3720174800K, dated July 19, 2022, and is designated as an AE zone with a regulated floodway and floodplain. Tom's Creek is the main source of flooding on Falconhurst Drive and the surrounding vicinity, but hydraulic models also predict the tributary to the principal culvert overtopping during the 50-year storm. The existing double pipe culvert under Falconhurst Drive conveying the tributary is experiencing heavy sediment deposition within the culverts contributing to decreased flow capacity, erosion around wingwalls, and potential overtopping.

Project goals included:

- Evaluation of existing conditions of the watershed
- Development of solutions to eliminate or reduce sediment deposition within culverts crossing Falconhurst Drive and project area in general
- Estimation of budgetary costs to for mitigation options

The objectives of the study included:

- Development of 1D and 2D hydrologic and hydraulic models to represent the existing and proposed conditions of the watershed
- Investigation of improvements to current stormwater infrastructure as well as stream/floodplain modifications to deter sedimentation
- Preparation of conceptual plan alternatives for pipe system improvements as well as stream/floodplain modifications
- Estimations of budgetary costs for conceptual plan alternatives

# 2 Approach

This study includes the analysis of the stream conveyance capacity of Tom's Creek as well as the tributaries conveying baseflow to Tom's Creek across Falconhurst Drive. The existing storm drainage infrastructure located at the principal crossing and the Hampton Chase Court were also analyzed. This analysis was done to understand the flooding nature, source, and extent in the area. Flooding and deposition issues within the watershed to be addressed were limited to the area along Tom's Creek. The area was extended to the west approximately 60' downstream of the culvert crossing located at the property at 3205 Falconhurst Drive. The project area extends to the east approximately 600' upstream of the principal culvert crossing on Falconhurst Drive. A hydrologic and hydraulic analysis of the existing conditions was completed using 1D and 2D HEC-RAS models to characterize the flooding extent as well as potential sources of deposition from Tom's Creek and the tributaries to Tom's Creek within the project area.

# 3 Data Collection

Data gathering was performed through a combination of desktop and field methods. Desktop data collection was done through review of topographic maps, satellite images and reference sources. Field data collection was accomplished through supplemental field surveys by Timmons Group, site visits to verify watershed characteristics, and a morphologic survey of Tom's Creek, Tributary A, and Tributary B.

## 3.1 Desktop Data

Available digital data was collected for hydro climatological information, GIS and mapping data, and topographic survey data. Data sources included the National Oceanic and Atmospheric Administration (NOAA), the United States Geological Survey (USGS) soil survey, and the Federal Emergency Management Agency (FEMA) publications.

## 3.2 Morphological Data

Morphological Data was collected on Tom's Creek, Tributary A, and Tributary B. The morphological data collected for Tom's Creek was along an approximately 425' length of Tom's Creek from approximately 120' upstream of the principle crossing on Falconhurst Drive to approximately 125' downstream of the crossing on the property located at 3205 Falconhurst Drive. Morphological data along Tributary A to Tom's Creek was taken along an approximately 260' length of the tributary from downstream of the crossing at Falconhurst Drive to the upstream of the Hampton Chase Court crossing. Tributary B which crosses Falconhurst at the property located at 3205 Falconhurst Drive had an approximate 330' length of the tributary where morph data was collected. The morphological data was collected from the confluence at Tom's Creek to approximately 180' upstream of the Falconhurst Drive crossing. Cross section and longitudinal profile data was collected to identify bank full, stream slope, and functional cross section geometry to be used in the repair design. The extent of the first morphological survey can be seen below in **Figure 1** and in **Appendix A**.

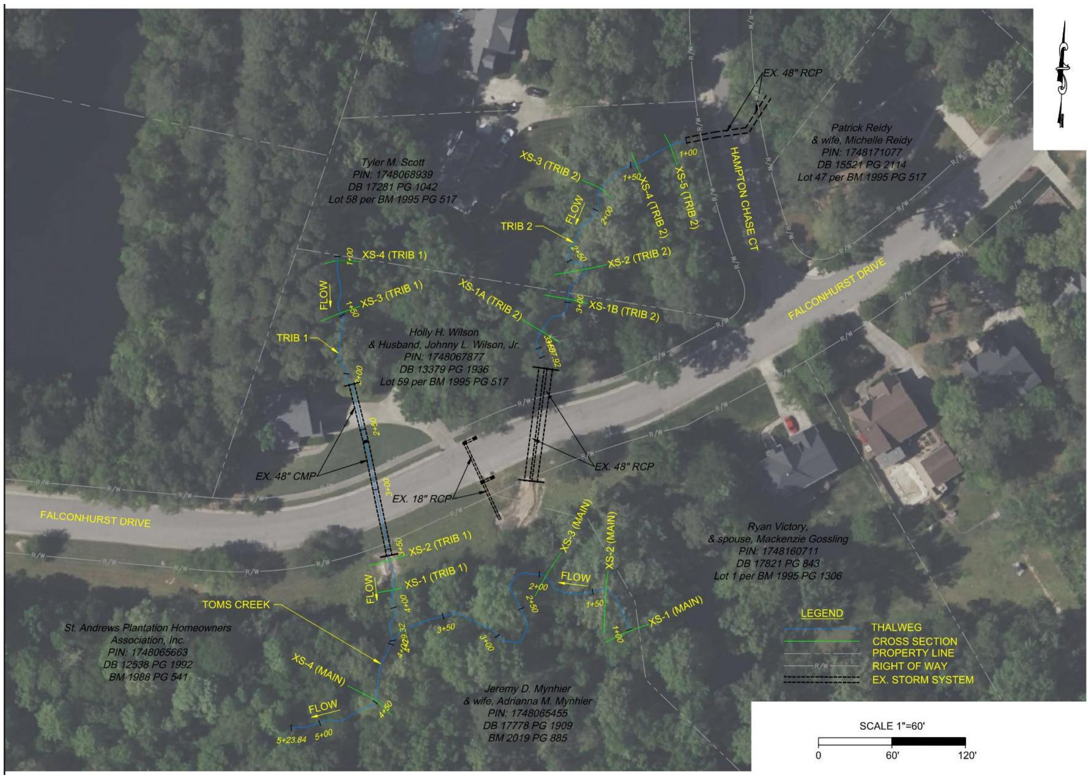



**Figure 1: Morphological Survey Map**

Additional morphological data was collected on Tributary B at a later date to further aid in creating a cost estimate associated with stream improvements on this tributary. In the second morphological data collection, data was collected from upstream of the Falconhurst Drive crossing to approximately 440' upstream. In this survey cross section geometry was collected to identify functional cross section geometry to be used in a repair design and a cost estimate associated with the repair. The last cross section collected during this field visit was a stable channel used as the reference reach for this channel.

On February 14, 2023, Timmons walked Tom's Creek with a representative from the Town of Wake Forest. This was done to determine the condition on the stream bank and to identify sources of sediment deposition into the stream. Most stream banks along the reach were in good condition and stable. However, there were various locations along the stream where portions of the banks exhibited active erosion with banks lacking in vegetation and steep slopes. Additionally, a significant amount of erosion occurs adjacent to the bridge at Coach Lantern Avenue and is most likely the largest source of sediment entering the stream.

## 3.3 Survey and Mapping Information

Town of Wake Forest LiDAR topographic data was obtained in February 2023 which was utilized for the hydrologic and hydraulic models. The topography data was based on the NAD 1983 horizontal datum in feet and the NAVD (88) vertical datum.

Additional survey data was collected by Timmons Group surveyors in November 2022 in the Tom's Creek floodplain and the along the tributaries to Tom's Creek. The topographical survey data was based on the NAD 1983 horizontal datum in feet and the NAVD (88) vertical datum. The extents collected were similar to the morphology survey discussed in Section 3.2. Refer to the **Appendix A** for the survey data. The survey data was combined with LiDAR data to create a digital elevation terrain model for use in the 1D and 2D HEC-RAS hydraulic modeling. There exists a potential utility conflict as an exposed sewer line crosses Tributary A approximately 30' downstream after the crossing at Falconhurst Drive.

# 4 Existing Conditions Hydrologic Analysis Summary

## 4.1 Effective/Base Models

A FEMA 1D HEC-RAS model was available for Tom's Creek (Basin 7, Stream 1). The effective FEMA model for Tom's Creek was used as the base for the existing conditions model in this study. The tributary to Tom's Creek at the principal crossing is not part of the 1D model beyond a flow change at the location of the crossing. The existing hydraulics and hydrology for this tributary was modeled separately.

A 2D HEC-RAS model developed by Freese and Nichols was made available to Timmons Group for this study. The 2D model was utilized as a secondary design tool to help quantify the flow direction and velocities in the existing and proposed conditions to aid in judging the performance of improvements. The 2D model received was updated with recent survey to represent existing conditions.

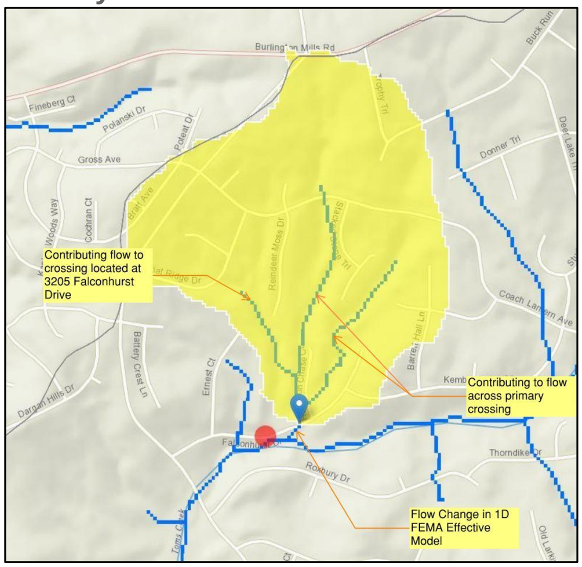
## 4.2 Tom's Creek 1D Model Hydrology

The effective FEMA model for Tom's Creek had a multiple profile and floodway run. The FEMA flows were unaltered and used for further modeling. There is a flow change at FEMA XS 5094 representing the combined inflow from both Tributary A and B across Falconhurst Drive. The FEMA model sees a change in flow of 200 cfs at this location in the 100-year storm, and this value was used to develop the hydrology for both of the tributary crossings at Falconhurst Drive.

## 4.3 Tributary A: Principal Culvert Crossing 1D Model Hydrology

The flow from Tributary A to the principal culvert crossing is not represented in the Effective 1D FEMA model beyond the flow change so a 1D model was developed for the Tributary. To develop the flows used in the model the flow change from the effective Tom's Creek model was compared to flow from Streamstats and the existing conditions 2D model. The crossings across Falconhurst Drive as depicted on Streamstats can be seen below in **Figure 2**. From the figure, Streamstats combined the flow from Tributary A and Tributary B across Falconhurst Drive. The 100-year storm flow for the area depicting both tributaries in Streamstats is 230 cfs, similar to the flow that is added in the Tom's Creek FEMA model. Streamstats information is included in **Appendix B**. After updating the Nichol and Freese 2D model to existing conditions, as summarized in section 4.1, the model was run and the flow across the 2-D connection representing the crossings at Falconhurst Drive was compared to the Streamstats and FEMA flows as well. In the existing 2D model, before being backed up by flooding from Tom's Creek, a maximum total of 160 cfs flowed through the crossings on Falconhurst Road. The three compared flows were similar and the hydrology for each tributary was developed using USGS Region 1 regression equations, the same method as the Streamstats flow calculations. The area for each tributary crossing Falconhurst Drive was delineated from the total area seen in **Figure 2**. For the impervious area % required in the regression calculations, the same value used in Streamstats was utilized. The impervious area % in Streamstats was from a 2006 land use map. To validate these values, the area was visually compared in Google Earth Pro. The 2006 map in Google Earth Pro showed no noticeable difference in build out to the 2023 map, leading to the Streamstats impervious area % values to be utilized. Supporting calculations are included in **Appendix B**.

**Figure 2: Streamstats: Tributary A and B combined before crossing Falconhurst Drive**




## 4.4 Tributary B: Secondary Culvert Crossing Hydrology (3205 Falconhurst Drive)

Similar to the tributary to the principal culvert crossing, the crossing located at the property at 3205 Falconhurst Drive is not represented in the Tom's Creek FEMA 1D model beyond the flow change at XS 5094. While the hydrologic analysis for this stream was not used in a 1D HEC-RAS 6.3.1 model, the flows were used in cost estimates and design for proposed improvements to the tributary. The flows were calculated with the same method as Tributary 1, using USGS Region 1 regression equations after delineating the stream separately. Supporting calculations are included in in **Appendix B**.

## 4.5 Project Area 2D Model Hydrology

The 2D HEC-RAS modeled provided to Timmons Group and developed by Nichols and Freese modeled precipitation and flow using rain on grid. No changes were made to the hydrology of these model beyond adjusting the 2D outfall connections when reducing the scope of the model to the project area.

# 5 Existing Conditions Hydraulic Analysis

## 5.1 Tom's Creek 1D Effective Model

The Effective Model for Tom's Creek includes both multiple and floodway profiles for the stream(.p01). The project impacts are located along the stream between FEMA cross-sections 4802 and 5339. The project site is located on FIRM Panel 3720174800K, dated July 19, 2022.The published data and Effective FIRM panels for this site are included in **Appendix B** and a flood study work map is included in **Appendix C**.

## 5.2 Tom’s Creek 1D Corrected Effective Model

The Effective Model for Tom’s Creek was downloaded and ran using HEC-RAS 6.3.1 and no errors were found requiring correction. The effective and future model plan was copied and renamed TG-Existing (.p03).

## 5.3 Tom’s Creek 1D Existing Conditions Model

Four (4) cross-sections were added to the effective model at proposed grade change locations inside the floodway and floodplain. One (1) FEMA cross section (XS 5094) was replaced due to conflict with a new stream centerline. The following modifications were made to the effective model in the creation of the Existing Conditions model:

- Stream centerline was adjusted based on provided topographical survey.
- Cross-section 5276: Added to model the start of potential floodplain changes due to proposed benches starting just downstream of this cross section. The geometry was created from LiDAR contours and provided topographic survey data. The downstream distance was set at 54.69 feet.
- Cross-section 5240: Added to evaluate changes due to the proposed bench grading. The geometry was created from LiDAR contours and topographic survey data. The downstream distance was set at 38.83 feet.
- Cross-section 5183: Replacing FEMA XS 5094 due to a conflict after updating the stream centerline based on provided topographical survey. This cross section similarly to the FEMA XS 5094 and was placed after the first proposed floodplain bench and before the second bench. Cross section also captures berms and grading from other improvements in the area. The geometry was created from LiDAR contours and topographic survey data. The downstream distance was set at 115.74 feet.
- Cross-section 5067: Added to model water surface changes due to the proposed grading. This cross section captures grading changes due to both the second and third proposed benches. The geometry was created from LiDAR contours and topographic survey data. The downstream distance was set at 182.53 feet.
- Cross-section 4884: Added to model at the end of topographical survey to better model Tom’s Creek through the extent of the project area. The geometry was created from LiDAR contours and topographic survey data. The downstream distance was set to 82.53 feet.
- Effective Model Manning’s n-values for the channel and overbank areas used in the bounding sections were used for the new sections.
    - Channel n-value: 0.05
    - Overbanks n-value: 0.09
    - Homes/lawns n-value: 0.06
    - Roadway n-value: 0.03
- Floodway stations were established for the additional cross-sections. Floodway limits were set to maintain a consistent width between the upstream and downstream FEMA sections and were adjusted to ensure no negative surcharge or surcharge over 1’ would occur at each section. The floodway stations (left and right) for the added cross-sections are provided in **Table 1**.

**Table 1 – Added Sections FEMA and Community Floodway Encroachment (ENC) Stations**

| Stream Station | FEMA | |
|---|---|---|
| | ENC Left | ENC Right |
| 5276 | 4961 | 5039 |
| 5240 | 4962 | 5039 |
| 5183 | 4963 | 5038 |
| 5067 | 4965 | 5036 |
| 4884 | 4968 | 5033 |

The model was run using HEC-RAS 6.3.1 and the water surface elevations compared to the Effective water surface elevations for the base flood and floodway (FW) as shown in **Table 2**.

**Table 2 – Effective and Existing Conditions 100-year and Floodway Water Surface Elevation (WSEL) Comparison – Base Flood**

| River Sta | Effective W.S. Elev | | Existing W.S. Elev | | Difference W.S. Elev | |
|---|---|---|---|---|---|---|
| | 100year | FW | 100year | FW | 100year | FW |
| 8511 | | | | | | |
| 8475 | 221.57 | 221.93 | 221.57 | 221.93 | 0.00 | 0.00 |
| 9335 | 220.61 | 221.03 | 220.61 | 221.03 | 0.00 | 0.00 |
| 7907 | 219.46 | 219.87 | 219.46 | 219.87 | 0.00 | 0.00 |
| 7281 | 215.71 | 216.61 | 215.71 | 216.61 | 0.00 | 0.00 |
| 6721 | 214.55 | 215.25 | 214.55 | 215.24 | 0.00 | -0.01 |
| 6315 | 213.79 | 213.99 | 213.79 | 213.97 | 0.00 | -0.02 |
| 5808 | 209.12 | 209.71 | 209.12 | 209.85 | 0.00 | 0.14 |
| 5339 | 207.81 | 208.05 | 207.89 | 208.7 | 0.08 | 0.65 |
| 5276 | Added XS | | | | | |
| 5240 | Added XS | | | | | |
| 5183 | Added XS | | | | | |
| 5094 | Replaced FEMA XS W/ 5183 | | | | | |
| 5067 | Added XS | | | | | |
| 4884 | Added XS | | | | | |
| 4802 | 206.89 | 207.19 | 206.89 | 207.19 | 0.00 | 0.00 |
| 4516 | 205.12 | 205.23 | 205.12 | 205.23 | 0.00 | 0.00 |
| 4030 | 202.49 | 202.49 | 202.49 | 202.49 | 0.00 | 0.00 |
| 3923 | 201.98 | 201.98 | 201.98 | 201.98 | 0.00 | 0.00 |
| 3864 | | | | | | |

## 5.4 Tributary A: Principal Culvert Crossing 1D Existing Conditions Model

The 1D Existing Conditions model for Tributary A was created specifically for this study. The model follows from the tributary's confluence with Tom's Creek, upstream, through the culvert at Falconhurst Drive and terminates upstream of the Hampton Chase Court crossing. This is an approximately 600' stretch of the tributary. The development of the model is summarized below:

- Stream centerline established based on topographic survey
- Ten (10) cross sections drawn at an approximate 50' interval. Cross section geometry created from topographic survey. Downstream reach lengths assigned for each cross section. N-values assigned to cross sections based on values used in effective model.
    - Channel n-value: 0.05
    - Overbanks n-value: 0.09
    - Homes/lawns n-value: 0.06
    - Roadway n-value: 0.03
- Roadway crossings at Falconhurst Drive and Hampton Chase Court added based on topographic survey information. Existing culverts at each crossing added based on survey information.
- Hydrologic flows calculated using USGS Region I regression equations. Flow change added at cross-section 386 due to inflow from the north at the downstream of the Hampton Chase Court crossing.

The model was run using HEC-RAS 6.3.1. In the existing model developed for the primary tributary to Tom's Creek, overtopping was only seen in the 500-year storm. This model did not assume backwater from Tom's Creek slowing the flow across Falconhurst. This indicates the tributary is not the principal culprit in water standing around as it should comfortably pass most storm events without overtopping.

## 5.5 Existing Project Area 2D model Hydraulics

The 2D HEC-RAS modeled provided to Timmons Group and developed by Nichols and Freese was updated with existing conditions based on survey. Modifications made can be seen below.

- The model provided encompassed a much larger area than required for analysis and so it was truncated to the project area. The area was clipped the smallest watershed containing the project area, and the outlet conditions originally used in the model for this watershed were preserved.
- Culvert information provided to the model for Falconhurst Drive and Hampton Chase Court was updated based on survey information. Size, upstream, and downstream inverts, dimensions, and lengths were updated as appropriate.
- An existing surface was created for the topographic survey and pasted onto the surface that was already present in the Nichol and Freese model to provide better model definition in the project area.
- Internal cell spacing around the 2D connections for the crossings in the project area were refined to better represent the topography around the crossings.

The model was then run using HEC-RS 6.3.1 and the results were analyzed to determine potential sources of the sediment deposition. From the results of the 2D model it can be seen that Falconhurst Drive overtops from Tom's Creek from the 10-year storm and larger. The crossing at Falconhurst Drive acts as a low spot where water from Tom's Creek and eventually the tributaries pond. Tom's Creek begins overtopping at 12:30 hours into a 24-hour storm and the ponding remains for approximately three hours. During this time, low velocity water around the principal Falconhurst Drive crossing has increased potential to deposit sediment. From the results of the 1 and 2D HEC-RAS models it was concluded that the sediment deposition that the site is currently experiencing is primarily due to the flooding from Tom's Creek rather than the tributaries themselves.

# 6 Proposed Improvements

## 6.1 Alternative 1

The first alternative prepared consists of downstream grading for the tributary to the principal crossing at Falconhurst Drive with a berm protecting its outlet from high water from Tom's Creek. From the 2D modeling done, the creation of a more defined channel combined with the berm protecting its flow allowed flow to continue during rainfall events that would normally back the culvert crossing up. The grading plan for alternative 1 can be seen below in **Figure 3**.


**Figure 3**: Alternative 1 grading plan

In this alternative it is recommended to adjust the geometry of the culverts crossing Falconhurst. Blocking the western culvert to a depth to match the natural stream profile and further blocking the eastern culvert to a depth to allow it to function as a floodplain culvert during high flows is recommended. The western culvert which will act as the channel culvert can be blocked to a depth of 0.8' to match the natural stream inverts used in the proposed replacement culverts in Alternative 2 Phase II. The western culvert can be blocked a further 0.5' to a total of 1.3' to act as a floodplain culvert. The existing configuration and water surface elevations (WSEL) are shown below in **Figure 4**, and the proposed blockage in the existing culverts is shown below in **Figure 5**.

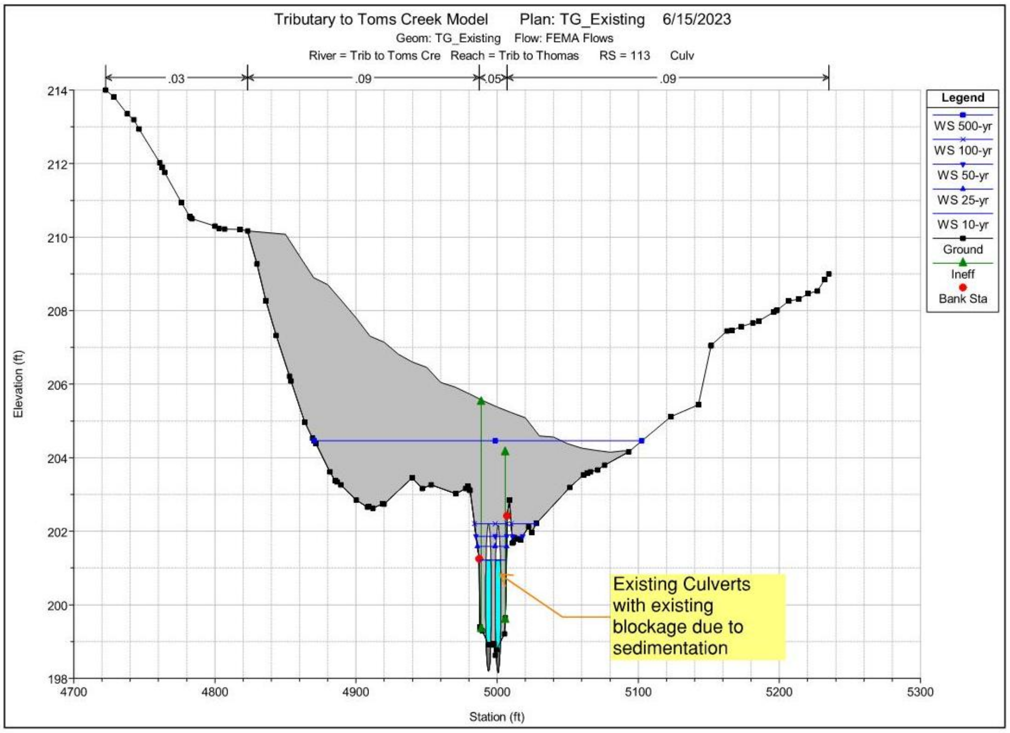



**Figure 4**: Existing Conditions US cross-section of the principal Falconhurst Drive crossing

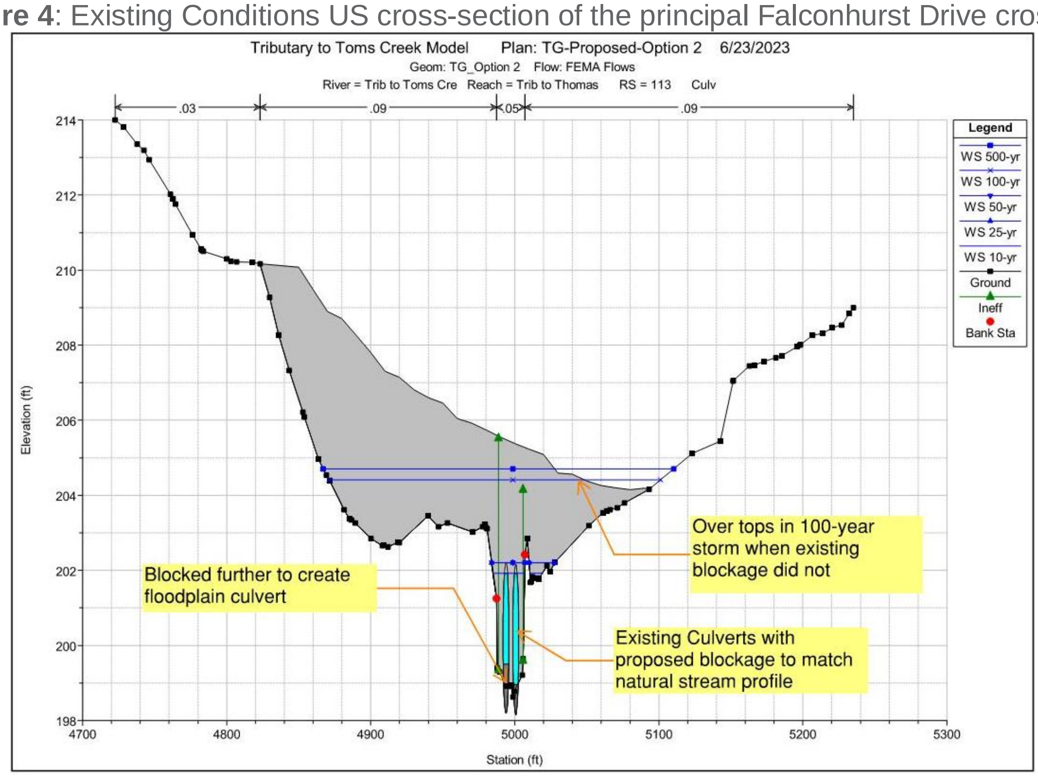



**Figure 5**: US cross-section of principal Falconhurst Drive crossing with proposed blockage

Further blocking the culverts in this configuration does cause overtopping in the 100-year storm versus the existing configuration which only overtops in the 500-year storm. However, this configuration can direct and convey flow better towards Tom's Creek lessening sedimentation potential.

### 6.1.1 Regrading downstream to confluence with Tom's Creek

Due to the noted historical sediment deposition, the area downstream of the principal Falconhurst Drive crossing has been dug out several times. The proposed improvements along this stream include grading out a more naturally sloped stream geometry to improve velocities and sediment transport capacity. Station 205.76 from the morphological data on Tom's Creek was chosen as a tie-in elevation for the starting point to grade back to the inverts of the Falconhurst Crossing. The tie in point is the end of a riffle of Tom's Creek before a pool at the confluence. The elevation of this tie in was 197.17 and with the reference slope of the tributary determined to be approximately 2.6%, the bottom of the tributary was then run from the confluence to the invert of the culverts crossing Falconhurst Drive at this slope. The channel of the stream was then narrowed and graded to be similar in geometry to the upstream channel to better direct flow towards Tom's Creek. An existing 24" sewer line crosses Tributary A approximately 30 LF downstream of the culverts. This sewer line is still above proposed grade, however the invert out of the proposed culvert design is raised approximately 0.8' above the existing inverts, and 0.2' above the existing pipes with existing blockage, leading to a smaller pool forming due to the pipe. The sewer line will need to be protected during the regrading of the channel and signage will need to be provided calling out the location of the sewer line in the case of additional work being done in the future. In the proposed alternatives where the culverts crossing Falconhurst Drive are not upgraded, the plan includes grading for the existing road stormwater system approximately 20' west of the principal crossing.

### 6.1.2 Berm to protect flow from tributary to Tom's Creek

From the existing conditions modeling performed, increased water surface elevation from Tom's Creek is the primary culprit of sitting water in the project area. This is a concern even in smaller storm events where flow from Tom's Creek does not overtop Falconhurst Drive. Even in smaller storm events water ponds around the downstream outlet of the principle crossing on Falconhurst Drive. This sitting water not only has increased potential for sediment deposition, but backs water up the culvert, stopping flow. To combat this, a proposed berm was designed to protect the flow from the principal Falconhurst crossing from flows from Tom's Creek. This will allow the crossing to continue flowing longer in storm events. The berm was designed to elevation 204' because this was the highest elevation of the floodplain that a berm could be graded to on the downstream of the culvert crossing.

The berm was modeled in the Tom's Creek 1D HEC-RAS model to confirm a no-rise and a cross section from that model can be seen below in **Figure 6**. A no-rise was confirmed showing the berm did not create a rise in the WSEL of Tom's Creek. Cross-section 5183 was the only cross section with adjusted geometry from the berm.

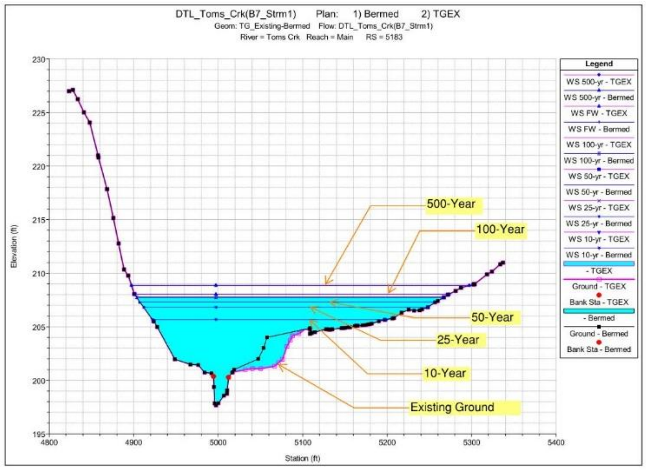



**Figure 6**: XS 5183 from Tom's Creek 1D model

## 6.2 Alternative 2

Alternative 2 is broken into two phases, Phase I&II, and aims to protect the project area from sedimentation and provide a redesigned culvert configuration for better conveyance. Phase I is primarily grading around the principal culvert crossing to reduce sedimentation potential and in Phase II the culvert configuration crossing Falconhurst Drive is redesigned as well as re-routing the roadway drainage system.

## 6.3 Alternative 2 Phase I

Alternative 2 Phase I sees the same improvements from Alternative 1 but with benches along Tom's Creek and grading out the low spot around the bend of Tom's Creek. This reduces the sedimentation potential from standing water in the low spot and provides additional floodplain storage and direction to Tom's Creek. Work for this phase stays outside of the roadway. It is anticipated that no traffic impacts will be required. The grading plan for Alternative 2 Phase I is included below in **Figure 7**.

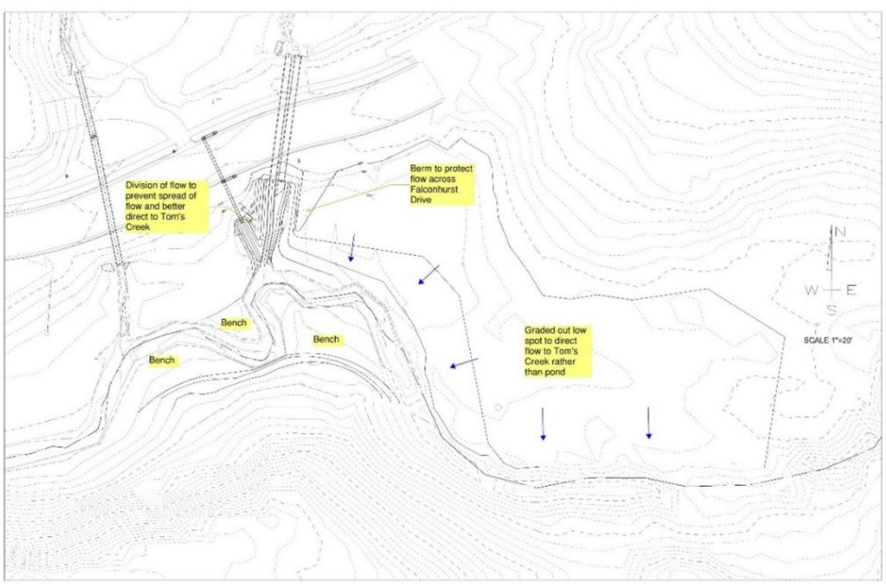



**Figure 7**: Alternative 2 Phase I grading plan

### 6.3.1 Tom's Creek floodplain storage

Proposed benches were explored to provide additional floodplain storage and as a method to better direct water downstream Tom's Creek. The proposed benches can be seen below in **Figure 8**. The benches were put into the 1D Tom's Creek model to confirm no-rise due to this change and the benches were put into a surface for use in the 2D model. The benches not only provide additional storage in high flow events, but in high flow events the benches widen the corridor flow can travel downstream within Tom's Creek.

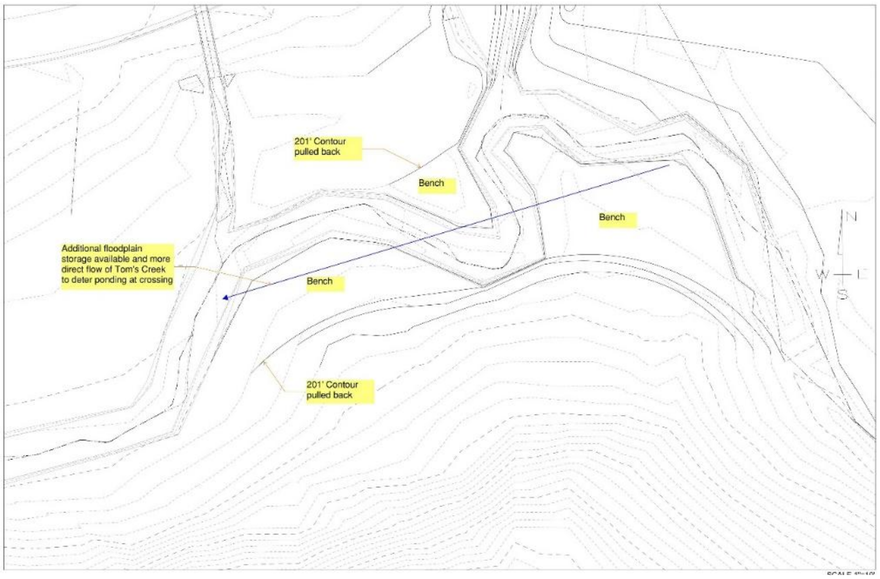



**Figure 8**: Grading work for benches along Tom's Creek

### 6.3.2 Protecting flow from Falconhurst Drive Crossing from low spot inundation

There currently exists a low spot along the sewer line to the east of the principal culvert crossing. This low spot collects water in high flow events and as it fills, this inundation contributes to blocking flow from the principal crossing. Two options were investigated to lessen this inundation. In the first, a berm was erected along tom's creek as it flows south to north on its approach toward the principal culvert crossing. In the second, the low spot was graded out to provide positive drainage toward Tom's Creek. Both options were put into a surface and into the 2D model to determine how they performed. The secondary berm performed poorly, the results of which are included in **Appendix C** and was not included in any alternative. Grading out the low spot however did provide positive drainage, does not allow permanent ponding, and can be seen in the grading plan for Alternative 2 Phase I above.

## 6.4 Alternative 2 Phase II

Alternative 2 Phase II consists of replacing the culverts at the principal crossing at Falconhurst Drive. In this phase it is recommended to upgrade the culverts after making the previous improvements. In this phase of Alternative 2 the western culvert is replaced with a 5' concrete pipe culvert placed at the natural stream slope and buried 1'. The eastern culvert is replaced by a 4' floodplain concrete pipe culvert placed on a bench 1' above the main channel culvert. In the 1D model for the tributary this configuration passed all of the storms up to a 500-year storm without overtopping. Work for this phase will impact Falconhurst Drive. It is assumed that there will be temporary double lane closures while the culvert and roadway work occur. The grading plan with culverts replaced is included below in **Figure 9**.

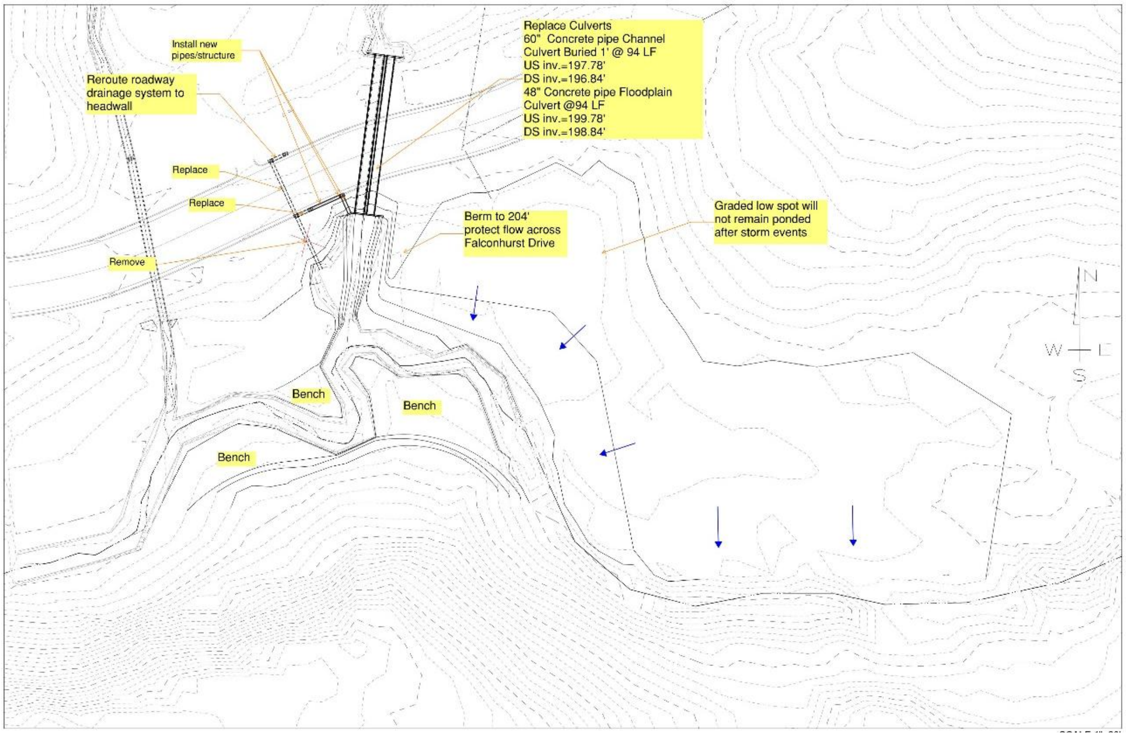



**Figure 9**: Alternative 2 Phase II: Replacing culvert crossing and rerouting roadway system

### 6.4.1 Principal Crossing Culvert Improvements

The option to upgrade the size, configuration, and geometry of the culverts at the principal crossing was analyzed. The crossing overtops the north side of Falconhurst Drive in the 500-year storm and the current configuration and geometry is not conducive to conveying flow to Tom's Creek. The goal of the design was to match current overtopping to the 500-year storm or more and to provide a better conveyance from the culvert to the confluence with Tom's Creek. In the design a channel culvert was used to convey flow during normal flow with a floodplain culvert to provide relief during storm events. This narrows and directs normal flow from the crossing to Tom's Creek. The culverts slope was matched to the stream slope of approximately 2.6%. The channel culvert is a 5' concrete pipe culvert buried 1' and the floodplain culvert is a 4' concrete pipe culvert raised 1' higher than the channel culvert. This only overtops in the 500-year storm, and more closely matches the natural stream to facilitate flow from the tributary to Tom's Creek. The profile can be seen below in **Figure 10**, and the WSEL table comparison can be seen in **Table 3**.

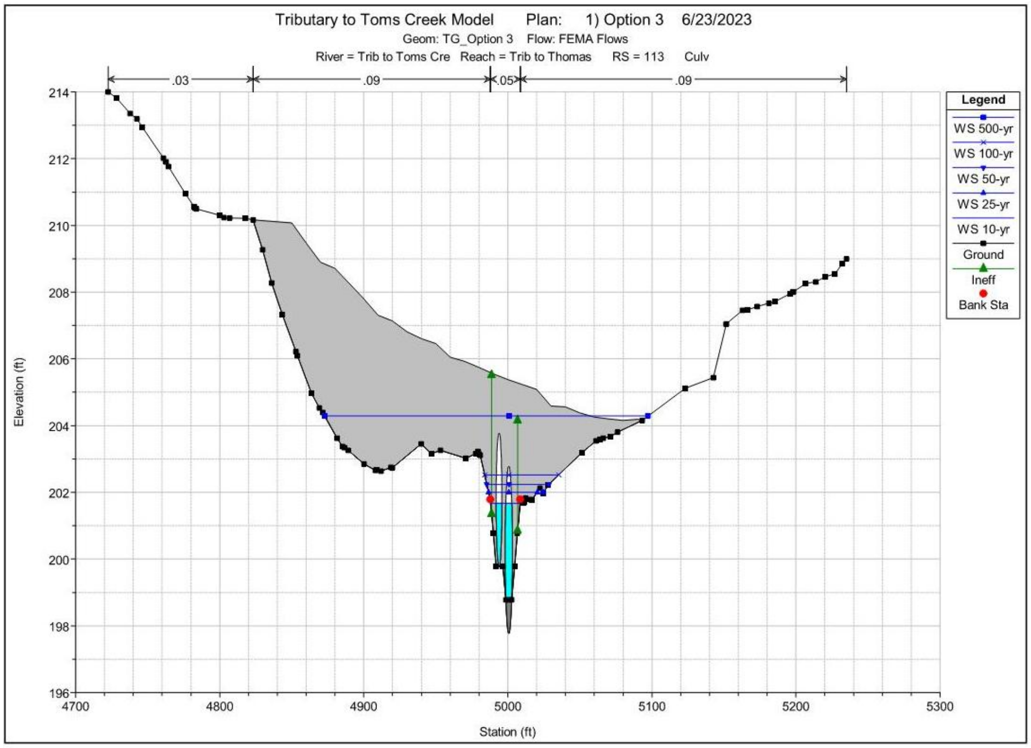



**Figure 10**: US cross-section of culvert improvements for Tributary A

**Table 3: Existing and Proposed Conditions 100-year and Floodway Water Surface Elevation (WSEL) Comparison – Base Flood**

| Cross Sections/Stream Station | 100-year WSEL (Existing) (NAVD88) | 100-year WSEL (Proposed) (NAVD88) | Difference (Proposed-Existing) (ft) |
|---|---|---|---|
| 608 | 208.65 | 208.65 | 0.00 |
| 558 | 208.6 | 208.6 | 0.00 |
| 511 | 208.58 | 208.58 | 0.00 |
| 460 | Hampton Chase Court | | |
| 414 | 204.66 | 204.66 | 0.00 |
| 386 | 203.53 | 203.53 | 0.00 |
| 326 | 203.66 | 203.59 | -0.07 |
| 243 | 203.39 | 203.34 | -0.05 |
| 170 | 203.32 | 203.2 | -0.12 |
| 113 | Falconhurst Drive | | |
| 69 | 200.64 | 201.7 | 1.06 |
| 28 | 200.4 | 201.39 | 0.99 |

The proposed culverts reduced WSEL in the 100-year storm leading up to the culvert crossing. The increase in WSEL that can be seen after the crossing is due to the increase in DS invert elevation when reconnecting to the natural stream profile. The improvements were also modeled in the 2D HEC-RAS model and compared to existing conditions. The existing conditions 2D model at 12:30 during the 24-hour storm is included below in **Figure 11**. Figures from the 2D model are taken at 12:30 because shortly after, even in the 10-year storm, the increased flow from Tom's Creek overtops Falconhurst Drive. This inundates the project area, making judgement of the improvements not possible. Improvements were analyzed at this time stamp to characterize performance before overtopping and then at the end of the model run to characterize the improvement's potential to drain the ponded water following Tom's Creek overtopping Falconhurst Drive.

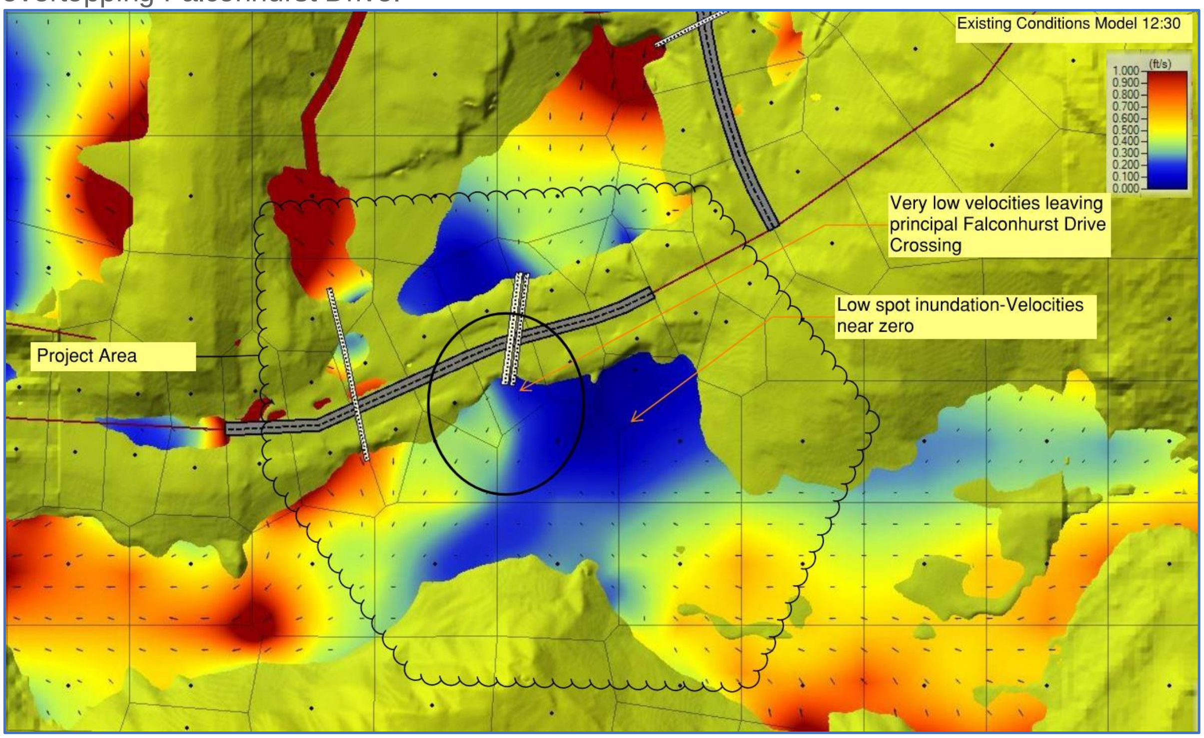



**Figure 11**: Existing Conditions 2D model velocities before overtopping

In the existing conditions the flow from the principal culvert has reduced velocities exiting even before Falconhurst overtopping, and the low spot stores water at a near zero velocity. The intention with the berm and grading out the low spot was to reduce the amount of time water sits in the low spot and to protect flow from the principal culvert. The 2D velocity map for the two-berm option can be seen in the appendices as the option was not implemented into any alternative. The 2D velocity map for the proposed conditions can be seen below in **Figure 12**.

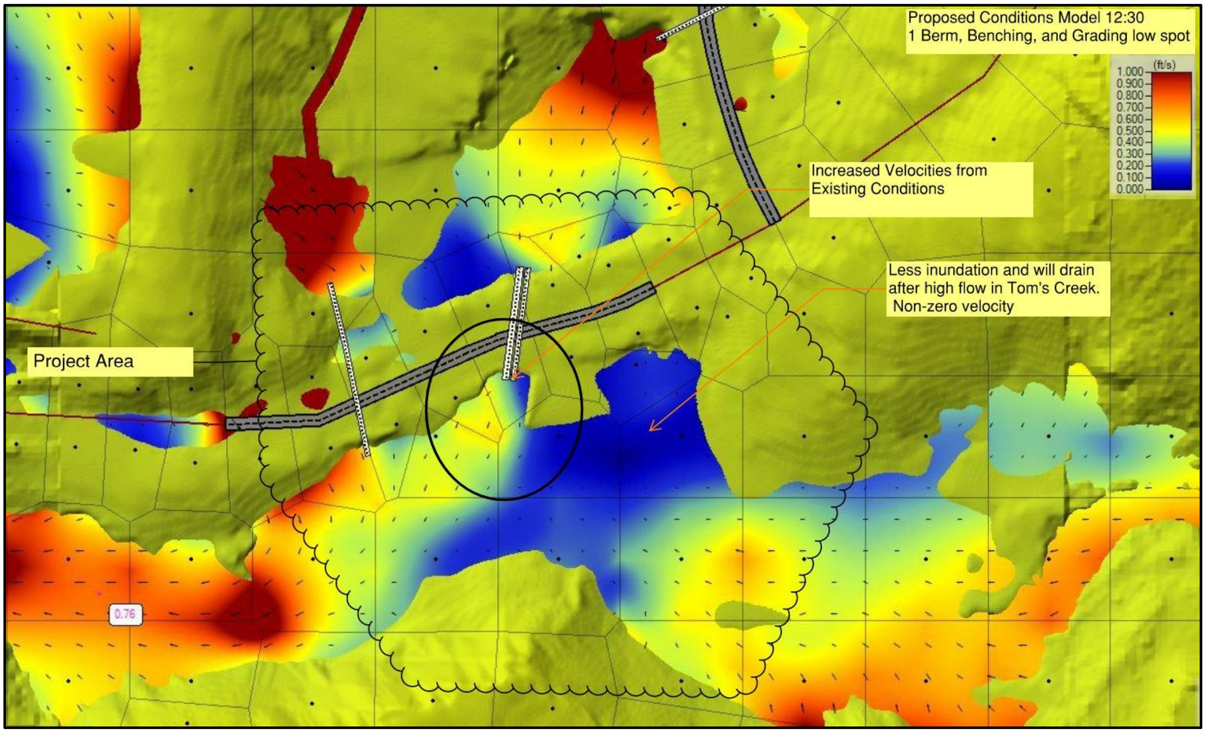



**Figure 12**: Proposed 2D model velocities before overtopping

The berm on the downstream of the crossing performs well before overtopping by protecting the flow from the principal culvert crossing from the flow from Tom's Creek. The velocities in this area are increased from the existing conditions seen in the previous figure. In smaller storms where Falconhurst does not overtop this will allow flow from the tributary to continue for a longer length of time in storm events. The low spot still sees ponding however, the velocity in the area is non-zero with the proposed grading, and the ponding will drain after high flows from Tom's Creek end. This greatly reduces the potential for sedimentation in this area due to water no long staying after storm events.

### 6.4.2 Stream stabilization for crossing at 3205 Falconhurst Drive

Timmons Group traveled to the project area on Monday 6-5-2023 to take measurements on Tributary B which flows through the property at 3205 Falconhurst Drive. Measurements along the reach were taken along with field notes to prepare a preliminary cost estimate. There were three distinct locations that showed a bench forming and showed a stable channel configuration. The first cross section taken was right at the upstream end of the culvert, and the last was collected at the most upstream limit of the measured reach and these two cross sections were used as the limits of a functional uplift or channel relocation. Based off preliminary observations, the narrow valley geometry of the stream between existing homes and a steep terrace bank precluded the option of relocating the stream due to the amount of earthwork required.

The functional uplift of the channel in the existing alignment was investigated for the concept design. From the reference cross section and field data, a channel geometry capable of containing the 2-year storm was designed. Due to the close proximity with houses in the area, a floodplain bench was also designed to contain the 100-year storm. A preliminary cost estimate was created for this repair and included in **Appendix E**. The floodplain bench was placed on the side of the stream that would require the least cut/fill in the preliminary estimate. The cross-section geometry can be seen below in **Figure 13**, and the cut/fill sections are included in **Appendix C**.

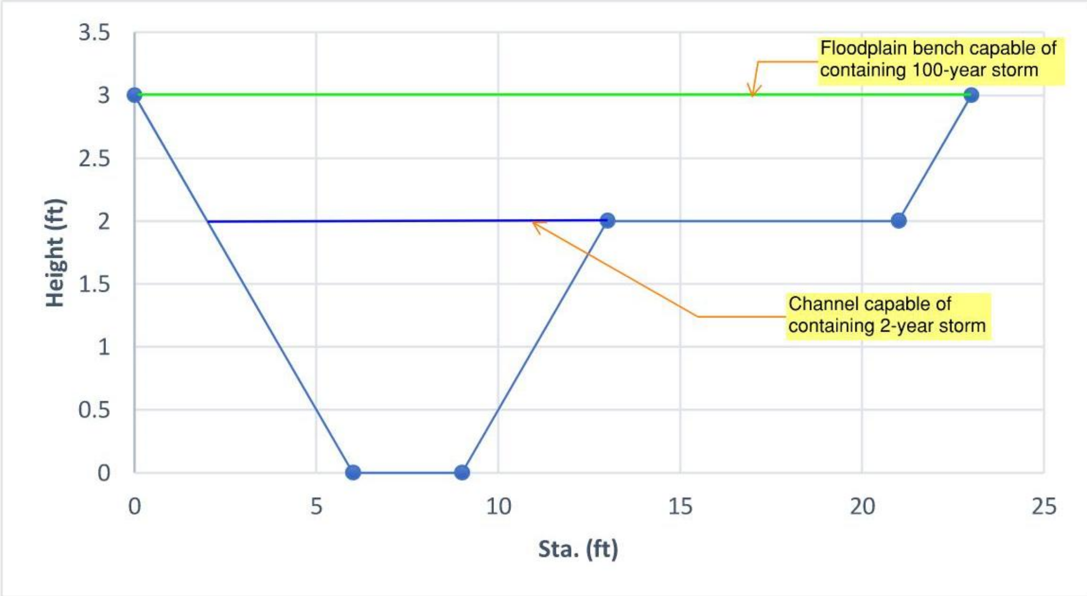



**Figure 13**: Cross-section Geometry for functional uplift

# 7 Recommendations and Budgetary Estimates

## 7.1 Recommendations

Timmons Group would recommend moving forward into phased construction drawings for Alternative 2 Phase I&II. Through collaboration with the client, Alternative 2 Phase I seems the most desirable for a quick efficient solution to the sediment problem currently being experienced at the Falconhurst Drive crossings. Alternative 2 Phase II could then be a phased option to be constructed after for a more holistic solution.

Regarding the tributary that crosses Falconhurst Drive at the 3205 Falconhurst Drive property, Timmons Group would recommend a functional uplift along the existing alignment. The floodplain was placed on the side of the stream as to incur the lesser cut/fill requirements. In this case that meant the floodplain was on the eastern side of the stream and would go into Homeowner’s property if placed on that side. This would necessitate the removal of the fence along the tributary and pool protection as needed for those properties. The cost estimate is included below as Tributary B Stabilization in **Table 4**.

Due to the possible sources of sediment noted on the February 14, 2023, site walk along Tom’s Creek, Timmons Group would also recommend addressing sources of sediment entering Tom’s Creek from upstream of the project area. Several locations are noted in the site walk that could be leading to increased sediment deposition into the stream that would then settle out in storm events where ponding occurs at the Falconhurst Drive crossing. Eliminating the source of this sediment would also lead to less deposition downstream at the project area.

## 7.2 Permitting

Tom's Creek is jurisdictional requiring USA COE 404, NC Water Qualification Certification 401, and buffer authorization permitting. Tom's Creek is also a FEMA regulated stream, requiring a no-rise certification for any proposed improvements.

For each of the alternatives that impacted the Tom's Creek 1D model a no-rise analysis was performed with the improvements to confirm that a no-rise could be achieved for this project. Supporting calculations can be found in **Appendix C**. Alternative 2 Phase II does not affect the cross-section geometry of the Tom's Creek 1D model so the no-rise was analyzed for the grading changes Alternative 1 and Alternative 2 Phase I proposed on the cross-section geometry of the model. A no-rise was achieved with both Alternatives. Supporting WSEL comparison tables can be seen in **Appendix C**.

## 7.3 Budgetary Estimates

Budgetary estimates were prepared for Alternative 2 Phase I&II. These budgets are preliminary based on the conceptual plans prepared in this study. Although the estimates provided are intended to be conservative, refinements during the design phase could impact the provided estimates as designs are further developed. The cost for Alternative 2 Phase II assumes that Alternative 2 Phase I has already been constructed. It has been assumed in this cost estimate that the two Alternative 2 phases will be in construction over separate funding cycles. Concept summary estimates are included in **Table 4**. Detailed cost estimate information is included in **Appendix E**.

**Table 4**: Proposed Budgetary Estimate Summary

| Proposed Improvements | Estimate |
|---|---|
| Alternative 2 Phase I | $289,000 |
| Alternative 2 Phase II | $290,500 |
| **Combined Alternative 2 Phase I&II** | **$579,500** |
| Tributary B Stabilization | $197,500 |

# 8 Computer models

The following list of computer models have been included with the report:

**Hydraulic HEC-RAS models**

**Tributary to Tom's Creek 1-D HEC-RAS Model**

Existing Conditions**:**

The existing conditions model includes the 10-, 25-, 50-, 100- and 500-year storm events.

| | |
|---|---|
| Project: Tributary to Toms Creek | TributarytoTomsC.prj |
| Plan: TG_Existing | TributarytoTomsC.p01 |
| Geometry: TG_Existing | TributarytoTomsC.g01 |
| Steady Flow: FEMA Flows | TributarytoTomsC.f01 |

Alternative 1:

| | |
|---|---|
| Project: Tributary to Toms Creek | TributarytoTomsC.prj |
| Plan: TG-Proposed-Alternative 1 | TributarytoTomsC.p02 |
| Geometry: TG_Option1 | TributarytoTomsC.g02 |
| Steady Flow: FEMA Flows | TributarytoTomsC.f01 |

Alternative 2 Phase I:

| | |
|---|---|
| Project: Tributary to Toms Creek | TributarytoTomsC.prj |
| Plan: TG-Proposed-Alternative 2 P1 | TributarytoTomsC.p03 |
| Geometry: TG_Alternative 2 P1 | TributarytoTomsC.g03 |
| Steady Flow: FEMA Flows | TributarytoTomsC.f01 |

Alternative 2 Phase II:

| | |
|---|---|
| Project: Tributary to Toms Creek | TributarytoTomsC.prj |
| Plan: TG-Proposed-Alternative 2 P2 | TributarytoTomsC.p04 |
| Geometry: TG_Alternative 2 P2 | TributarytoTomsC.g04 |
| Steady Flow: FEMA Flows | TributarytoTomsC.f01 |

**Tom's Creek 1-D HEC-RAS Model**

Effective Model**:**

The effective conditions model includes the 10-, 25-, 50-, 100- and 500-year storm events as well as a floodway profile.

| | |
|---|---|
| Project: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).prj |
| Plan: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).p01 |
| Geometry: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).g01 |
| Steady Flow: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).f01 |

Effective Model Future Flow**:**

| | |
|---|---|
| Project: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).prj |
| Plan: DTL_Toms_Crk(B7_Strm1)_Future | DTL_Toms_Crk(B7_Strm1).p02 |
| Geometry: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).g01 |
| Steady Flow: DTL_Toms_Crk(B7_Strm1)_Future | DTL_Toms_Crk(B7_Strm1).f02 |

TG-Existing:

| | |
|---|---|
| Project: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).prj |
| Plan: TG_Existing | DTL_Toms_Crk(B7_Strm1).p03 |
| Geometry: TG_Existing | DTL_Toms_Crk(B7_Strm1).g02 |
| Steady Flow: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).f01 |

Alternative 1:

| | |
|---|---|
| Project: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).prj |
| Plan: TG_Proposed-Alternative 1 | DTL_Toms_Crk(B7_Strm1).p04 |
| Geometry: TG_Alternative 1 | DTL_Toms_Crk(B7_Strm1).g03 |
| Steady Flow: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).f01 |

Alternative 2:

| | |
|---|---|
| Project: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).prj |
| Plan: TG_Proposed_Alternative 2 | DTL_Toms_Crk(B7_Strm1).p05 |
| Geometry: TG_Alternative 2 | DTL_Toms_Crk(B7_Strm1).g04 |
| Steady Flow: DTL_Toms_Crk(B7_Strm1) | DTL_Toms_Crk(B7_Strm1).f01 |

**Project Area 2-D HEC-RAS Model**

Existing 100-year:

| | |
|---|---|
| Project: WakeForest_Basin3 | WakeForest_Basin3.prj |
| Plan: 100_YR_NewDev | WakeForest_Basin3.p06 |
| Geometry: Basin3_NewDev | WakeForest_Basin3.g01 |
| Unsteady Flow: 100_YR | WakeForest_Basin3.u04 |

Existing 50-year:

| | |
|---|---|
| Project: WakeForest_Basin3 | WakeForest_Basin3.prj |
| Plan: 50_YR_NewDev | WakeForest_Basin3.p08 |
| Geometry: Basin3_NewDev | WakeForest_Basin3.g01 |
| Unsteady Flow: 50_YR | WakeForest_Basin3.u03 |

Existing 25-year:

| | |
|---|---|
| Project: WakeForest_Basin3 | WakeForest_Basin3.prj |
| Plan: 25_YR_NewDev | WakeForest_Basin3.p09 |
| Geometry: Basin3_NewDev | WakeForest_Basin3.g01 |
| Unsteady Flow: 50_YR | WakeForest_Basin3.u02 |

Existing 10-year:

| | |
|---|---|
| Project: WakeForest_Basin3 | WakeForest_Basin3.prj |
| Plan: 10_YR_NewDev | WakeForest_Basin3.p10 |
| Geometry: Basin3_NewDev | WakeForest_Basin3.g01 |
| Unsteady Flow: 50_YR | WakeForest_Basin3.u01 |

TG_Existing 100-year:

| | |
|---|---|
| Project: WakeForest_Basin3 | WakeForest_Basin3.prj |
| Plan: TG_Existing_100_YR | WakeForest_Basin3.p21 |
| Geometry: Basin3_NewDev | WakeForest_Basin3.g01 |
| Unsteady Flow: 100_YR | WakeForest_Basin3.u04 |

TG_Existing 10-year:

| | |
|---|---|
| Project: WakeForest_Basin3 | WakeForest_Basin3.prj |
| Plan: TG_Existing_10_YR | WakeForest_Basin3.p25 |
| Geometry: Basin3_NewDev | WakeForest_Basin3.g01 |
| Unsteady Flow: 10_YR | WakeForest_Basin3.u01 |

TG Proposed 100-year (Option with two berms):

| | |
|---|---|
| Project: WakeForest_Basin3 | WakeForest_Basin3.prj |
| Plan: TG-Proposed_100_YR | WakeForest_Basin3.p22 |
| Geometry: Basin3_NewDev-Prop | WakeForest_Basin3.g05 |
| Unsteady Flow: 100_YR | WakeForest_Basin3.u04 |

TG Proposed 10-year (Option with two berms):

| | |
|---|---|
| Project: WakeForest_Basin3 | WakeForest_Basin3.prj |
| Plan: TG-Proposed_10_YR | WakeForest_Basin3.p24 |
| Geometry: Basin3_NewDev-Prop | WakeForest_Basin3.g05 |
| Unsteady Flow: 10_YR | WakeForest_Basin3.u01 |

TG Proposed 10-year (Option with low spot graded):

| | |
|---|---|
| Project: WakeForest_Basin3 | WakeForest_Basin3.prj |
| Plan: TG-Proposed_100_YR_option2 | WakeForest_Basin3.p01 |
| Geometry: Basin3_NewDev-Prop2 | WakeForest_Basin3.g07 |
| Unsteady Flow: 10_YR | WakeForest_Basin3.u01 |

# Appendix A

## Field Data Collection

*Project Location Map*


SCALE 1"=600'

0 600' 1200'

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# TIMMONS GROUP

NORTH CAROLINA LICENSE NO. C-1652

## FALCONHURST DRIVE

TOWN OF WAKE FOREST - NORTH CAROLINA

*PROJECT LOCATION MAP*

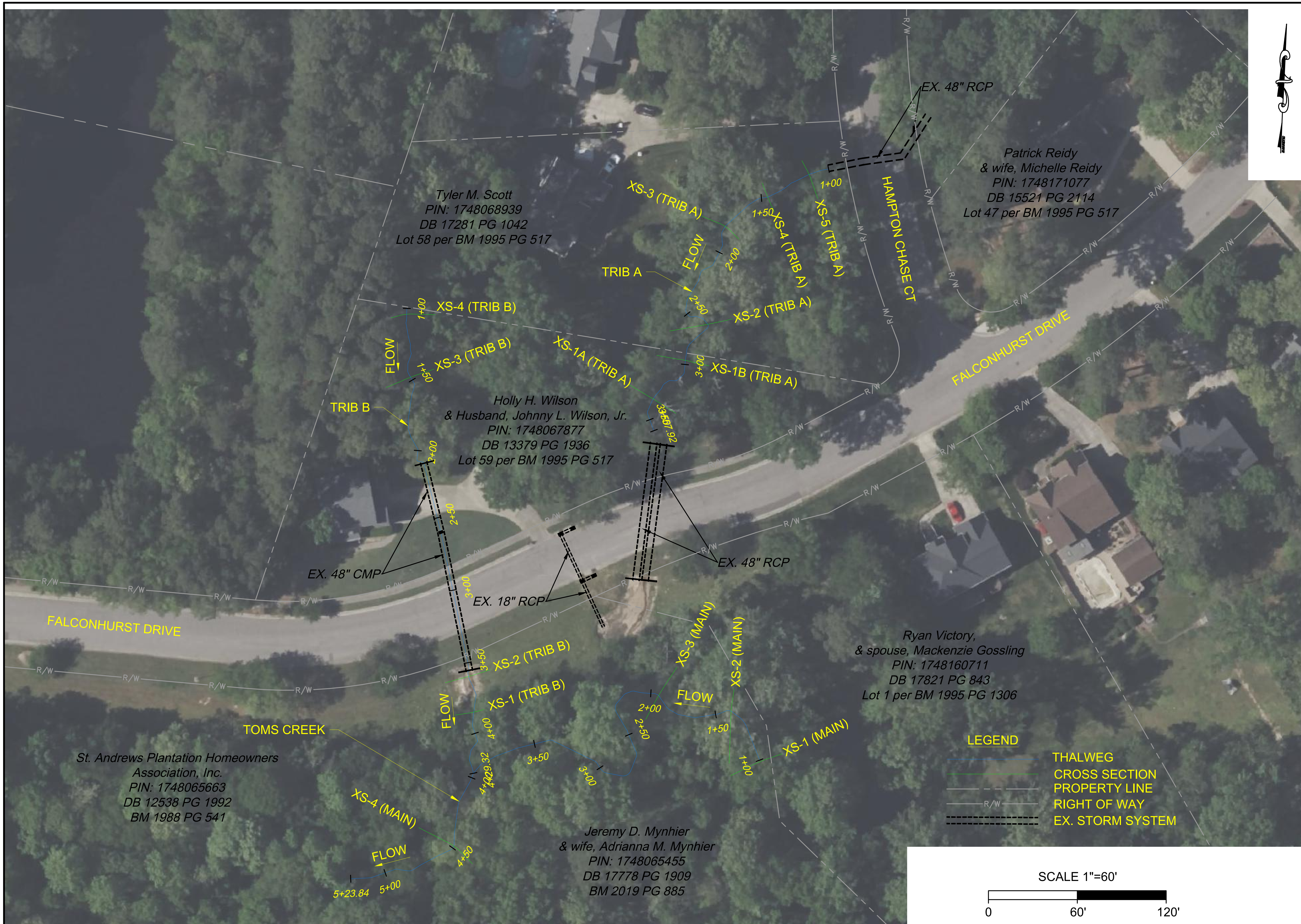
| REVISION DESCRIPTION | DATE |
| --- | --- |

DATE: 6-30-2023
DRAWN BY: S.VANDERGRIFT
DESIGNED BY: Z.GILSTRAP
CHECKED BY: D.DUNCAN
SCALE: 1"=600'
JOB NO.: 52780.001
SHEET NO.: A



L:\209\52780.001-TWF-Falconhurst\DWG\Sheet\Exhibit\52780.001-209C-LOCATION.dwg | Plotted on 7/6/2023 12:01 PM | by Shane Vandergrift

# Morphological Survey Map

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# TIMMONS GROUP

NORTH CAROLINA LICENSE NO. C-1652

## FALCONHURST DRIVE

TOWN OF WAKE FOREST - NORTH CAROLINA

*MORPHOLOGICAL SURVEY*

| | |
|---|---|
| DATE | 6-30-2023 |
| DRAWN BY | S.VANDERGRIFT |
| DESIGNED BY | Z.GILSTRAP |
| CHECKED BY | D.DUNCAN |
| SCALE | 1"=60' |
| JOB NO. | 52780.001 |
| SHEET NO. | C |

REVISION DESCRIPTION | DATE

# Existing Topographical Survey


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| DATE | REVISION DESCRIPTION |
|---|---|
| | |

# TIMMONS GROUP

NORTH CAROLINA LICENSE NO. C-1652

## FALCONHURST DRIVE STORM DRAINAGE IMPROVEMENTS

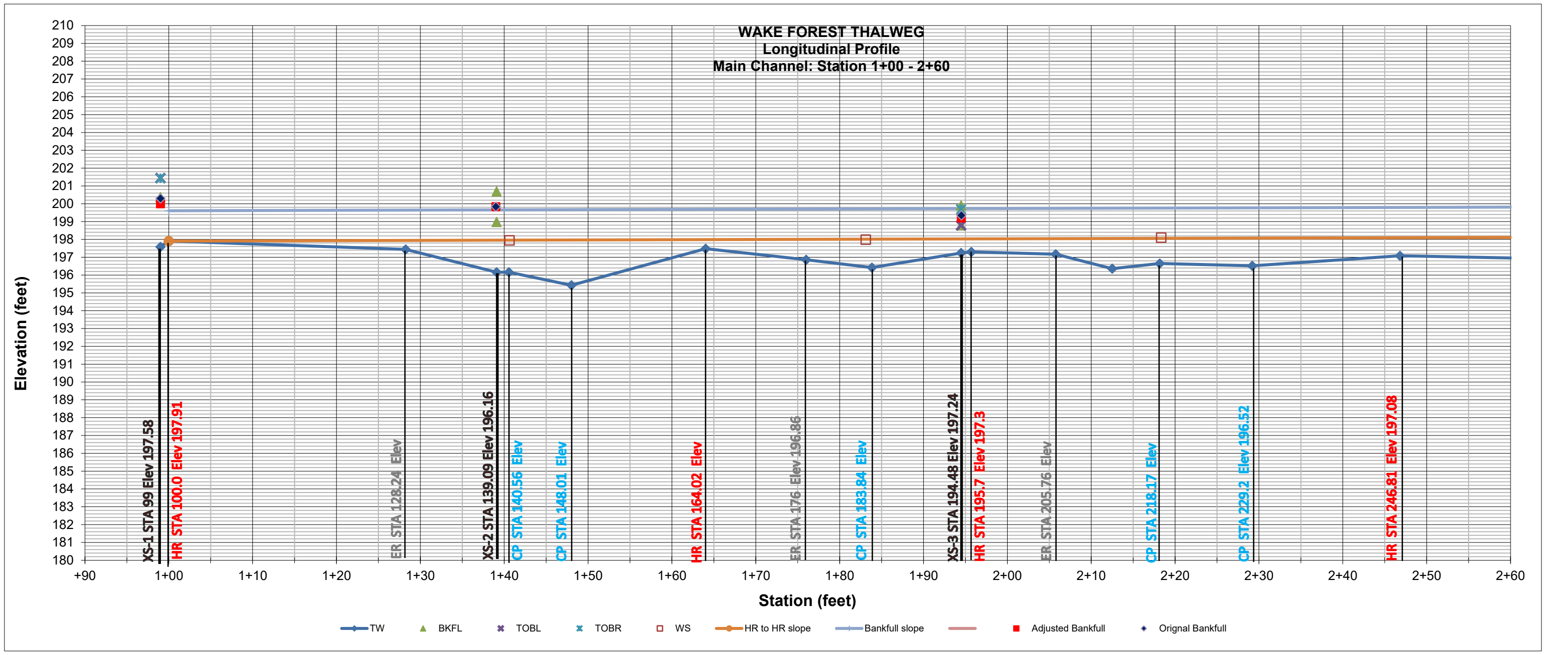
TOWN OF WAKE FOREST, NORTH CAROLINA

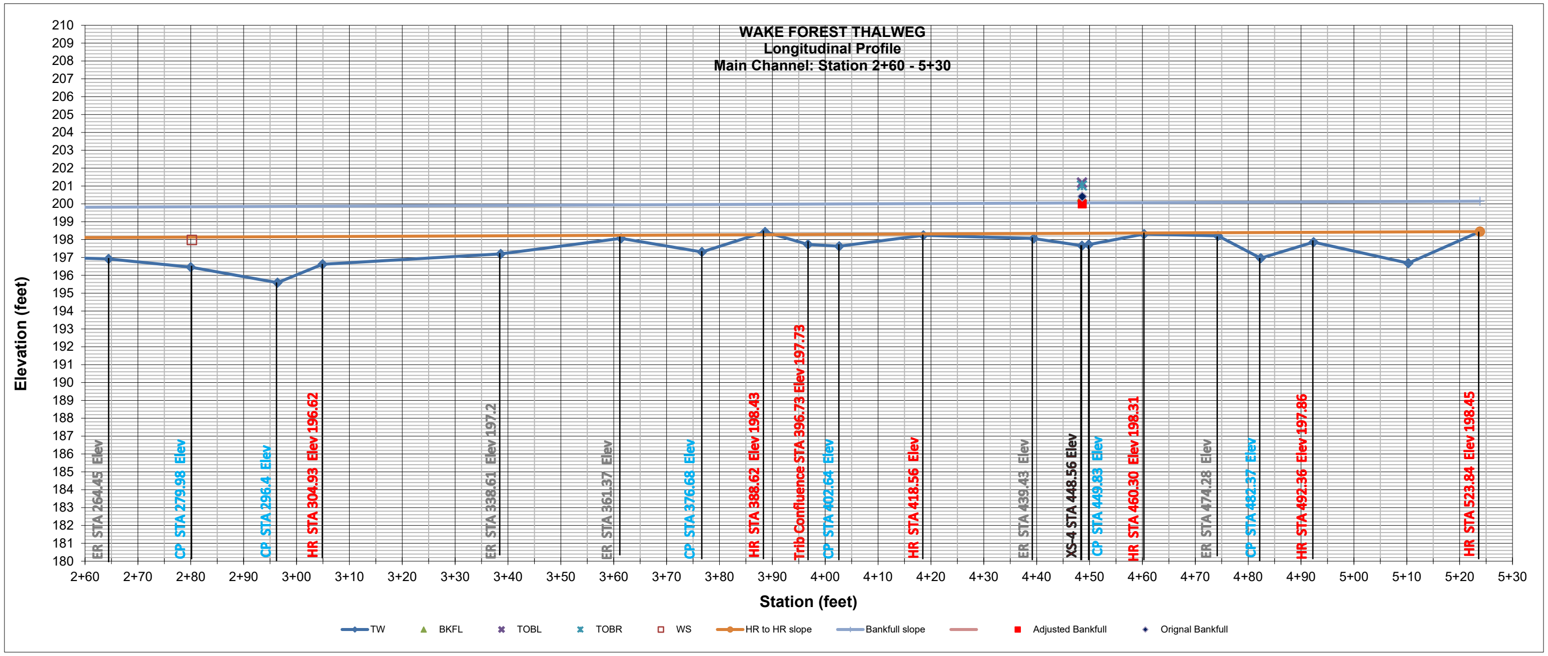
*EXISTING SURVEY*

| | |
|---|---|
| DATE | *6-28-2023* |
| DRAWN BY | *TIMMONS GROUP* |
| DESIGNED BY | *TIMMONS GROUP* |
| CHECKED BY | *TIMMONS GROUP* |
| SCALE | *1"=30'* |
| JOB NO. | *52780.001* |
| SHEET NO. | *B* |

# Longitudinal Profile-Tom’s Creek

Tom's Creek Longitudinal Profile

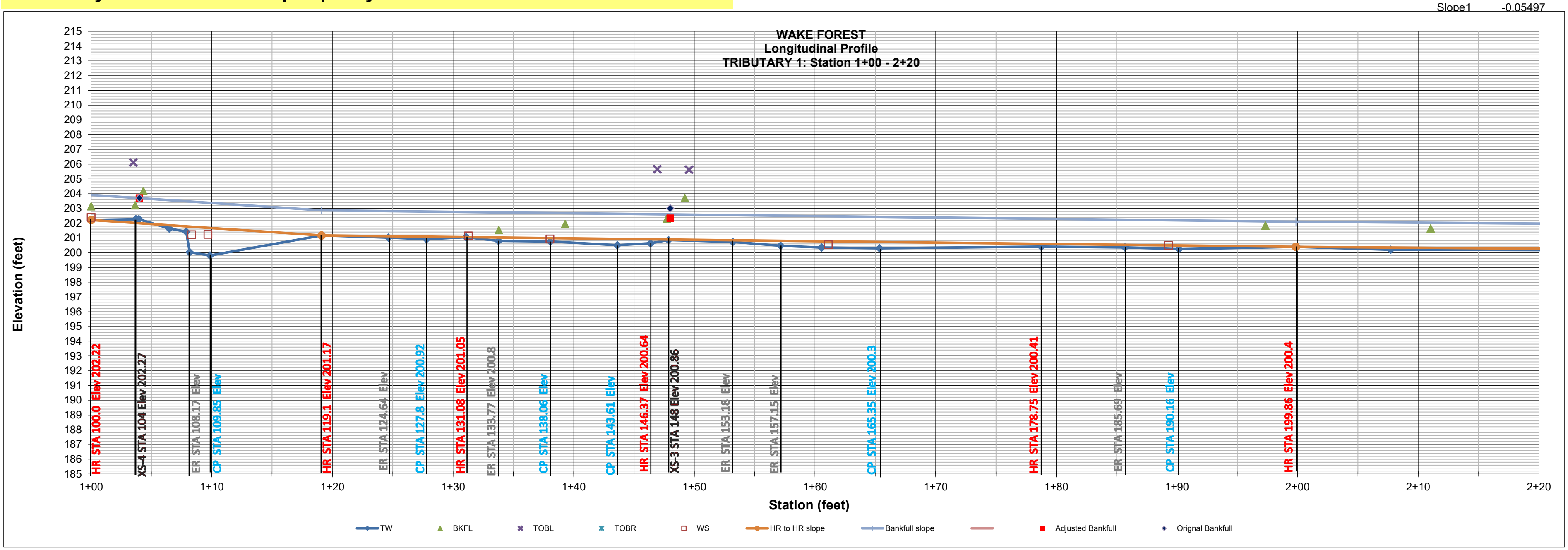


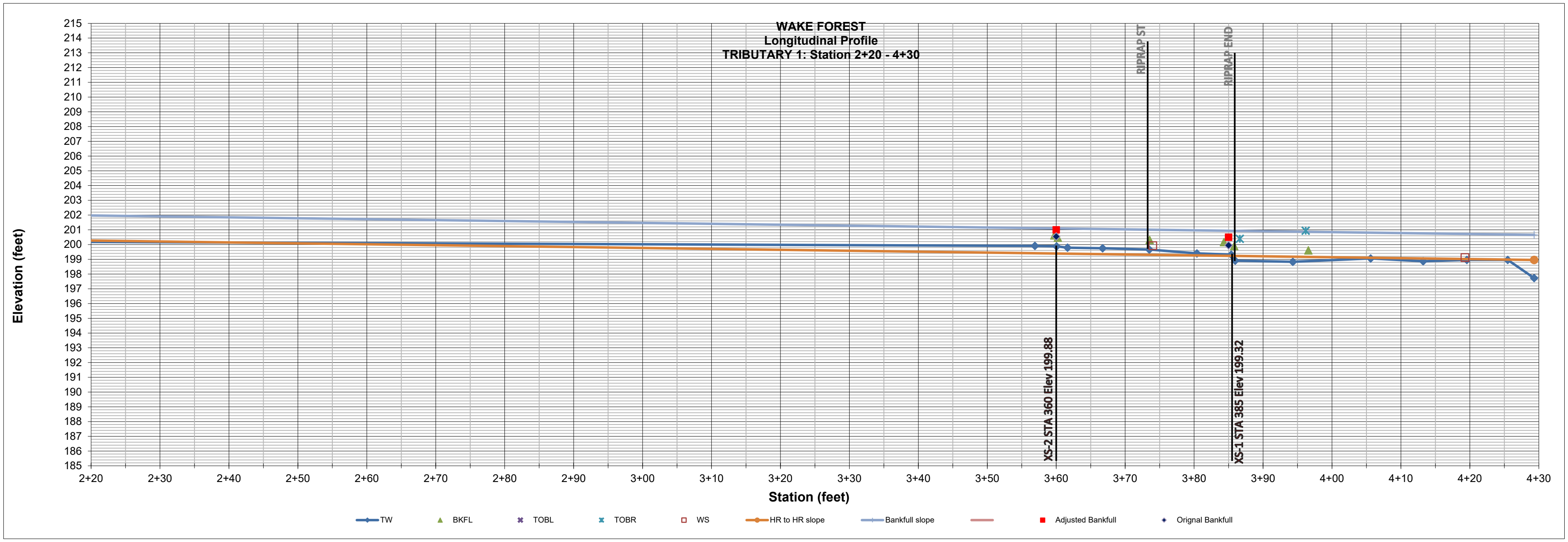



Longitudinal Profile-Tributary A

Tributary located at the property at 3205 Falconhurst drive

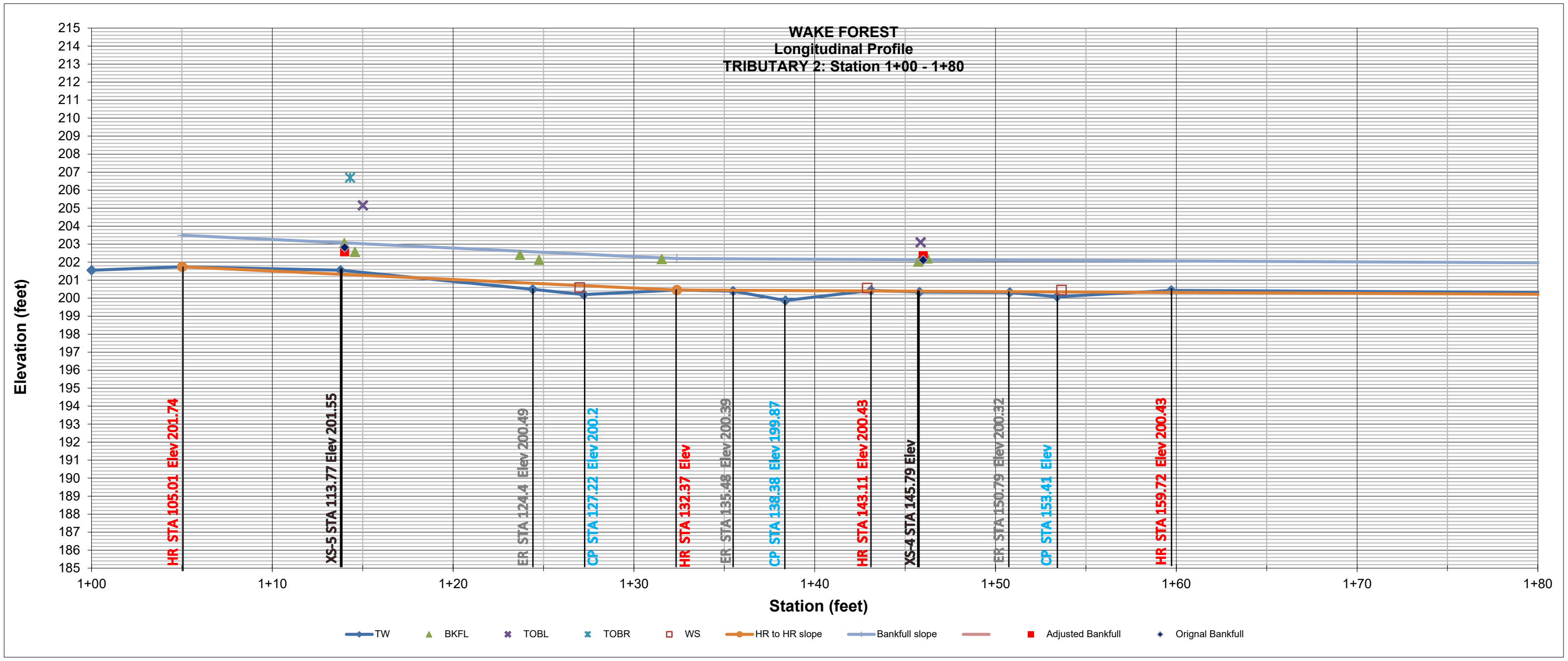
Slope1 -0.05497

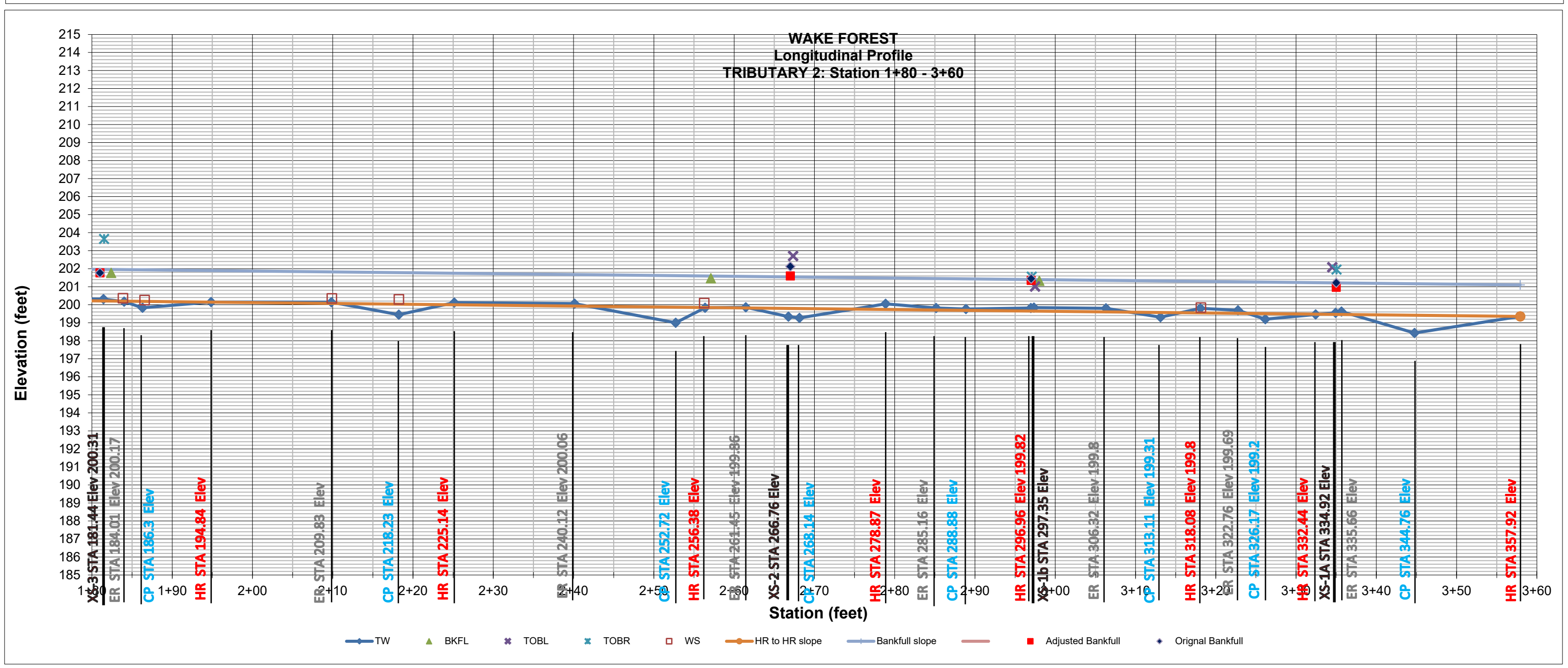


# Longitudinal Profile-Tributary B

Tributary to principal Falconhurst Drive Crossing Longitudinal Profile

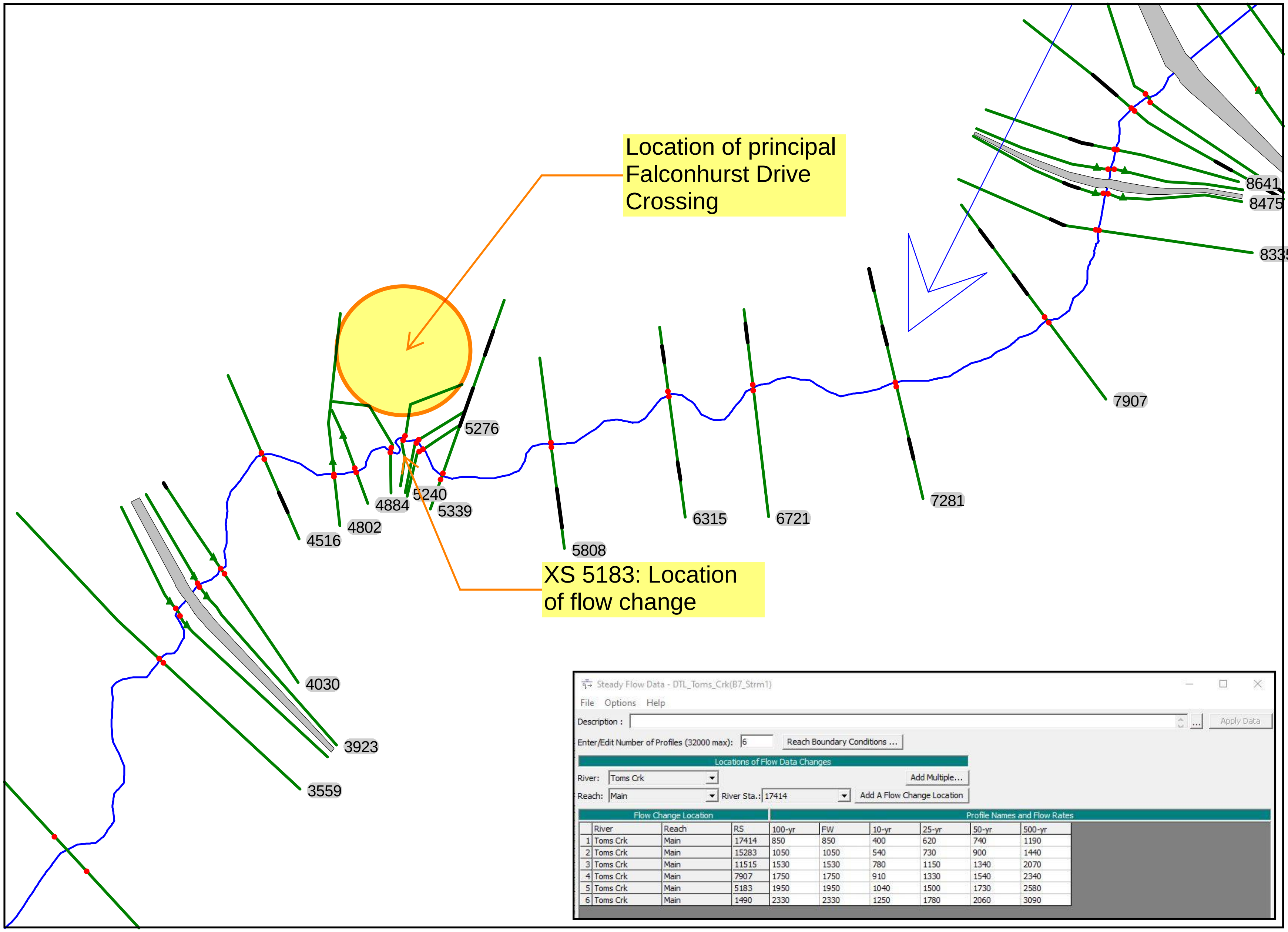


# Appendix B

## Hydrology

*Tom’s Creek Flow Change*

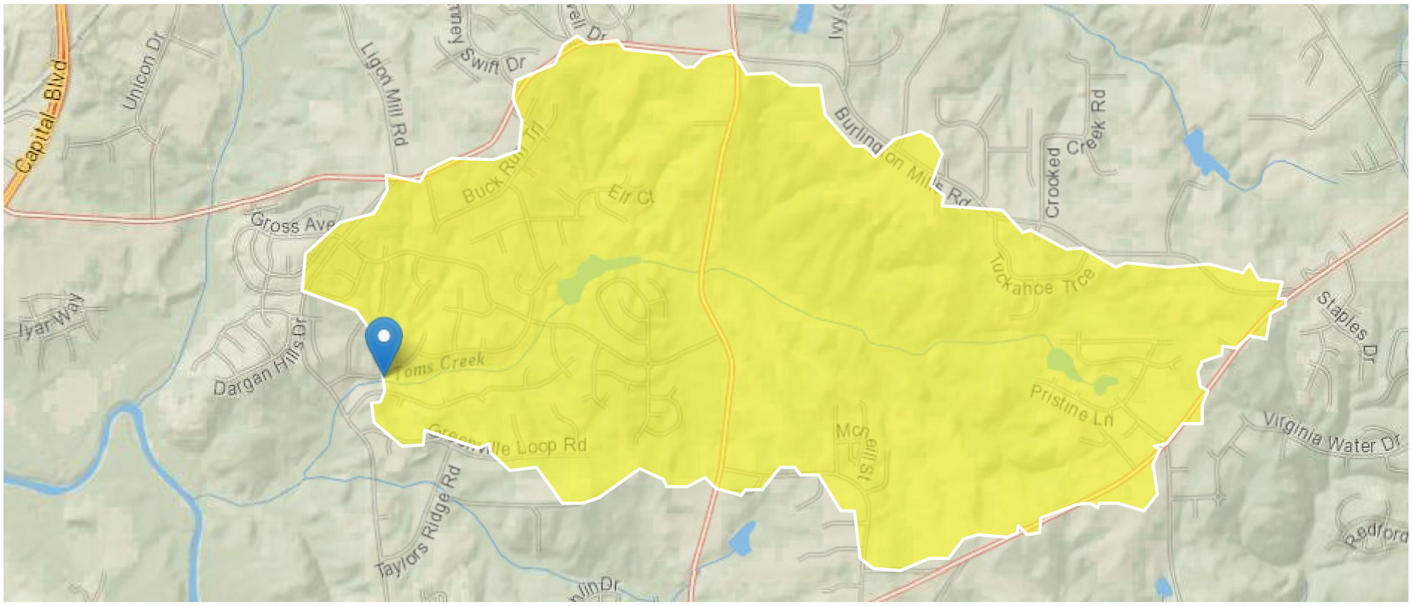



| | River | Reach | RS | 100-yr | FW | 10-yr | 25-yr | 50-yr | 500-yr |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Toms Crk | Main | 17414 | 850 | 850 | 400 | 620 | 740 | 1190 |
| 2 | Toms Crk | Main | 15283 | 1050 | 1050 | 540 | 730 | 900 | 1440 |
| 3 | Toms Crk | Main | 11515 | 1530 | 1530 | 780 | 1150 | 1340 | 2070 |
| 4 | Toms Crk | Main | 7907 | 1750 | 1750 | 910 | 1330 | 1540 | 2340 |
| 5 | Toms Crk | Main | 5183 | 1950 | 1950 | 1040 | 1500 | 1730 | 2580 |
| 6 | Toms Crk | Main | 1490 | 2330 | 2330 | 1250 | 1780 | 2060 | 3090 |

Streamstats-Tom’s Creek

# StreamStats Report

**Region ID:** NC
**Workspace ID:** NC20230627115520571000
**Clicked Point (Latitude, Longitude):** 35.91062, -78.52461
**Time:** 2023-06-27 07:55:42 -0400




Collapse All

## Basin Characteristics

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| DRNAREA | Area that drains to a point on a stream | 3.07 | square miles |
| LC06IMP | Percentage of impervious area determined from NLCD 2006 impervious dataset | 4.94 | percent |
| PCTREG1 | Percentage of drainage area located in Region 1 - Piedmont / Ridge and Valley | 100 | percent |
| PCTREG2 | Percentage of drainage area located in Region 2 - Blue Ridge | 0 | percent |
| PCTREG3 | Percentage of drainage area located in Region 3 - Sandhills | 0 | percent |
| PCTREG4 | Percentage of drainage area located in Region 4 - Coastal Plains | 0 | percent |
| PCTREG5 | Percentage of drainage area located in Region 5 - Lower Tifton Uplands | 0 | percent |

## Peak-Flow Statistics

### Peak-Flow Statistics Parameters [Peak Southeast US NC 2023 5006]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| PCTREG1 | Percent Area in Region 1 | 100 | percent | 0 | 100 |
| PCTREG2 | Percent Area in Region 2 | 0 | percent | 0 | 100 |
| PCTREG3 | Percent Area in Region 3 | 0 | percent | 0 | 100 |
| PCTREG5 | Percent Area in Region 5 | 0 | percent | 0 | 100 |

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 3.07 | square miles | 0.08 | 8902 |
| PCTREG4 | Percent Area in Region 4 | 0 | percent | 0 | 100 |

### Peak-Flow Statistics Flow Report [Peak Southeast US NC 2023 5006]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

| Statistic | Value | Unit | PIl | PIu | ASEp |
|---|---|---|---|---|---|
| 50-percent AEP flood | 308 | ft^3/s | 169 | 560 | 36.8 |
| 20-percent AEP flood | 541 | ft^3/s | 305 | 958 | 35.8 |
| 10-percent AEP flood | 727 | ft^3/s | 407 | 1300 | 36.3 |
| 4-percent AEP flood | 979 | ft^3/s | 526 | 1820 | 38.4 |
| 2-percent AEP flood | 1200 | ft^3/s | 639 | 2250 | 39.8 |
| 1-percent AEP flood | 1420 | ft^3/s | 740 | 2720 | 41.3 |
| 0.5-percent AEP flood | 1650 | ft^3/s | 841 | 3240 | 42.8 |
| 0.2-percent AEP flood | 1940 | ft^3/s | 967 | 3890 | 44.4 |

*Peak-Flow Statistics Citations*

**Feaster, T.D., Gotvald, A.J., Musser, J.W., Weaver, J.C, Kolb, K.R., Veilleux, A.G., and Wagner, D.M.2023, Magnitude and frequency of floods for rural streams in Georgia, South Carolina, and North Carolina, 2017—Results: U.S. Geological Survey Scientific Investigations Report 2023-5006, 75 p. (https://pubs.er.usgs.gov/publication/sir20235006)**

## > Urban Peak-Flow Statistics

### Urban Peak-Flow Statistics Parameters [Region 1 Piedmont Urban over 3 sqmi 2014 5030]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 3.07 | square miles | 3 | 436 |
| LC06IMP | Percent Impervious NLCD2006 | 4.94 | percent | 0 | 47.9 |

### Urban Peak-Flow Statistics Flow Report [Region 1 Piedmont Urban over 3 sqmi 2014 5030]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

| Statistic | Value | Unit | PIl | PIu | ASEp |
|---|---|---|---|---|---|
| Urban 50-percent AEP flood | 423 | ft^3/s | 220 | 815 | 34.4 |
| Urban 20-Percent AEP flood | 732 | ft^3/s | 399 | 1340 | 31.4 |
| Urban 10-percent AEP flood | 965 | ft^3/s | 535 | 1740 | 30.7 |
| Urban 4-percent AEP flood | 1280 | ft^3/s | 695 | 2360 | 31.4 |
| Urban 2-percent AEP flood | 1520 | ft^3/s | 810 | 2850 | 32.4 |
| Urban 1-percent AEP flood | 1780 | ft^3/s | 917 | 3450 | 34.2 |
| Urban 0.5-percent AEP flood | 2050 | ft^3/s | 1020 | 4110 | 35.8 |
| Urban 0.2-percent AEP flood | 2420 | ft^3/s | 1150 | 5080 | 38.7 |

*Urban Peak-Flow Statistics Citations*

**Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2014, Methods for estimating the magnitude and frequency of floods for urban and small, rural streams in Georgia, South Carolina, and North Carolina, 2011 (ver. 1.1, March 2014): U.S.**

**Geological Survey Scientific Investigations Report 2014–5030, 104 p. (http://pubs.usgs.gov/sir/2014/5030/)**

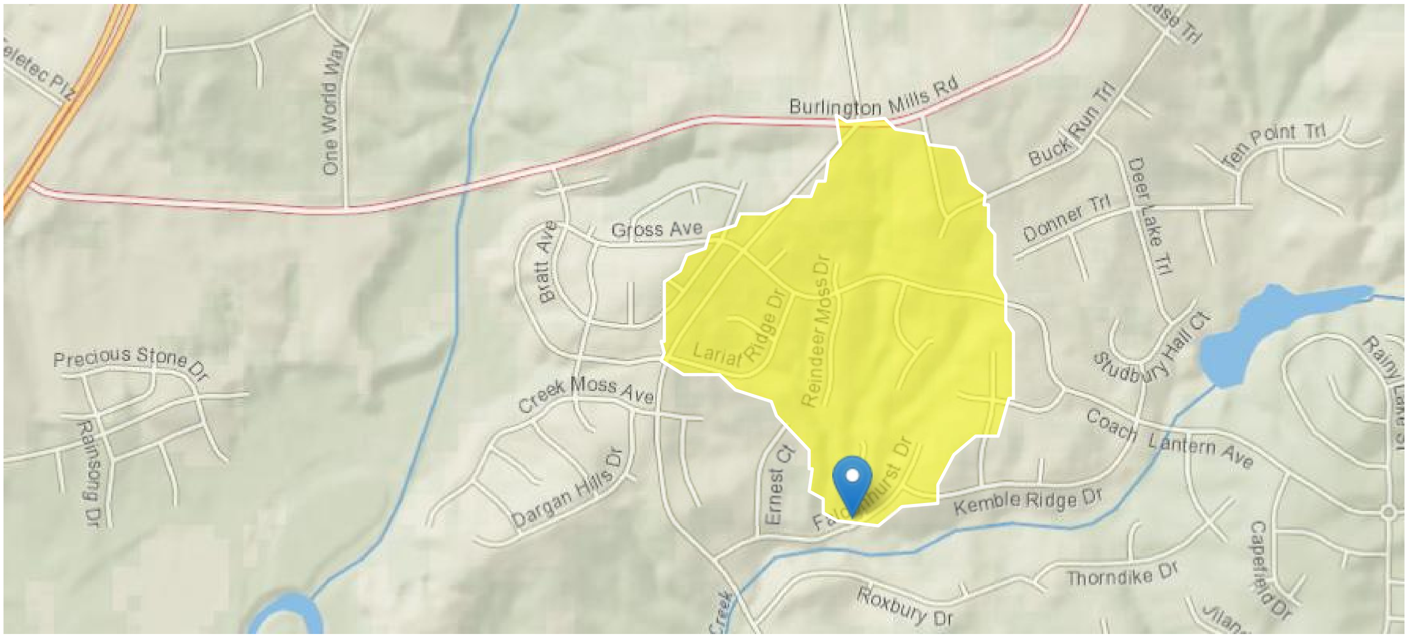


Application Version: 4.15.0
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

Streamstats-Tributary A+B

# StreamStats Report

**Region ID:** NC
**Workspace ID:** NC20230626193458335000
**Clicked Point (Latitude, Longitude):** 35.91109, -78.52403
**Time:** 2023-06-26 15:35:23 -0400




Collapse All

## Basin Characteristics

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| DRNAREA | Area that drains to a point on a stream | 0.21 | square miles |
| LC06IMP | Percentage of impervious area determined from NLCD 2006 impervious dataset | 12.37 | percent |
| PCTREG1 | Percentage of drainage area located in Region 1 - Piedmont / Ridge and Valley | 100 | percent |
| PCTREG2 | Percentage of drainage area located in Region 2 - Blue Ridge | 0 | percent |
| PCTREG3 | Percentage of drainage area located in Region 3 - Sandhills | 0 | percent |
| PCTREG4 | Percentage of drainage area located in Region 4 - Coastal Plains | 0 | percent |
| PCTREG5 | Percentage of drainage area located in Region 5 - Lower Tifton Uplands | 0 | percent |

## Peak-Flow Statistics

### Peak-Flow Statistics Parameters [Region 1 Piedmont rural under 1 sqmi 2014 5030]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.21 | square miles | 0.1 | 1 |
| LC06IMP | Percent Impervious NLCD2006 | 12.37 | percent | 0 | 47.9 |

### Peak-Flow Statistics Parameters [Peak Southeast US NC 2023 5006]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| PCTREG1 | Percent Area in Region 1 | 100 | percent | 0 | 100 |
| PCTREG2 | Percent Area in Region 2 | 0 | percent | 0 | 100 |
| PCTREG3 | Percent Area in Region 3 | 0 | percent | 0 | 100 |
| PCTREG5 | Percent Area in Region 5 | 0 | percent | 0 | 100 |
| DRNAREA | Drainage Area | 0.21 | square miles | 0.08 | 8902 |
| PCTREG4 | Percent Area in Region 4 | 0 | percent | 0 | 100 |

### Peak-Flow Statistics Flow Report [Region 1 Piedmont rural under 1 sqmi 2014 5030]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

| Statistic | Value | Unit | PII | PIu | ASEp |
|---|---|---|---|---|---|
| 50-percent AEP flood | 78.7 | ft^3/s | 42.3 | 147 | 31.9 |
| 20-percent AEP flood | 119 | ft^3/s | 72 | 197 | 25.4 |
| 10-percent AEP flood | 146 | ft^3/s | 90.1 | 236 | 25 |
| 4-percent AEP flood | 180 | ft^3/s | 106 | 305 | 27 |
| 2-percent AEP flood | 205 | ft^3/s | 116 | 363 | 29.3 |
| 1-percent AEP flood | 230 | ft^3/s | 123 | 431 | 32.1 |
| 0.5-percent AEP flood | 254 | ft^3/s | 129 | 502 | 35.1 |
| 0.2-percent AEP flood | 292 | ft^3/s | 141 | 607 | 37.5 |

### Peak-Flow Statistics Flow Report [Peak Southeast US NC 2023 5006]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

| Statistic | Value | Unit | PII | PIu | ASEp |
|---|---|---|---|---|---|
| 50-percent AEP flood | 54.5 | ft^3/s | 29.8 | 99.5 | 36.8 |
| 20-percent AEP flood | 99.6 | ft^3/s | 56 | 177 | 35.8 |
| 10-percent AEP flood | 137 | ft^3/s | 76.5 | 245 | 36.3 |
| 4-percent AEP flood | 188 | ft^3/s | 101 | 352 | 38.4 |
| 2-percent AEP flood | 234 | ft^3/s | 124 | 442 | 39.8 |
| 1-percent AEP flood | 281 | ft^3/s | 146 | 542 | 41.3 |
| 0.5-percent AEP flood | 329 | ft^3/s | 167 | 649 | 42.8 |
| 0.2-percent AEP flood | 392 | ft^3/s | 194 | 791 | 44.4 |

*Peak-Flow Statistics Citations*

**Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2014, Methods for estimating the magnitude and frequency of floods for urban and small, rural streams in Georgia, South Carolina, and North Carolina, 2011 (ver. 1.1, March 2014): U.S. Geological Survey Scientific Investigations Report 2014–5030, 104 p. (http://pubs.usgs.gov/sir/2014/5030/)**
**Feaster, T.D., Gotvald, A.J., Musser, J.W., Weaver, J.C, Kolb, K.R., Veilleux, A.G., and Wagner, D.M.2023, Magnitude and frequency of floods for rural streams in Georgia, South Carolina, and North Carolina, 2017—Results: U.S. Geological Survey Scientific Investigations Report 2023-5006, 75 p. (https://pubs.er.usgs.gov/publication/sir20235006)**

## Urban Peak-Flow Statistics

### Urban Peak-Flow Statistics Parameters [Region 1 Piedmont Urban under 3 sqmi 2014 5030]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.21 | square miles | 0.1 | 3 |
| LC06IMP | Percent Impervious NLCD2006 | 12.37 | percent | 0 | 47.9 |

### Urban Peak-Flow Statistics Flow Report [Region 1 Piedmont Urban under 3 sqmi 2014 5030]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

| Statistic | Value | Unit | PIl | PIu | ASEp |
|---|---|---|---|---|---|
| Urban 50-percent AEP flood | 78.7 | ft^3/s | 42.3 | 147 | 31.9 |
| Urban 20-Percent AEP flood | 119 | ft^3/s | 72 | 197 | 25.4 |
| Urban 10-percent AEP flood | 146 | ft^3/s | 90.1 | 236 | 25 |
| Urban 4-percent AEP flood | 180 | ft^3/s | 106 | 305 | 27 |
| Urban 2-percent AEP flood | 205 | ft^3/s | 116 | 363 | 29.3 |
| Urban 1-percent AEP flood | 230 | ft^3/s | 123 | 431 | 32.1 |
| Urban 0.5-percent AEP flood | 254 | ft^3/s | 129 | 502 | 35.1 |
| Urban 0.2-percent AEP flood | 292 | ft^3/s | 141 | 607 | 37.5 |

*Urban Peak-Flow Statistics Citations*

**Feaster, T.D., Gotvald, A.J., and Weaver, J.C.,2014, Methods for estimating the magnitude and frequency of floods for urban and small, rural streams in Georgia, South Carolina, and North Carolina, 2011 (ver. 1.1, March 2014): U.S. Geological Survey Scientific Investigations Report 2014–5030, 104 p. (http://pubs.usgs.gov/sir/2014/5030/)**

Rainfall data from HEC-RAS 2D Model

10-year Precipitation Hydrograph

| Ordinate | Date/Time | Precipitation Hydrograph |
|---|---|---|
| 1 | 31Dec2020 2400 | 0 |
| 2 | 01Jan2021 0006 | 0 |
| 3 | 01Jan2021 0012 | 0 |
| 4 | 01Jan2021 0018 | 0 |
| 5 | 01Jan2021 0024 | 0 |
| 6 | 01Jan2021 0030 | 0 |
| 7 | 01Jan2021 0036 | 0 |
| 8 | 01Jan2021 0042 | 0 |
| 9 | 01Jan2021 0048 | 0 |
| 10 | 01Jan2021 0054 | 0 |
| 11 | 01Jan2021 0100 | 0 |
| 12 | 01Jan2021 0106 | 0 |
| 13 | 01Jan2021 0112 | 0 |
| 14 | 01Jan2021 0118 | 0 |
| 15 | 01Jan2021 0124 | 0 |
| 16 | 01Jan2021 0130 | 0 |
| 17 | 01Jan2021 0136 | 0 |
| 18 | 01Jan2021 0142 | 0 |
| 19 | 01Jan2021 0148 | 0 |
| 20 | 01Jan2021 0154 | 0 |
| 21 | 01Jan2021 0200 | 0 |
| 22 | 01Jan2021 0206 | 0 |
| 23 | 01Jan2021 0212 | 0 |
| 24 | 01Jan2021 0218 | 0 |
| 25 | 01Jan2021 0224 | 0 |
| 26 | 01Jan2021 0230 | 0 |
| 27 | 01Jan2021 0236 | 0 |
| 28 | 01Jan2021 0242 | 0 |
| 29 | 01Jan2021 0248 | 0 |
| 30 | 01Jan2021 0254 | 0 |
| 31 | 01Jan2021 0300 | 0 |
| 32 | 01Jan2021 0306 | 0.01 |
| 33 | 01Jan2021 0312 | 0.01 |
| 34 | 01Jan2021 0318 | 0.01 |
| 35 | 01Jan2021 0324 | 0.01 |
| 36 | 01Jan2021 0330 | 0.01 |
| 37 | 01Jan2021 0336 | 0.01 |
| 38 | 01Jan2021 0342 | 0.01 |
| 39 | 01Jan2021 0348 | 0.01 |
| 40 | 01Jan2021 0354 | 0.01 |
| 41 | 01Jan2021 0400 | 0.01 |
| 42 | 01Jan2021 0406 | 0.01 |
| 43 | 01Jan2021 0412 | 0.01 |
| 44 | 01Jan2021 0418 | 0.01 |
| 45 | 01Jan2021 0424 | 0.01 |

| | | |
|---|---|---|
| 46 | 01Jan2021 0430 | 0.01 |
| 47 | 01Jan2021 0436 | 0.01 |
| 48 | 01Jan2021 0442 | 0.01 |
| 49 | 01Jan2021 0448 | 0.01 |
| 50 | 01Jan2021 0454 | 0.01 |
| 51 | 01Jan2021 0500 | 0.01 |
| 52 | 01Jan2021 0506 | 0.01 |
| 53 | 01Jan2021 0512 | 0.01 |
| 54 | 01Jan2021 0518 | 0.01 |
| 55 | 01Jan2021 0524 | 0.01 |
| 56 | 01Jan2021 0530 | 0.01 |
| 57 | 01Jan2021 0536 | 0.01 |
| 58 | 01Jan2021 0542 | 0.01 |
| 59 | 01Jan2021 0548 | 0.01 |
| 60 | 01Jan2021 0554 | 0.01 |
| 61 | 01Jan2021 0600 | 0.01 |
| 62 | 01Jan2021 0606 | 0.01 |
| 63 | 01Jan2021 0612 | 0.01 |
| 64 | 01Jan2021 0618 | 0.01 |
| 65 | 01Jan2021 0624 | 0.01 |
| 66 | 01Jan2021 0630 | 0.01 |
| 67 | 01Jan2021 0636 | 0.01 |
| 68 | 01Jan2021 0642 | 0.01 |
| 69 | 01Jan2021 0648 | 0.01 |
| 70 | 01Jan2021 0654 | 0.01 |
| 71 | 01Jan2021 0700 | 0.01 |
| 72 | 01Jan2021 0706 | 0.01 |
| 73 | 01Jan2021 0712 | 0.01 |
| 74 | 01Jan2021 0718 | 0.01 |
| 75 | 01Jan2021 0724 | 0.01 |
| 76 | 01Jan2021 0730 | 0.01 |
| 77 | 01Jan2021 0736 | 0.01 |
| 78 | 01Jan2021 0742 | 0.01 |
| 79 | 01Jan2021 0748 | 0.01 |
| 80 | 01Jan2021 0754 | 0.01 |
| 81 | 01Jan2021 0800 | 0.01 |
| 82 | 01Jan2021 0806 | 0.01 |
| 83 | 01Jan2021 0812 | 0.01 |
| 84 | 01Jan2021 0818 | 0.01 |
| 85 | 01Jan2021 0824 | 0.01 |
| 86 | 01Jan2021 0830 | 0.01 |
| 87 | 01Jan2021 0836 | 0.01 |
| 88 | 01Jan2021 0842 | 0.01 |
| 89 | 01Jan2021 0848 | 0.01 |
| 90 | 01Jan2021 0854 | 0.01 |
| 91 | 01Jan2021 0900 | 0.01 |
| 92 | 01Jan2021 0906 | 0.01 |

| | | |
|---|---|---|
| 93 | 01Jan2021 0912 | 0.01 |
| 94 | 01Jan2021 0918 | 0.02 |
| 95 | 01Jan2021 0924 | 0.02 |
| 96 | 01Jan2021 0930 | 0.02 |
| 97 | 01Jan2021 0936 | 0.02 |
| 98 | 01Jan2021 0942 | 0.02 |
| 99 | 01Jan2021 0948 | 0.02 |
| 100 | 01Jan2021 0954 | 0.02 |
| 101 | 01Jan2021 1000 | 0.02 |
| 102 | 01Jan2021 1006 | 0.02 |
| 103 | 01Jan2021 1012 | 0.02 |
| 104 | 01Jan2021 1018 | 0.02 |
| 105 | 01Jan2021 1024 | 0.02 |
| 106 | 01Jan2021 1030 | 0.02 |
| 107 | 01Jan2021 1036 | 0.03 |
| 108 | 01Jan2021 1042 | 0.03 |
| 109 | 01Jan2021 1048 | 0.03 |
| 110 | 01Jan2021 1054 | 0.04 |
| 111 | 01Jan2021 1100 | 0.04 |
| 112 | 01Jan2021 1106 | 0.05 |
| 113 | 01Jan2021 1112 | 0.05 |
| 114 | 01Jan2021 1118 | 0.06 |
| 115 | 01Jan2021 1124 | 0.06 |
| 116 | 01Jan2021 1130 | 0.07 |
| 117 | 01Jan2021 1136 | 0.11 |
| 118 | 01Jan2021 1142 | 0.12 |
| 119 | 01Jan2021 1148 | 0.16 |
| 120 | 01Jan2021 1154 | 0.22 |
| 121 | 01Jan2021 1200 | 0.39 |
| 122 | 01Jan2021 1206 | 0.66 |
| 123 | 01Jan2021 1212 | 0.22 |
| 124 | 01Jan2021 1218 | 0.16 |
| 125 | 01Jan2021 1224 | 0.12 |
| 126 | 01Jan2021 1230 | 0.11 |
| 127 | 01Jan2021 1236 | 0.07 |
| 128 | 01Jan2021 1242 | 0.06 |
| 129 | 01Jan2021 1248 | 0.06 |
| 130 | 01Jan2021 1254 | 0.05 |
| 131 | 01Jan2021 1300 | 0.05 |
| 132 | 01Jan2021 1306 | 0.04 |
| 133 | 01Jan2021 1312 | 0.04 |
| 134 | 01Jan2021 1318 | 0.03 |
| 135 | 01Jan2021 1324 | 0.03 |
| 136 | 01Jan2021 1330 | 0.03 |
| 137 | 01Jan2021 1336 | 0.02 |
| 138 | 01Jan2021 1342 | 0.02 |
| 139 | 01Jan2021 1348 | 0.02 |

| | | |
|---|---|---|
| 140 | 01Jan2021 1354 | 0.02 |
| 141 | 01Jan2021 1400 | 0.02 |
| 142 | 01Jan2021 1406 | 0.02 |
| 143 | 01Jan2021 1412 | 0.02 |
| 144 | 01Jan2021 1418 | 0.02 |
| 145 | 01Jan2021 1424 | 0.02 |
| 146 | 01Jan2021 1430 | 0.02 |
| 147 | 01Jan2021 1436 | 0.02 |
| 148 | 01Jan2021 1442 | 0.02 |
| 149 | 01Jan2021 1448 | 0.02 |
| 150 | 01Jan2021 1454 | 0.01 |
| 151 | 01Jan2021 1500 | 0.01 |
| 152 | 01Jan2021 1506 | 0.01 |
| 153 | 01Jan2021 1512 | 0.01 |
| 154 | 01Jan2021 1518 | 0.01 |
| 155 | 01Jan2021 1524 | 0.01 |
| 156 | 01Jan2021 1530 | 0.01 |
| 157 | 01Jan2021 1536 | 0.01 |
| 158 | 01Jan2021 1542 | 0.01 |
| 159 | 01Jan2021 1548 | 0.01 |
| 160 | 01Jan2021 1554 | 0.01 |
| 161 | 01Jan2021 1600 | 0.01 |
| 162 | 01Jan2021 1606 | 0.01 |
| 163 | 01Jan2021 1612 | 0.01 |
| 164 | 01Jan2021 1618 | 0.01 |
| 165 | 01Jan2021 1624 | 0.01 |
| 166 | 01Jan2021 1630 | 0.01 |
| 167 | 01Jan2021 1636 | 0.01 |
| 168 | 01Jan2021 1642 | 0.01 |
| 169 | 01Jan2021 1648 | 0.01 |
| 170 | 01Jan2021 1654 | 0.01 |
| 171 | 01Jan2021 1700 | 0.01 |
| 172 | 01Jan2021 1706 | 0.01 |
| 173 | 01Jan2021 1712 | 0.01 |
| 174 | 01Jan2021 1718 | 0.01 |
| 175 | 01Jan2021 1724 | 0.01 |
| 176 | 01Jan2021 1730 | 0.01 |
| 177 | 01Jan2021 1736 | 0.01 |
| 178 | 01Jan2021 1742 | 0.01 |
| 179 | 01Jan2021 1748 | 0.01 |
| 180 | 01Jan2021 1754 | 0.01 |
| 181 | 01Jan2021 1800 | 0.01 |
| 182 | 01Jan2021 1806 | 0.01 |
| 183 | 01Jan2021 1812 | 0.01 |
| 184 | 01Jan2021 1818 | 0.01 |
| 185 | 01Jan2021 1824 | 0.01 |
| 186 | 01Jan2021 1830 | 0.01 |

| | | |
|---|---|---|
| 187 | 01Jan2021 1836 | 0.01 |
| 188 | 01Jan2021 1842 | 0.01 |
| 189 | 01Jan2021 1848 | 0.01 |
| 190 | 01Jan2021 1854 | 0.01 |
| 191 | 01Jan2021 1900 | 0.01 |
| 192 | 01Jan2021 1906 | 0.01 |
| 193 | 01Jan2021 1912 | 0.01 |
| 194 | 01Jan2021 1918 | 0.01 |
| 195 | 01Jan2021 1924 | 0.01 |
| 196 | 01Jan2021 1930 | 0.01 |
| 197 | 01Jan2021 1936 | 0.01 |
| 198 | 01Jan2021 1942 | 0.01 |
| 199 | 01Jan2021 1948 | 0.01 |
| 200 | 01Jan2021 1954 | 0.01 |
| 201 | 01Jan2021 2000 | 0.01 |
| 202 | 01Jan2021 2006 | 0.01 |
| 203 | 01Jan2021 2012 | 0.01 |
| 204 | 01Jan2021 2018 | 0.01 |
| 205 | 01Jan2021 2024 | 0.01 |
| 206 | 01Jan2021 2030 | 0.01 |
| 207 | 01Jan2021 2036 | 0.01 |
| 208 | 01Jan2021 2042 | 0.01 |
| 209 | 01Jan2021 2048 | 0.01 |
| 210 | 01Jan2021 2054 | 0.01 |
| 211 | 01Jan2021 2100 | 0.01 |
| 212 | 01Jan2021 2106 | 0 |
| 213 | 01Jan2021 2112 | 0 |
| 214 | 01Jan2021 2118 | 0 |
| 215 | 01Jan2021 2124 | 0 |
| 216 | 01Jan2021 2130 | 0 |
| 217 | 01Jan2021 2136 | 0 |
| 218 | 01Jan2021 2142 | 0 |
| 219 | 01Jan2021 2148 | 0 |
| 220 | 01Jan2021 2154 | 0 |
| 221 | 01Jan2021 2200 | 0 |
| 222 | 01Jan2021 2206 | 0 |
| 223 | 01Jan2021 2212 | 0 |
| 224 | 01Jan2021 2218 | 0 |
| 225 | 01Jan2021 2224 | 0 |
| 226 | 01Jan2021 2230 | 0 |
| 227 | 01Jan2021 2236 | 0 |
| 228 | 01Jan2021 2242 | 0 |
| 229 | 01Jan2021 2248 | 0 |
| 230 | 01Jan2021 2254 | 0 |
| 231 | 01Jan2021 2300 | 0 |
| 232 | 01Jan2021 2306 | 0 |
| 233 | 01Jan2021 2312 | 0 |

| | | |
|---|---|---|
| 234 | 01Jan2021 2318 | 0 |
| 235 | 01Jan2021 2324 | 0 |
| 236 | 01Jan2021 2330 | 0 |
| 237 | 01Jan2021 2336 | 0 |
| 238 | 01Jan2021 2342 | 0 |
| 239 | 01Jan2021 2348 | 0 |
| 240 | 01Jan2021 2354 | 0 |
| 241 | 01Jan2021 2400 | 0 |

Rainfall Data from 2D HEC-RAS Model
100-year Precipitation Hydrograph

| Ordinate | Date/Time | Precipitation Hydrograph |
|---|---|---|
| 1 | 31Dec2020 2400 | 0 |
| 2 | 01Jan2021 0006 | 0.01 |
| 3 | 01Jan2021 0012 | 0.01 |
| 4 | 01Jan2021 0018 | 0.01 |
| 5 | 01Jan2021 0024 | 0.01 |
| 6 | 01Jan2021 0030 | 0.01 |
| 7 | 01Jan2021 0036 | 0.01 |
| 8 | 01Jan2021 0042 | 0.01 |
| 9 | 01Jan2021 0048 | 0.01 |
| 10 | 01Jan2021 0054 | 0.01 |
| 11 | 01Jan2021 0100 | 0.01 |
| 12 | 01Jan2021 0106 | 0.01 |
| 13 | 01Jan2021 0112 | 0.01 |
| 14 | 01Jan2021 0118 | 0.01 |
| 15 | 01Jan2021 0124 | 0.01 |
| 16 | 01Jan2021 0130 | 0.01 |
| 17 | 01Jan2021 0136 | 0.01 |
| 18 | 01Jan2021 0142 | 0.01 |
| 19 | 01Jan2021 0148 | 0.01 |
| 20 | 01Jan2021 0154 | 0.01 |
| 21 | 01Jan2021 0200 | 0.01 |
| 22 | 01Jan2021 0206 | 0.01 |
| 23 | 01Jan2021 0212 | 0.01 |
| 24 | 01Jan2021 0218 | 0.01 |
| 25 | 01Jan2021 0224 | 0.01 |
| 26 | 01Jan2021 0230 | 0.01 |
| 27 | 01Jan2021 0236 | 0.01 |
| 28 | 01Jan2021 0242 | 0.01 |
| 29 | 01Jan2021 0248 | 0.01 |
| 30 | 01Jan2021 0254 | 0.01 |
| 31 | 01Jan2021 0300 | 0.01 |
| 32 | 01Jan2021 0306 | 0.01 |
| 33 | 01Jan2021 0312 | 0.01 |
| 34 | 01Jan2021 0318 | 0.01 |
| 35 | 01Jan2021 0324 | 0.01 |
| 36 | 01Jan2021 0330 | 0.01 |
| 37 | 01Jan2021 0336 | 0.01 |
| 38 | 01Jan2021 0342 | 0.01 |
| 39 | 01Jan2021 0348 | 0.01 |
| 40 | 01Jan2021 0354 | 0.01 |
| 41 | 01Jan2021 0400 | 0.01 |
| 42 | 01Jan2021 0406 | 0.01 |
| 43 | 01Jan2021 0412 | 0.01 |
| 44 | 01Jan2021 0418 | 0.01 |
| 45 | 01Jan2021 0424 | 0.01 |

| | | |
|---|---|---|
| 46 | 01Jan2021 0430 | 0.01 |
| 47 | 01Jan2021 0436 | 0.01 |
| 48 | 01Jan2021 0442 | 0.01 |
| 49 | 01Jan2021 0448 | 0.01 |
| 50 | 01Jan2021 0454 | 0.01 |
| 51 | 01Jan2021 0500 | 0.01 |
| 52 | 01Jan2021 0506 | 0.01 |
| 53 | 01Jan2021 0512 | 0.01 |
| 54 | 01Jan2021 0518 | 0.01 |
| 55 | 01Jan2021 0524 | 0.01 |
| 56 | 01Jan2021 0530 | 0.01 |
| 57 | 01Jan2021 0536 | 0.01 |
| 58 | 01Jan2021 0542 | 0.01 |
| 59 | 01Jan2021 0548 | 0.01 |
| 60 | 01Jan2021 0554 | 0.01 |
| 61 | 01Jan2021 0600 | 0.01 |
| 62 | 01Jan2021 0606 | 0.01 |
| 63 | 01Jan2021 0612 | 0.01 |
| 64 | 01Jan2021 0618 | 0.01 |
| 65 | 01Jan2021 0624 | 0.01 |
| 66 | 01Jan2021 0630 | 0.01 |
| 67 | 01Jan2021 0636 | 0.01 |
| 68 | 01Jan2021 0642 | 0.01 |
| 69 | 01Jan2021 0648 | 0.01 |
| 70 | 01Jan2021 0654 | 0.01 |
| 71 | 01Jan2021 0700 | 0.01 |
| 72 | 01Jan2021 0706 | 0.01 |
| 73 | 01Jan2021 0712 | 0.01 |
| 74 | 01Jan2021 0718 | 0.01 |
| 75 | 01Jan2021 0724 | 0.01 |
| 76 | 01Jan2021 0730 | 0.02 |
| 77 | 01Jan2021 0736 | 0.02 |
| 78 | 01Jan2021 0742 | 0.02 |
| 79 | 01Jan2021 0748 | 0.02 |
| 80 | 01Jan2021 0754 | 0.02 |
| 81 | 01Jan2021 0800 | 0.02 |
| 82 | 01Jan2021 0806 | 0.02 |
| 83 | 01Jan2021 0812 | 0.02 |
| 84 | 01Jan2021 0818 | 0.02 |
| 85 | 01Jan2021 0824 | 0.02 |
| 86 | 01Jan2021 0830 | 0.02 |
| 87 | 01Jan2021 0836 | 0.02 |
| 88 | 01Jan2021 0842 | 0.02 |
| 89 | 01Jan2021 0848 | 0.02 |
| 90 | 01Jan2021 0854 | 0.02 |
| 91 | 01Jan2021 0900 | 0.02 |
| 92 | 01Jan2021 0906 | 0.02 |

| | | |
|---|---|---|
| 93 | 01Jan2021 0912 | 0.02 |
| 94 | 01Jan2021 0918 | 0.02 |
| 95 | 01Jan2021 0924 | 0.02 |
| 96 | 01Jan2021 0930 | 0.02 |
| 97 | 01Jan2021 0936 | 0.03 |
| 98 | 01Jan2021 0942 | 0.03 |
| 99 | 01Jan2021 0948 | 0.03 |
| 100 | 01Jan2021 0954 | 0.03 |
| 101 | 01Jan2021 1000 | 0.03 |
| 102 | 01Jan2021 1006 | 0.03 |
| 103 | 01Jan2021 1012 | 0.03 |
| 104 | 01Jan2021 1018 | 0.03 |
| 105 | 01Jan2021 1024 | 0.04 |
| 106 | 01Jan2021 1030 | 0.04 |
| 107 | 01Jan2021 1036 | 0.04 |
| 108 | 01Jan2021 1042 | 0.04 |
| 109 | 01Jan2021 1048 | 0.05 |
| 110 | 01Jan2021 1054 | 0.06 |
| 111 | 01Jan2021 1100 | 0.06 |
| 112 | 01Jan2021 1106 | 0.07 |
| 113 | 01Jan2021 1112 | 0.08 |
| 114 | 01Jan2021 1118 | 0.09 |
| 115 | 01Jan2021 1124 | 0.1 |
| 116 | 01Jan2021 1130 | 0.1 |
| 117 | 01Jan2021 1136 | 0.16 |
| 118 | 01Jan2021 1142 | 0.17 |
| 119 | 01Jan2021 1148 | 0.24 |
| 120 | 01Jan2021 1154 | 0.33 |
| 121 | 01Jan2021 1200 | 0.58 |
| 122 | 01Jan2021 1206 | 0.98 |
| 123 | 01Jan2021 1212 | 0.33 |
| 124 | 01Jan2021 1218 | 0.24 |
| 125 | 01Jan2021 1224 | 0.17 |
| 126 | 01Jan2021 1230 | 0.16 |
| 127 | 01Jan2021 1236 | 0.1 |
| 128 | 01Jan2021 1242 | 0.1 |
| 129 | 01Jan2021 1248 | 0.09 |
| 130 | 01Jan2021 1254 | 0.08 |
| 131 | 01Jan2021 1300 | 0.07 |
| 132 | 01Jan2021 1306 | 0.06 |
| 133 | 01Jan2021 1312 | 0.06 |
| 134 | 01Jan2021 1318 | 0.05 |
| 135 | 01Jan2021 1324 | 0.04 |
| 136 | 01Jan2021 1330 | 0.04 |
| 137 | 01Jan2021 1336 | 0.04 |
| 138 | 01Jan2021 1342 | 0.04 |
| 139 | 01Jan2021 1348 | 0.03 |

| | | |
|---|---|---|
| 140 | 01Jan2021 1354 | 0.03 |
| 141 | 01Jan2021 1400 | 0.03 |
| 142 | 01Jan2021 1406 | 0.03 |
| 143 | 01Jan2021 1412 | 0.03 |
| 144 | 01Jan2021 1418 | 0.03 |
| 145 | 01Jan2021 1424 | 0.03 |
| 146 | 01Jan2021 1430 | 0.03 |
| 147 | 01Jan2021 1436 | 0.02 |
| 148 | 01Jan2021 1442 | 0.02 |
| 149 | 01Jan2021 1448 | 0.02 |
| 150 | 01Jan2021 1454 | 0.02 |
| 151 | 01Jan2021 1500 | 0.02 |
| 152 | 01Jan2021 1506 | 0.02 |
| 153 | 01Jan2021 1512 | 0.02 |
| 154 | 01Jan2021 1518 | 0.02 |
| 155 | 01Jan2021 1524 | 0.02 |
| 156 | 01Jan2021 1530 | 0.02 |
| 157 | 01Jan2021 1536 | 0.02 |
| 158 | 01Jan2021 1542 | 0.02 |
| 159 | 01Jan2021 1548 | 0.02 |
| 160 | 01Jan2021 1554 | 0.02 |
| 161 | 01Jan2021 1600 | 0.02 |
| 162 | 01Jan2021 1606 | 0.02 |
| 163 | 01Jan2021 1612 | 0.02 |
| 164 | 01Jan2021 1618 | 0.02 |
| 165 | 01Jan2021 1624 | 0.02 |
| 166 | 01Jan2021 1630 | 0.02 |
| 167 | 01Jan2021 1636 | 0.02 |
| 168 | 01Jan2021 1642 | 0.01 |
| 169 | 01Jan2021 1648 | 0.01 |
| 170 | 01Jan2021 1654 | 0.01 |
| 171 | 01Jan2021 1700 | 0.01 |
| 172 | 01Jan2021 1706 | 0.01 |
| 173 | 01Jan2021 1712 | 0.01 |
| 174 | 01Jan2021 1718 | 0.01 |
| 175 | 01Jan2021 1724 | 0.01 |
| 176 | 01Jan2021 1730 | 0.01 |
| 177 | 01Jan2021 1736 | 0.01 |
| 178 | 01Jan2021 1742 | 0.01 |
| 179 | 01Jan2021 1748 | 0.01 |
| 180 | 01Jan2021 1754 | 0.01 |
| 181 | 01Jan2021 1800 | 0.01 |
| 182 | 01Jan2021 1806 | 0.01 |
| 183 | 01Jan2021 1812 | 0.01 |
| 184 | 01Jan2021 1818 | 0.01 |
| 185 | 01Jan2021 1824 | 0.01 |
| 186 | 01Jan2021 1830 | 0.01 |

| | | |
|---|---|---|
| 187 | 01Jan2021 1836 | 0.01 |
| 188 | 01Jan2021 1842 | 0.01 |
| 189 | 01Jan2021 1848 | 0.01 |
| 190 | 01Jan2021 1854 | 0.01 |
| 191 | 01Jan2021 1900 | 0.01 |
| 192 | 01Jan2021 1906 | 0.01 |
| 193 | 01Jan2021 1912 | 0.01 |
| 194 | 01Jan2021 1918 | 0.01 |
| 195 | 01Jan2021 1924 | 0.01 |
| 196 | 01Jan2021 1930 | 0.01 |
| 197 | 01Jan2021 1936 | 0.01 |
| 198 | 01Jan2021 1942 | 0.01 |
| 199 | 01Jan2021 1948 | 0.01 |
| 200 | 01Jan2021 1954 | 0.01 |
| 201 | 01Jan2021 2000 | 0.01 |
| 202 | 01Jan2021 2006 | 0.01 |
| 203 | 01Jan2021 2012 | 0.01 |
| 204 | 01Jan2021 2018 | 0.01 |
| 205 | 01Jan2021 2024 | 0.01 |
| 206 | 01Jan2021 2030 | 0.01 |
| 207 | 01Jan2021 2036 | 0.01 |
| 208 | 01Jan2021 2042 | 0.01 |
| 209 | 01Jan2021 2048 | 0.01 |
| 210 | 01Jan2021 2054 | 0.01 |
| 211 | 01Jan2021 2100 | 0.01 |
| 212 | 01Jan2021 2106 | 0.01 |
| 213 | 01Jan2021 2112 | 0.01 |
| 214 | 01Jan2021 2118 | 0.01 |
| 215 | 01Jan2021 2124 | 0.01 |
| 216 | 01Jan2021 2130 | 0.01 |
| 217 | 01Jan2021 2136 | 0.01 |
| 218 | 01Jan2021 2142 | 0.01 |
| 219 | 01Jan2021 2148 | 0.01 |
| 220 | 01Jan2021 2154 | 0.01 |
| 221 | 01Jan2021 2200 | 0.01 |
| 222 | 01Jan2021 2206 | 0.01 |
| 223 | 01Jan2021 2212 | 0.01 |
| 224 | 01Jan2021 2218 | 0.01 |
| 225 | 01Jan2021 2224 | 0.01 |
| 226 | 01Jan2021 2230 | 0.01 |
| 227 | 01Jan2021 2236 | 0.01 |
| 228 | 01Jan2021 2242 | 0.01 |
| 229 | 01Jan2021 2248 | 0.01 |
| 230 | 01Jan2021 2254 | 0.01 |
| 231 | 01Jan2021 2300 | 0.01 |
| 232 | 01Jan2021 2306 | 0.01 |
| 233 | 01Jan2021 2312 | 0.01 |

| | | |
|---|---|---|
| 234 | 01Jan2021 2318 | 0.01 |
| 235 | 01Jan2021 2324 | 0.01 |
| 236 | 01Jan2021 2330 | 0.01 |
| 237 | 01Jan2021 2336 | 0.01 |
| 238 | 01Jan2021 2342 | 0.01 |
| 239 | 01Jan2021 2348 | 0.01 |
| 240 | 01Jan2021 2354 | 0.01 |
| 241 | 01Jan2021 2400 | 0.01 |

# Region 1 Regression Method-Tributary A

**This spreadsheet computes the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent chance exceedance flows for an ungaged urban stream or small, rural stream in Georgia, South Carolina, and North Carolina, and that has a drainage area within hydrologic region 1. The spreasheet also includes the 95-percent prediction intervals, the minus and plus standard error of prediction intervals, and the average standard error of prediction. To use the spreadsheet, enter requested information in the yellow cells below.**

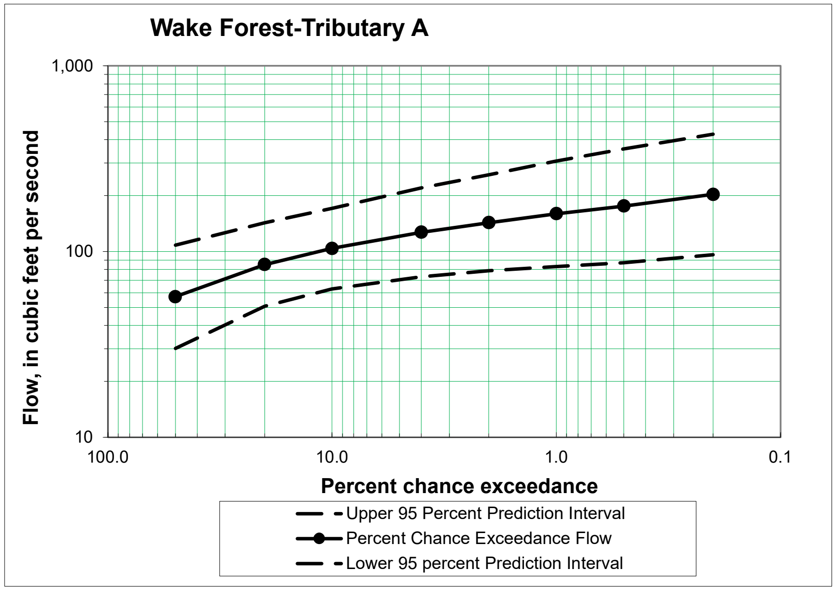
| **Enter a site-description name:** | Wake Forest-Tributary A |
|---|---|

**Enter the explanatory variables:**

| | | |
|---|---|---|
| Drainage area, in square miles | 0.134 | Applicable range of draingage area is 0.10 to 436 square miles. |
| Percentage of impervious area, in percent | 12.37 | Applicable range of percentage of impervious area is 0.0 to 47.9 percent. |

| Warnings and Cautions |
|---|
| |

| **Percent chance exceedance** | **Percent chance exceedance flow, in $ft^3/s$** | **Lower 95 percent prediction interval flow, in $ft^3/s$** | **Upper 95 percent prediction interval flow, in $ft^3/s$** | **$-S_{P,i}$ (percent)** | **$+S_{P,i}$ (percent)** | **Average $S_{p,i}$ (percent)** |
|---|---|---|---|---|---|---|
| 50 | 57 | 30 | 108 | -27.3 | 37.6 | 32.8 |
| 20 | 85 | 51 | 143 | -22.8 | 29.6 | 26.4 |
| 10 | 104 | 63 | 171 | -22.1 | 28.4 | 25.4 |
| 4 | 127 | 73 | 220 | -24.0 | 31.5 | 27.9 |
| 2 | 143 | 79 | 259 | -25.6 | 34.5 | 30.3 |
| 1 | 160 | 83 | 307 | -27.8 | 38.5 | 33.5 |
| 0.5 | 176 | 87 | 357 | -29.8 | 42.4 | 36.4 |
| 0.2 | 203 | 96 | 428 | -31.1 | 45.2 | 38.6 |



# Region 1 Regression Method-Tributary B

**This spreadsheet computes the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent chance exceedance flows for an ungaged urban stream or small, rural stream in Georgia, South Carolina, and North Carolina, and that has a drainage area within hydrologic region 1. The spreasheet also includes the 95-percent prediction intervals, the minus and plus standard error of prediction intervals, and the average standard error of prediction. To use the spreadsheet, enter requested information in the yellow cells below.**

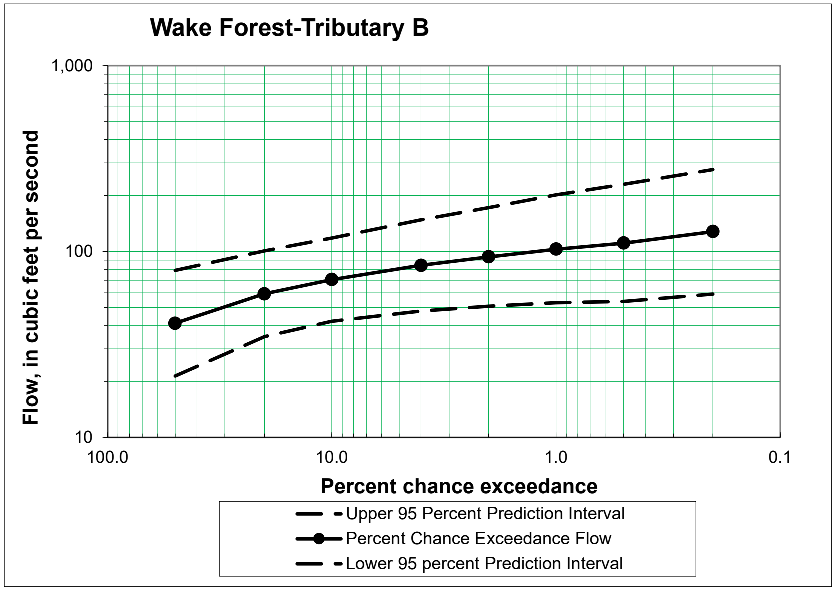
| **Enter a site-description name:** | Wake Forest-Tributary B |
|---|---|

**Enter the explanatory variables:**

| | | |
|---|---|---|
| Drainage area, in square miles | 0.076 | Applicable range of draingage area is 0.10 to 436 square miles. |
| Percentage of impervious area, in percent | 14.78 | Applicable range of percentage of impervious area is 0.0 to 47.9 percent. |

| Warnings and Cautions |
|---|
| WARNING: DRAINAGE AREA IS NOT WITHIN APPLICABLE RANGE OF 0.1 TO 436 SQUARE MILES. ACCURACY OF ESTIMATES ARE UNKNOWN. |

| **Percent chance exceedance** | **Percent chance exceedance flow, in $ft^3/s$** | **Lower 95 percent prediction interval flow, in $ft^3/s$** | **Upper 95 percent prediction interval flow, in $ft^3/s$** | **$-S_{P,i}$ (percent)** | **$+S_{P,i}$ (percent)** | **Average $S_{p,i}$ (percent)** |
|---|---|---|---|---|---|---|
| 50 | 41 | 21 | 79 | -27.9 | 38.7 | 33.6 |
| 20 | 59 | 35 | 101 | -23.4 | 30.5 | 27.1 |
| 10 | 71 | 42 | 118 | -22.7 | 29.3 | 26.2 |
| 4 | 84 | 48 | 148 | -24.6 | 32.6 | 28.8 |
| 2 | 94 | 51 | 172 | -26.3 | 35.7 | 31.3 |
| 1 | 103 | 53 | 202 | -28.5 | 39.9 | 34.5 |
| 0.5 | 111 | 54 | 230 | -30.5 | 43.9 | 37.6 |
| 0.2 | 128 | 59 | 276 | -31.9 | 46.9 | 39.9 |

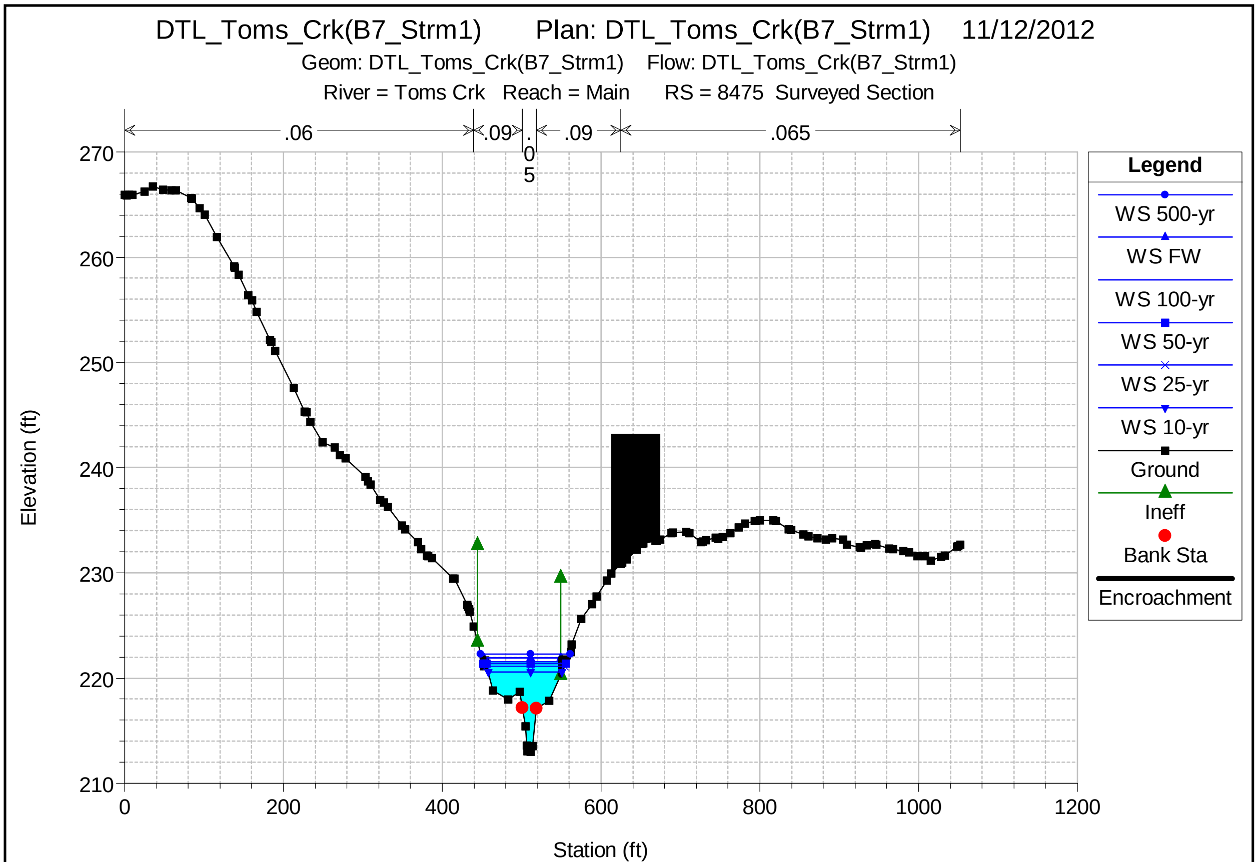


# Appendix C

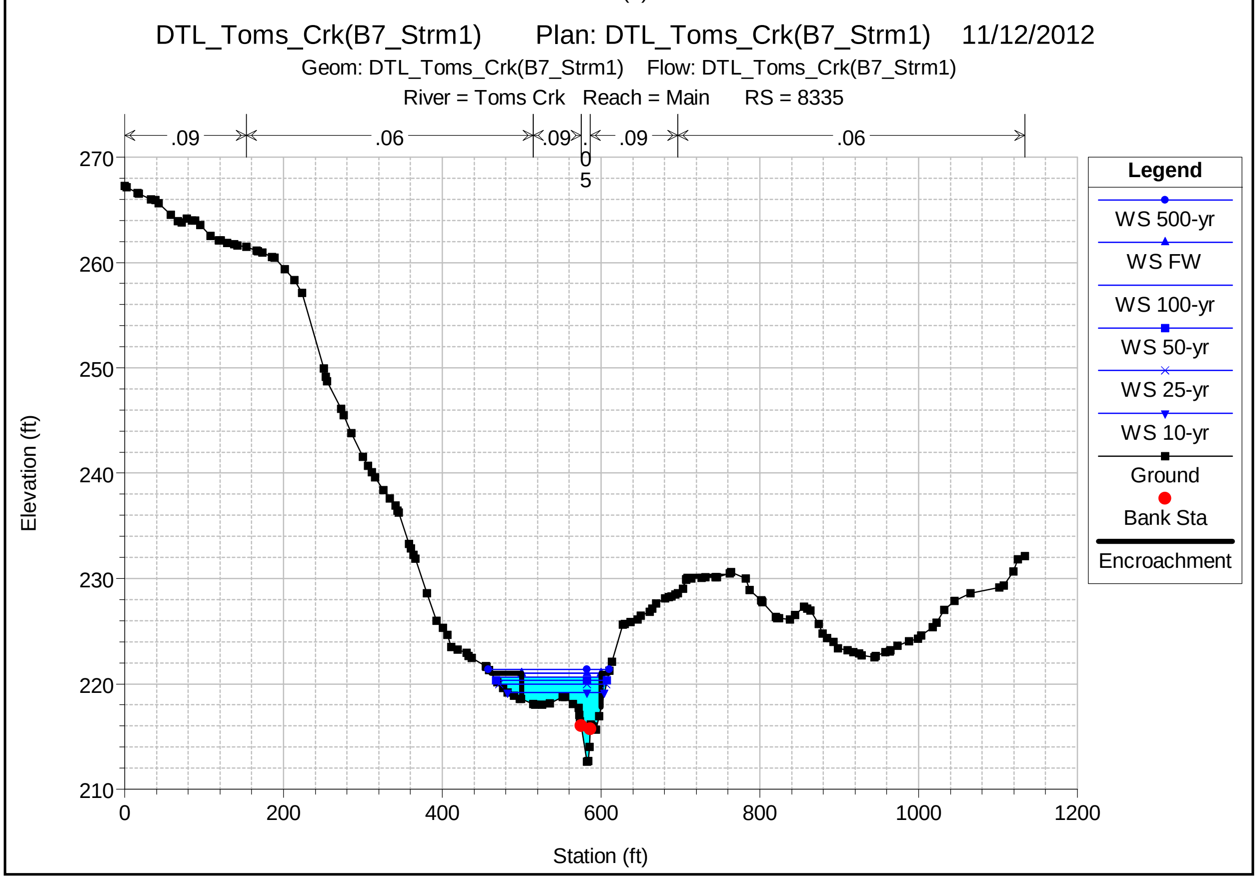
## Hydraulics

*Tom’s Creek*

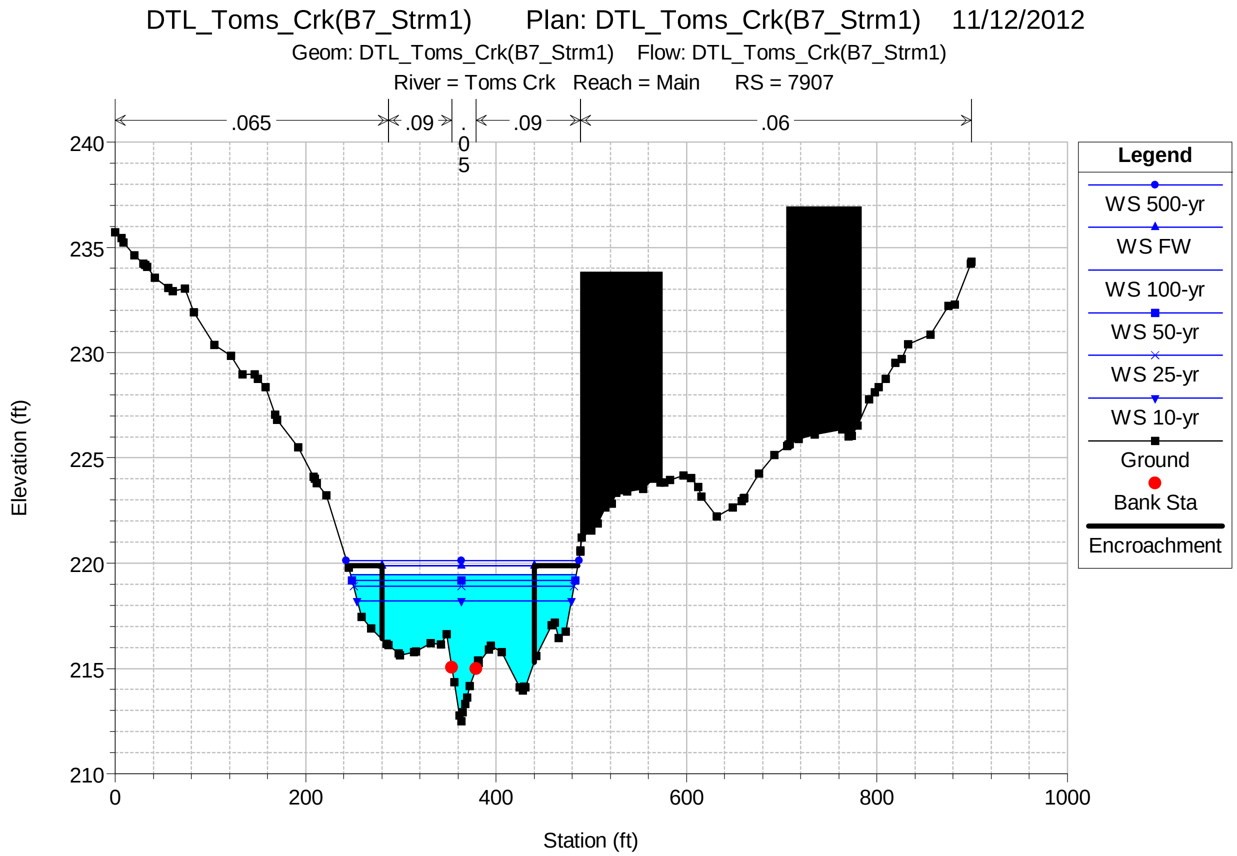
*Effective Cross Sections*



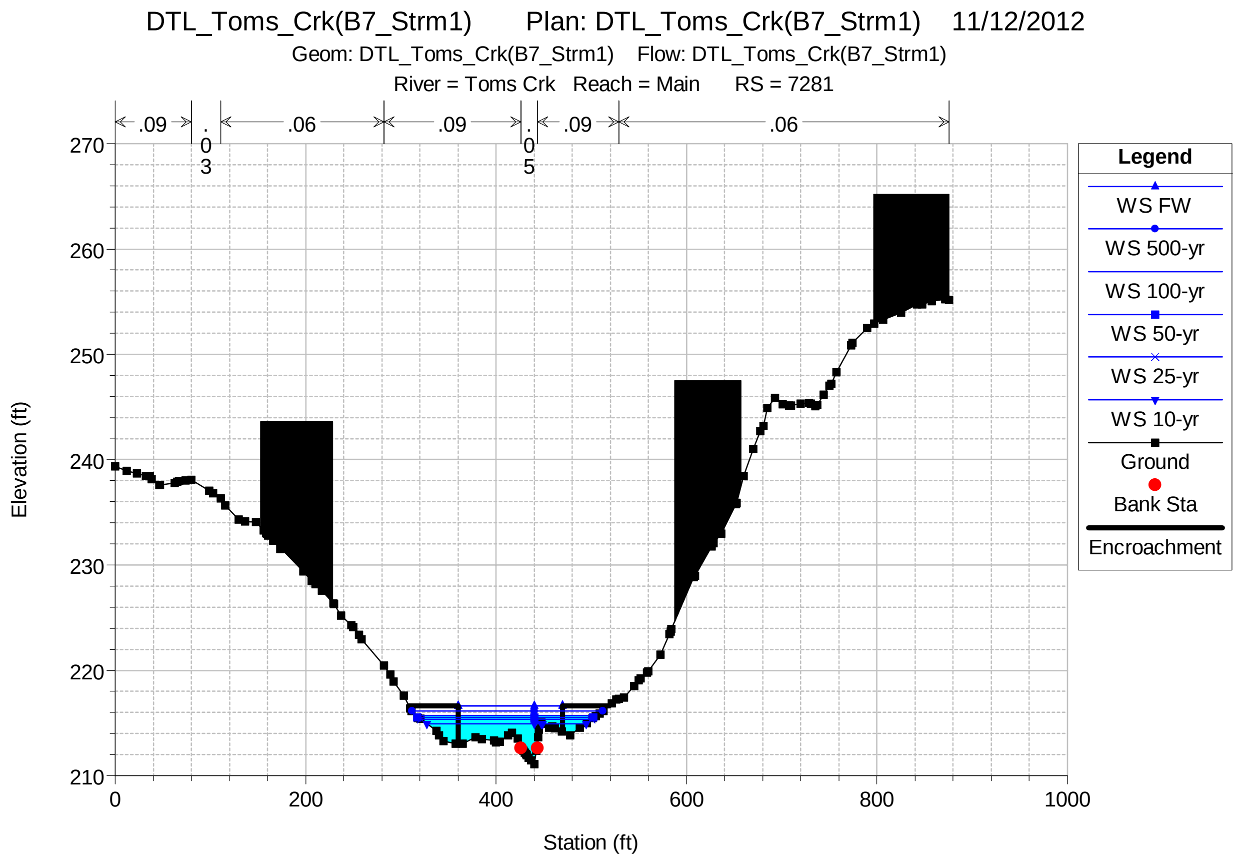
DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 8475 Surveyed Section
.06
.09
.05
.09
.065
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

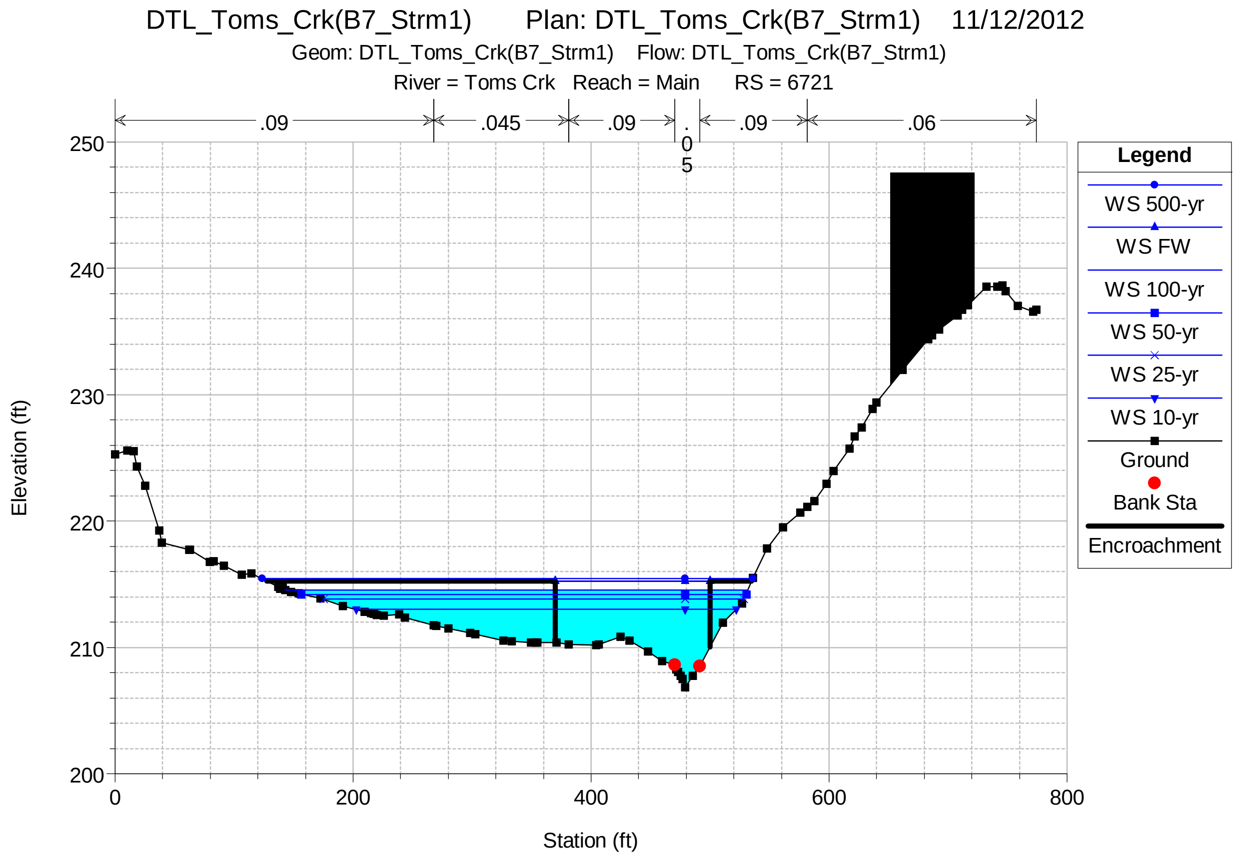
DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 8335
.09
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment



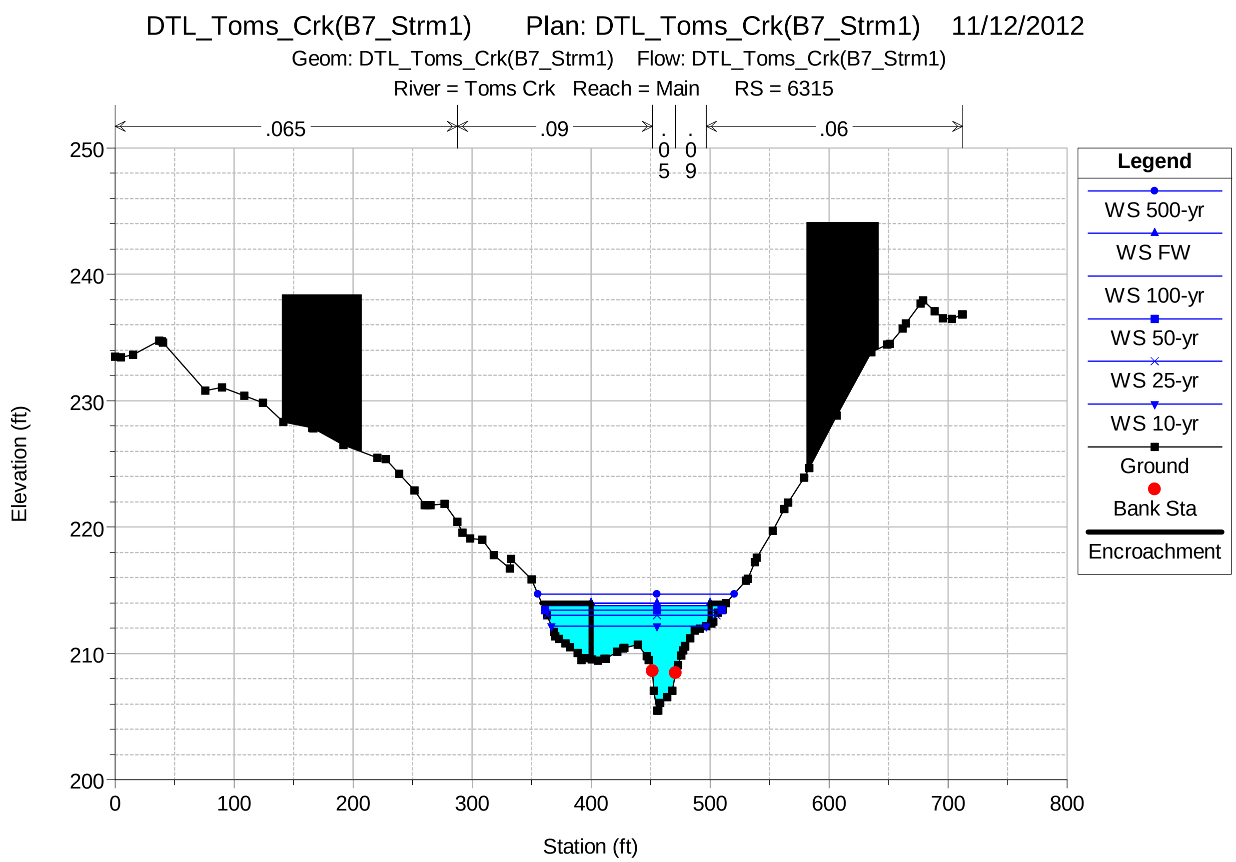
DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 7907
.065
.09
.05
.09
.06
Elevation (ft)
Station (ft)
240
235
230
225
220
215
210
0
200
400
600
800
1000
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

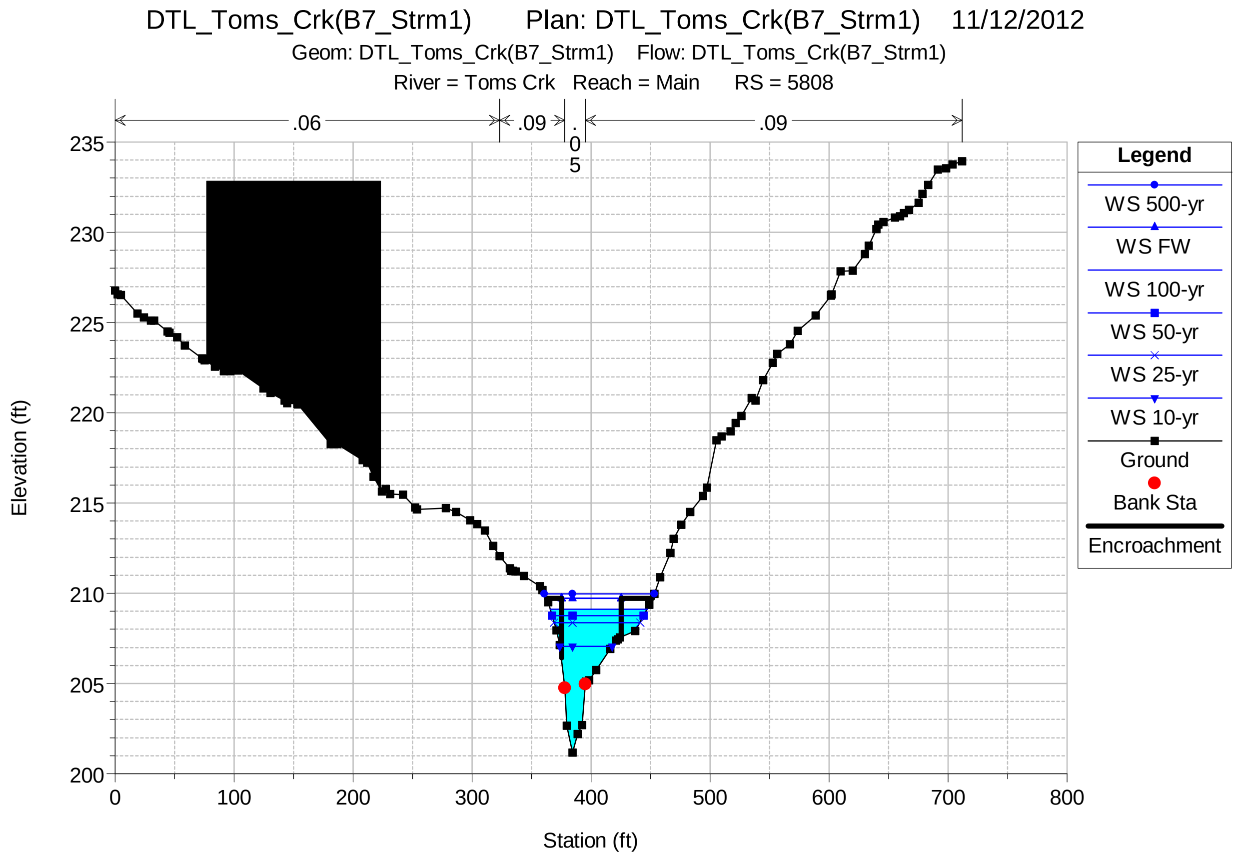
DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 7281
.09
.03
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
270
260
250
240
230
220
210
0
200
400
600
800
1000
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

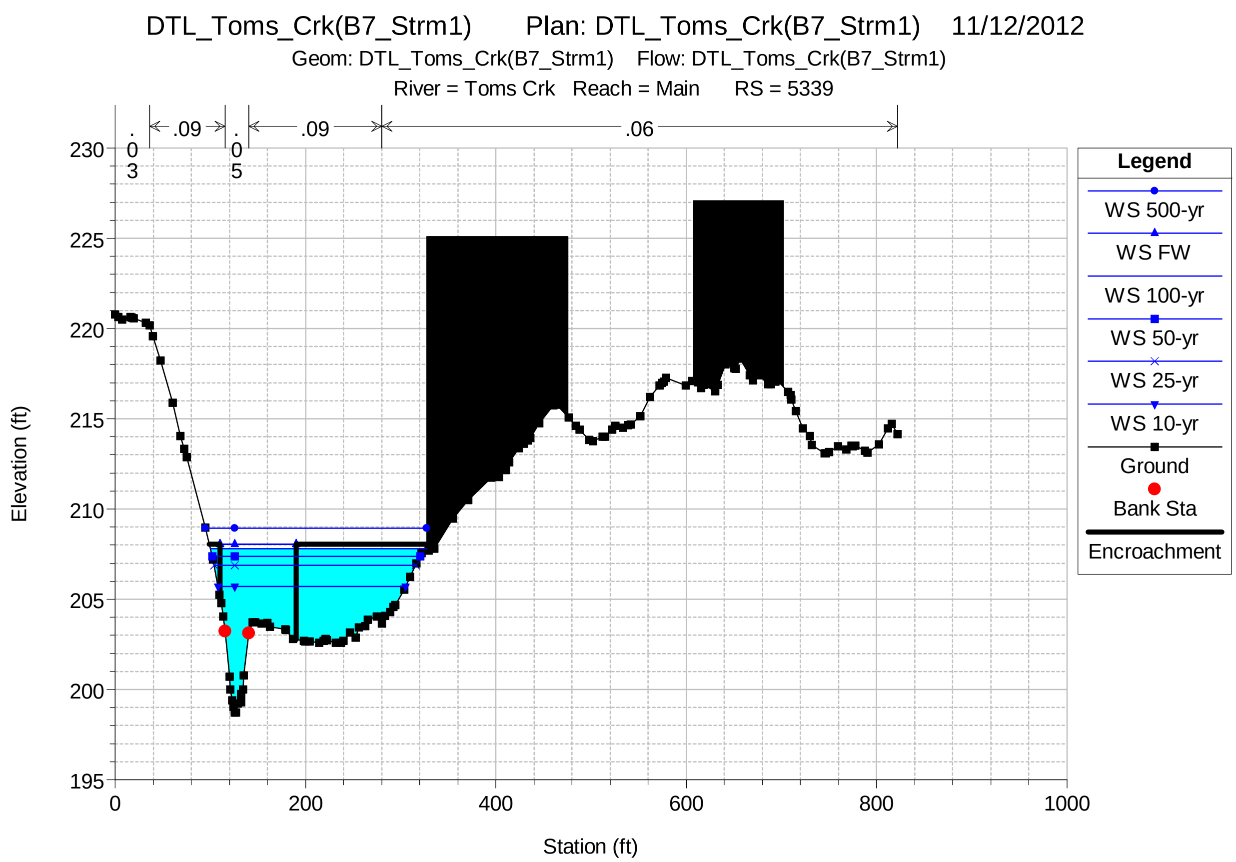


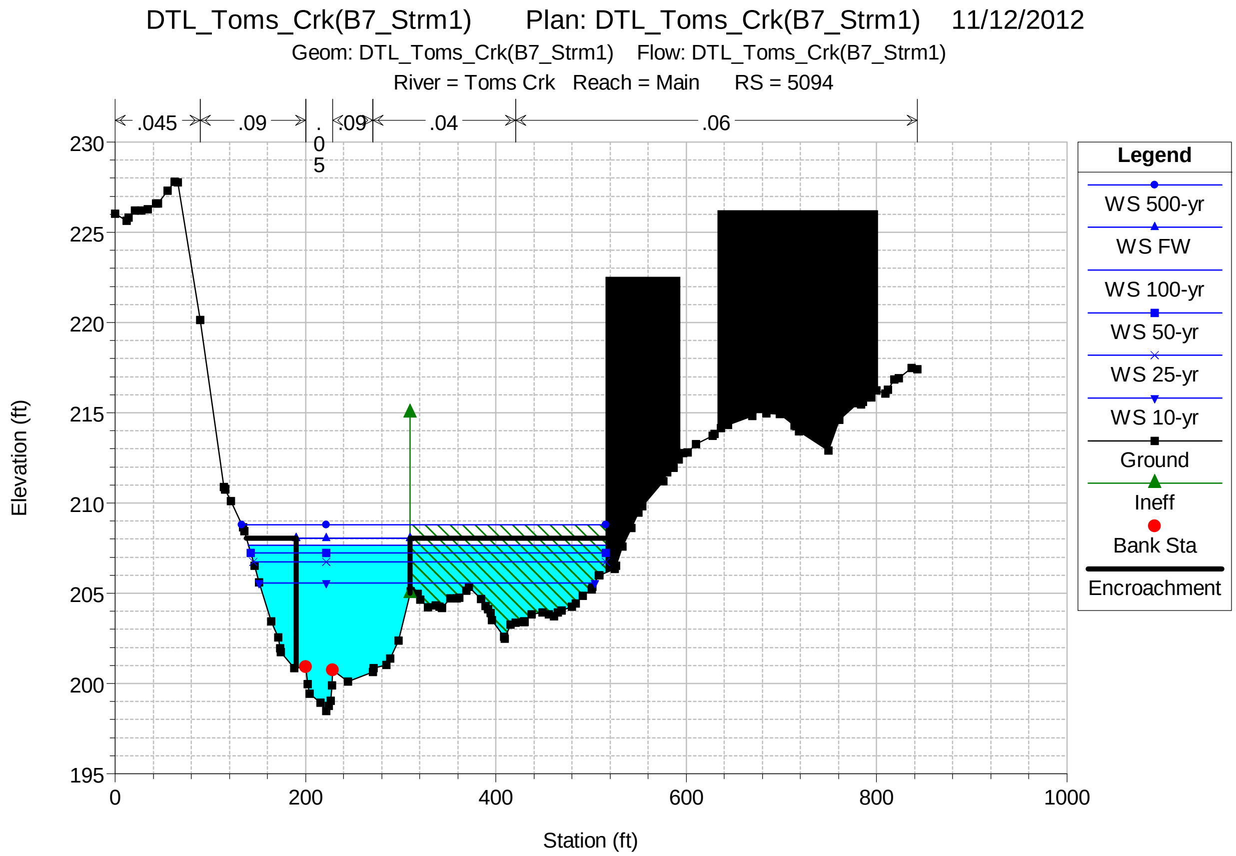
DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 6721
.09
.045
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 6315
.065
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5808
.06
.09
.05
.09
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment
Elevation (ft)
235
230
225
220
215
210
205
200
0
100
200
300
400
500
600
700
800
Station (ft)


DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5339
.03
.09
.05
.09
.06
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment
Elevation (ft)
230
225
220
215
210
205
200
195
0
200
400
600
800
1000
Station (ft)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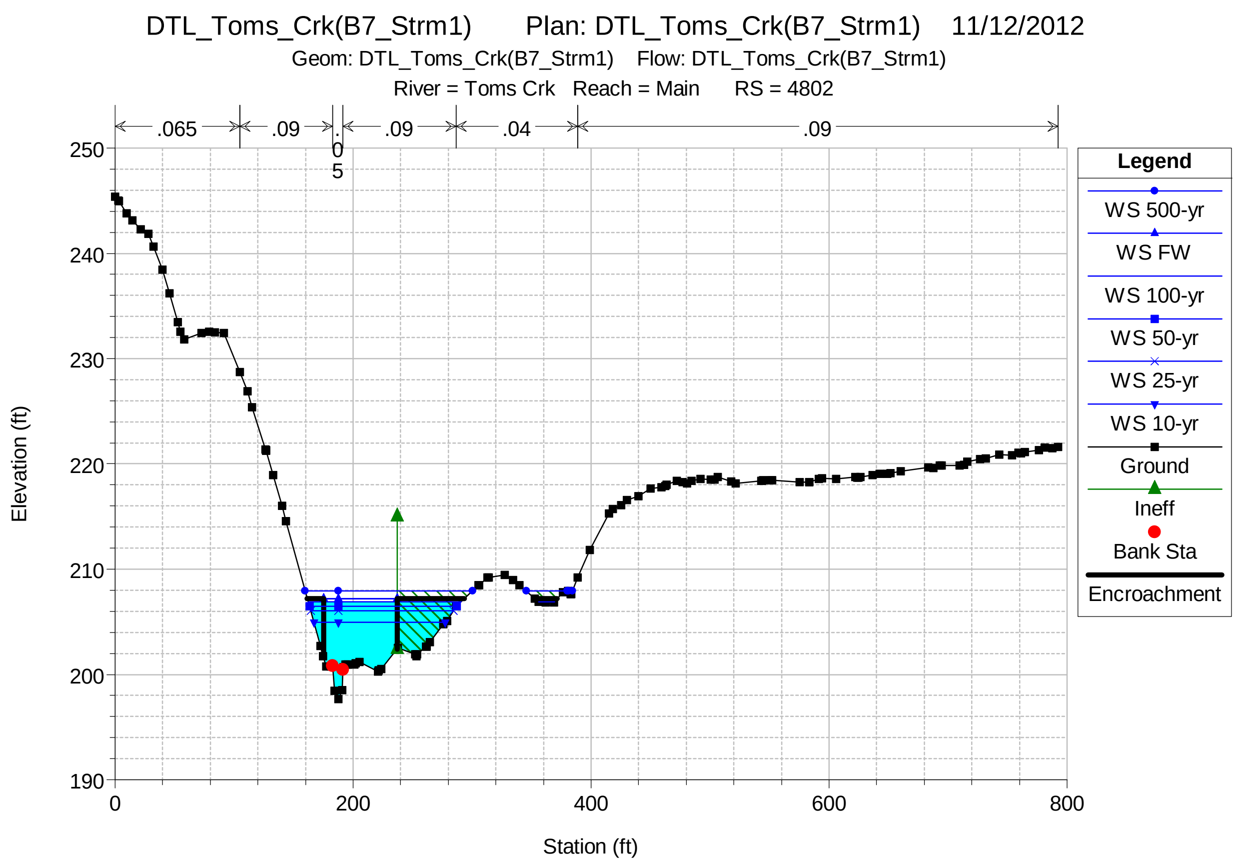
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5094
.045
.09
.05
.09
.04
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment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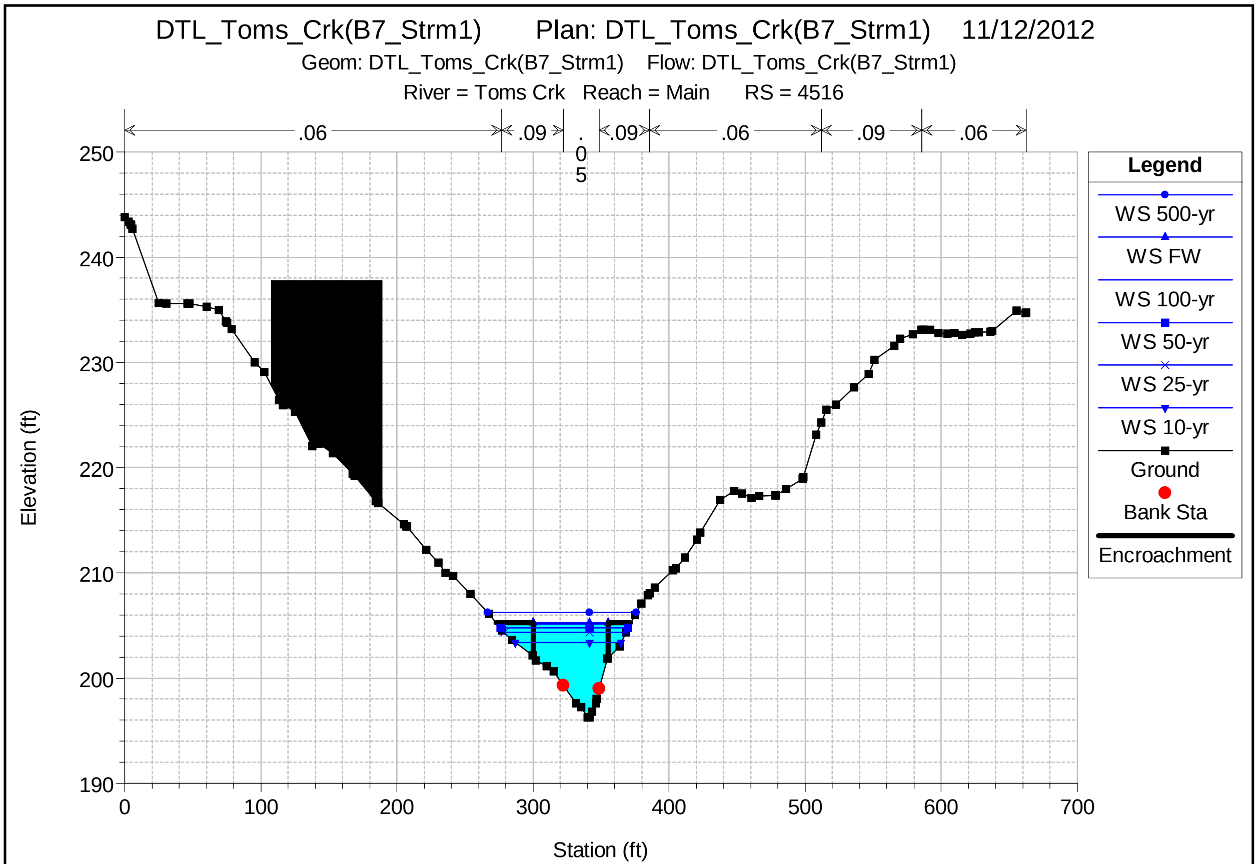
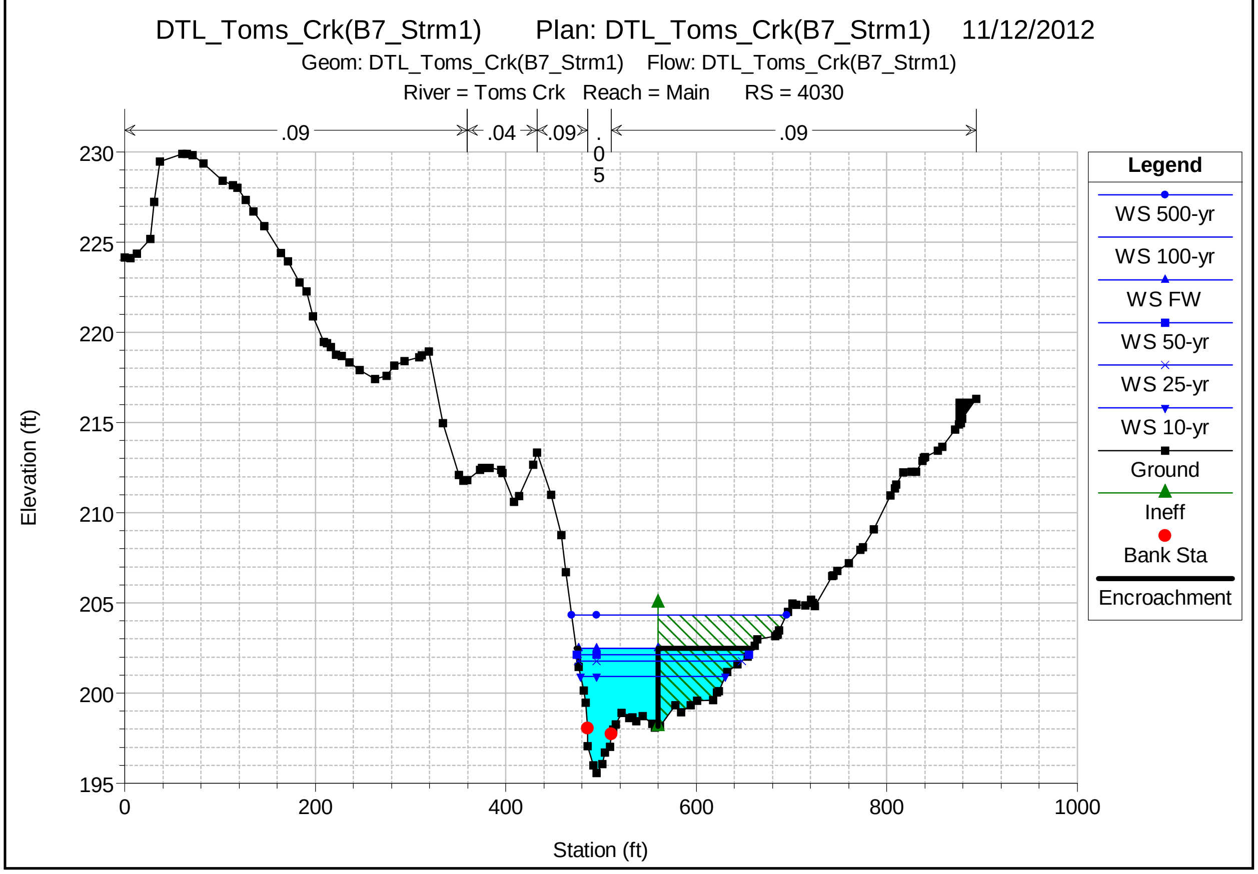
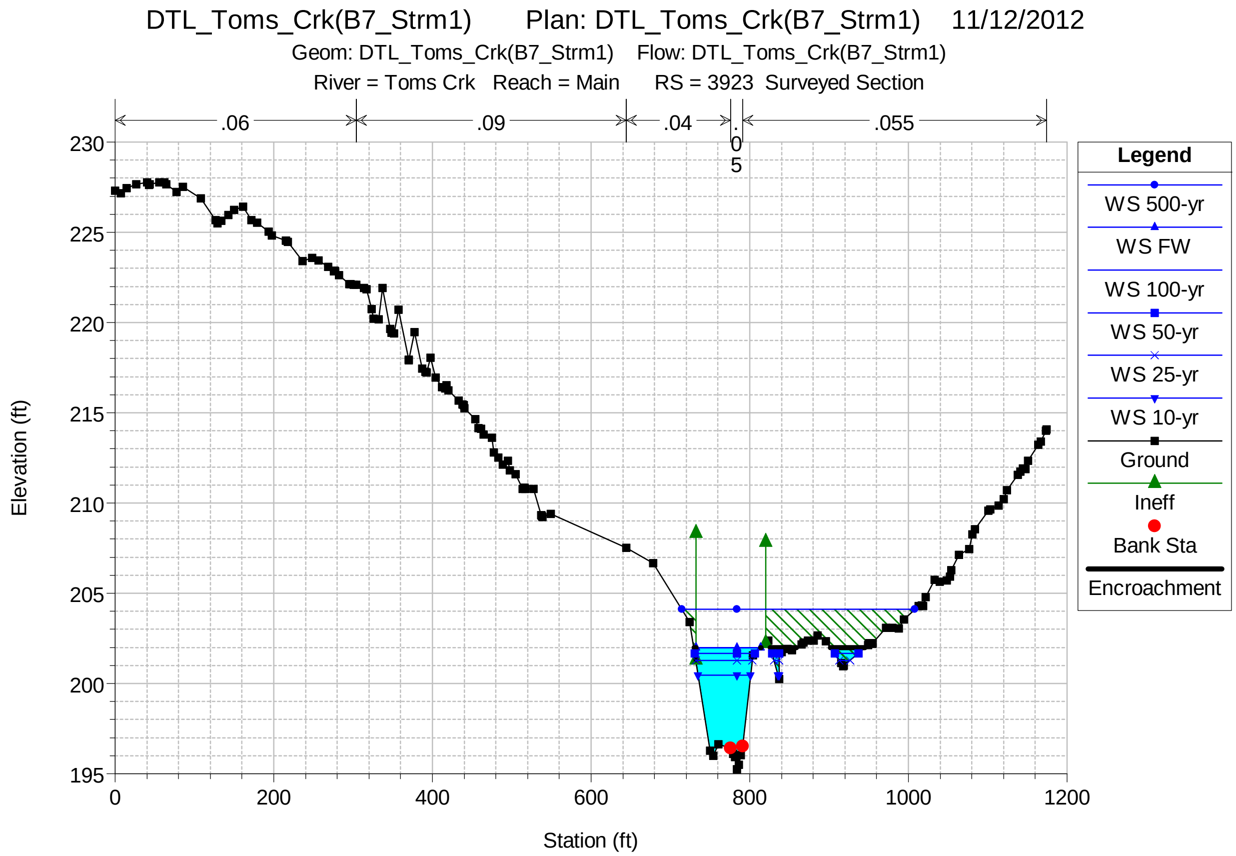
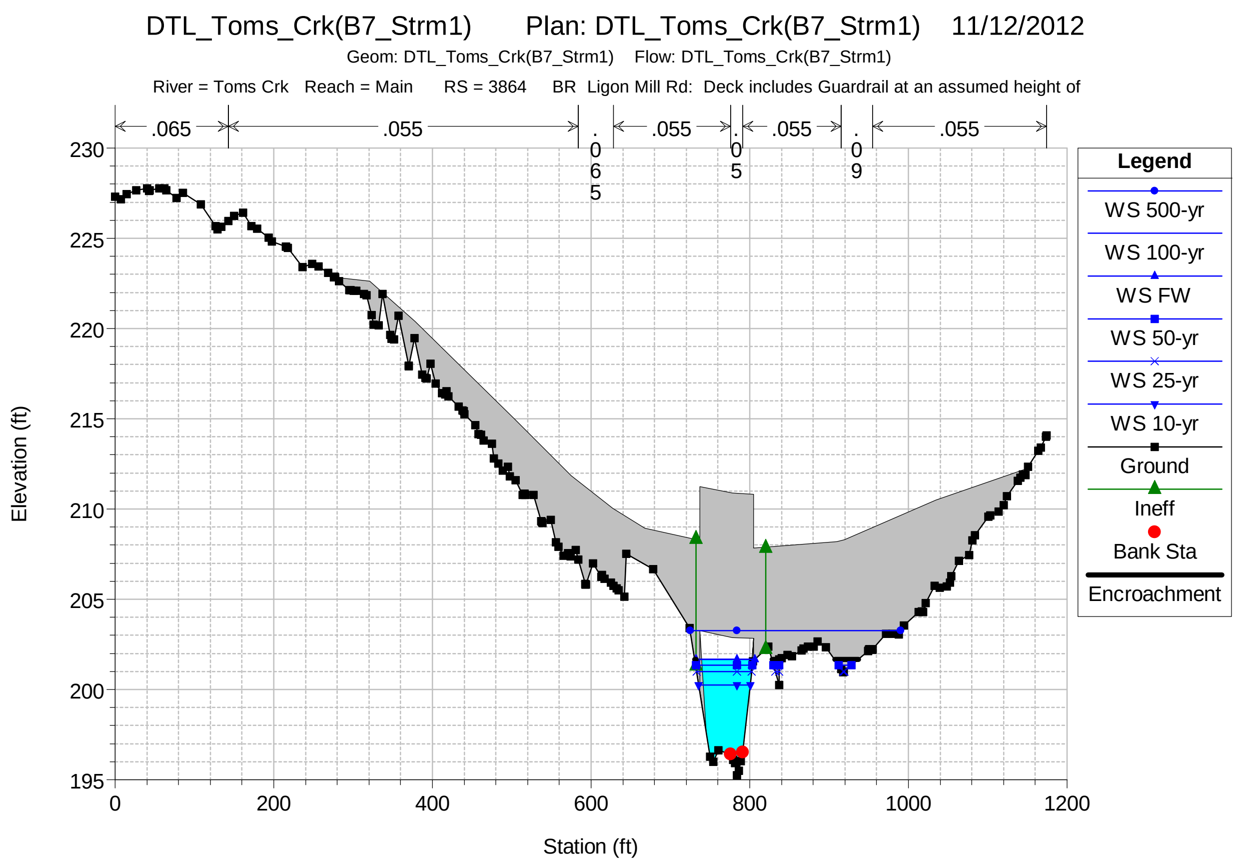
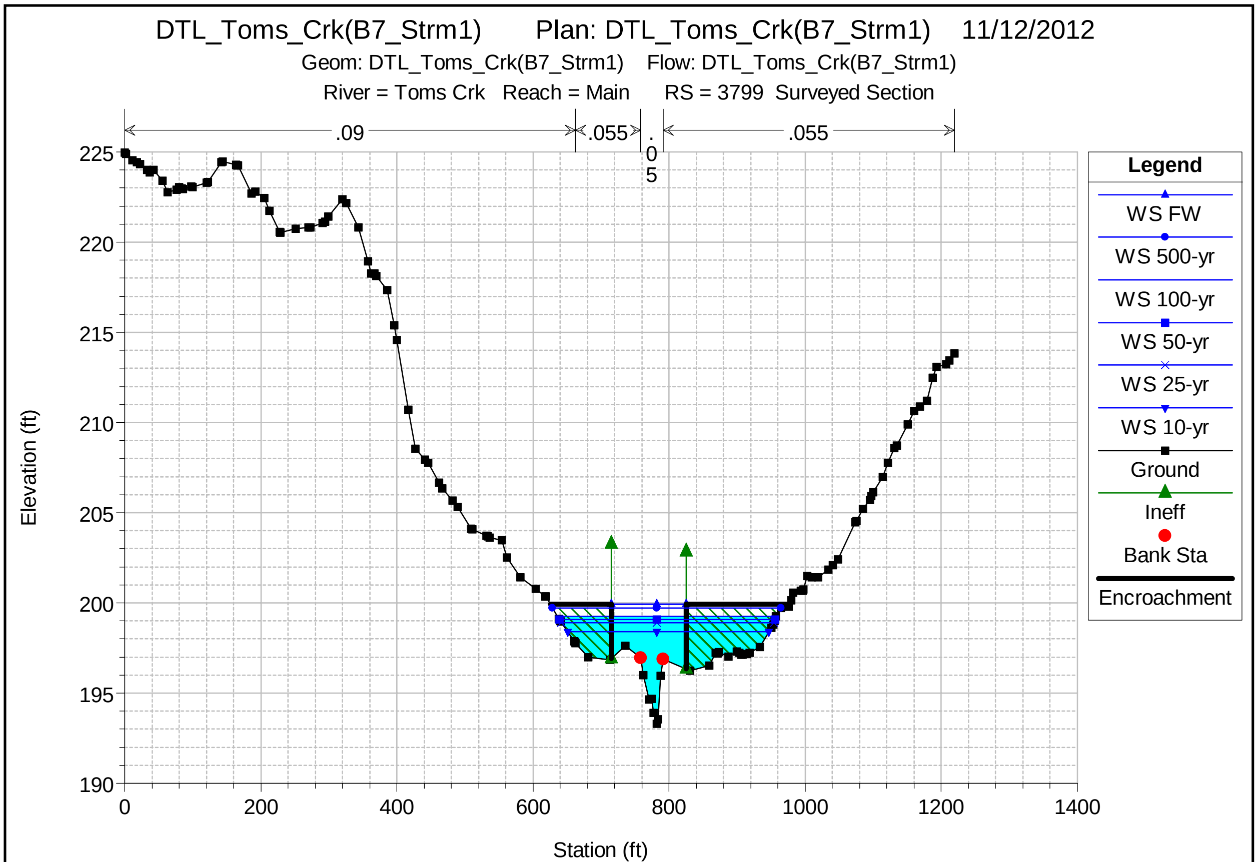
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4802
.065
.09
.05
.09
.04
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

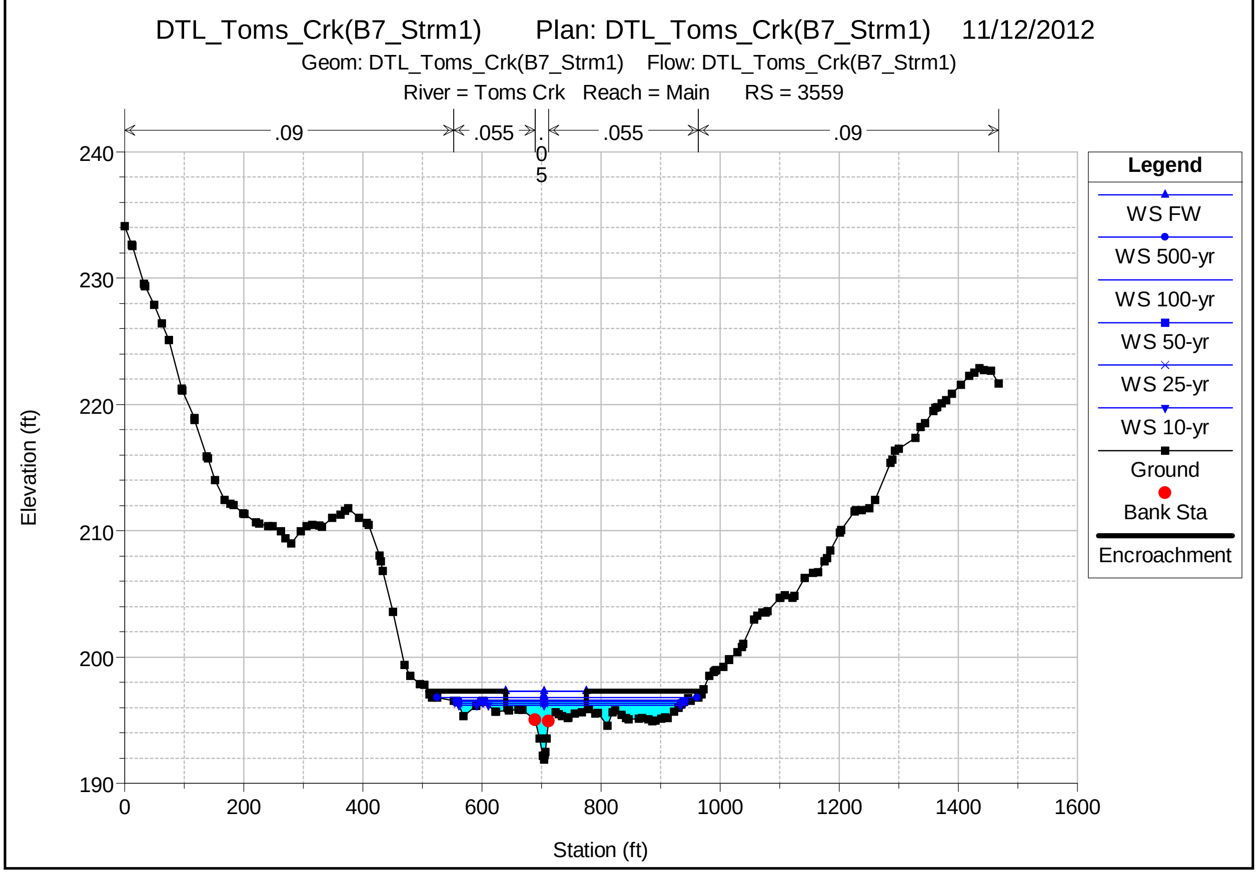

DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4516
.06
.09
.05
.09
.06
.09
.06
Elevation (ft)
250
240
230
220
210
200
190
0
100
200
300
400
500
600
700
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

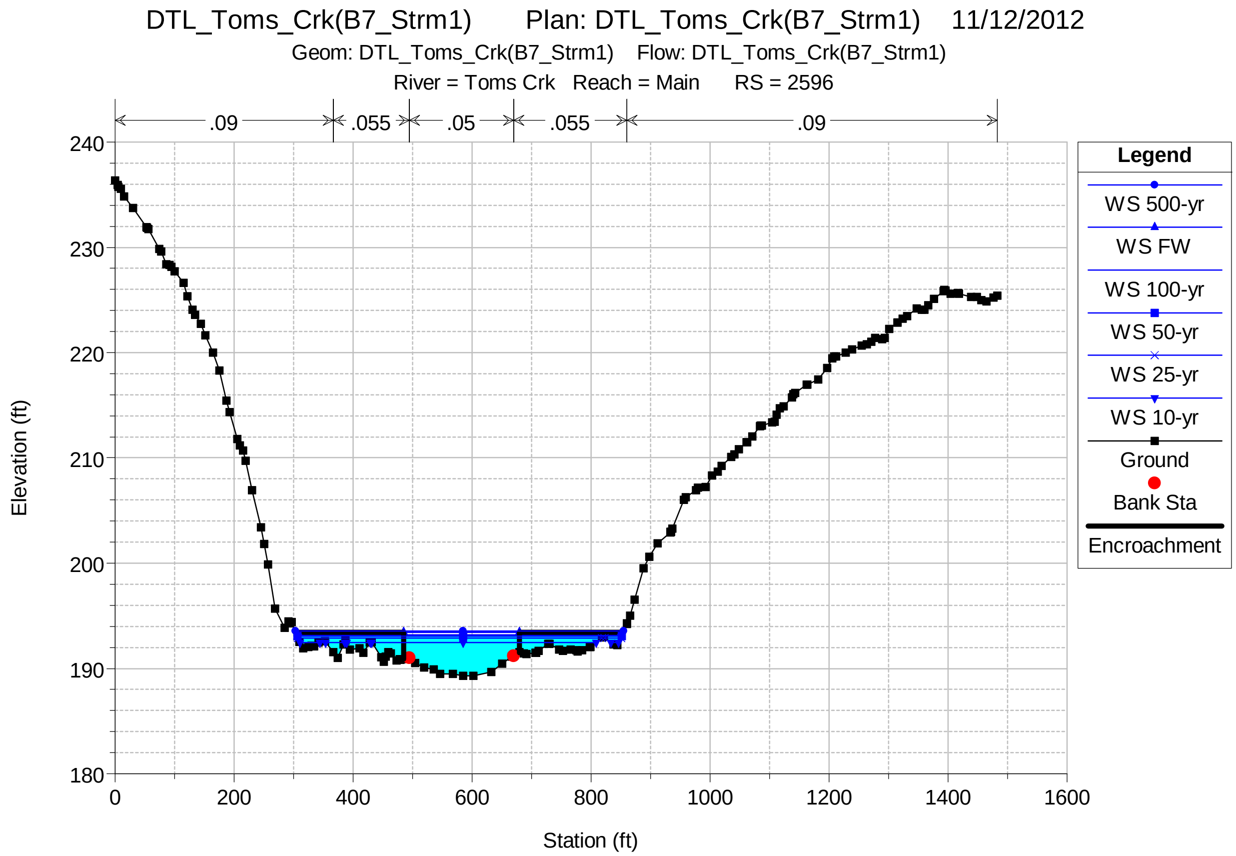

DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4030
.09
.04
.09
.05
.09
Elevation (ft)
230
225
220
215
210
205
200
195
0
200
400
600
800
1000
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS FW
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3923 Surveyed Section
.06
.09
.04
.05
.055
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

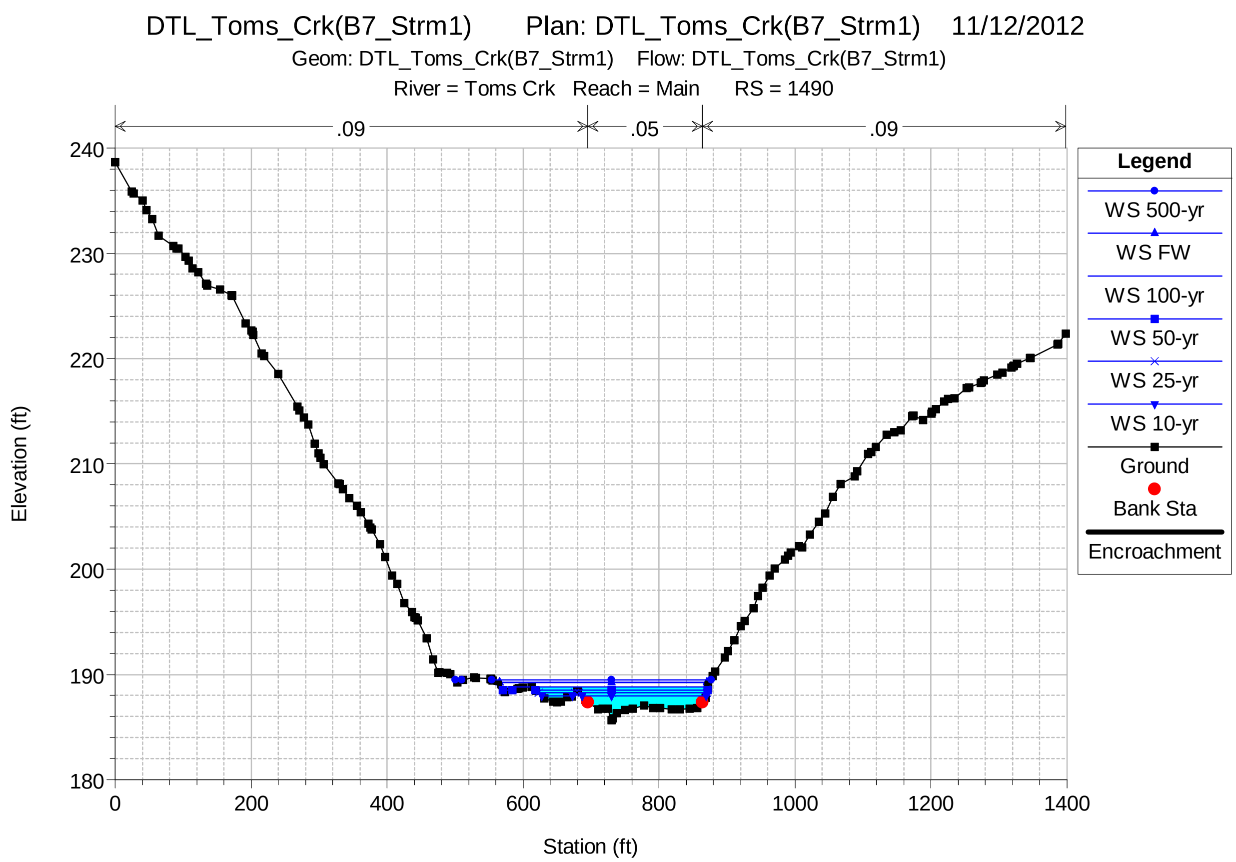

DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3864 BR Ligon Mill Rd: Deck includes Guardrail at an assumed height of
.065
.055
.065
.055
.05
.055
.09
.055
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS FW
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3799 Surveyed Section
.09
.055
.055
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

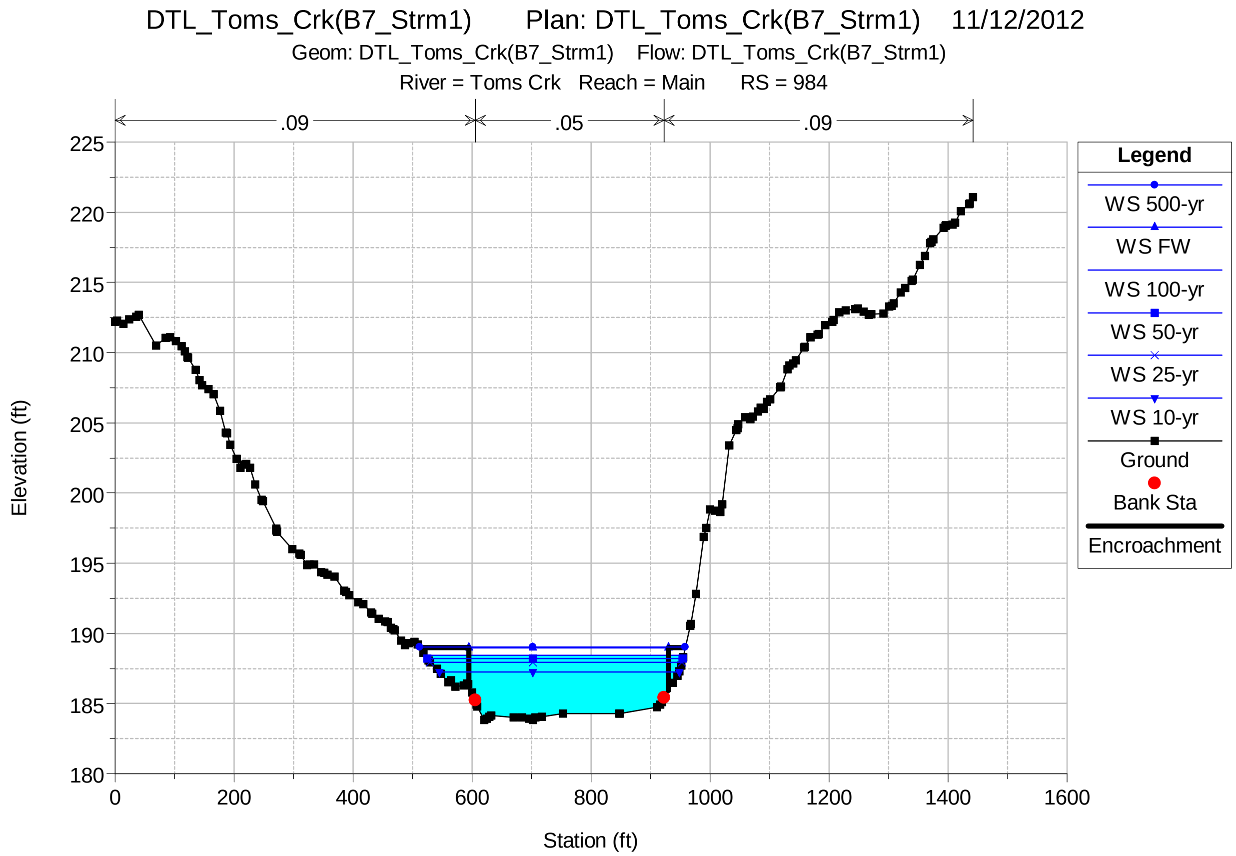

DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3559
.09
.055
.055
.09
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

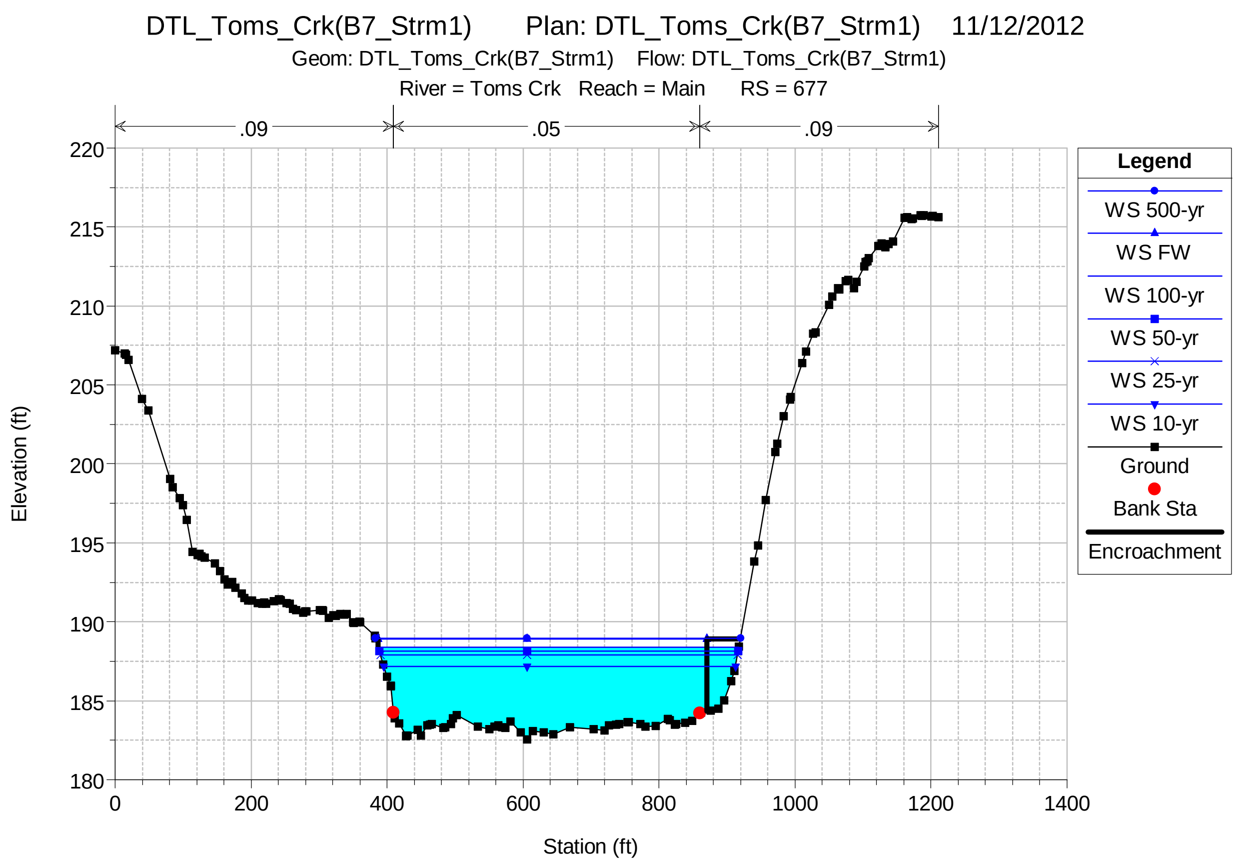


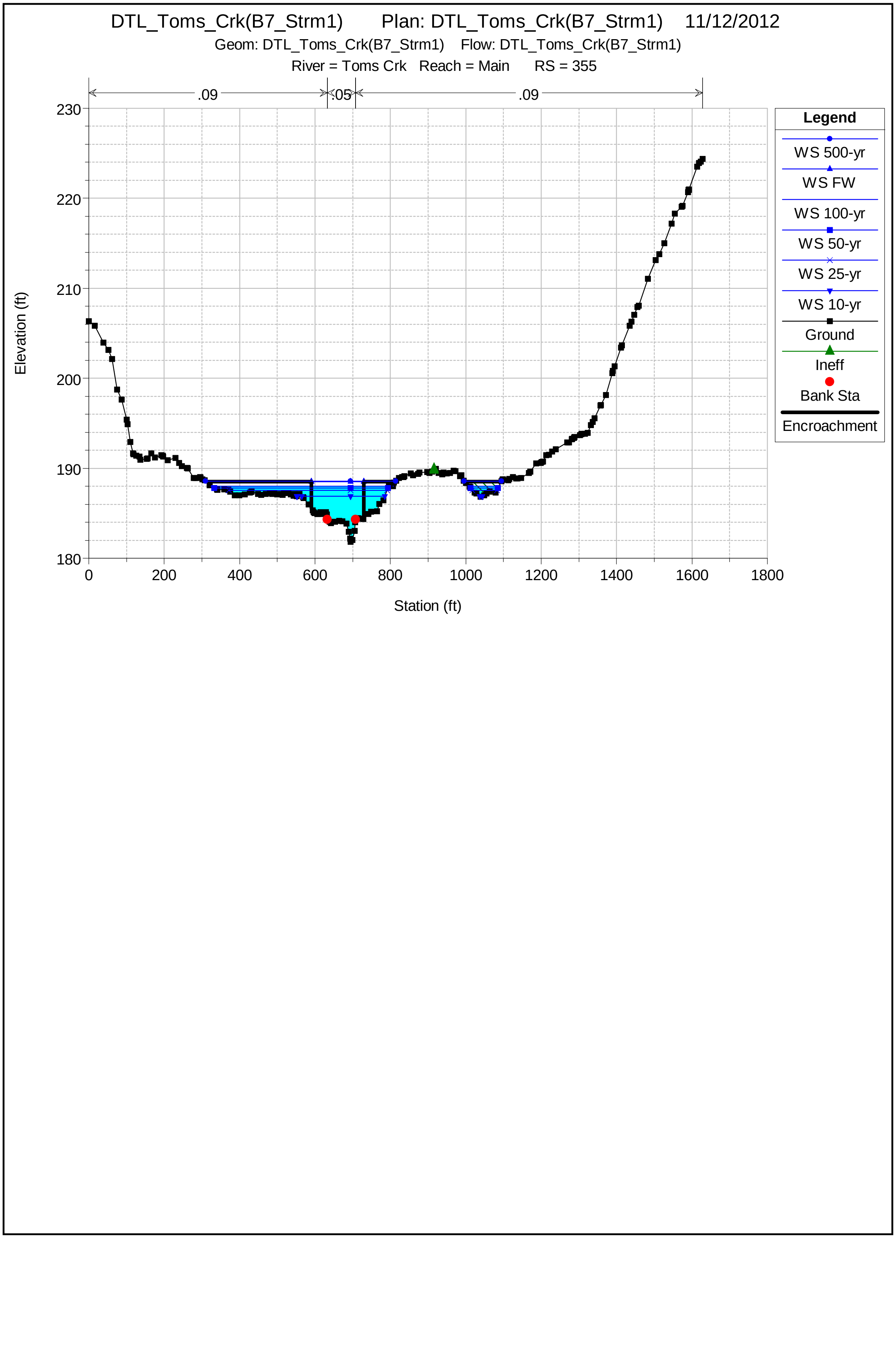
DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 2596
.09
.055
.05
.055
.09
Elevation (ft)
240
230
220
210
200
190
180
0
200
400
600
800
1000
1200
1400
1600
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

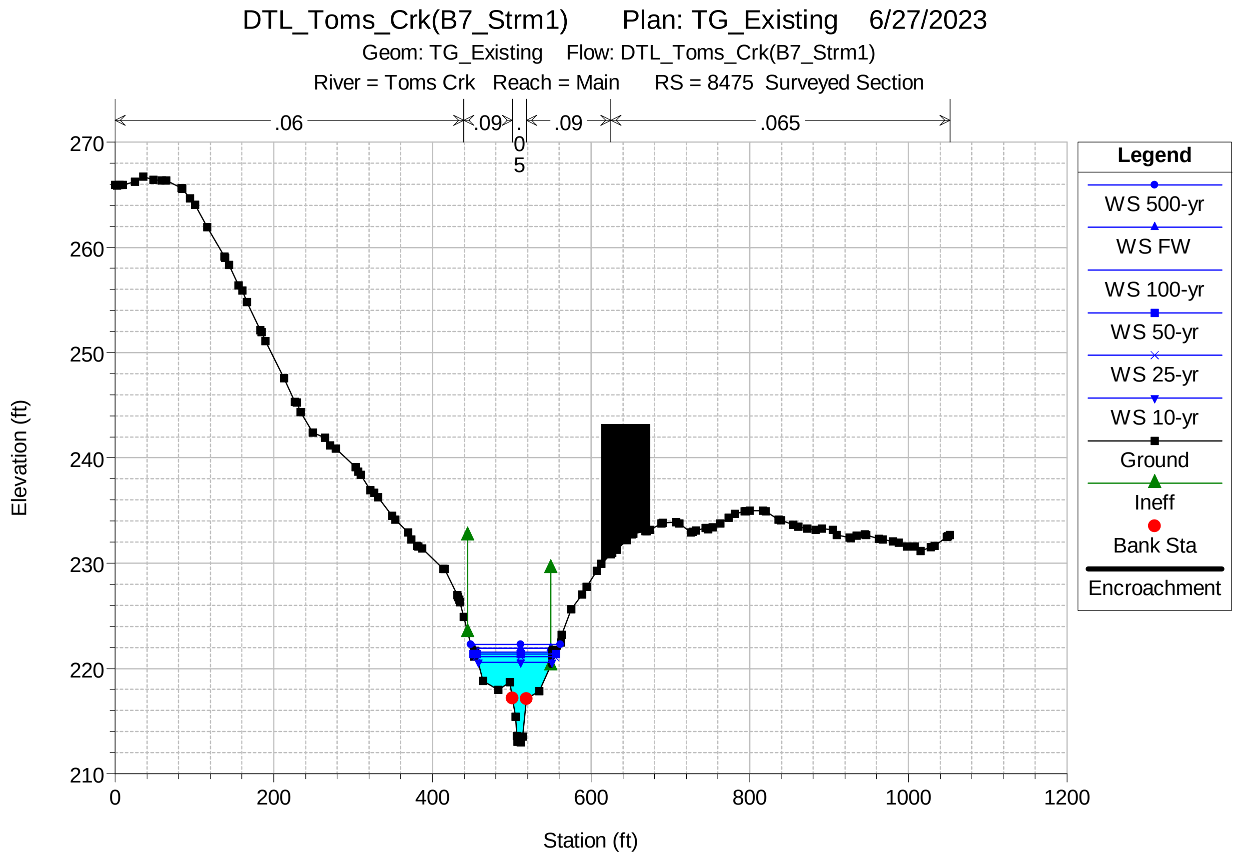
DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 1490
.09
.05
.09
Elevation (ft)
240
230
220
210
200
190
180
0
200
400
600
800
1000
1200
1400
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

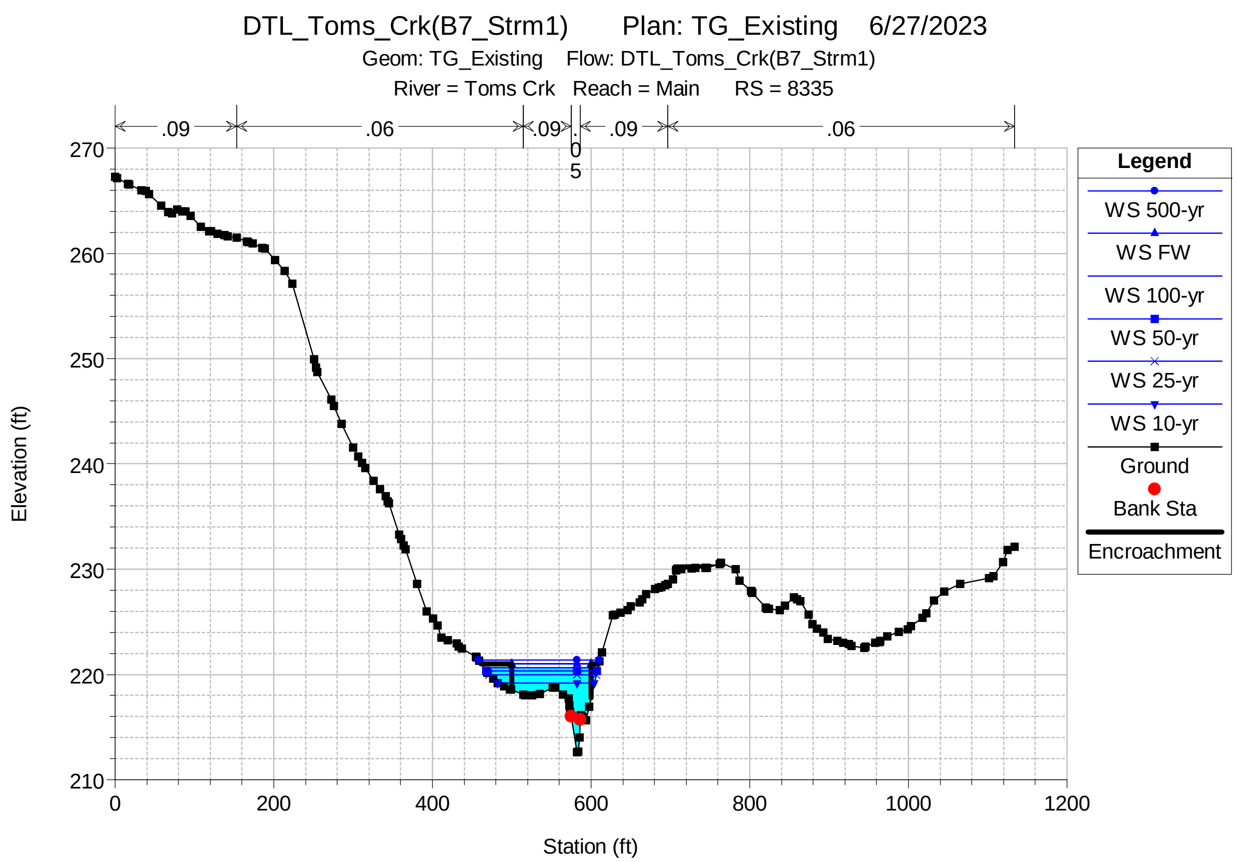

DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 984
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

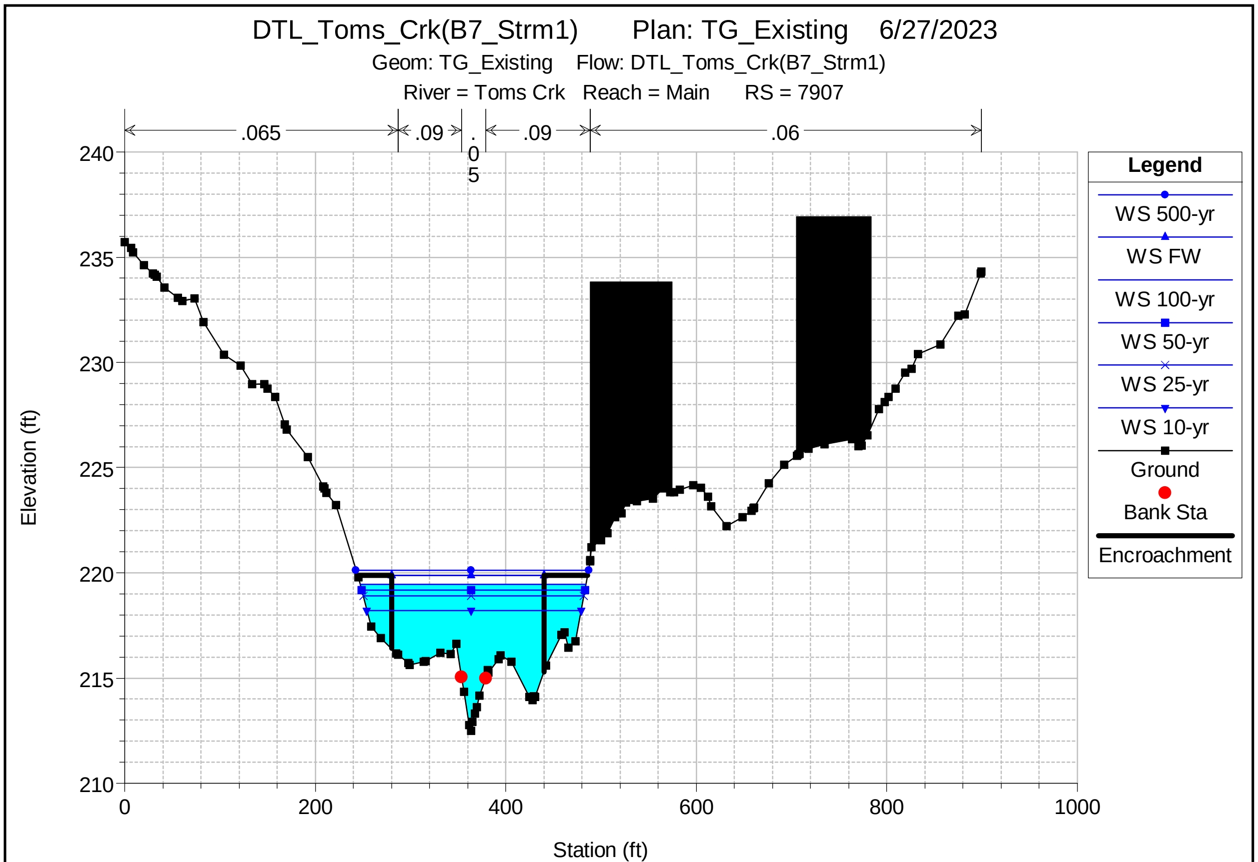

DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 677
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

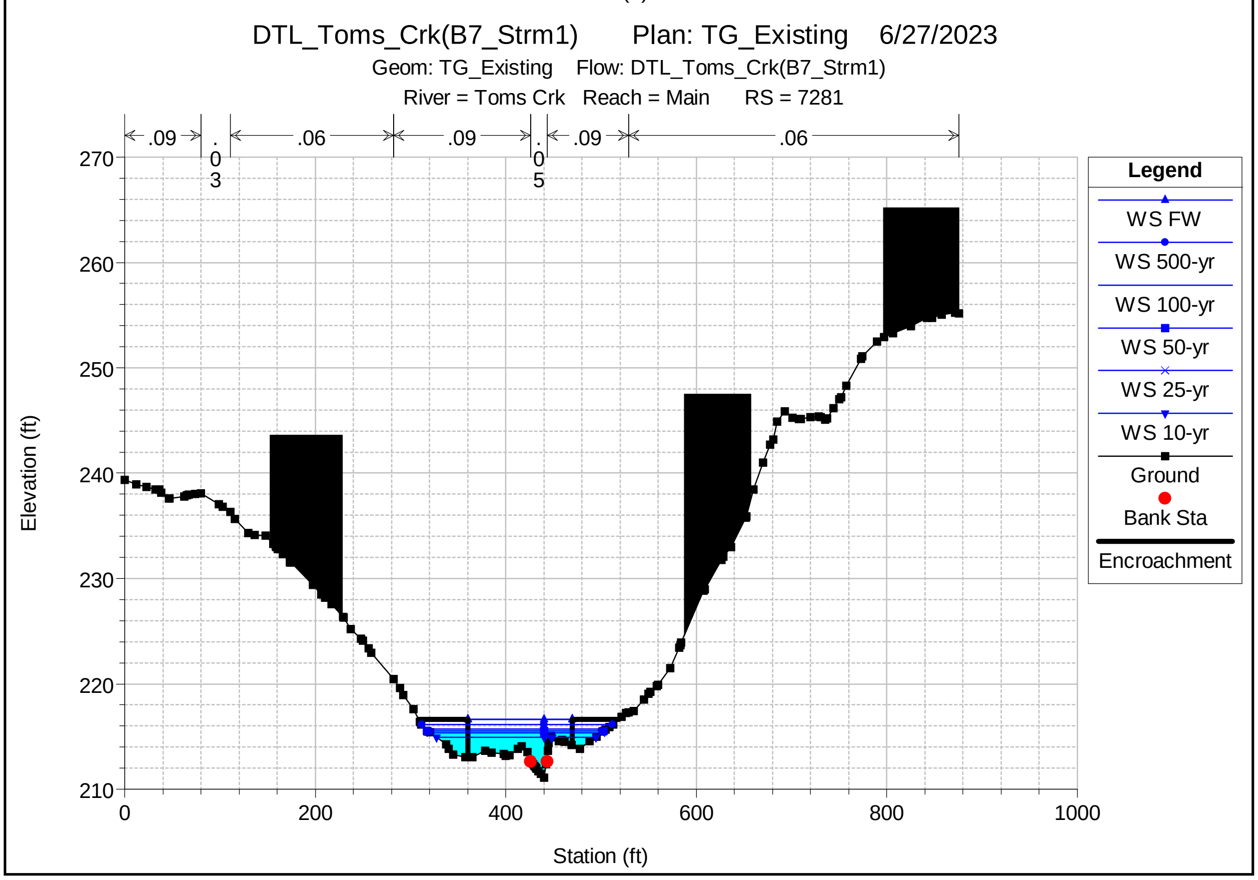

DTL_Toms_Crk(B7_Strm1) Plan: DTL_Toms_Crk(B7_Strm1) 11/12/2012
Geom: DTL_Toms_Crk(B7_Strm1) Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 355
.09
.05
.09
Elevation (ft)
230
220
210
200
190
180
0
200
400
600
800
1000
1200
1400
1600
1800
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

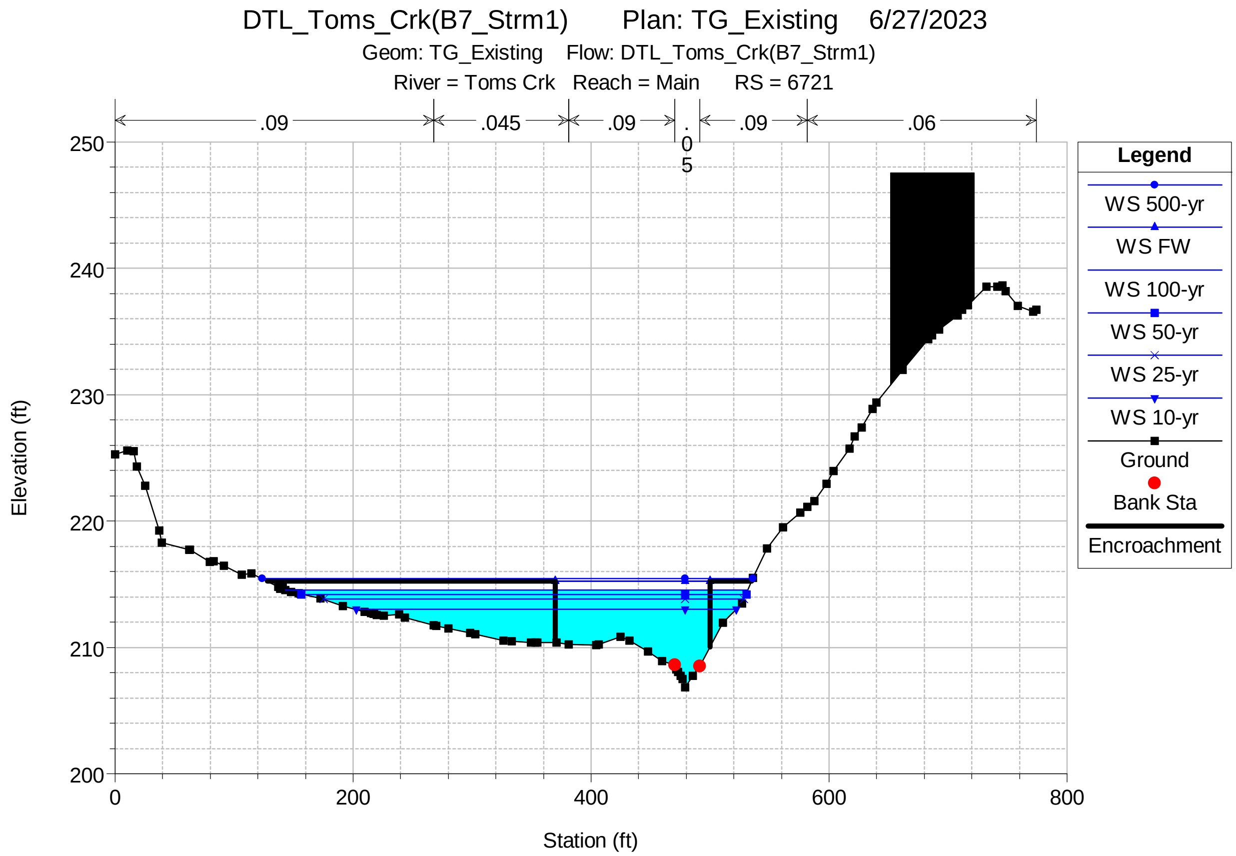
*Tom's Creek*
*Existing Cross Sections*

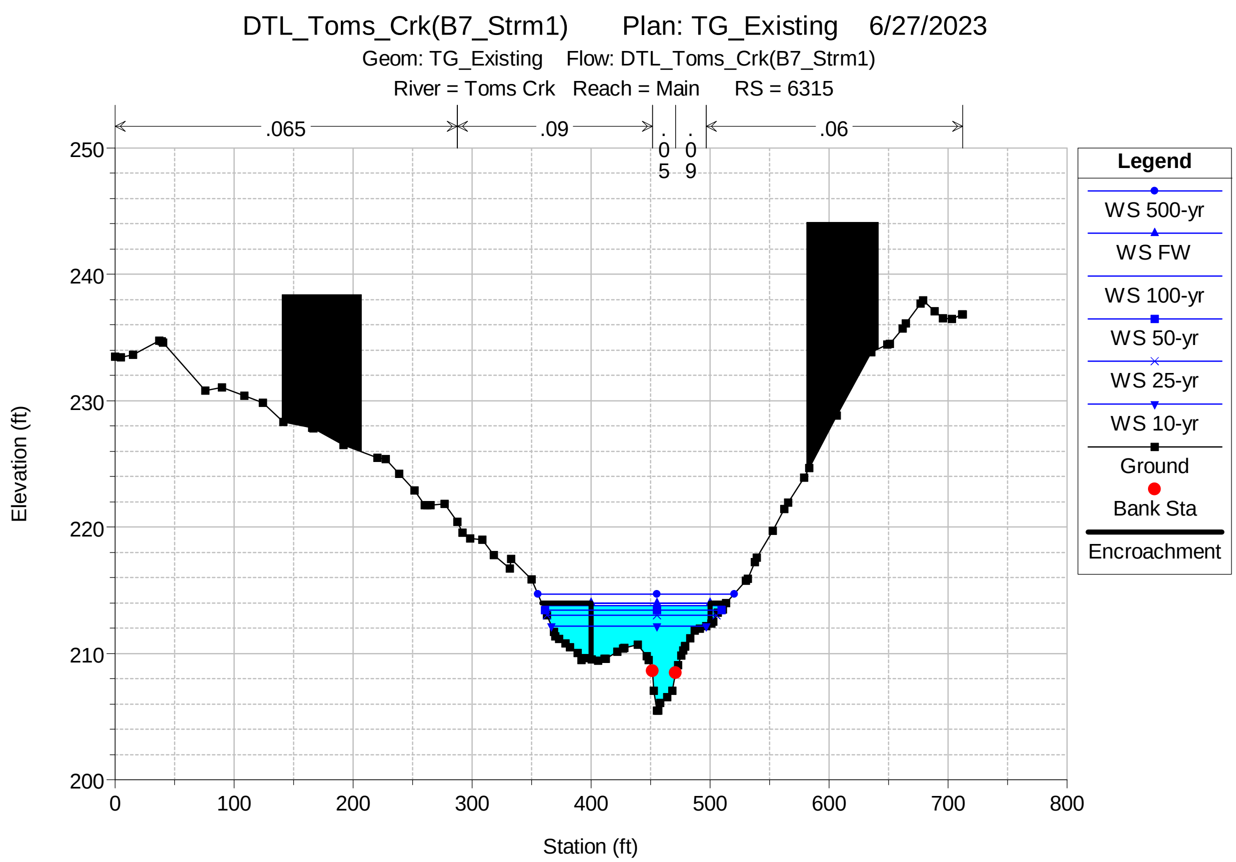

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 8475 Surveyed Section
.06
.09
.05
.09
.065
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

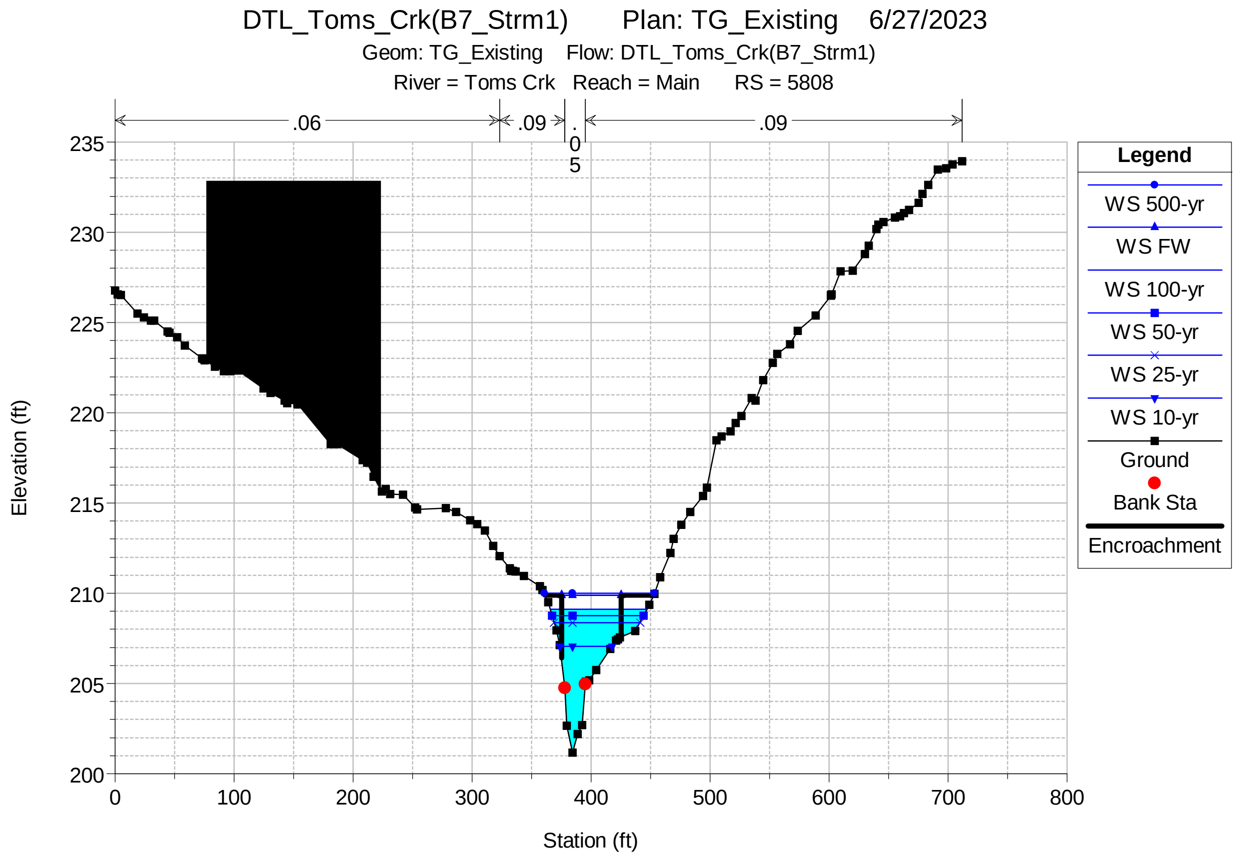

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 8335
.09
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

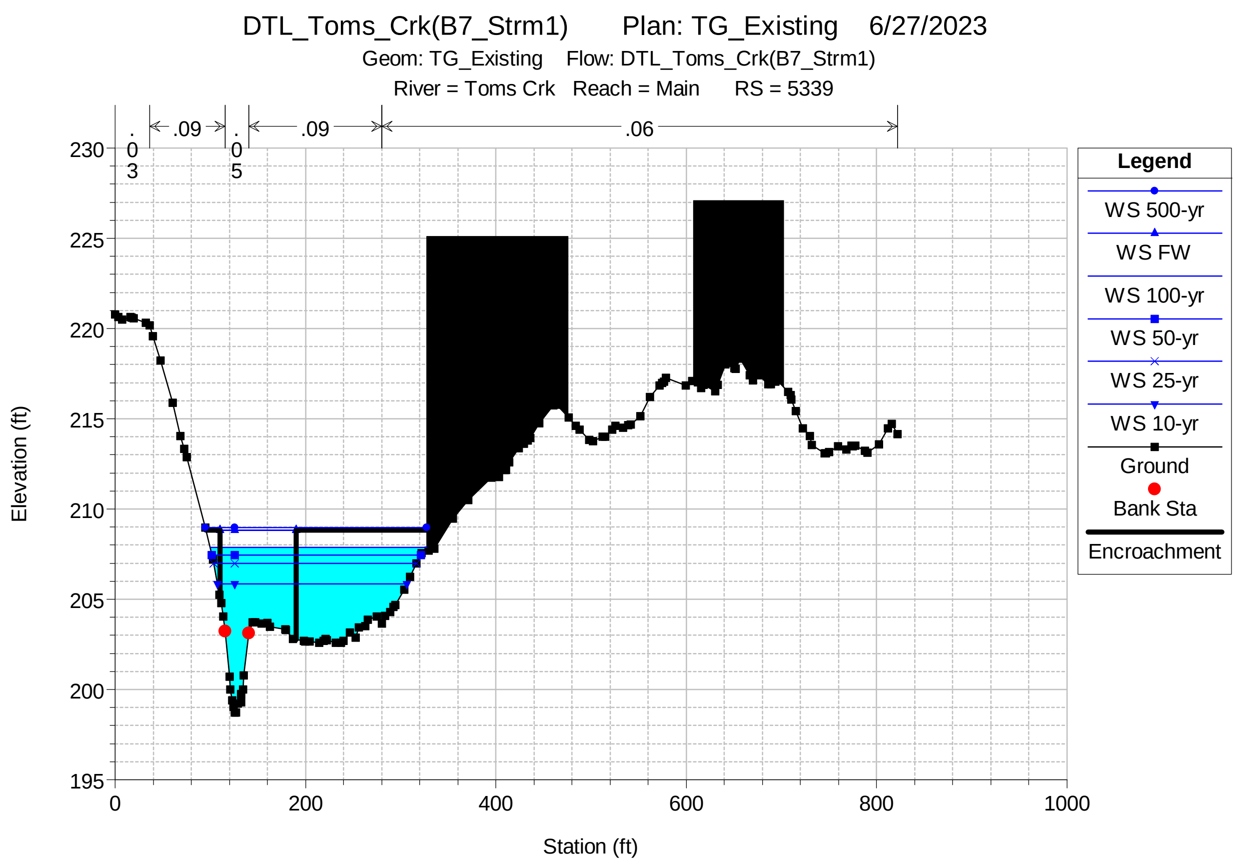

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 7907
.065
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

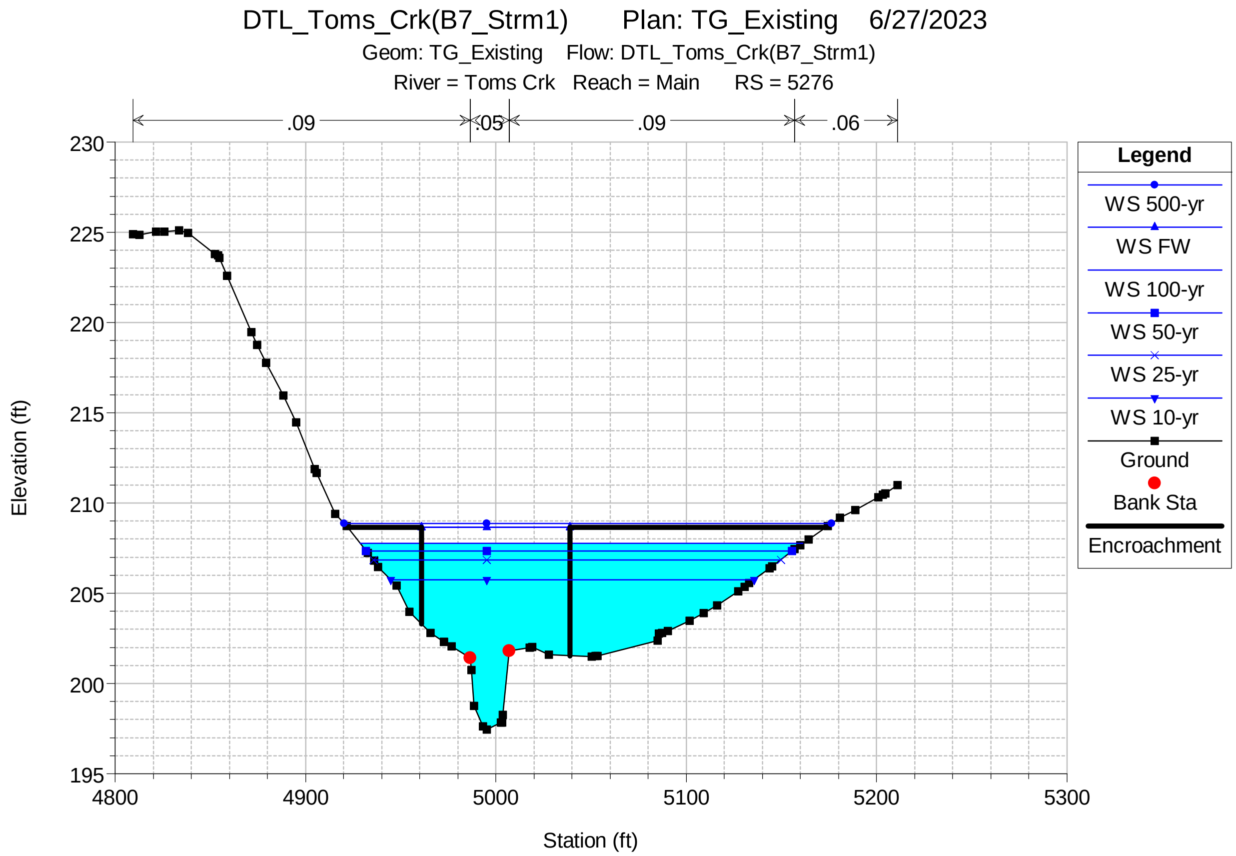

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 7281
.09
.03
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

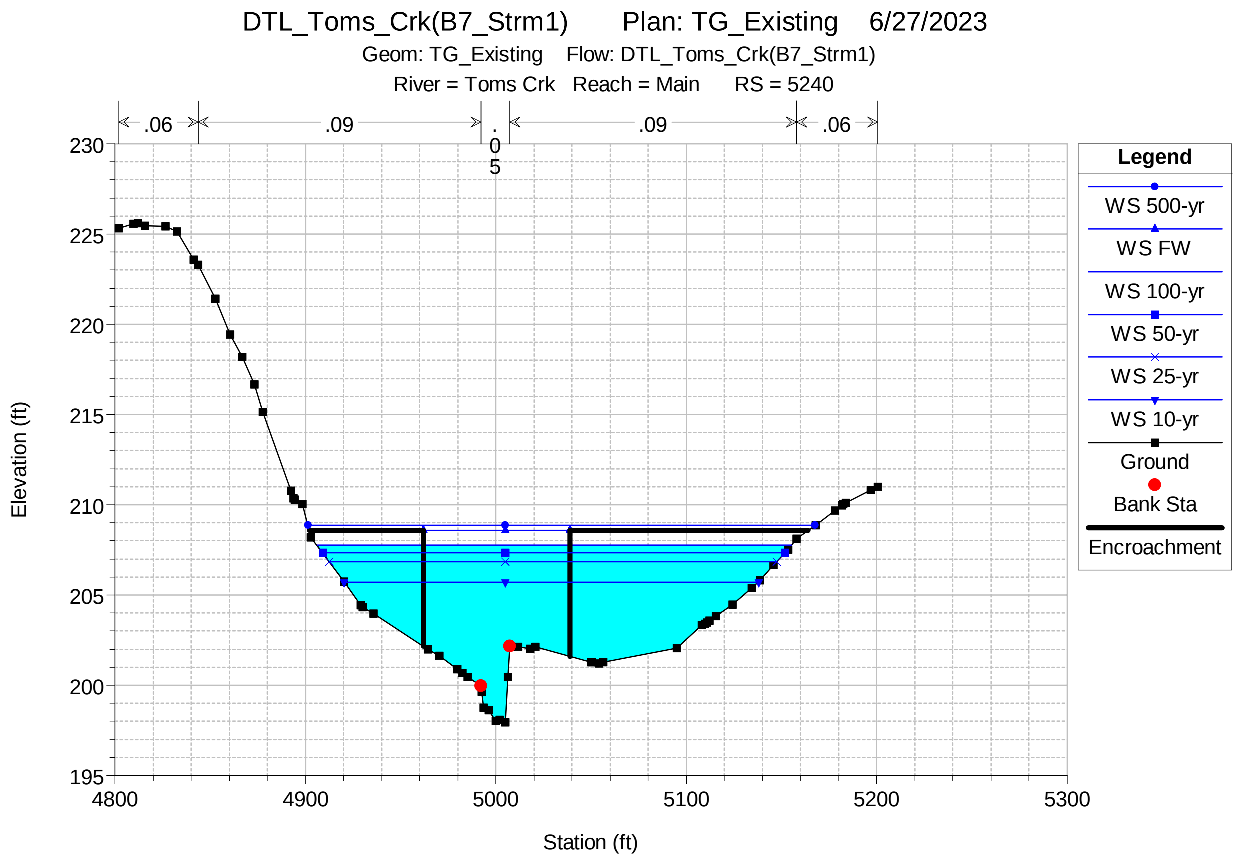

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 6721
.09
.045
.09
.05
.09
.06
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment
Elevation (ft)
Station (ft)
250
240
230
220
210
200
0
200
400
600
800

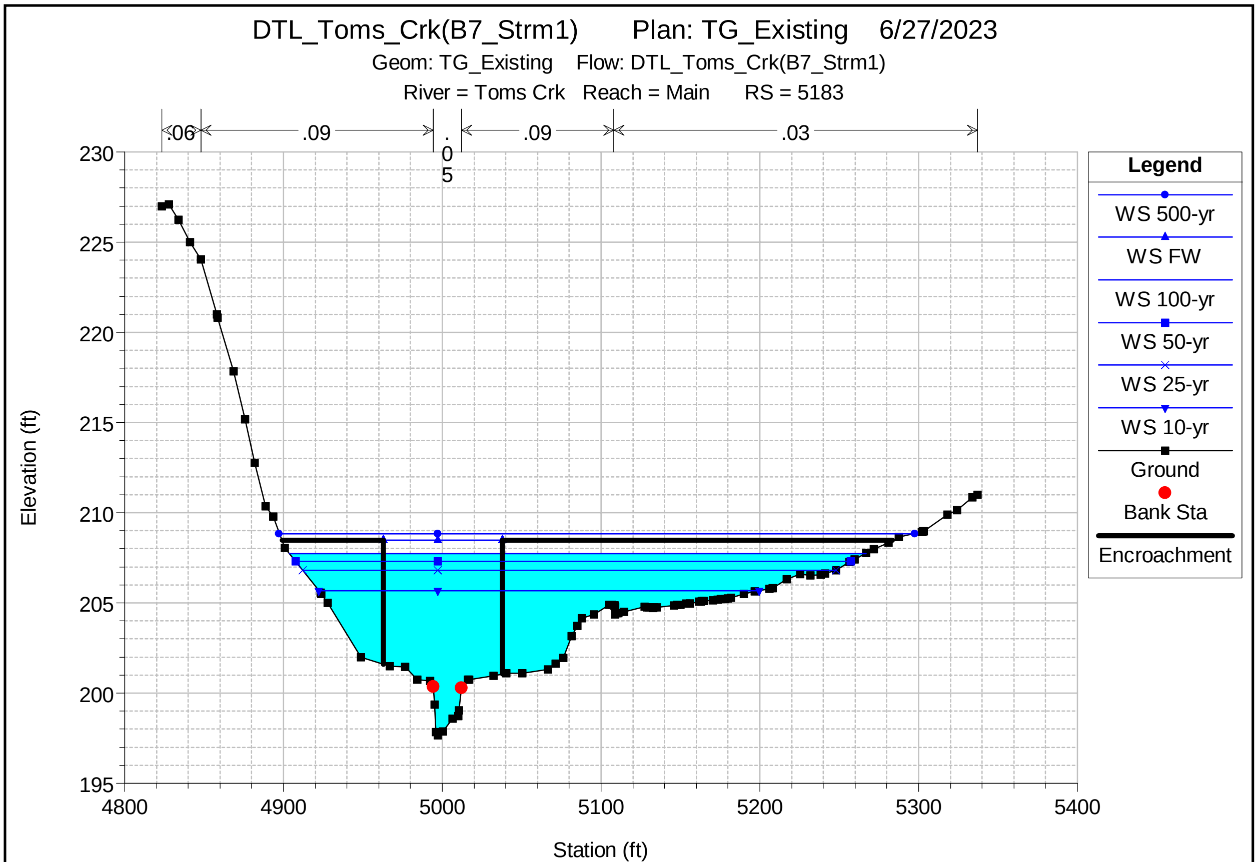

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 6315
.065
.09
.05
.09
.06
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment
Elevation (ft)
Station (ft)
250
240
230
220
210
200
0
100
200
300
400
500
600
700
800

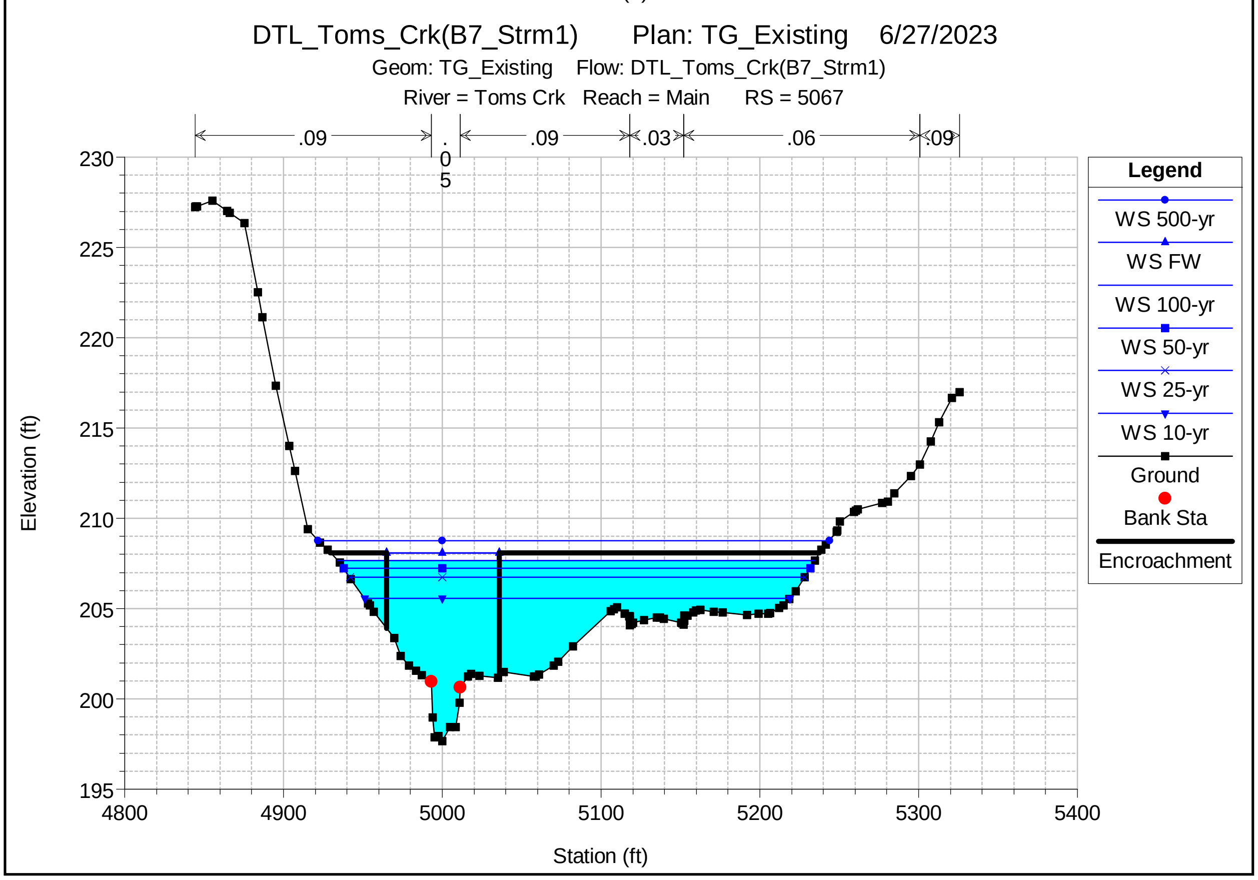

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5808
.06
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

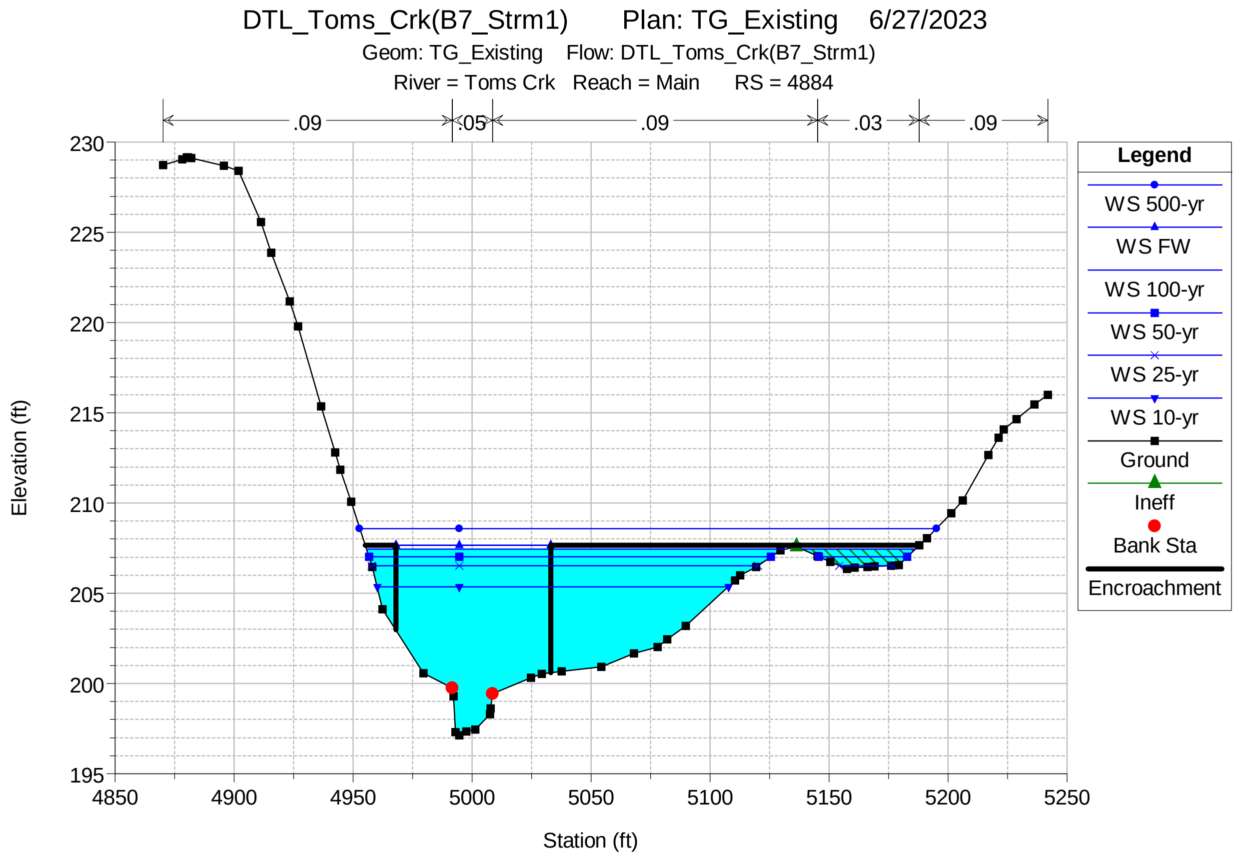

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5339
.03
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

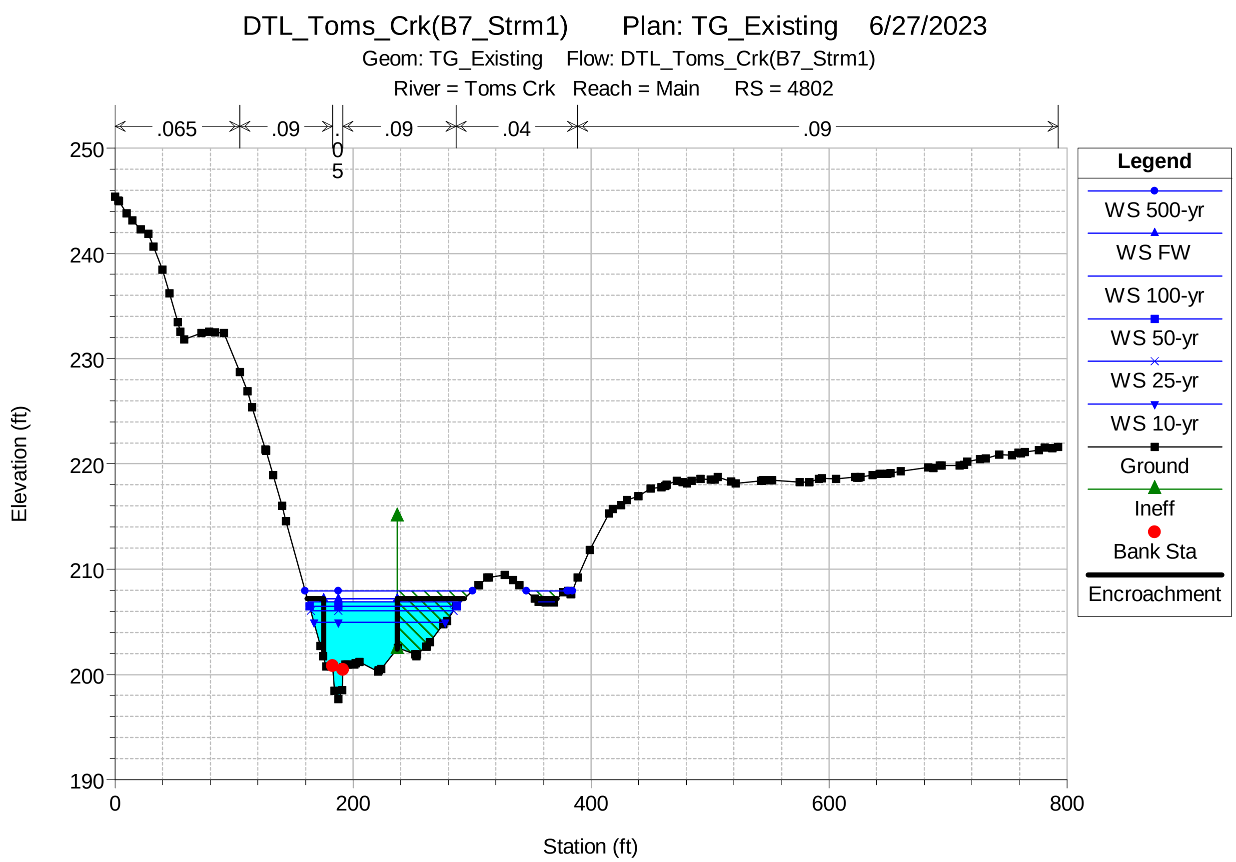

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5276
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

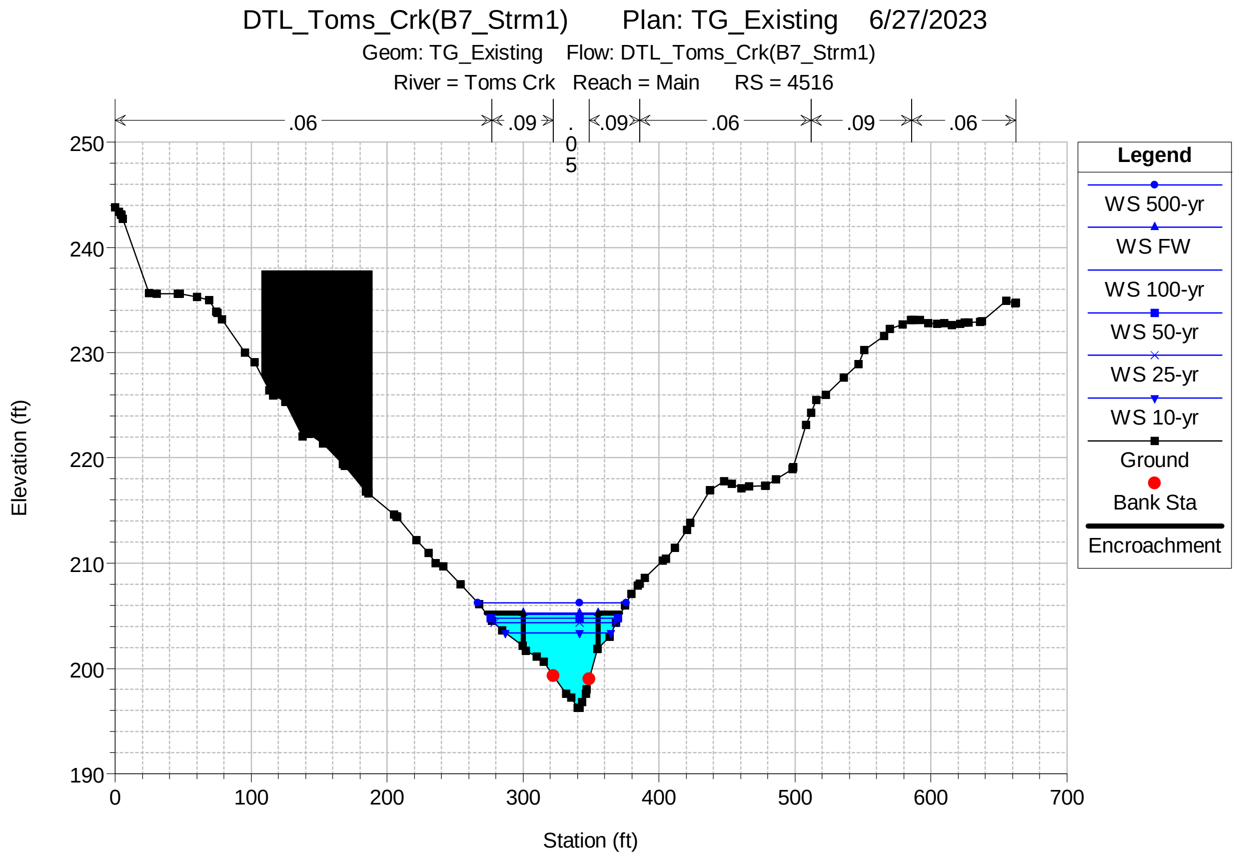

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5240
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5183
.06
.09
.05
.09
.03
Elevation (ft)
Station (ft)
230
225
220
215
210
205
200
195
4800
4900
5000
5100
5200
5300
5400
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

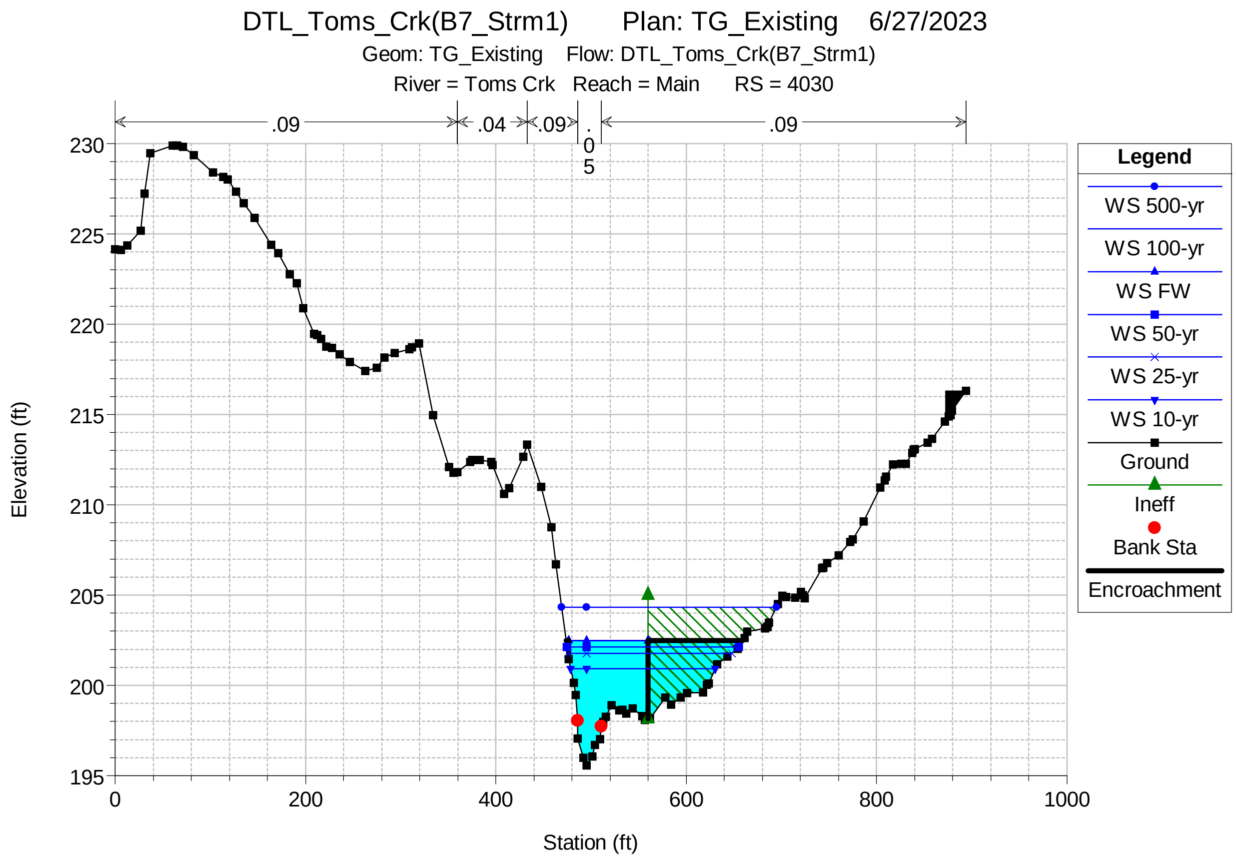

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5067
.09
.05
.09
.03
.06
.09
Elevation (ft)
Station (ft)
230
225
220
215
210
205
200
195
4800
4900
5000
5100
5200
5300
5400
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4884
.09
.05
.09
.03
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

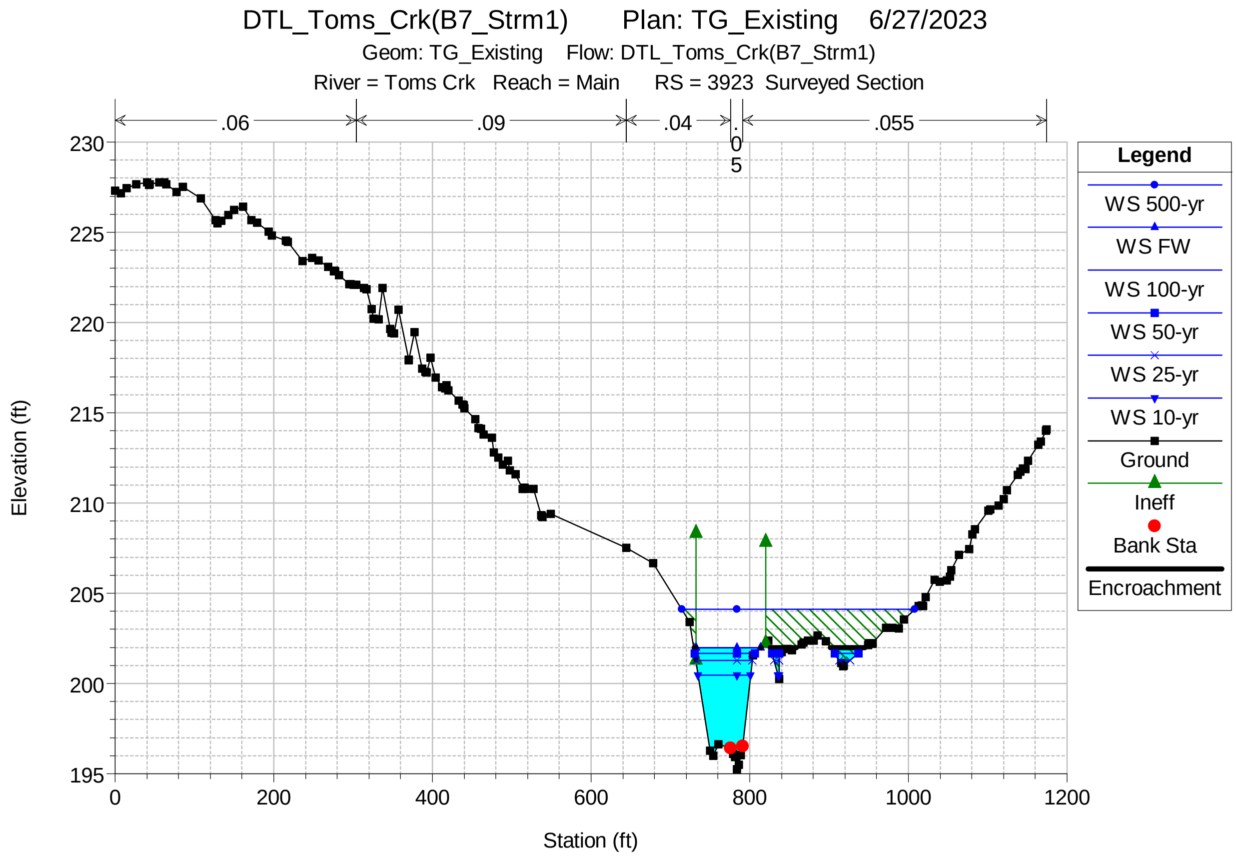

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4802
.065
.09
.05
.09
.04
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

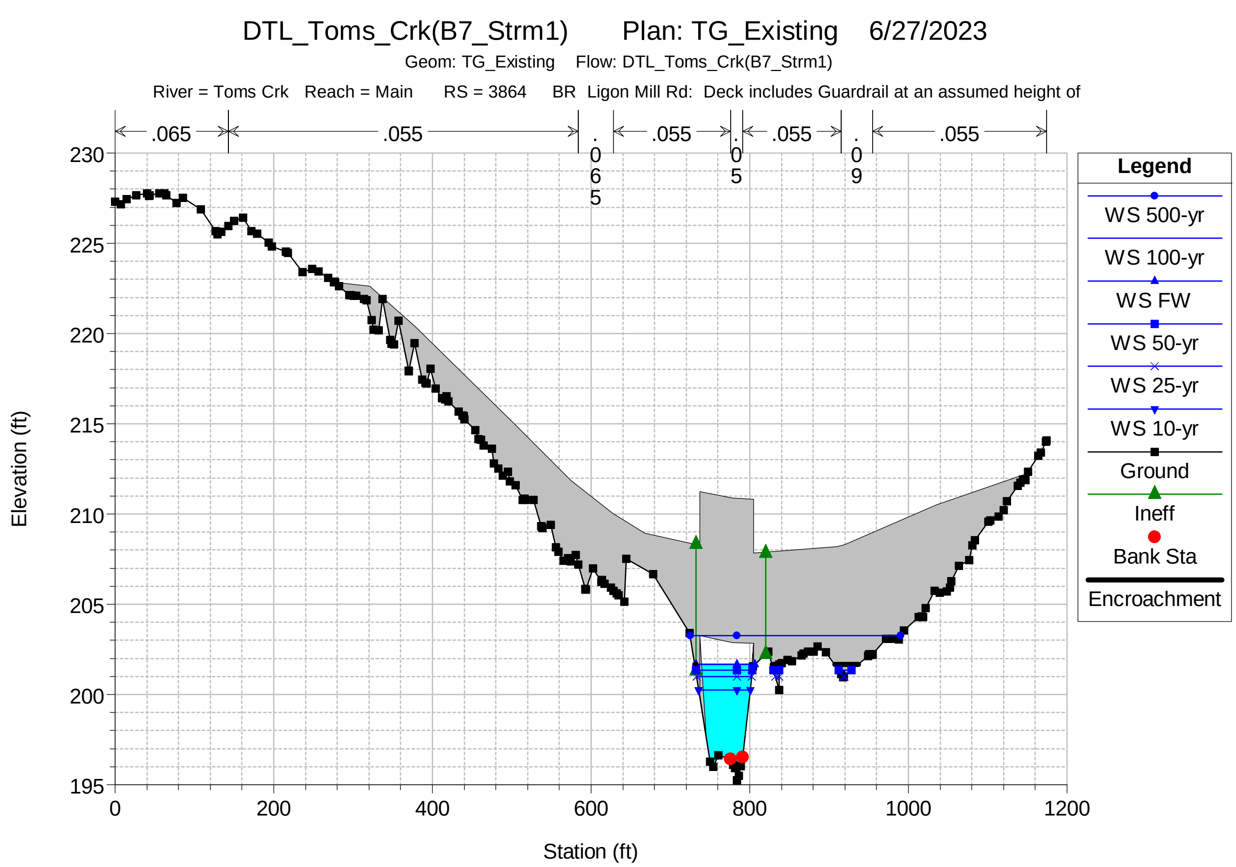


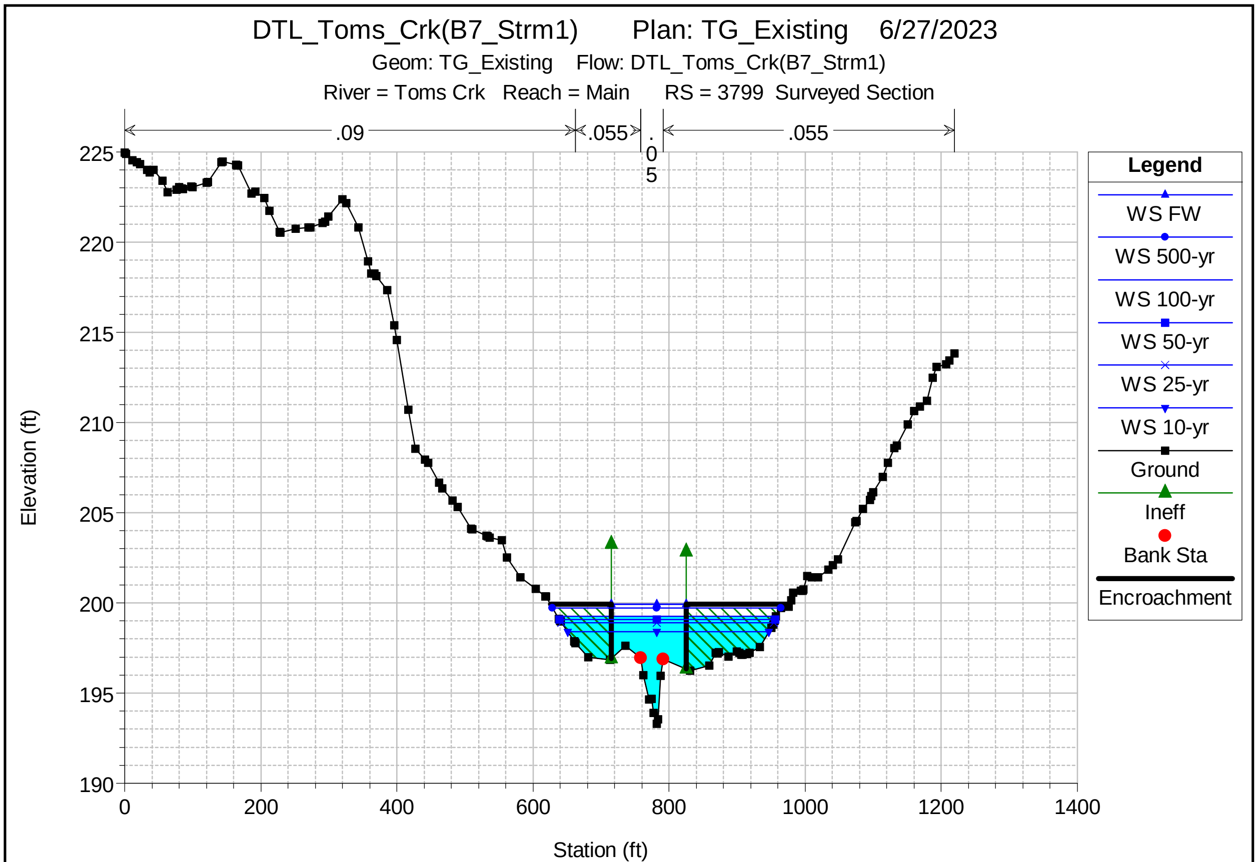
DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4516
.06
.09
.05
.09
.06
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

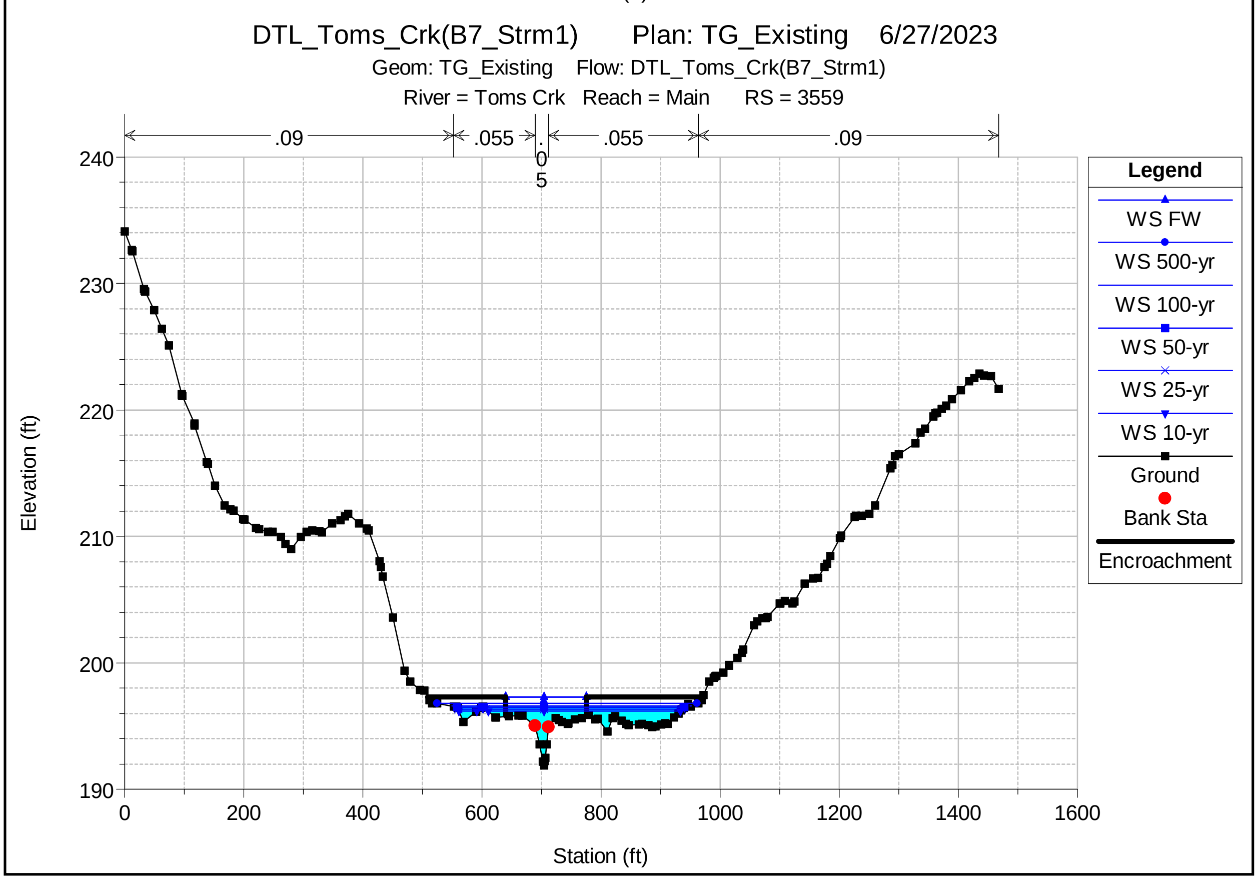



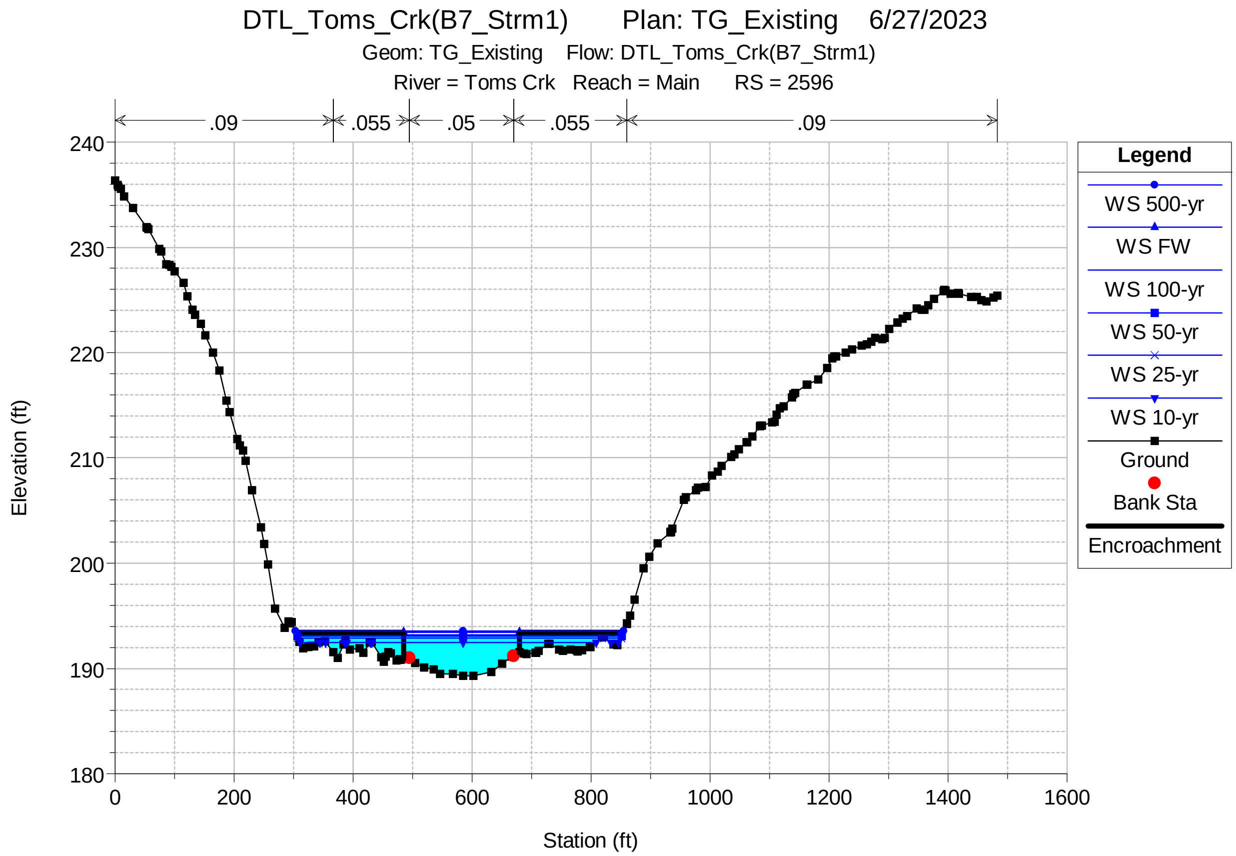
DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4030
.09
.04
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS FW
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

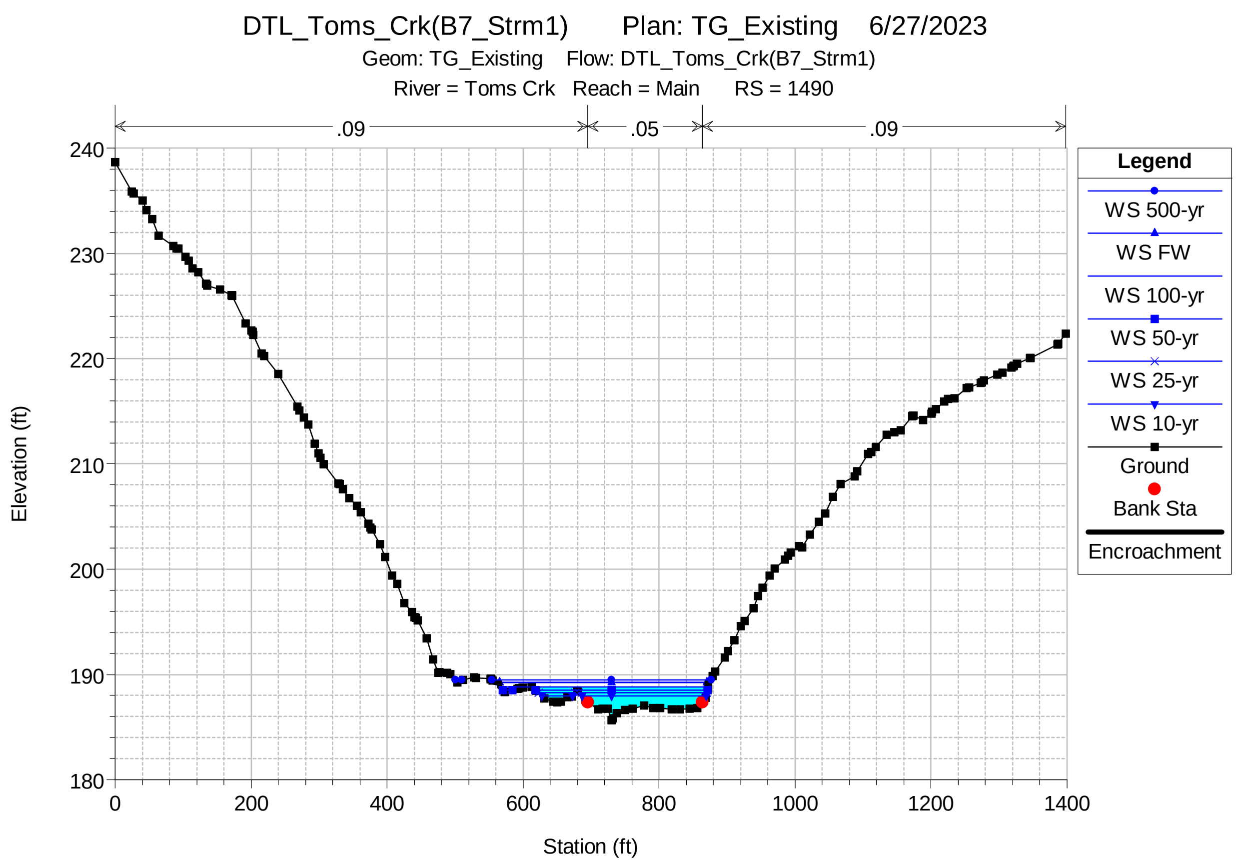

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3923 Surveyed Section
.06
.09
.04
.05
.055
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

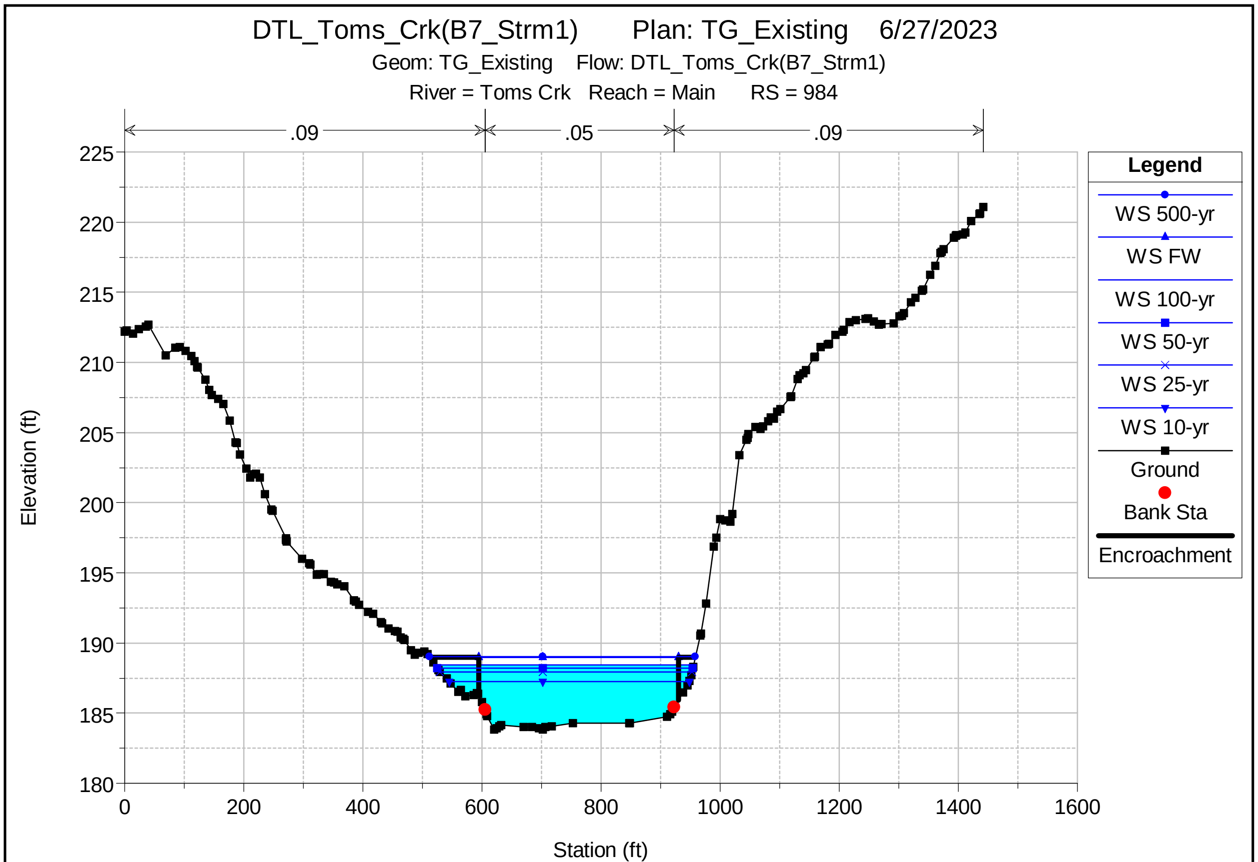

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3864 BR Ligon Mill Rd: Deck includes Guardrail at an assumed height of
.065
.055
.065
.055
.05
.055
.09
.055
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS FW
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3799 Surveyed Section
.09
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

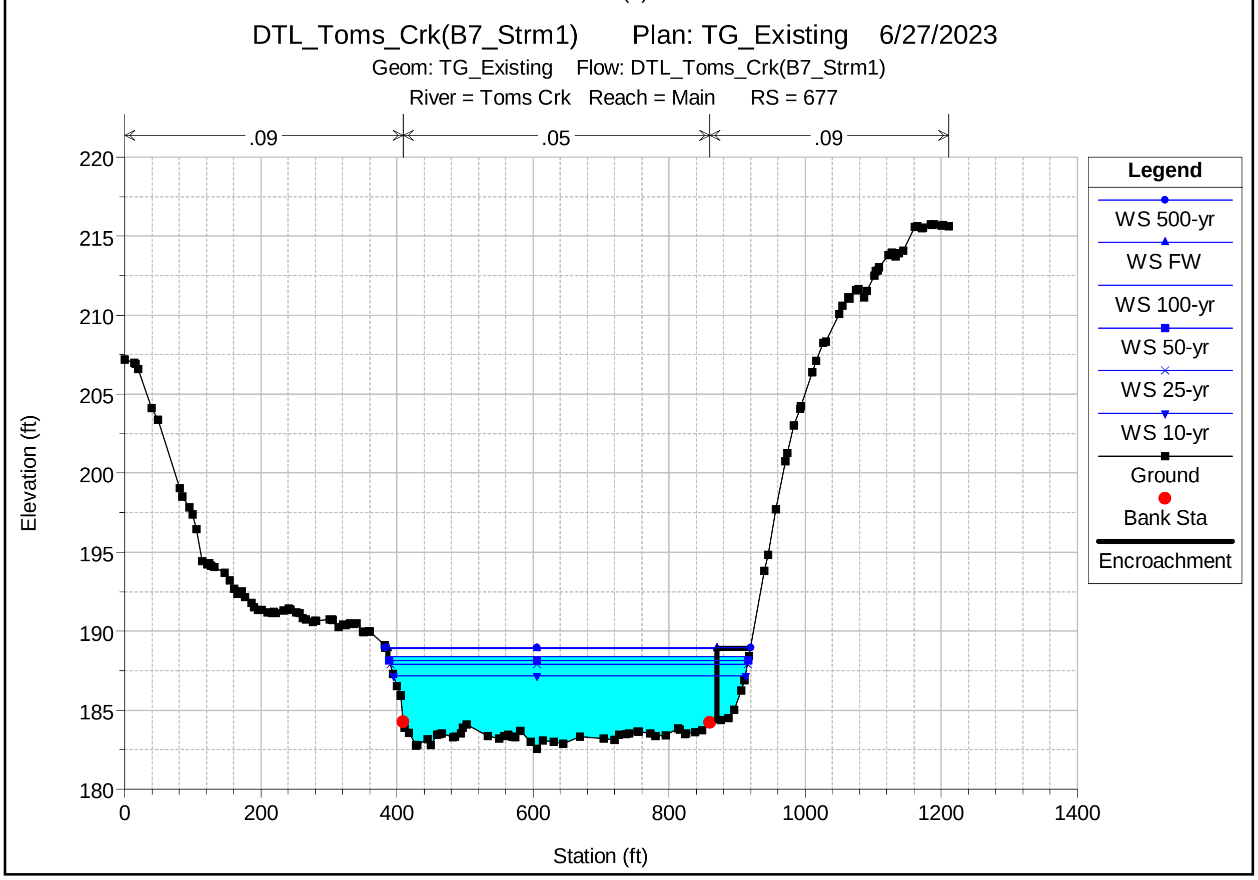

DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3559
.09
.055
.05
.055
.09
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 2596
.09
.055
.05
.055
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 1490
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

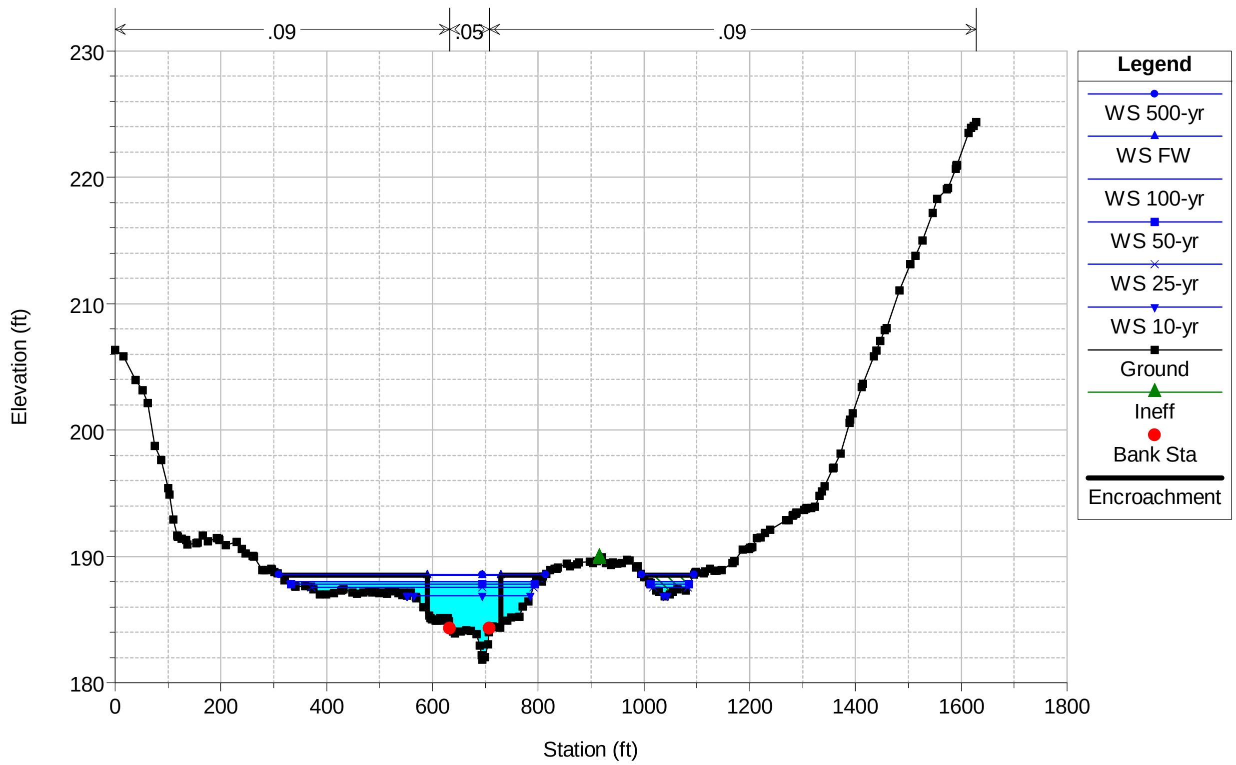


DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 984
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

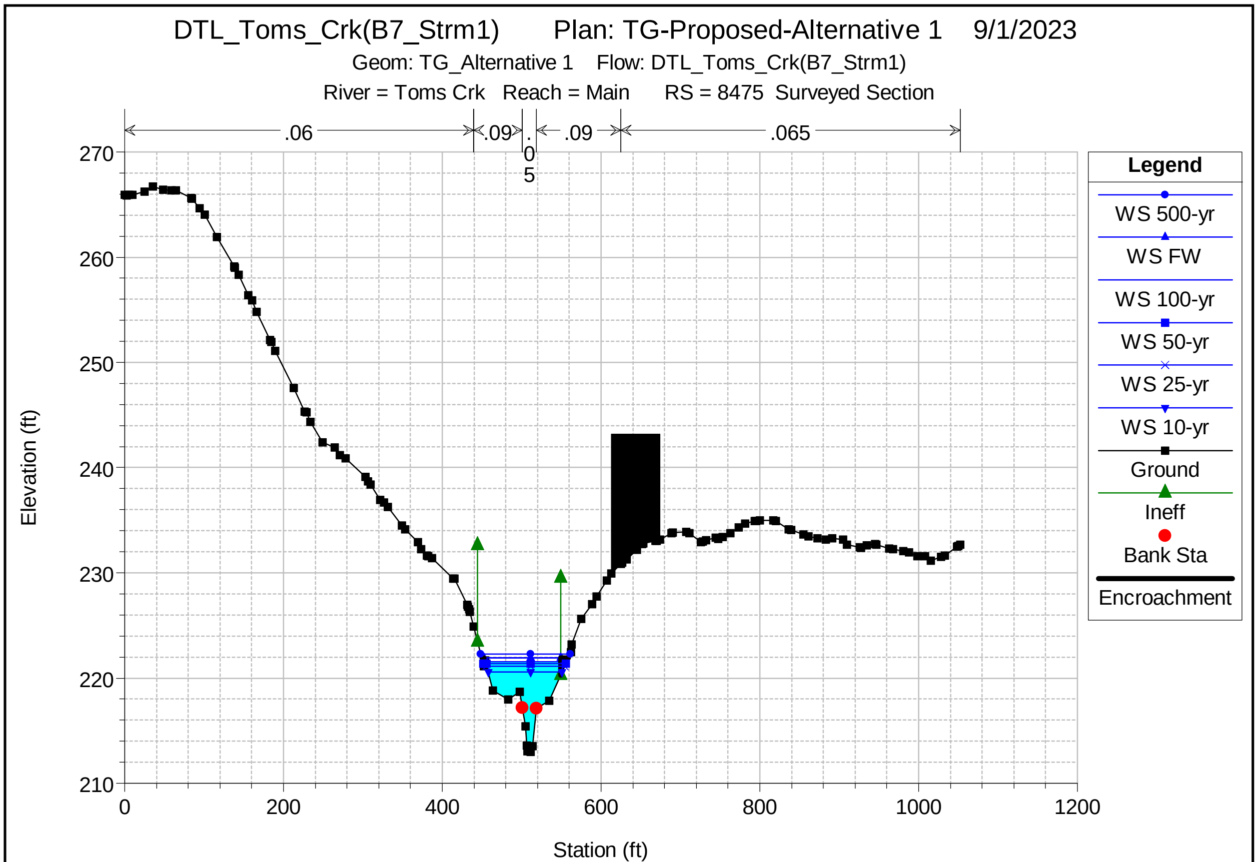



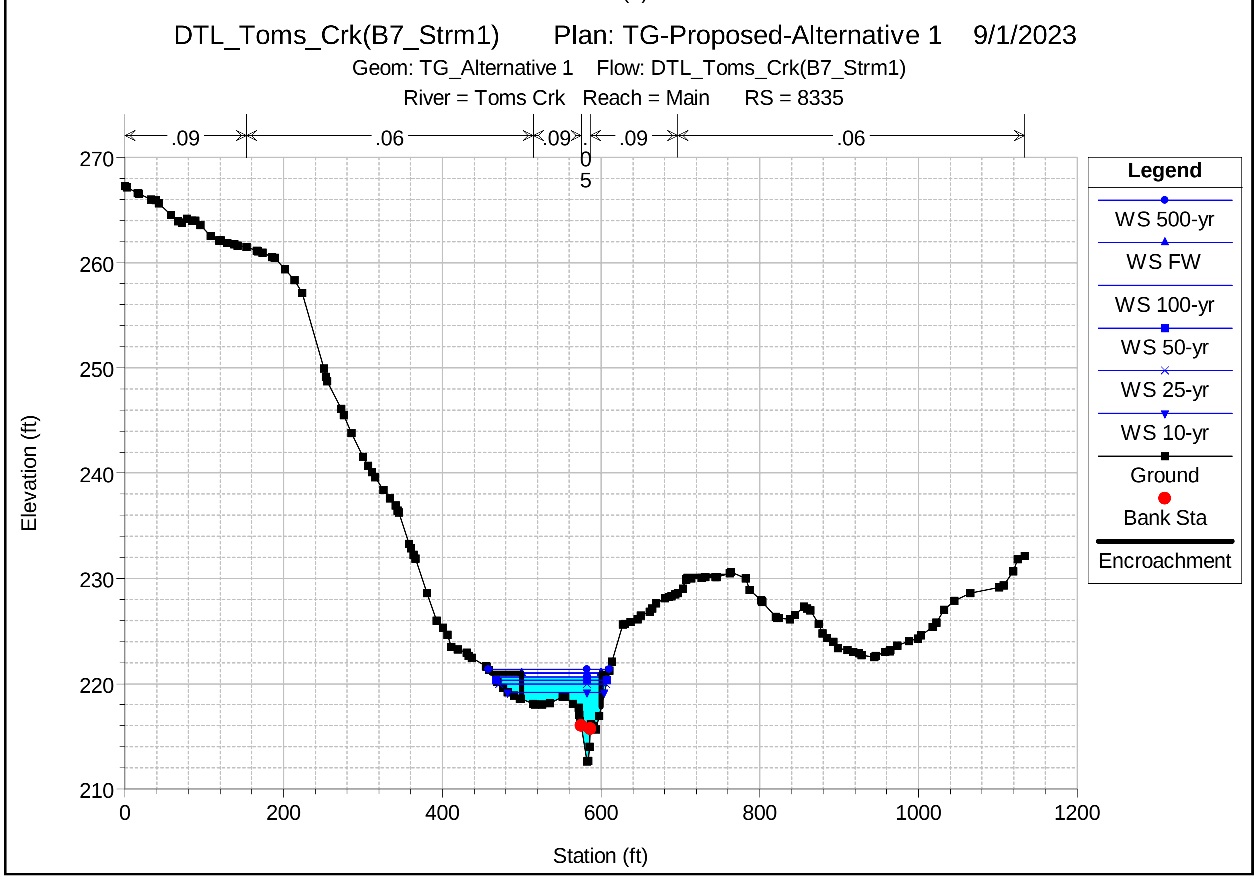
DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 677
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

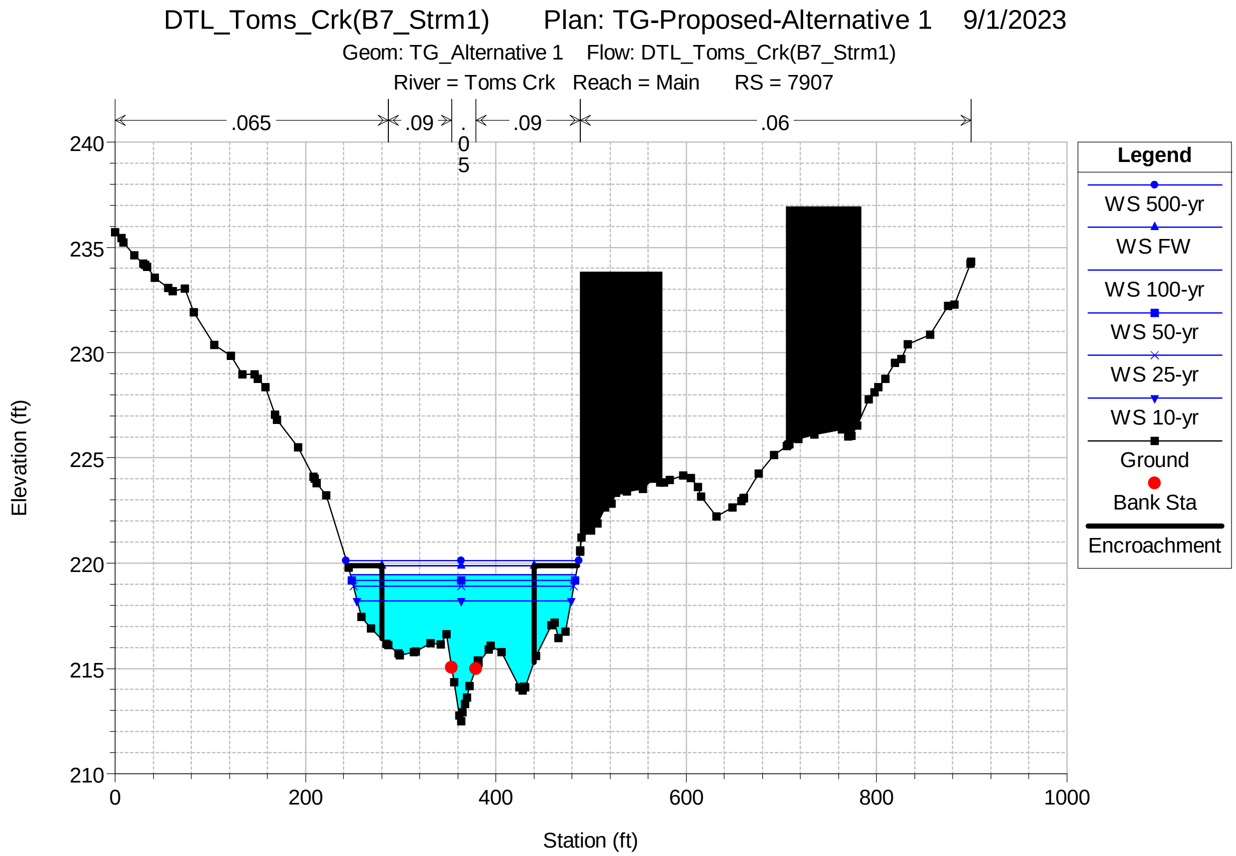
DTL_Toms_Crk(B7_Strm1) Plan: TG_Existing 6/27/2023
Geom: TG_Existing Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 355

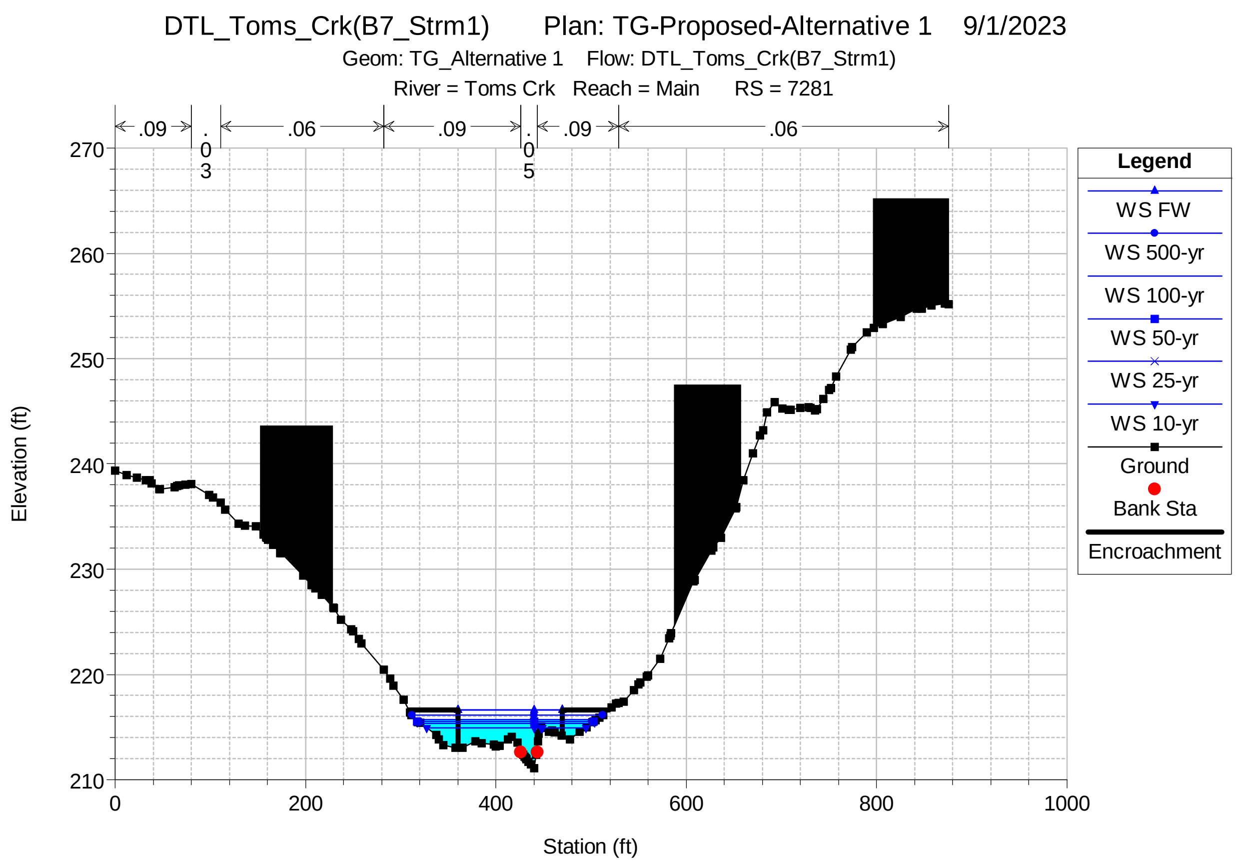


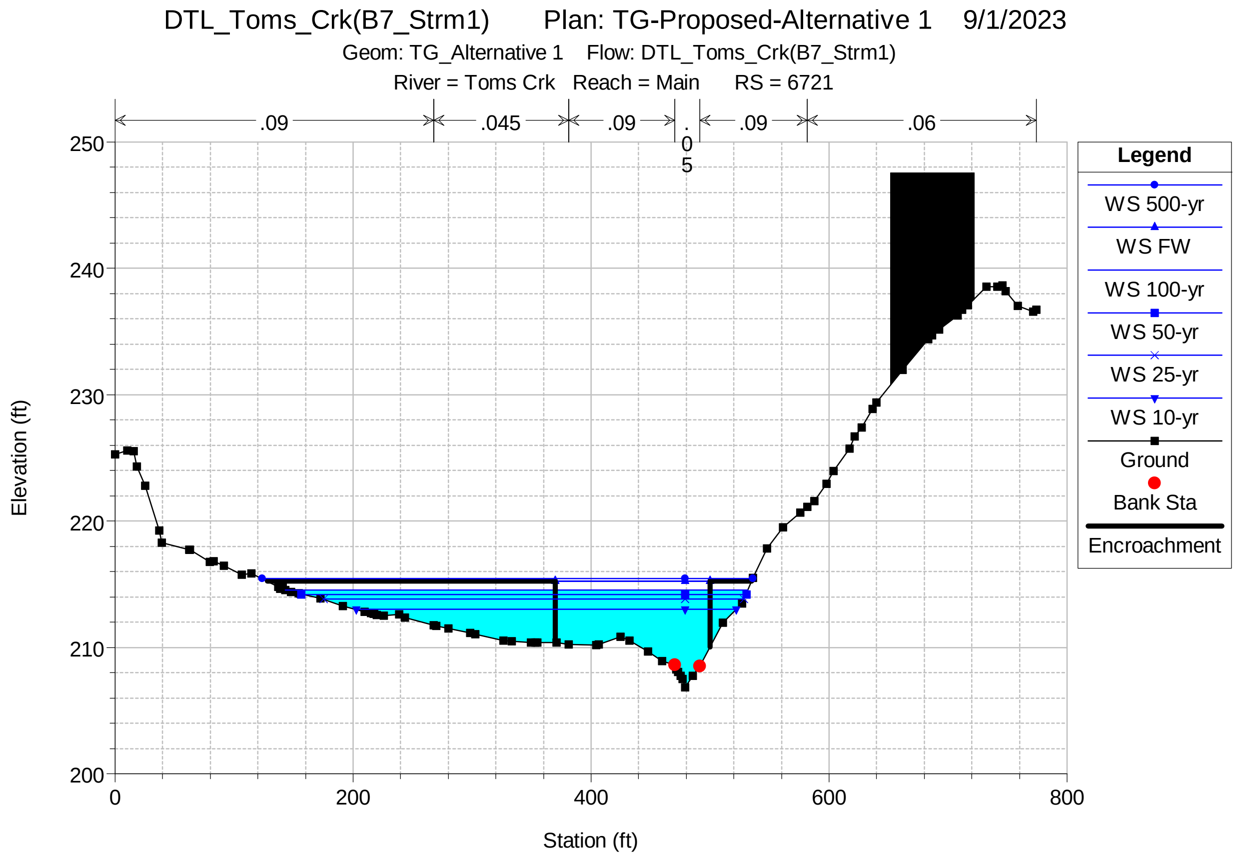
# Tom’s Creek
# Proposed Cross Sections-Alternative 1

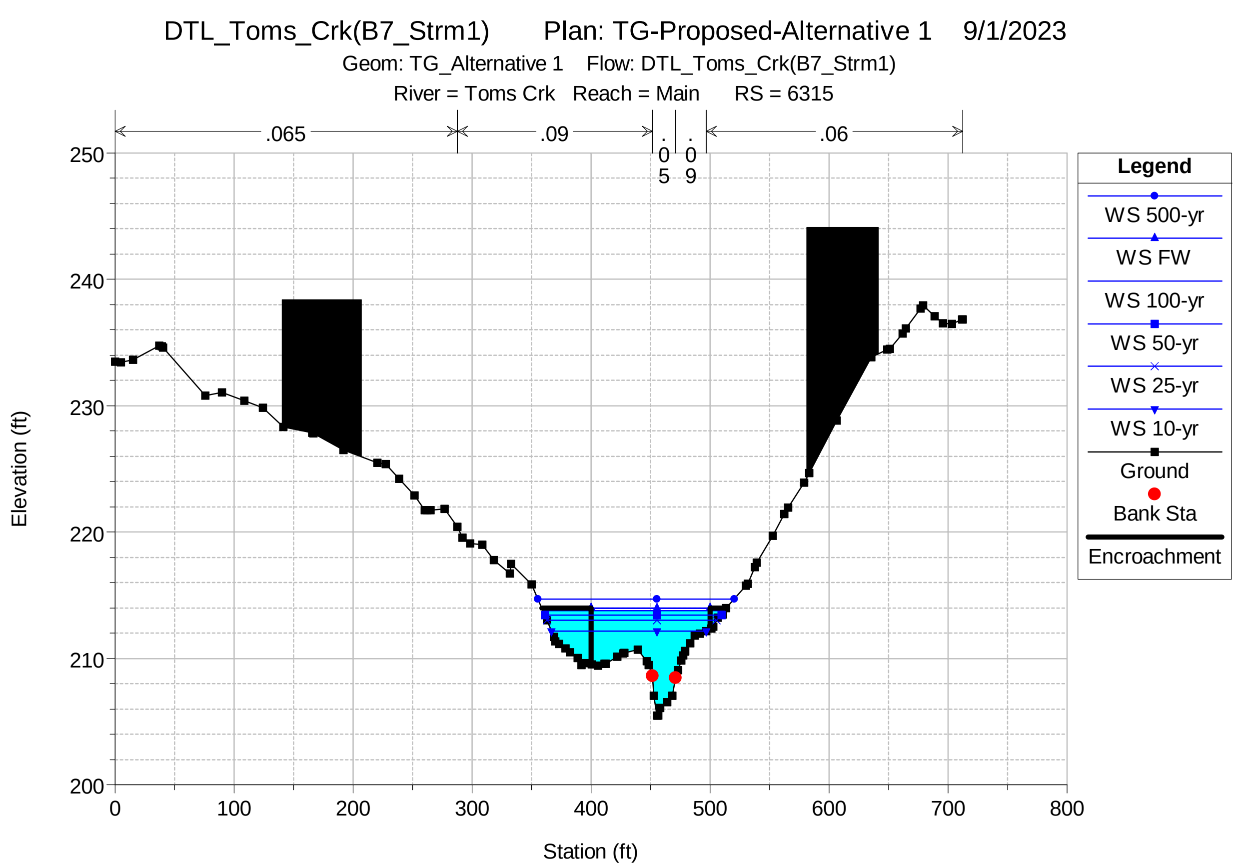

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 8475 Surveyed Section
.06
.09
.05
.09
.065
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

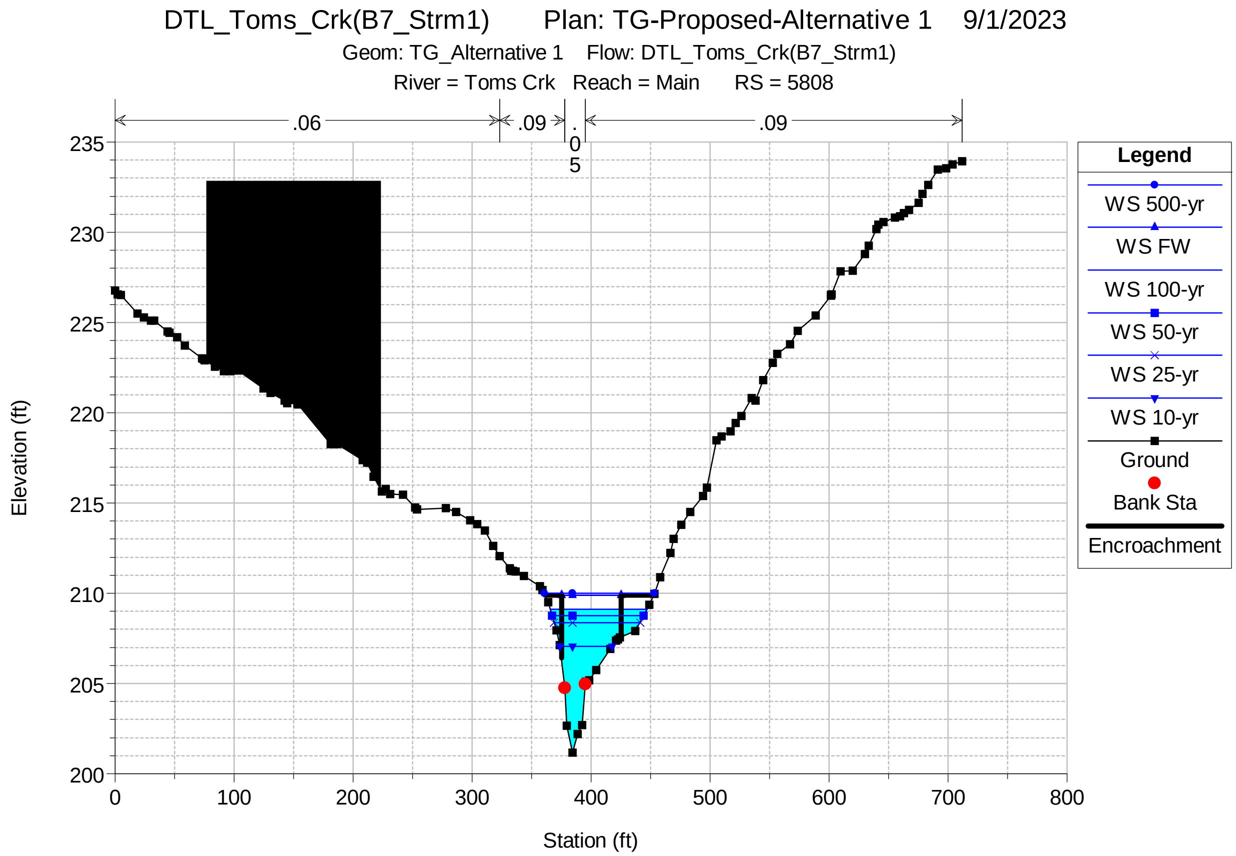

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 8335
.09
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

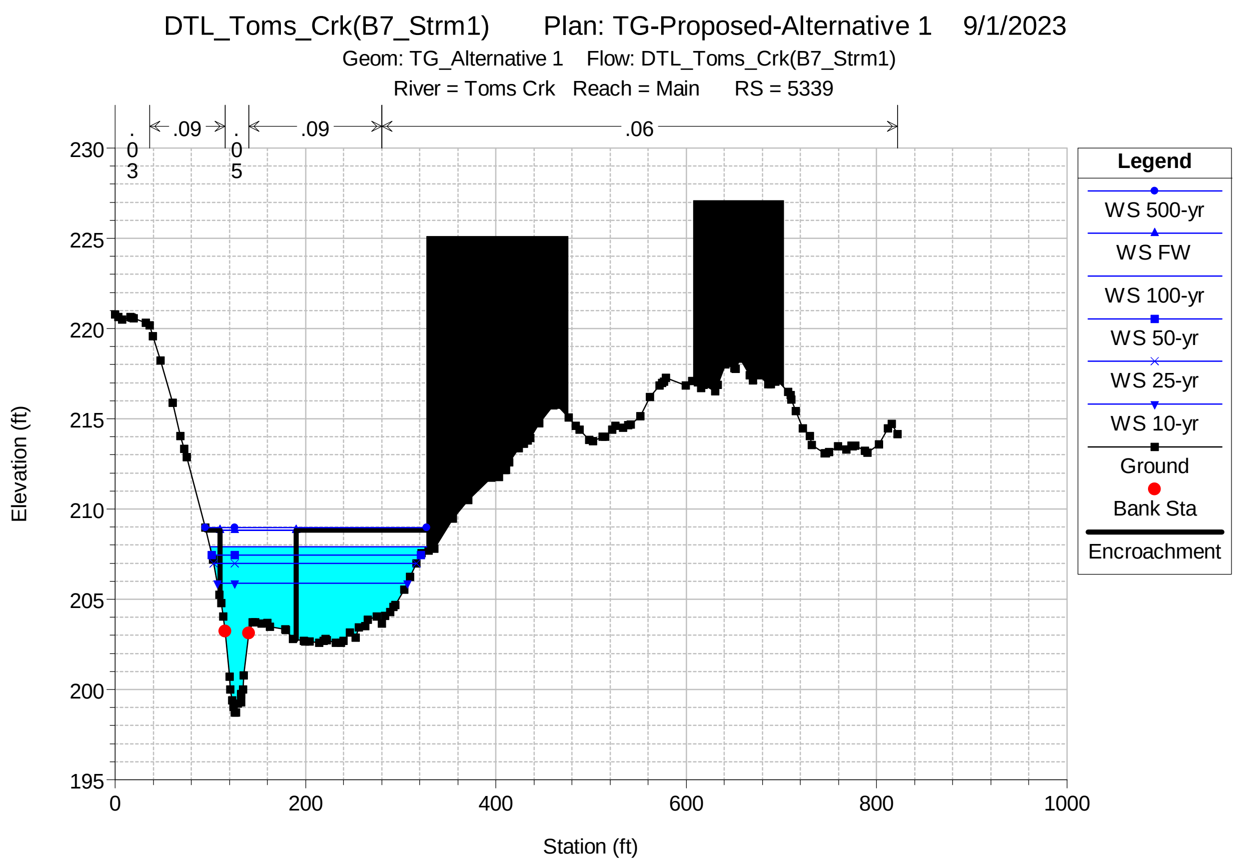

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 7907
.065
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

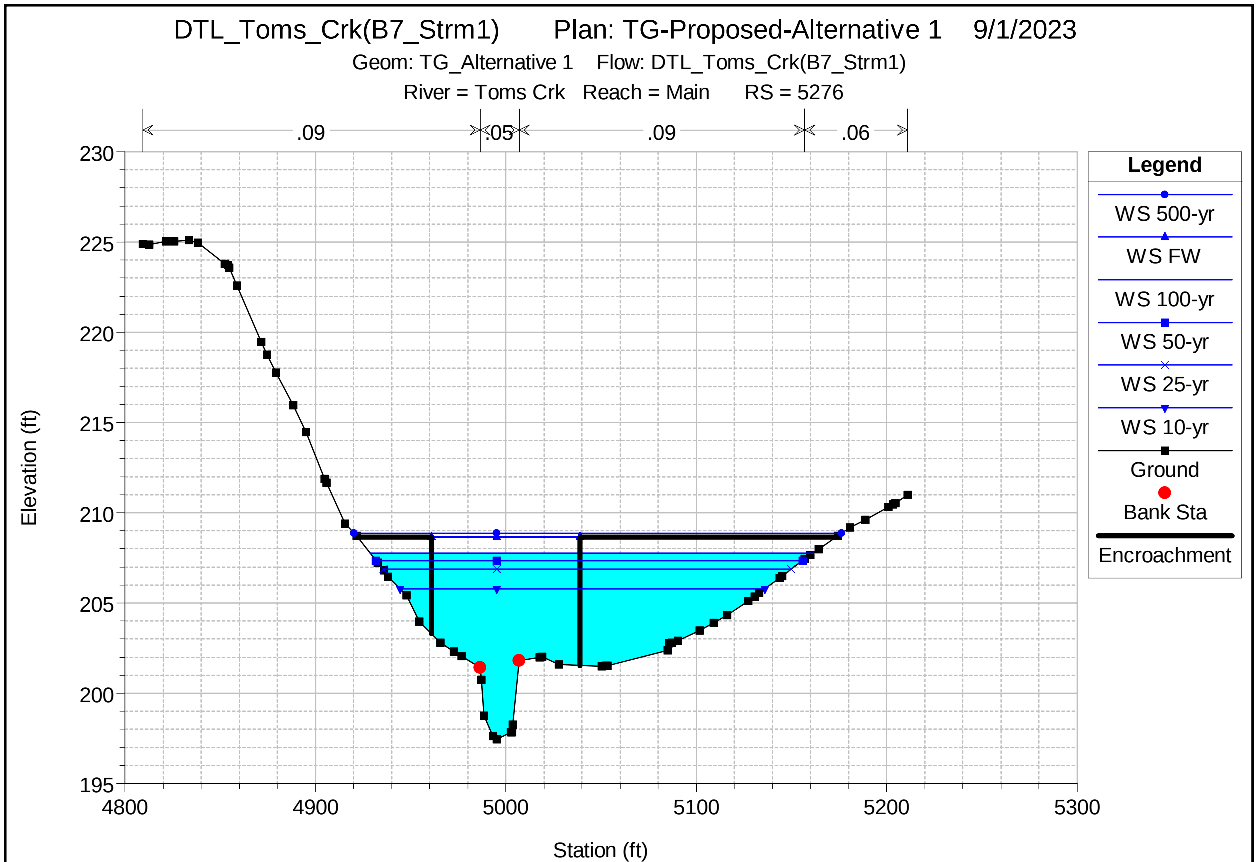

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 7281
.09
.03
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 6721
.09
.045
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

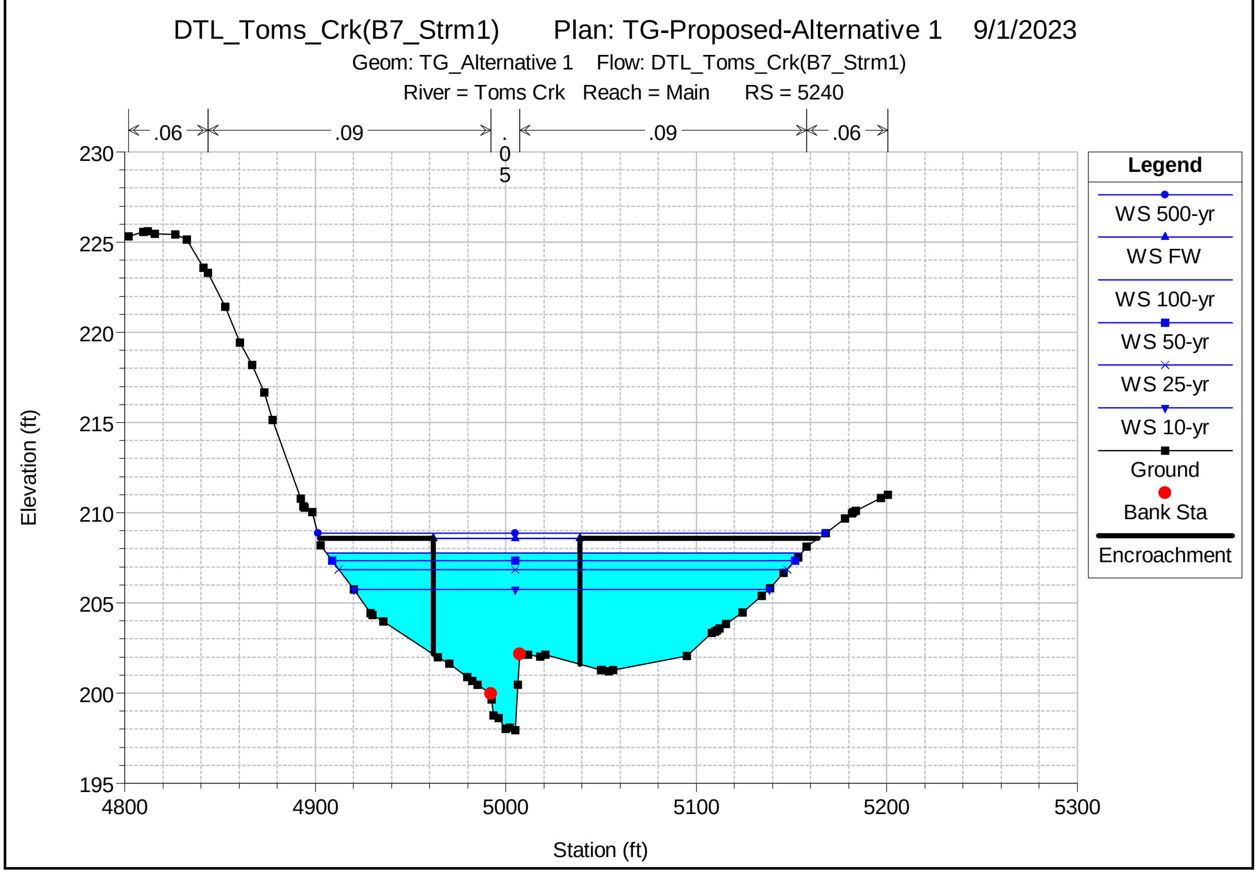

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 6315
.065
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5808
.06
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

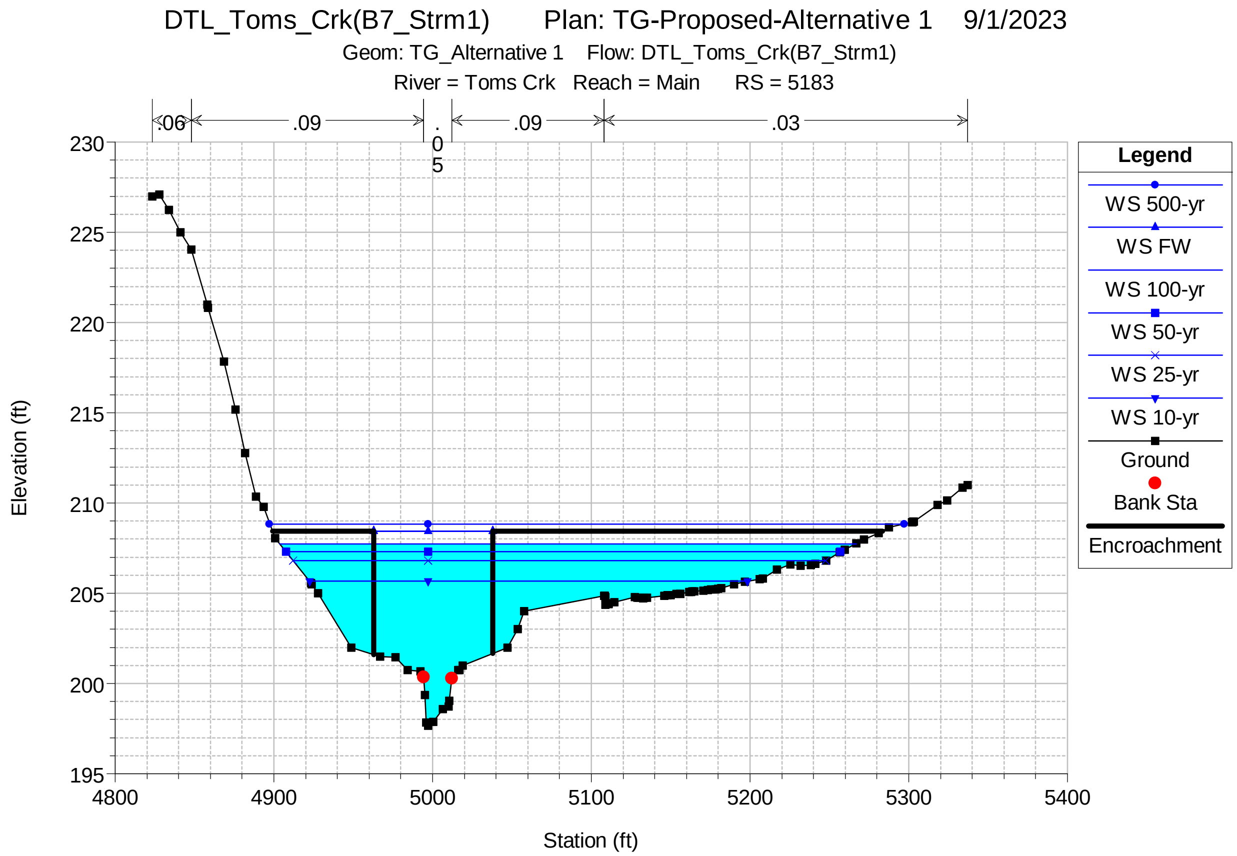

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5339
.03
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

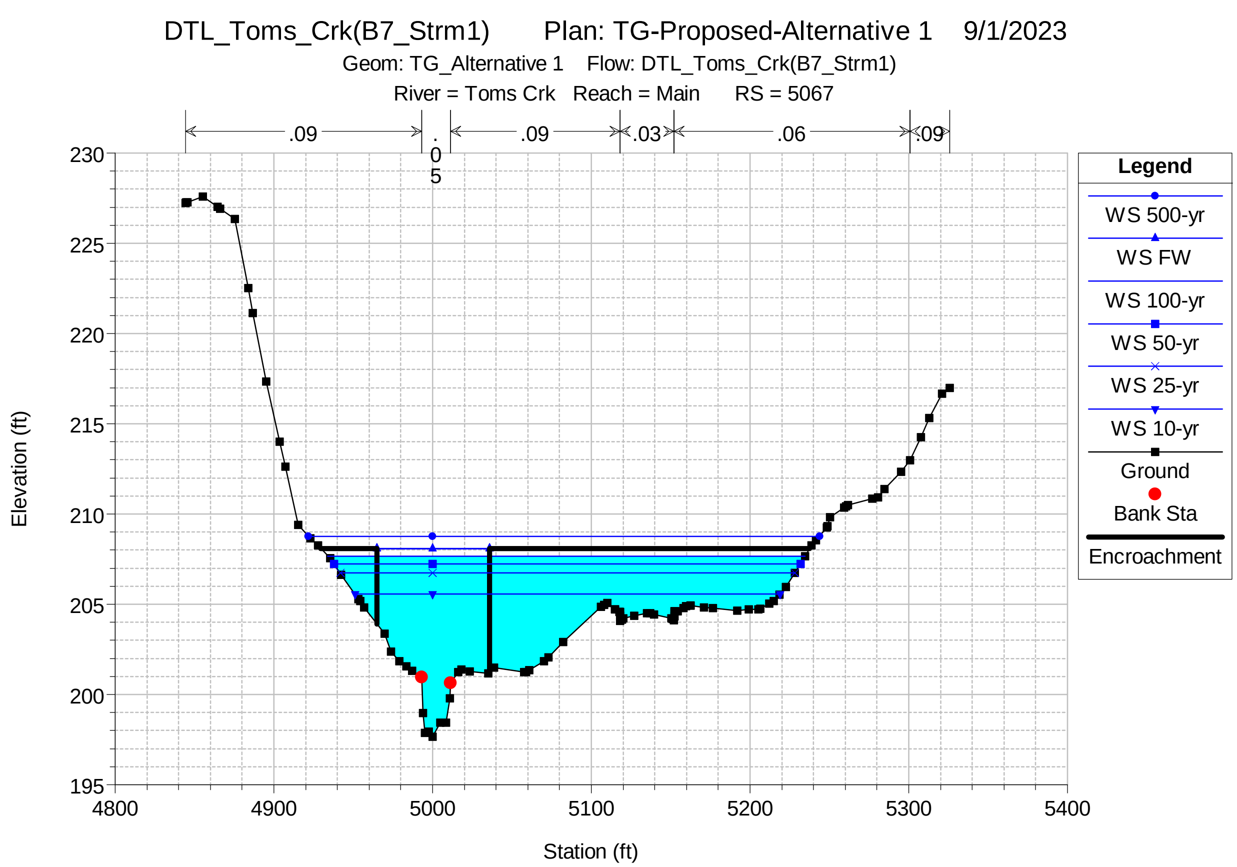


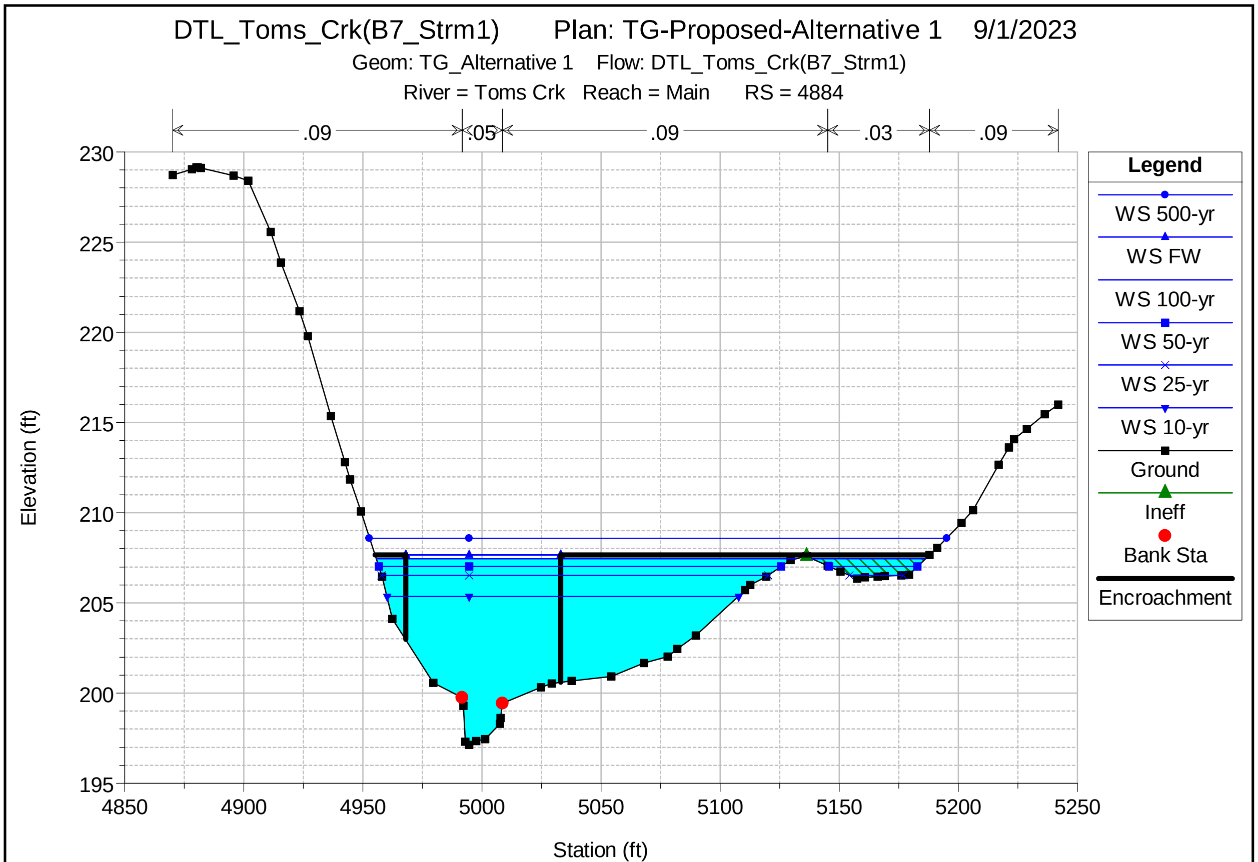
DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5276
.09
.05
.09
.06
Elevation (ft)
Station (ft)
230
225
220
215
210
205
200
195
4800
4900
5000
5100
5200
5300
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

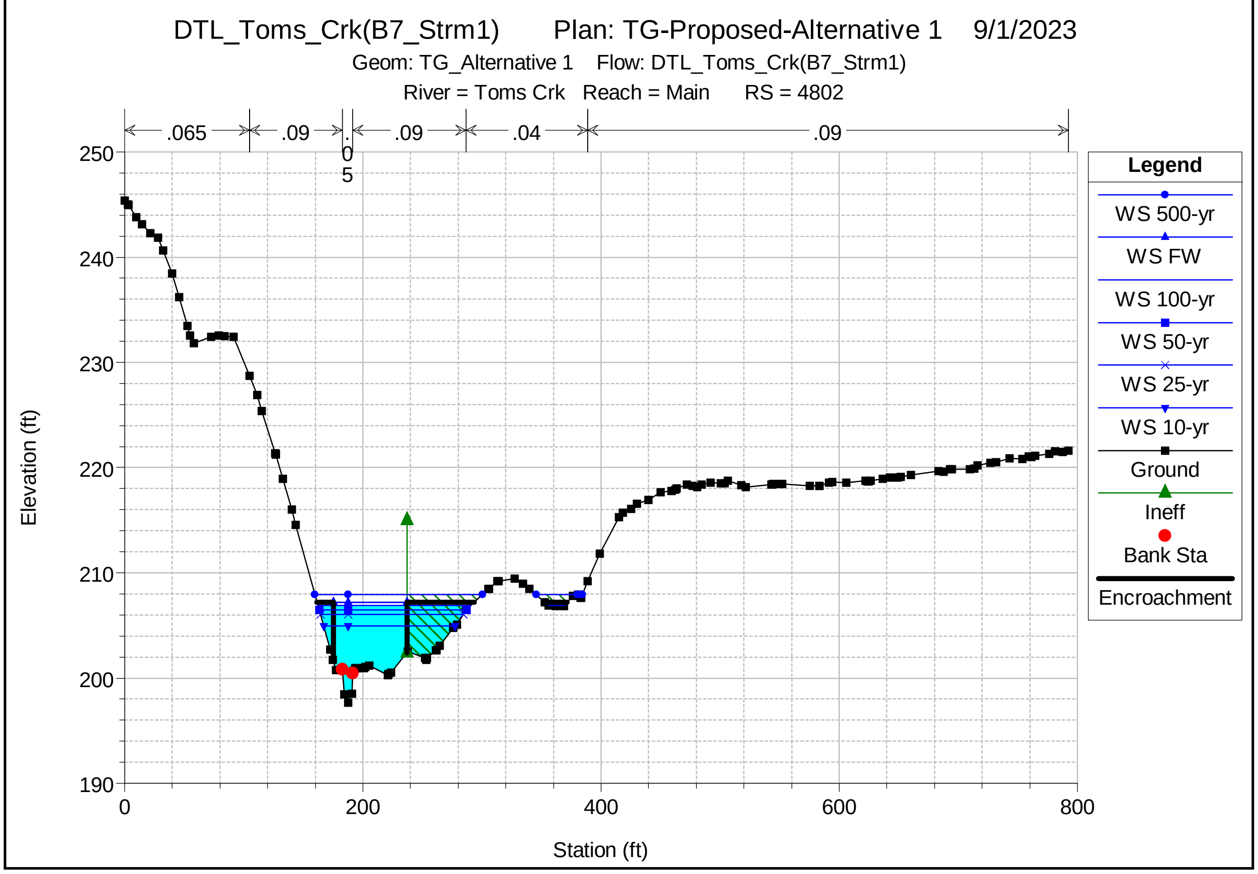
DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5240
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
230
225
220
215
210
205
200
195
4800
4900
5000
5100
5200
5300
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5183
.06
.09
.05
.09
.03
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

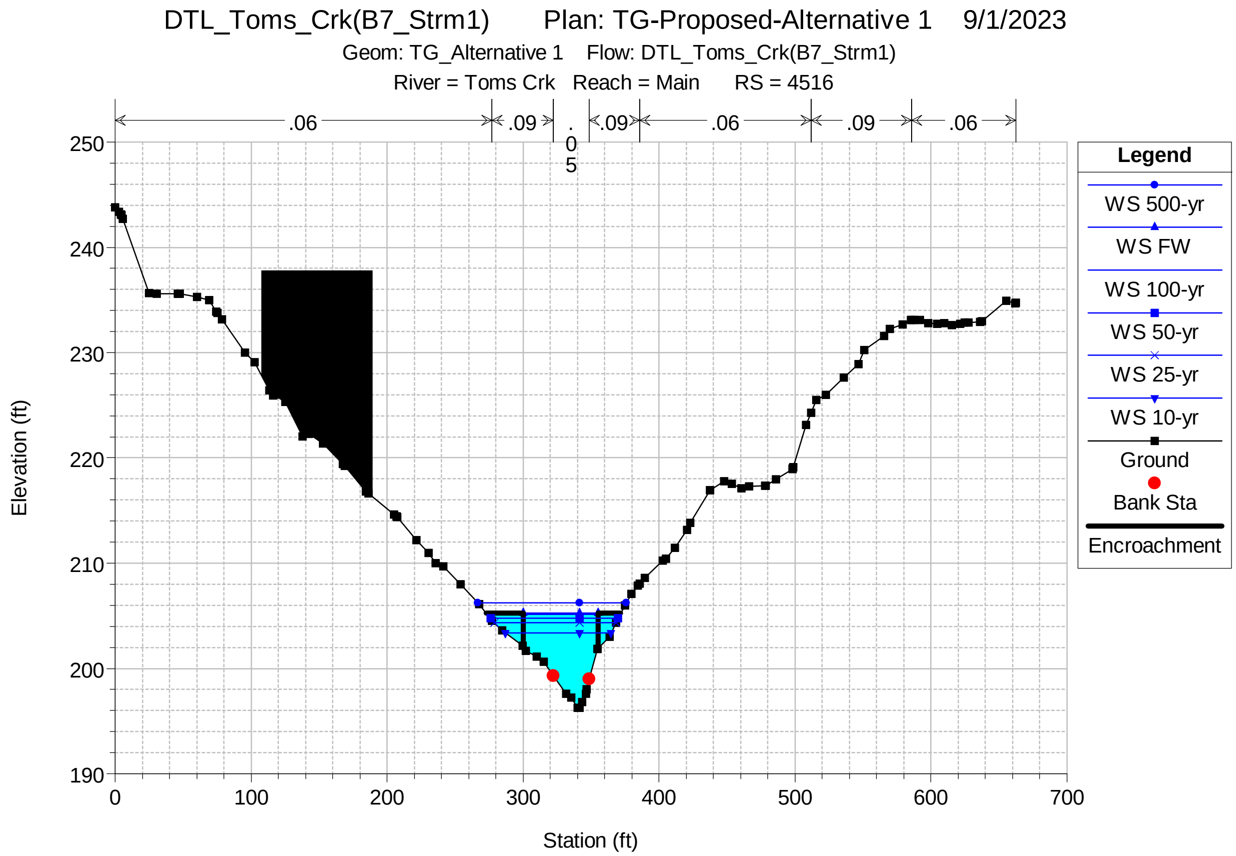

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5067
.09
.05
.09
.03
.06
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

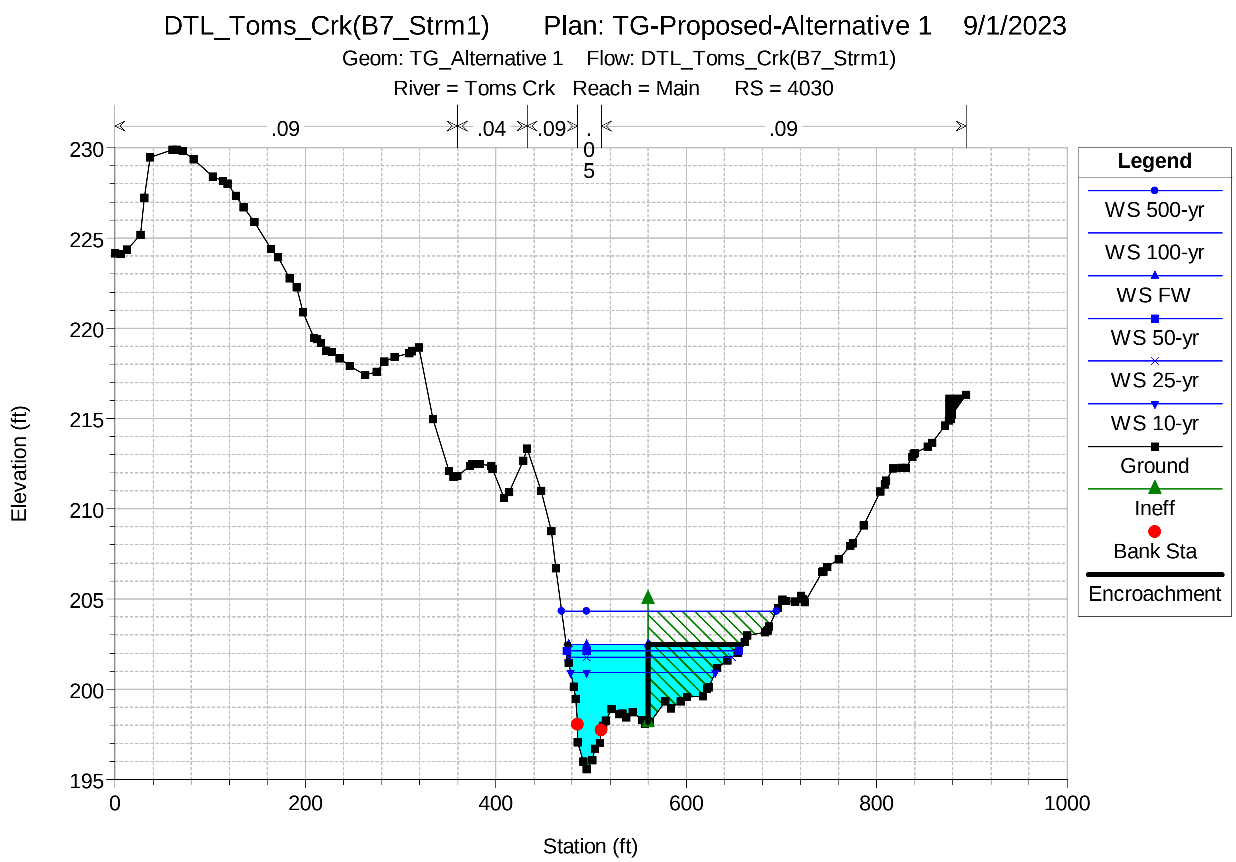


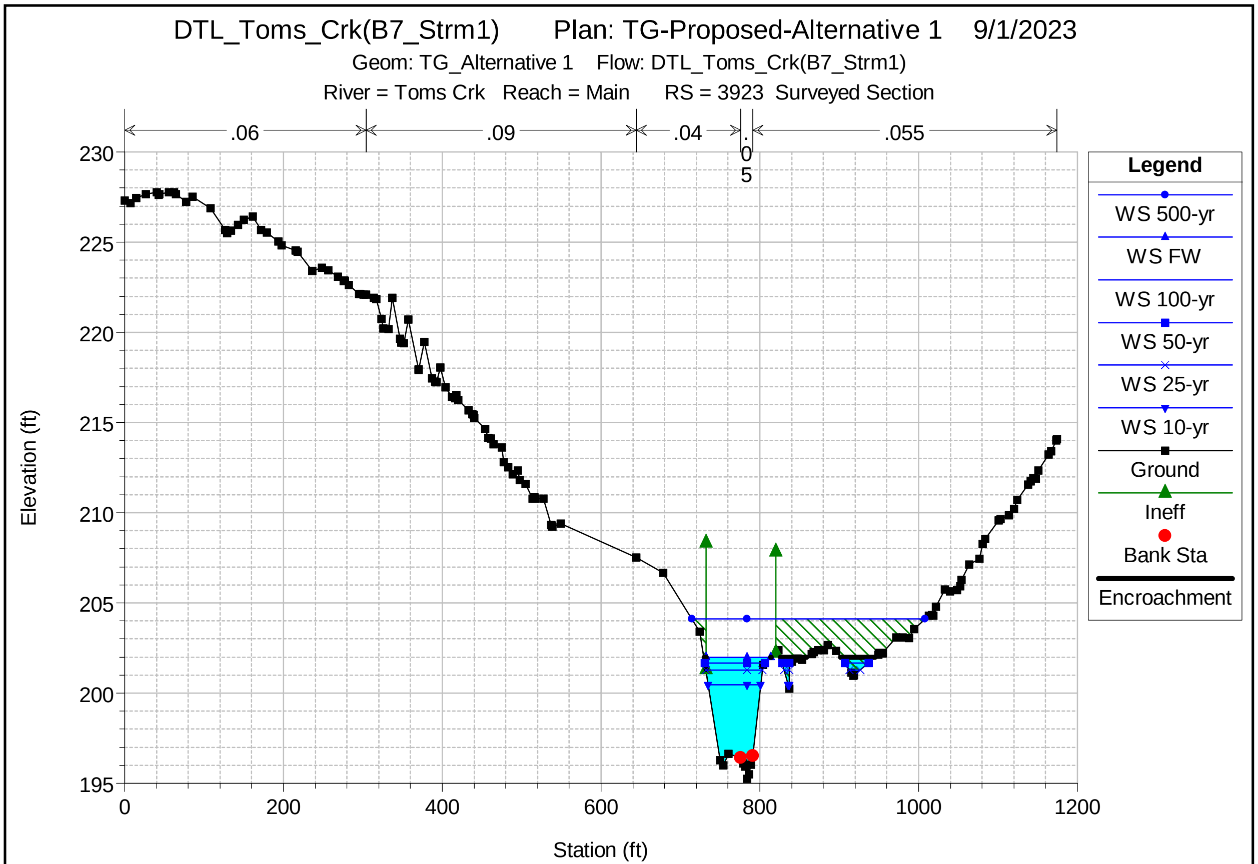
DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4884
.09
.05
.09
.03
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

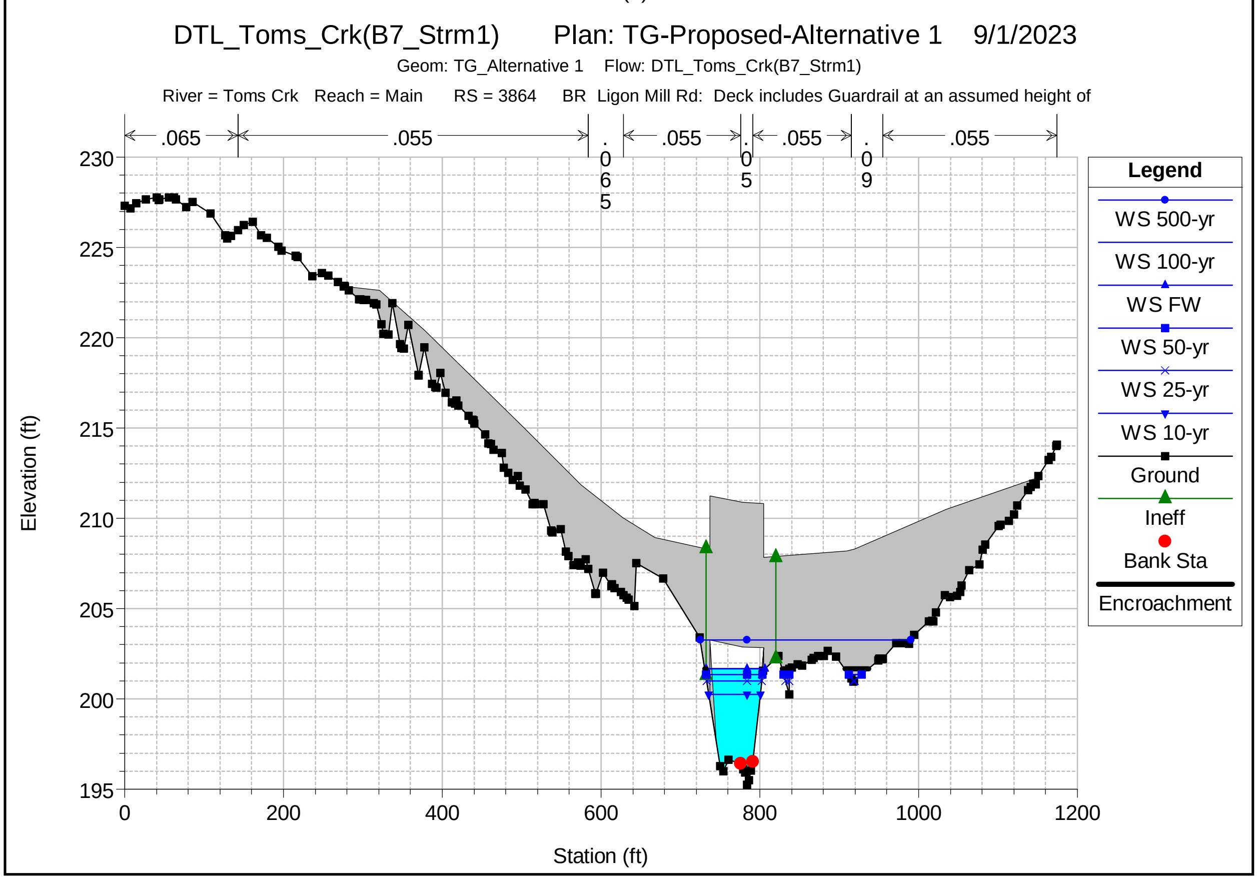



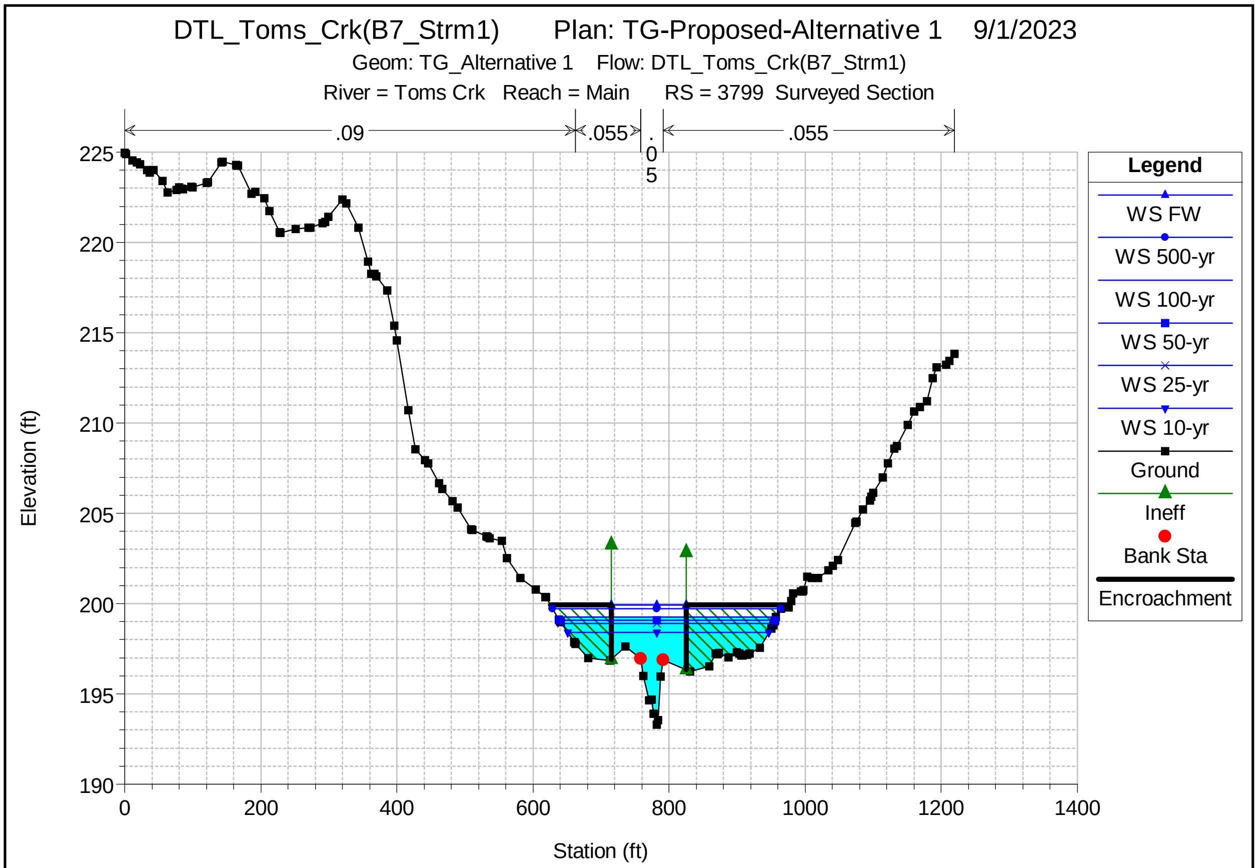
DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4802
.065
.09
.05
.09
.04
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

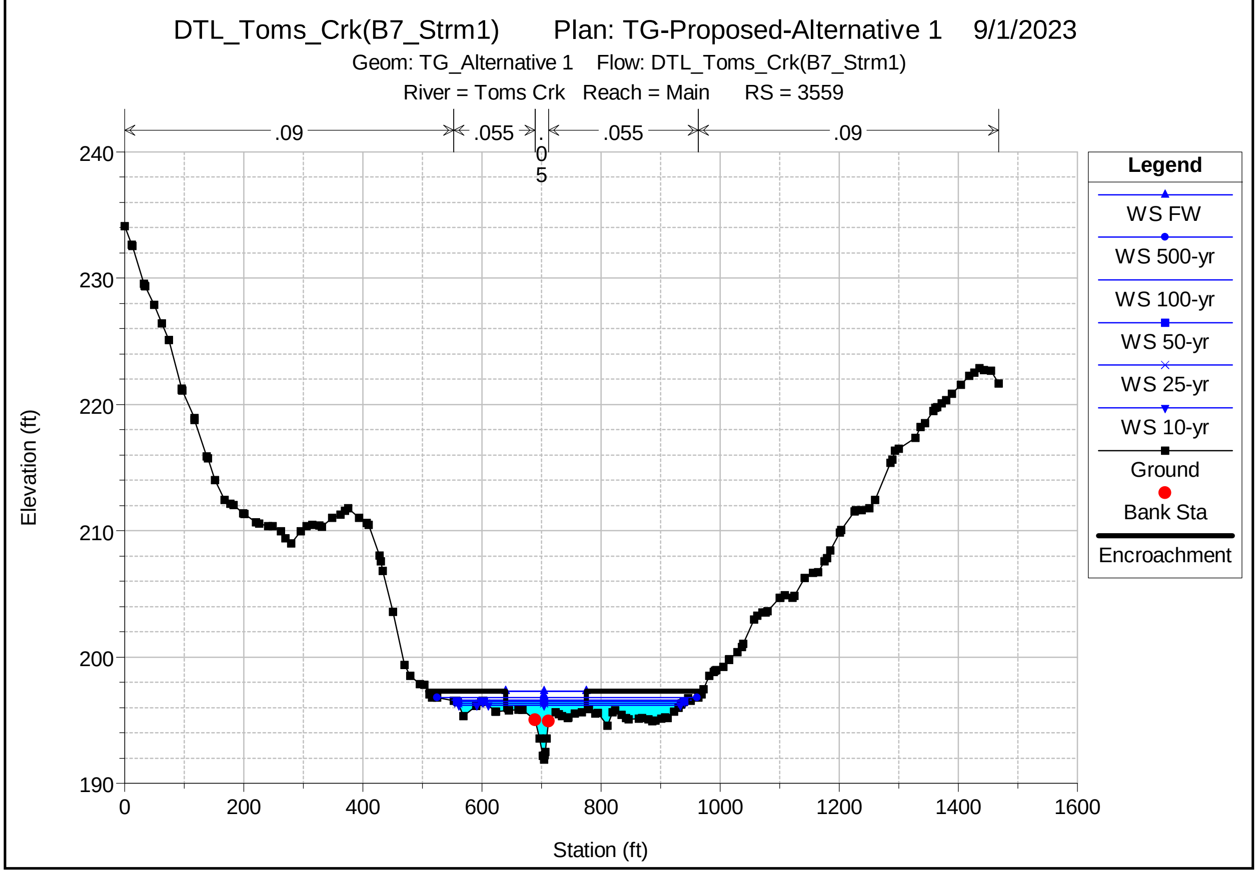

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4516
.06
.09
.05
.09
.06
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

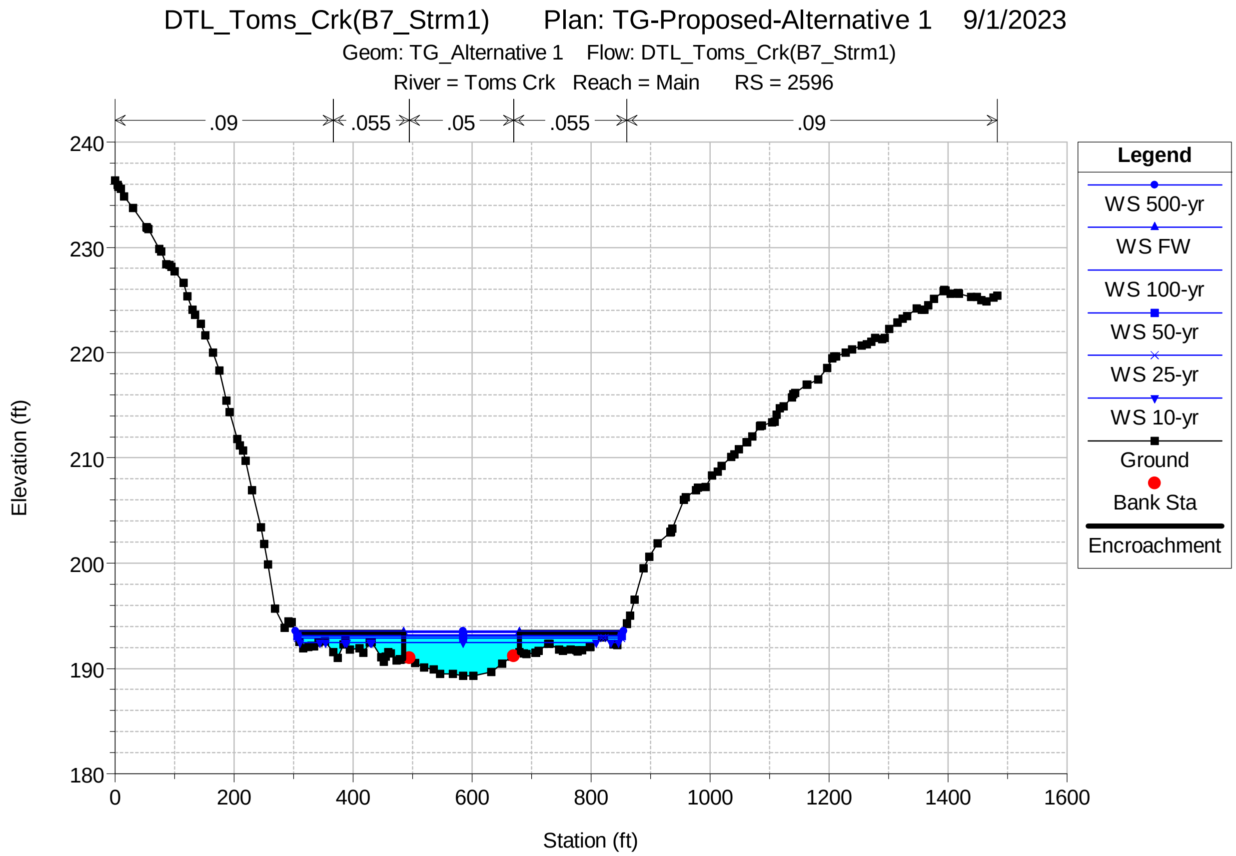

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4030
.09
.04
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS FW
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

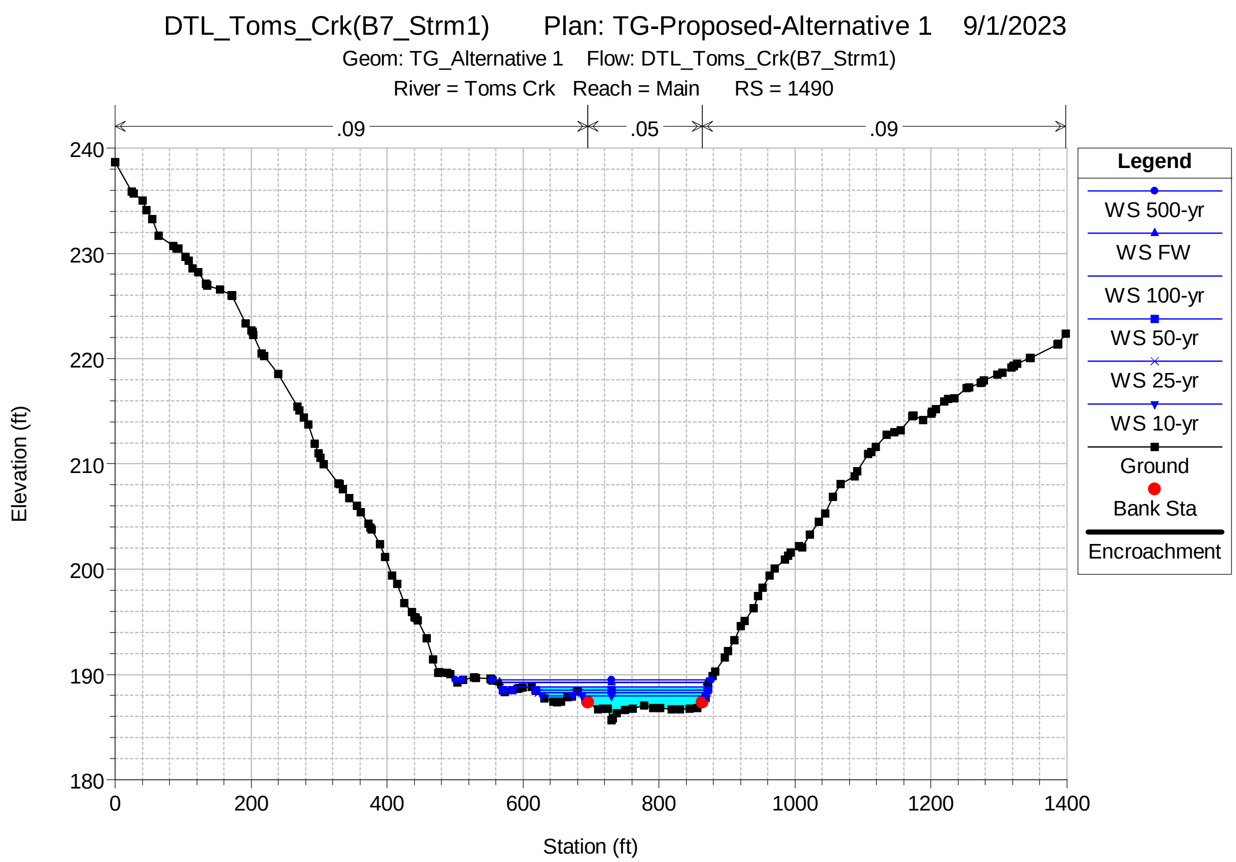

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3923 Surveyed Section
.06
.09
.04
.05
.055
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

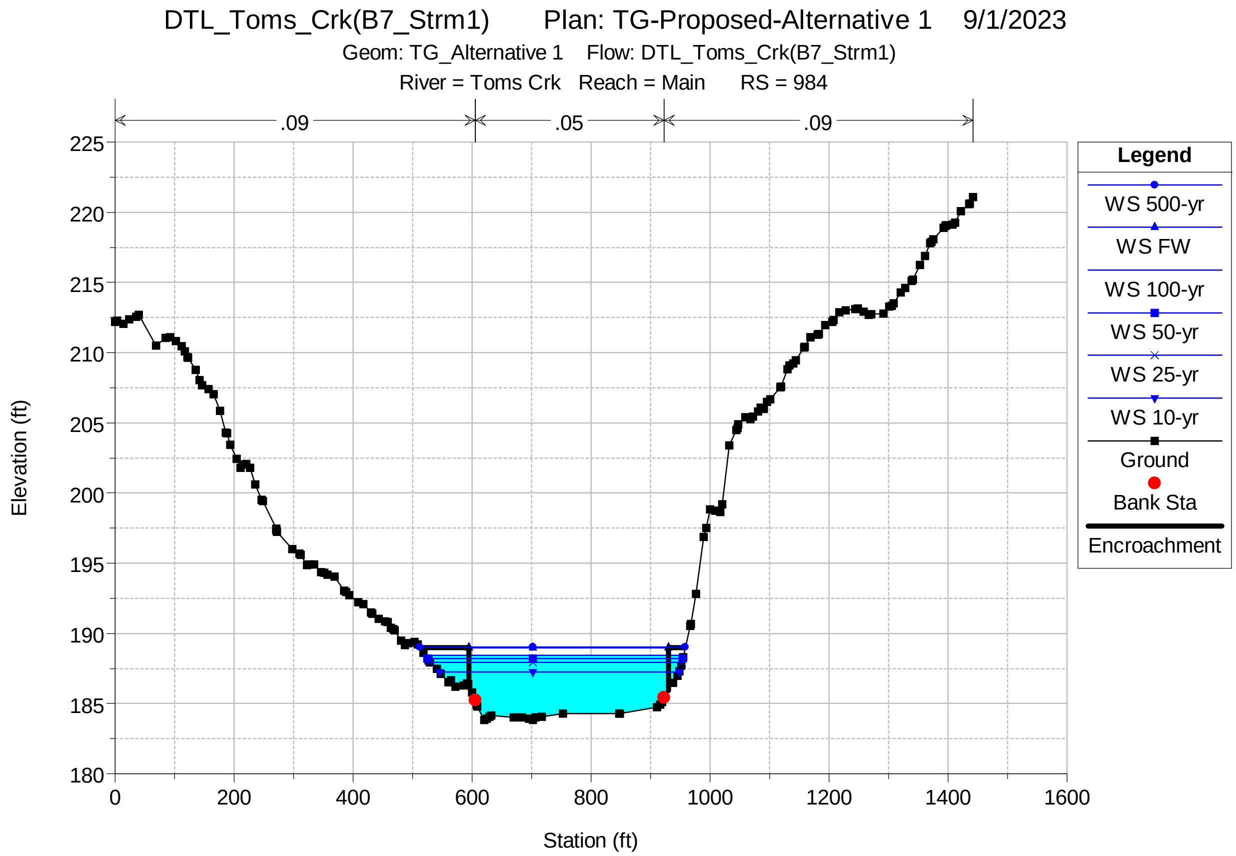

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3864 BR Ligon Mill Rd: Deck includes Guardrail at an assumed height of
.065
.055
.065
.055
.05
.055
.09
.055
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS FW
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3799 Surveyed Section
.09
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

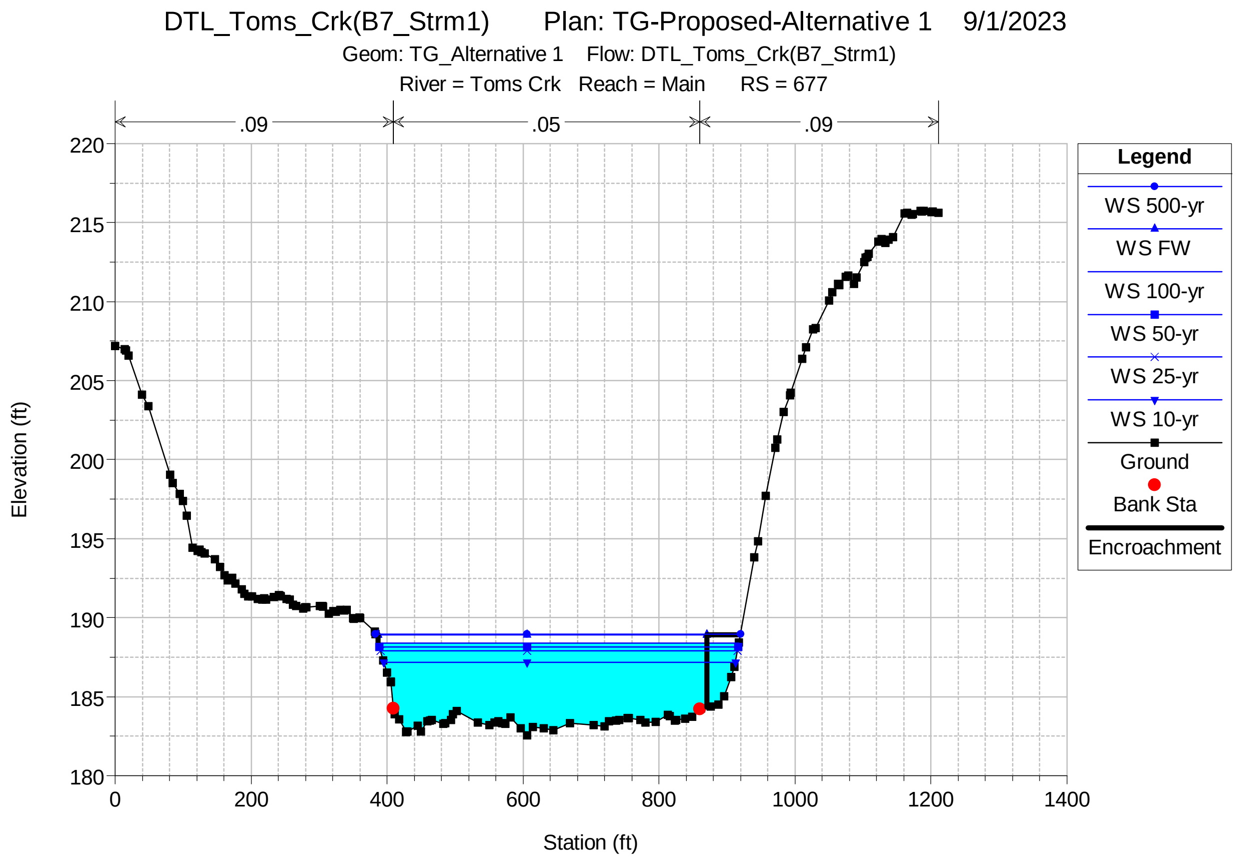

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3559
.09
.055
.05
.055
.09
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 2596
.09
.055
.05
.055
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

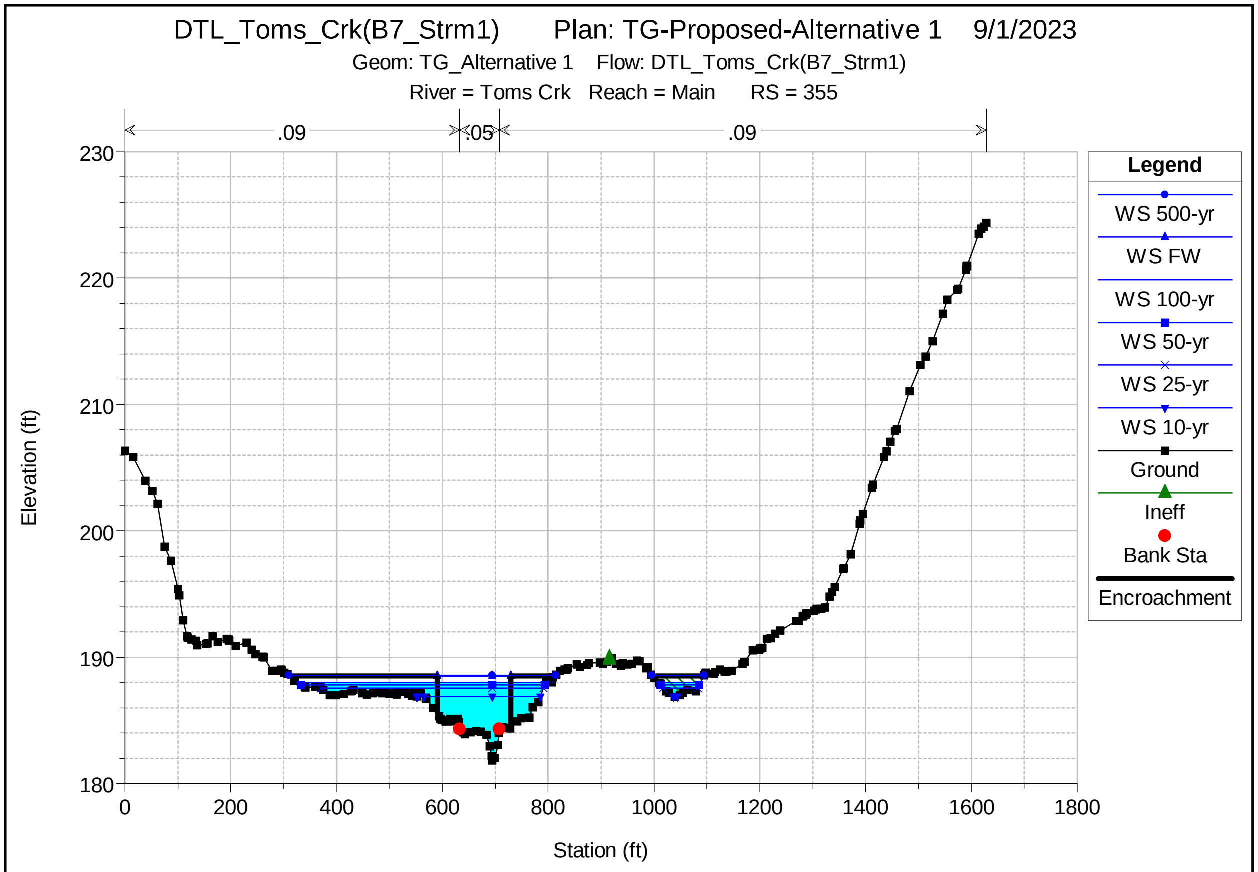

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 1490
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment



DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 984
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

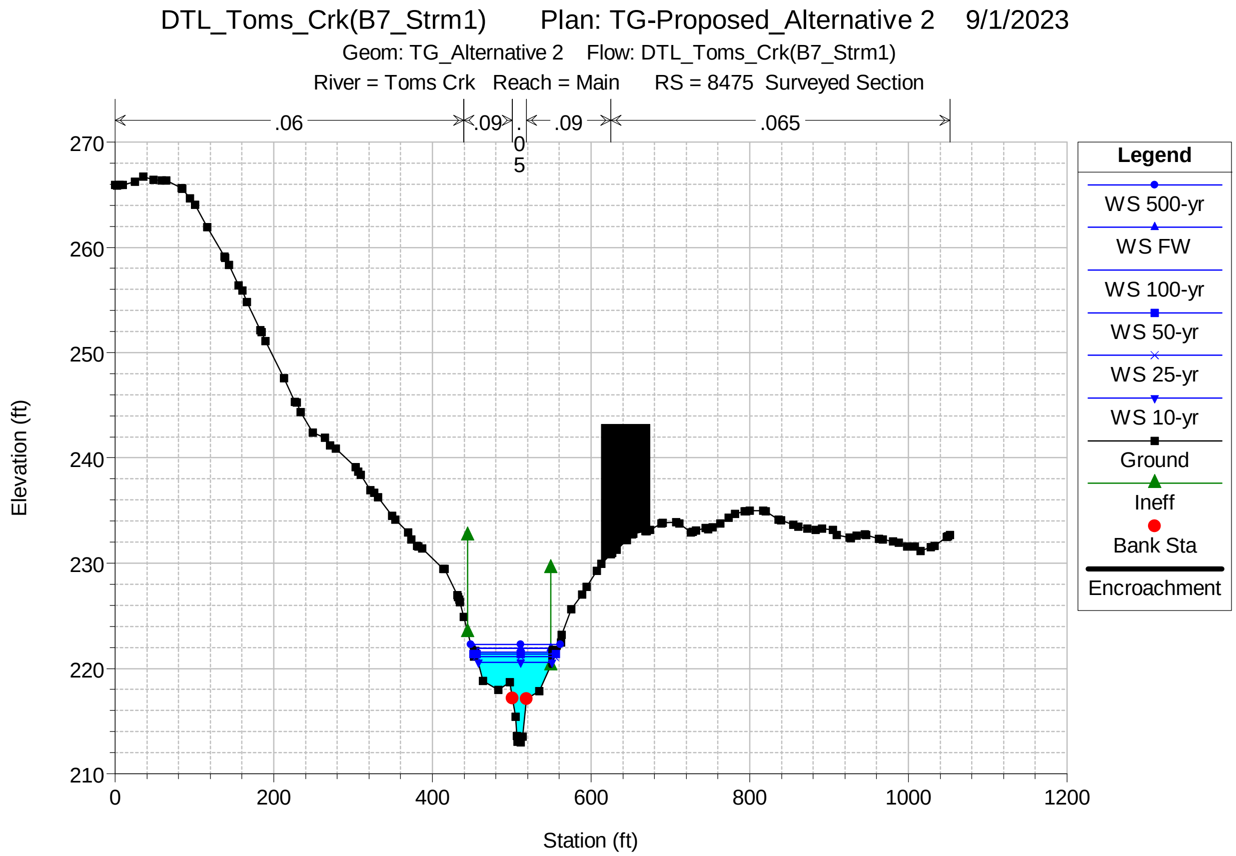
DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 677
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment



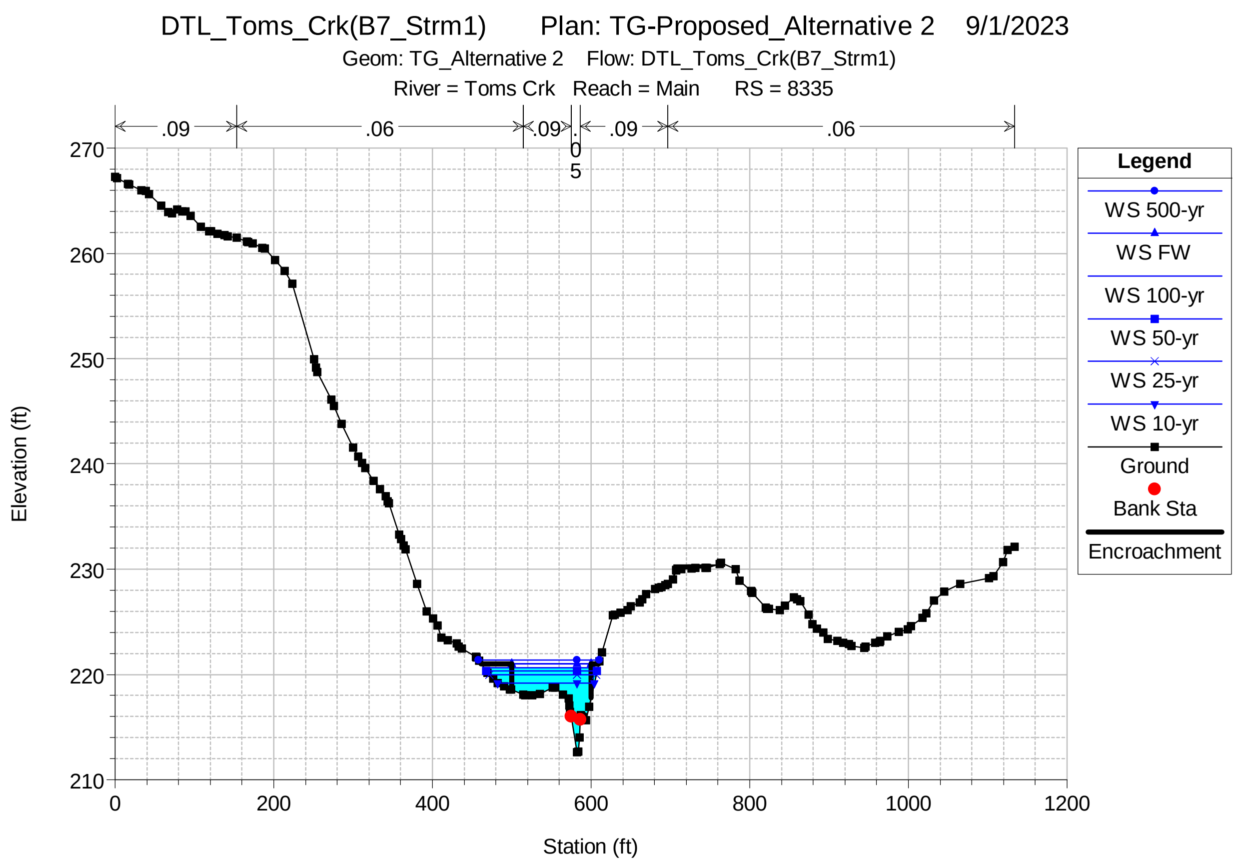
DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 355
.09
.05
.09
Elevation (ft)
Station (ft)
230
220
210
200
190
180
0
200
400
600
800
1000
1200
1400
1600
1800
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

Tom’s Creek

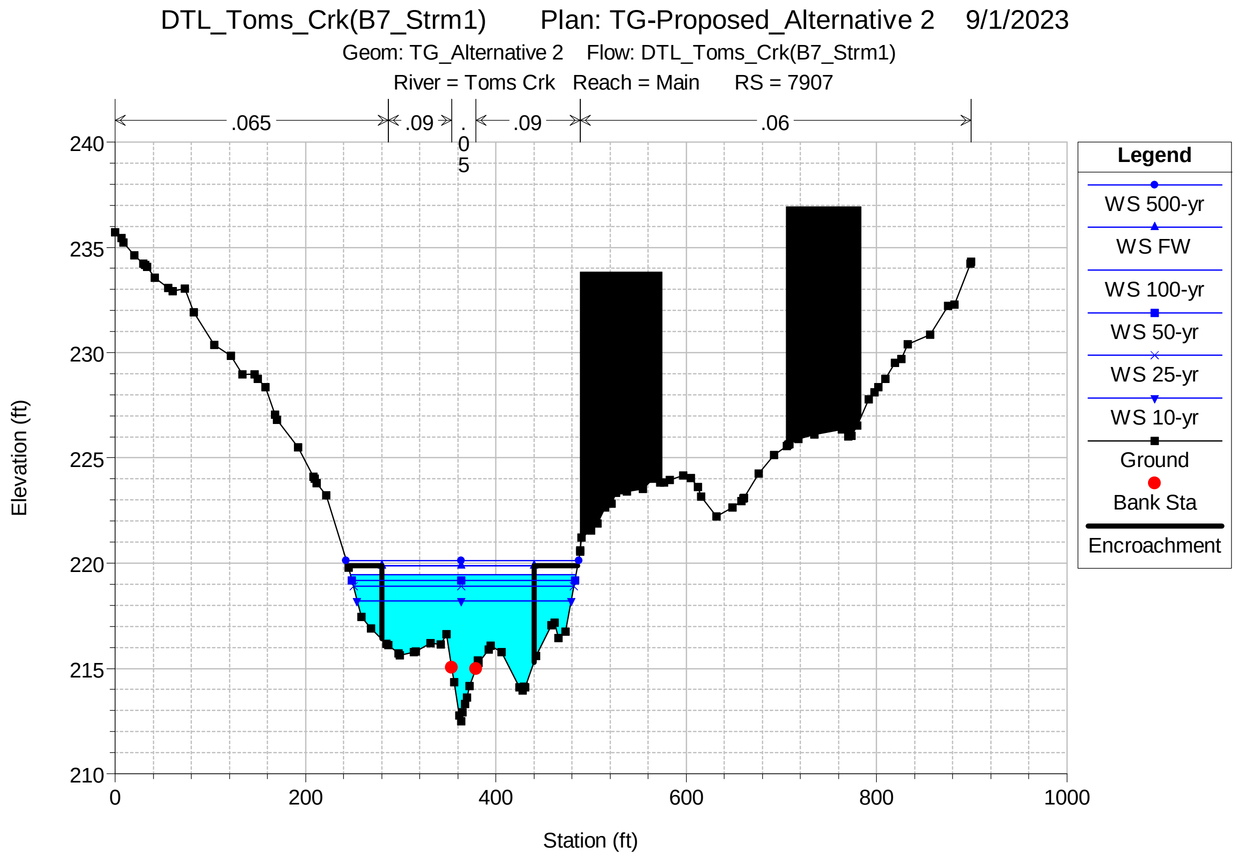
Proposed Cross Sections-Alternative 2

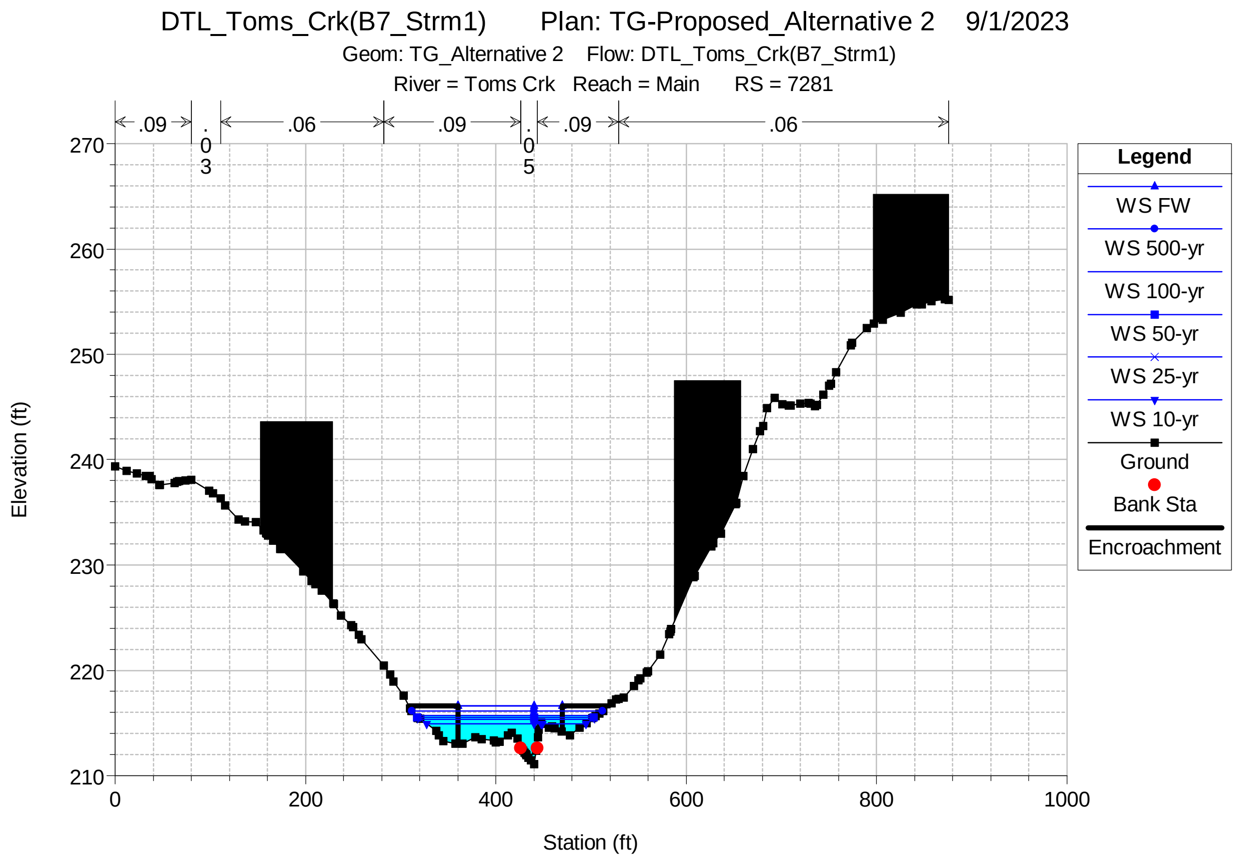


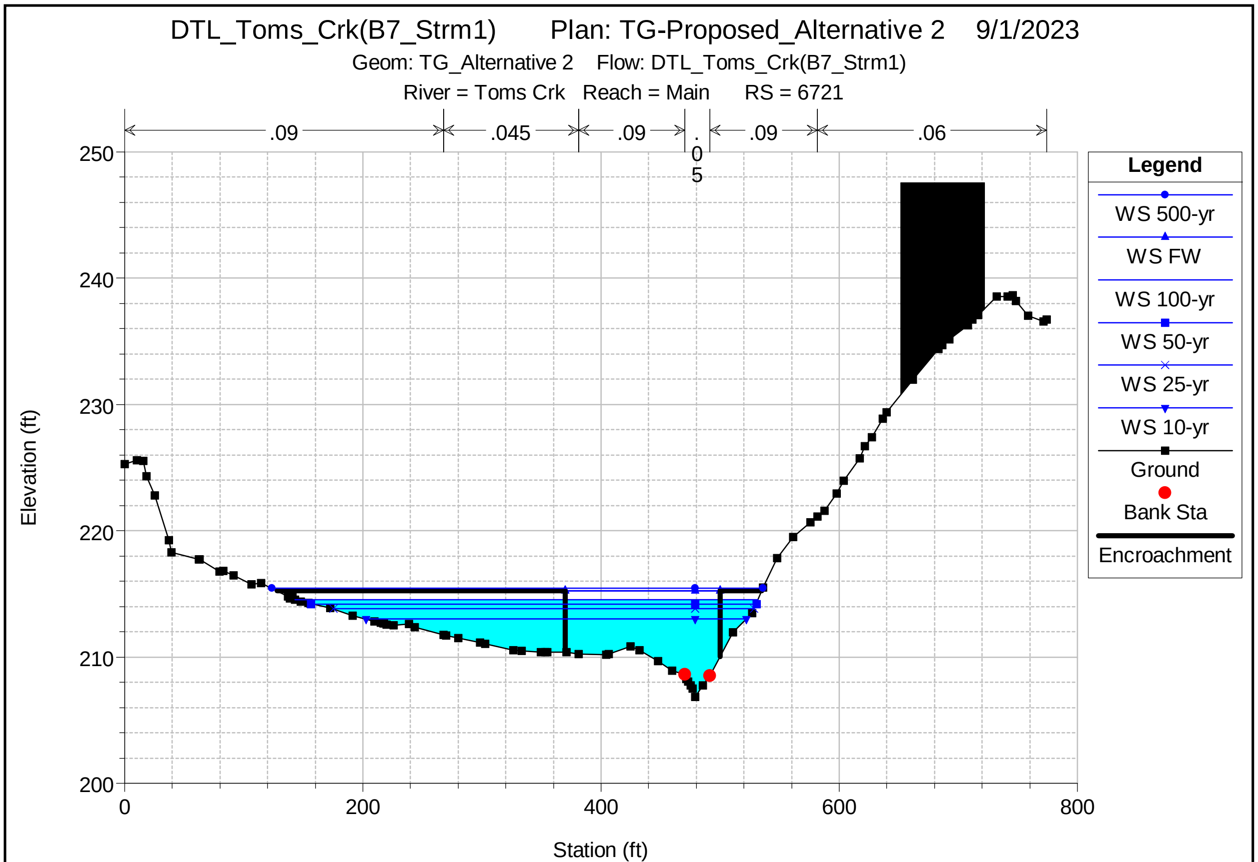
DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 8475 Surveyed Section
.06
.09
.05
.09
.065
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

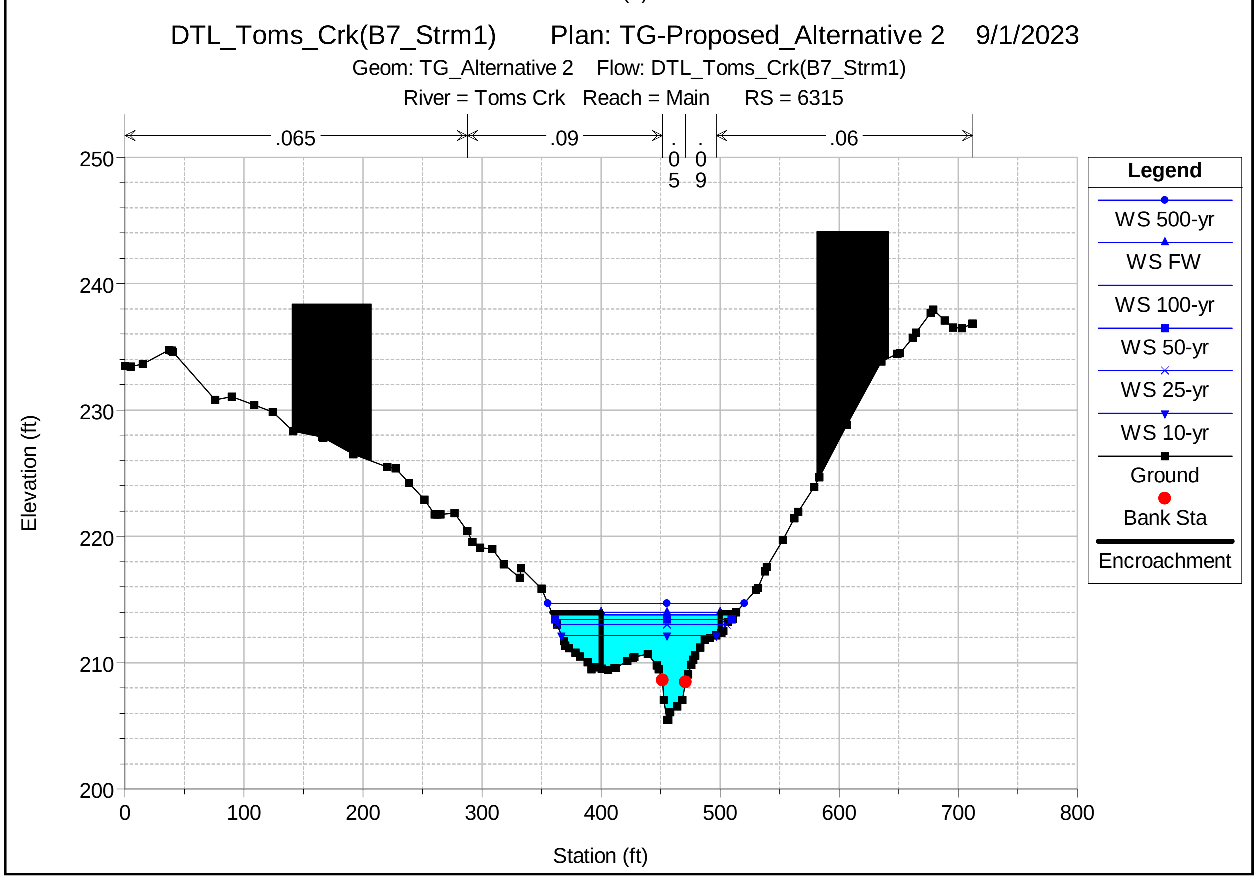



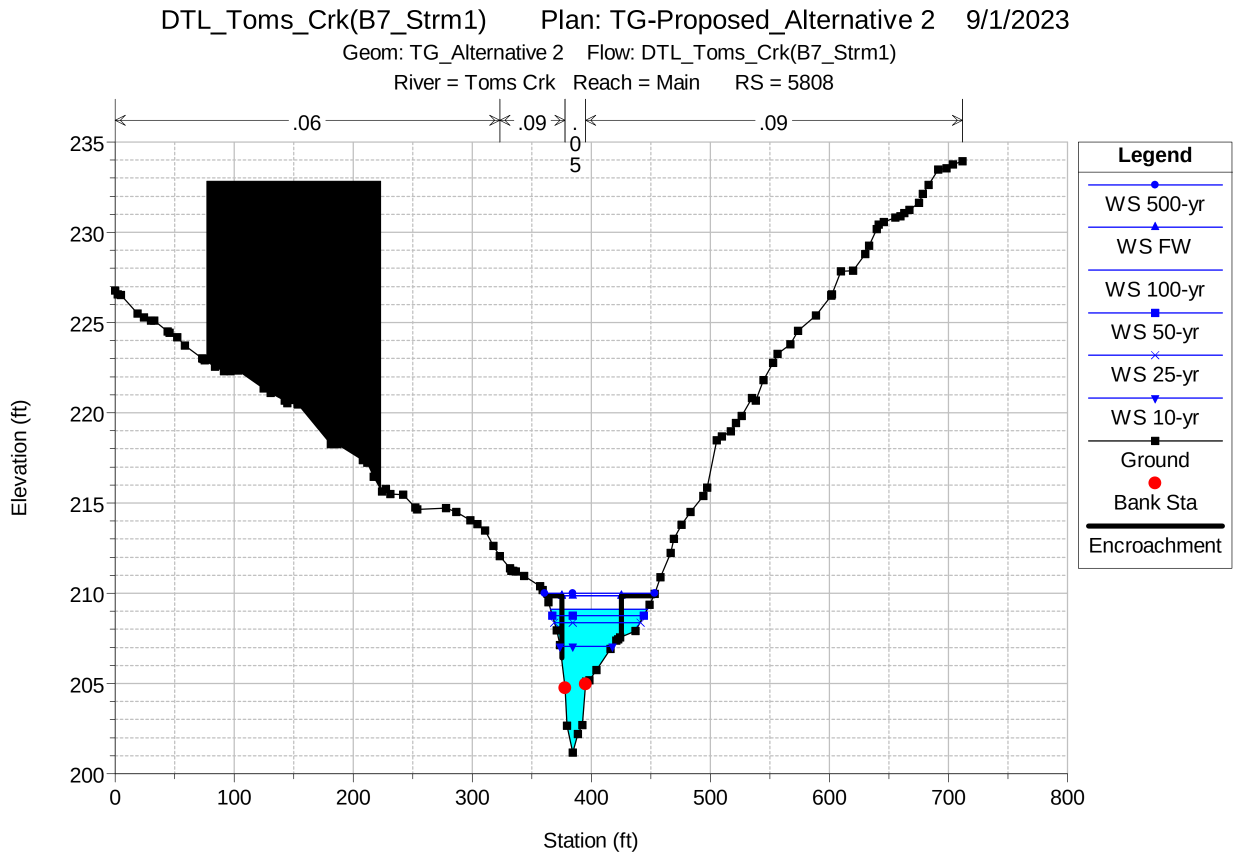
DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 8335
.09
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 7907
.065
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

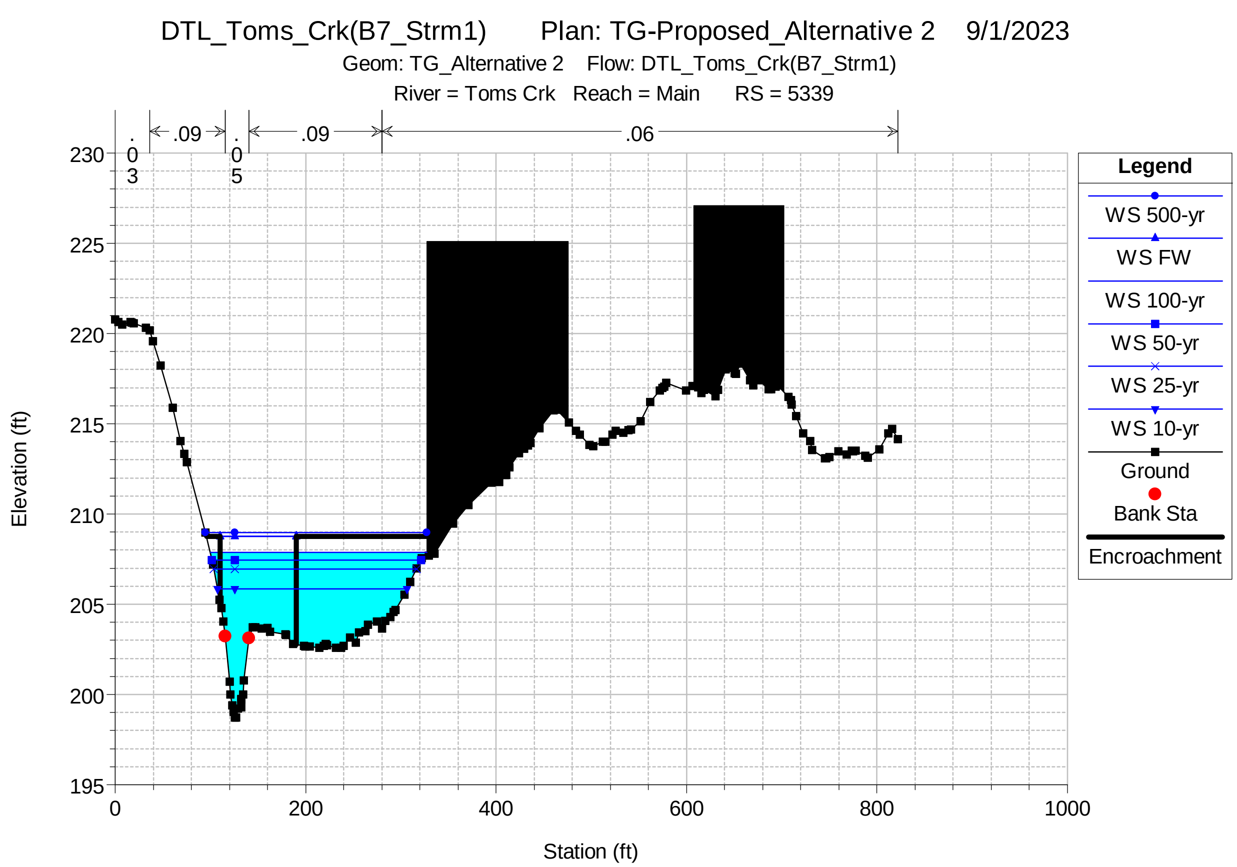

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 7281
.09
.03
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 6721
.09
.045
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

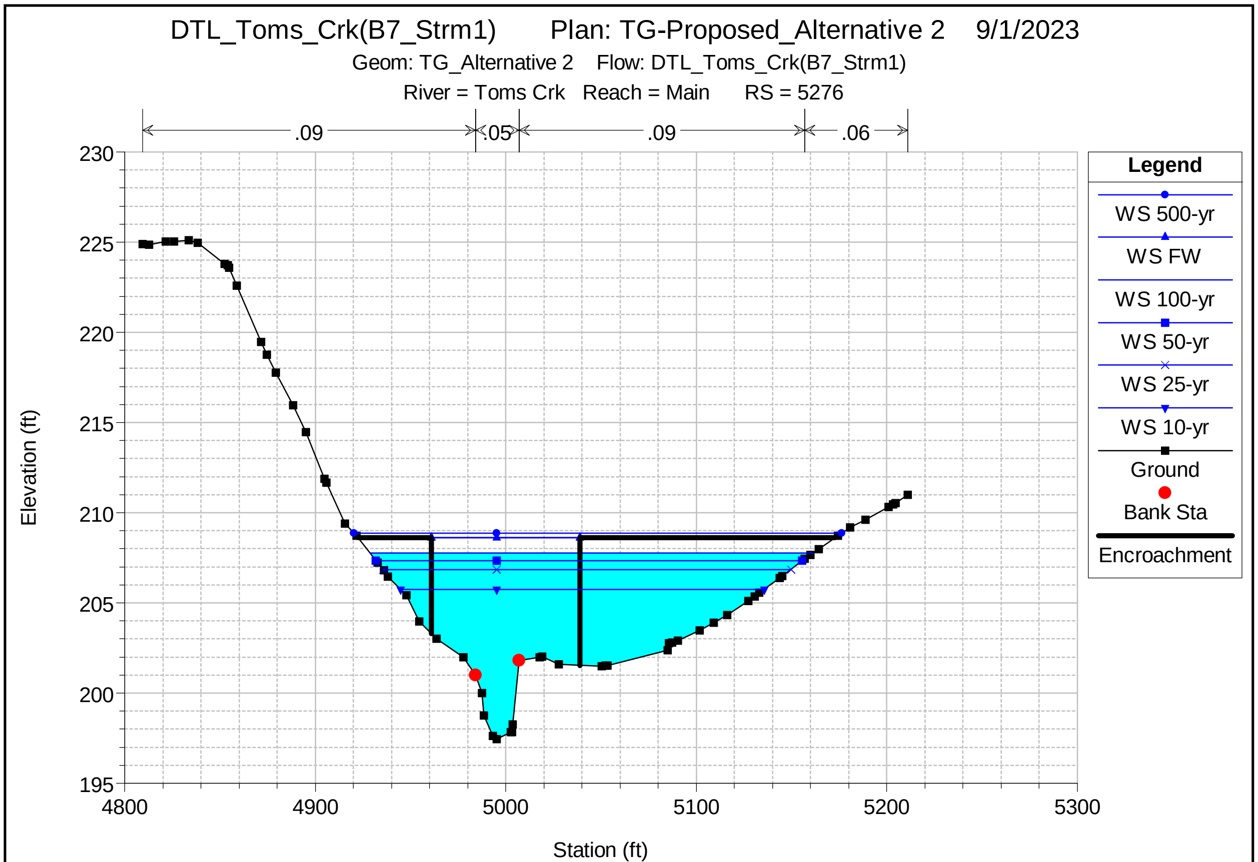

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 6315
.065
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

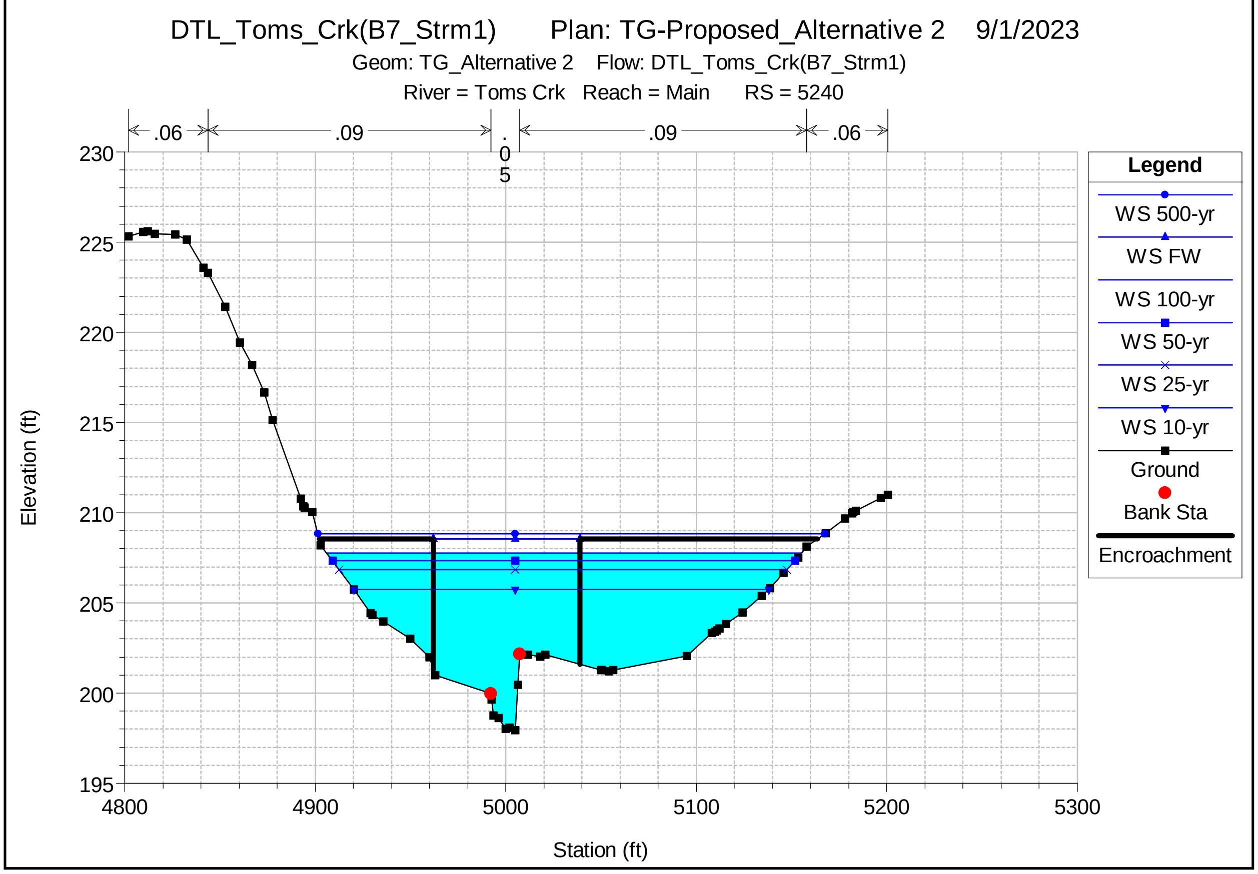


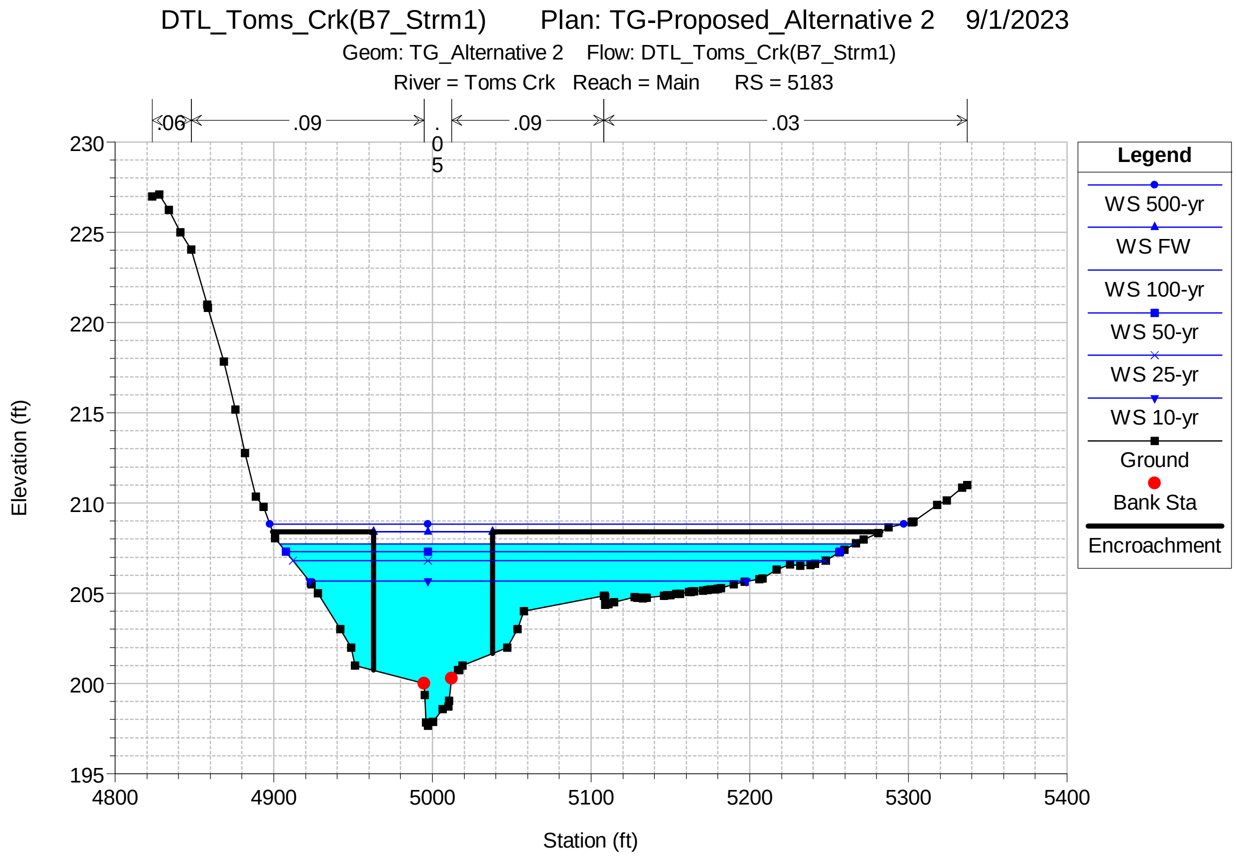
DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5808
.06
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

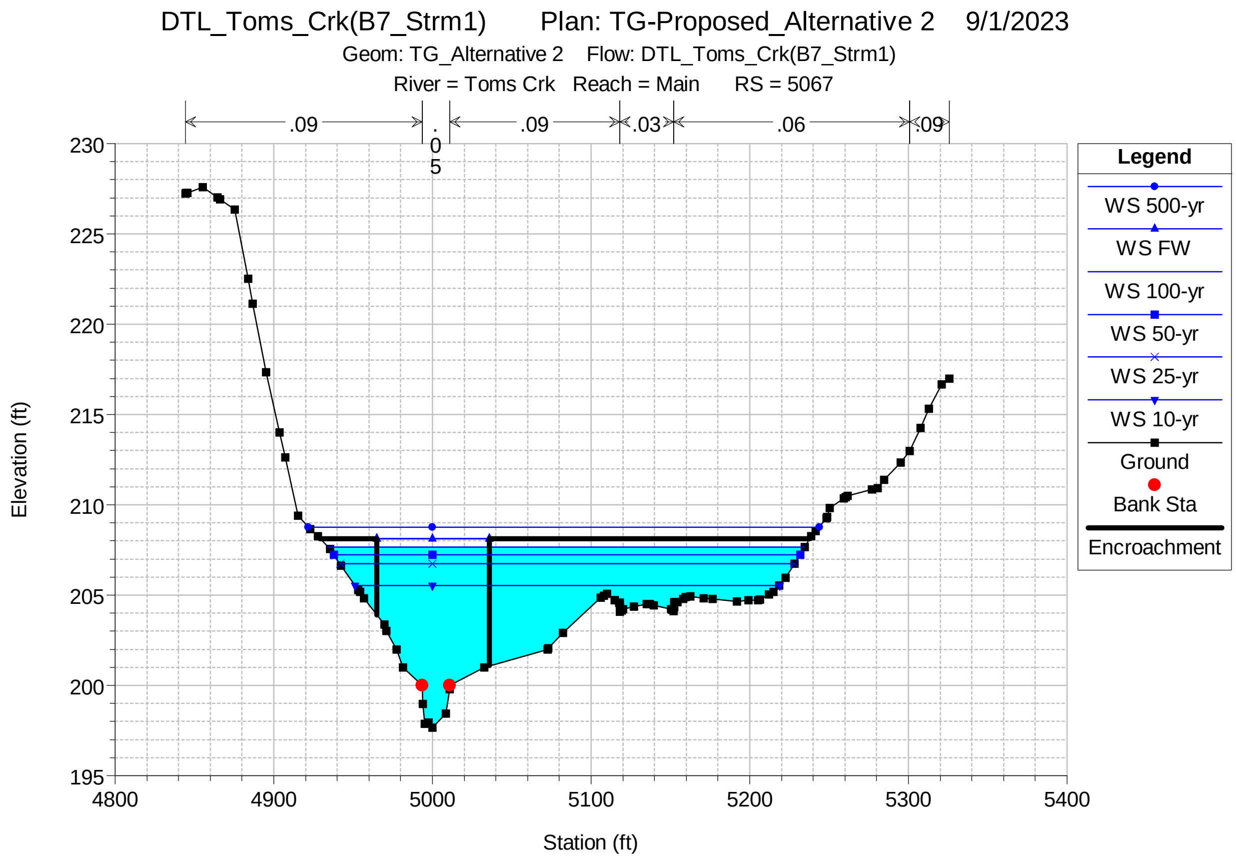



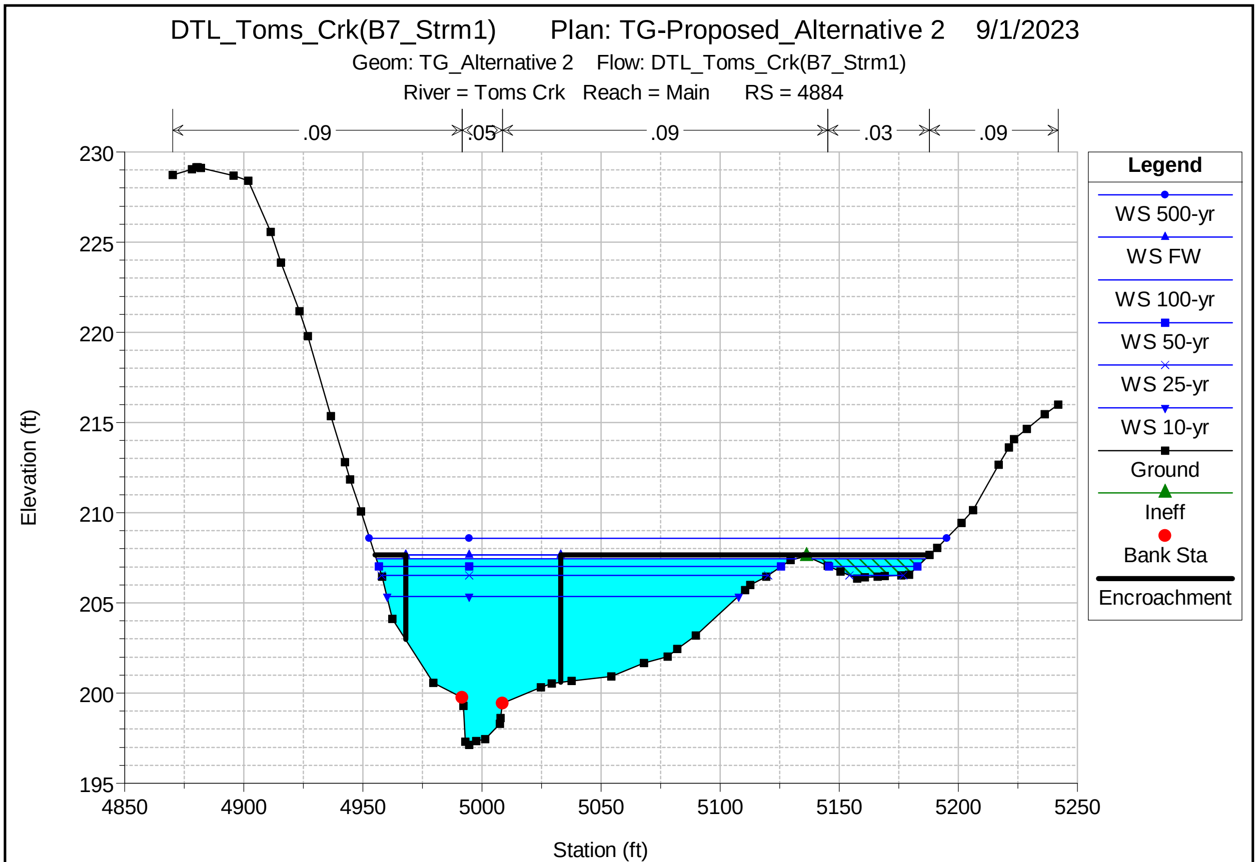
DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5339
.03
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

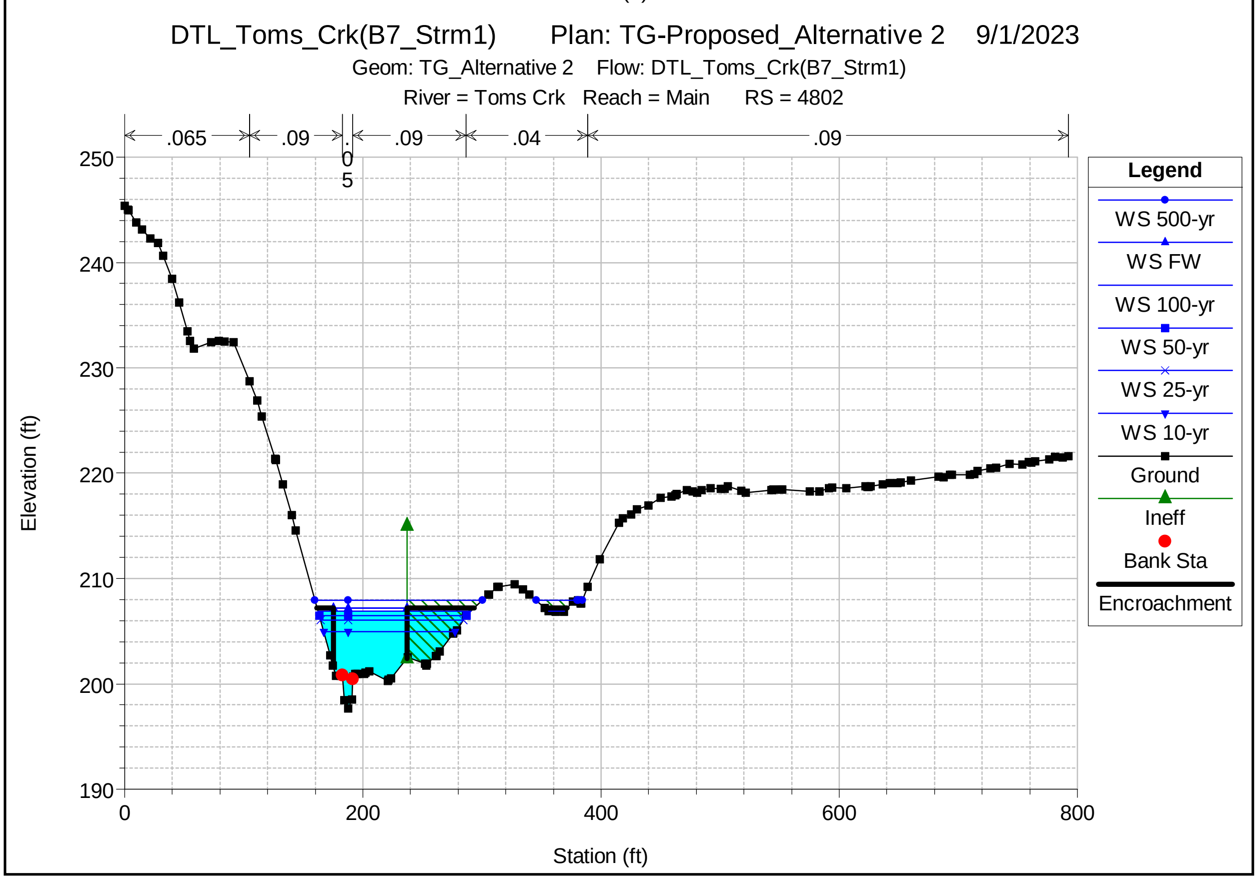

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5276
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

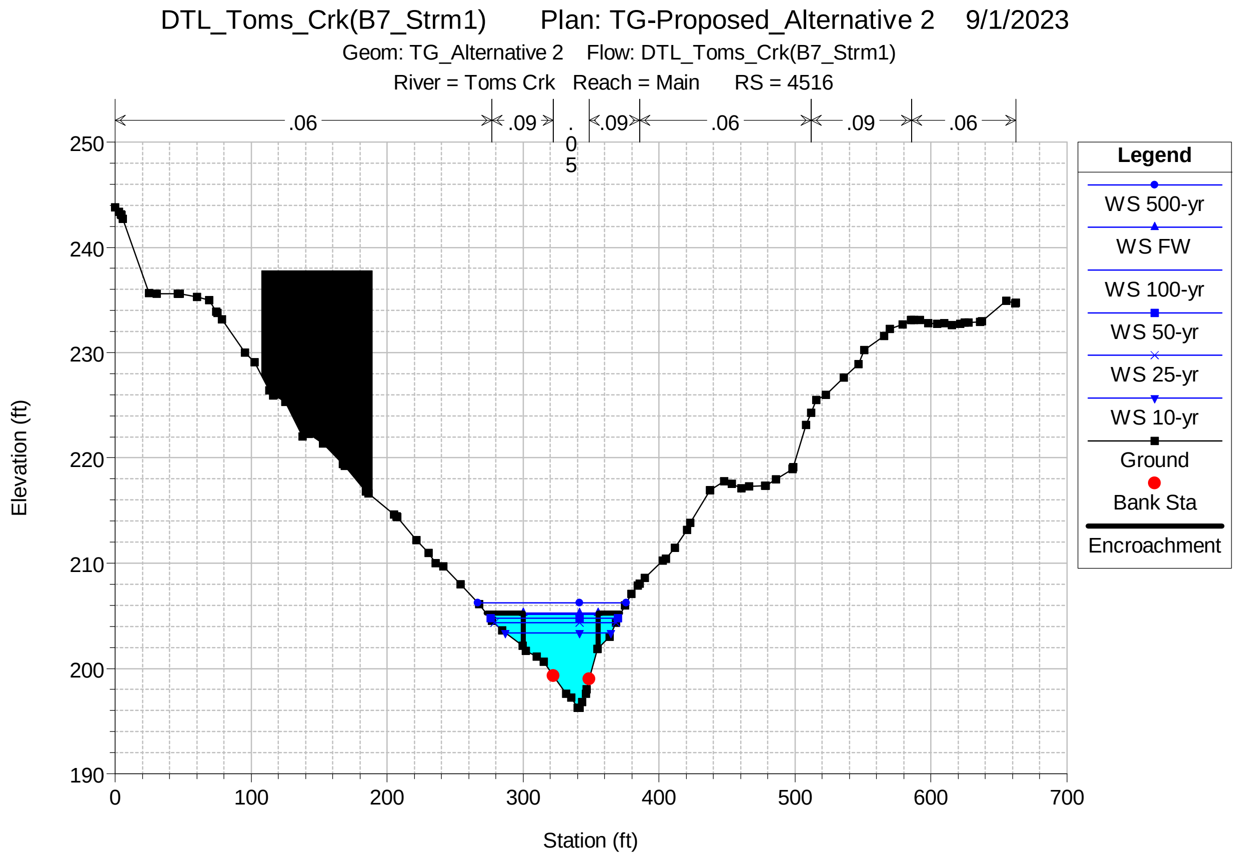

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5240
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

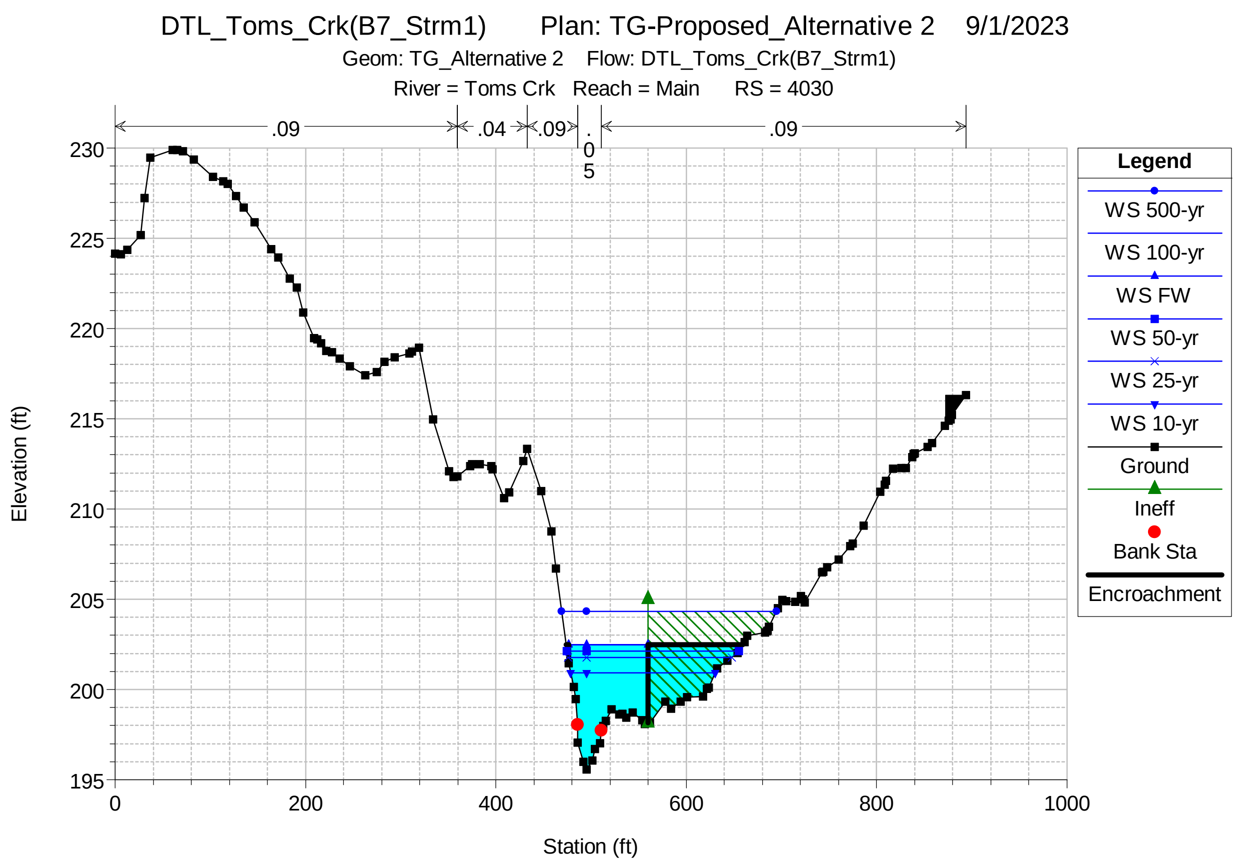

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5183
.06
.09
.05
.09
.03
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

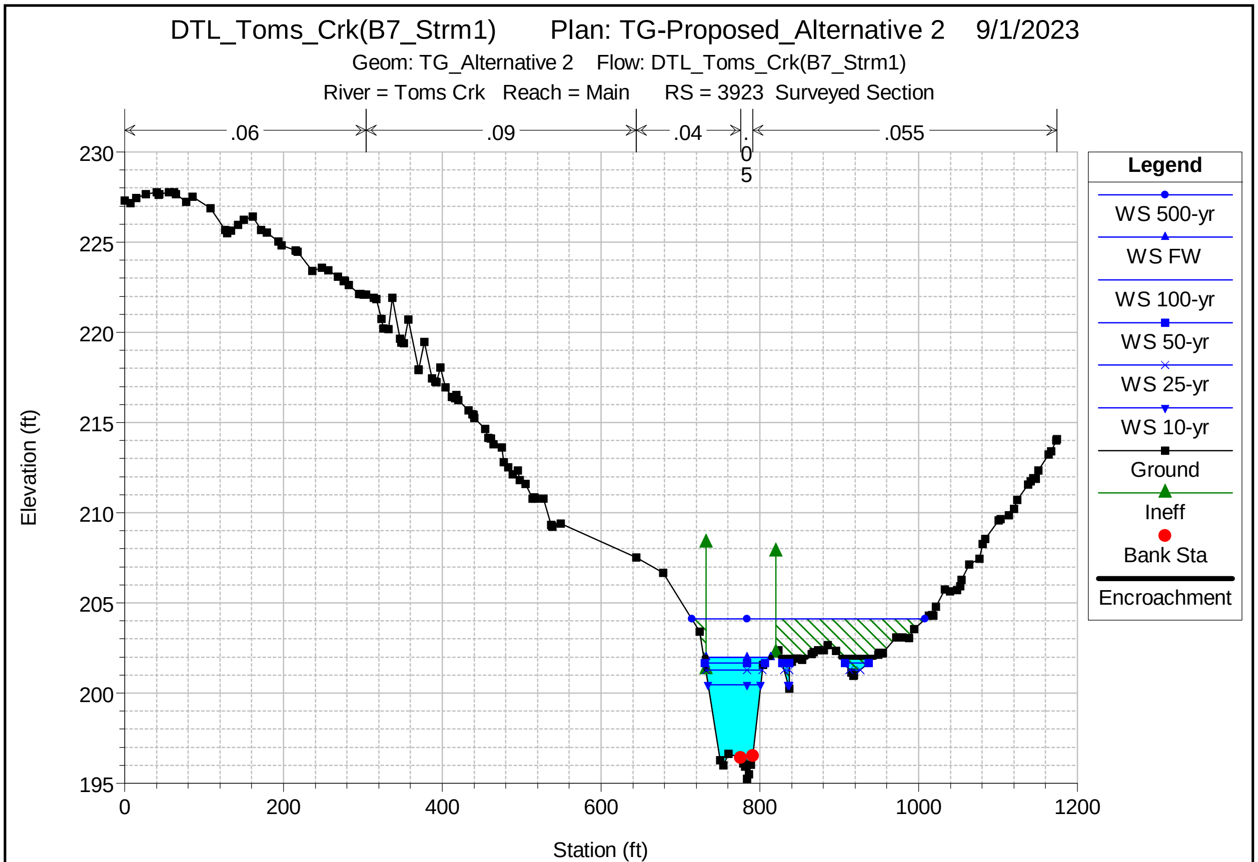

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 5067
.09
.05
.09
.03
.06
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

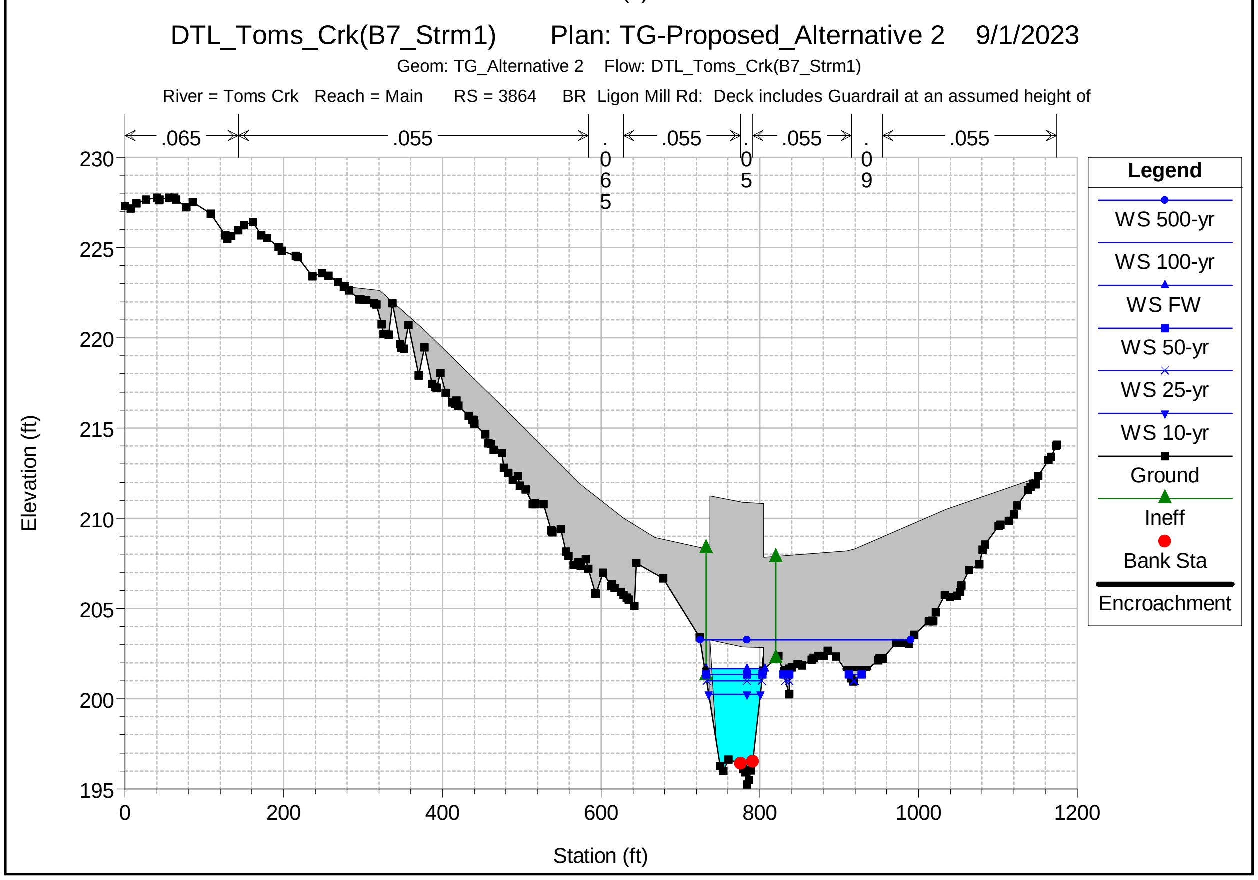

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4884
.09
.05
.09
.03
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

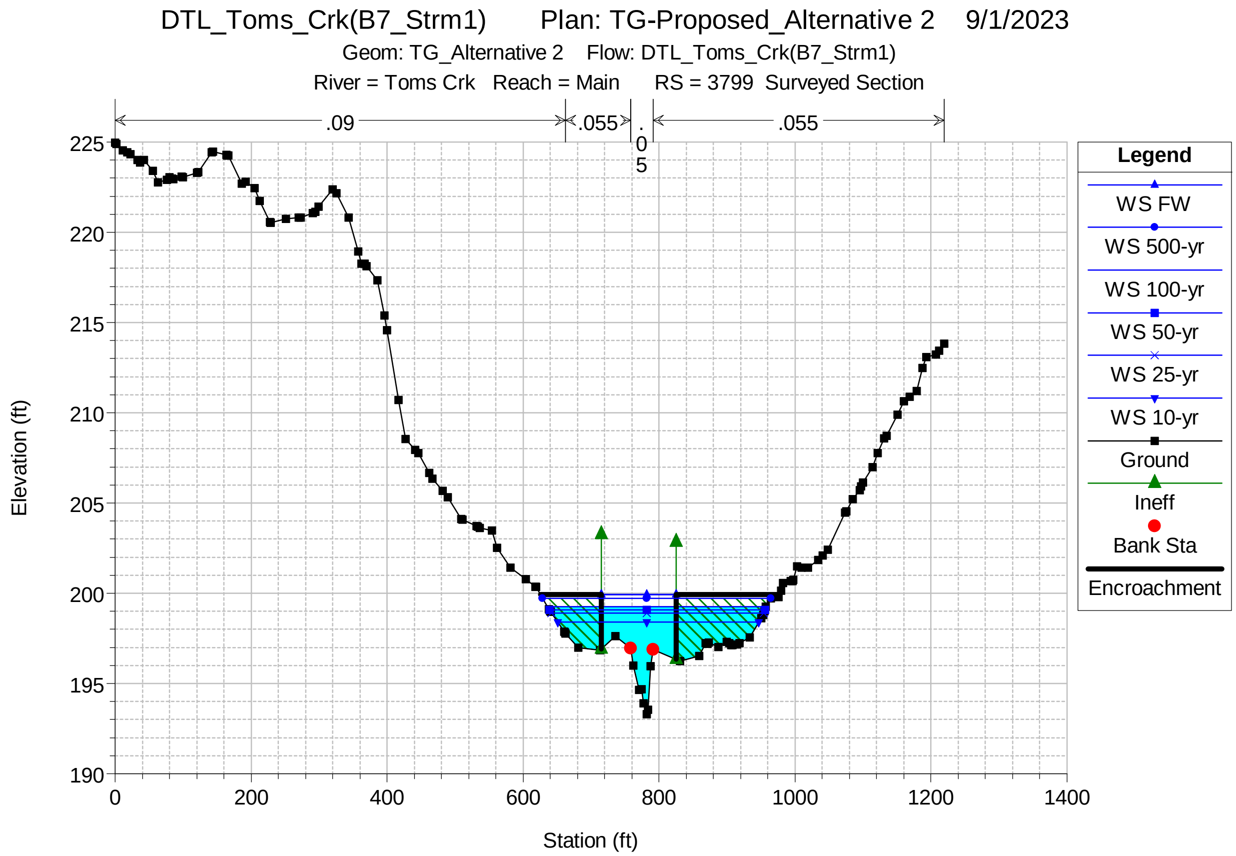

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4802
.065
.09
.05
.09
.04
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

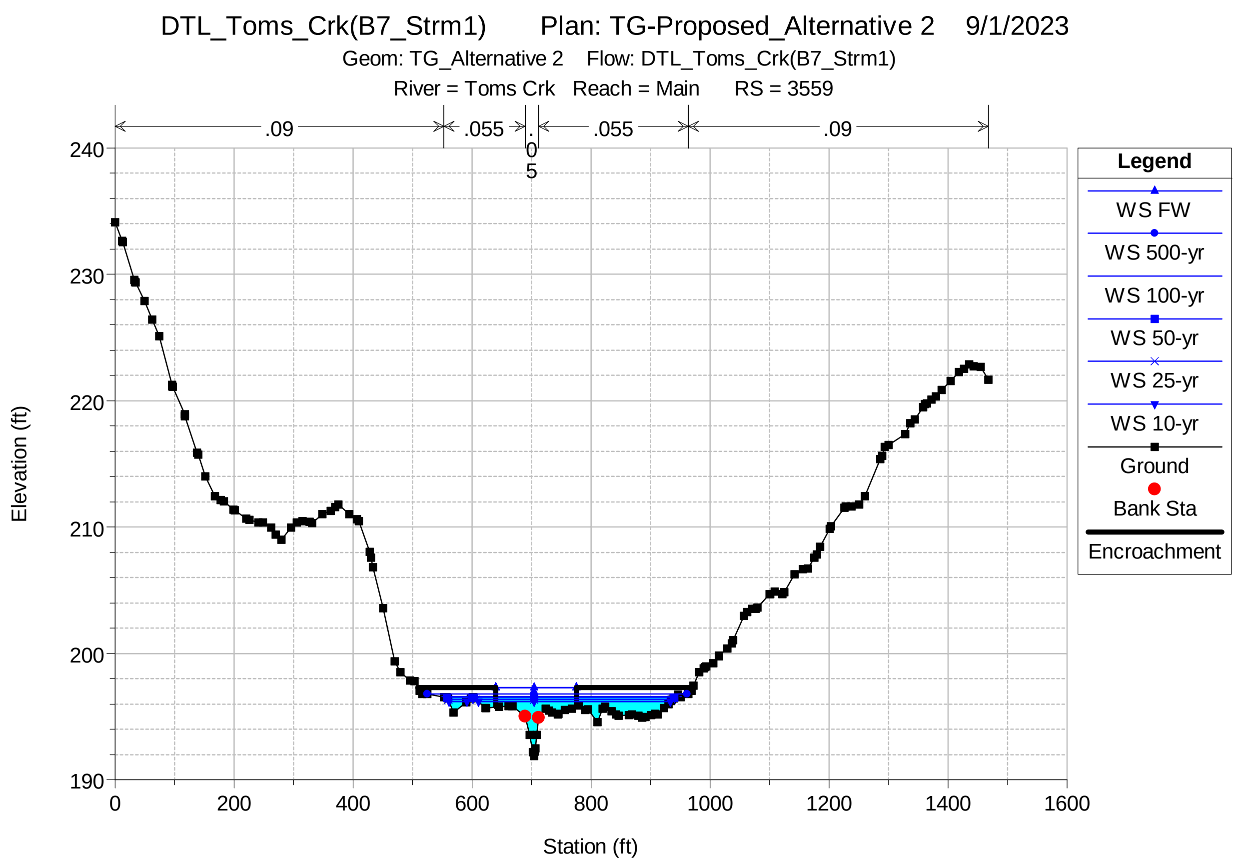

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4516
.06
.09
.05
.09
.06
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment

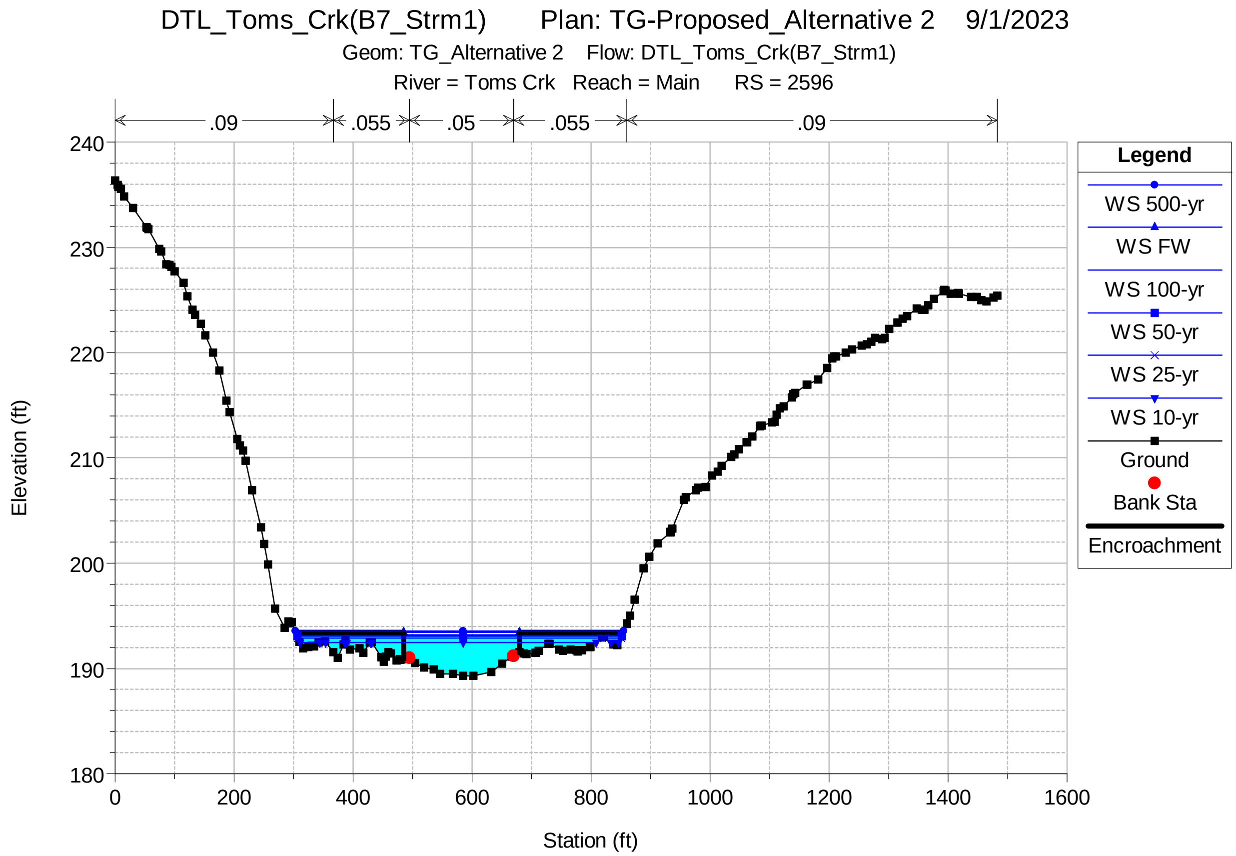

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 4030
.09
.04
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS FW
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

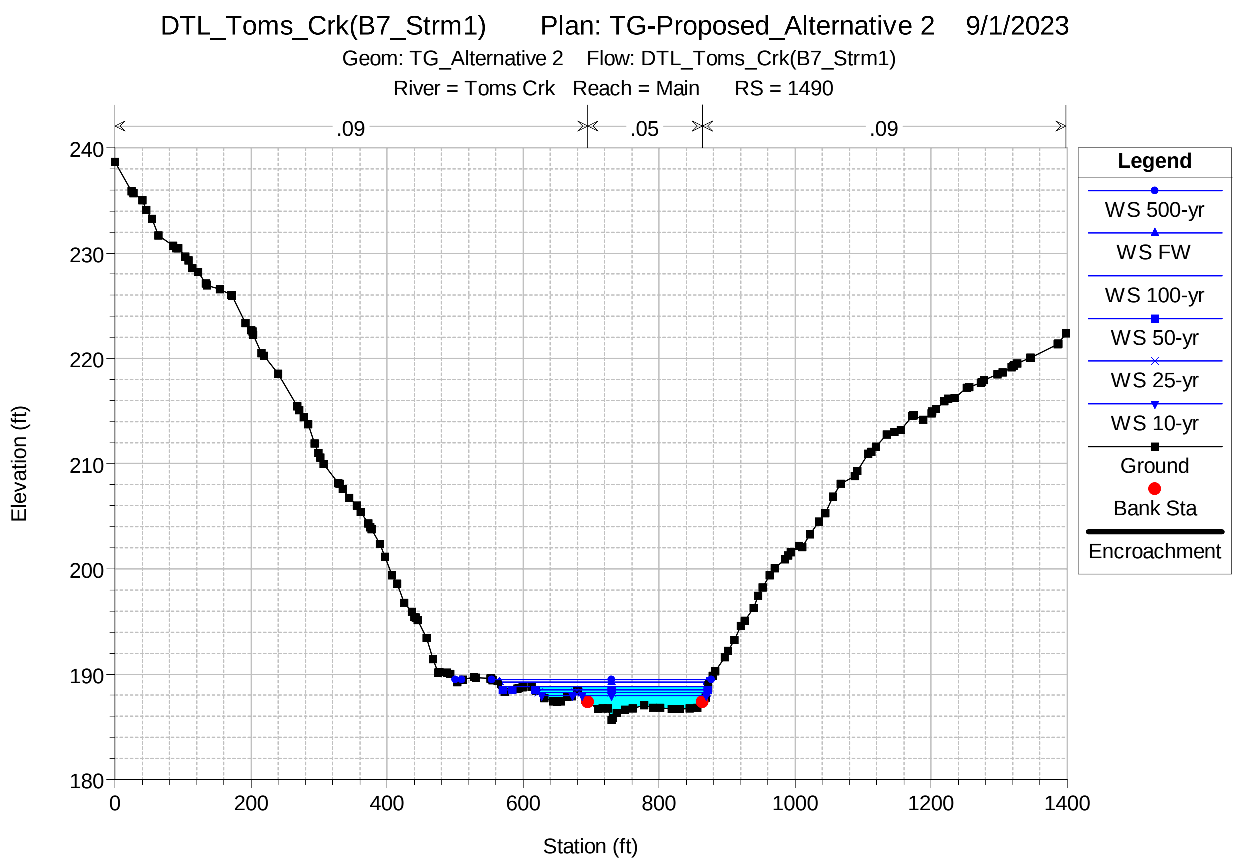

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3923 Surveyed Section
.06
.09
.04
.05
.055
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

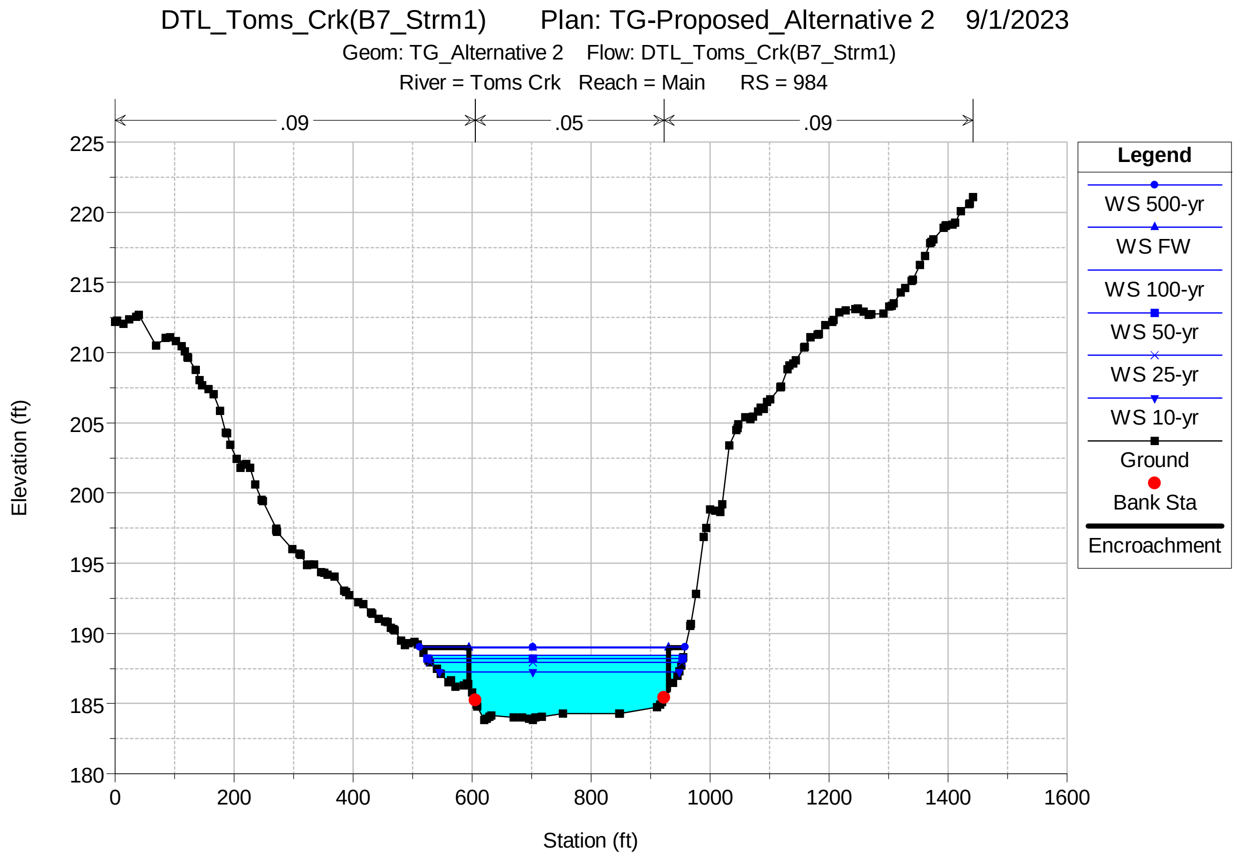

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3864 BR Ligon Mill Rd: Deck includes Guardrail at an assumed height of
.065
.055
.065
.055
.05
.055
.09
.055
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS FW
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

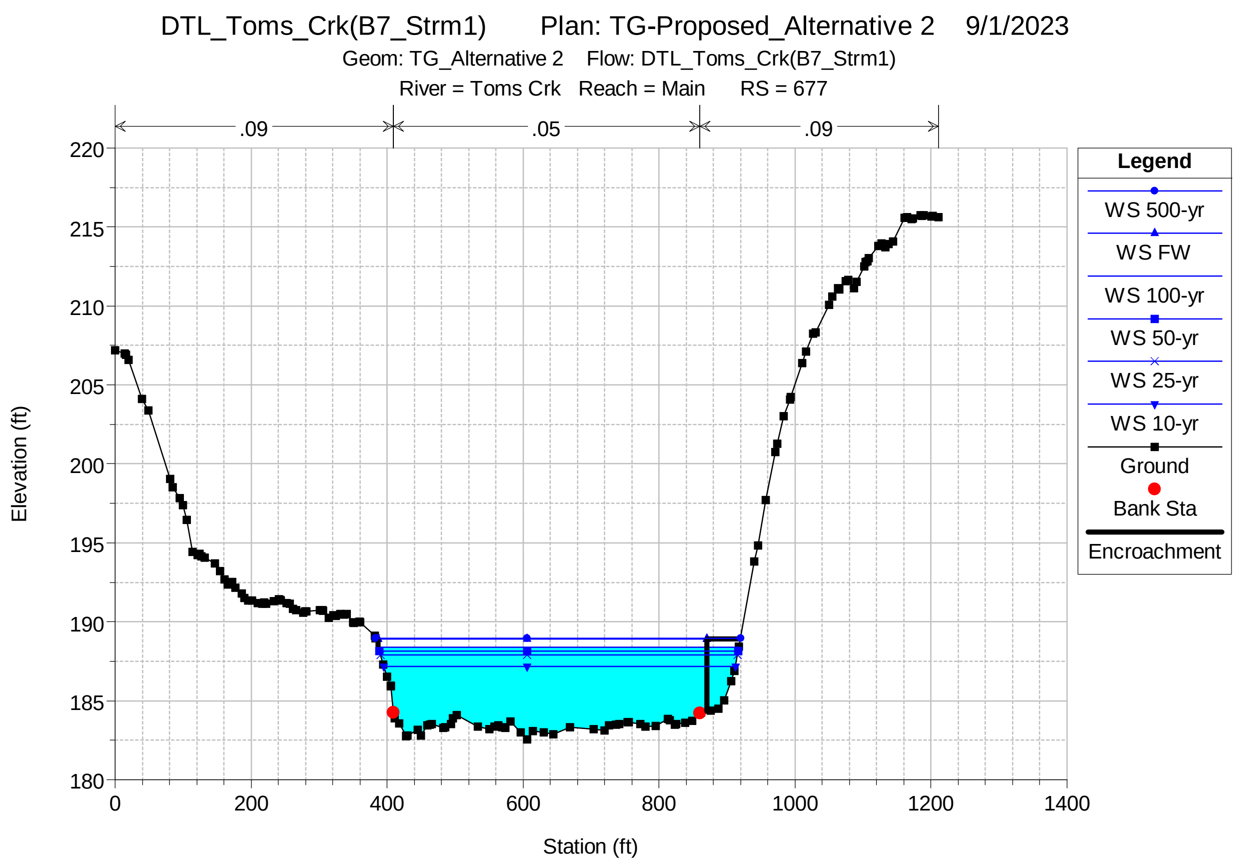

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3799 Surveyed Section
.09
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

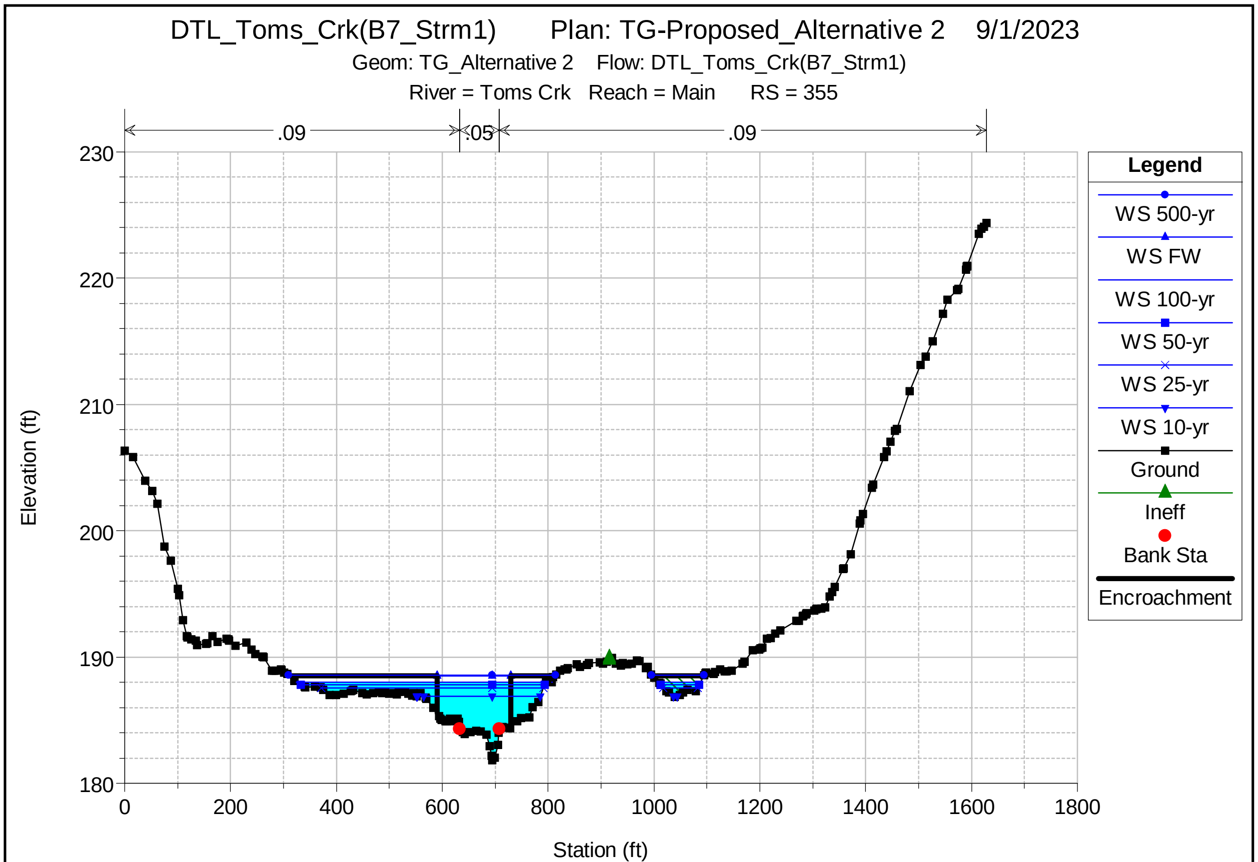

DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 3559
.09
.055
.05
.055
.09
Elevation (ft)
Station (ft)
Legend
WS FW
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 2596
.09
.055
.05
.055
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 1490
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 984
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment


DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 677
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Encroachment



DTL_Toms_Crk(B7_Strm1) Plan: TG-Proposed_Alternative 2 9/1/2023
Geom: TG_Alternative 2 Flow: DTL_Toms_Crk(B7_Strm1)
River = Toms Crk Reach = Main RS = 355
.09
.05
.09
Elevation (ft)
Station (ft)
230
220
210
200
190
180
0
200
400
600
800
1000
1200
1400
1600
1800
Legend
WS 500-yr
WS FW
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Encroachment

# Tom’s Creek
# WSEL Comparison Table-Alternative 1

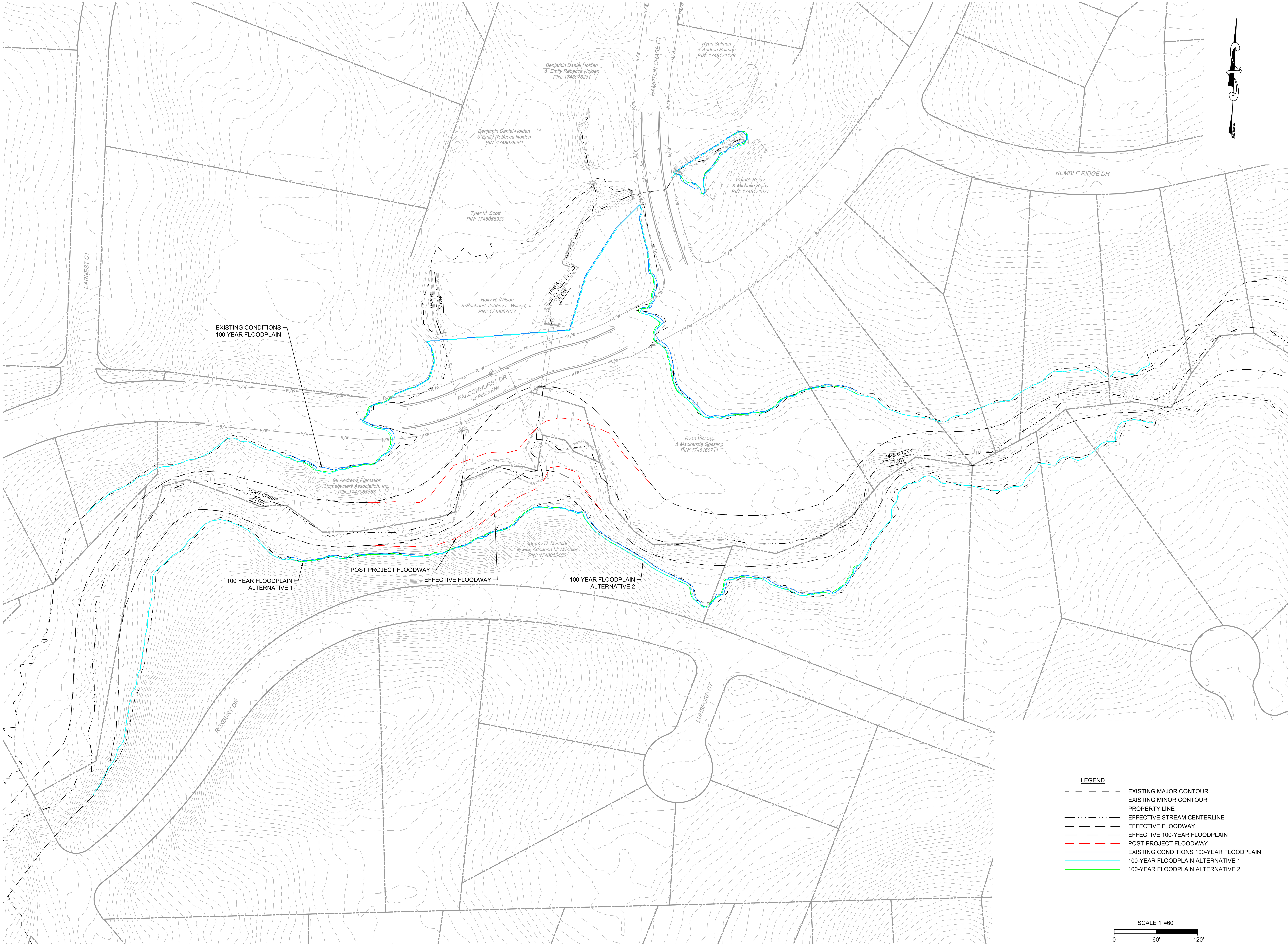
| | Existing | | Proposed | | Difference | | Surcharge | |
|---|---|---|---|---|---|---|---|---|
| River Sta | W.S. Elev | | W.S. Elev | | W.S. Elev | | W.S. Elev | |
| | 100year | FW | 100year | FW | 100year | FW | Existing | Proposed |
| 8511 | Coach Lantern Ave | | | | | | | |
| 8475 | 221.57 | 221.93 | 221.57 | 221.93 | 0.00 | 0.00 | 0.36 | 0.36 |
| 9335 | 220.61 | 221.03 | 220.61 | 221.03 | 0.00 | 0.00 | 0.42 | 0.42 |
| 7907 | 219.46 | 219.87 | 219.46 | 219.87 | 0.00 | 0.00 | 0.41 | 0.41 |
| 7281 | 215.71 | 216.61 | 215.71 | 216.61 | 0.00 | 0.00 | 0.90 | 0.90 |
| 6721 | 214.55 | 215.24 | 214.55 | 215.24 | 0.00 | 0.00 | 0.69 | 0.69 |
| 6315 | 213.79 | 213.96 | 213.79 | 213.97 | 0.00 | 0.00 | 0.18 | 0.18 |
| 5808 | 209.12 | 209.89 | 209.12 | 209.87 | 0.00 | -0.02 | 0.77 | 0.75 |
| 5339 | 207.89 | 208.82 | 207.89 | 208.75 | 0.00 | -0.07 | 0.93 | 0.86 |
| 5276 | 207.78 | 208.66 | 207.78 | 208.61 | 0.00 | -0.05 | 0.88 | 0.83 |
| 5240 | 207.76 | 208.58 | 207.76 | 208.54 | 0.00 | -0.04 | 0.82 | 0.78 |
| 5183 | 207.74 | 208.46 | 207.74 | 208.42 | 0.00 | -0.04 | 0.72 | 0.68 |
| 5067 | 207.67 | 208.1 | 207.67 | 208.1 | 0.00 | 0.00 | 0.43 | 0.43 |
| 4884 | 207.45 | 207.66 | 207.45 | 207.66 | 0.00 | 0.00 | 0.21 | 0.21 |
| 4802 | 206.89 | 207.19 | 206.89 | 207.19 | 0.00 | 0.00 | 0.30 | 0.30 |
| 4516 | 205.12 | 205.23 | 205.12 | 205.23 | 0.00 | 0.00 | 0.11 | 0.11 |
| 4030 | 202.49 | 202.49 | 202.49 | 202.49 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3923 | 201.98 | 201.98 | 201.98 | 201.98 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3864 | Ligon Mill Rd | | | | | | | |
| 3799 | 199.25 | 199.93 | 199.25 | 199.93 | 0.00 | 0.00 | 0.68 | 0.68 |
| 3559 | 196.57 | 197.31 | 196.57 | 197.31 | 0.00 | 0.00 | 0.74 | 0.74 |
| 2596 | 193.19 | 193.46 | 193.19 | 193.46 | 0.00 | 0.00 | 0.27 | 0.27 |
| 1490 | 188.8 | 189.24 | 188.8 | 189.24 | 0.00 | 0.00 | 0.44 | 0.44 |
| 984 | 188.43 | 188.97 | 188.43 | 188.97 | 0.00 | 0.00 | 0.54 | 0.54 |
| 677 | 188.38 | 188.93 | 188.38 | 188.93 | 0.00 | 0.00 | 0.55 | 0.55 |
| 355 | 188.03 | 188.51 | 188.03 | 188.51 | 0.00 | 0.00 | 0.48 | 0.48 |

Tom’s Creek

WSEL Comparison Table-Alternative 2

| | Existing | | Proposed | | Difference | | Surcharge | |
|---|---|---|---|---|---|---|---|---|
| River Sta | W.S. Elev | | W.S. Elev | | W.S. Elev | | W.S. Elev | |
| | 100year | FW | 100year | FW | 100year | FW | Existing | Proposed |
| 8511 | Coach Lantern Ave | | | | | | | |
| 8475 | 221.57 | 221.93 | 221.57 | 221.93 | 0.00 | 0.00 | 0.36 | 0.36 |
| 9335 | 220.61 | 221.03 | 220.61 | 221.03 | 0.00 | 0.00 | 0.42 | 0.42 |
| 7907 | 219.46 | 219.87 | 219.46 | 219.87 | 0.00 | 0.00 | 0.41 | 0.41 |
| 7281 | 215.71 | 216.61 | 215.71 | 216.61 | 0.00 | 0.00 | 0.90 | 0.90 |
| 6721 | 214.55 | 215.24 | 214.55 | 215.24 | 0.00 | 0.00 | 0.69 | 0.69 |
| 6315 | 213.79 | 213.96 | 213.79 | 213.96 | 0.00 | 0.00 | 0.18 | 0.17 |
| 5808 | 209.12 | 209.89 | 209.12 | 209.89 | 0.00 | 0.00 | 0.77 | 0.77 |
| 5339 | 207.89 | 208.82 | 207.89 | 208.82 | 0.00 | 0.00 | 0.93 | 0.93 |
| 5276 | 207.78 | 208.66 | 207.78 | 208.66 | 0.00 | 0.00 | 0.88 | 0.88 |
| 5240 | 207.76 | 208.58 | 207.76 | 208.58 | 0.00 | 0.00 | 0.82 | 0.82 |
| 5183 | 207.74 | 208.46 | 207.74 | 208.45 | 0.00 | -0.01 | 0.72 | 0.71 |
| 5067 | 207.67 | 208.1 | 207.67 | 208.1 | 0.00 | 0.00 | 0.43 | 0.43 |
| 4884 | 207.45 | 207.66 | 207.45 | 207.66 | 0.00 | 0.00 | 0.21 | 0.21 |
| 4802 | 206.89 | 207.19 | 206.89 | 207.19 | 0.00 | 0.00 | 0.30 | 0.30 |
| 4516 | 205.12 | 205.23 | 205.12 | 205.23 | 0.00 | 0.00 | 0.11 | 0.11 |
| 4030 | 202.49 | 202.49 | 202.49 | 202.49 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3923 | 201.98 | 201.98 | 201.98 | 201.98 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3864 | Ligon Mill Rd | | | | | | | |
| 3799 | 199.25 | 199.93 | 199.25 | 199.93 | 0.00 | 0.00 | 0.68 | 0.68 |
| 3559 | 196.57 | 197.31 | 196.57 | 197.31 | 0.00 | 0.00 | 0.74 | 0.74 |
| 2596 | 193.19 | 193.46 | 193.19 | 193.46 | 0.00 | 0.00 | 0.27 | 0.27 |
| 1490 | 188.8 | 189.24 | 188.8 | 189.24 | 0.00 | 0.00 | 0.44 | 0.44 |
| 984 | 188.43 | 188.97 | 188.43 | 188.97 | 0.00 | 0.00 | 0.54 | 0.54 |
| 677 | 188.38 | 188.93 | 188.38 | 188.93 | 0.00 | 0.00 | 0.55 | 0.55 |
| 355 | 188.03 | 188.51 | 188.03 | 188.51 | 0.00 | 0.00 | 0.48 | 0.48 |

*Tom’s Creek*
*Floodplain Map*




THIS DRAWING PREPARED AT THE
**RALEIGH OFFICE**
5410 Trinity Road, Suite 112 | Raleigh, NC 27607
TEL 919.866.4951 FAX 919.833.8124 www.timmons.com

YOUR VISION ACHIEVED THROUGH OURS.

| REVISION DESCRIPTION | DATE |
|---|---|
| | |

**TIMMONS GROUP**
NORTH CAROLINA LICENSE NO. C-1652

# FALCONHURST DRIVE STORM DRAINAGE IMPROVEMENTS

TOWN OF WAKE FOREST, NORTH CAROLINA

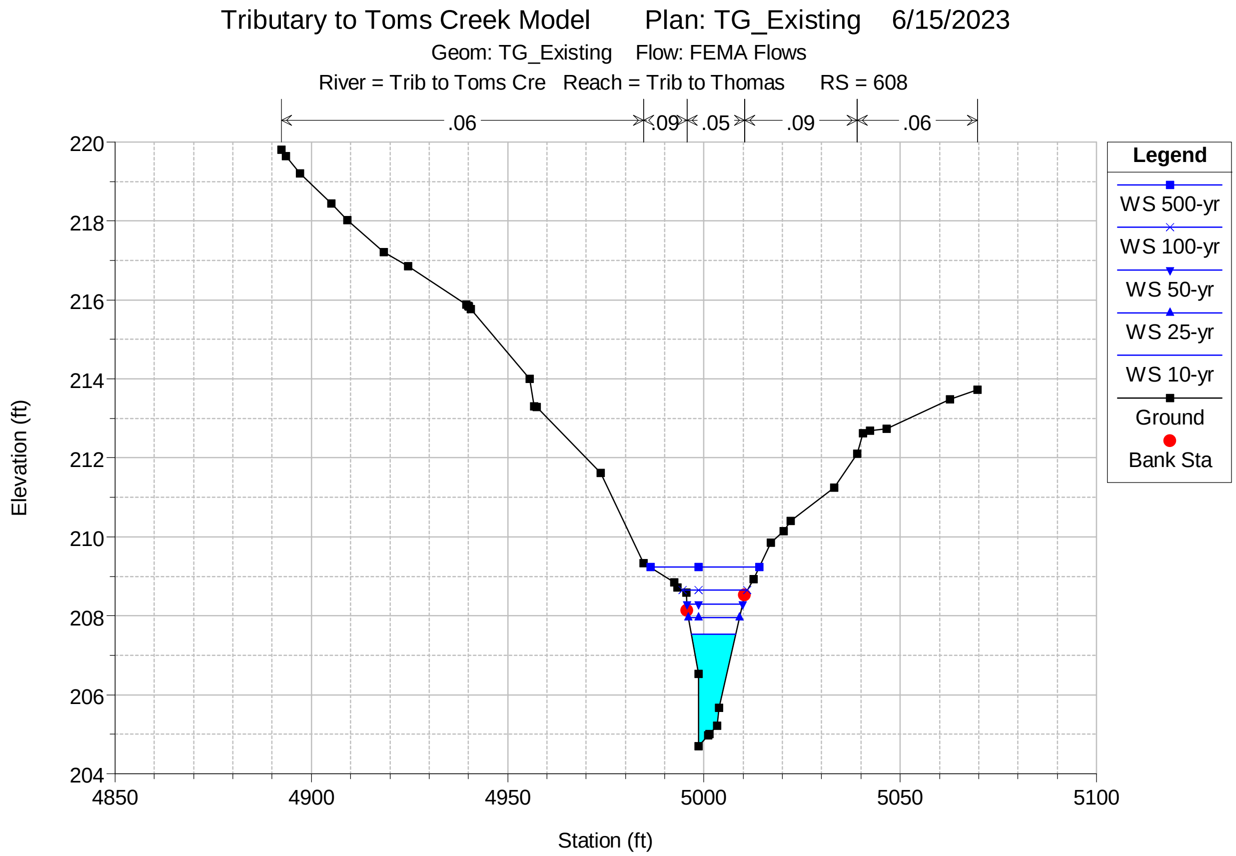
## *TOM'S CREEK FLOODPLAIN WORK MAP*

| | |
|---|---|
| DATE | 9-01-2023 |
| DRAWN BY | S.VANDERGRIFT |
| DESIGNED BY | Z. GILSTRAP |
| CHECKED BY | D. DUNCAN |
| SCALE | 1"=60' |
| JOB NO. | 52780.001 |
| SHEET NO. | D |

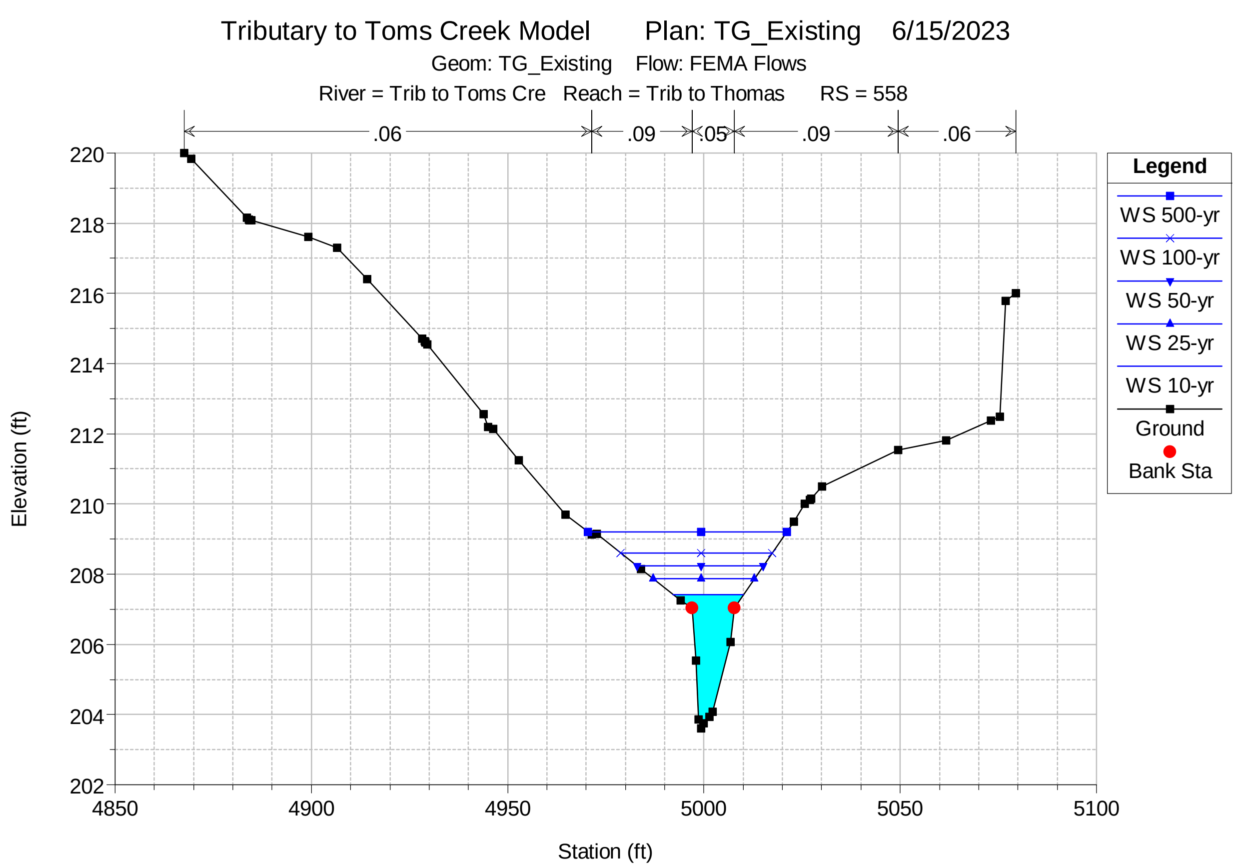


L:\209\52780.001-TWF-Falconhurst\DWG\Sheet\Exhibit\52780.001-209C-FPFL (TOM'S CREEK).dwg | Plotted on 9/1/2023 2:50 PM | by Zachary Gilstrap

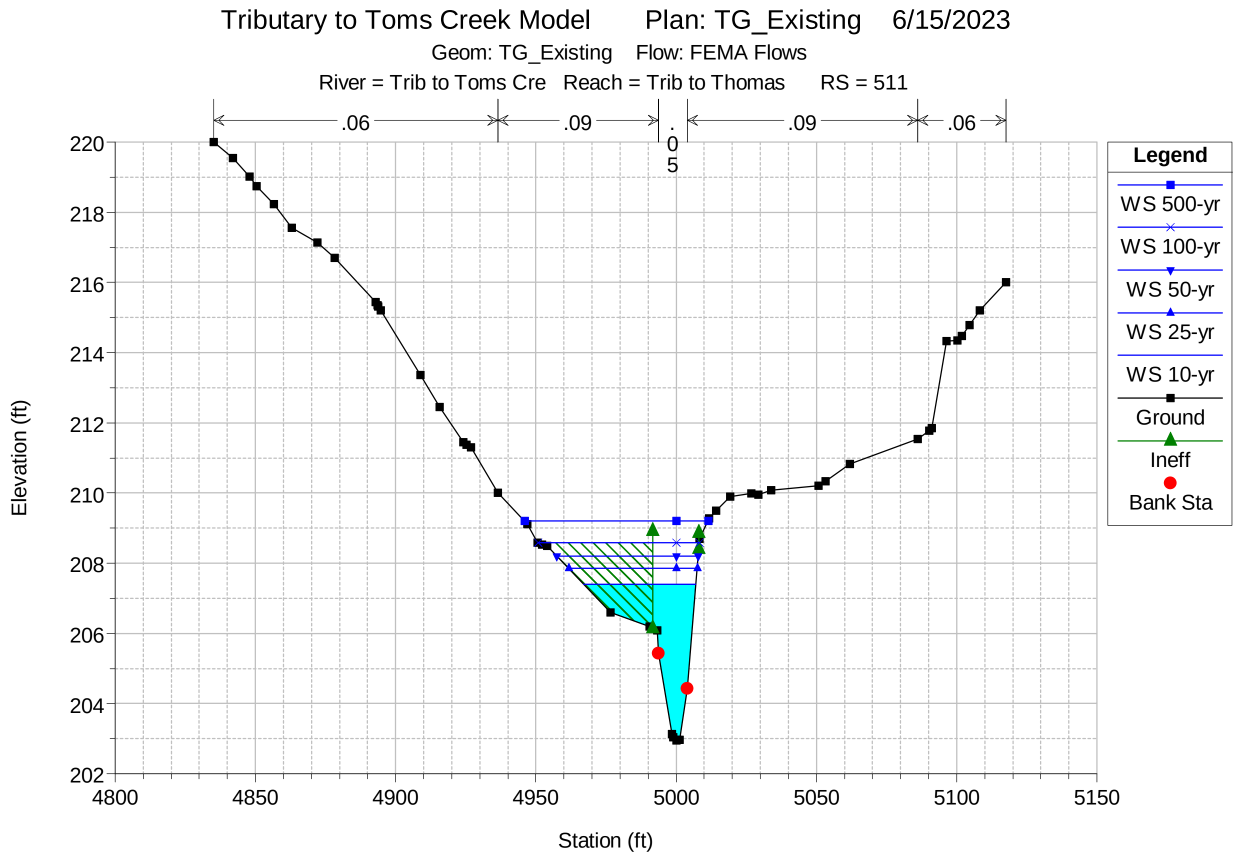
# Tributary A
# Existing Cross Sections



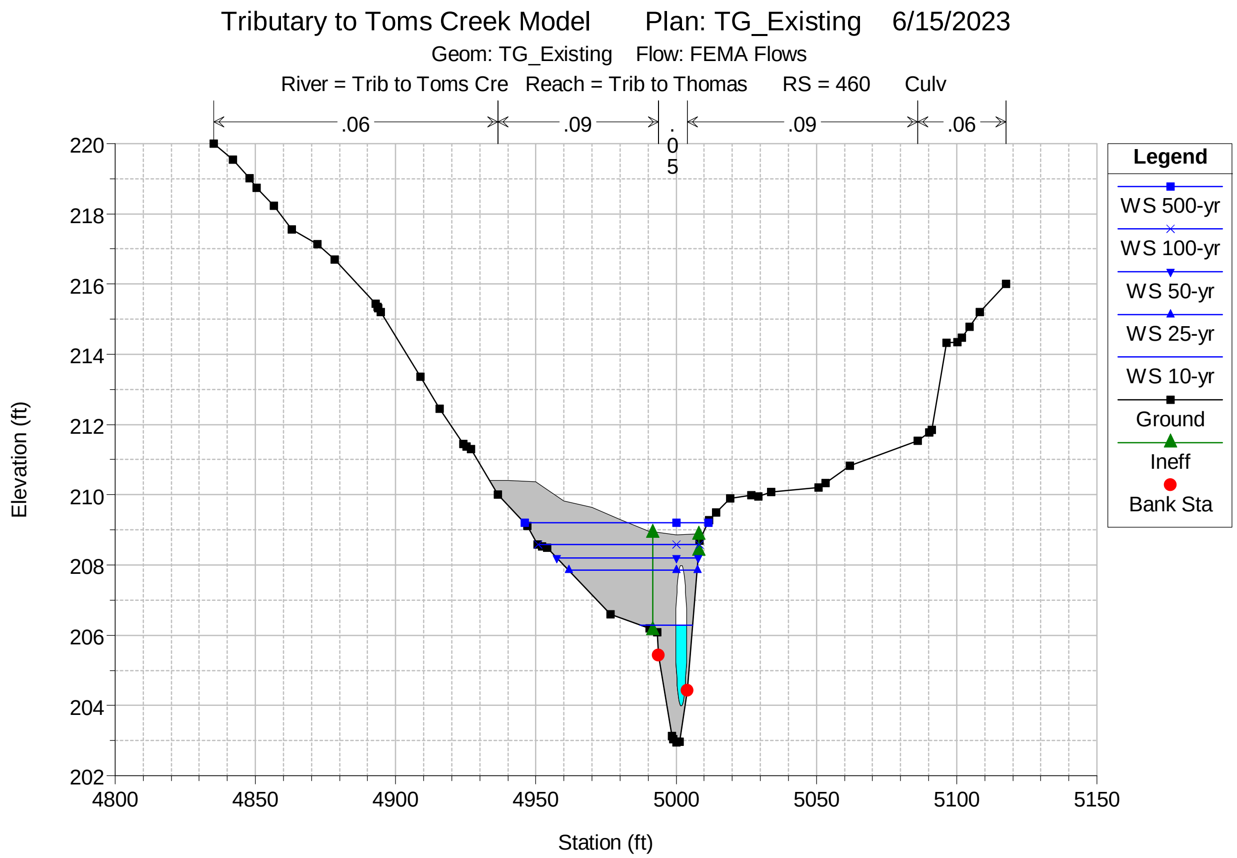
Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 608
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta

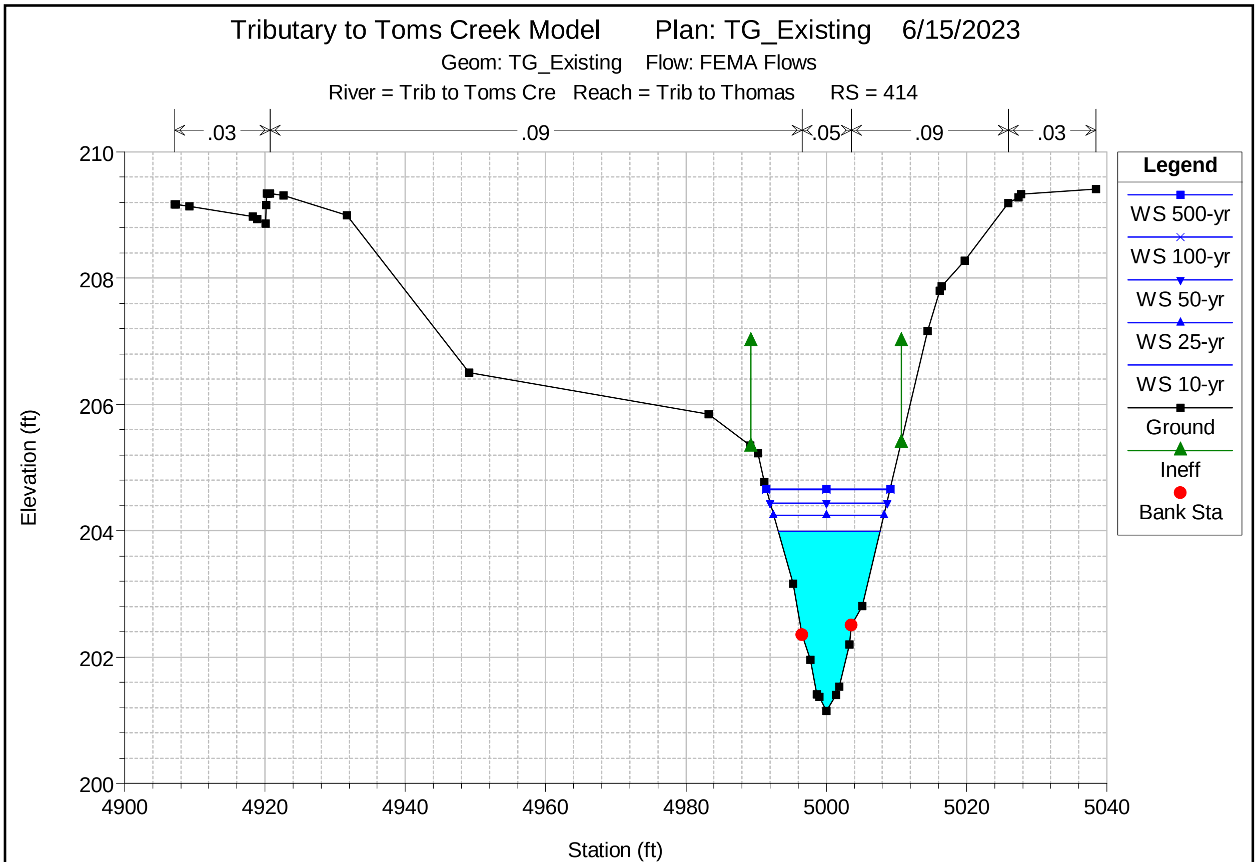
Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 558
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta

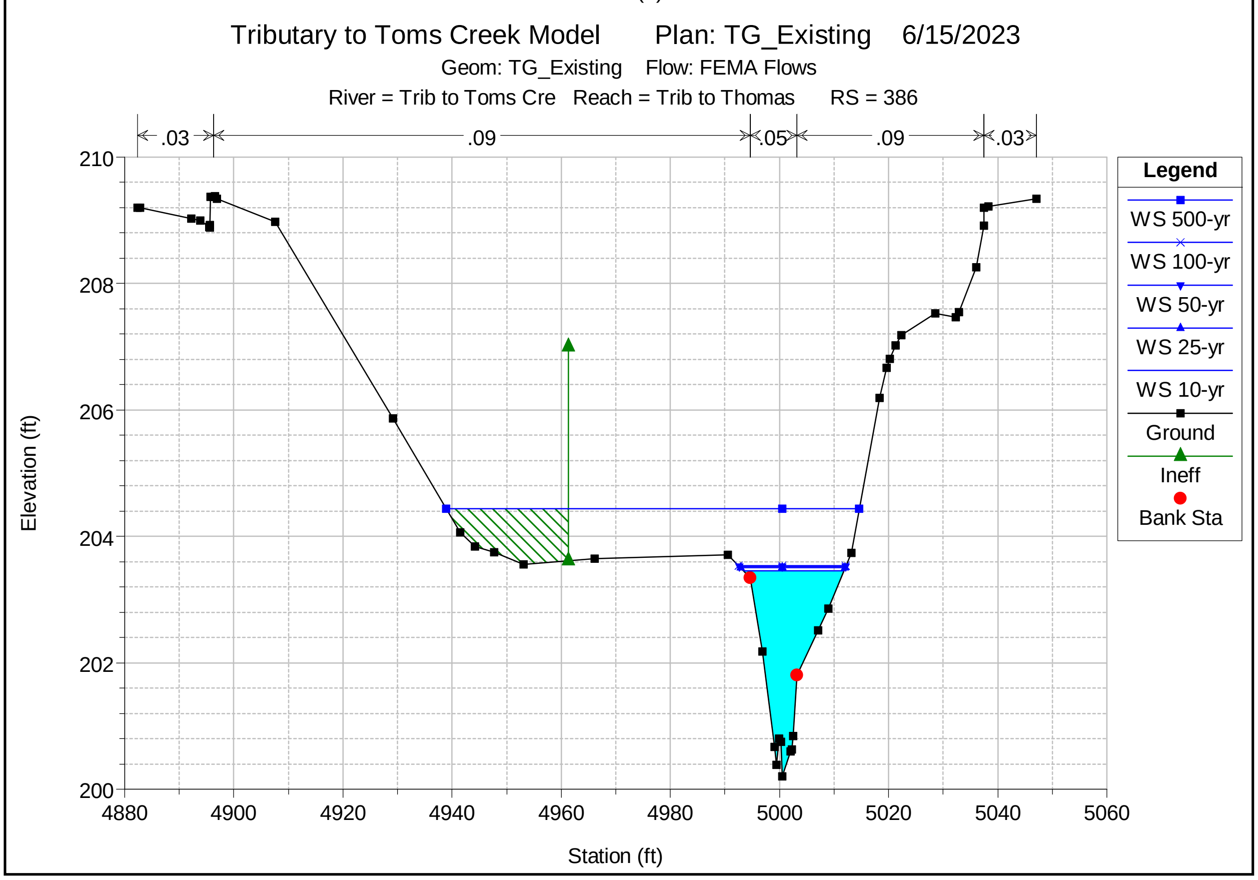


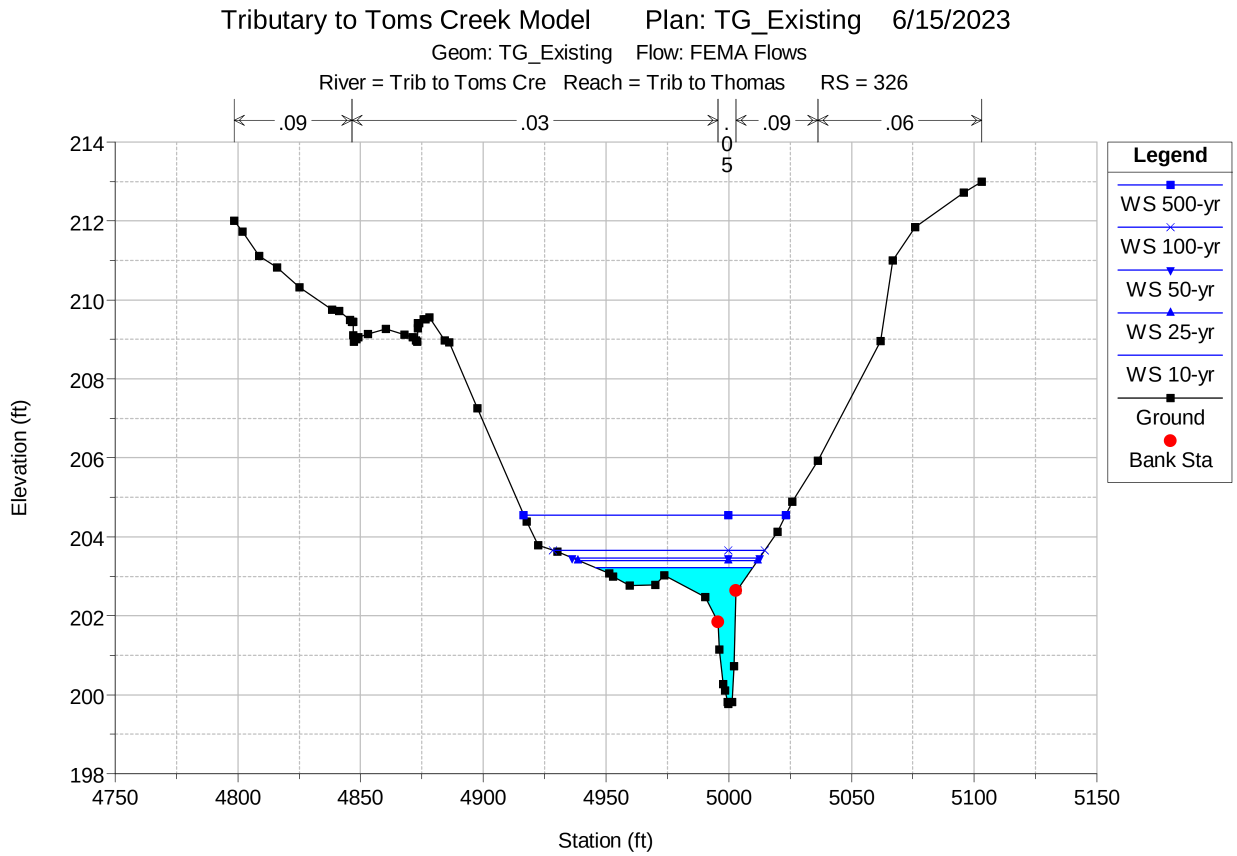
Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 511
.06
.09
.05
.09
.06
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
220
218
216
214
212
210
208
206
204
202
4800
4850
4900
4950
5000
5050
5100
5150

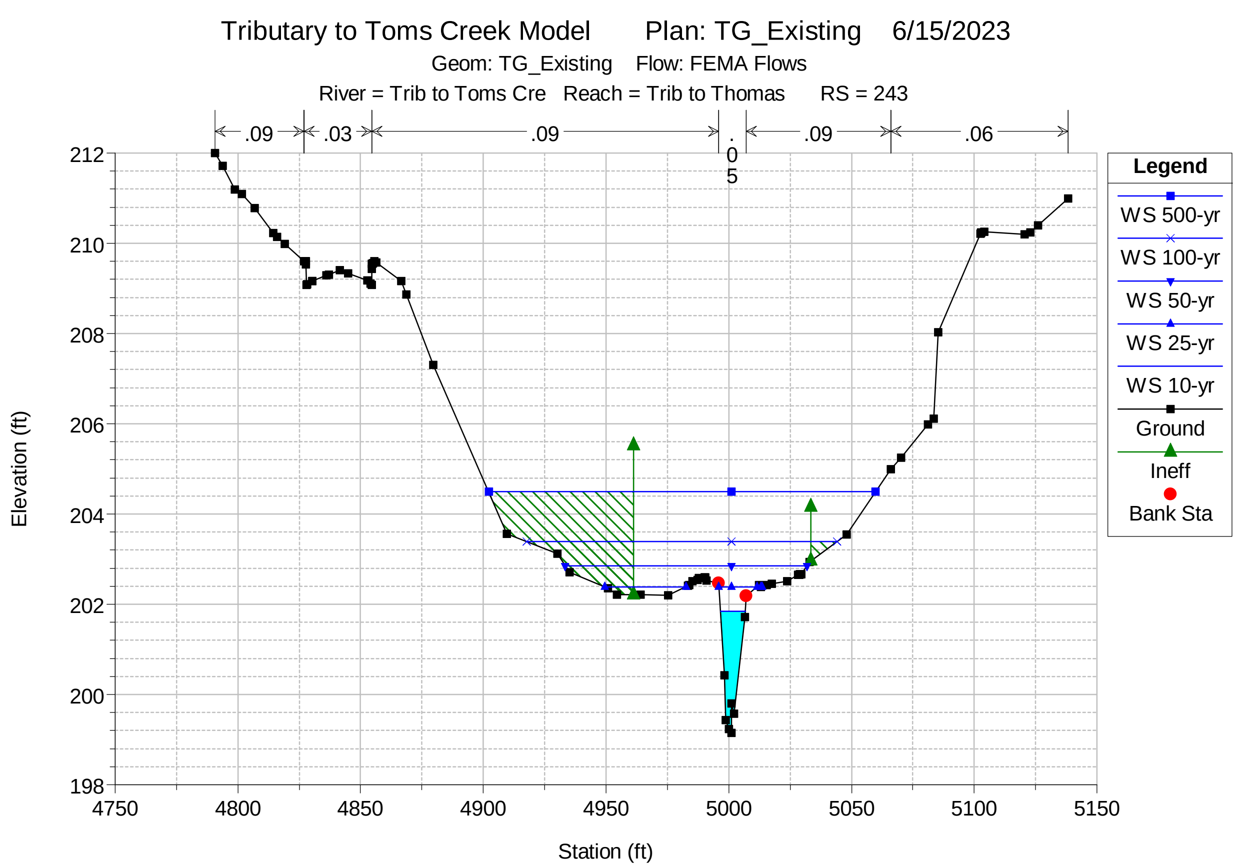



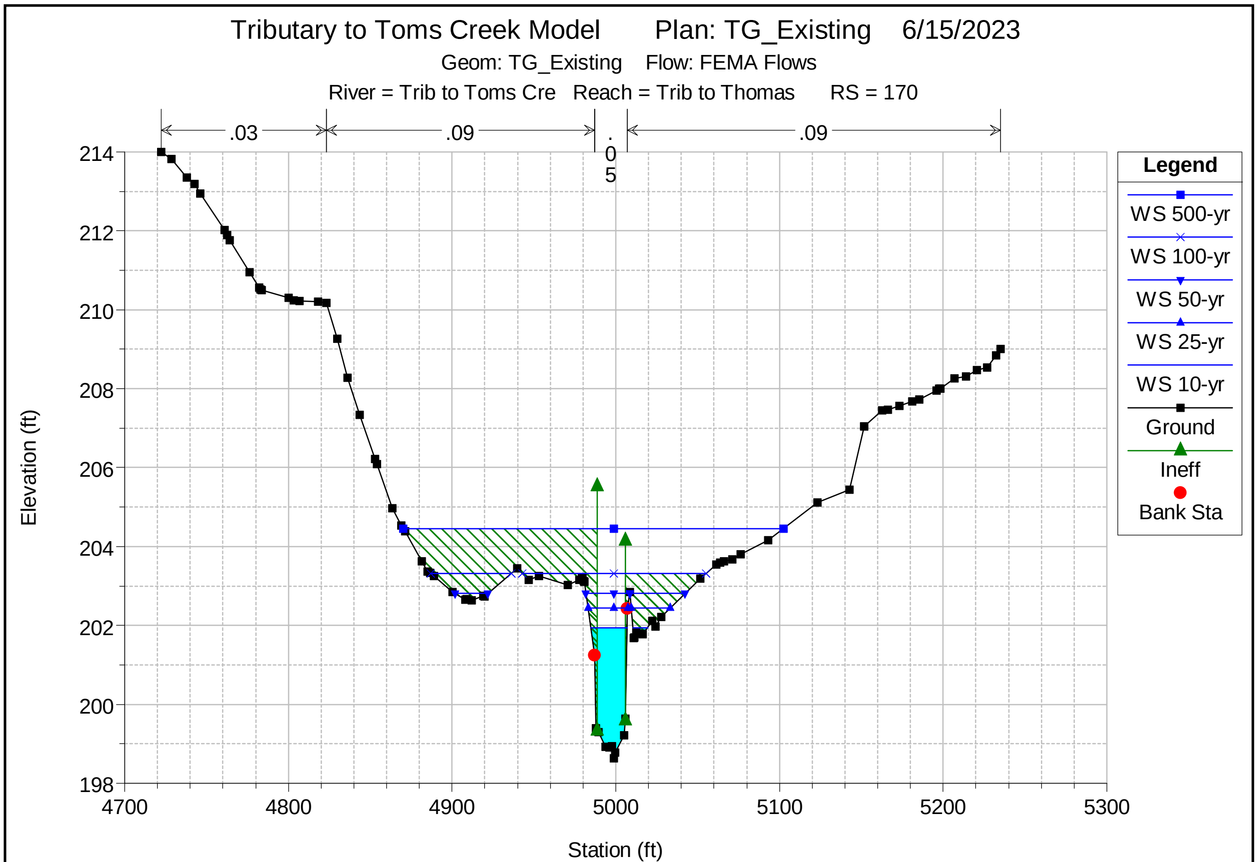
Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 460 Culv
.06
.09
.05
.09
.06
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
220
218
216
214
212
210
208
206
204
202
4800
4850
4900
4950
5000
5050
5100
5150


Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 414
.03
.09
.05
.09
.03
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

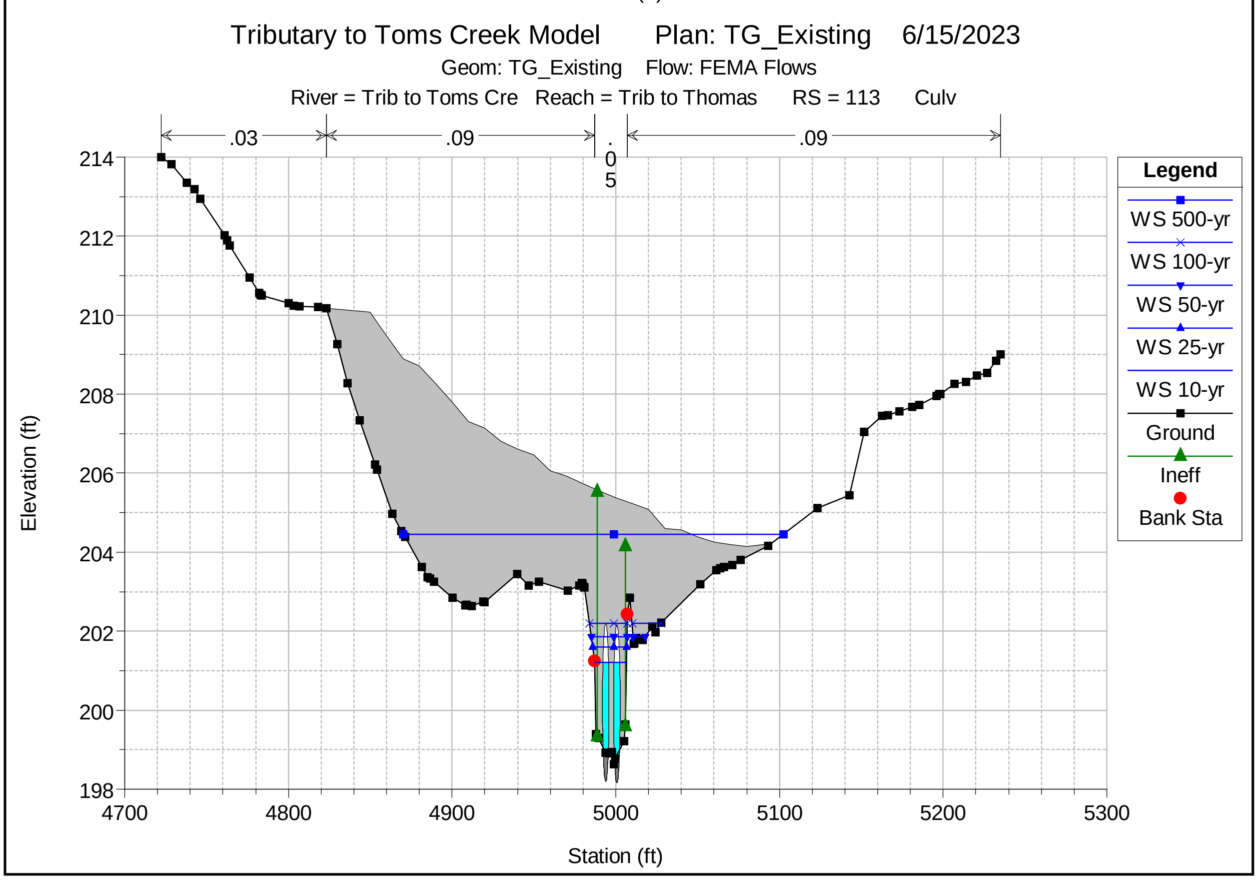

Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 386
.03
.09
.05
.09
.03
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta


Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 326
.09
.03
.05
.09
.06
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

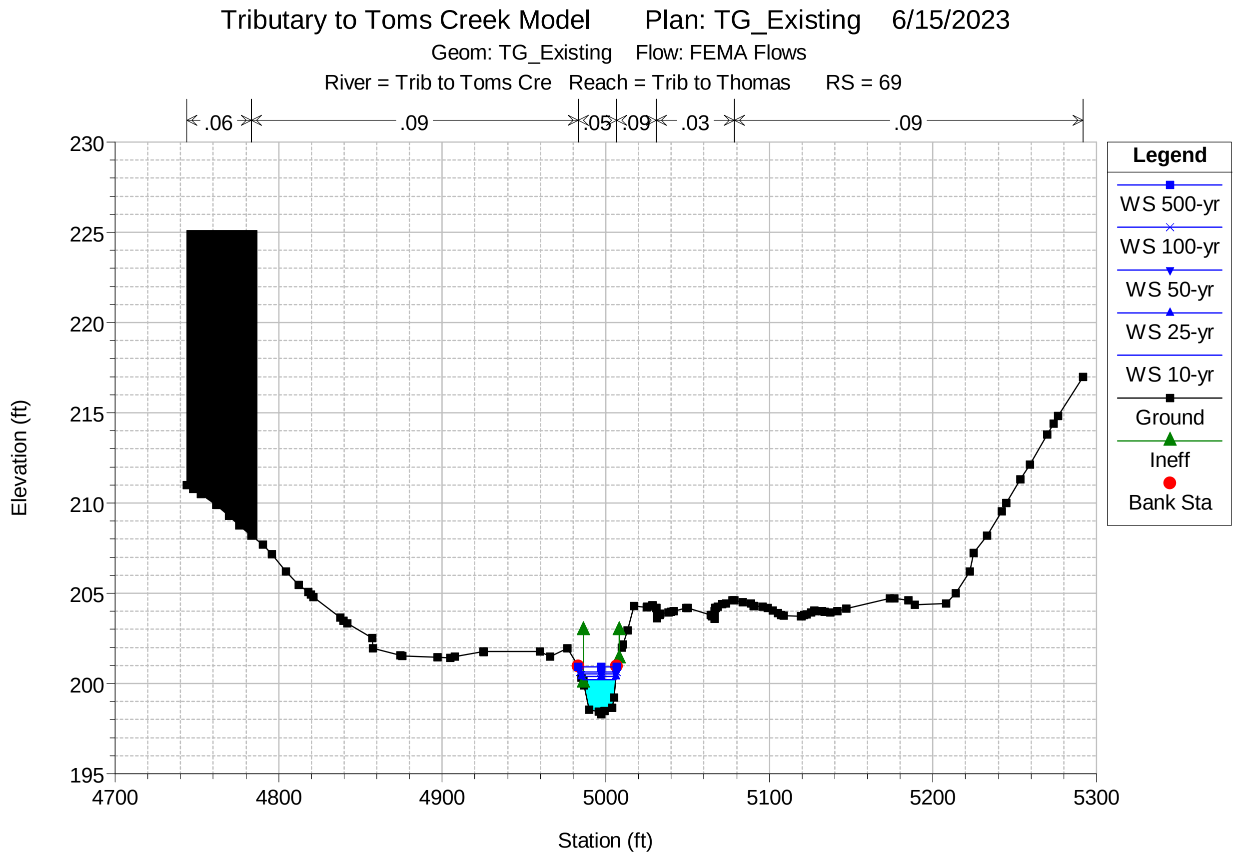

Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 243
.09
.03
.09
.05
.09
.06
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)



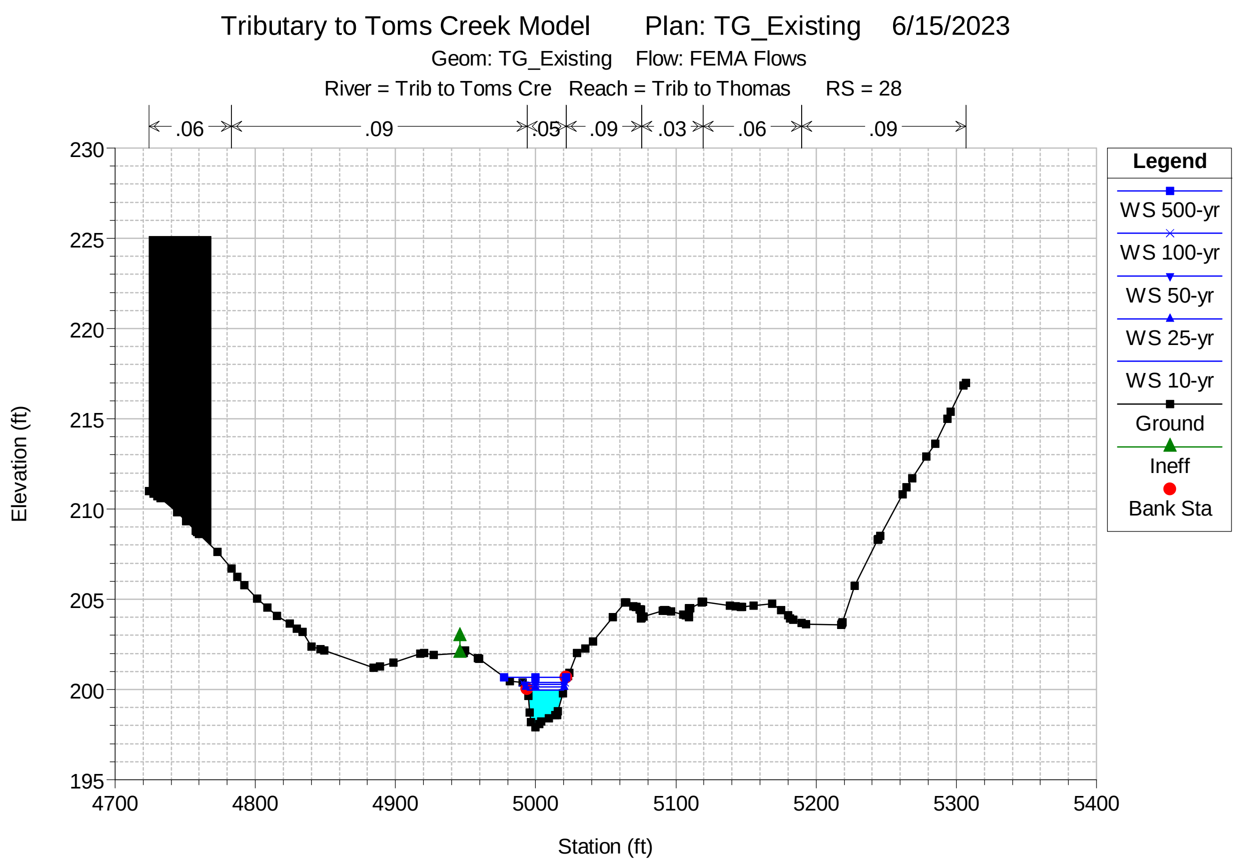
Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 170
.03
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 113 Culv
.03
.09
.05
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

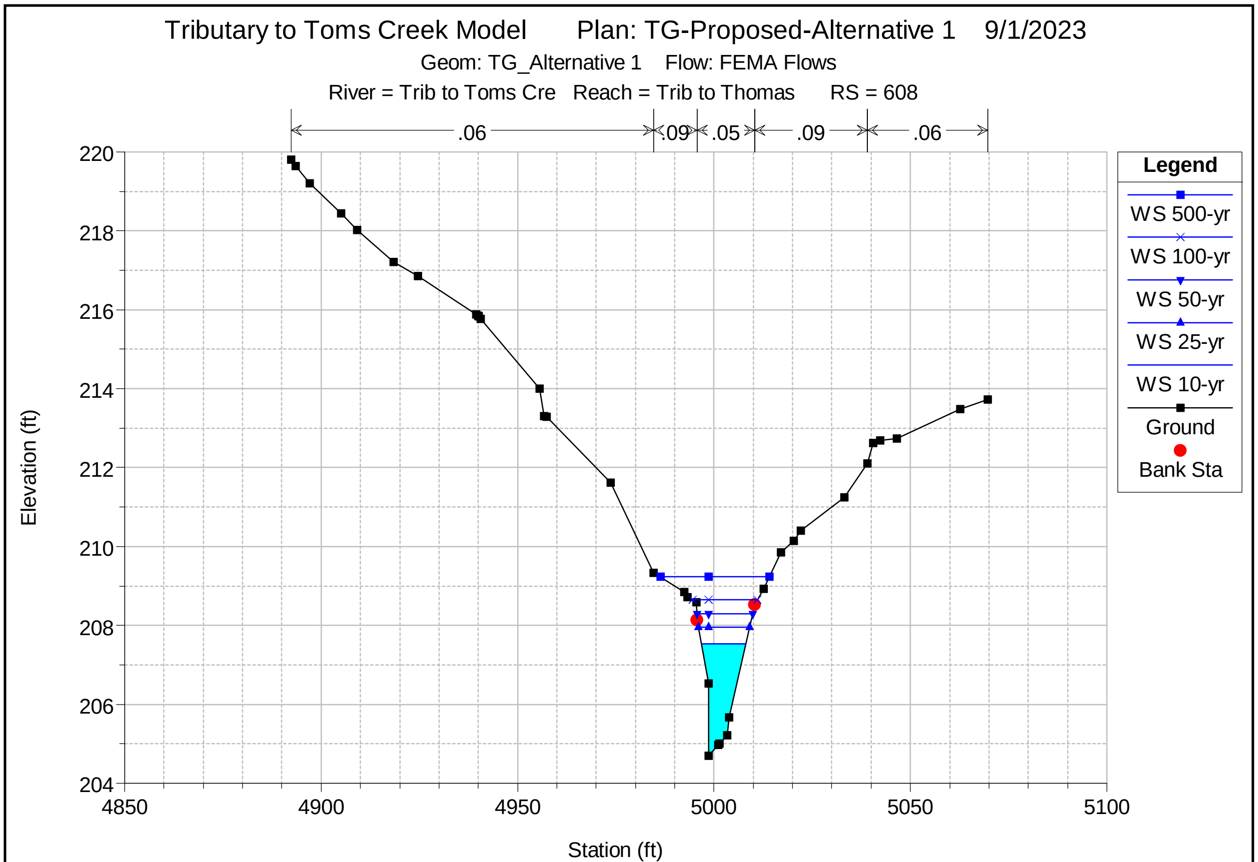


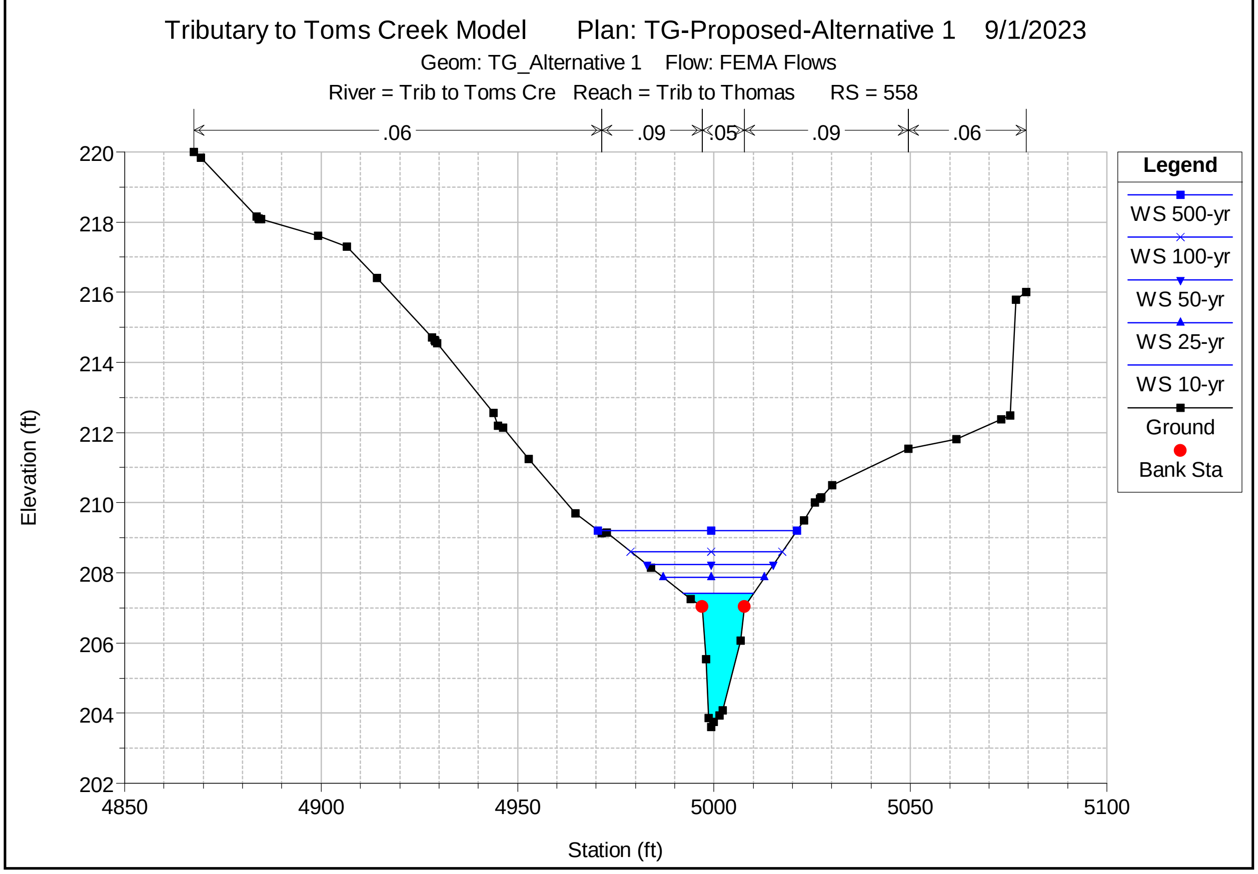
Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 69
.06
.09
.05
.09
.03
.09
Elevation (ft)
Station (ft)
230
225
220
215
210
205
200
195
4700
4800
4900
5000
5100
5200
5300
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

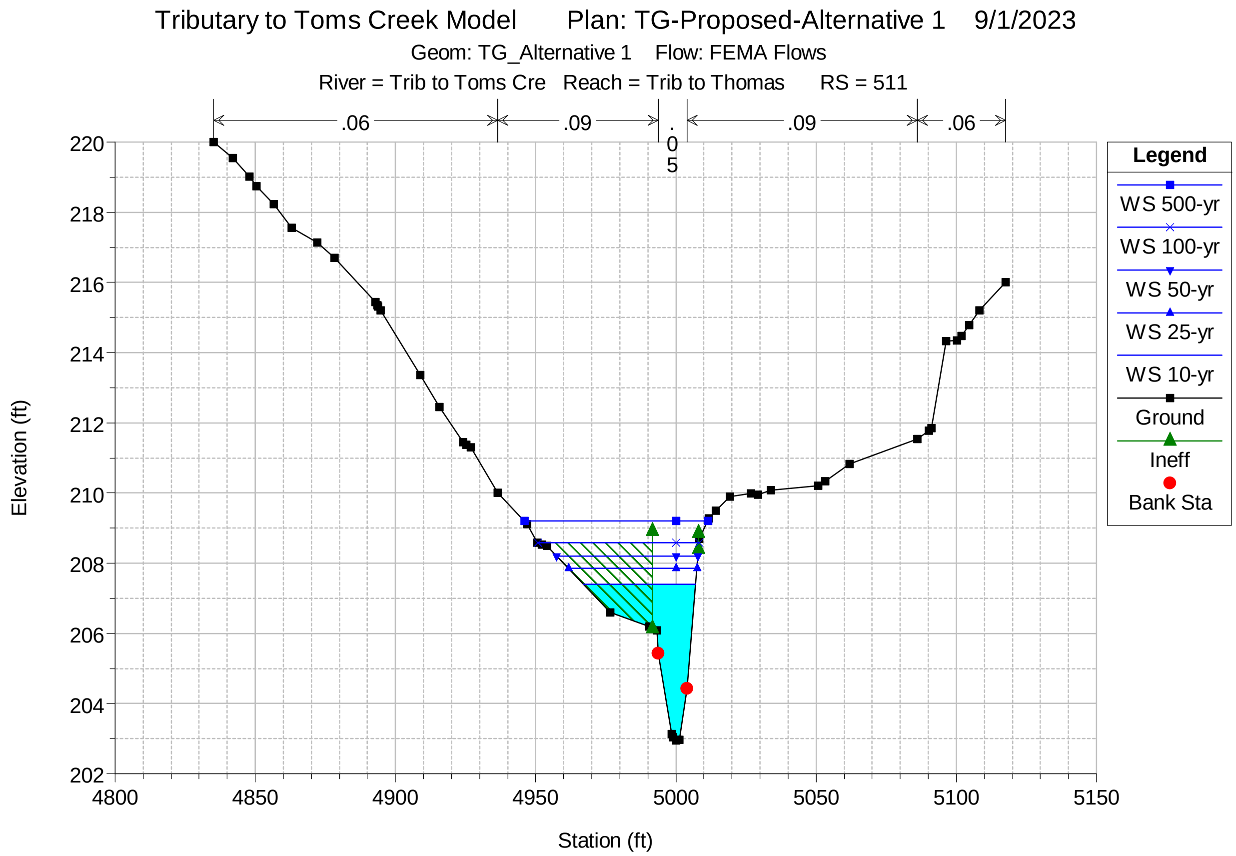



Tributary to Toms Creek Model Plan: TG_Existing 6/15/2023
Geom: TG_Existing Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 28
.06
.09
.05
.09
.03
.06
.09
Elevation (ft)
Station (ft)
230
225
220
215
210
205
200
195
4700
4800
4900
5000
5100
5200
5300
5400
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

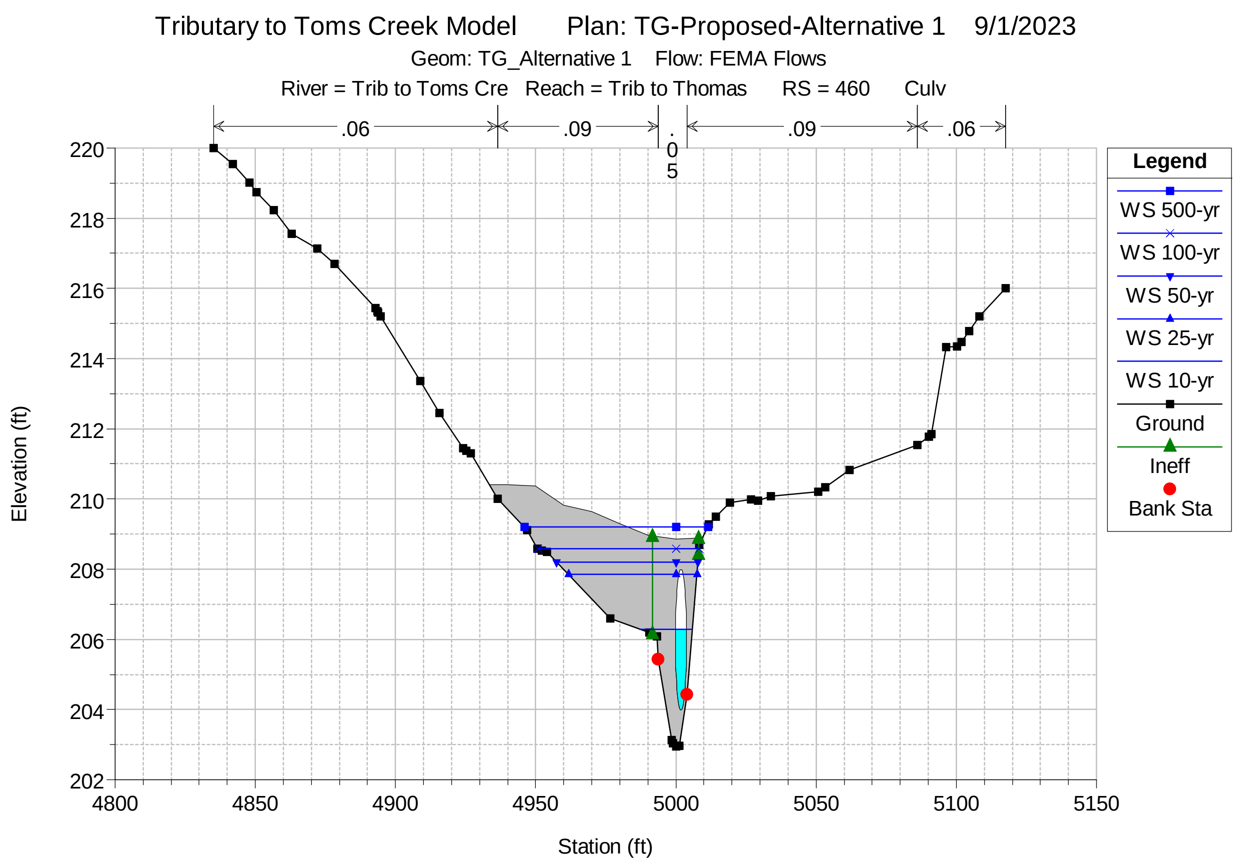
# Tributary A
# Proposed Cross Sections-Alternative 1


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 608
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta

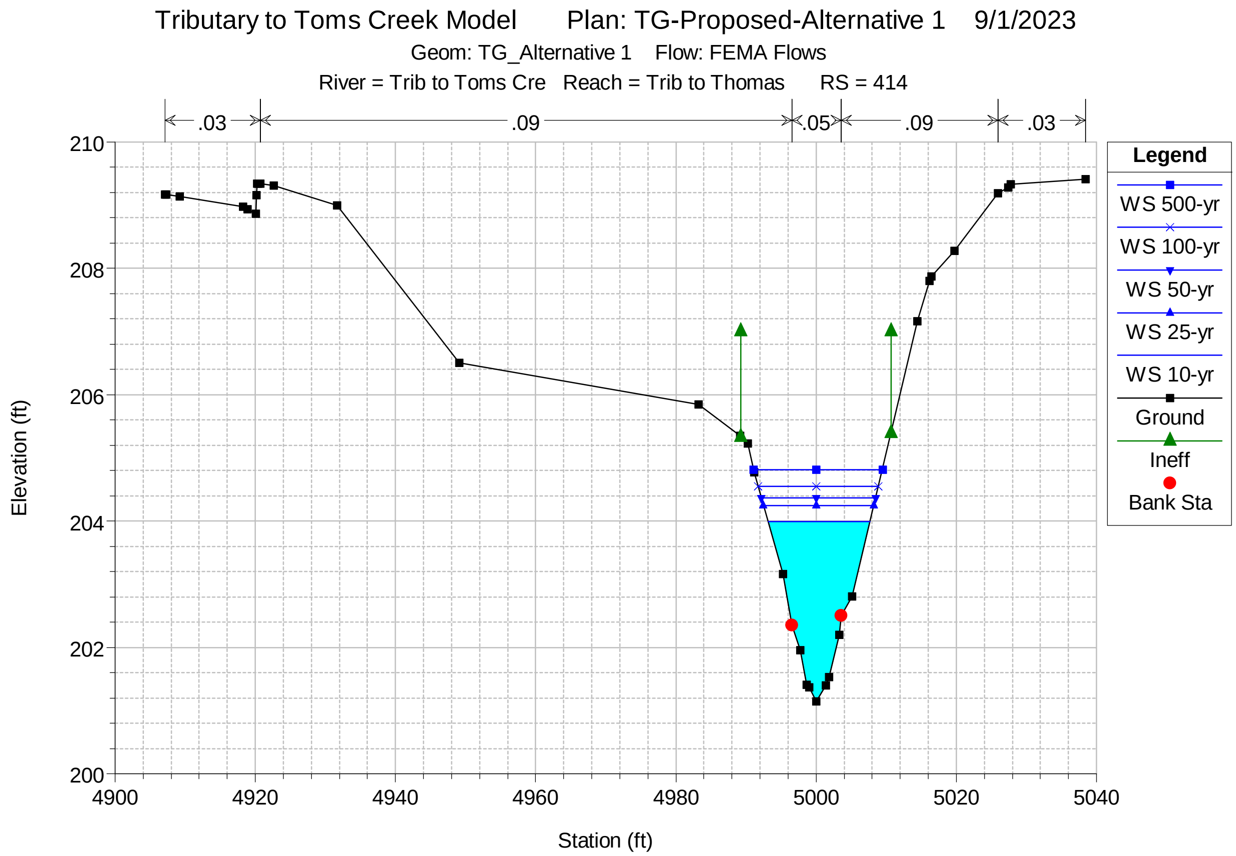

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 558
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta



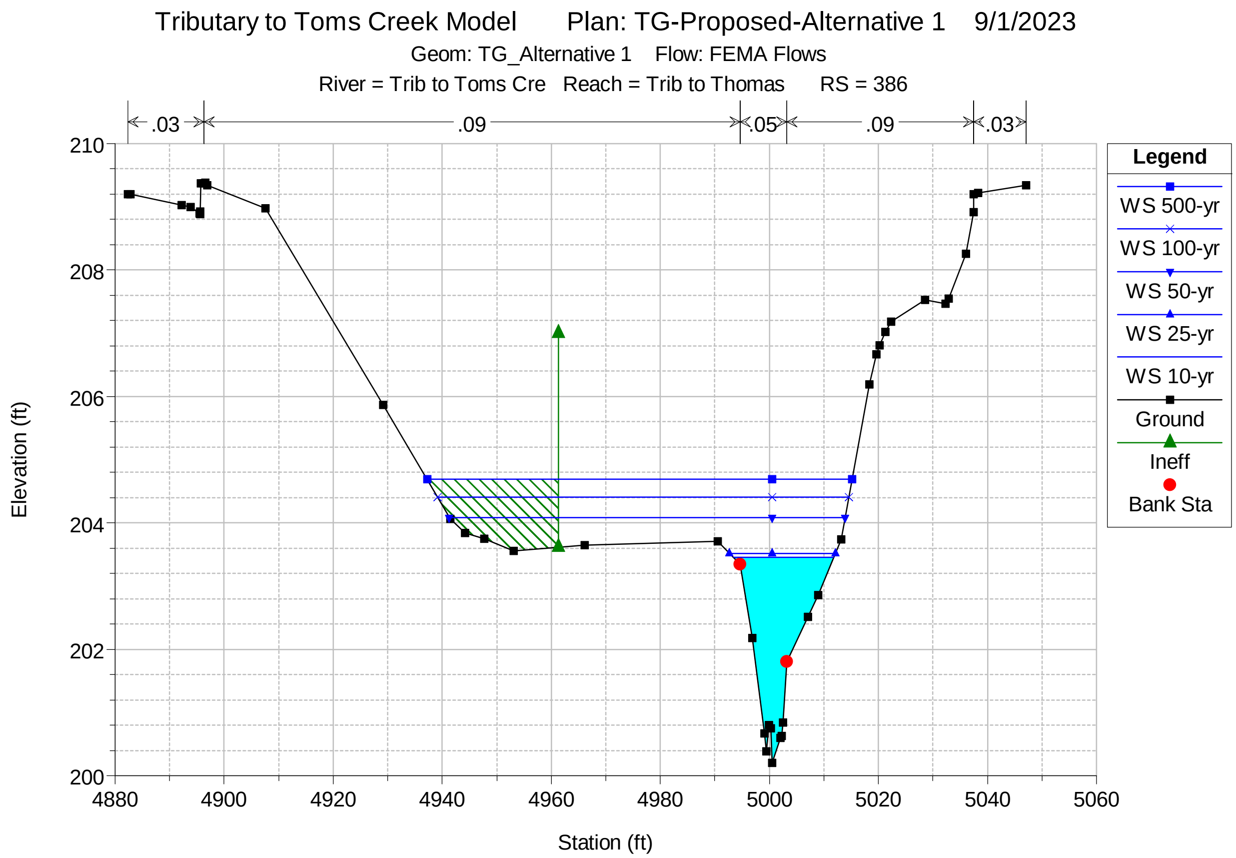
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 511
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

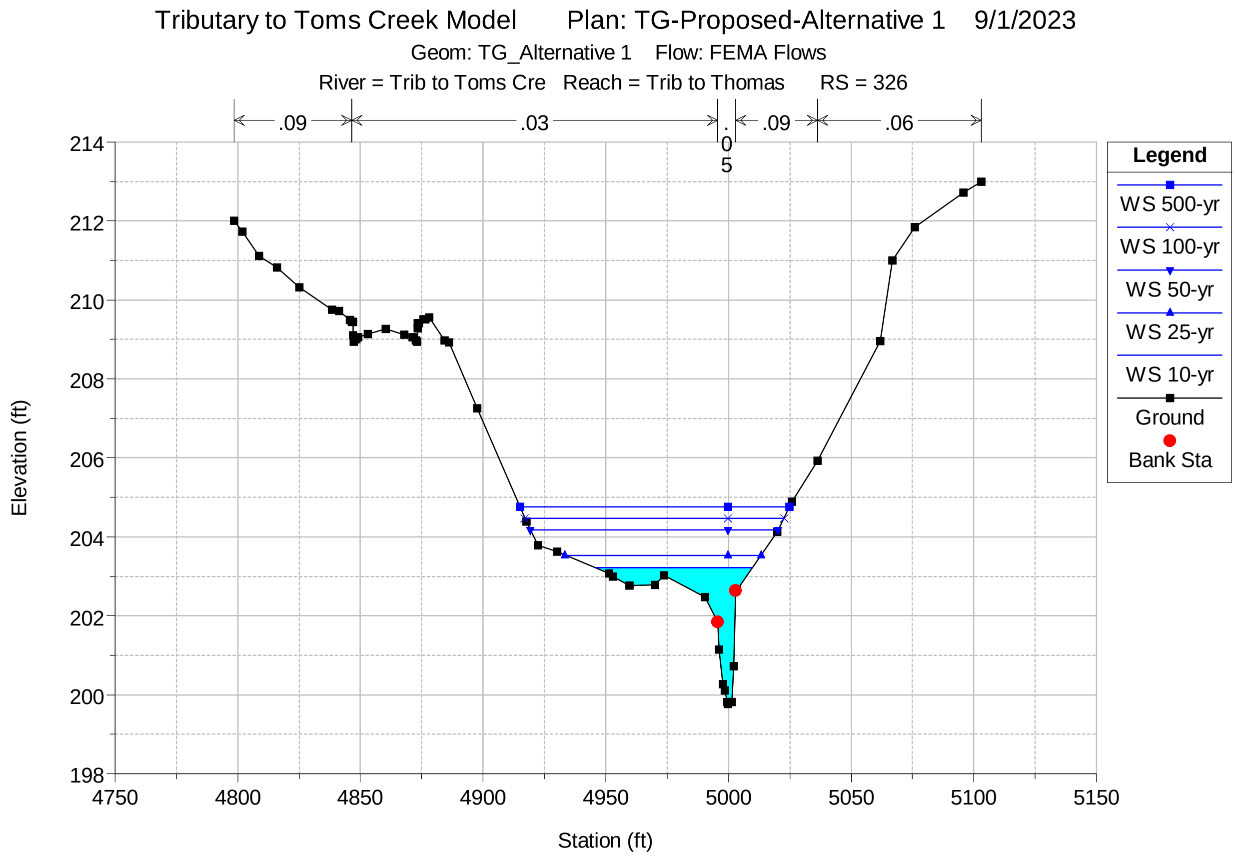
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 460 Culv
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta



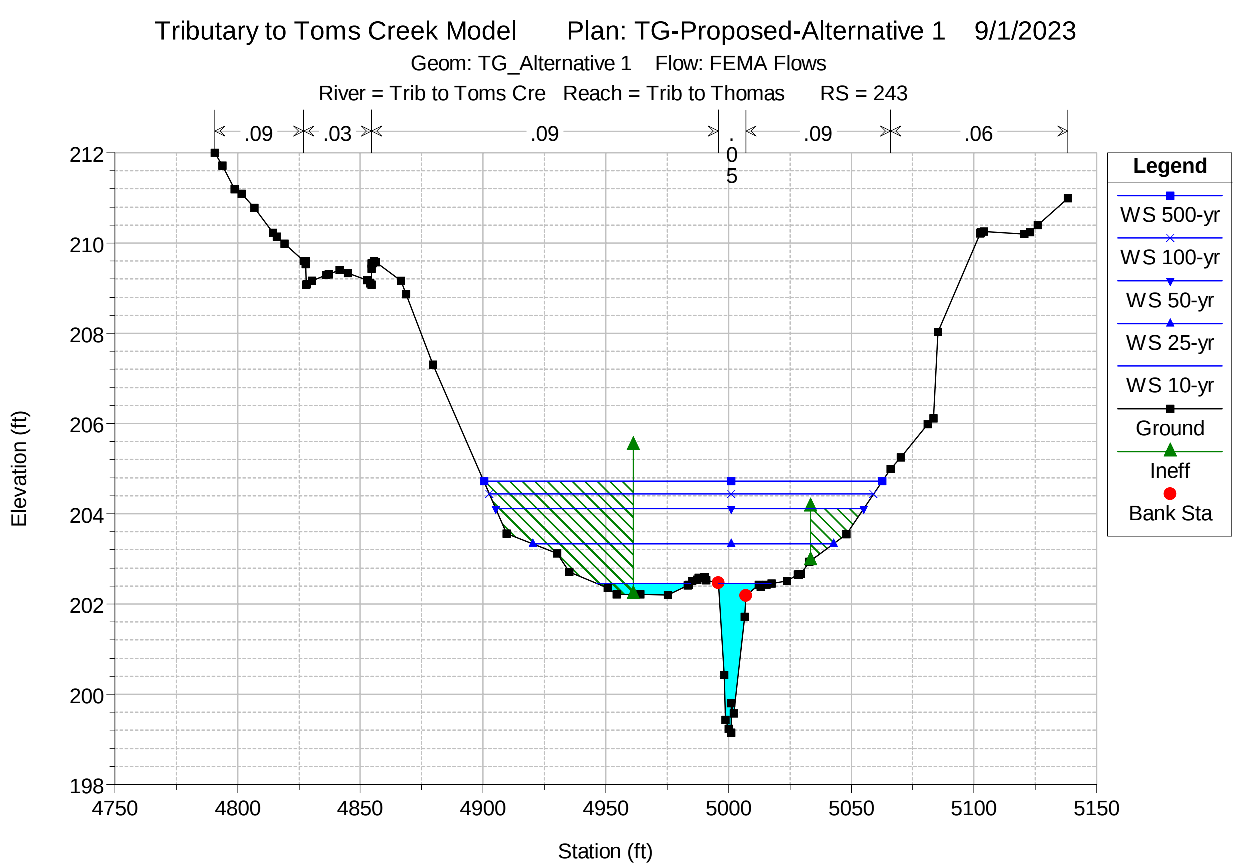
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 414
.03
.09
.05
.09
.03
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

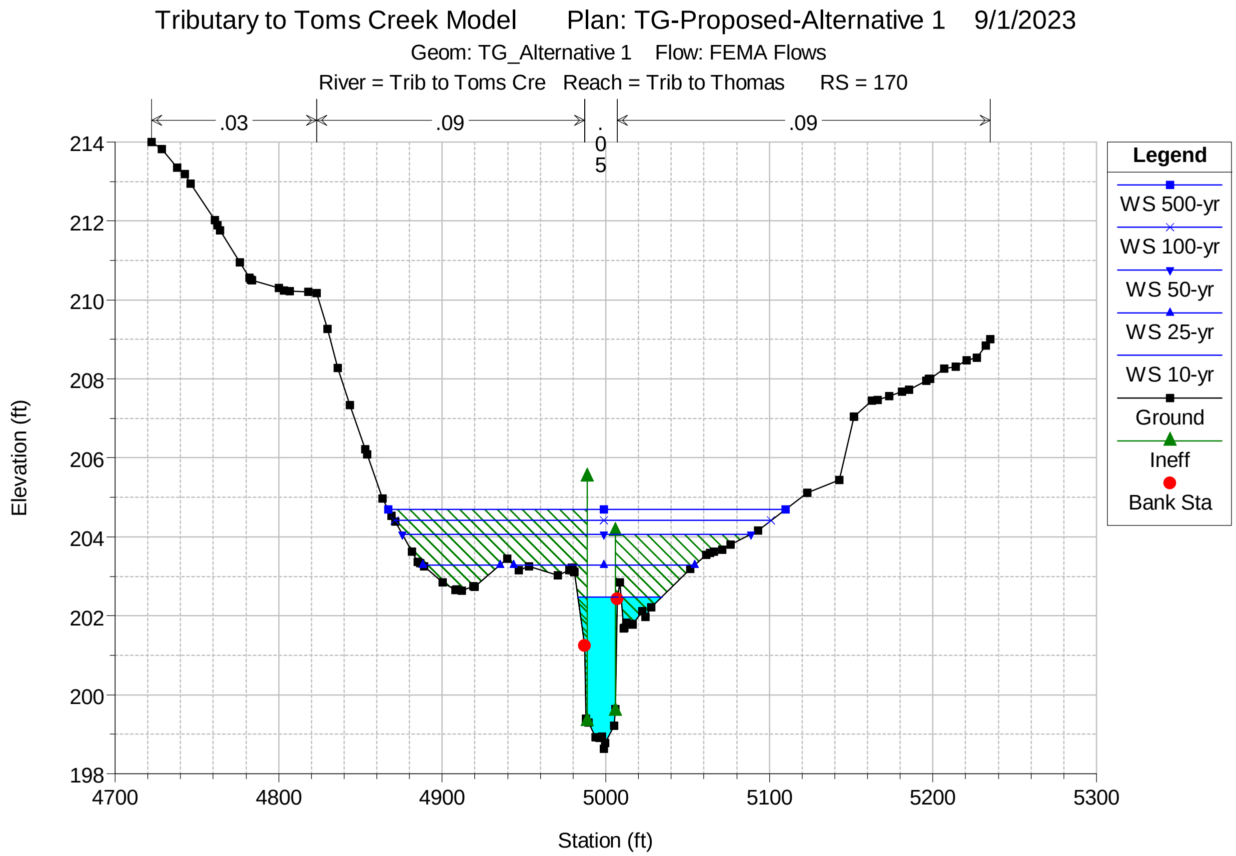
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 386
.03
.09
.05
.09
.03
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

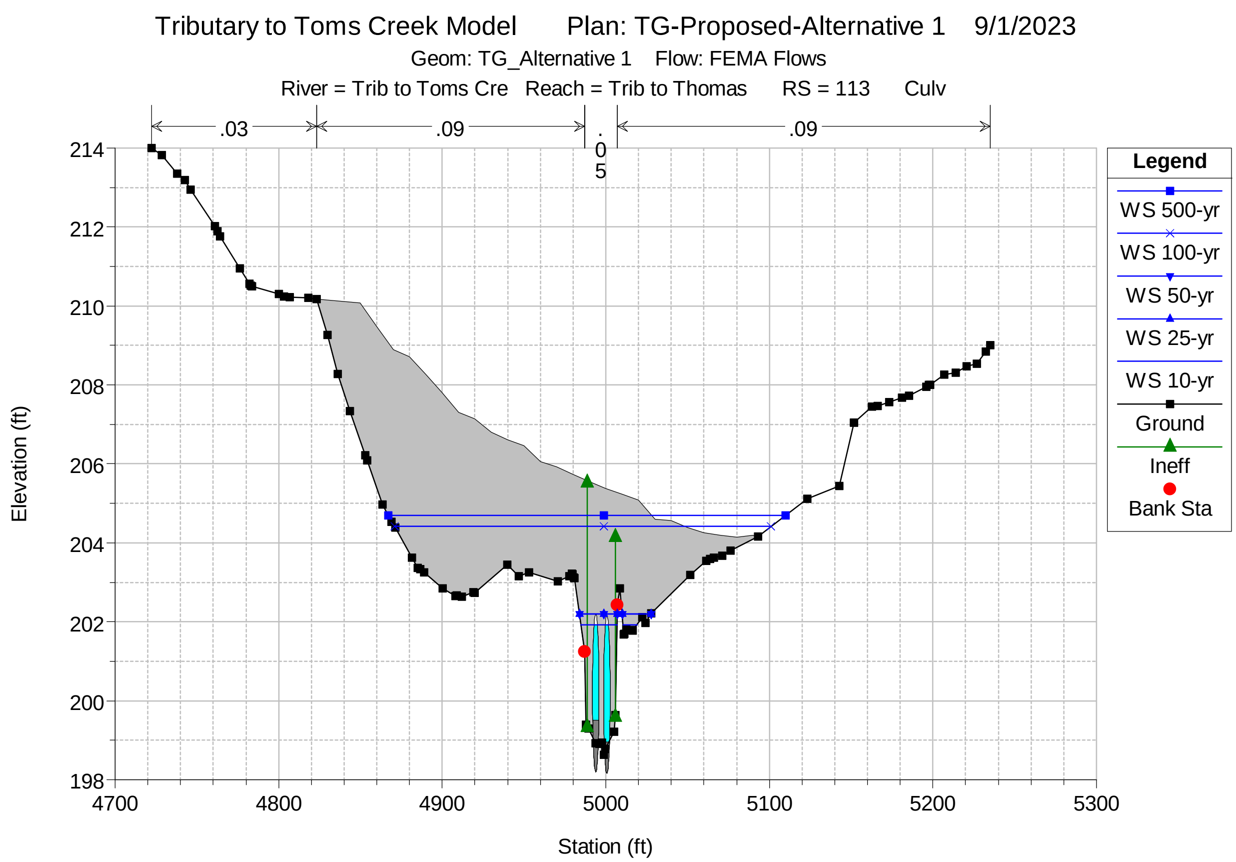


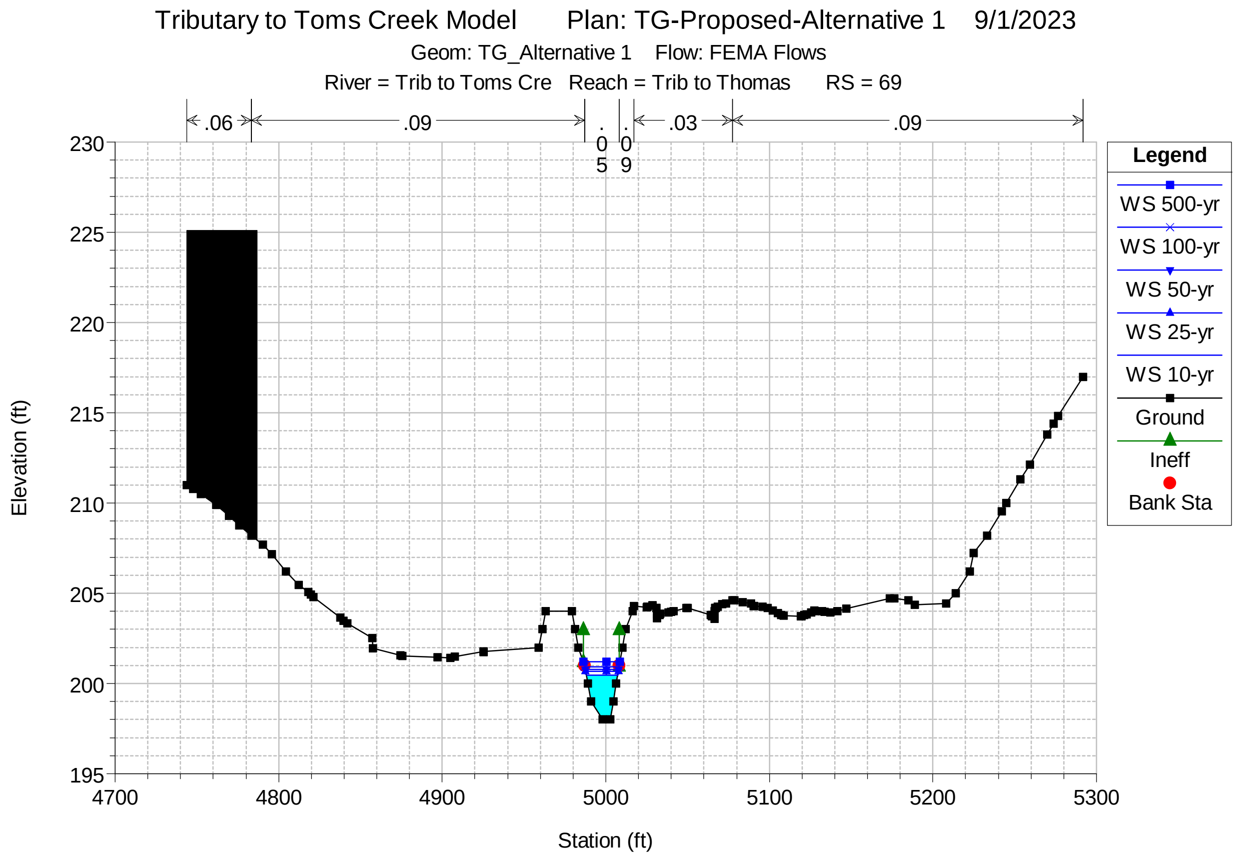
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 326
.09
.03
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta

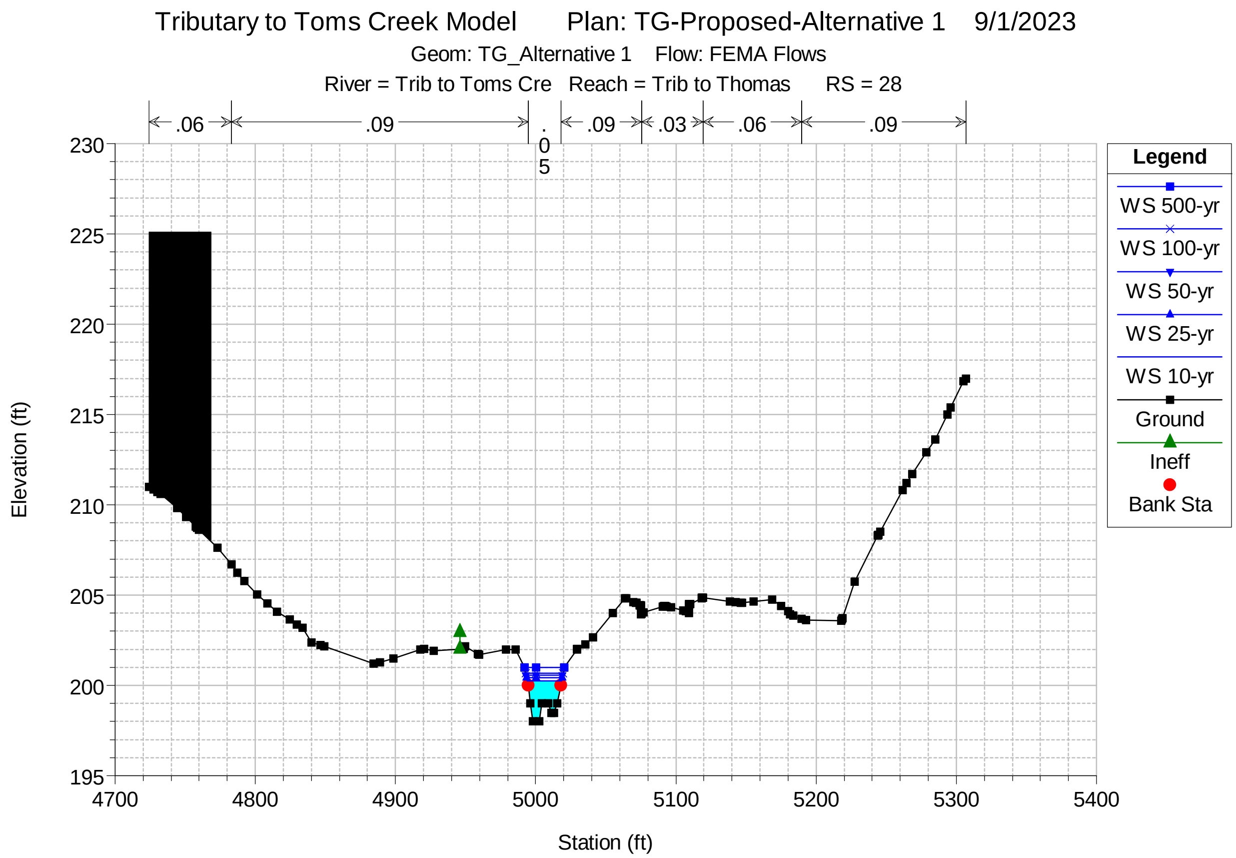



Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 243
.09
.03
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

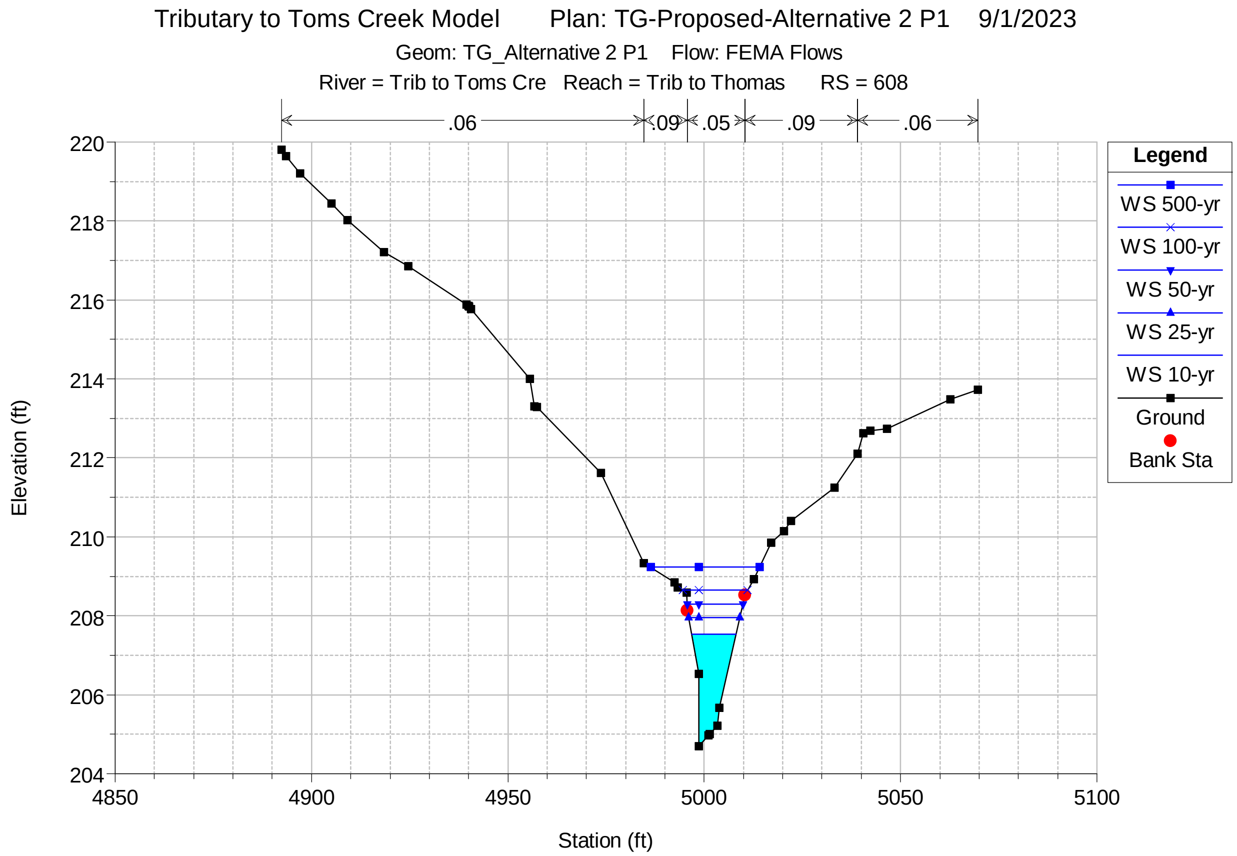

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 170
.03
.09
.05
.09
Elevation (ft)
Station (ft)
214
212
210
208
206
204
202
200
198
4700
4800
4900
5000
5100
5200
5300
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 113 Culv
.03
.09
.05
.09
Elevation (ft)
Station (ft)
214
212
210
208
206
204
202
200
198
4700
4800
4900
5000
5100
5200
5300
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

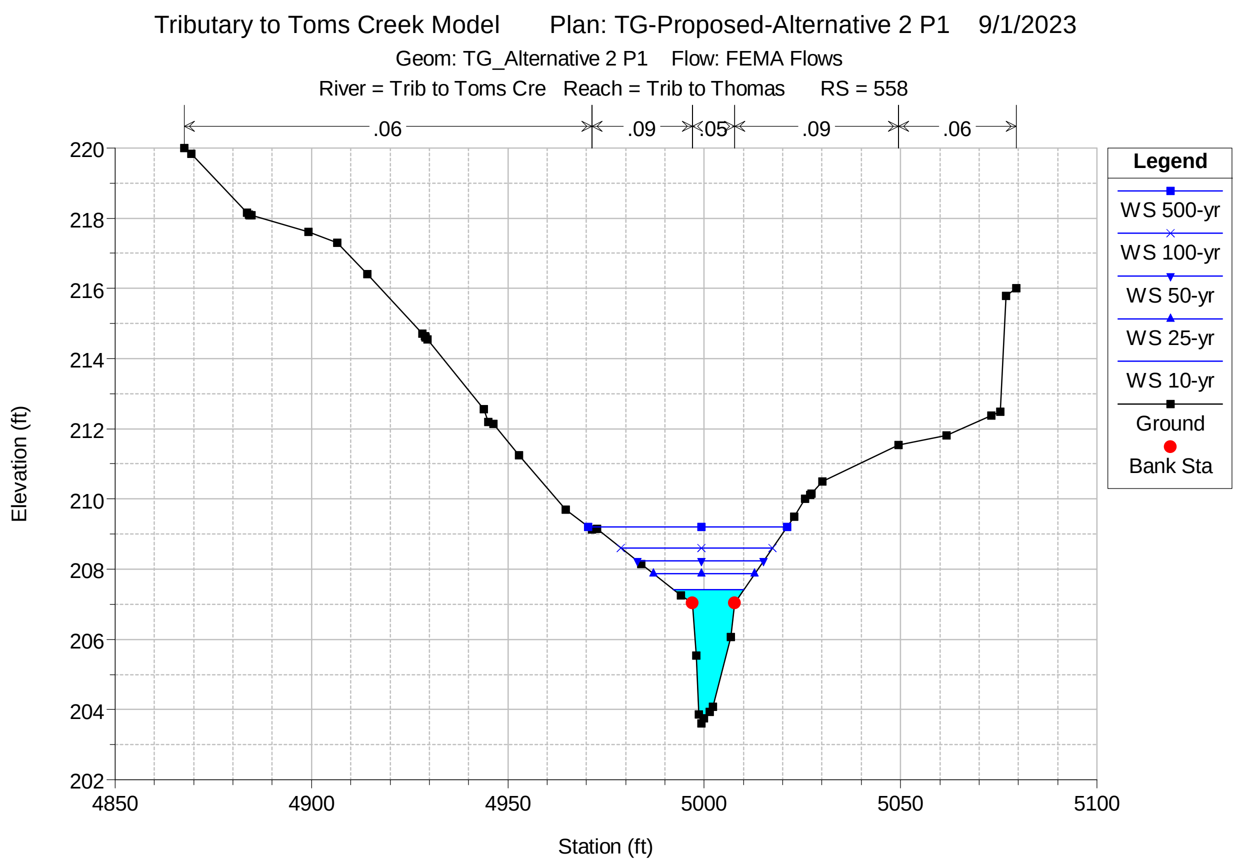

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 69
.06
.09
.05
.09
.03
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 1 9/1/2023
Geom: TG_Alternative 1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 28
.06
.09
.05
.09
.03
.06
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

# Tributary A
# Proposed Cross Sections-Alternative 2 Phase I

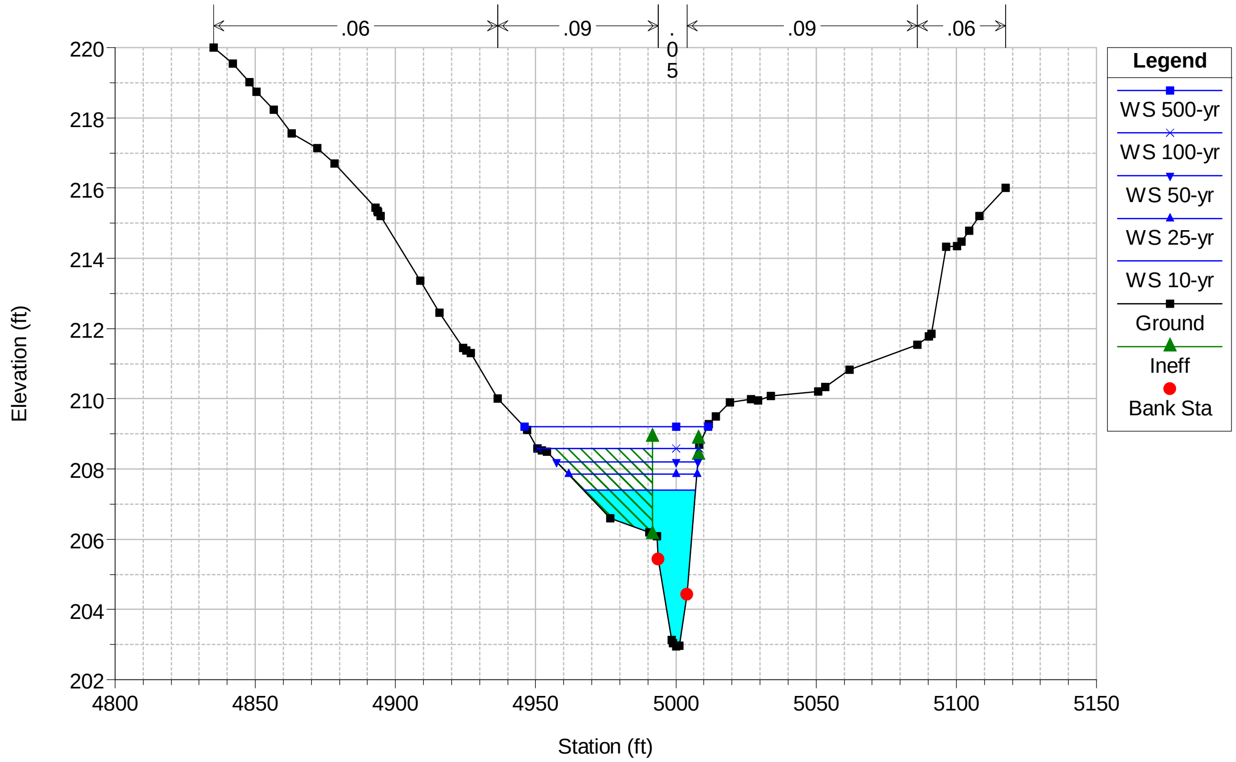


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 608
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta

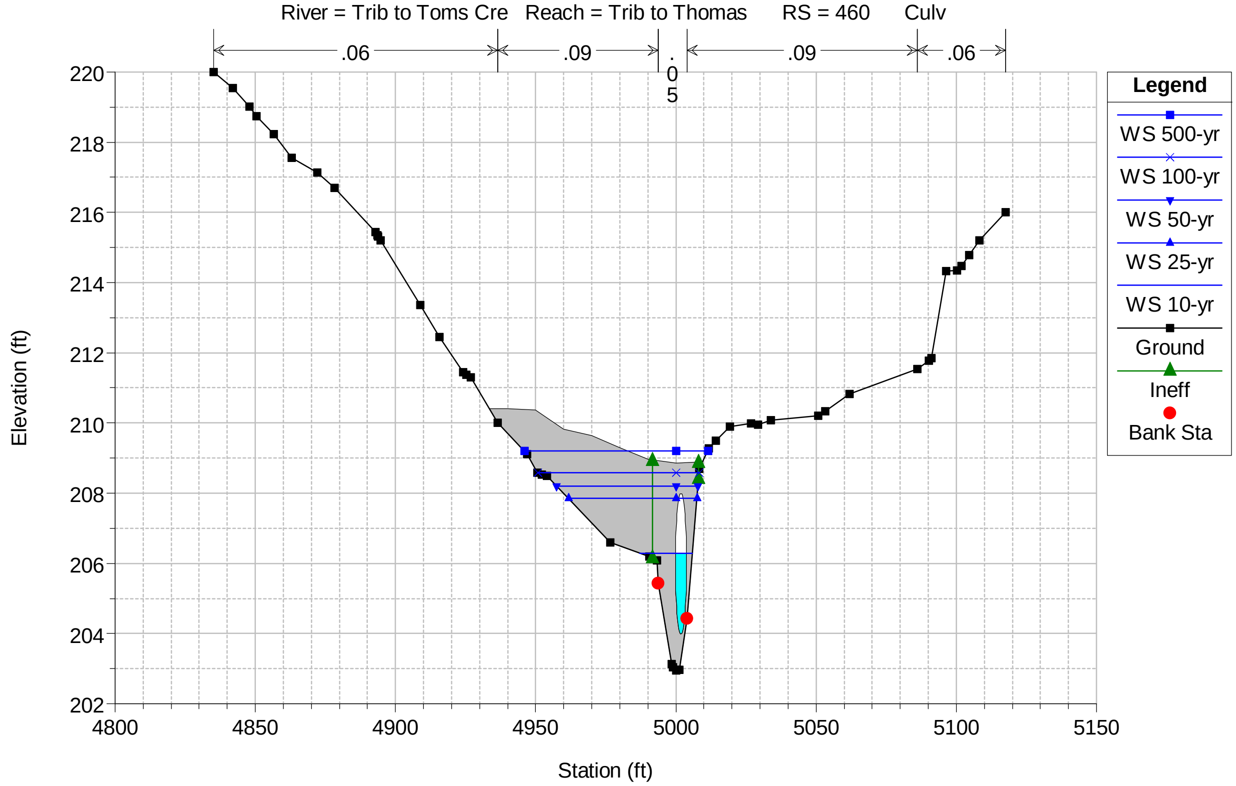



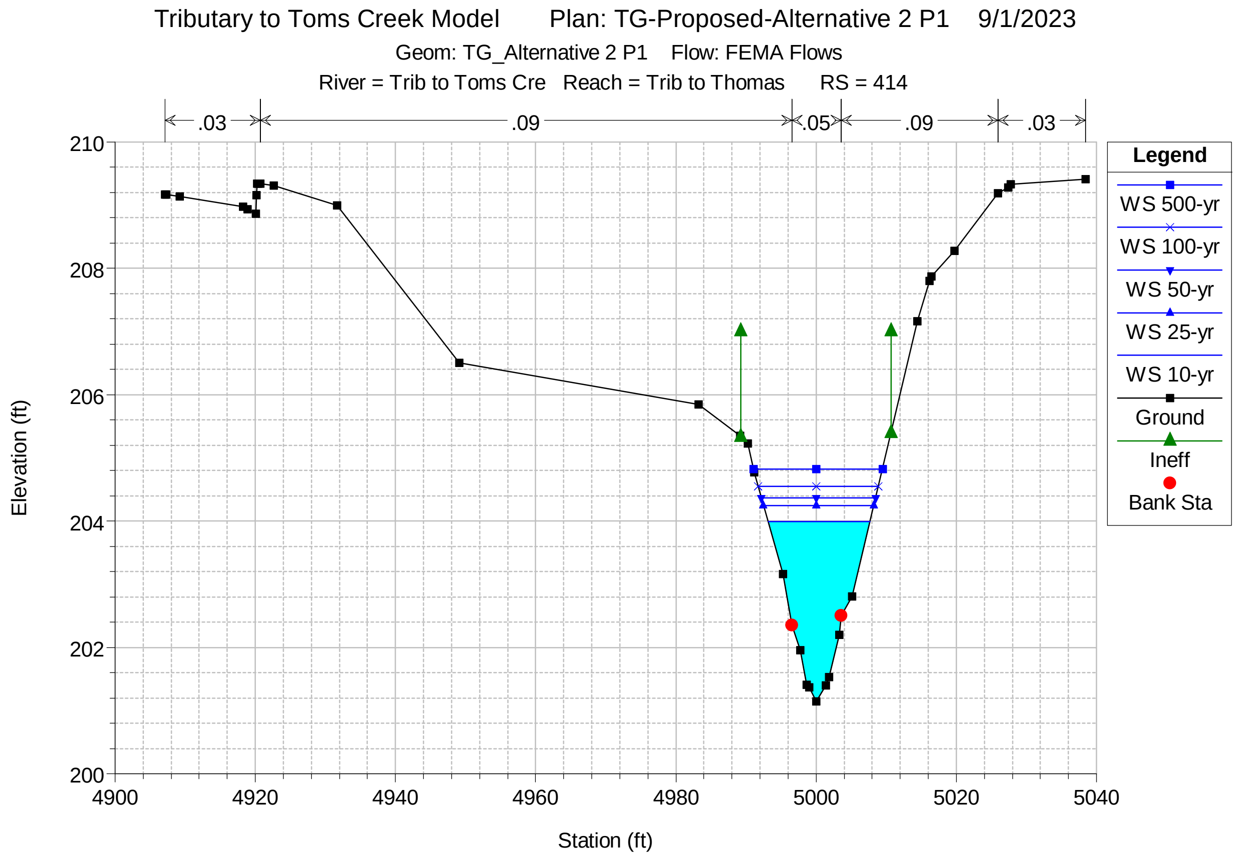
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 558
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 511

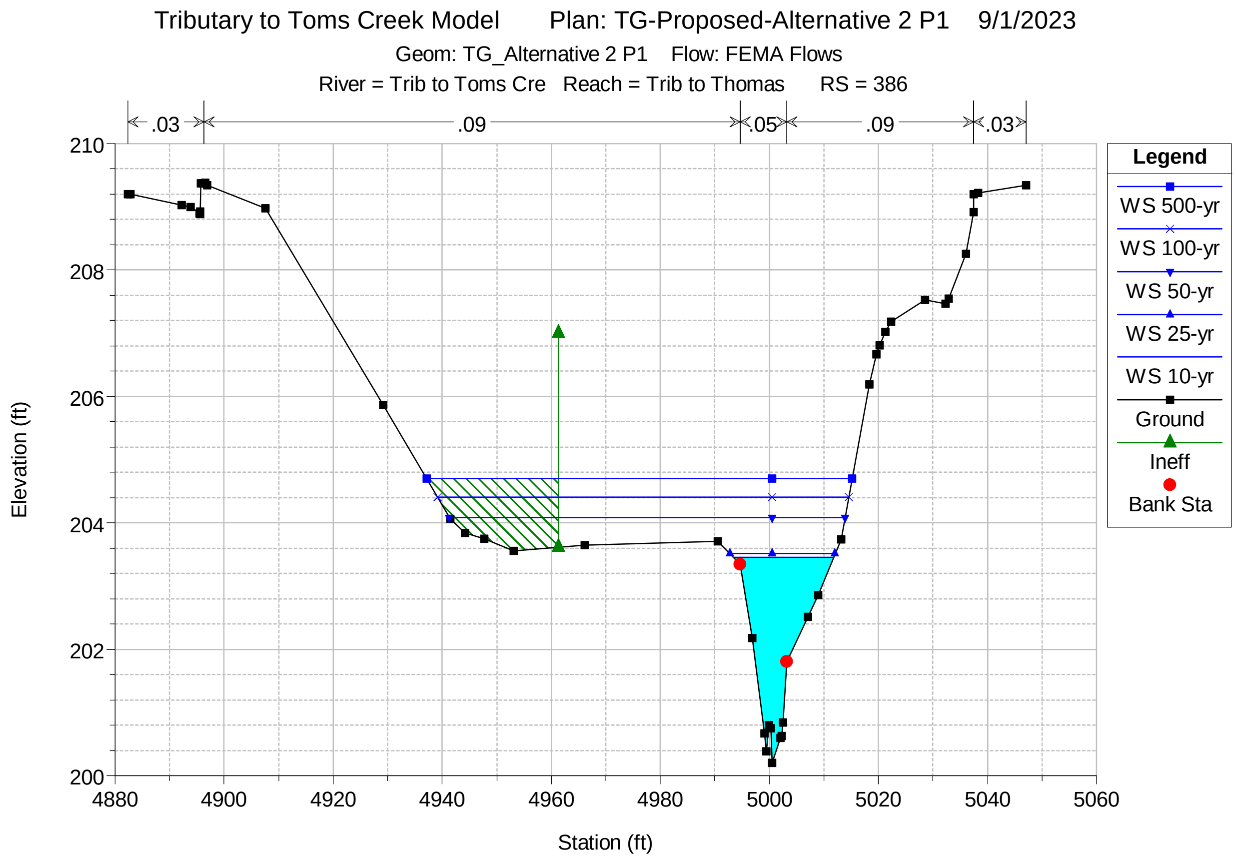



Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 460 Culv

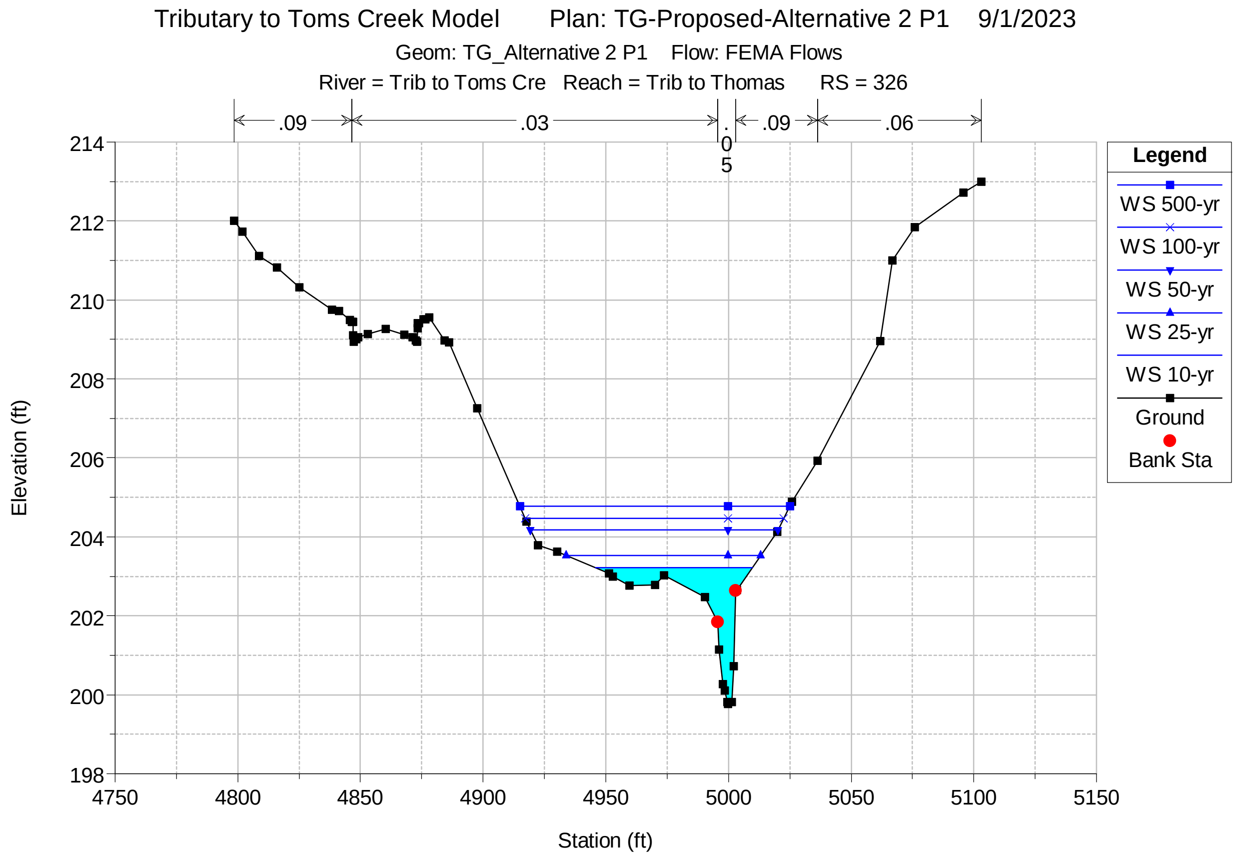




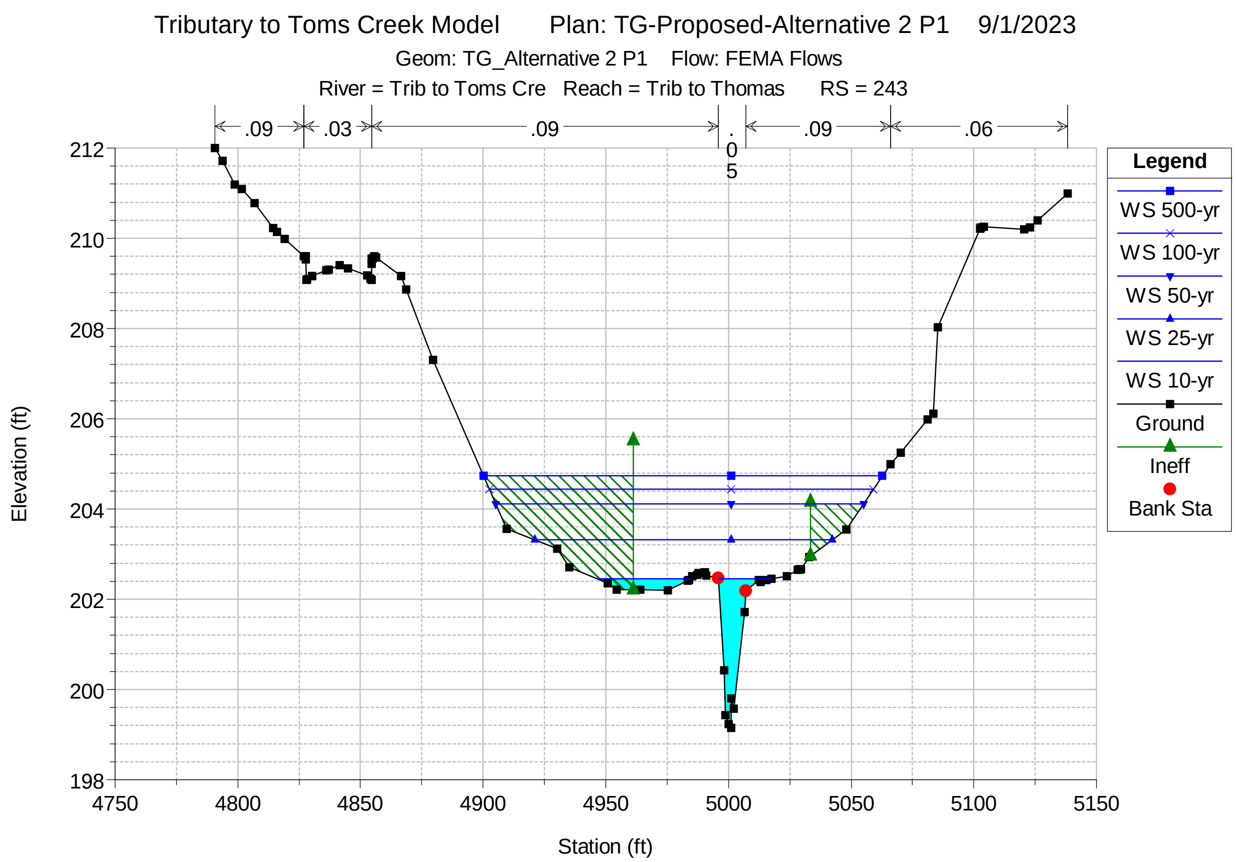
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 414
.03
.09
.05
.09
.03
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

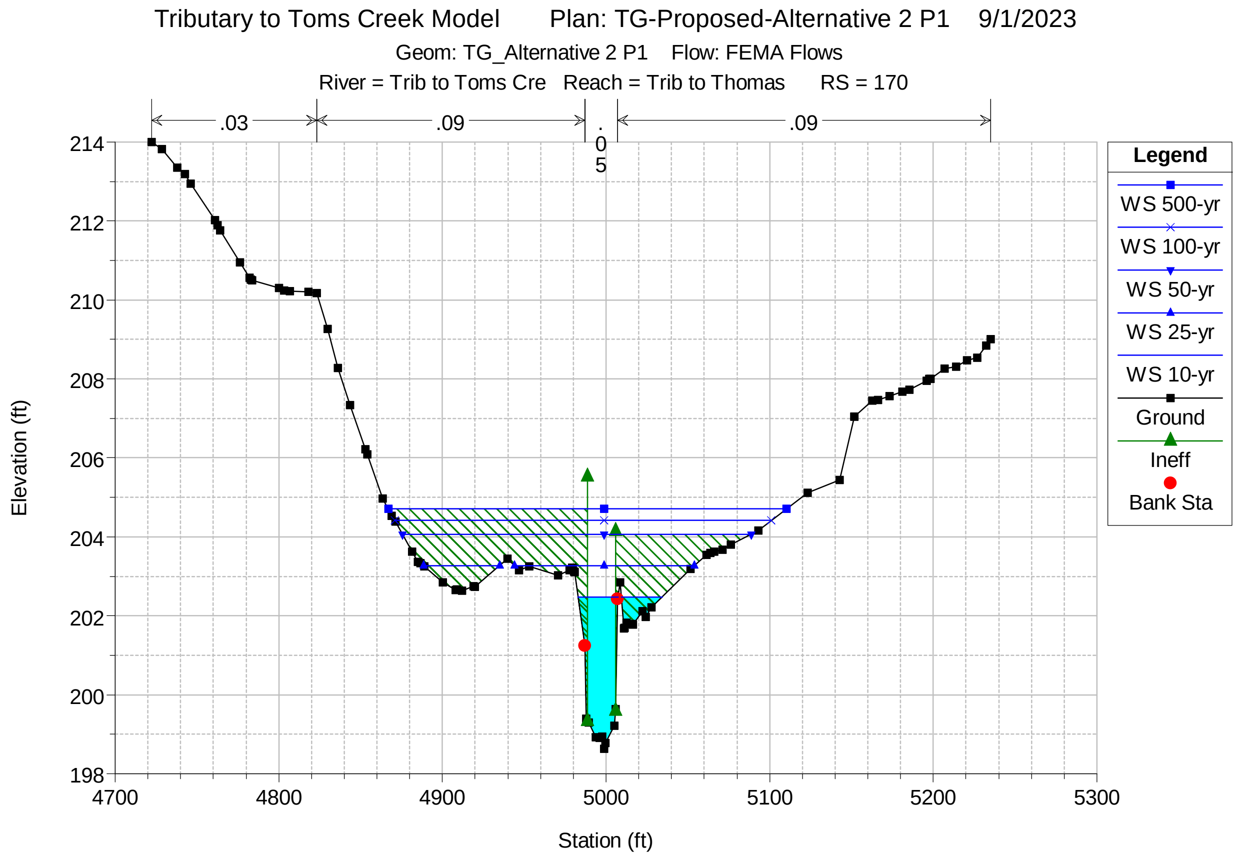
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 386
.03
.09
.05
.09
.03
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

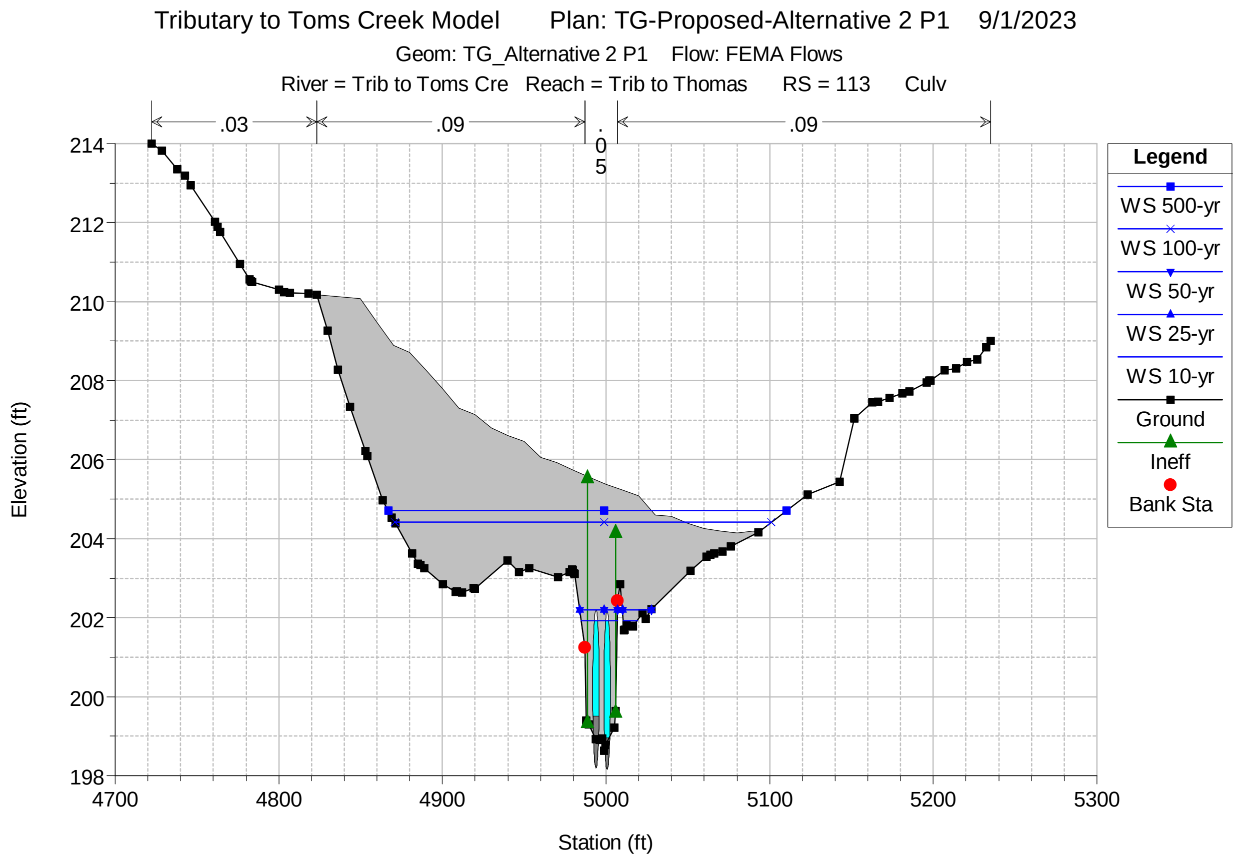


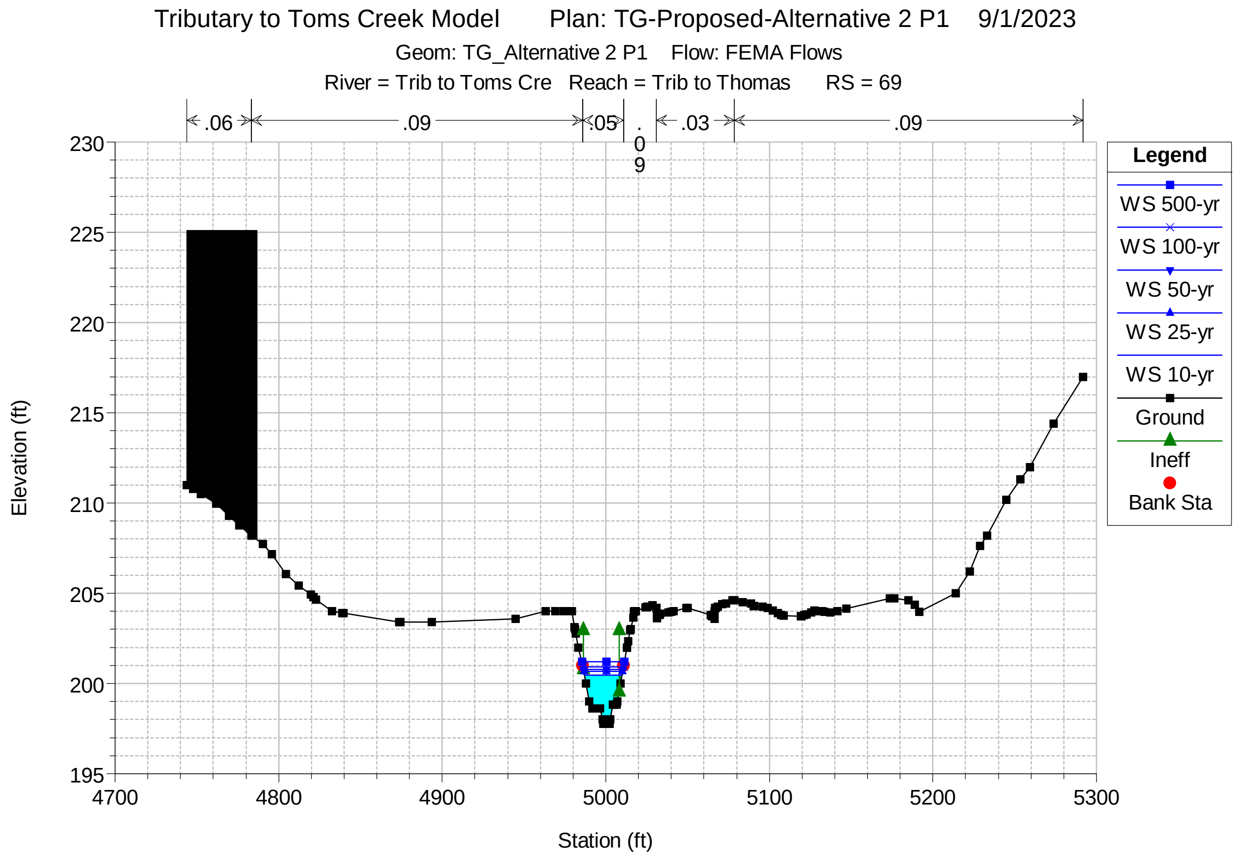
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 326
.09
.03
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta

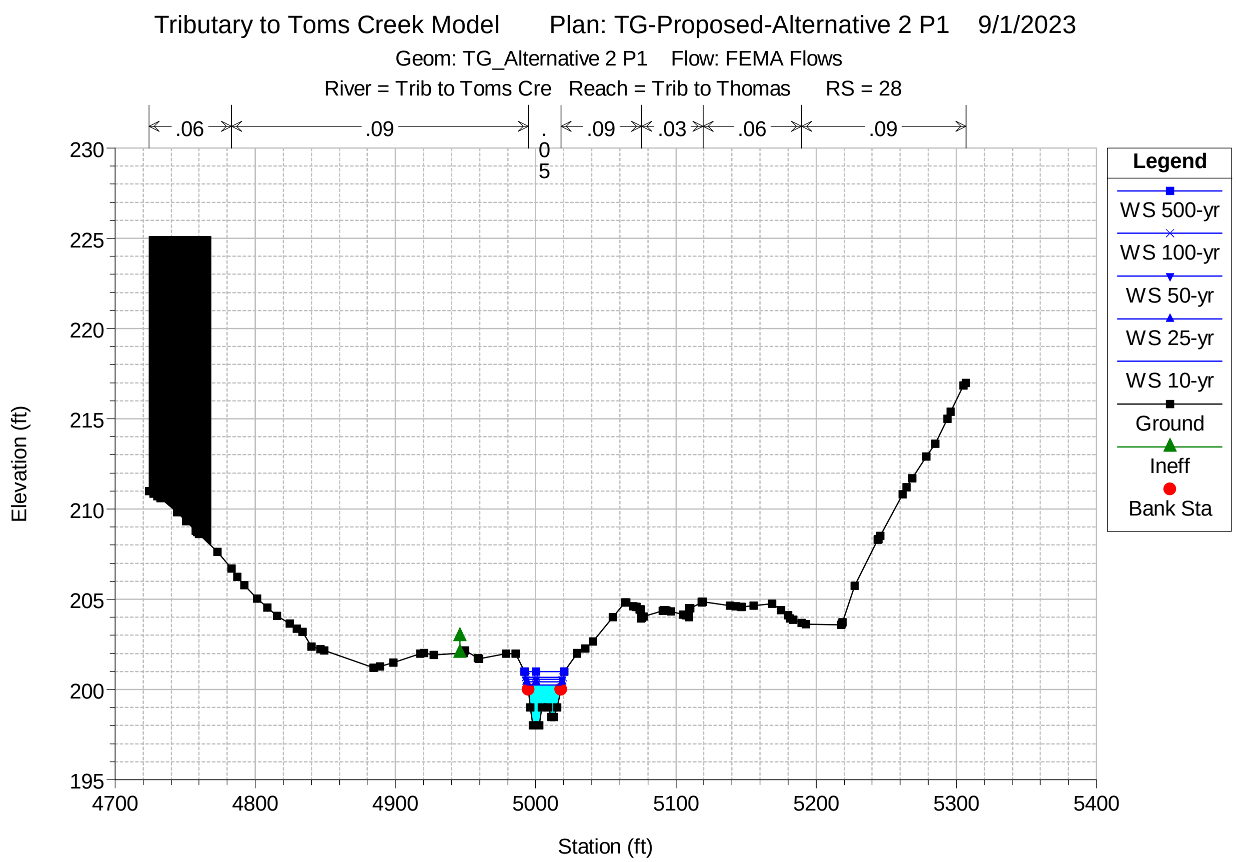



Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 243
.09
.03
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 170
.03
.09
.05
.09
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
214
212
210
208
206
204
202
200
198
4700
4800
4900
5000
5100
5200
5300

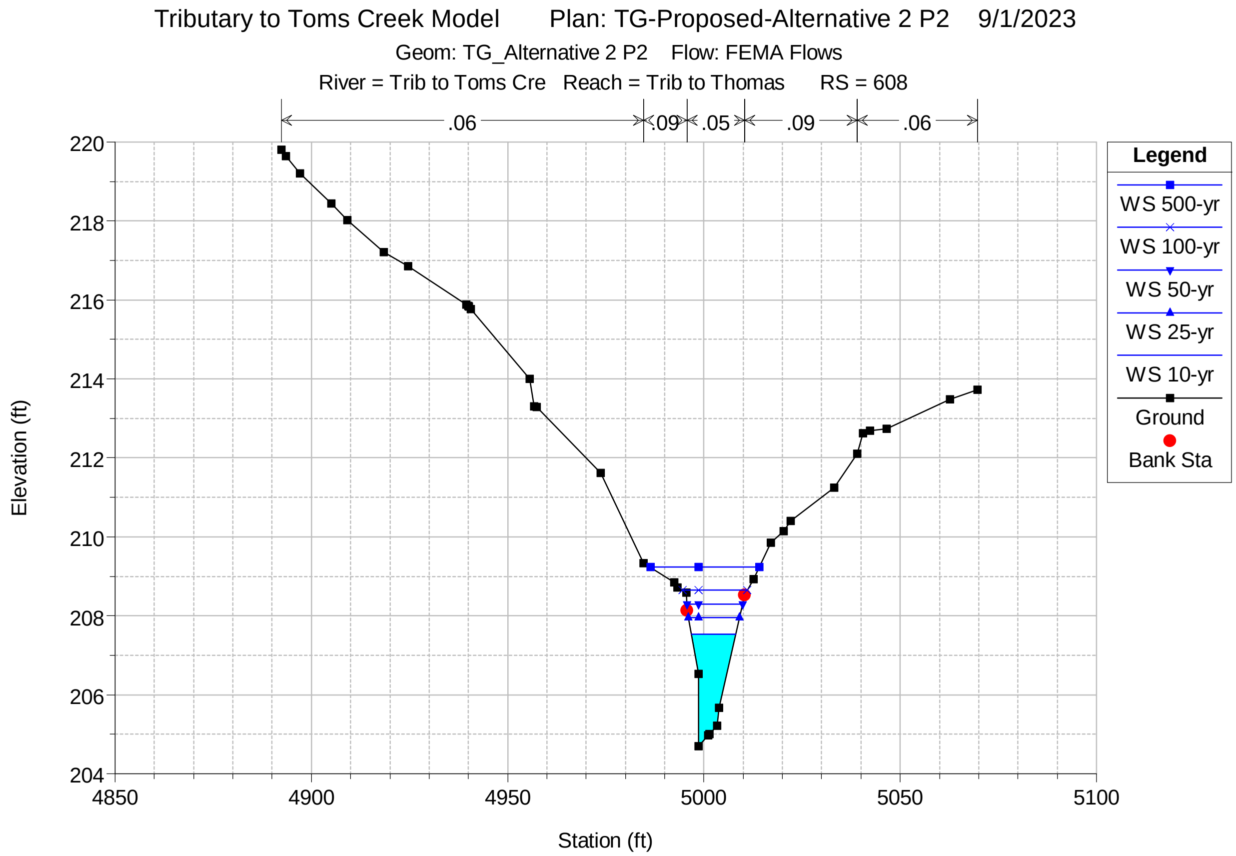

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 113 Culv
.03
.09
.05
.09
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
214
212
210
208
206
204
202
200
198
4700
4800
4900
5000
5100
5200
5300

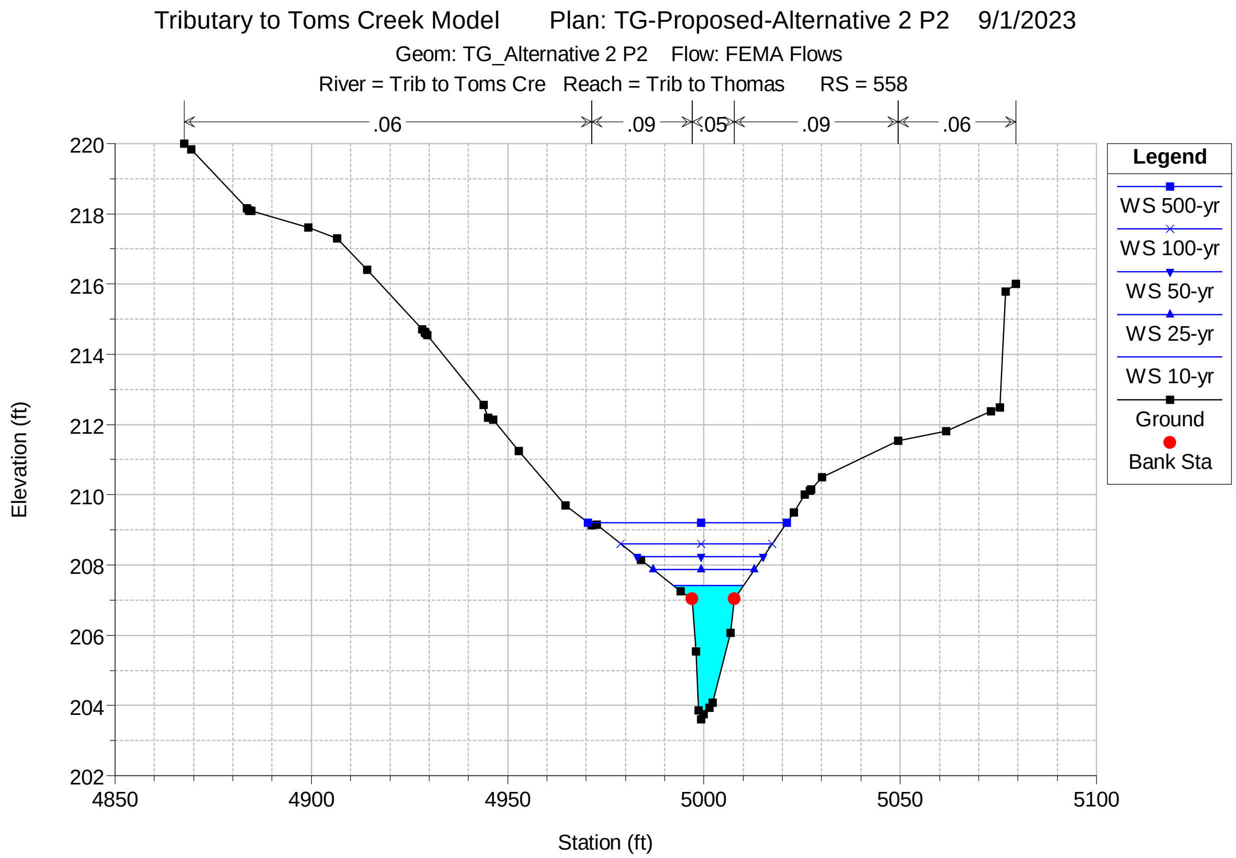

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 69
.06
.09
.05
.09
.03
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

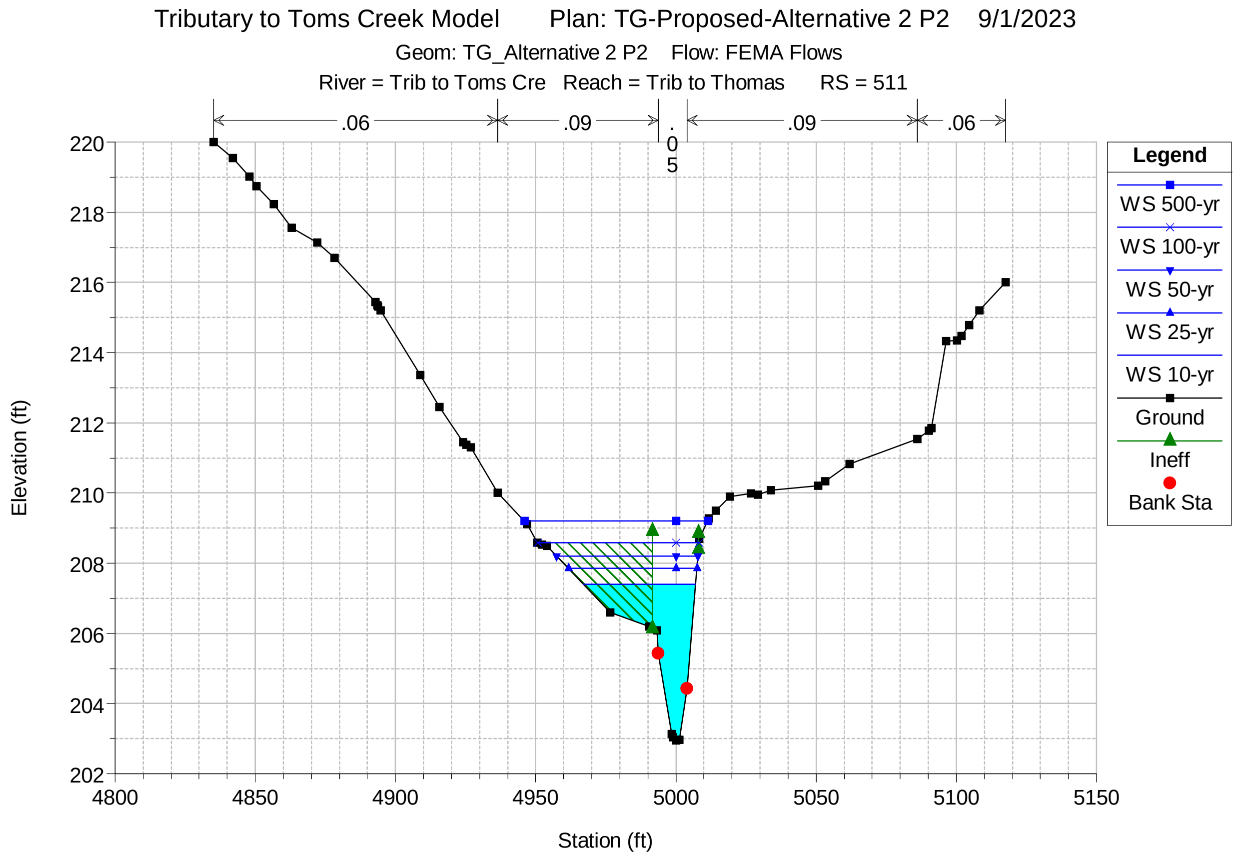

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P1 9/1/2023
Geom: TG_Alternative 2 P1 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 28
.06
.09
.05
.09
.03
.06
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

Tributary A

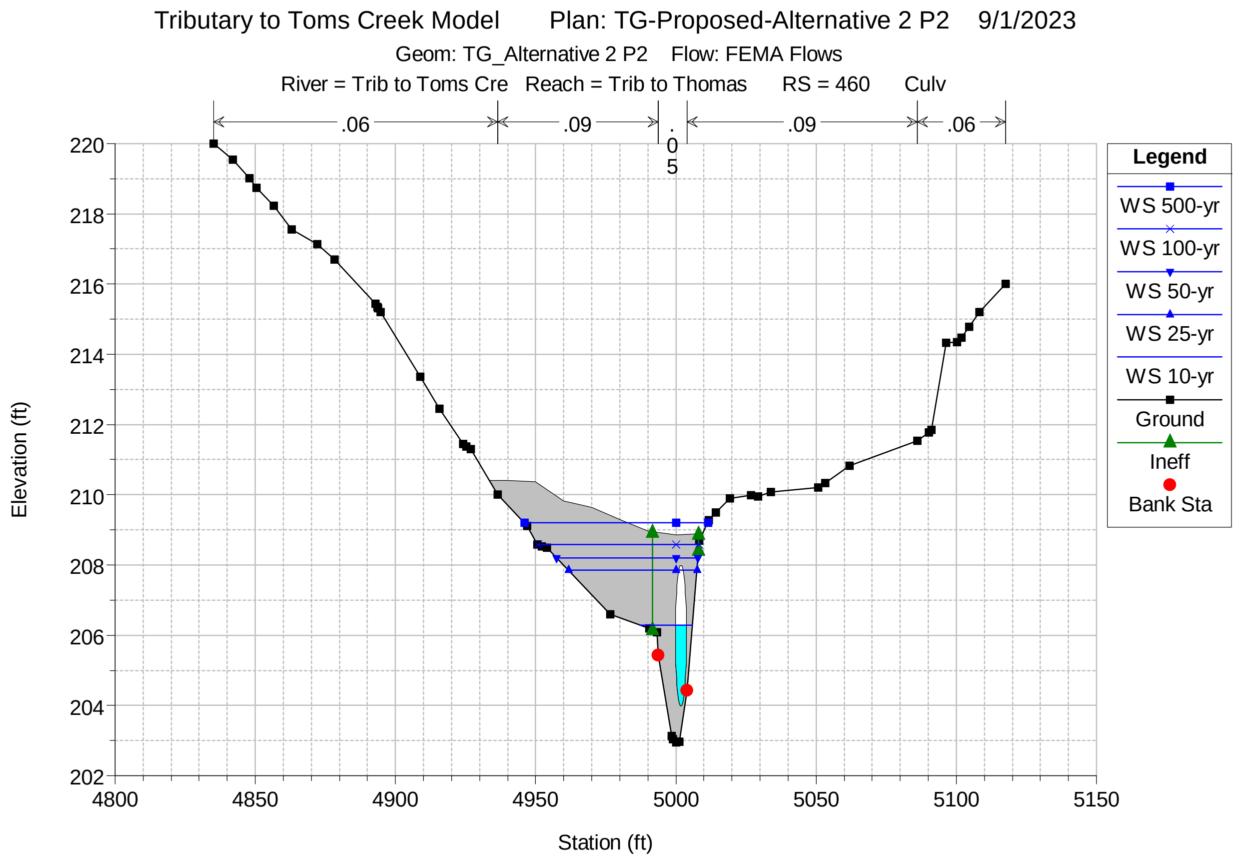
Proposed Cross Sections-Alternative 2 Phase II


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 608
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta

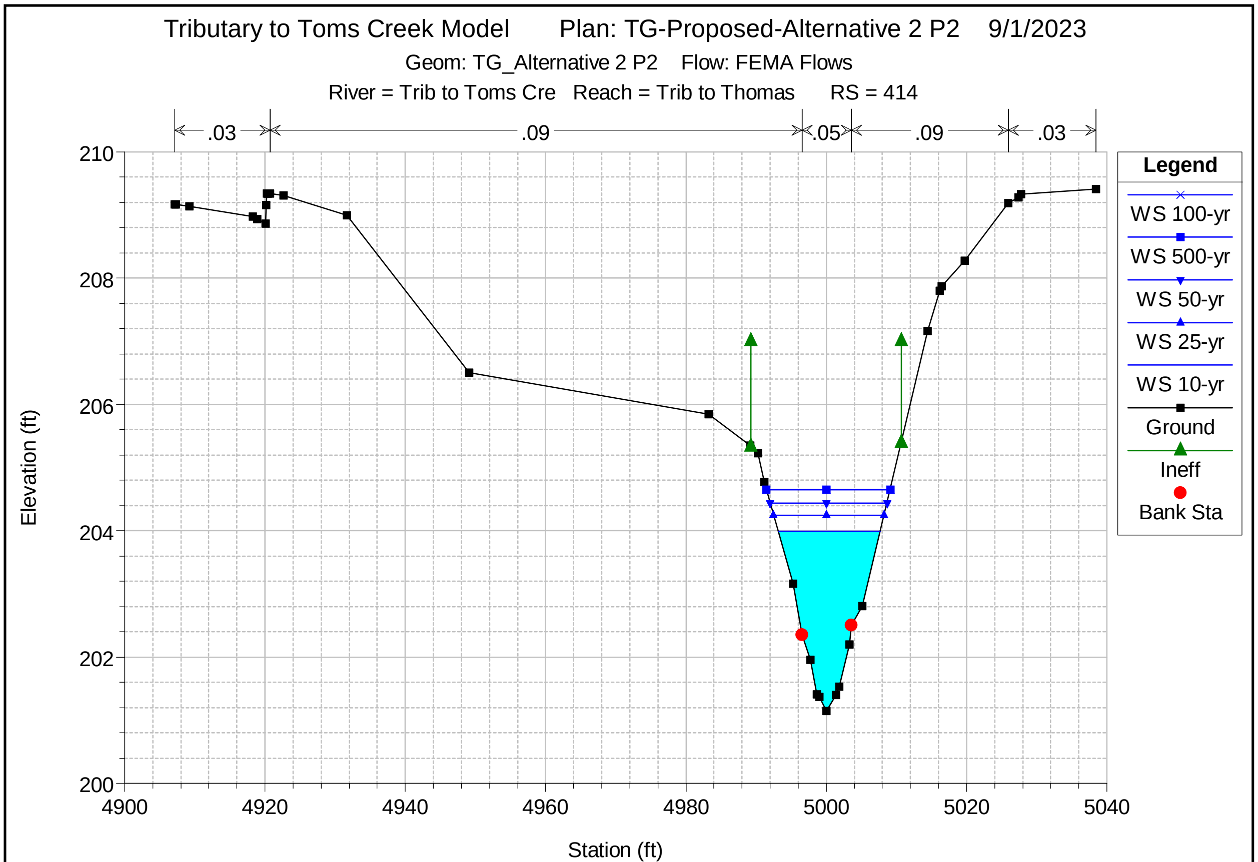

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 558
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta

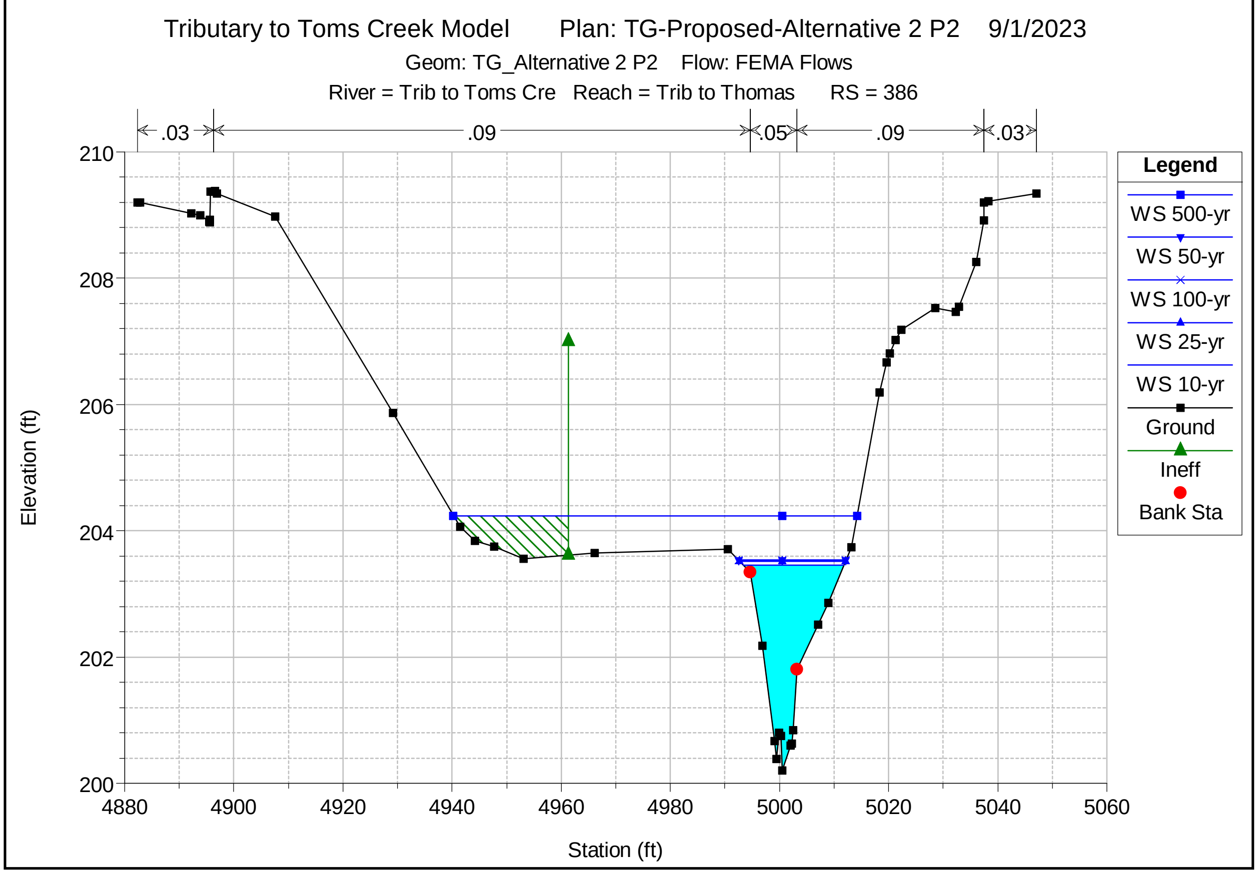


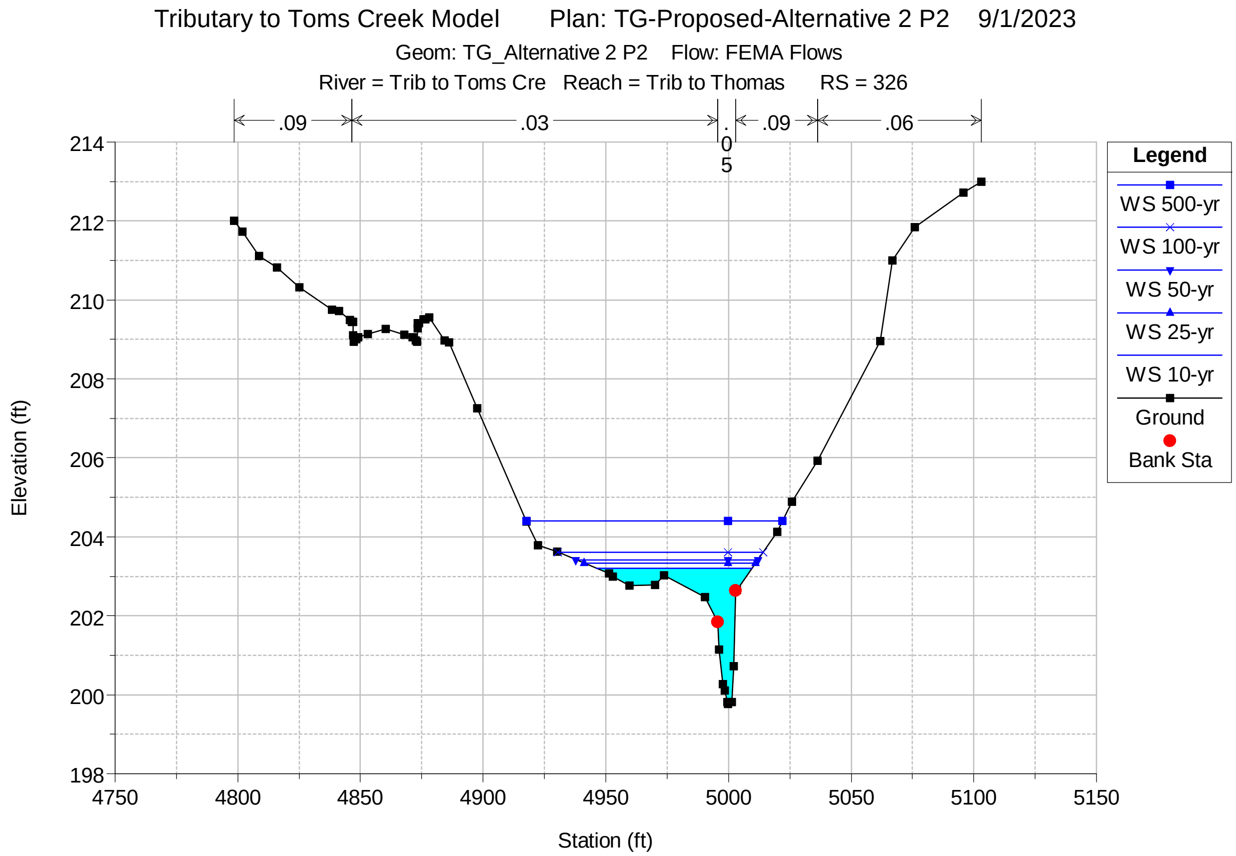
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 511
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

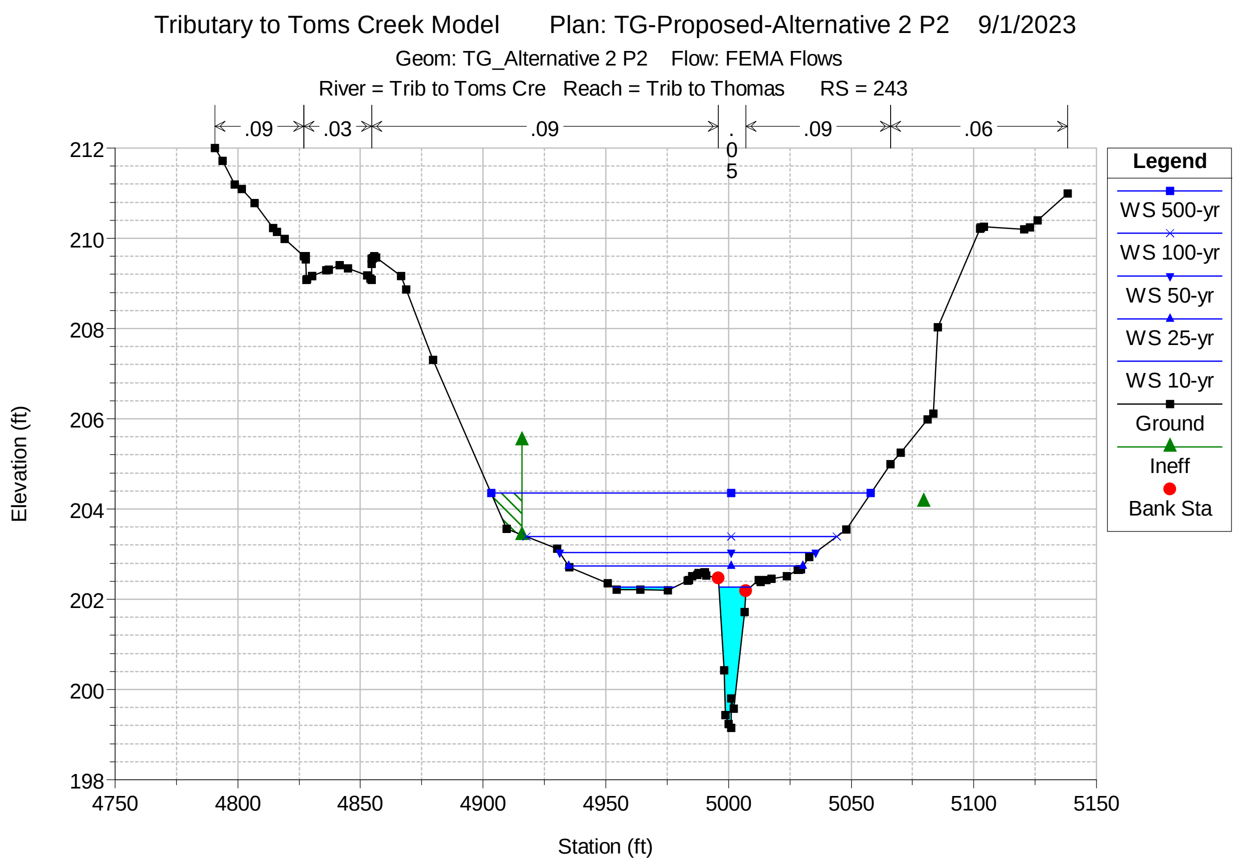



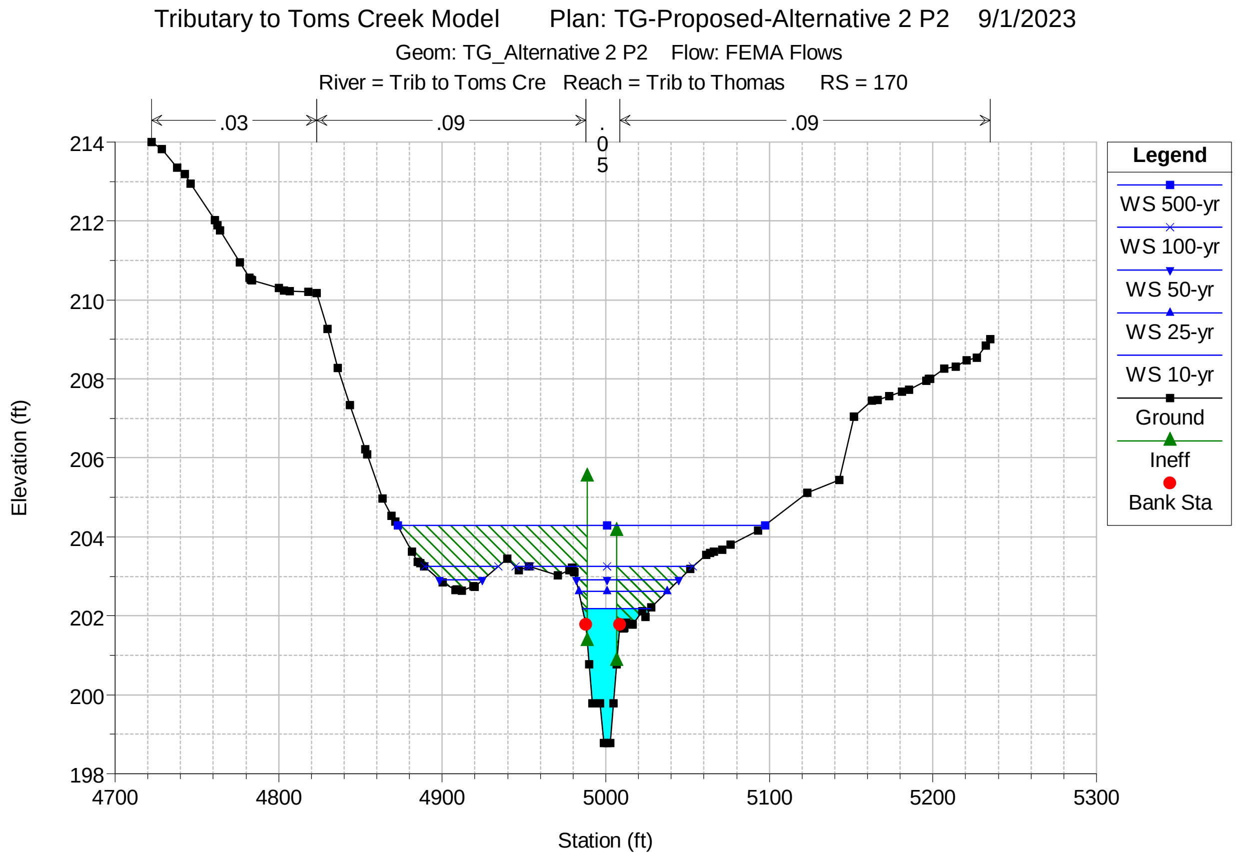
Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 460 Culv
.06
.09
.05
.09
.06
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 414
.03
.09
.05
.09
.03
Legend
WS 100-yr
WS 500-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
210
208
206
204
202
200
4900
4920
4940
4960
4980
5000
5020
5040

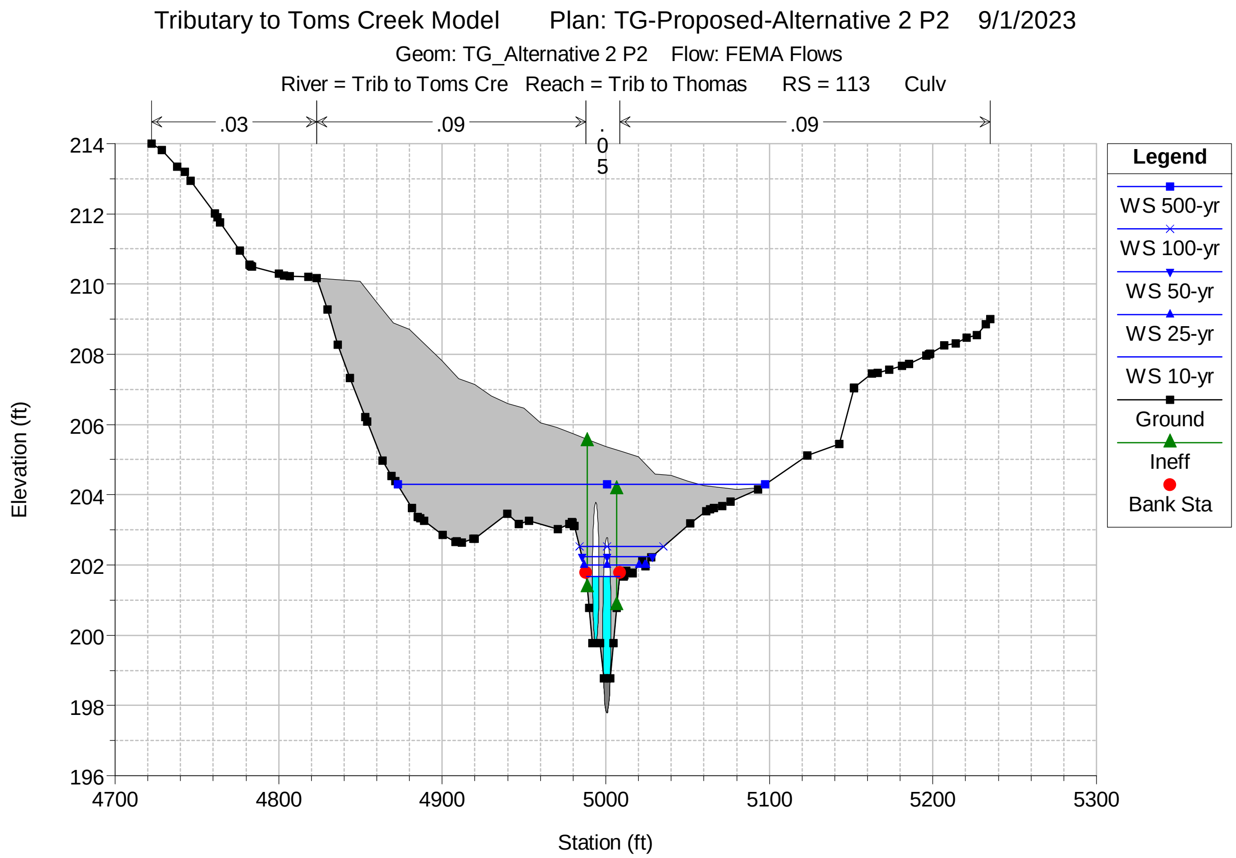

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 386
.03
.09
.05
.09
.03
Legend
WS 500-yr
WS 50-yr
WS 100-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
210
208
206
204
202
200
4880
4900
4920
4940
4960
4980
5000
5020
5040
5060


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 326
.09
.03
.05
.09
.06
Elevation (ft)
Station (ft)
214
212
210
208
206
204
202
200
198
4750
4800
4850
4900
4950
5000
5050
5100
5150
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Bank Sta

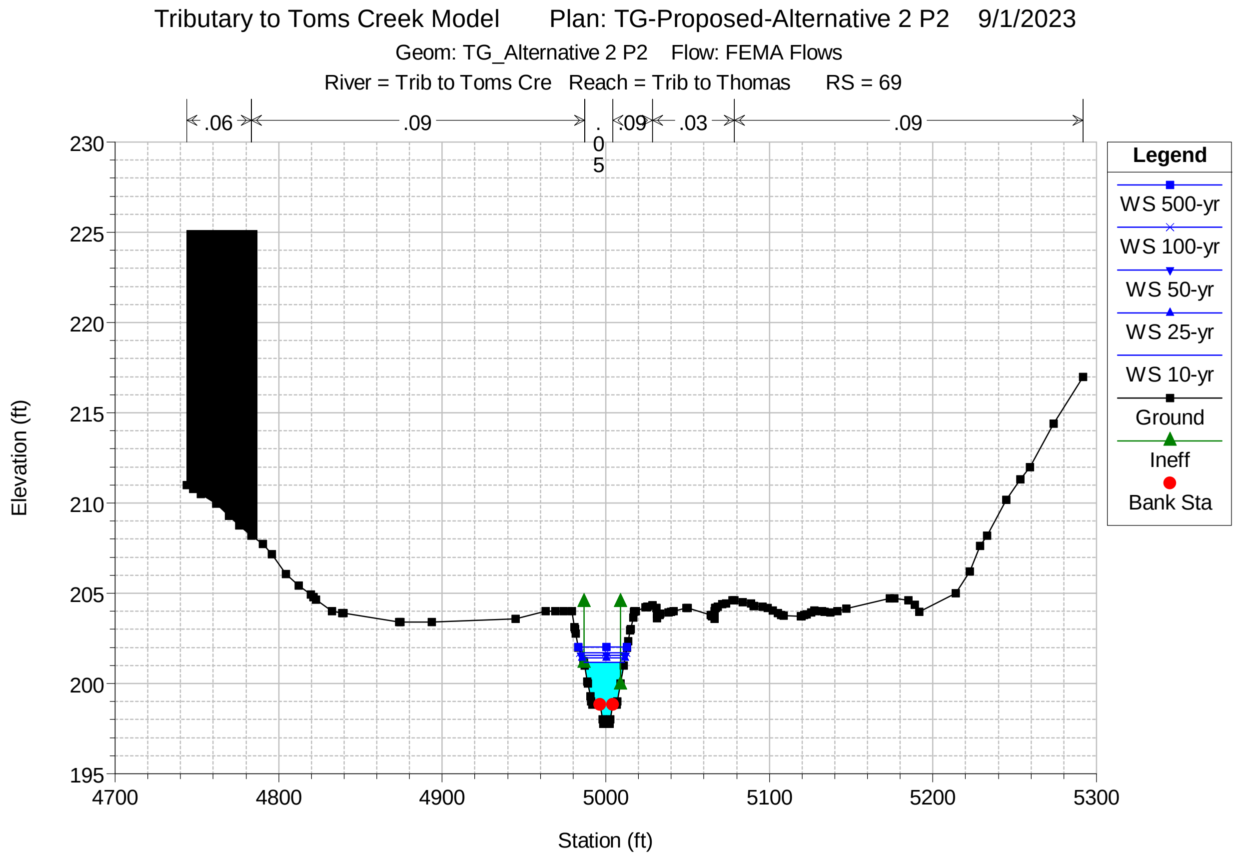

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 243
.09
.03
.09
.05
.09
.06
Elevation (ft)
Station (ft)
212
210
208
206
204
202
200
198
4750
4800
4850
4900
4950
5000
5050
5100
5150
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

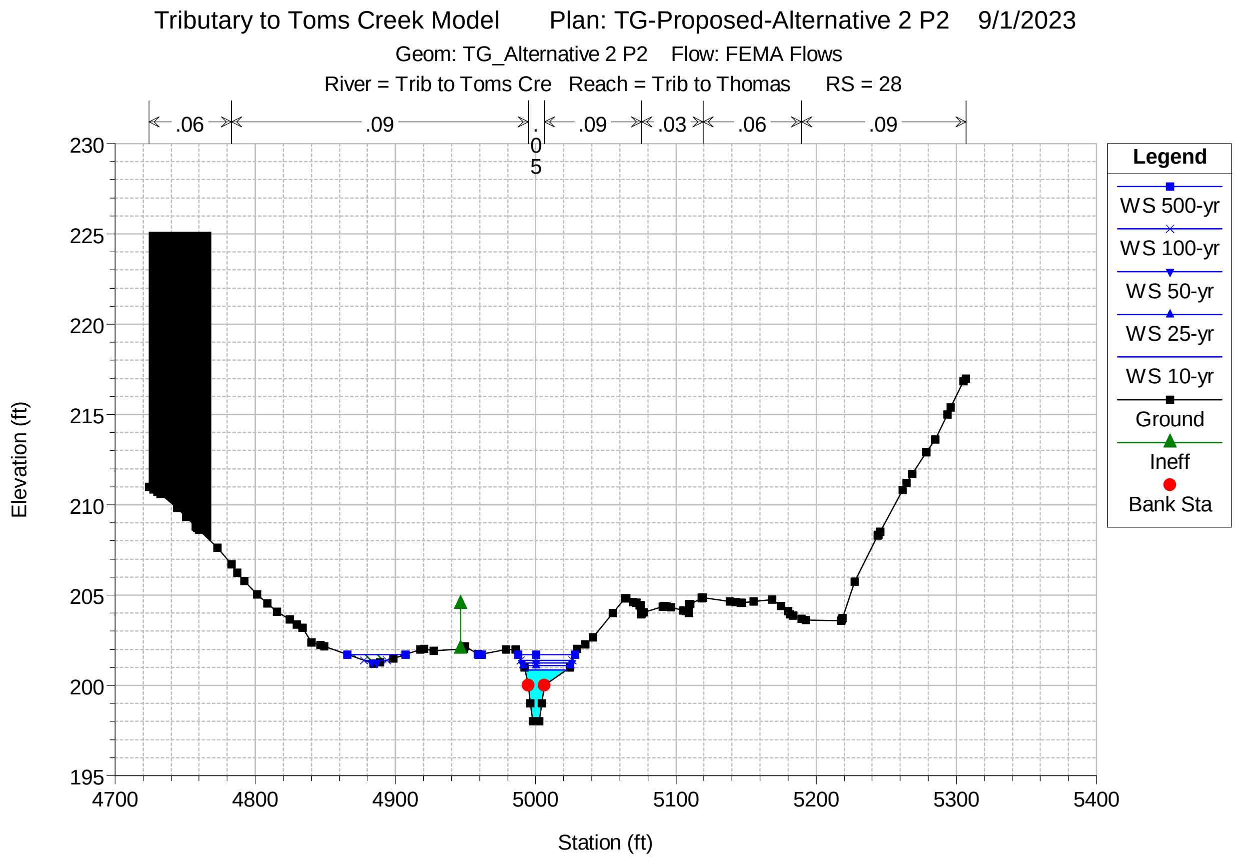


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 170
.03
.09
.05
.09
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
214
212
210
208
206
204
202
200
198
4700
4800
4900
5000
5100
5200
5300

Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 113 Culv
.03
.09
.05
.09
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
214
212
210
208
206
204
202
200
198
196
4700
4800
4900
5000
5100
5200
5300


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 69
.06
.09
.05
.09
.03
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta


Tributary to Toms Creek Model Plan: TG-Proposed-Alternative 2 P2 9/1/2023
Geom: TG_Alternative 2 P2 Flow: FEMA Flows
River = Trib to Toms Cre Reach = Trib to Thomas RS = 28
.06
.09
.05
.09
.03
.06
.09
Elevation (ft)
Station (ft)
Legend
WS 500-yr
WS 100-yr
WS 50-yr
WS 25-yr
WS 10-yr
Ground
Ineff
Bank Sta

# Tributary A
# WSEL Comparison Table-Alternative 1

| Cross Sections/Stream Station Alternative 1 | 100-year WSEL (Existing) (NAVD88) | 100-year WSEL (Proposed) (NAVD88) | Difference (Proposed-Existing) (ft) |
|---|---|---|---|
| 608 | 208.65 | 208.65 | 0.00 |
| 558 | 208.6 | 208.6 | 0.00 |
| 511 | 208.58 | 208.58 | 0.00 |
| 460 | Hampton Chase Court | | |
| 414 | 204.66 | 204.55 | -0.11 |
| 386 | 203.53 | 204.41 | 0.88 |
| 326 | 203.66 | 204.47 | 0.81 |
| 243 | 203.39 | 204.43 | 1.04 |
| 170 | 203.32 | 204.41 | 1.09 |
| 113 | Falconhurst Drive | | |
| 69 | 200.64 | 200.92 | 0.28 |
| 28 | 200.4 | 200.68 | 0.28 |

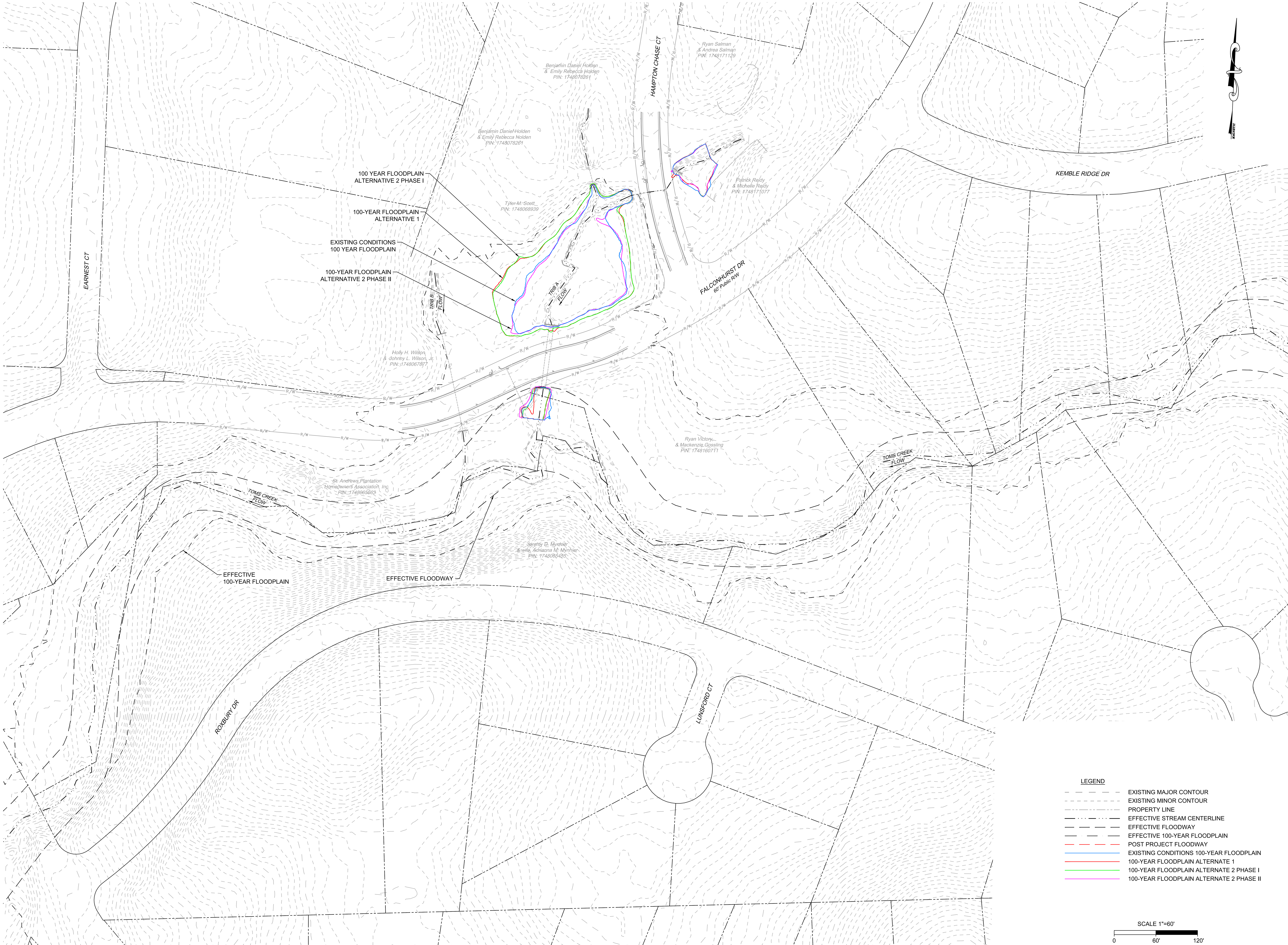
# Tributary A
# WSEL Comparison Table-Alternative 2 Phase I

| Cross Sections/Stream Station Alternative 2 Phase I | 100-year WSEL (Existing) (NAVD88) | 100-year WSEL (Proposed) (NAVD88) | Difference (Proposed-Existing) (ft) |
|---|---|---|---|
| 608 | 208.65 | 208.65 | 0.00 |
| 558 | 208.6 | 208.6 | 0.00 |
| 511 | 208.58 | 208.58 | 0.00 |
| 460 | Hampton Chase Court | | |
| 414 | 204.66 | 204.55 | -0.11 |
| 386 | 203.53 | 204.41 | 0.88 |
| 326 | 203.66 | 204.47 | 0.81 |
| 243 | 203.39 | 204.43 | 1.04 |
| 170 | 203.32 | 204.41 | 1.09 |
| 113 | Falconhurst Drive | | |
| 69 | 200.64 | 200.92 | 0.28 |
| 28 | 200.4 | 200.68 | 0.28 |

# Tributary A
# WSEL Comparison Table-Alternative 2 Phase II

| Cross Sections/Stream Station Alternative 2 Phase II | 100-year WSEL (Existing) (NAVD88) | 100-year WSEL (Proposed) (NAVD88) | Difference (Proposed-Existing) (ft) |
|---|---|---|---|
| 608 | 208.65 | 208.65 | 0.00 |
| 558 | 208.6 | 208.6 | 0.00 |
| 511 | 208.58 | 208.58 | 0.00 |
| 460 | Hampton Chase Court | | |
| 414 | 204.66 | 204.66 | 0.00 |
| 386 | 203.53 | 203.53 | 0.00 |
| 326 | 203.66 | 203.61 | -0.05 |
| 243 | 203.39 | 203.39 | 0.00 |
| 170 | 203.32 | 203.25 | -0.07 |
| 113 | Falconhurst Drive | | |
| 69 | 200.64 | 201.7 | 1.06 |
| 28 | 200.4 | 201.39 | 0.99 |

*Tributary A*
*Floodplain Map*

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| DATE | REVISION DESCRIPTION |
|---|---|
| | |

DATE: 9-01-2023
DRAWN BY: S.VANDERGRIFT
DESIGNED BY: Z. GILSTRAP
CHECKED BY: D. DUNCAN
SCALE: 1"=60'

# TIMMONS GROUP

NORTH CAROLINA LICENSE NO. C-1652

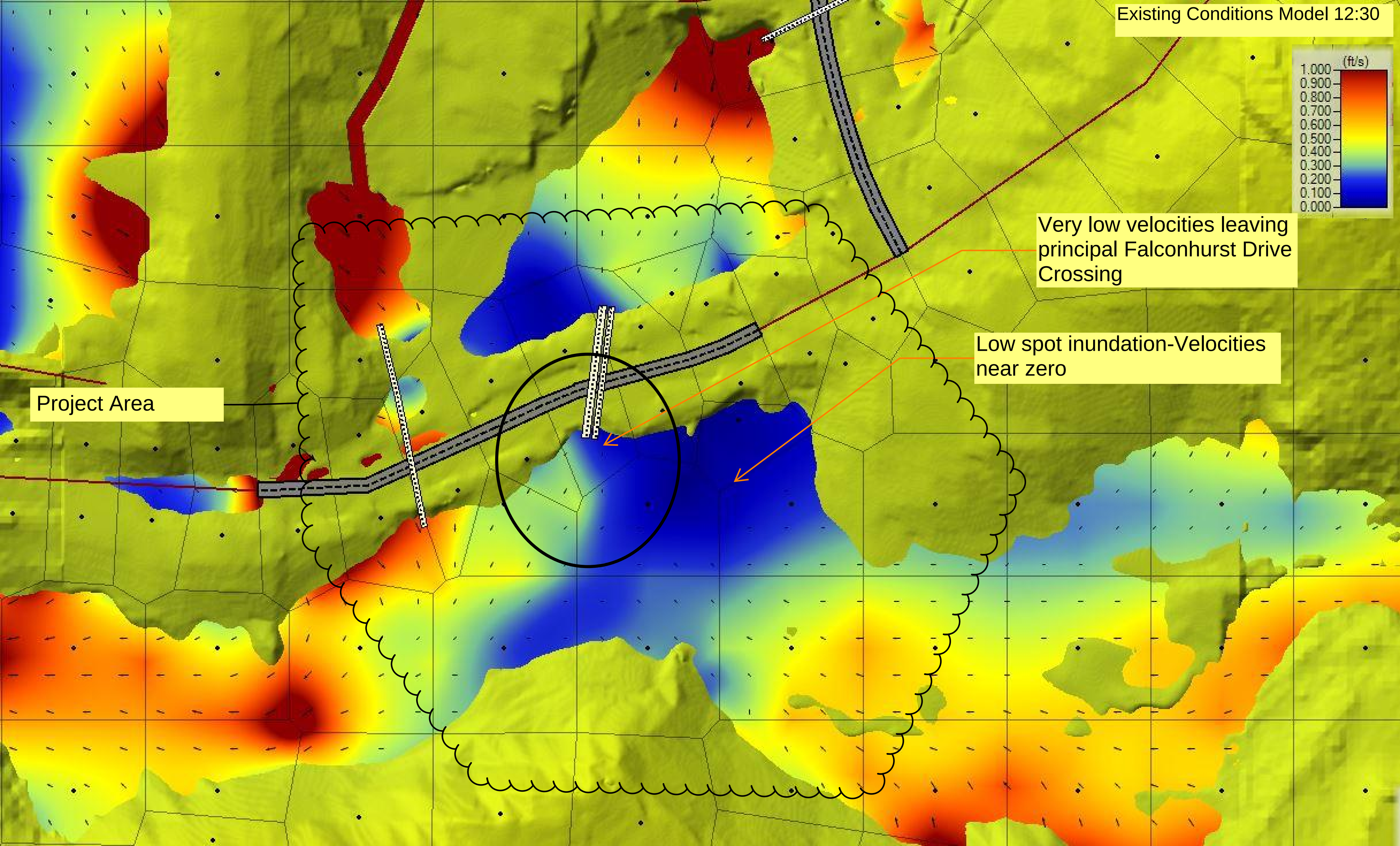
## FALCONHURST DRIVE STORM DRAINAGE IMPROVEMENTS

TOWN OF WAKE FOREST, NORTH CAROLINA

### *TRIB A FLOODPLAIN WORK MAP*

JOB NO.: 52780.001
SHEET NO.: E

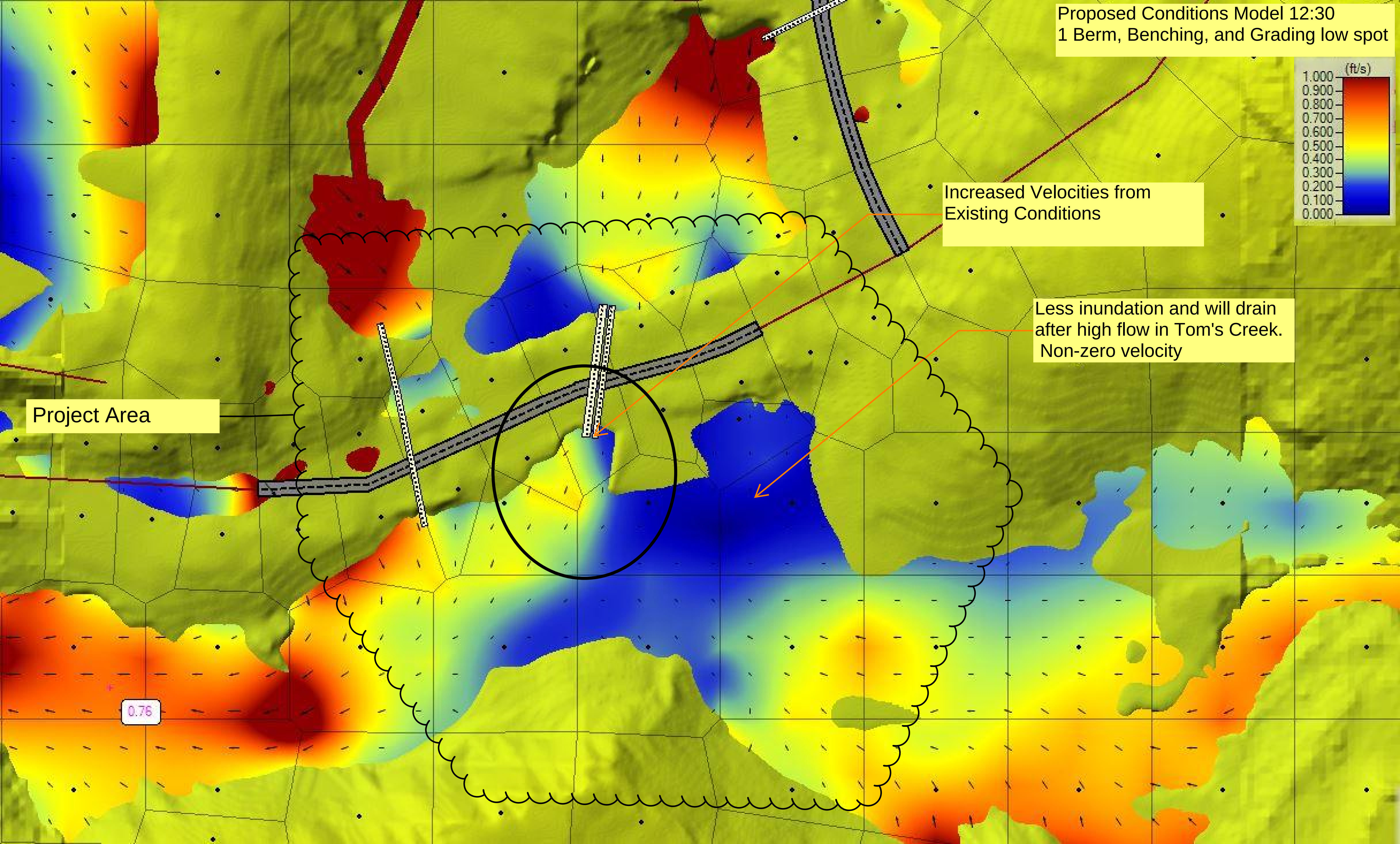
# 2D HEC-RAS Model Output
# 2D Velocity Map-Existing Conditions



Existing Conditions Model 12:30
(ft/s)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Very low velocities leaving principal Falconhurst Drive Crossing
Low spot inundation-Velocities near zero
Project Area

2D HEC-RAS Model Output

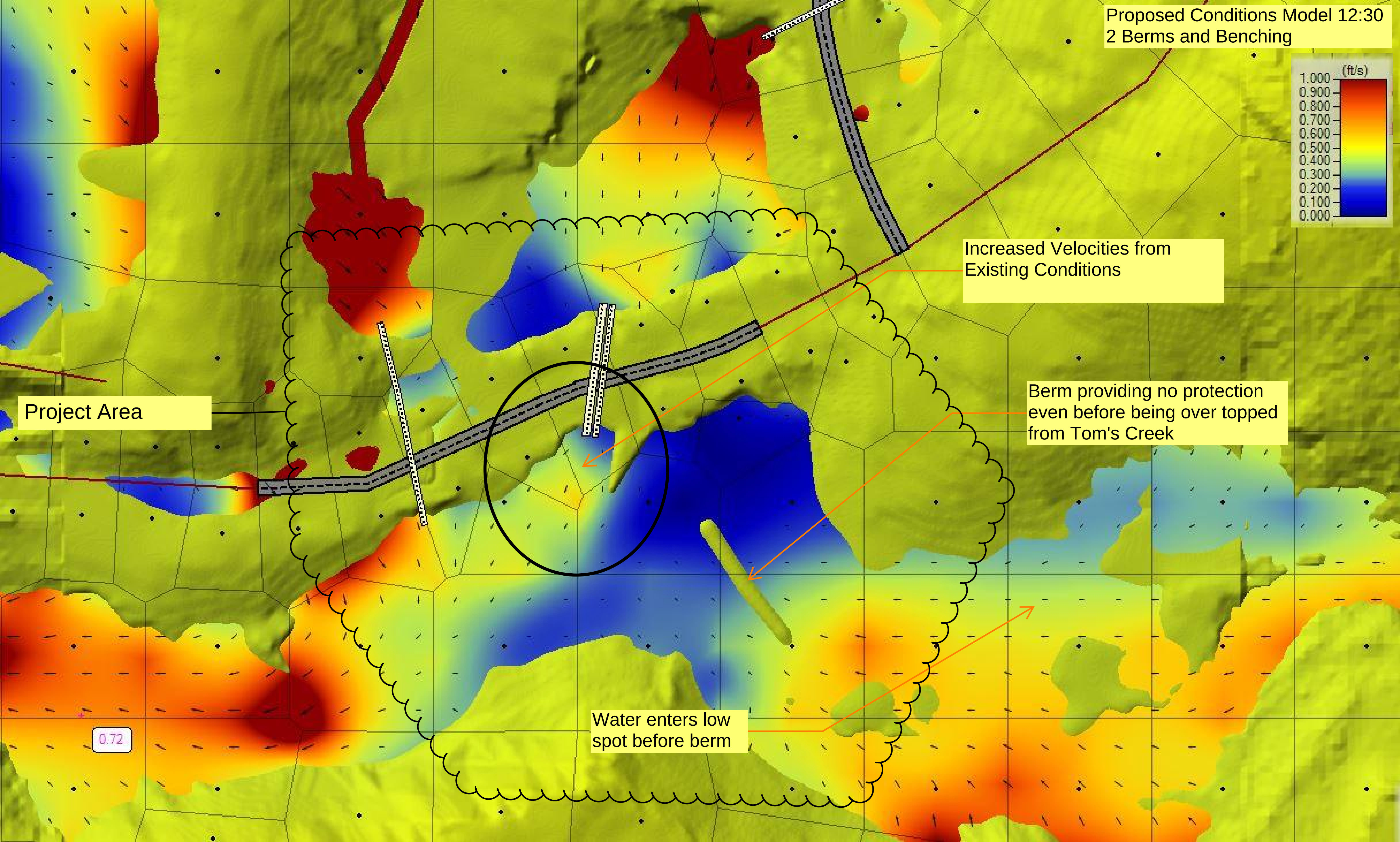
2D Velocity Map-Proposed Conditions



Proposed Conditions Model 12:30
1 Berm, Benching, and Grading low spot
(ft/s)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Increased Velocities from Existing Conditions
Less inundation and will drain after high flow in Tom's Creek. Non-zero velocity
Project Area
0.76

2D HEC-RAS Model Output

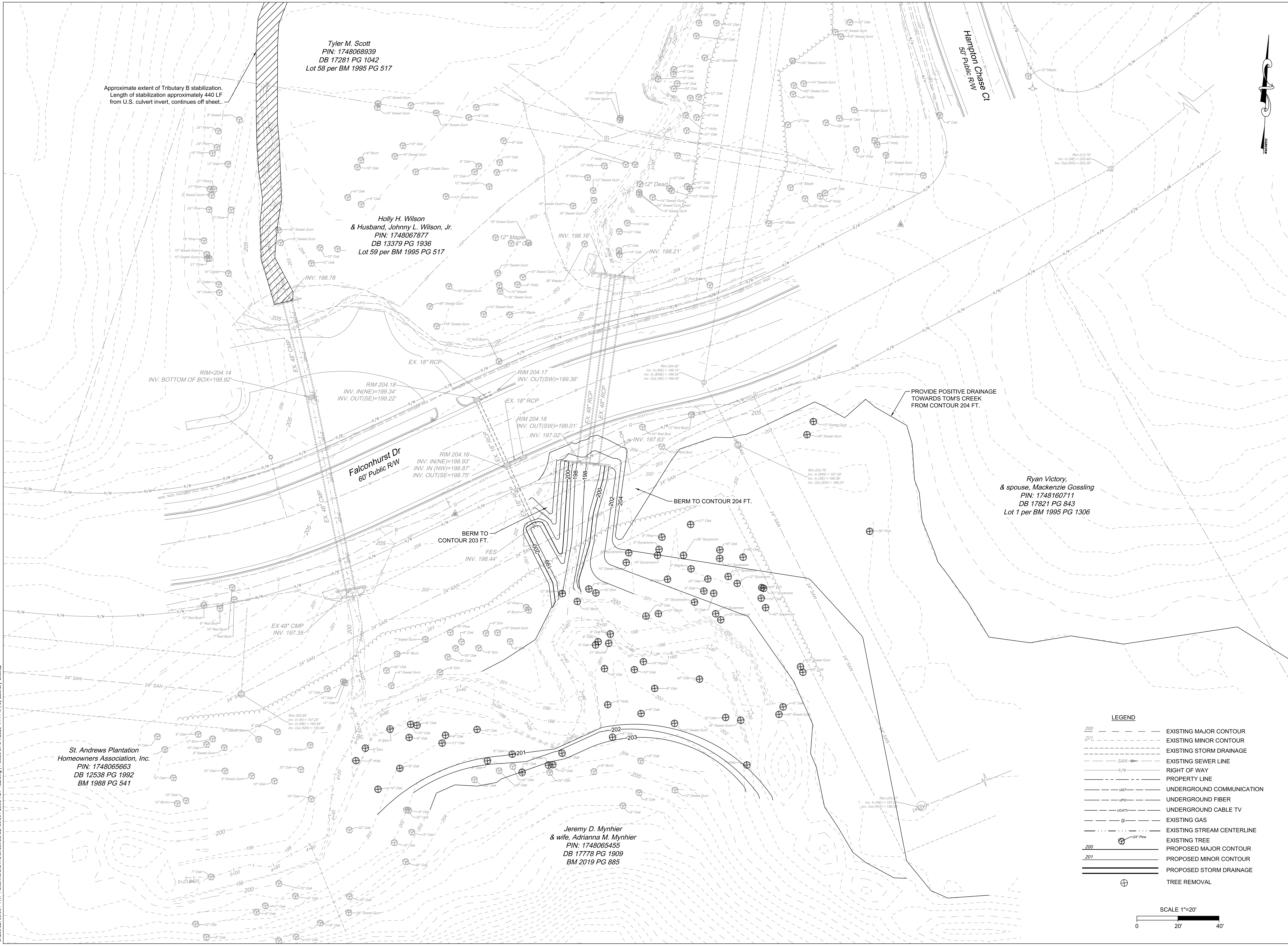
2D Velocity Map-Berm Investigation


Proposed Conditions Model 12:30
2 Berms and Benching
(ft/s)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Increased Velocities from
Existing Conditions
Project Area
Berm providing no protection
even before being over topped
from Tom's Creek
Water enters low
spot before berm
0.72

# Appendix D

## Conceptual Exhibits
## Proposed Improvements

Exhibit A-Alternative 2 Phase I

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| REVISION DESCRIPTION | DATE |
|---|---|
| | |

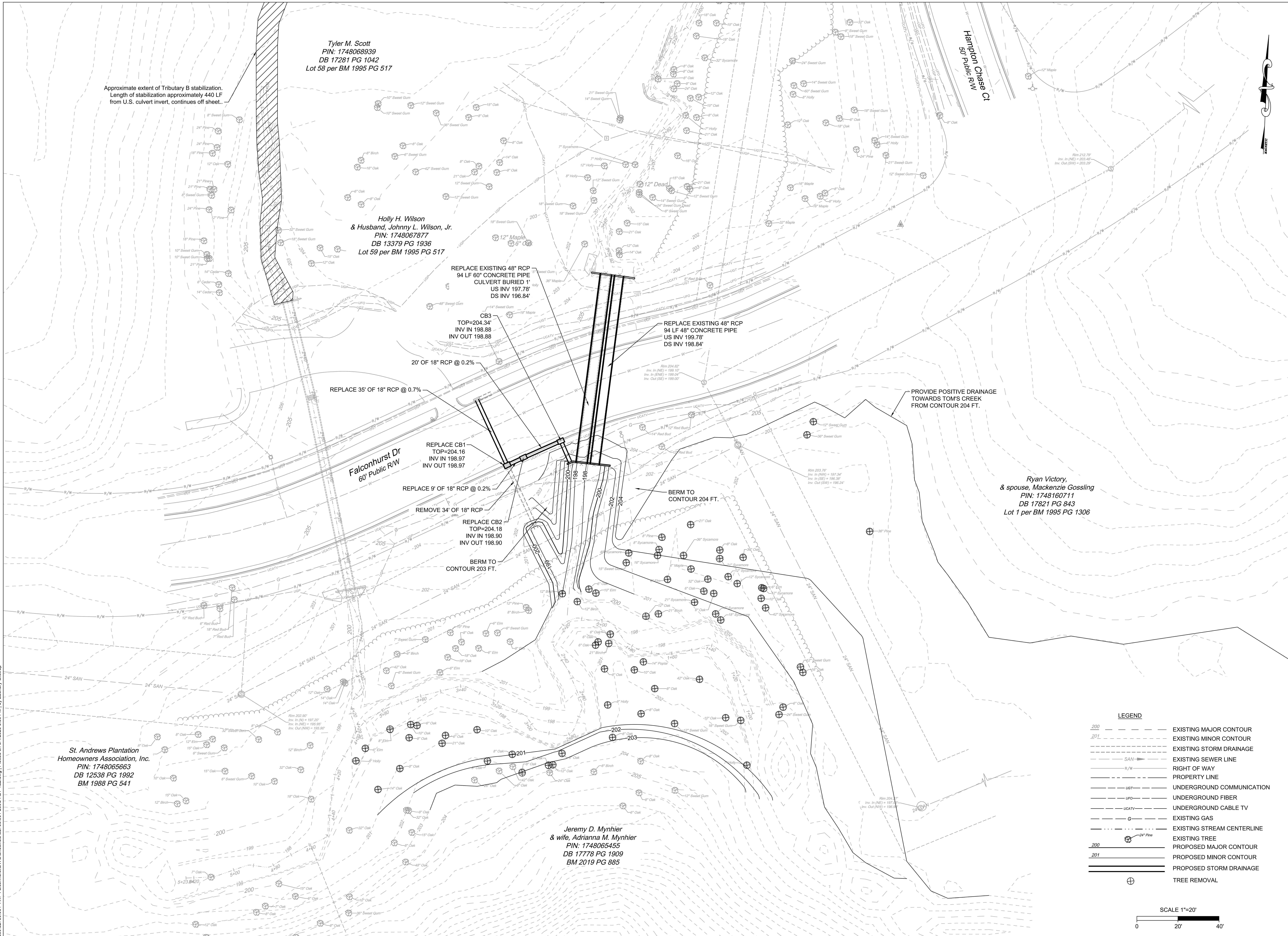
DATE: 9-01-2023
DRAWN BY: S.VANDERGRIFT
DESIGNED BY: Z. GILSTRAP
CHECKED BY: D. DUNCAN
SCALE: 1"=20'

# TIMMONS GROUP
NORTH CAROLINA LICENSE NO. C-1652

# FALCONHURST DRIVE STORM DRAINAGE IMPROVEMENTS
TOWN OF WAKE FOREST, NORTH CAROLINA
## CONCEPT ALTERNATIVE 2 PHASE I

JOB NO.: 52780.001
SHEET NO.: PHASE I

# Exhibit B-Alternative 2 Phase II

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TIMMONS GROUP

NORTH CAROLINA LICENSE NO. C-1652

FALCONHURST DRIVE STORM DRAINAGE IMPROVEMENTS

TOWN OF WAKE FOREST, NORTH CAROLINA

CONCEPT ALTERNATIVE 2 PHASE II

| DATE | REVISION DESCRIPTION |
|---|---|
| | |

| | |
|---|---|
| DATE | 9-01-2023 |
| DRAWN BY | S.VANDERGRIFT |
| DESIGNED BY | Z. GILSTRAP |
| CHECKED BY | D. DUNCAN |
| SCALE | 1"=20' |
| JOB NO. | 52780.001 |
| SHEET NO. | PHASE II |

# Appendix E

## Budgetary Cost Estimates

Alternative 2
Phase I

**City of Wake Forest, North Carolina**

**Stormwater Drainage Construction Contract**

**Engineer's Opinion of Probable Cost - Wake Forest-Falconhurst Drive Alternative 2 Phase I**

**Date: 09/01/2023**

| Item | Item Description | Specification Section | Units | Scheduled Quantity | Unit Price ($) | Total Amount |
|---|---|---|---|---|---|---|
| | **Contract and Project Mobilization** | | | | | |
| 1 | Contract Mobilization (maximum 5% of total base bid) | SGP | LS | 1 | | $11,467.14 |
| | **Site Preparation and Demolition** | | | | | |
| 2 | Clearing and Grubbing | 02100 | SY | 1553.327 | $15.00 | $23,299.91 |
| 3 | Tree root and Branch Pruning (Certified Arborist) | | HR | 8 | $100.00 | $800.00 |
| 4 | Furnish and Install Construction Fencing and/or Tree Protection Fencing | 02110 / 02270 | LF | 368.49 | $6.00 | $2,210.94 |
| 5 | Tree Removal (4"-6" in diameter) | | EA | 16 | $500.00 | $8,000.00 |
| 6 | Tree Removal (6"-12" in diameter) | | EA | 35 | $750.00 | $26,250.00 |
| 7 | Tree Removal (12"-24" in diameter) | | EA | 17 | $1,000.00 | $17,000.00 |
| 8 | Tree Removal (24"+ in diameter) | | EA | 11 | $1,250.00 | $13,750.00 |
| | **Erosion and Sediment Control** | | | | | |
| 9 | Furnish, Install, Maintain, and Remove Temporary Gravel Construction Entrance - NCDOT Class A Stone | 02270 /02200 | EA | 1 | $1,000.00 | $1,000.00 |
| 10 | Furnish Install , Maintain and Remove temporary Silt Fence | 02270 | LF | 1067 | $6.00 | $6,402.00 |
| 11 | Furnish Install, Maintain and Remove Temporary Silt Fence Outlet | | EA | 5 | $50.00 | $250.00 |
| 12 | Furnish and Install Temporary Seeding | | SY | 9703 | $1.50 | $14,554.50 |
| 13 | Furnish and Install Permanent Seeding (Lawn) | 02270/02933 | SY | 9453 | $2.50 | $23,632.50 |
| | **Excavation Grading and Earthwork** | | | | | |
| 14 | Excavate and Place as Fill (Total excavation - fill where needed) | 2200 | CY | 506 | $50.00 | $25,300.00 |
| 15 | Offsite Fill (Net Fill provided) | 2200 | CY | 587 | $50.00 | $29,350.00 |
| 16 | Rock Excavation Allowance | 2211 | LS | 1 | $5,000.00 | $5,000.00 |
| | **Stream Stabilization / Stream Restoration** | | | | | |
| 17 | Stream channel exavation/grading | 02900 | CY | 120 | $50.00 | $6,000.00 |
| 18 | Rooted Plant Plugs | | EA | 2697 | $5.00 | $13,485.00 |
| 19 | Furnish and Install Riparian Seed Mix | 02900 | SY | 250 | $5.00 | $1,250.00 |
| 20 | Furnish and Install C-700 Erosion Control Fabric with notched wooden stakes for installation | 02270 | SY | 312 | $9.00 | $2,808.00 |
| | **Sanitary Sewer** | | | | | |
| 21 | Adjust Manhole | | EA | 1 | $1,000.00 | $1,000.00 |
| 22 | Protect Sanitary Sewer | | LS | 1 | $5,000.00 | $5,000.00 |
| | **Miscellaneous** | | | | | |
| 23 | Construction Project Staking and Surveying | SGP / 01050 | LS | 1 | $3,000.00 | $3,000.00 |

**Base Bid Estimate Total = $240,809.99**

**20% Escalation & Estimating Contingency= $48,162.00**

**Opinion of Probable Costs= $289,000.00**

# Alternative 2
# Phase II

**City of Wake Forest, North Carolina**

**Stormwater Drainage Construction Contract**

**Engineer's Opinion of Probable Cost - Wake Forest-Falconhurst Drive Alternative 2 Phase II**

**Date: 09/01/2023**

| Item | Item Description | Specification Section | Units | Scheduled Quantity | Unit Price ($) | Total Amount |
|---|---|---|---|---|---|---|
| | **Contract and Project Mobilization** | | | | | |
| 1 | Contract Mobilization (maximum 5% of total base bid) | SGP | LS | 1 | $11,528.00 | $11,528.00 |
| | **Site Preparation and Demolition** | | | | | |
| 2 | Removal and Disposal of Existing Asphalt Pavement | | SY | 347 | $50.00 | $17,350.00 |
| 3 | Pipe Removal and Disposal - 18-Inch Diameter | | LF | 44 | $80.00 | $3,520.00 |
| 4 | Remove and Dispose of Pipe Culvert (concrete, masonry, other) | | LF | 188 | $150.00 | $28,200.00 |
| 5 | Excavate, Remove and Dispose of Existing Catch Basin | | EA | 2 | $1,500.00 | $3,000.00 |
| 6 | Removal and Disposal of Existing Concrete Curb and Gutter | | LF | 186 | $50.00 | $9,300.00 |
| 7 | Removal and Disposal of Existing Concrete Sidewalk | | SY | 22 | $25.00 | $550.00 |
| | **Erosion and Sediment Control** | | | | | |
| 8 | Furnish, Install, Maintain, and Remove Temporary Gravel Construction Entrance - NCDOT Class A Stone | 02270 /02200 | EA | 1 | $1,000.00 | $1,000.00 |
| 9 | Furnish, Install, Maintain, and Remove Temporary Curb Inlet Protection | 02270 | EA | 2 | $100.00 | $200.00 |
| 10 | Furnish, Install, Maintain, and Remove Temporary Silt Fence | 02270 | LF | 411 | $6.00 | $2,466.00 |
| 11 | Furnish, Install, Maintain, and Remove Temporary Silt Fence Outlet | | EA | 2 | $50.00 | $100.00 |
| 12 | Furnish and Install Permanent Seeding (Lawn) | 02270/02933 | SY | 200 | $2.50 | $500.00 |
| | **Storm Drainge** | | | | | |
| 13 | Furnish and Install NCDOT Catch Basin | | EA | 1 | $8,000.00 | $8,000.00 |
| 14 | Furnish and Replaced NCDOT Catch Basin | | EA | 2 | $8,000.00 | $16,000.00 |
| 15 | Furnish and Install 18-inch-diameter RCP (Class III) | | LF | 20 | $125.00 | $2,500.00 |
| 16 | Furnish and Replace 18-inch-diameter RCP (Class III) | | LF | 44 | $125.00 | $5,500.00 |
| 17 | Furnish and Install Headwall/Endwall/Wingwall Upstream | | LS | 1 | $9,120.00 | $9,120.00 |
| 18 | Furnish and Install Headwall/Endwall/Wingwall Downstream | | LS | 1 | $10,920.00 | $10,920.00 |
| 19 | Concrete Pipe Culvert (Falconhurst Drive) 48" | | LF | 94 | $250.00 | $23,500.00 |
| 20 | Concrete Pipe Culvert (Falconhurst Drive) 60" | | LF | 94 | $350.00 | $32,900.00 |
| | **Traffic Control** | | | | | |
| 21 | Vehicular Traffic Control | | LS | 1 | $4,900.00 | $4,900.00 |
| | **Asphalt & Concrete** | | | | | |
| 22 | Furnish and Install Asphalt Patch | | SY | 347 | $95.00 | $32,965.00 |
| 23 | Funish and Install Concrete Curb and Gutter | | LF | 186 | $75.00 | $13,950.00 |
| 24 | Furnish and Install Sidewalk | | SY | 22 | $50.00 | $1,100.00 |
| | **Miscellaneous** | | | | | |
| 25 | Construction Project Staking and Surveying | SGP / 01050 | LS | 1 | $3,000.00 | $3,000.00 |
| | | | | | | |
| | | | | | **Base Bid Estimate Total =** | **$242,069.00** |
| | | | | | **20% Escalation & Estimating Contingency=** | **$48,413.80** |
| | | | | | **Opinion of Probable Costs=** | **$290,500.00** |

# Tributary B Stabilization

**City of Wake Forest, North Carolina**

**Stormwater Drainage Construction Contract**

**Engineer's Opinion of Probable Cost - Wake Forest-Falconhurst Drive Tribtuary B Stablization**

**Date: 09/01/2023**

| Item | Item Description | Specification Section | Units | Scheduled Quantity | Unit Price ($) | Total Amount |
|---|---|---|---|---|---|---|
| | **Contract and Project Mobilization** | | | | | |
| 1 | Contract Mobilization (maximum 5% of total base bid) | SGP | LS | 1 | | $7,834.93 |
| | **Site Preparation and Demolition** | | | | | |
| 2 | Clearing and Grubbing | 31 10 | SY | 1367 | $15.00 | $20,505.00 |
| 3 | Tree Removal (6"-12" in diameter) | | EA | 3 | $750.00 | $2,250.00 |
| 4 | Tree Removal (12"-24" in diameter) | | EA | 2 | $1,000.00 | $2,000.00 |
| 5 | Tree Removal (24"+ in diameter) | 02 41 | EA | 5 | $1,250.00 | $6,250.00 |
| 6 | Debris Removal | 02 41 | LS | 1 | $2,500.00 | $2,500.00 |
| 7 | Fence Removal | | LF | 117 | $25.00 | $2,925.00 |
| 8 | Pool Protection | | LS | 1 | $1,000.00 | $1,000.00 |
| | **Erosion and Sediment Control** | | | | | |
| 9 | Furnish, Install, Maintain, and Remove Temporary Construction Entrance - NCDOT Class A Stone | 31 25 | EA | 1 | $1,000.00 | $1,000.00 |
| 10 | Furnish and Install Construction Fencing and/or Tree Protection Fencing | 31 .25 | LF | 918 | $2.00 | $1,836.00 |
| 11 | Furnish, Install, Maintain, and Remove Pump Around (6" pump or less) | 31 25 | DAY | 14 | $400.00 | $5,600.00 |
| 12 | Furnish, Install, Maintain, and Remove Temporary Check Dam | 31 25 | EA | 1 | $450.00 | $450.00 |
| 13 | Furnish and install Silt Fence | 31 25 | LF | 43 | $6.00 | $258.00 |
| 14 | Furnish and Install Temporary Seeding | 31 25 | SY | 2734 | $1.50 | $4,101.00 |
| 15 | Furnish and Install Permanent Seeding (Lawn) | 31 25 | SY | 1855 | $2.50 | $4,637.50 |
| 16 | Furnish and Install silt fence outlets | 31 25 | EA | 2 | $50.00 | $100.00 |
| 17 | Furnish and Install Straw Mulch | 31 25 | BALE | 246 | $10.00 | $2,460.00 |
| | **Stream Stabilization /Stream Restoration** | | | | | |
| 18 | Excavate and place as Fill (total excavatoin - fill where needed) | 31 20 | CY | 398 | $50.00 | $19,900.00 |
| 19 | Excess Fill Haul In | 31 20 | CY | 15 | $50.00 | $750.00 |
| 20 | Furnish and Install Constructed Riffle | | SY | 154 | $200.00 | $30,800.00 |
| 21 | Funish and Install stream structures A-vanes | | TN | 11 | $200.00 | $2,200.00 |
| 22 | Furnish and Install Rooted Plant Plugs | 32 93 | EA | 2635 | $5.00 | $13,175.00 |
| 23 | Furnish and Install Riparian Seed Mix | | SY | 879 | $5.00 | $4,395.00 |
| 24 | Furnish and Install C-700 Erosion Control Fabric with notched wooden stakes for installation | 31 25 | SY | 2734 | $9.00 | $24,606.00 |
| | **Miscellaneous** | | | | | |
| 25 | Construction Project Staking and Surveying | SGP / 01050 | LS | 1 | $3,000.00 | $3,000.00 |
| | | | | | | |

| | |
|---|---|
| **Base Bid Estimate Total =** | **$164,533.43** |
| **20% Escalation & Estimating Contingency=** | **$32,906.69** |
| **Opinion of Probable Costs=** | **$197,500.00** |