U.S. Army Corps of Engineers
Mobile District

SWEETWATER CREEK
FLOOD RISK MANAGEMENT PROJECT

COBB COUNTY, GEORGIA

APPENDIX A

ECONOMICS

September 2018

Contents

INTRODUCTION

This economic appendix documents the analysis of flood damage reduction, and regional economic development (RED) undertaken for this study. Section I documents the flood damage reduction analysis, Section II documents the evaluation of RED, section III discusses the TSP refinement, and Section IV documents derivation of recreation benefits.

SECTION I: FLOOD DAMAGE REDUCTION

PURPOSE

The study area encompassing Sweetwater Creek and its tributaries have experienced multiple large flooding events within the past decade prompting Cobb County, Georgia and the U.S. Army Corps of Engineers to enter into a Feasibility Cost Sharing Agreement. The agreement calls for Cobb County and the USACE to perform the analyses necessary to determine whether a Federal interest exists in measures to reduce the risk of flooding. This document explains what is known about the study area, the floodplain characteristics, existing condition flood damages and expected future condition flood damages in the absence of flood damage reduction measures. Within this report is the documentation of the procedures used to analyze various measures designed to reduce the risk of flood damages, and recommends a plan alternative regarding National Economic Development (NED).

STUDY AREA

The Sweetwater Creek study area is located in Georgia approximately 15 miles west of the city of Atlanta and is within Cobb, Douglas and Paulding Counties. The main urban areas which are affected by flooding are Austell, and Powder Springs in Cobb County. The urban areas mostly affected by flooding are Austell and Lithia springs which both closely boarder the Cobb-Douglas County line with Austell to the north in Cobb County and Lithia Springs directly south in Douglass County.

Cobb, Douglas and Paulding counties have experienced a period of steady growth for the past 40 years as they are in close proximity to the city of Atlanta. The growth of Atlanta has led to growth within the surrounding cities as has been seen with many other large cities across the nation. Since much of the development has occurred after the institution of the National Flood Insurance Program (NFIP), the development has largely occurred with flooding in mind and above the 100-year floodplain. Most of the small number of structures that are within the 100-year floodplain are located within the unincorporated, rural county areas and were built before the NFIP was created in 1968. This results in a scenario where the structures which account for the majority of economic damages to be few and far-between and with lower market prices and depreciated replacement costs than the newer housing developments which were built above the 100-year floodplain. The Sweetwater Creek study area floodplain has been managed wisely and this can be seen in the relatively low economic damages when compared to other areas that experience flooding.

The Federal Government has an interest in reducing economic damages caused by flooding, as doing so not only contributes to NED benefits, but may also improve the living conditions of some minority and low-income groups, may provide opportunities to enhance the environment and may reduce the costs of administering the Federal Flood Insurance program. The cities within the study area also have a valid interest in reducing those losses, as improved economic conditions benefit the area's economy while allowing the city to save on emergency, repair, maintenance and clean-up costs.

For the purposes of the economic and socioeconomic portions of this Report, the 'Study Area' is defined as the 500-year floodplain of Sweetwater Creek and its tributaries. The 'Floodplain' is defined as the area drained by Sweetwater Creek and its tributaries, extending to the boundaries of the 0.02% Annual Chance Exceedance (ACE) flood event. That floodplain will also include areas encompassing the 100-year event and other more frequent flood boundaries. Unless otherwise designated by its recurrence chance, the floodplain discussed in this report is the 500-year floodplain.

SOCIOECONOMIC

Over the last 100 years, Cobb, Douglas and Paulding counties have experienced 2 main periods of growth closely linked to the growth of Atlanta, the state's economic center. The first was in the 1960s and 1970s and the second during the 1990s and 2000s continuing to the current period as the city of Atlanta continues to grow.

Georgia Population and Demographics: The 2016 Census estimates Georgia with a total population of 10,310,371, with 51.3% identifying as female and 48.7% identifying as male. A strong majority of Georgians (97.5%) identify as one race alone, with 58.7% being White, 31.6% being Black or African American, 9.3% being Hispanic or Latino (of any race), 3.9% being Asian, and 0.4% being American Indian and Alaska Native. Within Georgia there are 3,686,135 households and an average household size of 2.73.

Cobb County Population and Demographics:

2016 Census data estimates the population of Cobb County to be 748,150.The population within the county is 51.7% female, 48.3% male and a median age of 36.5 years old. The population identifies as 58.7% being White, 27.0% being Black or African

American, 12.9% being Hispanic or Latino (of any race), 5.3% being Asian and 4.9% being some other race. Within Cobb County there are 297,399 housing units, 277,949 households, and an average household size of 2.66.

Cobb County Industry: The U.S. Census Bureau's American Community Survey 2016 estimates report Cobb County's largest industry as "Educational services and health care and social assistance" followed by "Professional, scientific, and management, and administrative and waste management" and "Retail trade".

Cobb County Employment and Occupations: In 2016 Cobb County's unemployment rate was 4.5%, 1.3% lower than the unemployment rate for Georgia as a whole. The most common occupations are "Management, business, science, and arts occupations" (45.0%), "Sales and office occupations" (23.9%), "Service occupations" (15.9%), "Production, transportation, and material moving occupations" (8.2%), and "Natural resources, construction, and maintenance occupations" (7.10%).

Cobb County Income and Poverty Status: Median household income in Cobb County is $70,947 with 9.6% of all people earning an income below the poverty level compared to the Georgia state median income of $53,559 and poverty rate of 14.0%.

Douglas County Population and Demographics:

2016 Census data estimates the population of Douglas County to be 142,224. The population within the county is 51.6% female, 48.4% male and a median age of 36 years old. The data reports 47.3% of the population as being White, 47.4% being Black or African American, 9.4% being Hispanic or Latino (of any race), 1.6% being Asian and 1.7% being two or more races. Within Douglas County there are 52,194 housing units, 48,901 households, and an average household size of 2.88.

Douglas Industry: The U.S. Census Bureau's American Community Survey 2016 estimates report Douglas County's largest industry as "Educational services and health care and social assistance" followed by "Retail trade" and "Transportation and warehousing, and utilities.

Douglas County Employment and Occupations: In 2016 Douglas County's unemployment rate was 7.5%, 1.7% higher than the unemployment rate for Georgia as a whole. The most common occupations are "Management, business, science, and arts occupations" (35.4%), "Sales and office occupations" (24.4%), "Service occupations" (16.1%), "Production, transportation, and material moving occupations" (14.8%), and "Natural resources, construction, and maintenance occupations" (9.3%).

Douglas County Income and Poverty Status: Median household income in Douglas County is $62,445 with 12.5% of all people earning an income below the poverty level compared to the Georgia state median income of $53,559 and poverty rate of 14.0%.

Paulding County Population and Demographics:

2016 Census data estimates the population of Paulding County to be 155,825. The population within the county is 51.4% female, 48.6% male and a median age of 36.4 years old. Within the county, race is divided to 74.3% of the population as being White, 22.1% being Black or African American, and 6.1% being Hispanic or Latino (of any race). Within Paulding County there are 54,840 housing units, 53,249 households, and an average household size of 2.91.

Paulding County Industry: The U.S. Census Bureau's American Community Survey 2016 estimates report Paulding County's largest industry as "Educational services and health care and social assistance" followed by "Retail trade", "Construction" and "Professional, scientific, and management, and administrative and waste management".

Paulding County Employment and Occupations: In 2016 Paulding County's unemployment rate was 3.0%, 2.8% lower than the unemployment rate for Georgia as a whole. The most common occupations are "Management, business, science, and arts occupations" (33.1%), "Sales and office occupations" (26.7%), "Service occupations" (18.2%), "Production, transportation, and material moving occupations" (11.3%), and "Natural resources, construction, and maintenance occupations" (9.4%).

Paulding County Income and Poverty Status: Median household income in Paulding County is $60,856 with 8.7% of all people earning an income below the poverty level compared to the Georgia state median income of $53,559 and poverty rate of 14.0%.

FLOODPLAIN CHARACTERISTICS

The floodplain primarily consists of single family housing developments built at elevations above the 100-year floodplain. The majority of structures built below the 100-year floodplain are single family houses built between the 1960s and 1980s. Nonresidential structures within the 100-year floodplain are warehouses and service stations built in the same time period. The residential development is typical of periods of fast growth, having structures built on slab and crawlspace foundations. A majority of the rural residential structures are ranch style homes built on slab or crawlspace foundations.

Most of the commercial structures are slab-on-grade pre-fabricated construction with first floor elevations of two feet or less above ground. Many of the residential structures are wood or brick construction with the first floor elevated one to two feet above ground.

No major agricultural production is known to occur within the study area floodplain, with the exception of sever rural ranch properties. Development in the floodplain also includes the transportation, communication and utility infrastructure needed to serve the residents and businesses located in the area. This includes roads, bridges, storm water collection and drainage structures, telephone networks and systems for water distribution, wastewater collection and electricity.

METHODOLOGY

In order to develop plans to address water resource problems within a study area, three conditions must be fully analyzed: the "existing," the future "without" project and "with" project conditions. In this analysis, the existing condition represents current floodplain conditions.

The future without project condition (FWOP) is the condition which would likely exist in the future without the implementation of a Federal project. This condition is evaluated for a 50-year period for urban flood control projects, and the results are expressed in terms of mean expected annual damages. For this study, the without project condition project life is for the years 2020-2070. This same 50-year period is then analyzed with a project in place. The difference in expected annual flood damages to the floodplain properties between the future "without" and "with" project conditions represents the flood damage reduction benefits to the project. Other economic and other significant outputs may accrue to the project as well, including recreation benefits, ecosystem restoration benefits, regional economic benefits, and other social effects. Other social effects, which often escape quantification in monetary terms, range from improvement in the quality of life within the study area to community impacts. This report attempts to recognize and, where possible, quantify all of the outputs of a Federal project in the study area.

This section of the analysis presents the assumptions and methods used in computing average annual equivalent flood damages for the study area. The methods employed in computing the outputs of other features are documented in separate sections within the economic appendix.

ASSUMPTIONS

- Floodplain residents will react to a floodplain management plan in a rational manner.
- Real property will continue to be repaired to pre-flood conditions subsequent to each flood event.
- The residential depth-percent damage relationships for structure and content contained in Economic Guidance Memorandum 01-03 (2000) and 04-01 (2003) are assumed to be representative of residential structures in the floodplain.
- The residential depth-percent damage relationships for vehicles contained in Economic Guidance Memorandum 09-04 are assumed to be representative of vehicles in the floodplain.

- Non-residential depth-percent damage relationships for structure and content are from expert elicitation found in the revised 2013 manual by the Institute of Water Resources, USACE, Draft Report, Nonresidential Flood Depth-Damage Functions Derived from Expert Elicitation are assumed to be representative of non-residential structures in the floodplain.
- The project's first costs and benefits will be annualized using the FY 2018 Federal discount rate of 2 ¾% assuming a period of analysis of 50 years.
- All values are equivalent to FY18 dollars.
- All project alternatives are evaluated for a 50-year period of analysis.
- The project construction is scheduled to begin in 2020.
- Any new property development will occur above the 100-year floodplain elevation

RISK AND UNCERTAINTY FACTORS

Risk and uncertainty are inherent in water resources planning and design. These factors arise due to errors in measurement and from the innate variability of complex physical, social, and economic situations. The measured or estimated values of key planning and design variables are rarely known with certainty and can take on a range of possible values.

Methodology Description - Risk analysis in flood damage reduction projects is a technical task of balancing risk of design exceedance with flood damage prevented; trading off uncertainty of flood levels with design accommodations; and providing for safe, reasonably predictable project performance. Risk-based analysis is therefore a methodology that enables issues of risk and uncertainty to be included in project formulation. A computerized risk based model, Hydrologic Engineering Center-Flood Damage Reduction Analysis (HEC-FDA); version 1.4.2 (July 2017) was used in this analysis. This model is a product of USACE and was created by the Corps' Hydrologic Engineering Center in Davis, California. HEC-FDA is a certified model used for flood damage analysis. It is a frequency-based model, relating expected flood damages to flood frequency and incorporating a multitude of variables.

Input Variables - Uncertainty was quantified for errors in the underlying components of the stage-damage relationship functions, structure values for all residential, nonresidential and vehicles. Depth-percent damage relationship uncertainty was quantified for both residential and nonresidential structures as well as content to structure value ratios for residential and nonresidential, and first elevations for all structures.

Residential Structural Values - Structure values are crucial sources of uncertainty in the stage-damage relationship. Structure values play an important role in determining the dollar value of damage caused by a given depth of flooding to both to the structure itself and the contents of the structure. In this analysis, the “existing” condition structure values were obtained from County Tax Assessor's Offices. Based on information provided by the tax assessors, the assessed value included a depreciated replacement value for the residential structures. This value was exclusive of market and land values and meant to reflect an estimated replacement value estimate less depreciation for the residential structures. Furthermore, using the Marshall & Swift Residential Estimator Software Program, these values were compared to similar structures derived by the program with similar results. Therefore, the residential structural values obtained from the tax assessor were verified as being reasonable estimates of replacement cost less depreciation. HEC-FDA uses standard deviation as a percentage of value in order to quantify the uncertainty surrounding structure values. The residential structure inventory standard deviation applied to the entire population of residential structures was 21%, based on market value estimates for the same structure from 3 separate real estate database companies. From these separate estimates, the mean value was approximately $159,023.22 in FY2018 dollars. Average standard deviations were shown to be approximately 33,193.17 or 21% of average estimated values. For residential structures which tax assessor data was not available, average value was used based on structure type within the study area.

Vehicle Inventory - Based on 2010-2014 American Community Survey 5-year estimates for the study area, it was determined that the average household had 2 vehicles available. *Economic Guidance Memorandum, 09-04, Generic Depth-Damage Relationships for Vehicles (2009)* states that the average number of people who do not move vehicles to higher ground during flooding events is 26.93. That is to say, 26.93 percent of vehicles remain in the area of flooding and are susceptible to flood damages. According to the *Edmunds 2016 Used Vehicle Market Report*, the average price of a used vehicle was $19,189 at an average age of 4.5 years. Since only 26.93% of vehicles remain susceptible to damage during a flood event, a value of $10,335 (2*$19,189*0.2693) was assigned to each residential structure. Vehicle damages were only calculated for residential properties, and not applied to nonresidential properties such as warehouses or offices. Furthermore, vehicle damage was not calculated for trailer parks due to disproportionately and unrealistic HEC-FDA results. It is likely that trailer park residents will self-mitigate if large repetitive damages at high frequency events occur. The Edmund's vehicle value adjusted for number of vehicles per household and for the evacuation of vehicles prior to the storm event was used as the most likely value. Moreover, the uncertainty surrounding the values assigned to the vehicles in the inventory was determined using a triangular probability distribution function with a maximum of 268% and a minimum of 21%, the mean value in the triangular distribution is the value of the vehicle within the structure inventory. The average value of a new vehicle before taxes, license, and shipping charges ($27,738) was used as the maximum value which is approximately 268% of $10,335. The average 10-year depreciation value of a used vehicle ($2,215) was used as the minimum value which is approximately 21% of $10,335. These maximum and minimum percent values were entered in as the maximum and minimum values of the triangular distribution.

Nonresidential- Nonresidential structure values were derived using Marshall & Swift Commercial Estimator Software Program and for structures within the tax assessor data which appeared to be outliers. In order to quantify uncertainty, 21% was used as the standard deviation for these structures as was applied to residential structures.

Residential Depth-Damage Curves - The structure and content depth damage functions relate flood damage as a percent of the value of the structure or contents at various depths of flooding above the first floor elevation. These functions are contained in EGM-01-03 (2000) and 04-01 (2003), and are based on surveys administered through the Corps of Engineers Institute for Water Resources. The functions show strong correlations between depth of flooding and percent of value in structure damage. The residential structures in the study area floodplain are represented by these curves. Moreover, both EGMs contained a normal distribution function with an associated standard deviation of damage to account for uncertainty surrounding the damage percentage associated with each depth of flooding.

Nonresidential Depth-Damage curves - The structure and content depth-damage functions relate flood damage as a percent of the value of the structure or contents at various depths of flooding above the first floor elevation. These functions are contained in the Draft Report, Nonresidential Flood Depth-Damage Functions Derived from Expert Elicitation. These values can be found in Appendix D, Tables D-22 through D-42 for structures and Tables D-42 through D-63 for content, of the report. In 2008, the Federal Emergency Management Agency (FEMA) contracted to have an expert elicitation panel derive nonresidential content-to-structure value ratios and flood depth-damage functions for 21 of the most commonly affected categories of nonresidential properties. USACE Institute for Water Resources (IWR) fully participated in the planning, process, implementation, and analysis of the results. The functions show strong correlations between depth of flooding and percent of value in structure damage. The vast majority of the nonresidential structures in the Village Creek floodplain are represented by these curves. Moreover, these functions contained a triangular distribution (i.e. minimum, maximum, most likely) to account for the uncertainty surrounding the damage percentage associated with each depth of flooding.

Residential Content to Structure Value Ratio - The content to structure value ratios included in this report are the content depth- damage curves contained in the aforementioned Economic Guidance Memorandum 01-03 and 04-01 . Moreover, both EGMs contained guidance to account for uncertainty associated with content/structure value ratio which implies that the uncertainty in the content-to-structure value ratio should be inherent in the content depth-damage relationship as contained in both respective EGMs.

Nonresidential Content to Structure Value Ratio - The content to structure value ratios included in this report are contained in the aforementioned draft report, Nonresidential Flood Depth-Damage Functions Derived from Expert Elicitation, specifically Appendix E, Table E-1. Moreover, these functions contained a triangular distribution (i.e. minimum, maximum, most likely) to account for the uncertainty surrounding the ratio for each nonresidential occupancy type.

First Floor Elevations – The same NAVD88 topographical data obtained from Light Detection and Ranging (LIDAR) used for the study's H&H model area were used to determine ground elevations at the structure location of each parcel due to the non-uniform shape and elevation of parcels within the study area. The heights above ground were estimated from a Google earth™ street view survey of the structures in the study area which was conducted in 2017 using imagery from 2017. The sum of the ground elevation plus the finished floor height above ground elevation is the first floor elevation. Vehicles were assigned to the ground elevation of the adjacent residential structures. A first floor standard deviation of 0.6 feet assuming normal distribution was used to quantify uncertainty of foundation heights based on guidance found in Engineering Manual (EM) 1110-2-1619, Table 6-5, aerial survey, 2-ft contour interval.

Water Surface Elevations – Uncertainty for water surface elevations is captured in HEC-FDA using the graphical method with a 50 year equivalent record length when calculating exceedance probability functions. H&H modeling parameters and can be found in the H&H appendix of this report.

HISTORIC CONDITIONS

The study area has experienced multiple minor and major flood events over the past 50 years, with the largest on record occurring in 2009 as an estimated 0.01% ACE. Following this large event, many of the structures at highest risk of flooding were removed from the floodplain through voluntary FEMA buyout programs. Previous studies have been conducted within portions of the study area, showing small amounts of remaining flood damages. These past events and studies provide a basis for expected results and model calibration for this study.

EXISTING CONDITIONS

In June, 2017, parcels within the 500-year floodplain for Sweetwater Creek and its tributaries within Cobb, Douglas and Paulding Counties were surveyed for use in a FRM study. For the Sweetwater Creek study area parcel data was obtained by each county's tax assessor's office and used to build a GIS database for identifying which parcels were located within the FEMA 500-year floodplain. The structure inventory survey identified 2,230 structures within 1,902 parcels not including vacant lots.

Structure inventory depreciated replacement values for Cobb County were gathered from the Cobb County Tax Assessor's Office. For values not included in the tax assessor data, average values were used based off of structure type. More unique structures, such as apartment complexes, warehouses, shops and schools not included in the tax assessor data were appraised using Marshall and Swift Residential and Commercial estimates based off of structure age, square footage and construction type. In cases where square footage was not available from county data the Square footage was calculated by digitally drawing a polygon over the building and measuring the area of the polygon footprint in GIS software and multiplied by the number of stories.

Base elevations of structures were determined from structure location within each parcel instead each parcel’s center. This is due to structure locations often being at one end of a parcel instead of at the parcel’s center as is common in more urban settings. Because of the irregular parcel shapes within the floodplain many parcels are located within the 500-year floodplain but the structures themselves are often located outside of all analyzed events as seen in figure 1 below.

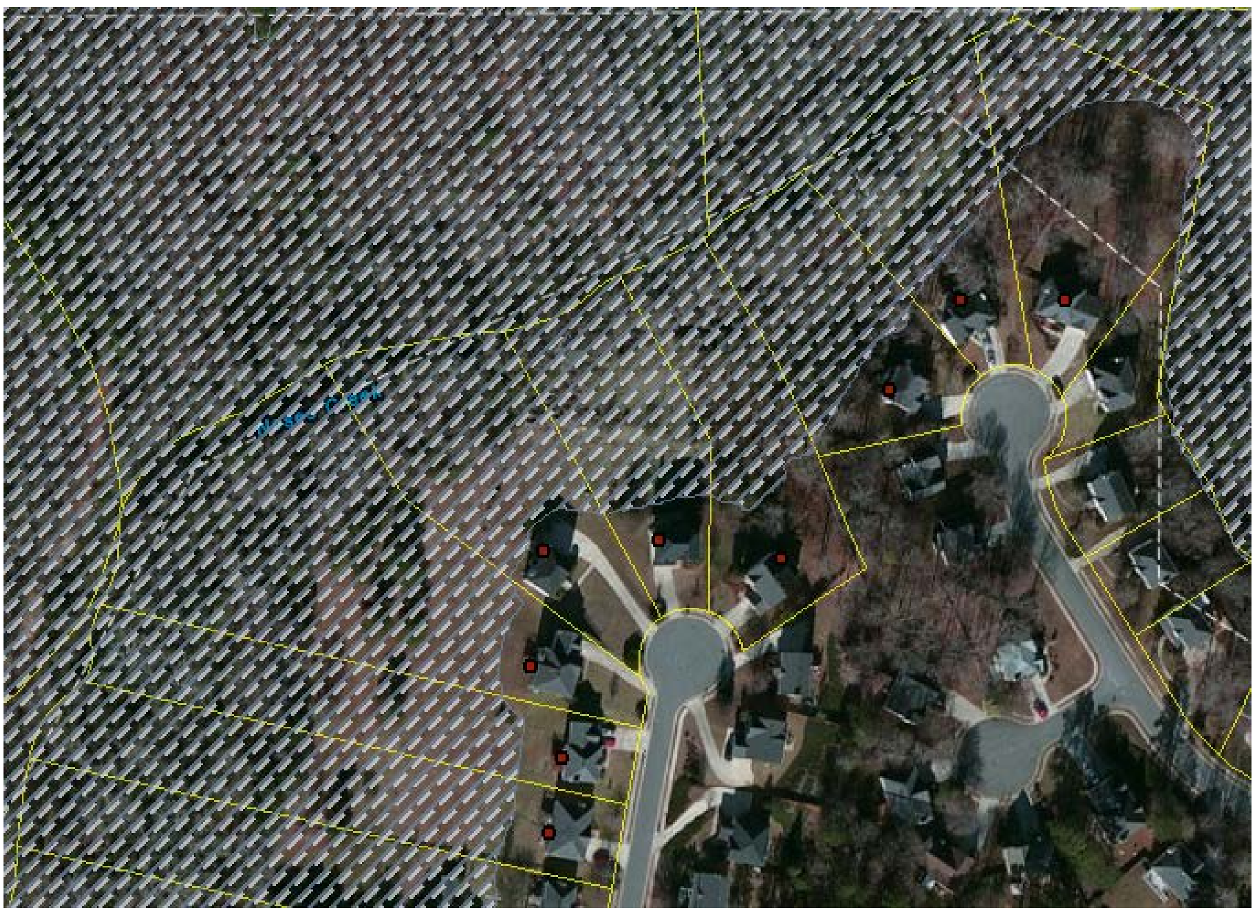


Figure 1: Example of study area floodplain. Hashed grey area represents extent of 500-year floodplain. Red dots represent the point at which ground elevation was measured.

Content values and depth damage relationships were used from EGM 04-01, EGM 01-03 and the Revised 2013 Draft Report: Nonresidential Flood Depth-Damage Functions Derived from Expert Elicitation.

STREAMS AND REACH DELINEATION
Within the study area are seven individual streams; Buttermilk Creek, Mill Creek, Mud Creek, Noses Creek, Olley Creek, Powder Springs Creek, and Sweetwater Creek. Each creek is divided into at least one reach, with Noses Creek containing 2 reaches and Sweetwater Creek containing 6 reaches.

The term “reach” describes a section of a stream having similar hydraulic, hydrologic, political, geographic or economic characteristics. Dividing the floodplain into reaches facilitates evaluation of flood damages by breaking the floodplain down into several areas having some common features, and analyzing them separately.

River Stations are sections of an individual reach which represent the water surface elevations during flood events. Hydraulic and hydrologic engineers assign river stations to streams to represent the floodplain as accurate as possible. Structures are assigned river stations to represent water surface elevations based on their proximity to the nearest river station.

Buttermilk Creek begins (downstream) at river station 617.0778 and ends (upstream) at 10413.3600; Mill Creek begins at river station 184.7000 and ends at 14860.0600; Mud Creek begins at 707.0146 and ends at 6502.4520; Noses Creek begins at 30927.4300 and ends at 30292.5300; Olley Creek begins at 778.4826 and ends at 14552.7100; Powder Springs begins at 79.1615 and ends at 34618.2400; and Sweetwater Creek begins at 130930.8000 and ends at 143265.0000.

Table A-1 1: Stream Reach Description and Location

Stream Name	Reach Name	Reach Description	Beginning Station	Ending Station	Index Station
Buttermilk Creek	BMC1	Buttermilk Creek Reach 1	617.0778	10413.36	5929.044
Mud Creek	MDC1	Mud Creek Reach 1	707.0146	6502.452	3090.924
Mill Creek	MIC1	Mill Creek Reach 1	184.7	14860.06	5880.904
Noses Creek 1	NCC1	Noses Creek Reach 1	30927.43	33120.14	31603.33
Noses Creek 2	NCC2	Noses Creek Reach 1	2193.528	30292.53	16578
Olley Creek	OLC1	Olley Creek Reach 1	778.4826	14552.71	7795.065
Powder Springs Creek	PSC1	Powder Springs Creek Reach 1	79.1615	34618.24	19295.86
Sweetwater Creek 1	SWC1	Sweetwater Creek Reach 1	130930.8	143265	137153.1
Sweetwater Creek 2	SWC2	Sweetwater Creek Reach 2	93306.57	130164.6	111349.5
Sweetwater Creek 3	SWC3	Sweetwater Creek Reach 3	75678.23	92326.93	84556.76
Sweetwater Creek 4	SWC4	Sweetwater Creek Reach 4	74534.92	75124.97	75124.97
Sweetwater Creek 5	SWC5	Sweetwater Creek Reach 5	63836.73	73747.23	70253.64
Sweetwater Creek 6	SWC6	Sweetwater Creek Reach 6	43.7165	63230.32	20022.9

Structure Inventory

The setting of the Sweetwater Creek study area is mostly rural and suburban with small cities such as Austell and Powder Springs which have developed near the floodplains of Sweetwater Creek and Powder Springs Creek respectively.

The existing structure inventory within the floodplain contains 2,230 structures on 1,902 parcels. Residential structures account for 1,959 of structures, with the remaining 271 being nonresidential. There are 62 structures located within the Buttermilk reach; 69 structures within the Mill Creek reach; 43 structures within the Mud Creek reach; 589 structures within the Noses Creek reaches; 133 structures within the Olley Creek reach; 220 structures within the Powder Springs Creek reach; and 1,114 structures within the Sweetwater Creek reaches.

Table A-1 2 and Table A-1 5 summarize the number of structures in each reach along with their depreciated replacement cost and vehicle depreciated replacement cost in FY 18 dollars.

All 2,230 structures were entered into the HEC-FDA model. Stage/damage was calculated for each structure, using risk parameters described in the assumptions. Stage/damage simulations were made on the variables described in the assumptions and risk analysis overview. The existing aggregated mean stage/damage of each reach is shown below in Table A-1 3. The error curve limits (standard deviations) for the reaches are not shown in this report but are documented in the study data.

Stage/damage was integrated with stage/frequency in the HEC-FDA model. The result of the integration is damage/frequency. These are the expected annual damages, which reflect both the damage expected from a given event weighted by the incremental probability of that event's occurrence. The Sweetwater Creek Watershed expected annual damages calculation is performed within HEC-FDA using the Annual Chance Exceedance (ACE) events. HEC-FDA performs this calculation using a Monte-Carlo simulation. The simulation samples from the various distributions of each random variable and runs until the expected annual damages in the last iteration falls within 1% of the one before it.

Table A-1 2: Total Depreciated Replacement Value (x 1,000) of Study Area

Reach	Structures	Total Structure Value	Total Content Value	Total Vehicle Value	Total Value

	Residential	Non-Residential	Total				
Buttermilk Creek	46	16	62	$9,010	$5,588	$475	$15,073
Mill Creek	62	7	69	$6,242	$6,030	$641	$12,913
Mud Creek	38	5	43	$5,827	$5,601	$393	$11,821
Noses Creek 1	36	0	36	$11,917	$11,917	$372	$24,206
Noses Creek 2	515	38	553	$49,427	$46,575	$5,312	$101,314
Olley Creek	116	17	133	$35,570	$15,798	$1,199	$52,567
Powder Springs Creek	189	31	220	$50,829	$32,430	$1,912	$85,171
Sweetwater Creek 1	63	2	65	$6,493	$6,439	$651	$13,583
Sweetwater Creek 2	274	26	300	$30,331	$29,247	$2,822	$62,400
Sweetwater Creek 3	64	21	85	$27,441	$12,179	$661	$40,281
Sweetwater Creek 4	13	0	13	$1,342	$1,342	$134	$2,818
Sweetwater Creek 5	374	39	413	$19,989	$16,079	$1,437	$37,505
Sweetwater Creek 6	169	69	238	$181,229	$79,509	$1,220	$261,958
Total	**1,959**	**271**	**2,230**	**$435,647**	**$268,734**	**$17,229**	**$721,610**

The structure inventory was modeled in HEC-FDA using stage-damage relationship with uncertainty along with stage-probability relationship with uncertainty. The HEC-FDA model used the economic and engineering inputs to generate a stage-damage relationship for each structure category in each study reach in the existing and future conditions. The possible occurrences of each economic variable were derived through the use of Monte Carlo simulation and were executed by the model for the Sweetwater Creek study. The sum of all sampled values was divided by the number of samples to yield the expected value for a specific simulation. A mean and standard deviation was automatically calculated for the damages at each stage. The HEC-FDA model used an equivalent record length (50 years) for each study area reach to generate a stage-probability relationship with uncertainty for the existing and FWOP through the use of graphical analysis. The model used the eight stage-probability events together with the equivalent record length to define the full range of the stage-probability functions by interpolating between the data points. Confidence bands surrounding the stages for each of the probability events were also provided. The eight ACE events that water surface profiles were provided for use in the damage calculations are as followed: 50%(2-year), 20%(5-year), 10%(10-year), 4%(25-year), 2%(50-year), 1%(100-year), 0.4%(250-year), and 0.2%(500-year). Damages were reported at the index location for each study area reach. Following the conclusion of the Monte Carlo simulation, a mean is calculated from the observed expected annual damage calculation. Table A-1 3 displays the existing condition mean expected annual damages according to reach and damage category.

Under the FWOP condition which represents annual damages in the absence of a flood damage reduction project, damages are expected to increase in the future. Changing hydrology as development within the drainage area increases contribute to increased runoff rates. These factors result in higher stages in the future, and correspondingly higher flood levels for any given event. A comparison of damages for the existing and FWOP conditions can be seen in Table A-1 6.

Table A-1 3: Existing Condition Mean Expected Annual Damages (x 1,000)

Reach	Category	Existing Condition Damages
Buttermilk Creek	Residential	$5
	Nonresidential	$1
	Total	$6
Mill Creek	Residential	$69
	Nonresidential	$0
	Total	$69
Mud Creek	Residential	$0
	Nonresidential	$0
	Total	$0
Noses Creek 1	Residential	$19
	Nonresidential	$0
	Total	$19
Noses Creek 2	Residential	$466
	Nonresidential	$0
	Total	$466
Olley Creek	Residential	$37
	Nonresidential	$11
	Total	$48
Powder Springs Creek	Residential	$13
	Nonresidential	$1
	Total	$15
Sweetwater Creek 1	Residential	$23
	Nonresidential	$6
	Total	$29
Sweetwater Creek 2	Residential	$296
	Nonresidential	$25
	Total	$321
Sweetwater Creek 3	Residential	$7
	Nonresidential	$53
	Total	$60
Sweetwater Creek 4	Residential	$3
	Nonresidential	$0
	Total	$3
Sweetwater Creek 5	Residential	$21

	Nonresidential	$18
	Total	$39
Sweetwater Creek 6	Residential	$141
	Nonresidential	$96
	Total	$237
Total	**Residential**	**$1,100**
	Nonresidential	**$212**
	Total	**$1,312**

According to Table A-1 3, there are about $1.3 million in expected annual flood damages under existing condition. The existing flood damages are the potential average annual dollar damages to structures, contents, and vehicles affected by flooding at the time of the study. No projection is involved, and the existing conditions encompasses relevant factors that best characterize the planning perceptions of the affected area in the situation without a plan. This existing condition will provide the data from which to evaluate the condition that would likely exist in the future without the implementation of a Federal project. Under the without project condition, damages are expected to increase as development within the drainage area increases and contributes to higher runoff rates. Those higher runoff rates translate into higher stages in the future and correspondingly higher water surface profiles for any given flood event.

FUTURE WITHOUT PROJECT CONDITION

According to Georgia residential population projections, the population of the counties within the study area (Cobb, Douglass and Paulding) are expected to increase by approximately 34.89% by the year 2050. The average household size in the state of Georgia is 2.73 persons. Dividing the percent increase by 2.73 households estimates the expected increase in households in the year 2050 is 12.78%. This is represented by the addition of 213 residential structures in the 2070 analysis year. These structures were added to the year 2050 structure inventory in proportion to the number of structures within each reach. The number of structures for Table A-1 4: Future Structure Counts differs from overall structure count due to counting multi-structure parcels as one, resulting in a difference of 286. These structures were entered into the structure inventory at the year 2050 to assure damage calculation in the 2070 analysis year, but not at the base year 2020. It is assumed that by the year 2050 the floodplain will be fully developed and no future development will occur.

The future residential structures were projected with a first floor elevation equal to the stage elevation of a 1% ACE flood event due to the assumption that floodplain management will restrict development within the 1% ACE floodplain area. Structures were added in proportion to the number of structures within each stream at the index location (point at which damages are aggregated) for the stream. The most common type residential structure built since the year 2000 has been 2 Story single family home with slab foundation and was used to represent future structures with a depreciated replacement cost set to the average value of this structure type. Vehicles were added to the analysis year 2050 as well and in accordance with the vehicle methodology.

Table A-1 4: Future Structure Counts

Reach	Analysis Year 2020 Number of Structures	Percent of Residential Structures	Future Structures Added	Analysis Year 2070 number of structures
Buttermilk	46	2.75%	6	52
Mill	62	3.71%	8	70
Mud	38	2.27%	5	43
Noses	551	32.93%	70	621
Olley	116	6.93%	15	131
Powder Springs	189	11.30%	24	213
Sweetwater	671	40.11%	85	756
Total:	**1,673**	**100%**	**213**	**1,886**

Table A-1 5: Total Depreciated Replacement Value of Future Development

Reach	Structures		Total Future Development Structure Value (x$1,000)	Total Future Development Content Value (x$1,000)	Total Future Development Vehicle Value (x$1,000)	Total Future Development Construction Value (x$1,000)
	Residential	Total				
Buttermilk Creek	6	6	695	$695	$62	$1,452
Mill Creek	8	8	927	$927	$83	$1,936
Mud Creek	5	5	579	$579	$52	$1,210
Noses Creek 1	70	70	8109	$8,109	$723	$16,942
Noses Creek 2	0	0	0	$0	$0	$0
Olley Creek	15	15	1738	$1,738	$155	$3,630
Powder Springs Creek	24	24	2780	$2,780	$248	$5,809
Sweetwater Creek 1	0	0	0	$0	$0	$0
Sweetwater Creek 2	0	0	0	$0	$0	$0
Sweetwater Creek 3	0	0	0	$0	$0	$0
Sweetwater Creek 4	0	0	0	$0	$0	$0
Sweetwater Creek 5	0	0	0	$0	$0	$0
Sweetwater Creek 6	85	85	9847	$9,847	$878	$20,573
Total	**213**	**213**	**$24,676**	**$24,676**	**$2,201**	**$51,553**

The year 2070 was selected to represent the FWOP condition. No additional development within the 100-year floodplain of the study area is anticipated due to the conditions of the Federal Flood Insurance Program. However, a combination of both wealth and complementary effects are likely to contribute to growth in the value of the assets at risk in the floodplain. The same 2,230 structures plus the additional future development of 213 structures lying in the 100-year floodplain will continue to be affected by the risk of flooding and suffer increasing losses each year.

Additional development within the drainage basin, but at elevations beyond the 1% ACE, is likely. The development, consisting of a variety of commercial, industrial and residential construction, will contribute to an increase in the land area impervious to stormwater runoff. This in turn will lead to slightly higher stream inflows at any given event and accordingly, somewhat higher stages at the various flood frequencies. The end result is an increase in the expected annual damages for the future, meaning that the losses suffered by the affected structures will increase between 2020 and 2070.

Like that of the existing condition, the HEC-FDA used Monte Carlo simulation to sample from the stage-probability curve with uncertainty. For each of the iterations within the simulation, stages were simultaneously selected for the entire range of probability events. The sum of all damage values divided by the number of iterations run by the model yielded the expected value, or mean damage value, with confidence bands for each probability event. The probability-damage relationships are integrated by weighting the damages corresponding to each magnitude of flooding (stage) by the percentage chance of exceedance (probability). From these weighted damages, the model determined the expected annual damages (EAD) with confidence bands (uncertainty). For the without project alternative, the EAD were totaled for each study area reach to obtain the total without project EAD under future conditions as shown in Table A-1 6.

Table A-1 6: Base Year vs. Future Without Project Mean Expected Annual Damages (x 1,000)

Reach	Residential	Nonresidential	Total
Base Year 2020			
Buttermilk Creek	$5	$1	$6
Mill Creek	$69	$0	$69
Mud Creek	$0	$0	$0
Noses Creek 1	$19	$0	$19
Noses Creek 2	$466	$0	$466
Olley Creek	$37	$11	$48
Powder Springs Creek	$13	$1	$15
Sweetwater Creek 1	$23	$6	$29
Sweetwater Creek 2	$296	$25	$321
Sweetwater Creek 3	$7	$53	$60

Sweetwater Creek 4	$3	$0	$3
Sweetwater Creek 5	$21	$18	$39
Sweetwater Creek 6	$141	$96	$237
Total	**$1,100**	**$212**	**$1,312**
Future Year 2070			
Buttermilk Creek	$9	$1	$10
Mill Creek	$94	$0	$94
Mud Creek	$4	$0	$4
Noses Creek 1	$75	$0	$75
Noses Creek 2	$502	$0	$502
Olley Creek	$50	$12	$61
Powder Springs Creek	$38	$2	$40
Sweetwater Creek 1	$29	$8	$37
Sweetwater Creek 2	$330	$29	$359
Sweetwater Creek 3	$8	$58	$65
Sweetwater Creek 4	$3	$0	$3
Sweetwater Creek 5	$22	$20	$42
Sweetwater Creek 6	$220	$105	$325
Total	**$1,385**	**$233**	**$1,618**

Moreover, damages for each of the years during the period of analysis were computed by linear interpolation between 2020 and 2070. The FY 2018 Federal discount rate of 2.75 percent was used to compound the stream of expected annual damages and benefits before the project base year and to discount the stream of expected annual damages and benefits occurring after the base year to calculate the total present value of the damages over the period of analysis. The present value of the expected annual damages was then amortized over the 50 year period of analysis using the Federal discount rate to calculate the equivalent annual damages. The results are shown in Table A-1 7.

Table A-1 7: Future Year 2070 Equivalent Annual Damages (x1000Prices)

Reach	Damage Category	FWOP Damages
Buttermilk Creek	Residential	$6
	Nonresidential	$1
	Total	$7
Mill Creek	Residential	$79
	Nonresidential	$0
	Total	$79
Mud Creek	Residential	$2
	Nonresidential	$0
	Total	$2

Noses Creek 1	Residential	$40
	Nonresidential	$0
	Total	$40
Noses Creek 2	Residential	$480
	Nonresidential	$0
	Total	$480
Olley Creek	Residential	$42
	Nonresidential	$11
	Total	$53
Powder Springs Creek	Residential	$23
	Nonresidential	$1
	Total	$24
Sweetwater Creek 1	Residential	$25
	Nonresidential	$7
	Total	$32
Sweetwater Creek 2	Residential	$309
	Nonresidential	$26
	Total	$336
Sweetwater Creek 3	Residential	$7
	Nonresidential	$55
	Total	$62
Sweetwater Creek 4	Residential	$3
	Nonresidential	$0
	Total	$3
Sweetwater Creek 5	Residential	$21
	Nonresidential	$19
	Total	$40
Sweetwater Creek 6	Residential	$171
	Nonresidential	$99
	Total	$270
Total for Stream	**Residential**	**$1,208**
	Nonresidential	**$220**
	Total	**$1,428**

Table A-1 8: Existing Condition Chance Exceedance Water Surface Elevations at Reach Index Locations

Existing Condition									
		Index location Stage in Feet at Chance Exceedance							
Reach Name	Stream Name	0.5	0.2	0.1	0.04	0.02	0.01	0.004	0.002
BMC1	Buttermilk	887.34	888.24	888.75	889.33	889.88	891.3	892.52	894.21

MDC1	Mud Creek	905.45	907.09	907.85	908.78	909.6	910.04	910.26	910.9
MIC1	Mill Creek	907.51	908.96	910.23	911.17	912.09	913.09	914	915.03
NCC1	Noses Creek	905.06	907.18	908.12	909.08	910.13	910.99	911.75	912.58
NCC2	Noses Creek	893.3	895.27	895.86	897.1	898.24	899.33	899.95	900.52
OLC1	Olley Creek	890.12	891.32	893.61	897.47	901.6	903.67	905.53	907.74
PSC1	Powder Springs	902.65	904.46	905.72	907	908.13	909.12	911.17	913.79
SWC1	Sweetwater	908.02	909.67	910.28	911.35	912.75	913.8	914.84	916.17
SWC2	Sweetwater	894.47	897.8	899.85	902.25	903.88	906.32	907.8	910.4
SWC3	Sweetwater	886.22	889.48	891.25	893.72	894.98	896.47	897.71	899.13
SWC4	Sweetwater	883.04	885.98	887.84	890.49	892.89	894.46	895.76	897.41
SWC5	Sweetwater	880.92	884.17	886.01	888.53	890.93	892.48	893.63	895.18
SWC6	Sweetwater	836.88	837.81	838.28	838.93	839.56	840.53	841.11	841.82

Table A-1 9: Future Without Project Condition Chance Exceedance Water Surface Elevations at Reach Index Locations

Future Without Project Condition									
		Index location Stage in Feet at Chance Exceedance							
Reach Name	Stream Name	0.5	0.2	0.1	0.04	0.02	0.01	0.004	0.002
BMC1	Buttermilk	887.47	888.33	888.82	889.37	889.9	891.42	892.62	894.33
MDC1	Mud Creek	905.69	907.22	907.95	908.84	909.63	910.05	910.27	910.92
MIC1	Mill Creek	907.94	909.42	910.48	911.33	912.22	913.21	914.1	915.11
NCC1	Noses Creek	905.66	907.47	908.3	909.2	910.2	911.05	911.79	912.62
NCC2	Noses Creek	893.79	895.28	896.04	897.23	898.3	899.38	899.98	900.54
OLC1	Olley Creek	890.2	891.43	893.77	897.71	901.67	903.72	905.57	907.76
PSC1	Powder Springs	903.13	904.73	905.93	907.12	908.19	909.17	911.31	913.88
SWC1	Sweetwater	908.56	909.85	910.51	911.57	912.89	913.91	914.95	916.31
SWC2	Sweetwater	895.3	898.26	900.39	902.46	904.33	906.51	908.01	910.55
SWC3	Sweetwater	887.13	889.92	891.75	893.83	895.15	896.63	897.8	899.26
SWC4	Sweetwater	883.63	886.43	888.29	890.84	893.06	894.61	895.88	897.52
SWC5	Sweetwater	881.59	884.59	886.46	888.88	891.1	892.61	893.74	895.29
SWC6	Sweetwater	837.05	837.91	838.38	839.01	839.65	840.58	841.15	841.87

Table A-1 10: Future Without Project Condition Structure Count and Damages (Without Uncertainty) per Annual Chance Exceedance

Chance Exceedance	0.5	0.2	0.1	0.05	0.02	0.01	0.004	0.002
FWOP Structures	20	86	107	269	347	618	743	975
FWOP Damages (x$1,000 2018)	$605	$1,300	$2,240	$3,820	$6,928	$12,149	$19,870	$33,526

The forecasted higher stages in the FWOP condition shown in Table A-1 9: Future Without Project Condition Chance Exceedance Water Surface Elevations at Reach Index Locations above, resulted in a higher level of FWOP condition damages. According to Table A-1 7, the total FWOP equivalent annual damages are approximately $1.4 million, an increase of approximately $0.1 million from the existing condition equivalent annual damages. This $1.4 million represents the maximum possible annual benefits accruable to a flood damage reduction project at Sweetwater Creek (i.e. with project condition). The forecast of the FWOP condition reflects the conditions expected during the period of analysis and provides the basis from which alternative plans are evaluated, compared, and selected. Because with a Federal project in place, a portion of the flood damages that would occur in the without project condition would be prevented (i.e. flood damages reduced).

FUTURE WITH-PROJECT CONDITION

The with-project condition is the most likely condition expected to exist in the future if a specific project is undertaken. There are as many with project condition as there are project alternatives. A total of 9 alternatives were considered for the Sweetwater Creek Flood Risk Management Study. Of these, 5 were structural and 4 were nonstructural. A discussion of residual flood damages and flood damage reduction for each alternative are as followed:

EVALUATION OF ALTERNATIVE PLANS

Relevant data for each of the alternatives described below were entered into the HEC-FDA and potential for flood damages reduced were calculated. The modeling results for each alternative are summarized as followed:

Alternative 1: Relocation/Evacuation of Structures (Buyouts)

This alternative would be to purchase structures within first floor elevations at or below the FWOP condition water surface elevations of the 10, 4, 2, or 1 percent chance of exceedance storms. Table A-1 11 shows the number of structures that would be purchased as part of each level of buyout.

Table A-1 11: Structures for Purchase by Return Event

Alternative	Percent Chance of Exceedance	Number of Structures
1	10	20

1.1	4	26
1.2	2	66
1.3	1	117

Alternative 2: Brown Road Detention Alternative
The alternative consists of an inline dry detention facility on Sweetwater Creek located just upstream of Brown Road in Cobb County, creating up to 9,000 acre-feet of flood storage. The objective of the alternative is to temporarily detain floodwaters from the approximately 100 square miles that drain to the facility location. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges. This alternative would reduce flood risk along a section of Sweetwater Creek and along the tributaries of Mill Creek, Power Springs Creek, Noses Creek, Olley Creek and other small tributaries which experience backwater flooding from Sweetwater Creek. The facility would consist of a 1,400 feet long, 33 feet high structure built approximately perpendicular to Sweetwater Creek and its adjoining floodplain. The outlet works of the structure would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream of the structure.

Alternative 4: Austell Channel Modification
This alternative consists of a channel modification from near the CH James Parkway to the rapids in Sweetwater Creek State Park near the historic mill site (14.2 miles). The channel would be widened to 80 feet and would have 2V:1H side slopes. The length of the channel modification is approximately 74,000 linear feet and would remove approximately 3 Million cubic yards of material from the channel. The objective of the alternative is to increase channel conveyance through the creation of a more optimal channel design that will reduce flood elevations and concurrently provide a more stable channel.

Alternative 5H: Multiple Detention Structures on Sweetwater Creek
This alternative consists of two inline dry detention structures on Sweetwater Creek. All the detention sites would be dry within 24 after an event. The first is a 10 feet high structure upstream of Bakers Bridge Road in Paulding County near the Douglas and Paulding County line. This approximately 400 acre detention site would hold water in both Paulding and Douglas Counties. The second is a 33 feet high structure upstream of Brown Road in Cobb County near the Paulding County line. This approximately 900 acre detention site would hold water in both Paulding and Douglas Counties. These structures would provide a combined 18,900 acre-feet of flood storage in the basin. The objective of the alternative is to temporarily detain floodwaters along Sweetwater Creek. By temporarily detaining floodwaters, the facility will reduce the peak downstream

discharges. The outlet works on each structure would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream of the structure.

Alternative 5D: Multi-subbasin Detention

This alternative consists multiple inline dry detention structures with three on Sweetwater Creek, one on Powder Springs Creek, one on Ollie Creek, and one on Mill Creek. All the detention sites would be dry within 24 hours after an event. The first on Sweetwater Creek is a 24 feet high structure upstream of Bakers Bridge Road in Paulding County near the Douglas and Paulding County line. This approximately 400 acre detention site would hold water in both Paulding and Douglas Counties. The second on Sweetwater Creek is a 15 feet high structure upstream of Highway 92 in Paulding County. This approximately 250 acre detention site would hold water in Paulding and Douglas Counties. The third on Sweetwater Creek is a 33 feet high structure upstream of Brown Road in Cobb County near the Paulding County line. This approximately 900 acre detention site would hold water in both Paulding and Douglas Counties. The one on Powder Springs Creek is a 25 feet high structure upstream of C.H. James Parkway in Cobb County near the Cobb and Paulding County Line. This approximately 400 acre detention site would hold water in Cobb County. The structure on Ollie Springs Creek is a 29 feet high structure upstream of Flint Hill Rd Southwest in Cobb County. This approximately 250 acre detention site would hold water in Cobb County. The structure on Mill Creek is a 20 feet high structure upstream of Morningside Drive in Paulding County. This approximately 300 acre detention site would hold water in Paulding County. These structures would provide a combined 25,040 acre-feet of flood storage. The objective of the alternative is to temporarily detain floodwaters along Sweetwater Creek. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges. The outlet works on each structure would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream of the structure.

Alternative 5J: South Paulding High Detention Short

This alternative is an inline dry detention facility on Sweetwater Creek, located approximately 1 mile upstream of Bakers Bridge Road in Paulding County, creating up to 7,660 acre-feet of flood storage. The objective of the alternative is to temporarily detain floodwaters from the approximately 42 square miles that drain to the facility location. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges in addition to delaying the timing of the hydrograph peak. The delaying of the hydrograph at the site will have the additional benefit of allowing Mill Creek, which confluences with Sweetwater Creek approximately 7.5 miles downstream of the site, to drain longer before the peak discharge of Sweetwater Creek reaches the confluence, resulting in less coincidental peaks and reducing the combined peak downstream of the confluence for most flood events. This alternative would reduce flood risk along a section of Sweetwater Creek and along the tributaries of Mill Creek, Powder Springs Creek, Noses Creek, Olley Creek and other small tributaries which experience backwater flooding as a result of Sweetwater Creek. The structure would consist of a 1,500 feet long, 19 feet high structure built approximately perpendicular to Sweetwater Creek and its adjoining floodplain. The outlet works of the structure would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream of the structure.

Alternatives Analysis:

Alternative 1 consisted of 4 versions of buyout levels. Each version included both residential and nonresidential structures with first floor elevations at or below a certain FWOP condition flood event.

The first version of Alternative 1 (1.0) was to purchase all 20 structures with a first floor elevation equal to or lesser than the water surface elevation of a 10% ACE flood event. Version 1.0 consisted of 20 structures, both residential and nonresidential. Version 1.1 considered purchasing 6 additional structures at the 4% ACE flood event to total 26. Version 1.2 considered purchasing an additional 40 structures at the 2% ACE flood event for a total of 66. Finally version 1.3 considered purchasing an additional 51 structures at the 1% ACE flood event totaling 117. The number of benefits increased with each larger buyout, however it was not a directly proportional increase due to the larger buyouts purchasing additional structures in the floodplains of less frequent events. This analysis revealed that the damages occurring in the designed flood events are weighted towards the more frequent events, even though there are less structures in the floodplains of the more frequent events.

Table A-1 12: Alternative 1.0 Equivalent Annual Damages (x1000)

Reach	Damage Category	Residual Damages	Damages Reduced
Buttermilk Creek	Residential	$6	$0
	Nonresidential	$1	$0
	Total	$7	$0
Mill Creek	Residential	$79	$0
	Nonresidential	$0	$0
	Total	$79	$0
Mud Creek	Residential	$2	$0
	Nonresidential	$0	$0
	Total	$2	$0
Noses Creek 1	Residential	$31	$9

	Nonresidential	$0	$0
	Total	$31	$9
Noses Creek 2	Residential	$291	$190
	Nonresidential	$0	$0
	Total	$291	$190
Olley Creek	Residential	$34	$7
	Nonresidential	$7	$4
	Total	$42	$12
Powder Springs Creek	Residential	$23	$0
	Nonresidential	$1	$0
	Total	$24	$0
Sweetwater Creek 1	Residential	$25	$0
	Nonresidential	$7	$0
	Total	$32	$0
Sweetwater Creek 2	Residential	$45	$264
	Nonresidential	$26	$0
	Total	$71	$264
Sweetwater Creek 3	Residential	$7	$0
	Nonresidential	$9	$46
	Total	$16	$46
Sweetwater Creek 4	Residential	$3	$0
	Nonresidential	$0	$0
	Total	$3	$0
Sweetwater Creek 5	Residential	$19	$3
	Nonresidential	$11	$8
	Total	$29	$11
Sweetwater Creek 6	Residential	$171	$0
	Nonresidential	$99	$0
	Total	$270	$0
Total for Stream	**Residential**	**$735**	**$473**
	Nonresidential	**$162**	**$58**
	Total	**$897**	**$531**

Table A-1 13: Alternative 1.1 Equivalent Annual Damages (x1000)

Reach	Damage Category	Residual Damages	Damages Reduced
Buttermilk Creek	Residential	$4	$3
	Nonresidential	$1	$0
	Total	$5	$3
Mill Creek	Residential	$79	$0
	Nonresidential	$0	$0
	Total	$79	$0
Mud Creek	Residential	$2	$0
	Nonresidential	$0	$0

	Total	$2	$0
Noses Creek 1	Residential	$31	$9
	Nonresidential	$0	$0
	Total	$31	$9
Noses Creek 2	Residential	$286	$194
	Nonresidential	$0	$0
	Total	$286	$194
Olley Creek	Residential	$31	$11
	Nonresidential	$7	$4
	Total	$38	$15
Powder Springs Creek	Residential	$23	$0
	Nonresidential	$1	$0
	Total	$24	$0
Sweetwater Creek 1	Residential	$25	$0
	Nonresidential	$7	$0
	Total	$32	$0
Sweetwater Creek 2	Residential	$40	$269
	Nonresidential	$15	$11
	Total	$55	$280
Sweetwater Creek 3	Residential	$7	$0
	Nonresidential	$9	$46
	Total	$16	$46
Sweetwater Creek 4	Residential	$3	$0
	Nonresidential	$0	$0
	Total	$3	$0
Sweetwater Creek 5	Residential	$19	$3
	Nonresidential	$11	$8
	Total	$29	$11
Sweetwater Creek 6	Residential	$171	$0
	Nonresidential	$99	$0
	Total	$270	$0
Total for Stream	**Residential**	**$719**	**$489**
	Nonresidential	**$151**	**$69**
	Total	**$870**	**$558**

Table A-1 14: Alternative 1.2 Equivalent Annual Damages (x1000)

Reach	Damage Category	Residual Damages	Damages Reduced
Buttermilk Creek	Residential	$4	$3
	Nonresidential	$1	$0
	Total	$5	$3
Mill Creek	Residential	$79	$0
	Nonresidential	$0	$0
	Total	$79	$0

Mud Creek	Residential	$2	$0
	Nonresidential	$0	$0
	Total	$2	$0
Noses Creek 1	Residential	$28	$13
	Nonresidential	$0	$0
	Total	$28	$13
Noses Creek 2	Residential	$267	$213
	Nonresidential	$0	$0
	Total	$267	$213
Olley Creek	Residential	$19	$23
	Nonresidential	$7	$4
	Total	$26	$28
Powder Springs Creek	Residential	$21	$2
	Nonresidential	$1	$0
	Total	$22	$2
Sweetwater Creek 1	Residential	$25	$0
	Nonresidential	$7	$0
	Total	$32	$0
Sweetwater Creek 2	Residential	$38	$271
	Nonresidential	$15	$11
	Total	$53	$282
Sweetwater Creek 3	Residential	$6	$2
	Nonresidential	$2	$52
	Total	$8	$54
Sweetwater Creek 4	Residential	$3	$0
	Nonresidential	$0	$0
	Total	$3	$0
Sweetwater Creek 5	Residential	$16	$5
	Nonresidential	$8	$11
	Total	$24	$16
Sweetwater Creek 6	Residential	$169	$2
	Nonresidential	$96	$3
	Total	$265	$5
Total for Stream	**Residential**	**$676**	**$532**
	Nonresidential	**$138**	**$82**
	Total	**$814**	**$615**

Table A-1 15: Alternative 1.3 Equivalent Annual Damages (x1000)

Reach	Damage Category	Residual Damages	Damages Reduced
Buttermilk Creek	Residential	$3	$3
	Nonresidential	$1	$0
	Total	$4	$3
Mill Creek	Residential	$79	$0

	Nonresidential	$0	$0
	Total	$79	$0
Mud Creek	Residential	$2	$0
	Nonresidential	$0	$0
	Total	$2	$0
Noses Creek 1	Residential	$26	$14
	Nonresidential	$0	$0
	Total	$26	$14
Noses Creek 2	Residential	$251	$229
	Nonresidential	$0	$0
	Total	$251	$229
Olley Creek	Residential	$13	$29
	Nonresidential	$7	$4
	Total	$20	$33
Powder Springs Creek	Residential	$15	$7
	Nonresidential	$1	$0
	Total	$17	$7
Sweetwater Creek 1	Residential	$25	$0
	Nonresidential	$7	$0
	Total	$32	$0
Sweetwater Creek 2	Residential	$36	$273
	Nonresidential	$15	$11
	Total	$51	$284
Sweetwater Creek 3	Residential	$4	$3
	Nonresidential	$2	$53
	Total	$6	$56
Sweetwater Creek 4	Residential	$3	$0
	Nonresidential	$0	$0
	Total	$3	$0
Sweetwater Creek 5	Residential	$14	$7
	Nonresidential	$5	$14
	Total	$19	$21
Sweetwater Creek 6	Residential	$169	$2
	Nonresidential	$94	$6
	Total	$263	$7
Total for Stream	**Residential**	**$642**	**$567**
	Nonresidential	**$132**	**$88**
	Total	**$774**	**$655**

Alternative 2 produced some flood damage reductions across most reaches. However, in Mill Creek, Sweetwater Creek reach 1 and Sweetwater Creek reach 2 there were small increases in water surface elevations and damages compared to the FWOP condition.

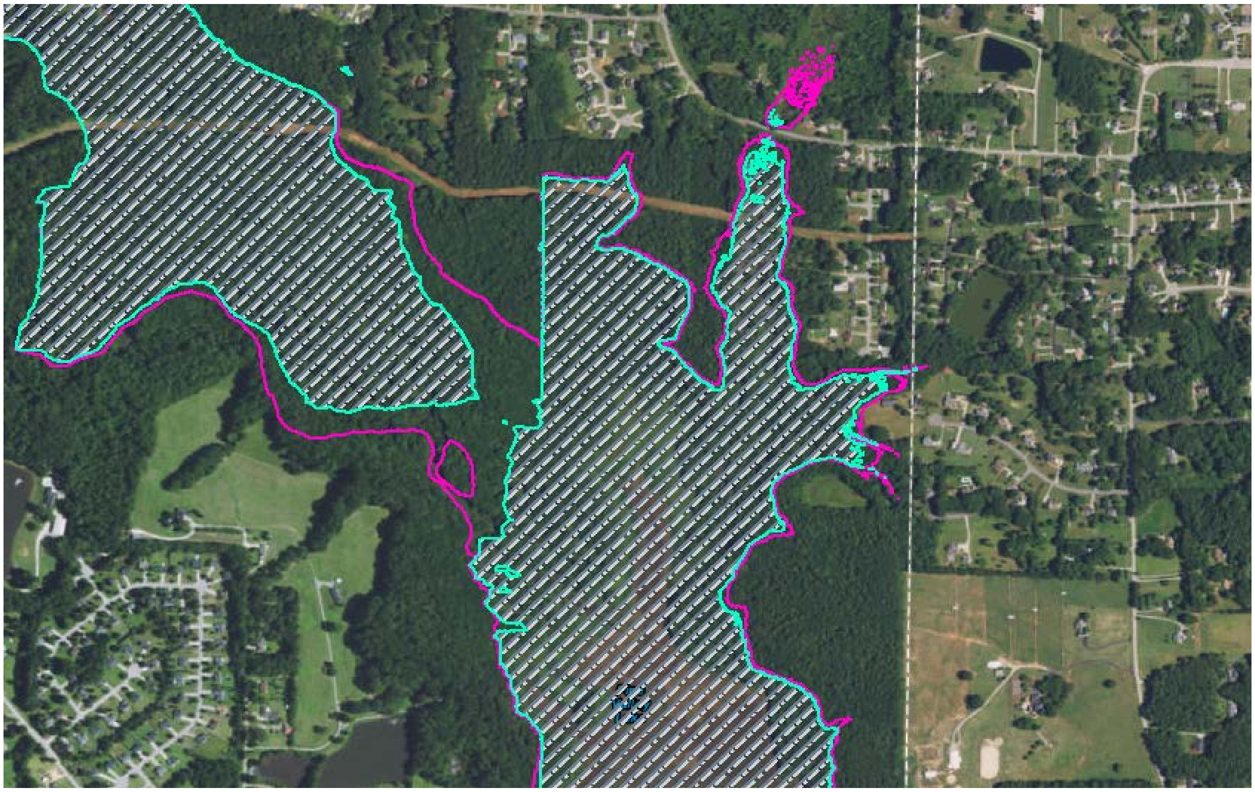


Figure 1: Increased water surface elevations at Mill Creek in Alternative 2 at the 1% chance exceedance. FWOP 1% chance exceedance floodplain is represented by hashed grey and green. Alternative 2 1% chance exceedance floodplain extent represented by pink outline.

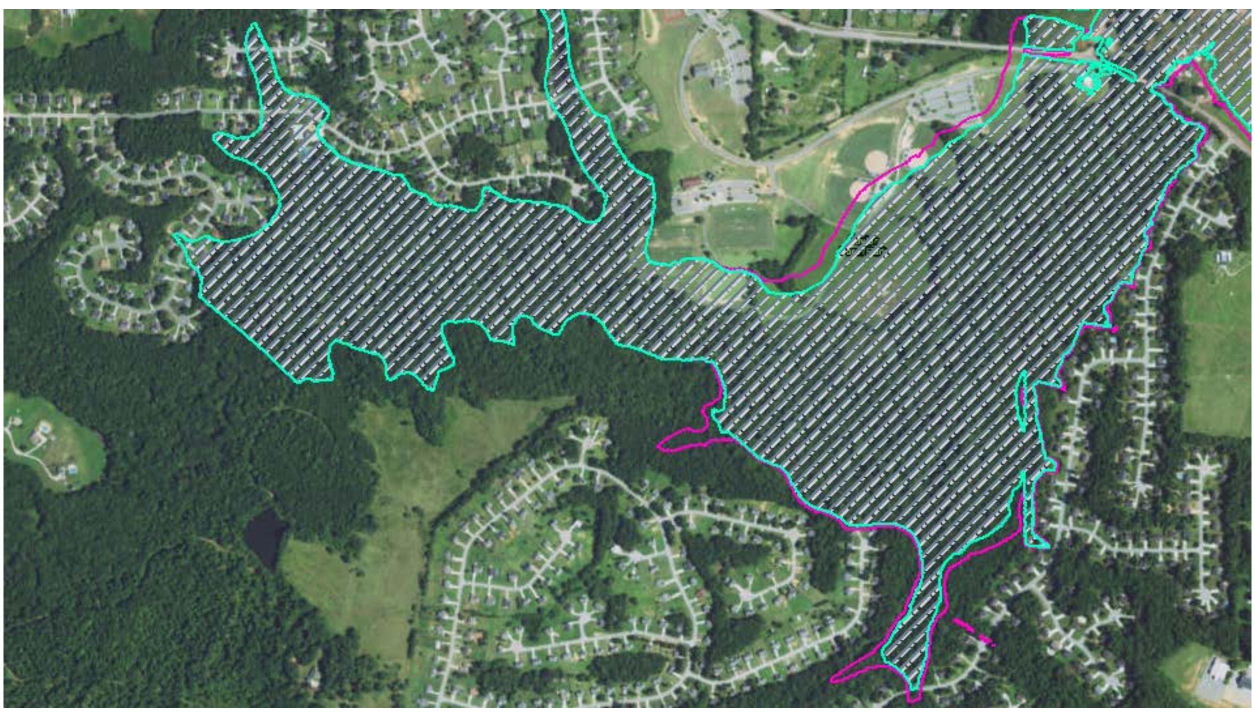


Figure 2: Increased water surface elevations at Sweetwater Creek Reach 1 in Alternative 2 at the 1% chance exceedance. FWOP 1% chance exceedance floodplain is represented by hashed grey and green. Alternative 2 1% chance exceedance floodplain extent represented by pink outline.

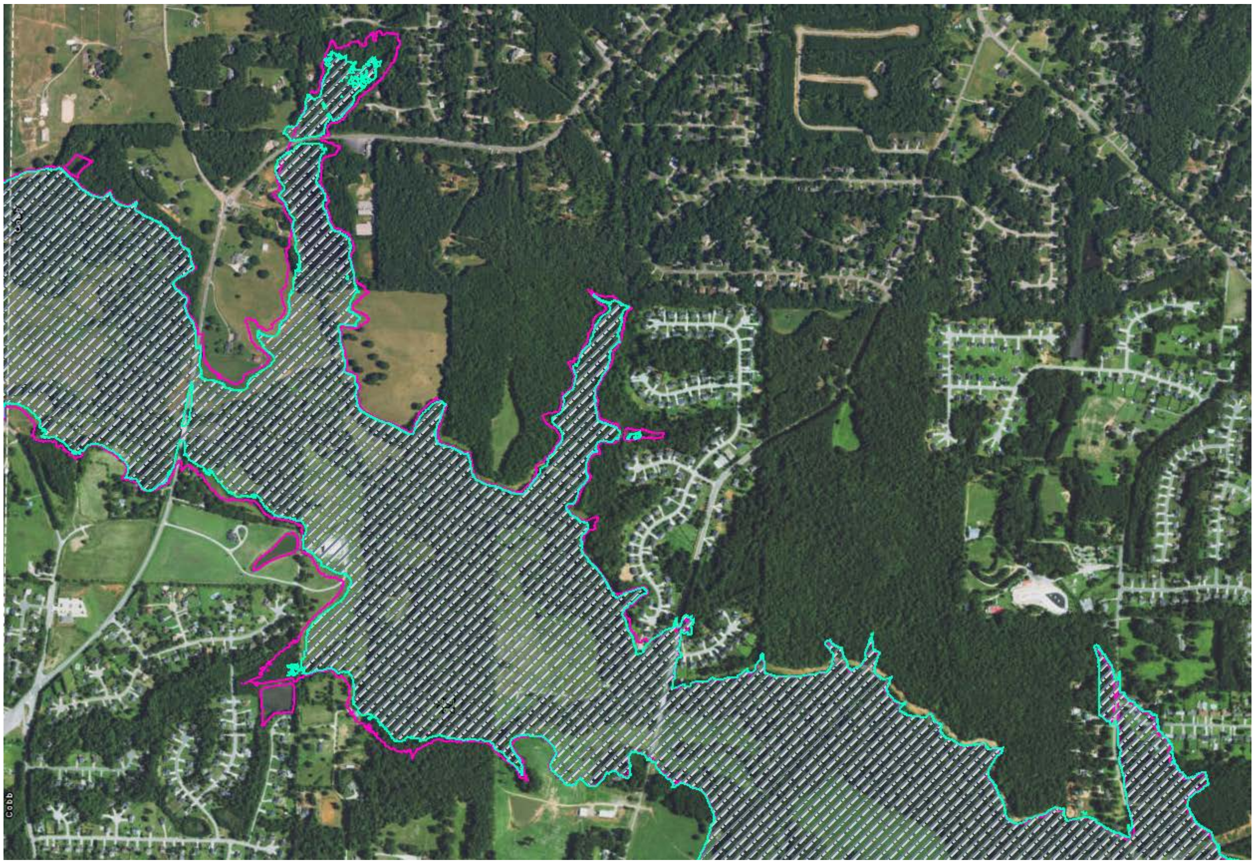


Figure 3: Increased water surface elevations at Sweetwater Creek Reach 2 in Alternative 2 at the 1% chance exceedance. FWOP 1% chance exceedance floodplain is represented by hashed grey and green. Alternative 2 1% chance exceedance floodplain extent represented by pink outline.

Table A-1 16: Alternative 2 Equivalent Annual Damages (x1000)

Reach	Damage Category	Residual Damages	Damages Reduced
Buttermilk Creek	Residential	$6	$1
	Nonresidential	$1	$0
	Total	$7	$1
Mill Creek	Residential	$82	-$3
	Nonresidential	$0	$0
	Total	$82	-$3
Mud Creek	Residential	$2	$0
	Nonresidential	$0	$0
	Total	$2	$0
Noses Creek 1	Residential	$40	$0
	Nonresidential	$0	$0
	Total	$40	$0
Noses Creek 2	Residential	$476	$4
	Nonresidential	$0	$0
	Total	$476	$4

Olley Creek	Residential	$41	$1
	Nonresidential	$11	$0
	Total	$53	$1
Powder Springs Creek	Residential	$22	$1
	Nonresidential	$1	$0
	Total	$23	$1
Sweetwater Creek 1	Residential	$27	-$2
	Nonresidential	$7	$0
	Total	$34	-$2
Sweetwater Creek 2	Residential	$306	$3
	Nonresidential	$27	-$1
	Total	$333	$3
Sweetwater Creek 3	Residential	$7	$1
	Nonresidential	$54	$1
	Total	$60	$2
Sweetwater Creek 4	Residential	$3	$0
	Nonresidential	$0	$0
	Total	$3	$0
Sweetwater Creek 5	Residential	$19	$2
	Nonresidential	$18	$1
	Total	$37	$3
Sweetwater Creek 6	Residential	$164	$7
	Nonresidential	$93	$7
	Total	$256	$14
Total for Stream	**Residential**	**$1,194**	**$15**
	Nonresidential	**$212**	**$8**
	Total	**$1,406**	**$23**

Alternative 4 reduced flood damages in all reaches except for Olley Creek. The slight increases in Olley Creek as well as small damages reduced across the study area caused the alternative produced a low overall level of benefits to the entire study area.

Table A-1 17: Alternative 4 Equivalent Annual Damages (x1000)

Reach	Damage Category	Residual Damages	Damages Reduced
Buttermilk Creek	Residential	$4	$3
	Nonresidential	$1	$0
	Total	$5	$3
Mill Creek	Residential	$78	$0
	Nonresidential	$0	$0
	Total	$78	$0
Mud Creek	Residential	$2	$0
	Nonresidential	$0	$0

	Total	$2	$0
Noses Creek 1	Residential	$40	$0
	Nonresidential	$0	$0
	Total	$40	$0
Noses Creek 2	Residential	$446	$34
	Nonresidential	$0	$0
	Total	$446	$34
Olley Creek	Residential	$41	$1
	Nonresidential	$13	-$2
	Total	$54	-$1
Powder Springs Creek	Residential	$21	$2
	Nonresidential	$1	$0
	Total	$22	$2
Sweetwater Creek 1	Residential	$25	$0
	Nonresidential	$7	$0
	Total	$32	$0
Sweetwater Creek 2	Residential	$290	$19
	Nonresidential	$25	$1
	Total	$315	$20
Sweetwater Creek 3	Residential	$5	$2
	Nonresidential	$45	$10
	Total	$50	$12
Sweetwater Creek 4	Residential	$2	$1
	Nonresidential	$0	$0
	Total	$2	$1
Sweetwater Creek 5	Residential	$14	$7
	Nonresidential	$14	$5
	Total	$28	$12
Sweetwater Creek 6	Residential	$137	$34
	Nonresidential	$75	$25
	Total	$212	$59
Total for Stream	**Residential**	**$1,105**	**$103**
	Nonresidential	**$181**	**$39**
	Total	**$1,286**	**$142**

Alternative 5H reduced damages across all reaches except for in Olley Creek. However, ultimately the damages reduced were not great enough to produce a large number of flood damage reduction benefits in the overall study area

Table A-1 18: Alternative 5H Equivalent Annual Damages (x1000)

Reach	Damage Category	Residual Damages	Damages Reduced
Buttermilk Creek	Residential	$4	$2

	Nonresidential	$1	$0
	Total	$5	$2
Mill Creek	Residential	$79	$0
	Nonresidential	$0	$0
	Total	$79	$0
Mud Creek	Residential	$2	$0
	Nonresidential	$0	$0
	Total	$2	$0
Noses Creek 1	Residential	$40	$0
	Nonresidential	$0	$0
	Total	$40	$0
Noses Creek 2	Residential	$468	$12
	Nonresidential	$0	$0
	Total	$468	$12
Olley Creek	Residential	$40	$2
	Nonresidential	$11	$0
	Total	$52	$2
Powder Springs Creek	Residential	$20	$3
	Nonresidential	$1	$0
	Total	$21	$3
Sweetwater Creek 1	Residential	$17	$8
	Nonresidential	$4	$3
	Total	$21	$11
Sweetwater Creek 2	Residential	$275	$34
	Nonresidential	$22	$4
	Total	$297	$38
Sweetwater Creek 3	Residential	$6	$2
	Nonresidential	$50	$5
	Total	$56	$7
Sweetwater Creek 4	Residential	$2	$1
	Nonresidential	$0	$0
	Total	$2	$1
Sweetwater Creek 5	Residential	$16	$5
	Nonresidential	$15	$4
	Total	$31	$9
Sweetwater Creek 6	Residential	$142	$29
	Nonresidential	$76	$23
	Total	$219	$52
Total for Stream	**Residential**	**$1,111**	**$97**
	Nonresidential	**$181**	**$39**
	Total	**$1,292**	**$136**

Alternative 5D reduced damages across all reaches Except for Mill Creek. Additionally, there were slight increases in water surface elevations in Mill Creek and ultimately the alternative produced a low amount of flood damage reduction benefits.

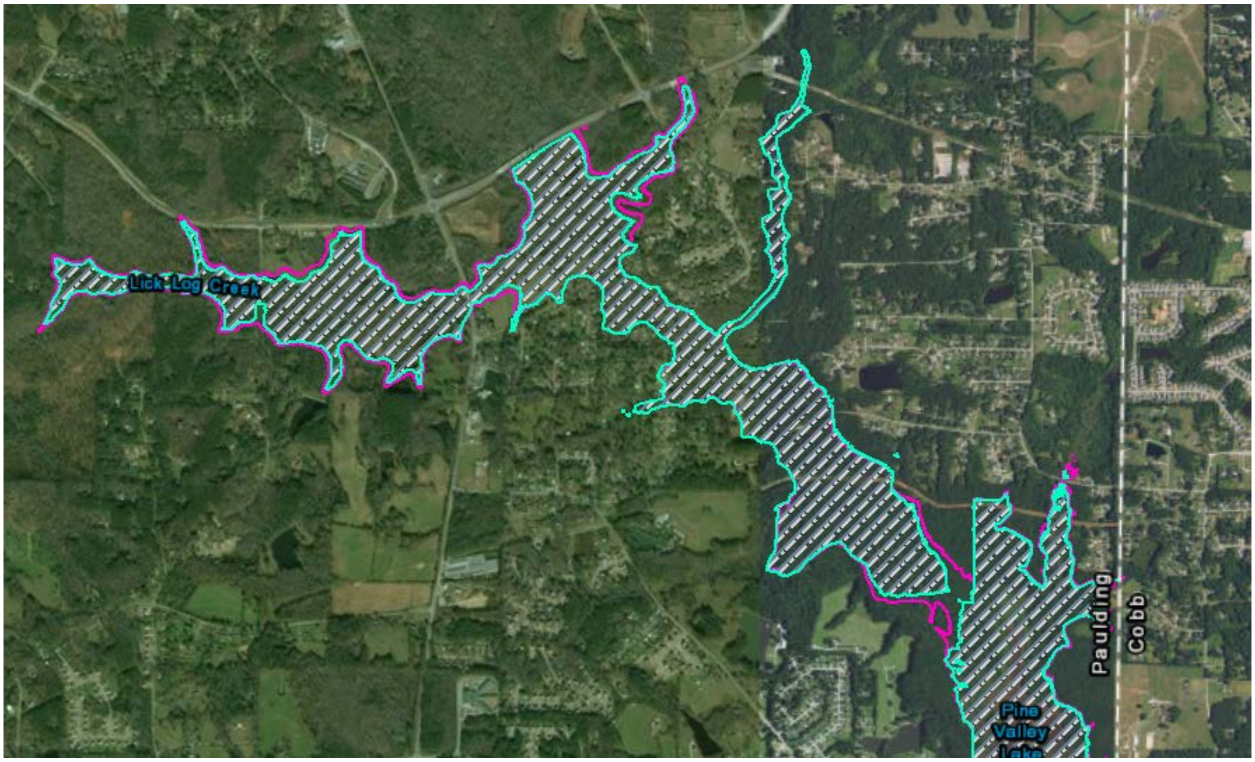


Figure 4: Increased water surface elevations at Mill Creek in Alternative 5D at the 1% chance exceedance. FWOP 1% chance exceedance floodplain is represented by hashed grey and green. Alternative 5D 1% chance exceedance floodplain extent represented by pink outline.

Table A-1 19: Alternative 5D Equivalent Annual Damages (x1000)

Reach	Damage Category	Residual Damages	Damages Reduced
Buttermilk Creek	Residential	$5	$1
	Nonresidential	$1	$0
	Total	$6	$1
Mill Creek	Residential	$83	-$4
	Nonresidential	$0	$0
	Total	$83	-$4
Mud Creek	Residential	$2	$0
	Nonresidential	$0	$0
	Total	$2	$0
Noses Creek 1	Residential	$40	$0
	Nonresidential	$0	$0
	Total	$40	$0
Noses Creek 2	Residential	$465	$15
	Nonresidential	$0	$0

	Total	$465	$15
Olley Creek	Residential	$41	$1
	Nonresidential	$11	$0
	Total	$52	$1
Powder Springs Creek	Residential	$20	$3
	Nonresidential	$1	$0
	Total	$21	$3
Sweetwater Creek 1	Residential	$17	$8
	Nonresidential	$4	$3
	Total	$21	$11
Sweetwater Creek 2	Residential	$265	$44
	Nonresidential	$20	$6
	Total	$286	$50
Sweetwater Creek 3	Residential	$5	$2
	Nonresidential	$49	$6
	Total	$54	$8
Sweetwater Creek 4	Residential	$2	$1
	Nonresidential	$0	$0
	Total	$2	$1
Sweetwater Creek 5	Residential	$15	$6
	Nonresidential	$14	$5
	Total	$30	$11
Sweetwater Creek 6	Residential	$135	$36
	Nonresidential	$72	$27
	Total	$207	$63
Total for Stream	**Residential**	**$1,094**	**$114**
	Nonresidential	**$174**	**$46**
	Total	**$1,268**	**$161**

Alternative 5J reduced flood damages across all reaches except for Mill Creek. However, ultimately the alternative produced a low amount of flood damage reduction benefits.

Table A-1 20: Alternative 5J Equivalent Annual Damages (x1000)

Reach	Damage Category	Residual Damages	Damages Reduced
Buttermilk Creek	Residential	$5	$1
	Nonresidential	$1	$0
	Total	$6	$1
Mill Creek	Residential	$83	-$4
	Nonresidential	$0	$0
	Total	$83	-$4
Mud Creek	Residential	$2	$0
	Nonresidential	$0	$0

	Total	$2	$0
Noses Creek 1	Residential	$40	$0
	Nonresidential	$0	$0
	Total	$40	$0
Noses Creek 2	Residential	$472	$8
	Nonresidential	$0	$0
	Total	$472	$8
Olley Creek	Residential	$41	$1
	Nonresidential	$11	$0
	Total	$53	$1
Powder Springs Creek	Residential	$21	$2
	Nonresidential	$1	$0
	Total	$22	$2
Sweetwater Creek 1	Residential	$22	$3
	Nonresidential	$5	$2
	Total	$27	$5
Sweetwater Creek 2	Residential	$292	$18
	Nonresidential	$24	$2
	Total	$316	$20
Sweetwater Creek 3	Residential	$6	$1
	Nonresidential	$52	$3
	Total	$58	$4
Sweetwater Creek 4	Residential	$2	$1
	Nonresidential	$0	$0
	Total	$2	$1
Sweetwater Creek 5	Residential	$18	$3
	Nonresidential	$16	$3
	Total	$34	$6
Sweetwater Creek 6	Residential	$142	$29
	Nonresidential	$77	$22
	Total	$219	$51
Total for Stream	**Residential**	**$1,145**	**$63**
	Nonresidential	**$189**	**$31**
	Total	**$1,334**	**$95**

ROUGH ORDER MAGNITUDE (ROM) COSTS

Continuing the evaluation process, ROM first cost estimates were developed for each of the alternatives that were evaluated as described above. The ROM costs were provided by Mobile District’s Cost Engineering Section in January 2018 price levels. For comparison to the benefits, which are average annual flood damages reduced, the ROM first costs were stated in average annual terms using the current Federal discount rate of 2.75% and a 50-year period of analysis. Interest during construction was added to the ROM first costs assuming 24 months for alternative 1, 48 months for alternative 1.1, 60 months for alternative 1.2, 72 months for alternative 1.2, 12 months for alternative 2, 30 months for alternative 4, 17 months for alternative 5h, 29 months for alternative 5d, and 9 months for alternative 5j. In addition, annual operation and maintenance (O&M) costs were added to the alternatives. Table A-1 21 displays the results of the costs calculation.

Table A-1 21: Project Costs

Alternative	Project First Cost	Construction Period (months)	Interest During Construction	Total Cost	Average Annual Cost	Annual O&M Cost	Total Average Annual Cost
1	$4,669,100	24	$123,567	$4,792,667	$177,526	$0	$177,526
1.1	$5,674,100	48	$312,534	$5,986,634	$221,751	$0	$221,751
1.2	$15,708,300	60	$1,096,202	$16,804,502	$622,455	$0	$622,455
1.3	$23,028,400	72	$1,951,896	$24,980,296	$925,294	$0	$925,294
2	$22,784,000	12	$285,767	$23,069,767	$854,525	$20,000	$874,525
4	$134,178,600	30	$4,497,869	$138,676,469	$5,156,704	$0	$5,156,704
5h	$33,342,000	17	$610,584	$33,952,584	$1,257,635	$26,000	$1,283,635
5d	$152,668,600	29	$4,937,447	$157,606,047	$5,837,873	$36,000	$5,873,873
5j	$8,685,700	9	$79,049	$8,764,749	$324,654	$18,000	$342,654

RESULTS

The equivalent annual benefits were then compared to the average annual cost to develop net benefits and a benefit-to-cost ratio (BCR) for each alternative. The net benefits for each alternative were calculated by subtracting the average annual costs form the equivalent average annual benefits and a benefit-to-cost ratio was derived by dividing average benefits by average annual costs. Net benefits were used for identification of the NED plan in accordance with the Federal objective. For comparison purposes, Table A-1 22 summarizes the equivalent annual damages reduced (benefits), average annual costs, total first cost, net benefits, and benefit-to-cost ratio for each alternative.

Table A-1 22: Benefit-Cost Analysis

Alternative	Description	Average Annualized Benefits	Average Annualized Costs	First Cost	Net Benefits	Benefit Cost Ratio
1	10 Year Buyouts (20 Structures)	$531,210	$177,526	$4,669,100	$353,684	3.0
1.1	25 Year Buyouts (26 Structures)	$558,210	$221,751	$5,674,100	$336,459	2.5
1.2	50 Year Buyouts (66 Structures)	$614,680	$622,455	$15,708,300	-$7,775	0.99
1.3	100 Year Buyouts (117 Structures)	$654,780	$925,294	$23,028,400	-$270,514	0.7
2	SC6	$22,660	$874,525	$22,784,000	-$851,865	0.0
4	Channelization	$142,090	$5,156,704	$134,178,600	-$5,014,614	0.0
5h	SC1, SC6	$135,750	$1,283,635	$33,342,000	-$1,147,885	0.1
5d	All Detention	$160,540	$5,873,873	$152,668,600	-$5,713,333	0.0
5j	SC1 (small)	$95,210	$342,654	$8,685,700	-$247,444	0.3

Since Alternatives 1.0, 1.1, 1.2, and 1.3 are nonstructural plans, there is a potential for benefits to be evaluated using an alternative land use approach. When the candidate (for relocation) structures are removed, the land can no longer be used for urban development, and an alternative land use can be implemented. For Alternatives 1.0, 1.1, 1.2, these alternative land uses were not determined in this study.

As a result of the comparison of the alternatives, Alternative 1.0 is identified as the NED plan yielding the highest net benefits and BCR.

UNCERTAINTY

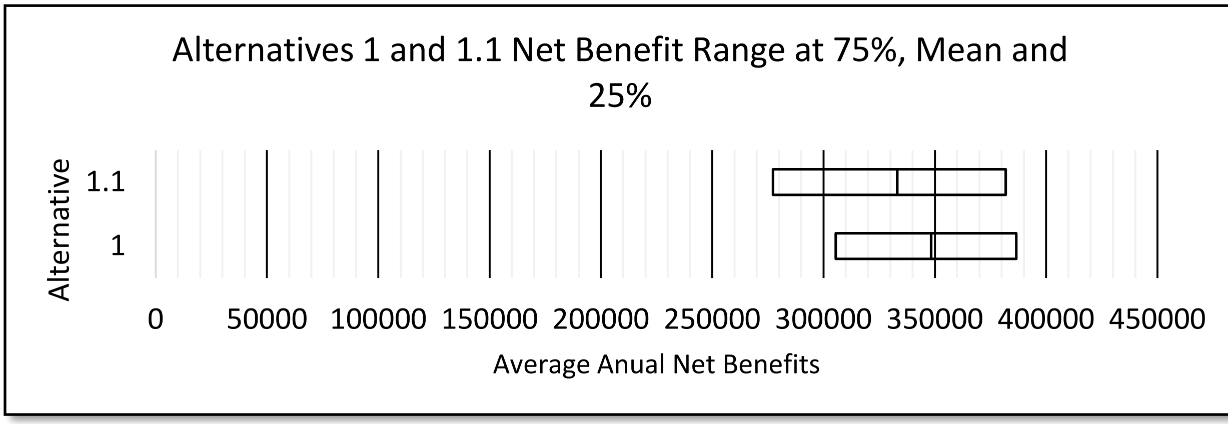
Uncertainty associated with the results from the HEC-FDA analysis are shown in the following table. Figure 5 displays the range of benefits with uncertainty.

Table A-1 23: Benefit Ranges due to Uncertainty

Probability Net Benefits Exceeds Indicated Values (2018price levels $1000) given the Annual Cost						
Alternative	Equivalent Annual Damages Reduced (2018 prices $1000)	Net Benefits at Percentiles			Annual Costs (2018 price levels $1000)	Mean Net Benefits (2018 price levels $1,000)
		0.75	0.50	0.25		
1	531	306	348	387	178	354
1.1	558	277	330	382	222	336
1.2	615	-101	-24	63	622	-8

1.3	655	-390	-298	-182	925	-271
2	23	-866	-854	-831	875	-852
4	142	-5,033	-5,015	-4,970	5,157	-5,015
5H	136	-1,186	-1,156	-1,095	1,284	-1,148
5D	161	-5,764	-5,730	-5,655	5,874	-5,713
5J	95	-279	-257	-218	344	-247

Figure 5: Box Chart of Benefits with Uncertainty



The alternative with the lowest uncertainty is the 10% ACE buyouts and is an economically justified alternative. It also, has the highest possible net benefits at the 75%, 50%, and 25% likelihood of exceedance scenarios. This further supports the identification of Alternative 1.0 as the NED.

SECTION II: REGIONAL ECONOMIC DEVELOPMENT IMPACTS

BACKGROUND

The Sweetwater Creek flood risk management project alternatives consist of dry detention structures, evacuating structures, and constructing dry detention areas. For this analysis, the regional economic development (RED) effects of implementing each project alternative. The RECONS impact area Lake Allatoona, which included the Atlanta, GA Metropolitan Statistical Areas was selected based on the labor market, commuter-shed, and population centers serving the project area. According to RECONS' 2014 data, the population of the study area is 5,543,990. The number of households is 2,012,567.

METHODOLOGY

This Regional Economic Development (RED) analysis employs input-output economic analysis, which measures the interdependence among industries and workers in an economy. This analysis uses a matrix representation of a region's economy to predict the effect of changes in one industry on others. The greater the interdependence among industry sectors, the larger the multiplier effect on the economy. Changes to government spending drive the input-output model to project new levels of sales (output), value added (GRP), employment, and income for each industry.

The specific input-output model used in this analysis is RECONS (Regional Economic System). This model was developed by the Institute for Water Resources (IWR), Michigan State University, and the Louis Berger Group. RECONS uses industry multipliers derived from the commercial input-output model IMPLAN to estimate the effects that spending on USACE projects has on a regional economy. The model is linear and static, showing relationships and impacts at a certain fixed point in time. Spending impacts are composed of three different effects: direct, indirect, and induced.

Direct effects represent the impacts the new federal expenditures have on industries which directly support the new project. Labor and construction materials can be considered direct components to the project. Indirect effects represent changes to secondary industries that support the direct industries. Induced effects are changes in consumer spending patterns caused by the change in employment and income within the industries affected by the direct and induced effects. The additional income workers receive via a project may be spent on clothing, groceries, dining out, and other items in the regional area.

The inputs for the RECONS model are expenditures that are entered by work activity or industry sector, each with its own unique production function. For the relocation alternative 1.0, the production function “FRM Construction” was selected to gauge the impacts of the removal of structures and clearing of the parcel. The baseline data used by RECONS to represent the regional economy of Alabama are annual averages from the Bureau of the Census, the Bureau of Labor Statistics, and the Bureau of Economic Analysis for the year 2009. The model results are expressed in FY 19 dollars.

ASSUMPTIONS

Input-output analysis rests on the following assumptions. The production functions of industries have constant returns to scale, so if output is to increase, inputs will increase in the same proportion. Industries face no supply constraints; they have access to all the materials they can use. Industries have a fixed commodity input structure; they will not substitute any commodities or services used in the production of output in response to price changes. Industries produce their commodities in fixed proportions, so an industry will not increase production of a commodity without increasing production in every other commodity it produces. Furthermore, it is assumed that industries use the same technology to produce all of its commodities. Finally, since the model is static, it is assumed that the economic conditions of 2009, the year of the socio-economic data in the RECONS model database, will prevail during the years of the construction process.

DESCRIPTION OF METRICS

“Output” is the sum total of transactions that take place as a result of the construction project, including both value added and intermediate goods purchased in the economy. “Labor Income” includes all forms of employment income, including employee compensation (wages and benefits) and proprietor income. “Gross Regional Product (GRP)” is the value-added output of the study regions. This metric captures all final goods and services produced in the study areas because of the project’s existence. It is different from output in the sense that one dollar of a final good or service may have multiple transactions associated with it. “Jobs” is the estimated worker-years of labor required to build the project.

RESULTS

For the region encompassing alternative 1.0, USACE is planning on expending $3,835,000 on the project. Of this total project expenditure $3,268,903 will be captured within the regional impact area. The rest will be leaked out to the state or the nation.

The expenditures made by the USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table A-2 1 is the overall economic impacts for the State and Nation for this analysis.

Table A-2 1: Overall Summary Economic Impacts for Alternative 1.0

Impact Areas / Impacts		Regional	State	National
Total Spending		$3,835,000	$3,835,000	$3,835,000
Direct Impact				
	Output	$3,268,903	$3,465,556	$3,818,123
	Jobs	38.29	39.64	41.06
	Labor Income	$1,975,409	$2,106,484	$2,217,041
	GRP	$2,265,366	$2,420,802	$2,602,533
Total Impact				
	Output	$6,451,264	$6,948,907	$10,344,182
	Jobs	63.64	67.92	85.43
	Labor Income	$3,171,038	$3,391,382	$4,374,289
	GRP	$4,286,494	$4,598,867	$6,314,961

SECTION III: TSP REFINEMENT

After the identification of the NED plan the PDT continued to refine alternative 1.0 as the tentatively selected plan (TSP). As part of the refinement process of Alternative 1.0, each of the 20 structures were analyzed to verify the exact location of the structure in reference to the FWOP floodplain and the corresponding FWOP water surface profiles at each structure location.

This analysis, conducted by the H&H PDT member, determined that 8 of the original 20 structures were physically located outside the 1% ACE event water surface elevation and 1 structure designed to be flooded which incurs no flood damages. That is in the FWOP condition these structures would not see inundation from the 1% ACE event. Additionally, 2 more structures were removed from the alternative because the structure was built after the year 1991. According to the Water Resources Development Act of 1990, Section 308, benefit base for justifying Federal flood damage reduction projects shall not include new or substantially improved structures built in the 100-year floodplain (i.e. 1% ACE event) with a first floor elevation less than the 100-year flood elevation after July 1, 1991. The first floor elevation of the 11 removed structures were then raised equal to the elevation of the 1% ACE event and the alternative was re-run using the HEC-FDA model to calculate the equivalent annual damages, the results of which are shown below.

Table A-3 1: Equivalent Annual Damages for Alternative 1.0 (x$1,000 FY18Prices)

Reach	Damage Category	Residual Damages	FWOP Damages	Damages Reduced	Change in Damage Reduced
Buttermilk Creek	Residential	$6.50	$6.50	$0.00	$0.00
	Nonresidential	$1.04	$1.04	$0.00	$0.00
	Total	$7.54	$7.54	$0.00	$0.00
Mill Creek	Residential	$80.46	$80.46	$0.00	$0.00
	Nonresidential	$0.00	$0.00	$0.00	$0.00
	Total	$80.46	$80.46	$0.00	$0.00
Mud Creek	Residential	$1.64	$1.64	$0.00	$0.00
	Nonresidential	$0.00	$0.00	$0.00	$0.00
	Total	$1.64	$1.64	$0.00	$0.00
Noses Creek 1	Residential	$32.77	$32.77	$0.00	-$9.13
	Nonresidential	$0.00	$0.00	$0.00	$0.00
	Total	$32.77	$32.77	$0.00	-$9.13
Noses Creek 2	Residential	$302.96	$334.43	$31.47	-$158.06
	Nonresidential	$0.06	$0.06	$0.00	$0.00
	Total	$303.02	$334.49	$31.47	-$158.06
Olley Creek	Residential	$35.41	$43.13	$7.72	$0.27
	Nonresidential	$7.19	$11.45	$4.26	$0.00
	Total	$42.60	$54.58	$11.98	$0.27
Powder Springs Creek	Residential	$23.06	$23.06	$0.00	$0.00
	Nonresidential	$1.47	$1.47	$0.00	$0.00
	Total	$24.53	$24.53	$0.00	$0.00
Sweetwater Creek 1	Residential	$26.27	$26.27	$0.00	$0.00
	Nonresidential	$6.66	$6.66	$0.00	$0.00
	Total	$32.93	$32.93	$0.00	$0.00
Sweetwater Creek 2	Residential	$49.06	$49.06	$0.00	-$263.86
	Nonresidential	$25.96	$25.96	$0.00	-$0.33
	Total	$75.02	$75.02	$0.00	-$264.19
Sweetwater Creek 3	Residential	$7.38	$7.63	$0.25	$0.02
	Nonresidential	$9.01	$54.70	$45.69	-$0.01
	Total	$16.39	$62.33	$45.94	$0.01
Sweetwater Creek 4	Residential	$3.04	$3.04	$0.00	$0.00
	Nonresidential	$0.00	$0.00	$0.00	$0.00
	Total	$3.04	$3.04	$0.00	$0.00
Sweetwater Creek 5	Residential	$20.00	$20.00	$0.00	-$2.55
	Nonresidential	$11.53	$11.53	$0.00	-$8.17

	Total	$31.53	$31.53	$0.00	-$10.72
Sweetwater Creek 6	Residential	$325.10	$325.10	$0.00	$0.00
	Nonresidential	$98.82	$98.82	$0.00	$0.00
	Total	$423.92	$423.92	$0.00	$0.00
Total for Stream	**Residential**	**$913.65**	**$953.09**	**$39.44**	**-$433.31**
	Nonresidential	**$161.74**	**$211.69**	**$49.95**	**-$8.51**
	Total	**$1,075.39**	**$1,164.78**	**$89.39**	**-$441.82**

As seen in Table A-3 1 above, after the revision of alternative 1.0, benefits were reduced. The previous iteration of alternative 1.0 resulted in about $531,000 in expected annual damages reduced while the revised alternative 1.0 resulted in expected annual damages reduced of $89,390, and approximate reduction in benefits of $441,820.

Also during refinement of the TSP, the inclusion of a recreation component was analyzed because a relocation alternative allows for the implementation of recreation in the evacuated area of the floodplain. The benefits can be evaluated using an alternative land use approach. In this approach, the candidate structures for relocation are removed, and the land can no longer be used for urban development. An alternative land use can then be implemented. This alternative land use is for recreation where recreation measures would not be harmed by frequent flooding yet provides measurable benefits. The annual recreation benefits attributable to the refined TSP were approximately $73,800 (as seen in section IV).

Due to the addition of a recreational component to the TSP and the refinement from 20 structures to 9 structures, refined costs were also developed. The total project cost summary (TPCS) was provided by Mobile District's Cost Engineering Section in FY19 price levels. For comparison to the benefits, the TPCS first costs were stated in average annual terms using the current Federal discount rate of 2.875% and a 50-year period of analysis. Therefore, the cost benefit analysis of alternative 1.0 was also reevaluated. As displayed in the following tables, the refinement of the benefits and costs for the TSP yielded an average annual net benefits of approximately $13,164 with a BCR of 1.09. Additional analysis of benefits using the FY2019 Federal discount rate of 2.875%, which yielded an average annual net benefits of approximately $9,353 with a BCR of 1.06.

Table A-3 2: Refined TSP Cost Breakdown

Alternative	Project First Cost	Construction Period (months)	Discount Rate	Interest During Construction	Total Cost	Average Annual Cost	Annual O&M Cost	Total Average Annual Cost
1	$3,183,000	24	2.75%	$84,238	$3,267,238	$121,022	$0	$121,022
Alt 1 @ FY2019 DR	*$3,183,000*	*24*	*2.875%*	*$88,083*	*$3,271,083*	*$124,132*	*$0*	*$124,132*
1 (with Rec)	$3,835,000	26	2.75%	$110,486	$3,945,486	$146,144	$3,900	$150,044

1 (with Rec) @ FY 2019 DR	*$3,835,000*	*26*	*2.875%*	*$115,538*	*$3,950,538*	*$149,915*	*$3,900*	*$153,815*

Table A-3 3: Refined TSP Benefit Cost Analysis

Alternative	Description	Average Annualized Benefits	Discount Rate	Average Annualized Costs	First Cost	Net Benefits	Benefit Cost Ratio
1	**10 Year Buyouts (9 Structures)**	$89,390	2.75%	$121,022	$3,183,000	-$31,632	0.74
Alt 1 @ FY2019 DR		*$89,350*	*2.875%*	*$124,132*	*$3,183,000*	*-$34,782*	*0.72*
1 (with Rec)	**Buyouts with Recreation**	$163,208	2.75%	$150,044	$3,835,000	$13,164	1.09
1 (with Rec) @ FY 2019 DR		*$163,168*	*2.875%*	*$153,815*	*$3,835,000*	*$9,353*	*1.06*

SECTION IV: RECREATION BENEFITS

The following paragraphs and tables display how recreation benefits were calculated. Recreation value is estimated in a manner consistent with ER-1105-2-100, Appendix E, Section VII, and Economic Guidance Memorandum # 18-03. Five basic steps are used to estimate recreation benefits: **1)** estimate market size, **2)** estimate market demand, **3)** estimate unit day value, **4)** estimate seasonal influence on demand, and **5)** calculate annual demand based on expected seasonal use and demand satisfied by a new recreational facility.

EXISTING AND WITHOUT PROJECT CONDITIONS

Generally speaking, the Sweetwater Creek Watershed does not lack quality recreational developments that are specifically linked to water resources. There are many parks of this kind in the study area such as Sweetwater Creek State Park. Sweetwater Creek State Park offers trails, swimming, fishing, kayaking, boating, picnicking, camping, and sightseeing just to name some of the recreational activities the park provides. The park is located within the lower Sweetwater Creek reach. The recreation opportunities at Sweetwater Creek State Park are well known in the study area. The park is considered one of the most visited in State of Georgia. However, no specific data describing recreation experience, satisfaction, or carrying capacity of the resource is available. Given the park’s reputation to provide more than an above average recreation experience in the watershed offering water-based recreation activities and in discussions with the park's rangers, the park is known to approach capacity during peak season weekends.

In the future without project condition, no significant improvement is expected in the quality or quantity of recreation opportunities associated with Sweetwater Creek watershed. Parks such as Sweetwater Creek State Park will continue to see capacity or near capacity visitation during peak seasons, and recreation opportunities for which consumers have expressed a demand for will be foregone.

The refinement of the TSP resulted in a plan that purchases and remove 9 structures within the floodplain. The non-federal sponsor expressed interest in converting evacuated lands into recreational facilities. Current recreational facilities in the Cobb County-Powder Springs area do not fulfill the recreation demand for day use activities. The 9 structures selected are located within 3 census tracts in southwest Cobb County as shown in Figure A-4 1. Of the 9 structures, 4 were identified as being on parcels which would be appropriate for development of recreation; a group of 3 on the border of census tracts 315.06 and 315.07, and a group of 2 in census tract 314.9 as shown in Figure A-4 2 and A-4 3 respectively.

Figure A-4 1: Overview

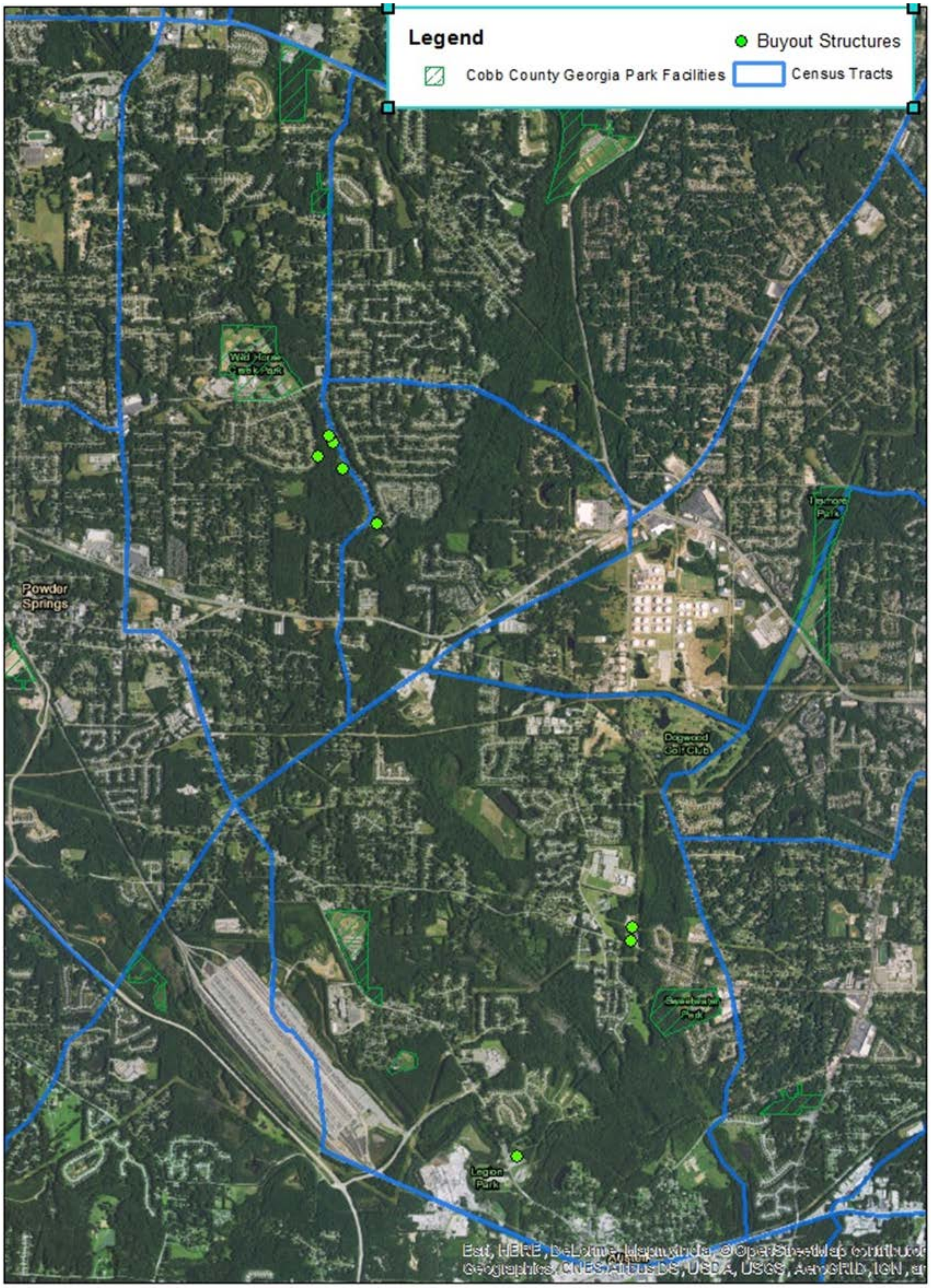
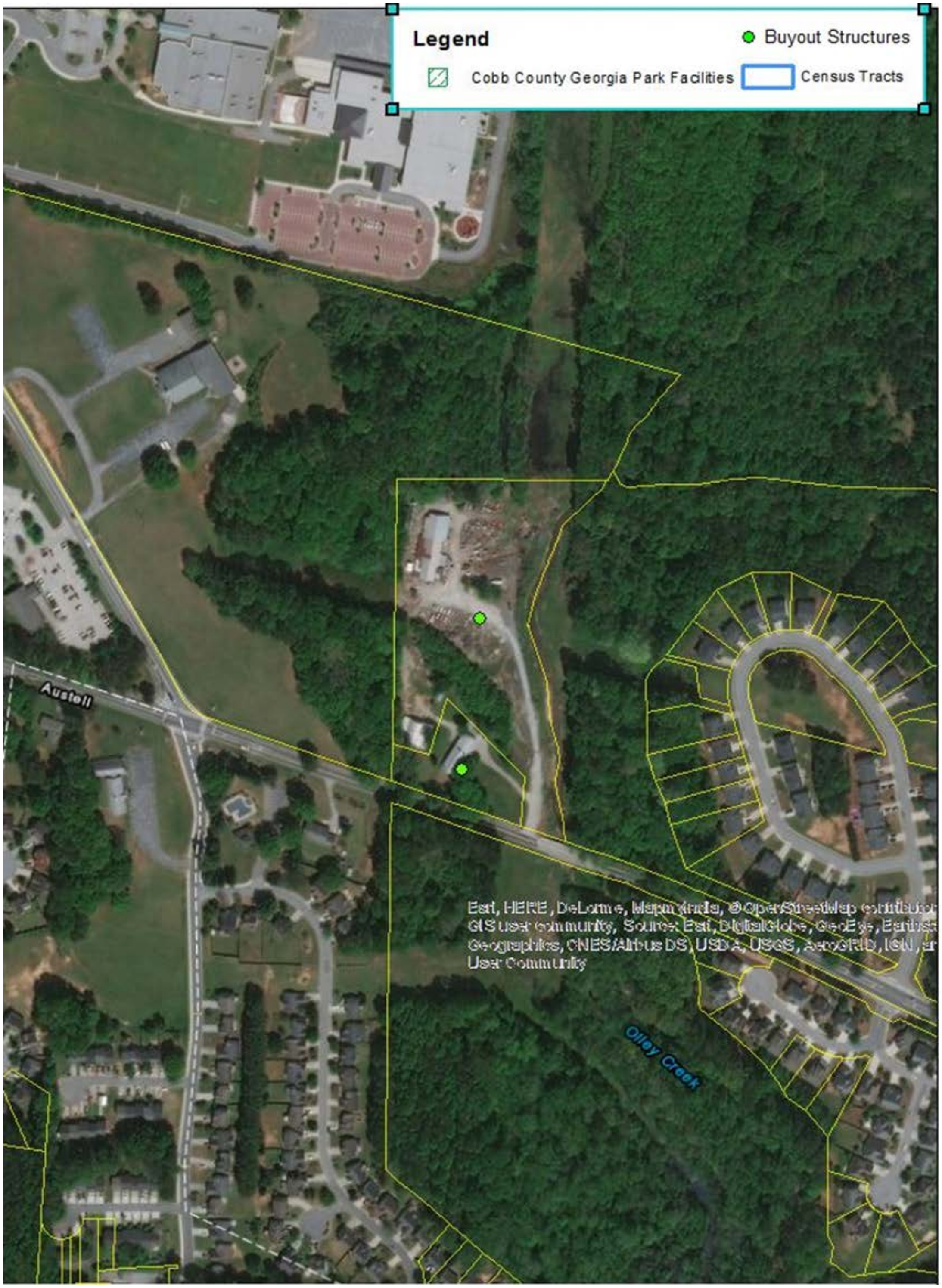


Figure A-4 2: Census Tract 315.06 and 315.07

Figure A-4 3: Census Tract 314.9



There are 7 county parks within census tracts, 3 within 315.06 and 315.07, and 4 within 314.9. The nearby parks offer general recreation such as sports fields and courts, playground equipment as well as more developed recreation such as a BMX track, splash pad and indoor facilities. Based on the number of facilities in the area, the recreational experience in the project area would be considered above average, however there is not a specific set of data for the area available.

Table A-4 1: Parks and Population by Census Tract

Tract	Population	Parks
315.06	4,814	3
315.07	3,339	0
314.09	5,112	4
Total Population	13,265	7

The project area (3 census tracts) has recently experienced a period of growth and development, and is considered to be fully developed from a recreational standpoint.

FUTURE WITH PROJECT CONDITION

Methodology

Five steps were identified as a reasonable method for estimating benefits for recreational features to be included within the project area. These five steps are described below.

Step 1: Define Market Area and Estimate Market Size

The State of Georgia prepared a Public Survey as part of the Georgia Plan for Outdoor Recreation 2017-2021 also known as the Georgia' Statewide Comprehensive Outdoor Recreation Plan (SCORP). The data it produced is the latest and most reliable information available. The recreation plan is an assessment of preferences and demands for public outdoor recreation needs. The survey conducted was a telephone questionnaire of 1,100 respondents about outdoor recreation preferences. According to that current SCORP, 63% of survey respondents self-identified as being outdoor recreators, 42% of respondents identified crowded facilities as a barrier to recreation, and 84% of respondents claim to visit parks at least several times per year. For the purposes of this study, the population of recreators that identified as being willing to pay for an increase in the availability of recreation is the percent of population which identified crowded facilities as a barrier to recreation (i.e. unmet demand for recreational facilities or demand not satisfied by current recreational facilities).

$$\text{Census Tract Population} \times 63\% \times 42\% = \text{Single Visit Recreators in Project Area}$$

$$\text{Single Visit Recreators} \times 84\% = \text{Multiple Visit Recreators}$$

Table A-4 2: Percent of Population likely to participate in Recreation

Tract	Population	63% of Population (Outdoor Recreators)	42% of Outdoor Recreators that will Participate	84% of Outdoor Recreators (Multiple Visit Group)	Parks
315.06	4,814	3,033	1,274	1,070	3
315.07	3,339	2,104	883	742	0
314.09	5,112	3,221	1,353	1,136	4
Total	13,265	8,357	3,510	2,948	7

Step 2: Estimate Market Demand

As seen in step 1, 3,510 people are expected to participate in recreation for the project area, with 2,948 of those participants visiting recreation areas multiple times.

Due to the location and features of the project areas identified as suitable for recreation, foot travel, picnicking, and paddling were identified as the types of recreation to be evaluated. Based off of the Georgia SCORP data, 90% of recreators can be expected to participate in foot travel activities (jogging, running, walking), 78% of recreators can be expected to participate in picnicking activities, and 33% of recreators are expected to participate in paddling activities (kayaking, canoeing). The recreation type percentage was then multiplied by the number of expected recreators (3,510 and 2,948) and summed in the following table as “Number of Visits (Annually)”. To show daily recreation participation the annual visits were divided by 365.

$$\text{Annual Foot Travel Visits} = (\text{Single Visit Recreators} + \text{Multiple Visit Recreators}) \times 90\%$$

$$\text{Annual Picnic Visits} = (\text{Single Visit Recreators} + \text{Multiple Visit Recreators}) \times 78\%$$

$$\text{Annual Paddling Visits} = (\text{Single Visit Recreators} + \text{Multiple Visit Recreators}) \times 33\%$$

Table A-4 3: Expected Visitation by Recreation Type

	Foot Travel (90%)	Picnic (78%)	Paddling (33%)	Total
Number of Visits (Annually)	5,812	5,037	2,131	12,980
Number of Visits (Daily)	16	14	6	36

Step 3: Estimate Unit Day Value

The Unit Day Value (UDV) method was selected for this analysis. The UDV approach is justified based on the following:

- There is no known reliable regional recreation model produced by Federal, state or local sources.

- Uses affected do not involve any specialized recreation activities such as big-game hunting or whitewater rafting.
- Estimated annual visits are less than 750,000, and specific annual recreation costs are a small fraction of the $2.28 million threshold for use of a regional model (see Figure E-10, ER 1105-2-100, Appendix E)

As noted above, the recreation opportunity provided will not provide any particularly unique or outstanding recreation experience. The value lies in providing a recreation opportunity with reduced crowding for the 42% of recreators that identified being impeded by crowded facilities. This is shown through a relatively low UDV point value of 21 relative to the maximum possible 98 in reference to EGM #18-03.

The analysis utilized the guidelines for assigning points for general recreation, as well as for general boating. The explanation and values assessed are as follows:

- “Recreation Experience” was assigned 0 points due to the relatively small amount of types of recreation that will be provided (foot travel, picnicking, paddling).
- “Availability of Opportunity” was assigned 0 points due to the relatively high number of recreational areas within the project area.
- “Carrying Capacity” was assigned 6 points assuming that any facility built for recreation will have adequate facilities to allow for the designed activity without degrading the site.
- “Accessibility” was assigned 11 points due to the close proximity to well-developed neighborhood roads and sidewalks, as well as the assumption that any newly constructed recreation site will be easily accessibly within the site.
- “Environmental Quality” was assigned 4 points assuming that any new construction will be designed with a minimum of average esthetic quality.

Table A-4 4: UDV Recreation Quality Judgment Factors

Criteria	Judgment factors				
Recreation Experience	Two general activities	Several General Activities	Several General Activities: One High Quality Activity	Several General Activities: more than one high quality activity	Numerous high quality value activities: some general activities
Total Points: 30	0-4 Points	5-10 Points	11-16 Points	17-23 Points	24-30 Points
Point Value:	**0.0**				
Availability of Opportunity	Several within 1 hour; a few within 30 minutes travel time	Several within 1 hour travel time; none within 30	One or two within 1 hour travel time: none within 45	None within 1 hour travel time	None within 2 hours travel time

		minutes travel time	minutes travel time		
Total Points: 18	0-3 Points	4-6 Points	7-10 Points	11-14 Points	15-18 Points
Point Value:	**0.0**				
Carrying Capacity	Minimum facility development for public health and safety	Basic facility to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected alternative
Total Points: 14	0-2 Points	3-5 Points	6-8 Points	9-11 Points	12-14 Points
Point Value:	**6.0**				
Accessibility	Limited access by any means to site or within site	Fair access, poor quality roads to site; limited access within site	Fair access, fair road to site; fair access, good roads within site	Good access, good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site
Total Points: 18	0-3 Points	4-6 Points	7-10 Points	11-14 Points	15-18 Points
Point Value:	**11.0**				
Environmental quality	Low esthetic factors that significantly lower quality	Average esthetic quality; factors exist that lower quality to minor degree	Above average esthetic quality; any limiting factors can be reasonably rectified	High esthetic quality; no factors exist that lower quality	Outstanding esthetic quality; no factors exist that lower quality
Total Points: 18	0-3 Points	4-6 Points	7-10 Points	11-14 Points	15-18 Points
Point Value:	**4.0**				
Point Total:	**21.0**				

The assessment shows that of the possible 98 points the proposed recreation areas received a point total of 21 largely due to the limited number of activities the projects will provide as well as the availability of other nearby recreation sites. Based on the Georgia SCORP, there is likely a willingness to pay for an increase in the availability of recreation due to issues of crowdedness in the existing condition. Interpolation of the above assessed points into dollar values results in a general recreation UDV dollar value of $5.40 for general recreation (including foot travel and picnicking), and $7.17 for general boating (including paddling). General fishing and hunting values were used for paddling recreation because the activity is assumed to have a higher willingness to pay value than general recreation values.

Table A-4 5: UDV Recreation Values

Point Values	General Recreation Values	General Fishing and Hunting Values
0	$4.05	$5.82
10	$4.81	$6.58
20	$5.32	$7.09
30	$6.08	$7.85
40	$7.59	$6.61
50	$8.61	$9.37
60	$9.37	$10.38
70	$9.87	$10.89
80	$10.89	$11.64
90	$11.64	$11.90
100	$12.15	$12.15

Table A-4 6: UDV Point Interpolation

Point Interpolation					
Base Equation	y1	y2	x	x1	x2
y=y1+(x-x1)(y2-y1/x2-x1)	$ 5.32	$ 6.08	21	20	30
y=y1+(x-x1)(y2-y1/x2-x1)	$ 7.09	$ 7.85	21	20	30
Value From Interpolation					
General Recreation	5.40				
General Fishing, Hunting, Boating	7.17				

Table A-4 7: Final UDV Point Value from Interpolation

Point Values from Table one	**General Recreation Values**	**General Fishing, Hunting and Boating Values**
0	$4.05	$5.82
10	$4.81	$6.58
20	$5.32	$7.09
21	**$5.40**	**$7.17**
30	$6.08	$7.85
40	$7.59	$6.61
50	$8.61	$9.37
60	$9.37	$10.38
70	$9.87	$10.89
80	$10.89	$11.64
90	$11.64	$11.90
100	$12.15	$12.15

Point to Value Interpolation	**$ 5.40**	**$ 7.17**

Step 4: Estimate Seasonal Use, Daily, and Annual Demand

While the weighted average daily demand produced a demand value for any given day of the week at any given time of the year, and while the UDV measures the value of that experience, it is not likely that the project will see visitation every day of the year due to factors such as seasonal weather, severe weather and holidays. Since the participation rate expected to be low due to a large opportunity for recreation in the area, and assuming only 1 or several visits per year for 42% of the project area population, it is assumed that recreators will choose appropriate days to recreate throughout the year and not cancel their yearly visit(s) due to a potential foul-weather-day or holiday. For example if a recreators has to cancel a trip to the recreation area because foul-weather occurs, it is assumed that they will choose another day within the same year to visit the recreation area.

Step 5: Estimate Annual Willingness to Pay

The final step is to estimate annual willingness to pay by multiplying the expected number of annual visits by the estimated UDV of a visit in regards to the activity.

Table A-4 8: Recreation Benefits by Census Tract

315.06				
	Foot Travel (90%)	Picnic (78%)	Paddling (33%)	Total
Number of Visits (Annually)	2109.4	1828.1	773.4	4,711
Number of Visits (Average Daily)	5.8	5.0	2.1	12.9
Expected UDV of a Visit	$5.40	$5.40	$7.17	
Expected Annual Willingness to pay	$11,382.3	$9,864.6	$5,542.5	$26,789
315.07				
	Foot Travel (90%)	Picnic (78%)	Paddling (33%)	Total
Number of Visits (Annually)	1463.1	1268.0	536.5	3,268
Number of Visits (Average Daily)	4.0	3.5	1.5	9.0
Expected UDV of a Visit	$5.40	$5.40	$7.17	

Expected Annual Willingness to pay	$7,894.8	$6,842.1	$3,844.3	$18,581
314.09				
	Foot Travel (90%)	Picnic (78%)	Paddling (33%)	Total
Number of Visits (Annually)	2240.0	1941.3	821.3	5,003
Number of Visits (Average Daily)	6.1	5.3	2.3	13.7
Expected UDV of a Visit	$5.40	$5.40	$7.17	
Expected Annual Willingness to pay	$12,086.8	$10,475.3	$5,885.6	$28,448

Table A-4 9: Total Project Area Recreation Benefits

	Foot Travel (90%)	Picnic (78%)	Paddling (33%)	Total
Number of Visits (Annually)	5,812	5,037	2,131	12,981
Number of Visits (Average Daily)	16	14	6	36
Expected UDV of a Visit	$5.40	$5.40	$7.17	
Expected Annual Willingness to pay	$31,364	$27,182	$15,272	$73,818

As seen in the table above, the project area's population is willing to pay a maximum of $73,818 annually for new recreation facilities in the project area.

Rough Order of Magnitude Costs

In order to determine the economic feasibility of the proposed recreation, rough order of magnitude costs must be developed. Recreation is economically justified when the NED benefit of the recreation exceeds the cost. The total benefits and costs for recreation are shown in the following tables.

Table A-4 10: Rough Order Magnitude Costs

Alternative	Project First Cost	Construction Period (months)	Interest During Construction	Total Cost	Average Annual Cost	Annual O&M Cost	Total Average Annual Cost
Recreation	$652,000	2	$738	$652,738	$24,178	$3,900	$28,078
Recreation with FY2019 DR	$652,000	2	$771	$652,771	$24,771	$3,900	$28,671

Table A-4 11: Benefits and Cost of Recreation

Alternative	Description	Average Annualized Benefits	Average Annualized Costs	First Cost	Net Benefits	Benefit Cost Ratio
Recreation	**Recreation at Buyout Locations**	$73,818	$28,078	$652,000	$45,740	2.63
Recreation with FY2019 DR	**Recreation at Buyout Locations**	$73,818	$28,671	$652,000	$45,147	2.57

SWEETWATER CREEK
FLOOD RISK MANAGEMENT FEASIBILITY STUDY
APPENDIX B: DRAFT ENGINEERING APPENDIX

JULY 2018

US Army Corps
of Engineers ®
Mobile District

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. Introduction

The U.S. Army Corps of Engineers (USACE), Mobile District, in partnership with Cobb County, Georgia (the Non-Federal Sponsor), is conducting a general investigation Flood Risk Management (FRM) study to evaluate the feasibility of reducing the flooding risks in the Sweetwater Creek Basin. The specific focus of the study is to identify measures with the potential to reduce the level of flooding risk incurred by structures adjacent to Sweetwater Creek and its tributaries. A team comprised of engineering technical experts from the USACE Mobile District and Dewberry Engineering firm were charged with (1) characterizing the existing and future (with- and without-project) hydraulic, hydrologic, and geologic conditions of the study area, (2) developing of the hydrologic and hydraulic models used to evaluate the effects/benefits of potential alternatives, (3) producing concept and feasibility level designs for the various alternatives considered, and (4) generating feasibility level cost estimates for all potential alternatives for use in the plan formulation process. Details of the engineering efforts to satisfy items (1) – (3) are discussed below in this appendix. The efforts to support item (4) are discussed in a separate Cost Engineering Appendix. Additional details on the measures and hydrologic and hydraulic modeling approach can be found in the report *Numerical Model Development and Testing for Sweetwater Creek Watershed, GA* (Oct 2017) prepared by Dewberry.

2. Study Area

The study area is made up of the entire 264-square mile Sweetwater Creek Watershed (Figure 1); which covers portions of Cobb, Douglas, Paulding and Carroll Counties in Georgia. While the study considers the entire watershed, the focus for flood risk reductions is the Cobb County portion of the basin. The Cobb County portion includes the Cities of Marietta, Austell, and Powder Springs as well as a portion of unincorporated Cobb County, Georgia. Located inside the study area are 14 public schools, 7 senior care facilities, and 1 hospital.

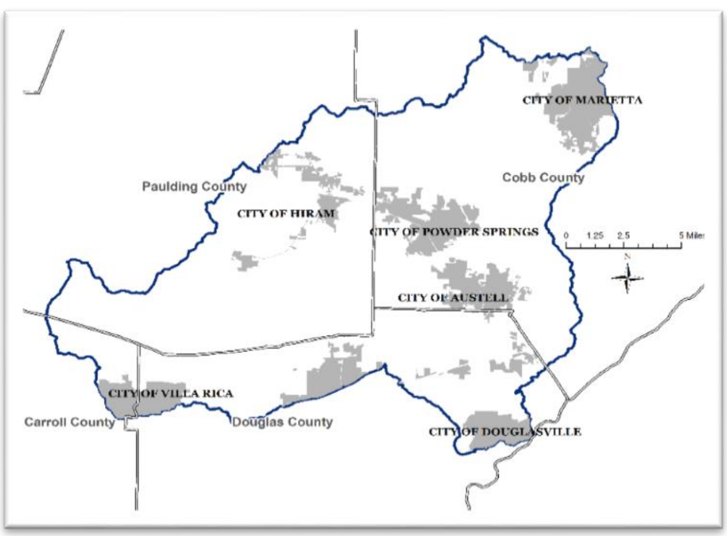


Figure 1: Study Area

2.1. Watershed Characteristics

2.1.1. Drainage Area Description

The Sweetwater Creek Watershed is located in the upper reaches of the Middle Chattahoochee-Lake Harding HUC8 basin. The watershed is 264 square miles, and drains south east into the Chattahoochee River. It covers portions of Cobb, Douglas, Paulding and Carroll Counties and the Cities of Austell, Powder Springs, Hiram, Douglasville, Villa Rica, and Marietta. The main stem of Sweetwater Creek is approximately 46 miles long and has approximately 58 miles of main tributaries. Buttermilk Creek, Mill Creek, Noses Creek, Olley Creek, and Powder Springs Creek are all tributaries of Sweetwater Creek and are predominantly located in Cobb County, Georgia. **Error! Reference source not found.** 2 shows a map of the Sweetwater Creek Watershed.

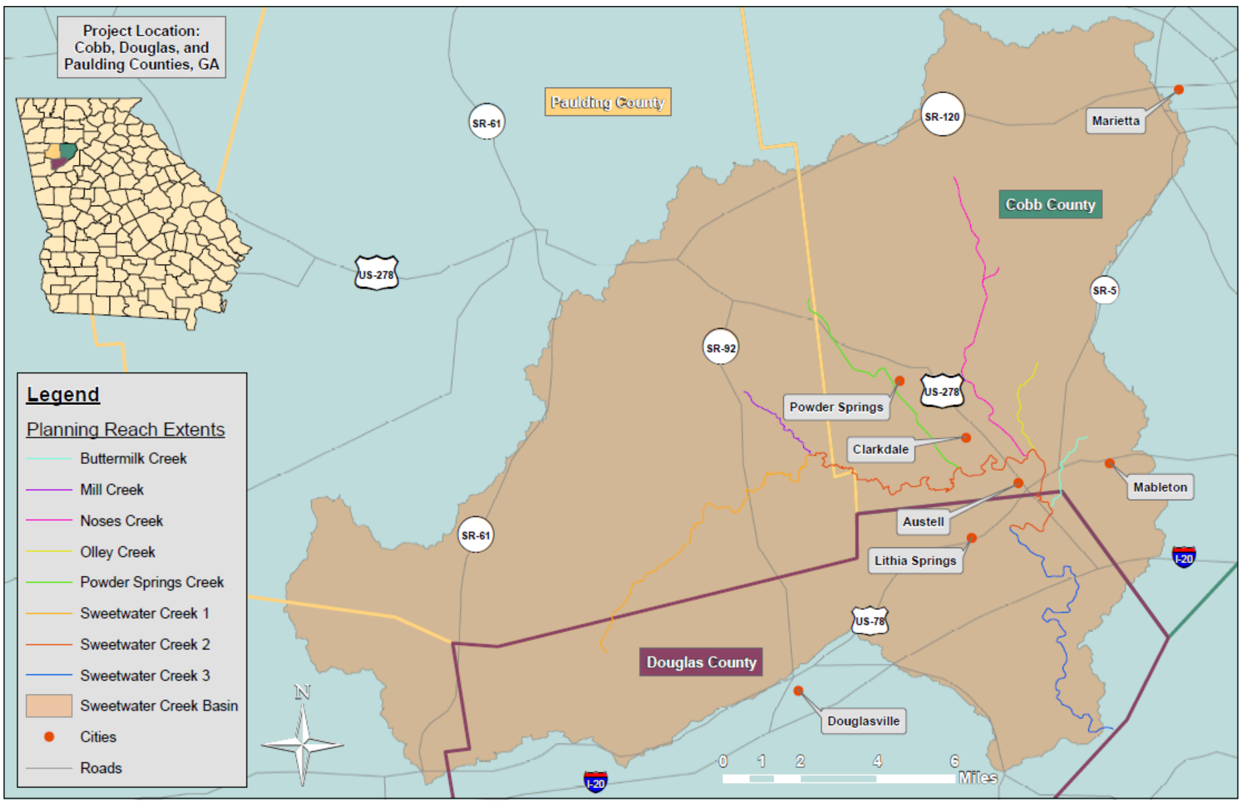


Figure 2: Sweetwater Creek Basin Map

2.1.2. Flooding History

Based on the Cobb County Flood Insurance Study (FIS) Report, dated March 4, 2013, the City of Powder Springs experienced severe flooding in June 1999 from a slow-moving thunderstorm over a three-hour period resulting in approximately $1.2 million in property damage (FEMA 2013).

In September 2004, rainfall associated with Hurricane Ivan inundated Cobb County with six to 10 inches of rain, with a majority of it falling during one afternoon and evening. Many streams experienced record flooding, and parts of the Chattahoochee River crested at more than eight feet above normal stage. Portions of Six Flags amusement park in Austell were also flooded. Shortly after this event, remnants of Tropical Storm Jeanne also hit the Sweetwater Creek basin, causing additional damages to homes that were impacted by Hurricane Ivan (FEMA 2013).

Figure 3: 2009 Sweetwater Creek flooding at Veterans Memorial Highway

Most recently, the Sweetwater Creek basin experienced a historical flooding event in September 2009, where portions of the county saw flooding that exceeded the 0.2-percent-chance-annual exceedance event (FEMA 2013). The areas in and around Austell, Georgia, where Sweetwater Creek confluences with Noses Creek and Olley Creek, were significantly impacted. Figure 3 shows the flooding experienced at Veterans Memorial Highway along Sweetwater Creek near Austell.

Figure 4 shows the annual flood peaks for the USGS gage 02337000 Sweetwater Creek near Austell, Georgia from 1905-2015. During its period of record, the gage recorded 11 major floods (17 foot stage or greater), 21 moderate floods (13-17 foot crest), and 25 minor floods (10-13 foot crest).

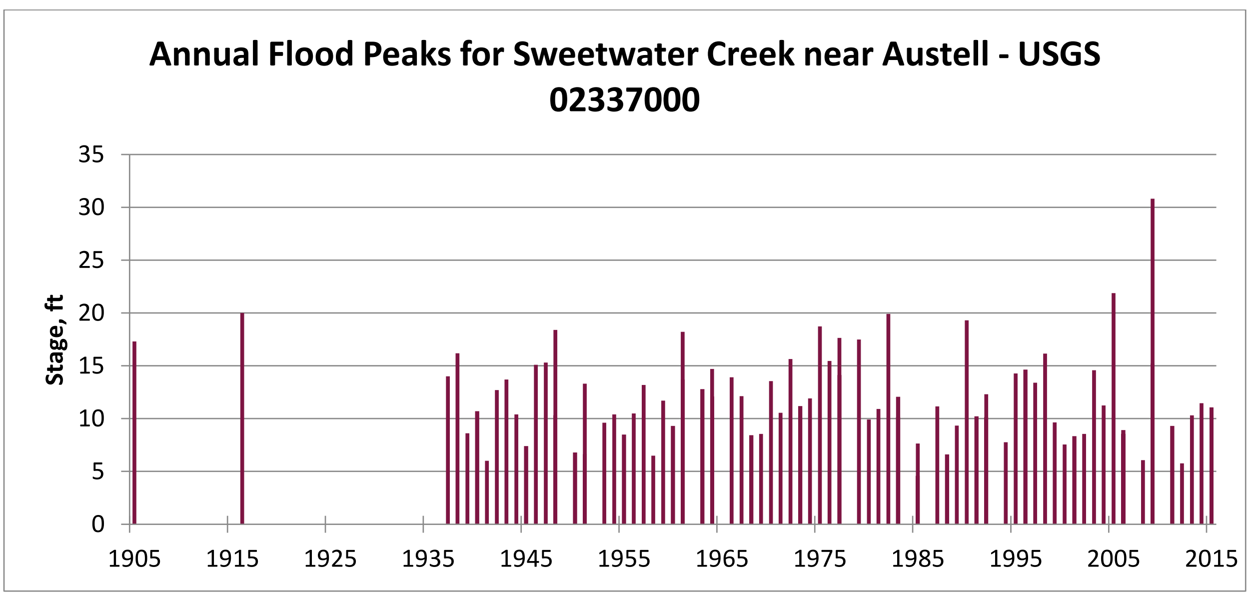


Figure 4: Annual Peaks for USGS 02337000

2.1.3. Hydrology/Runoff Characteristics

2.1.3.1. Temperature

The average daily low and high temperatures in the study area range from the low-30s to the low to mid-50s (in ºF) in the winter months and the mid to high-60s to the mid-80s in the summer months. (Data source: http://www.usclimatedata.com/climate/atlaustell/georgia/united-states/usga1329).

2.1.3.2. Rainfall

The average annual precipitation is approximately 55 inches, with monthly averages ranging from a low of 3.54 inches in April to a high of 6.46 inches in July (this data comes from the same source as that listed above). Synthetic rainfall data for the study area, per National Oceanic Administration (NOAA) Atlas 14, show that rainfall depths range from 0.402 inches for the 1-year, 5-minute storm to 9.93 inches for the 500-year, 24-hour storm.

2.1.3.3. Hydrograph Characteristics

The Sweetwater Creek Watershed ranges from rural undeveloped reaches to highly developed urban areas near the Cities of Austell and Power Springs. In the rural areas in the headwaters of the basin, runoff is not far from natural conditions. Urban development and increased impervious area in the watershed lead to increased runoff volumes compared to pre-development conditions as more rainfall is converted directly to runoff. In addition to increased runoff volumes, the timing of rainfall runoff is also impacted by development. Runoff is delivered to streams much more quickly through stormwater pipes and impervious areas, resulting in “flashy” or “spikey” hydrographs that quickly rise and fall with each storm event. The result is more frequent and higher “flood” events. A typical “flashy” hydrograph from the United States Geological Survey (USGS) gage on Sweetwater Creek is shown in Figure 5. Stormwater management measures such as detention ponds mitigate the impacts of development, but these features are few in the Sweetwater Creek basin.

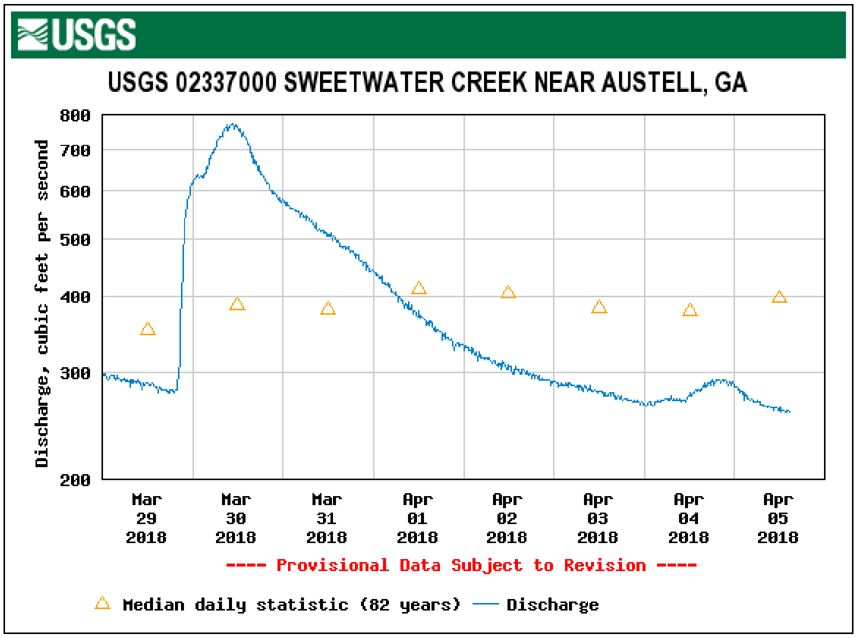


Figure 5: Typical Sweetwater Creek Hydrograph

2.1.4. Stream Hydraulics: Conveyance and Regulation

The Sweetwater Creek basin is a fairly diverse basin. In the headwaters of the basin are heavily wooded with mostly rural areas. Water conveys very slowly through the top of the basin. The lower end of the basin, which is far more urbanized experiences flashy hydrographs and much higher stream velocities. Large sections of Sweetwater Creek near the Town of Austell, Georgia have experienced significant channel degradation. Much of this is tied to the September 2009 flood.

Many areas along Sweetwater Creek and its tributaries exceed bankfull capacity on an annual basis. Areas around Austell and Powder Springs experience out of bank flows as frequently as every year, however, do not experience damages as a result of smaller events below the two-year event. There are no significant flood reregulation structures on Sweetwater Creek or its major tributaries.

2.1.5. Land Use

The setting of the Sweetwater Creek study area is mostly rural and suburban with small cities such as Austell and Powder Springs, which have developed near the floodplains of Sweetwater Creek and Powder Springs Creek respectively. Data obtained from the Multi-Resolution Land Characteristics Consortium 2011 National Land Cover Database (NLCD), depicted in Figure 6: Sweetwater Creek Watershed NLCD Overview, provides a visual representation of the land use overview throughout the entire study area.

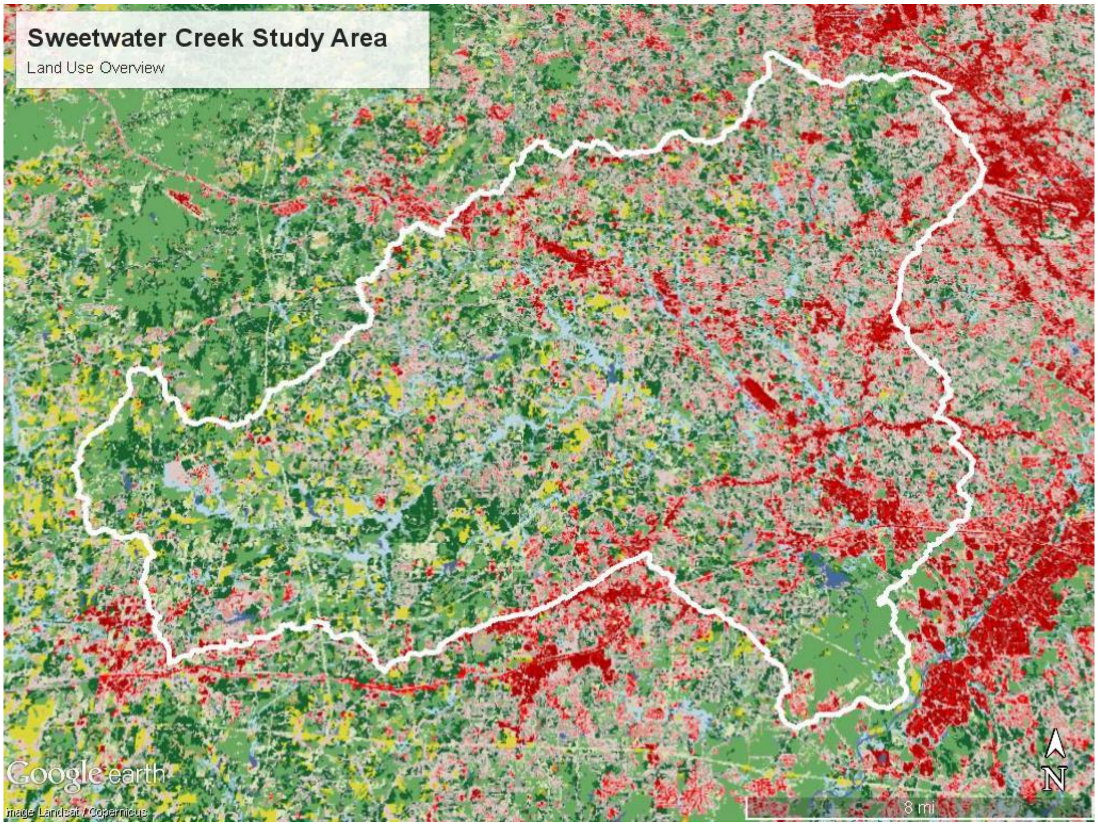


Figure 6: Sweetwater Creek Watershed NLCD Overview

2.1.6. Alluvium and Soils

The study area is located in what is known as the upper Piedmont physiographic province. This area is in what can be considered the foothills of the Appalachian Mountains. The Piedmont is a region of moderate-to-high-grade metamorphic rocks, such as schists, amphibolites, gneisses, and migmatites, and igneous rocks like granite. Topographically, the Piedmont mostly consists of rolling hills. Piedmont soils are commonly a red color for which Georgia is famous. Those soils consist of kaolinite and halloysite (1:1 aluminosilicate clay minerals) and of iron oxides. They result from the intense weathering of feldspar-rich igneous and metamorphic rocks. This intense weathering dissolves or alters nearly all minerals and leaves behind a residue of aluminum-bearing clays and iron-bearing iron oxides because of the low solubilities of aluminum and iron at earth-surface conditions. Those iron oxides give the red color to the clay-rich soil.

2.1.7. Geology and Soils

Sweetwater Creek Watershed is a tributary to the Chattahoochee River which runs parallel to the Brevard Fault Zone which a prominent geologic feature of the Southeast United States formed through seismic activity (Vauchez 1987). Bedrock in the USEPA defined Piedmont Ecoregion consists of Precambrian and Paleozoic metamorphic and igneous rocks such as granite, gneiss, and marble (GWRD 2001).

Soils of the USEPA defined Piedmont Ecoregion are comprised of fine grained saprolites and ultisols which are chemically weathered rocks and leached acidic sandy or loams soils respectively. Ultisols of the Piedmont Ecoregion range in color from bright red or reddish-yellow to orange or pale yellow-brown. Due to 19th century farming practices, topsoil erosion has led to the exposure of these soils which were formed through the weathering of igneous and metamorphic bedrock.

2.1.8. Groundwater

The ground water in the area is shallow groundwater that lies on top of the shallow bedrock. The top of the bedrock is typically about 17 to 27 feet below ground surface. In most places in the project area.

Groundwater is not a major source of potable water in the Atlanta area. Major production sources for deep groundwater is typically fracture flow with fracture occurrences from 77 to 545-feet below ground surface.

3. Formulation of Alternatives

3.1. Problems and Opportunities

The USACE project delivery team (PDT), through coordination with the non-Federal sponsor and other interested stakeholders, identified flooding problems and opportunities within the Sweetwater Creek Watershed. These were elicited during the planning charrette and stakeholder coordination meetings, and were further investigated and refined through on-site field assessments. The specific problems and opportunities identified through these efforts are discussed in the following sections.

3.1.1. Problem Identification

The existing problems in the study area include:

- Routine rainfall events cause flooding along Sweetwater Creek increasing flood risk and damaging residential and commercial structures throughout Cobb County
    - The cities of Austell and Powder Springs and the surrounding areas experience the most extensive and frequent flooding in the study area
- Emergency services disrupted during routine flood events
- Reduced channel conveyance from sedimentation caused by erosion and run-off during the 2009 flood event, which increases the likelihood of flooding during a rainfall event

3.1.2. Opportunities

The existing opportunities in the study area include:

- Reduce flood damages along Sweetwater Creek and its tributaries within Cobb County

- Reduce impacts to emergency services during flood events
- Reduce stream bank erosion
- Improve flood risk communication among stakeholders

3.2. Study Goals, Objectives, and Constraints

The study goal of this feasibility study is to meet specific objectives within the constraints set forth by policy, the study PDT and with input from the sponsor. The specific objectives and constraints of this study are discussed below.

3.2.1. Specific Objectives

The planning objectives for the 50-year period of analysis from 2023 to 2073, within the Sweetwater Creek Watershed inside Cobb County, are:

1. Reduce average annual flood damages
2. Reduce number of structures impacted
3. Reduce response times for emergency services during flood events
4. Increase access to emergency services during flood events

3.2.2. Constraints

Impacts to the below planning constraints should be avoided when able, minimized where possible, and mitigated if there are any resulting impacts.

1. Induced flooding in developed areas
2. Impacts to cultural resources
3. HTRW sites
4. Impacts to Threatened and Endangered Species

3.3. General Types of Flood Risk Management Measures Considered

A number of non-structural and structural measures were considered for alternative plan development. The measures considered were based on local input, local conditions, and professional judgment. The measures considered for Sweetwater Creek consisted are shown in Table 1.

Table 1: Measures Considered

	Measure	Various Methods to Develop Measure
Non-Structural Measures	Structure Relocation/Evacuation (Buyouts)	
	Elevating Structures	
	Flood Proofing Structures	
	Flood Warning System	
	Flood Plain Regulation	

Structural Measures	Modifying Channel Capacity	Clearing and snagging, Channel deepening and/or widening, Modifying bridge crossings and culverts
	Retention/Attenuation	In-channel/Off-channel, Rehabilitation/Modification of existing dams
	Levees/Floodwalls	
	Diversion	High flow, Full flow, Channelized tunnel

3.3.1. Non-Structural Measures

3.3.1.1. Structure Relocation/Evacuation (Buyouts)

Buyouts consist of purchasing residential and commercial structures affected by flooding at various probable ACEs. Those ranged from the 10 percent to the 1 percent ACE. Buyouts are discussed in more detail in the Main Report as well as the Real Estate and Economics Appendices of this report.

3.3.1.2. Elevating Structures

Elevation of structures was briefly considered as a measure. However, this was screened out as it was clear that many of the structures in the basin that would likely need to be elevated were masonry on slab, making it unfeasible to raise them. Therefore, this was screened out as a measure.

3.3.1.3. Flood Proofing Structures

Flood proofing was discussed however, it was determined that there was no easy and cost effective way to flood proof numerous isolated individual structures throughout the basin. Therefore, this was screened out as a measure.

3.3.1.4. Flood Warning System

A reverse 911 style flood warning system, that could send a text to a cell phone, would help alert those in the area to the potential for a flood event. Sweetwater Creek, Powder Springs Creek, Noses Creek, and Olley Creek all have USGS stream gauges that could be used to trigger the notifications for an area while allowing time for those in the area to avoid the flood waters. This does not address all of the objectives but would enhance any of them to reduce the flood risk in the area.

3.3.2. Structural Measures

3.3.2.1. Modifying Channel Capacity

Channel modification of Sweetwater Creek beginning upstream of the City of Austell extending downstream until induced flooding can be mitigated or does not occur. The objective of the measure is to increase channel conveyance through the creation of a more optimal channel design that will reduce flood elevations and concurrently provide a more stable channel.

Clearing and snagging was eliminated since it would not achieve the project objectives. Modifying bridges and culverts was removed since the ponding that occurs on the upstream side of the structures does not appear to be causing damages to adjacent property owners. Sweetwater Creek has a small elevation change from the Cobb/Paulding County line to Sweetwater Creek State Park. In the 44,000 feet of creek the elevation drops by only 20 feet. The small elevation changes in the area make it so that there is large areas of induced flooding caused by the increased flow of a channel deepening and/or widening if it is not connected to the rapids and falls in the state park. The location of the channel modification is shown in Figure 8.

3.3.2.2. Retention/Attenuation

No offline retention sites were identified that would provide a measurable hydrologic or hydraulic change in the flood effected areas. In line sites of various sizes and locations on Sweetwater Creek and its tributaries were identified. The locations of the retention measures are shown in Figure 7.

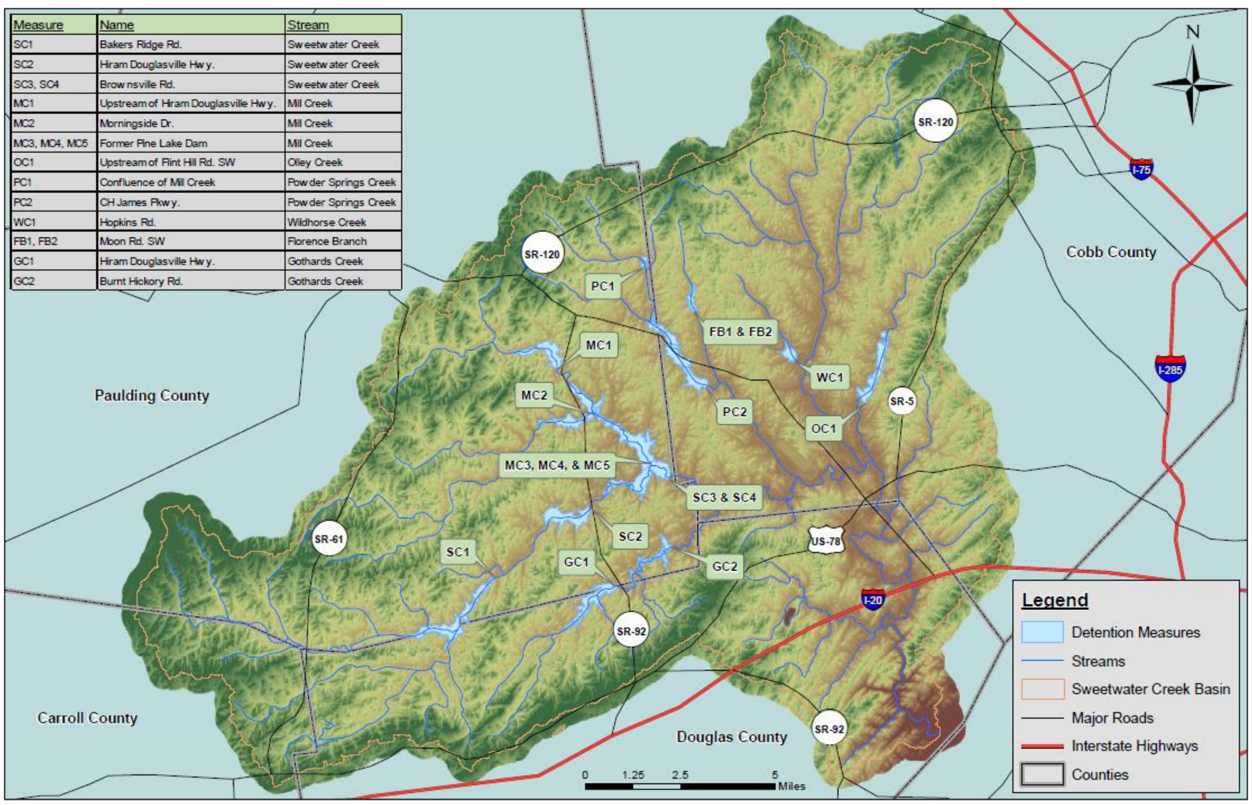


Figure 7: Possible Retention Sites

Some of the sites were small and not close enough to flood damages to affect any measurable change even when combined with other measures and retention sites. Other sites when the retention structure was made large enough to affect a change did not have high enough ground to tie into. Those sites were removed from further consideration.

Combinations of retention sites were developed as part of capturing additional benefits through modified designs of the same structure. One retention combination was to combine all the sites to determine a relative maximum effect from retention

3.3.2.3. Levees/Floodwalls

Levees at some locations where briefly considered but were determined to by not likely cost effective.

3.3.2.4. Diversions

Diversion channel alternatives were investigated. Alignments included connecting tributaries, such as Noses and Ollie Creek, as well as by passing developed areas on Sweetwater Creek itself. One alignment would require a tunnel under the City of Austell that would be 3 12x12 foot culverts in order to pass sufficient flow. The diversion alignments are shown in Figure 8.

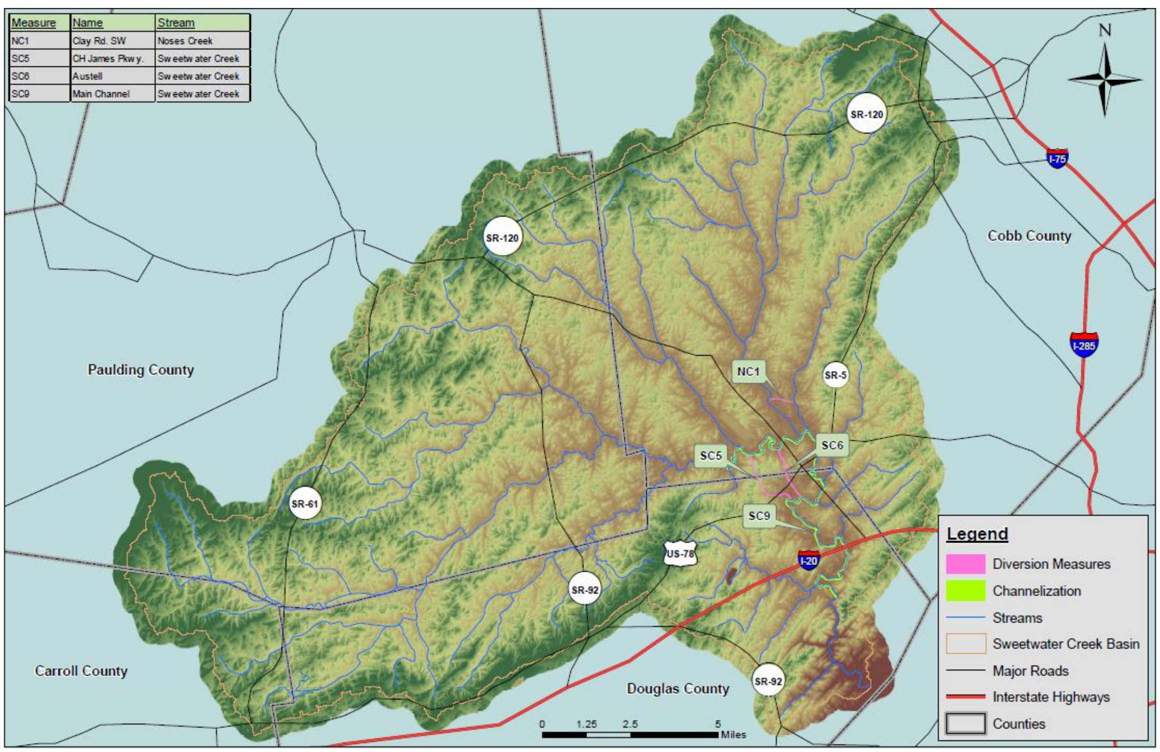


Figure 8: Channel Modification and Diversion Measures

3.3.3. Screening of General Measures

The criteria for screening the initial measures by using professional judgement including 1) was it implementable, 2) not likely to induce flooding, 3) meet the project objectives and 4) relative effectiveness to other measures. Elevating structures and flood proofing were removed because the type of construction (i.e. slab on grade foundations) in the flood prone areas does not allow for elevating the structures. Floodplain regulation has already been implemented by the non-Federal sponsor (NFS) and so was not carried forward.

3.4. Description of Site Specific Measures Considered for the Final Array of Alternatives

A final array of detailed alternatives where developed to be carried forward into alternative development. Table 2 shows the final array of measures and Figure 9 shows the location of the measures. The following sections describe the measures in detail.

Table 2: Final measures with description

Measure	Description
10% ACE Buyouts (20 Structures)	Buyout of structures with 1st flood elevation lower than 10% ACE storm
4% ACE Buyouts (26 Structures)	Buyout of structures with 1st flood elevation lower than 25% ACE storm
2% ACE Buyouts (66 Structures)	Buyout of structures with 1st flood elevation lower than 2% ACE storm
1% ACE Buyouts (117 Structures)	Buyout of structures with 1st flood elevation lower than 1% ACE storm
SC1	A 24 feet high structure upstream of Bakers Bridge Road in Paulding County near the Douglas and Paulding County line
SC1s	A 19 feet high structure upstream of Bakers Bridge Road in Paulding County near the Douglas and Paulding County line
SC2	A 15 feet high structure upstream of Highway 92 in Paulding County
SC6	A 33 feet high structure upstream of Highway 92 upstream of Brown Road in Cobb County
SC6LF	A 33 feet high structure upstream of Highway 92 upstream of Brown Road in Cobb County with a smaller outfall structure
MC2	A 20 feet high structure upstream of Morningside Drive in Paulding County
PC2	A 25 feet high structure upstream of C.H. James Parkway in Cobb County near the Cobb and Paulding County Line
OC2	A 29 feet high structure upstream of Flint Hill Rd Southwest in Cobb County
Channel Modification	A channel modification from near the CH James Parkway to the rapids in Sweetwater Creek State Park near the historic mill site (14.2 miles)

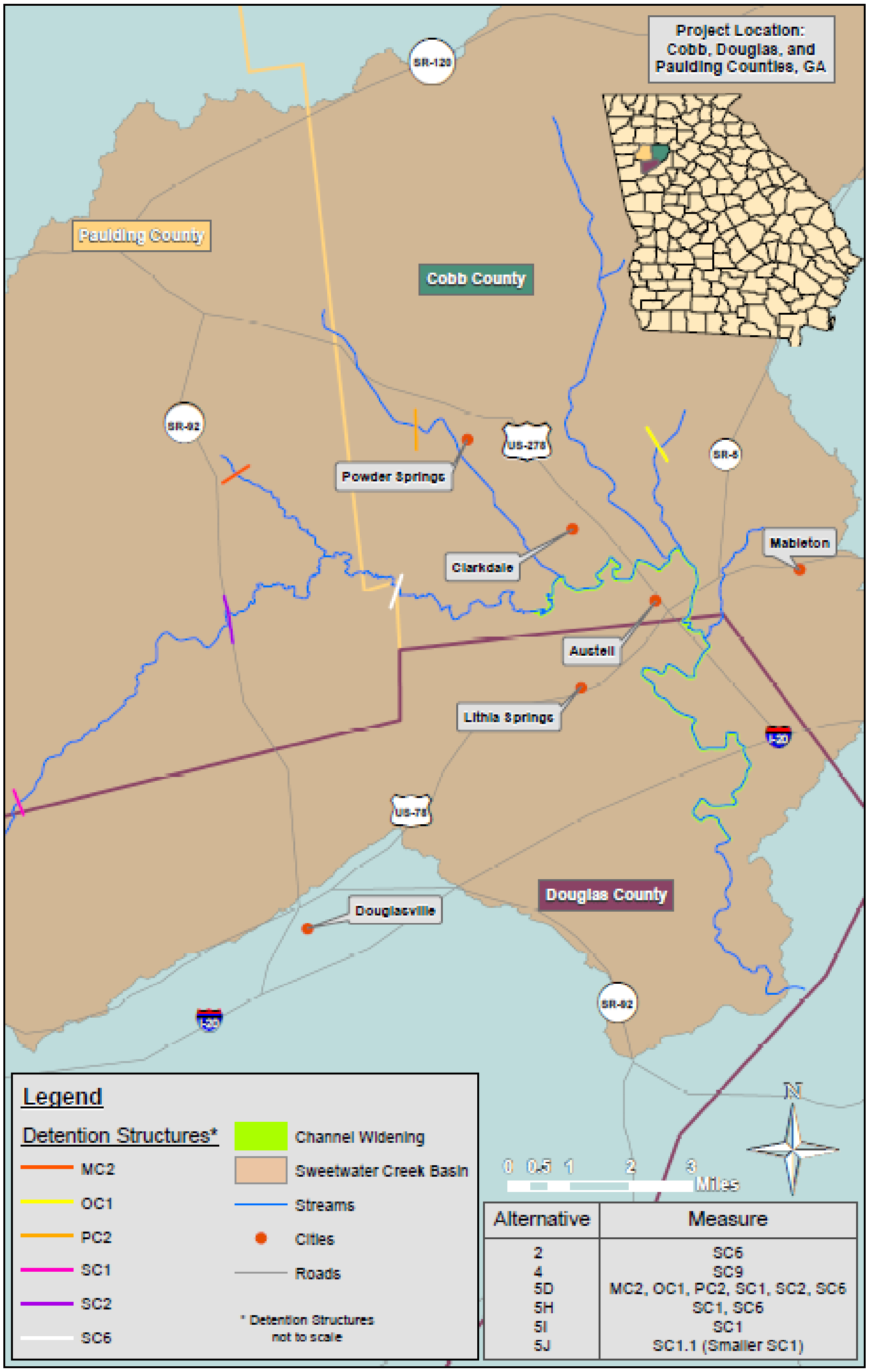


Figure 9: Map of Measures

3.4.1. Non-Structural (Buyouts)

Purchasing residential and commercial structures affected by flooding at various probable ACEs. The 10%, 5%, 2% and 1% ACE where considered. Buyouts are discussed in more detail in the Main Report as well as the Real Estate and Economics Appendices of this report.

3.4.2. Structural

3.4.2.1. Detention Structures

3.4.2.1.1. Modeling

In-line detention structures SC1, SC2, and SC1S were modeled hydrologically as a reservoir element using HEC-HMS version 4.2.1 within HEC-WAT. All storage and elevations data was estimated from low-quality digital terrain data obtained through the USGS National Elevation Dataset. Higher quality Light Detection and Ranging (LiDAR) was not available for the area of the basin within Paulding County. The slots through the dam, discussed in detail in the following sections, were modeled as outflow structures using the broad crested weir equation. A downstream rating curve was applied to the weirs as a tail water boundary condition using the effective Federal Emergency Management Agency (FEMA) flood profile elevations for various return periods with corresponding Flood Insurance Study discharges. This enabled submergence considerations to be simply modeled within HEC-HMS, refining the accuracy of the model.

In-line detention structures SC6, MC2, MC5, OC1, and PC2 were modeled dynamically using HEC-RAS version 5.0.3 within HEC-WAT. All storage and elevation data was estimated using cross sections derived from a combination of high quality digital terrain provided by Cobb County and lower quality data obtained through the USGS National Elevation Dataset for portions of the flood pool extending into Paulding County. The slots through the dam were modeled as inline structures within HEC-RAS using the broad crested weir equation.

3.4.2.1.2. Future Detail Design Considerations for Detention Structures

The concept of these structures developed during the feasibility study was developed in line with the principles of SMART planning which generally defer all detail design from the feasibility phase of a study to the preconstruction phase. Key considerations, recommendations, and requirements for detailed hydraulic and civil design include:

1. Refinement of the storage-elevation information that HEC-RAS determines to give greater detail by:
    - Performing a basic tree survey to develop a storage area reduction factor for the reservoir to account for the loss of volume associated with trees (assuming that clear cutting of trees will not be performed beyond the footprint of the dam structure and a permanent easement around the dam

required to allow construction, inspection, and maintenance access). This would be modeled within HEC-RAS as cross section flow obstructions.

2. Refinement of the design and size of the dam outlet work slots by:
    - Using HEC-RAS, develop a 2D model of the structure and flow through the outlet works slot. This will enable the slot to be more accurately designed and optimized using energy flow methods rather than weir flow as it is currently modeled. Since the slot elevation extends below the invert of the channel, true weir flow will not be experienced through the low-stage weir and would therefore be more suited to energy flows. A rating curve would then be determined from the 2D model and applied to the cross section immediately upstream of the dam in lieu of the existing in-line structure. The detailed design of the slot will require:
        i. Determining the wall angles to enable the smooth contraction and expansion of flows into and through the throat of the slot. When the wall angles and longitudinal length of the slot throat have been determined as shown in Figure 10, the width of the slot will need to be modified slightly to achieve similar hydrologic performance to the original HEC-RAS model that used weir methods.

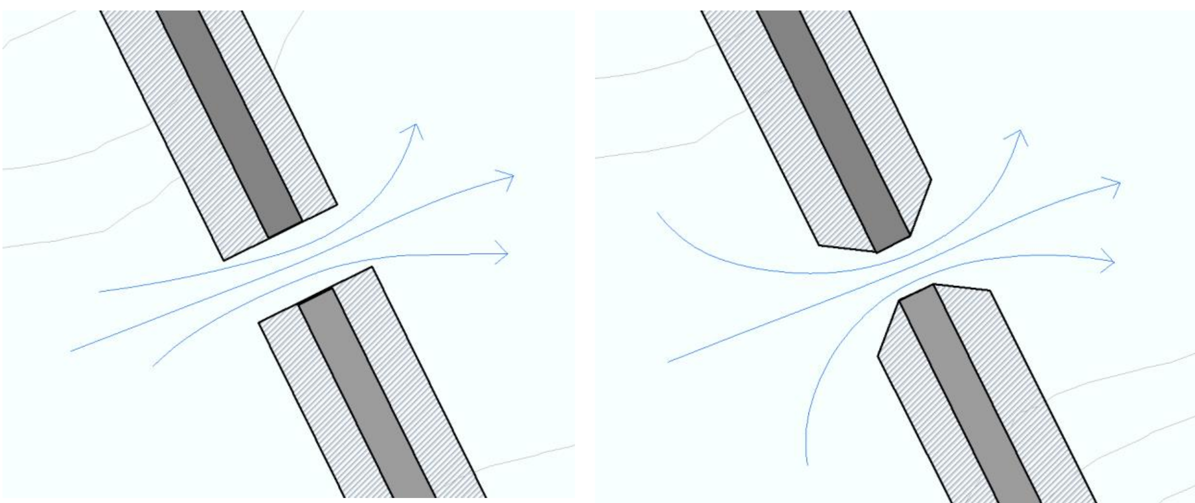


Figure 10: Wall Angle Refinement

3. Determining the hazard potential classification of the dam to determine the required spillway design flood and spillway size by:
    - Developing a sunny day dam failure hydraulic model in accordance with the U.S. Army Corps of Engineers dam safety guidelines and Georgia Safe Dams Program Engineering Guidelines to determine the hazard potential classification and required spillway design flood.
    - Once the spillway design flood is determined, the high stage slot width will need to be modified to accommodate the spillway design flood. Alternatively, to preserve the flood attenuation benefits of the high stage

slot, an auxiliary spillway could potentially be added to bypass flow over or around the dam structure. Wherever possible, the high-stage slot/weir or auxiliary spillway should be located to the side of the dam to allow flow to bypass the dam face. If the high stage slot/weir cannot be located to the side of the structure, a concrete chute spillway and stilling basin will be required for overtopping and downstream channel protection. It should be noted that widening of the high-stage slot will likely result in a decrease in flood attenuation for flood events greater than the 1% annual chance discharge.

3.4.2.1.3. Site Descriptions of Measures

Measure SC1

Measure SC1s is a conceptual online dry detention facility on Sweetwater Creek, located approximately one mile upstream of Bakers Bridge Road in Paulding County, creating up to 5,720 acre-feet of flood storage. It is located at the same location as SC1 with a smaller configuration that provides protection for events below the 2% annual chance exceedance. The objective of the measure is to temporarily detain floodwaters from the approximately 42 square miles that drain to the facility location. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges in addition to delaying the timing of the hydrograph peak. The delaying of the hydrograph at the facility will have the additional benefit of allowing Mill Creek, which confluences with Sweetwater Creek approximately 7.5 miles downstream of the facility, to drain longer before the peak discharge of Sweetwater Creek reaches the confluence, resulting in less coincidental peaks and reducing the combined peak downstream of the confluence for most flood events. This concept would reduce flood risk along a section of Sweetwater Creek and along the Tributaries of Mill Creek, Power Springs Creek, Noses Creek, and Olley Creek to name a few which experience large depths of backwater flooding as a result of Sweetwater Creek. Figure 11 below illustrates the approximate location and alignment of measure SC1.

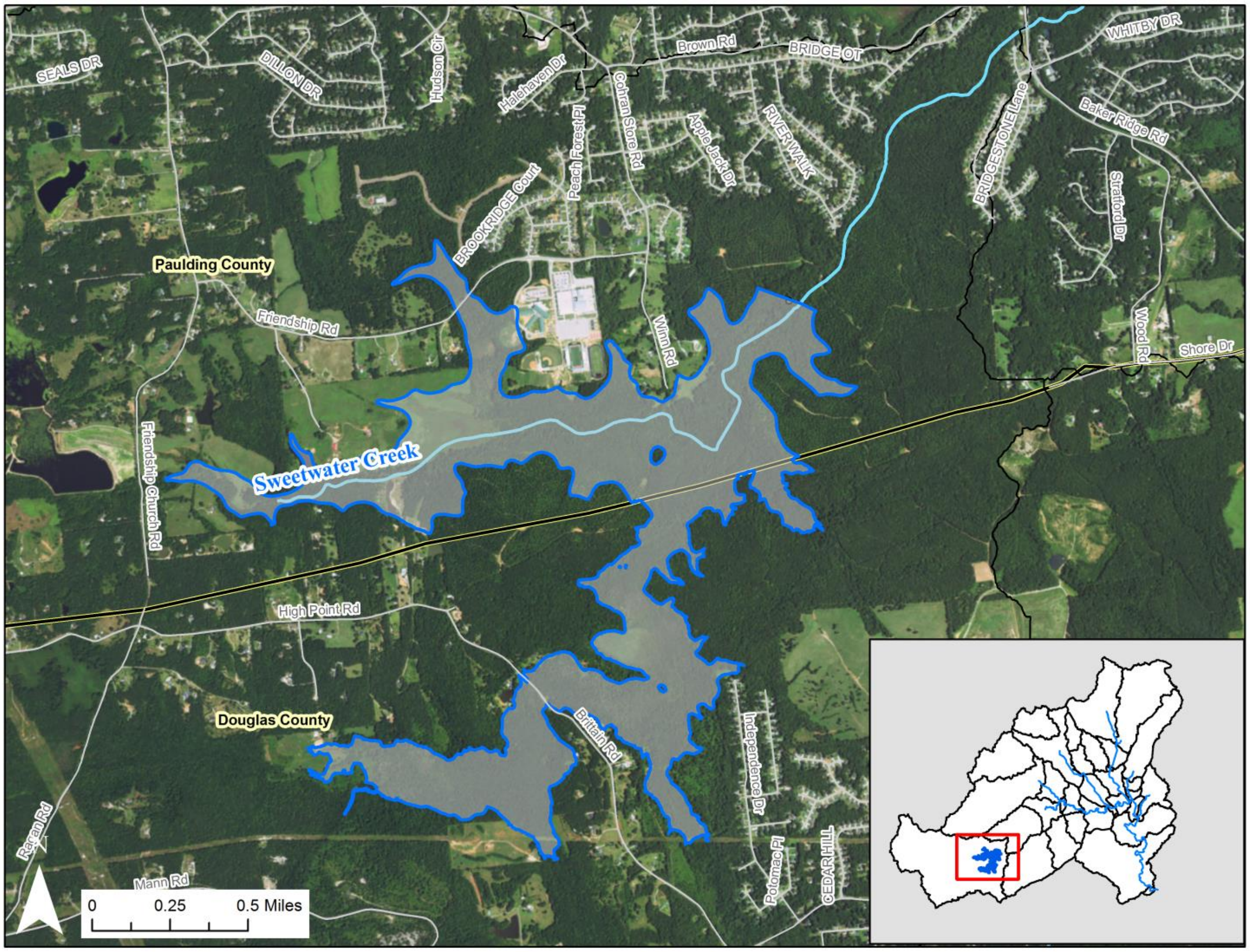


Figure 11: Approximate Location of SC1

Measure SC1 Configuration

Figure 12: Example of Slot Dam Configuration from Mark Avenue Project in Cobb County

The facility would consist of a 1,500 feet long, 24 feet high earthen or concrete dam (roller compacted or traditional concrete) built approximately perpendicular to Sweetwater Creek and its adjoining floodplain. The outlet works of the dam would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream of the dam. The slot was sized to allow smaller storm events to freely pass through the structure, allowing maximum storage for the larger events, and adjusted as needed for maximum potential attenuation. The slot would begin with an approximately 8-feet wide low-stage section extending to the top of the dam with the invert of the slot sunken approximately 2 feet or more below the channel invert. The sinking of the slot below the channel invert will allow for sediment backfill, creating a more natural channel bottom through the dam supporting the unrestricted passage of various aquatic species including fish. The high-stage slot would be approximately 50-feet wide beginning at an elevation of 954 feet, extending upwards to the top of dam elevation of 959 feet and would only be expected to engage when the 1% annual chance flood discharges are exceeded and is not intended to provide significant flood attenuation. An example of a similar slot dam structure is shown in Figure 12, which is a recently completed project located at Mark Avenue in Cobb County. The facility is estimated to provide 7,660 acre-feet of storage during the peak elevation of the 1% annual chance flood elevation of 956 feet and 10,015 acre-feet of storage at the top of dam elevation of 959 feet.

Measure SC1s

Measure SC1s is a conceptual online dry detention facility on Sweetwater Creek, located approximately one mile upstream of Bakers Bridge Road in Paulding County, creating up to 5,720 acre-feet of flood storage. It is located at the same location as SC1 with a smaller configuration that provides protection for events below the 2% annual chance exceedance. The objective of the measure is to temporarily detain floodwaters from the approximately 42 square miles that drain to the facility location. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges in addition to delaying the timing of the hydrograph peak. The delaying of the hydrograph at the facility will have the additional benefit of allowing Mill Creek, which confluences with Sweetwater Creek approximately 7.5 miles downstream of the facility, to drain longer before the peak discharge of Sweetwater Creek reaches the confluence, resulting in less coincidental peaks and reducing the combined peak downstream of the confluence for most flood events. This concept would reduce flood risk along a section of Sweetwater Creek and along the Tributaries of Mill Creek, Power Springs Creek, Noses Creek, and Olley Creek to name a few which experience large depths of backwater flooding as a result of Sweetwater Creek.

Figure 13 below illustrates the approximate location and alignment of measure SC1.

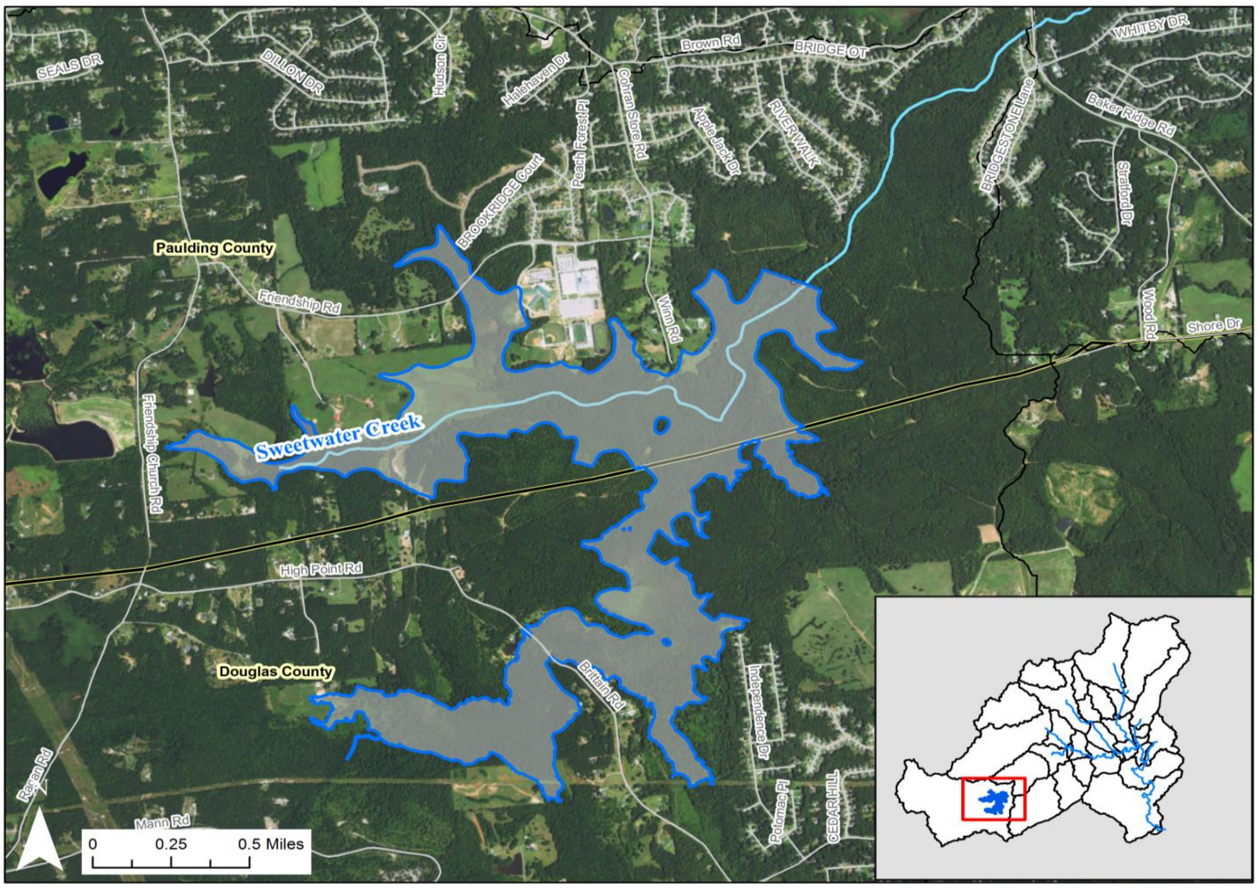


Figure 13: Approximate Location of SC1s

Measure SC1s Configuration

The facility would consist of a 1,500 feet long, 19 feet high earthen or concrete dam (roller compacted or traditional concrete) built approximately perpendicular to Sweetwater Creek and its adjoining floodplain. The outlet works of the dam would consist of a single stage concrete slot with vertical side walls discharging into a stilling basin downstream of the dam. The slot was sized to allow smaller storm events to freely pass through the structure, allowing maximum storage for the larger events up to the 50-year storm, and adjusted as needed for maximum potential attenuation. The slot would begin with an approximately eight feet wide low-stage section extending to the top of the dam with the invert of the slot sunken approximately two feet or more below the channel invert. The sinking of the slot below the channel invert will allow for sediment backfill, creating a more natural channel bottom through the dam supporting the unrestricted passage of various aquatic species including fish. This configuration does not contain an upper stage slot for larger events. The dam would be armored to fully overtop in an event exceeding the 50-year storm with a roller compacted concrete shell followed by graded riprap over a filter fabric at the toe. It is anticipated the dam would need to be inspected after an event in which the embankment was overtopped. The facility is geared towards providing reduced damages to smaller storms and is estimated to provide 5,720 acre-feet of storage during the peak elevation of the 2% annual chance flood elevation of 954 which corresponds to the top of dam elevation.

Measure SC2

Measure SC2 is a conceptual online dry detention facility on Sweetwater Creek, located just upstream of Hiram Douglasville Highway in Paulding County, creating up to 2,260 acre-feet of flood storage. The objective of the measure is to temporarily detain floodwaters from the approximately 51 square miles that drain to the facility location. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges. This concept would reduce flood risk along a section of Sweetwater Creek and along the tributaries of Power Springs Creek, Noses Creek, and Olley Creek to name a few which experience large depths of backwater flooding as a result of Sweetwater Creek.

Figure 14 below illustrates the approximate location and alignment of measure SC2.

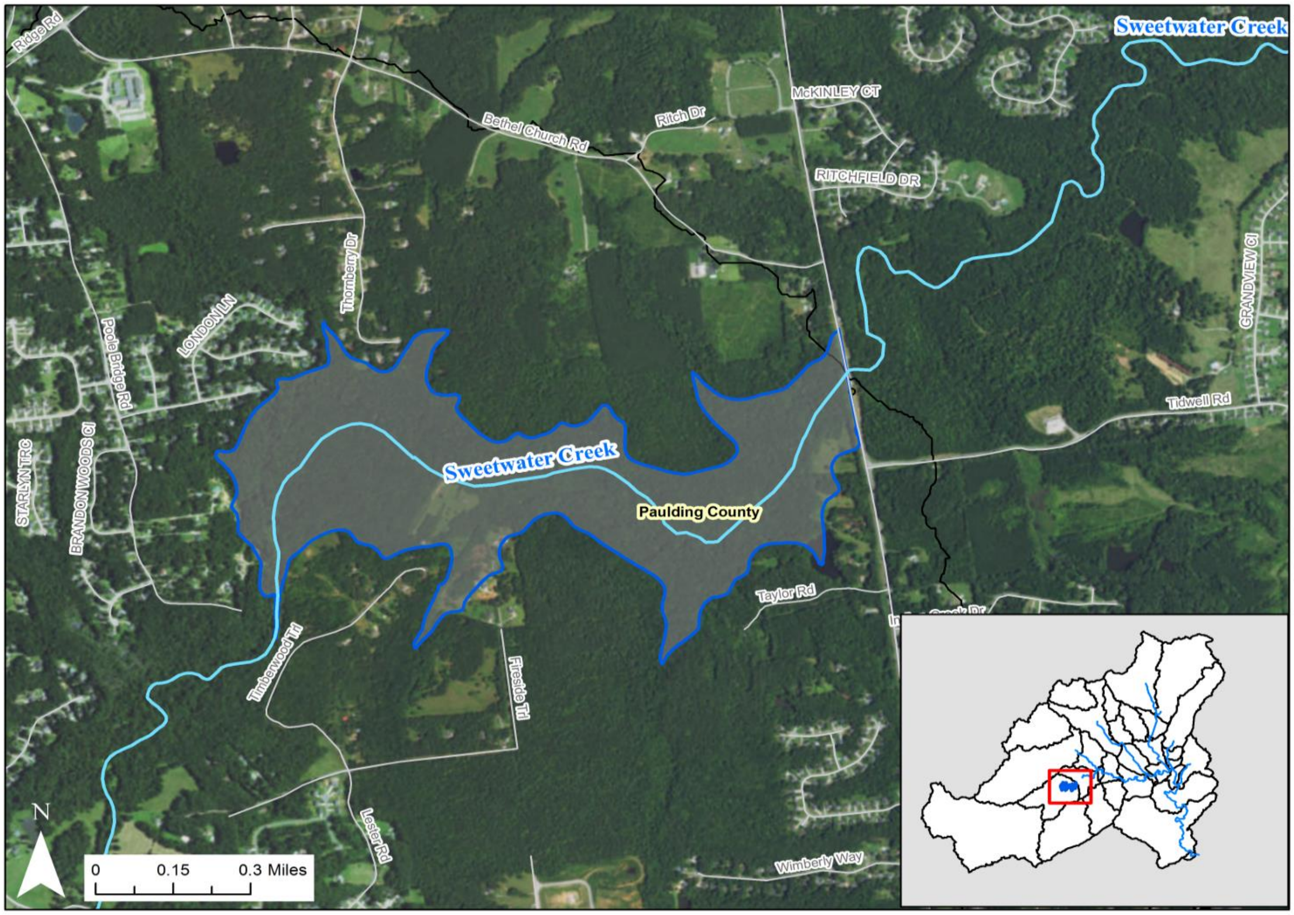


Figure 14: Approximate Location of SC2

Measure SC2 Configuration

The facility would consist of a 1,600 feet long, 15 feet high earthen or concrete dam (roller compacted or traditional concrete) built approximately perpendicular to Sweetwater Creek and its adjoining floodplain. The outlet works of the dam would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream of the dam. The slot was sized to allow smaller storm events to freely pass through the structure, allowing maximum storage for the larger events, and adjusted as needed for maximum potential attenuation. The slot would begin with an approximately 10-feet wide low-stage section extending to the top of the dam with the invert of the slot sunken approximately 2 feet or more below the channel invert. The sinking of the slot below the channel invert will allow for sediment backfill, creating a more natural channel bottom through the dam supporting the unrestricted passage of various aquatic species including fish. The high-stage slot would vary approximately 100 feet wide beginning at an elevation of 923 feet, extending upwards to the top of dam elevation of 929 feet and would only be expected to engage when the 1% annual chance flood discharges are exceeded and is not intended to provide significant flood attenuation. The facility is estimated to provide 2,260 acre-feet of storage during the peak elevation of the 1% annual chance flood elevation of 926 feet and 3,050 acre-feet of storage at the top of dam elevation of 929 feet.

Measure SC6 and SC6LF

Measures SC6 and SC6LF is a conceptual online dry detention facility on Sweetwater Creek, located just upstream of Brown Road in Cobb County, creating up to 9,000 acre-feet of flood storage. The objective of the measure is to temporarily detain floodwaters from the approximately 100 square miles that drain to the facility location. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges. This concept would reduce flood risk along a section of Sweetwater Creek and along the tributaries of Power Springs Creek, Noses Creek, and Olley Creek to name a few which experience large depths of backwater flooding as a result of Sweetwater Creek.

Figure 15 below illustrates the approximate location and alignment of measure SC6.

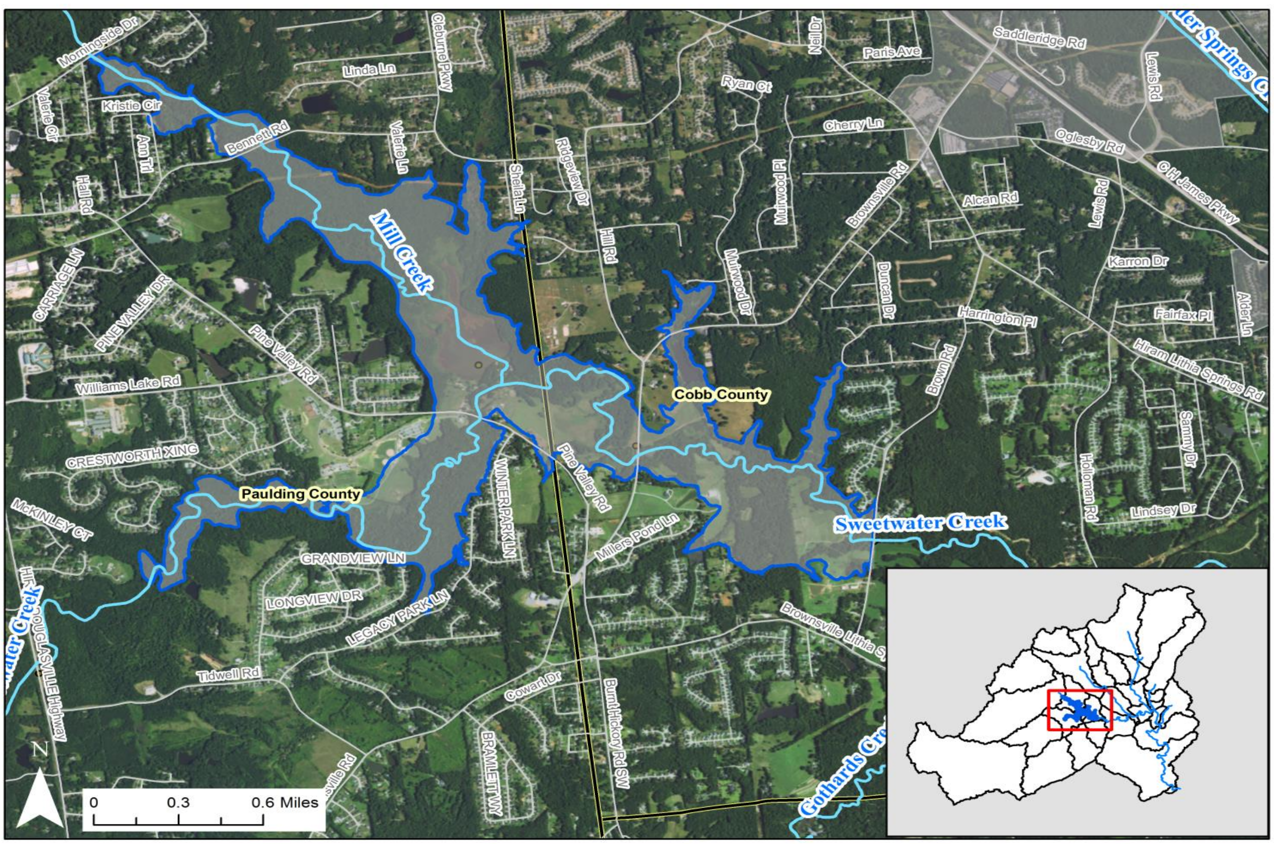


Figure 15: Approximate Location of SC6

Measure SC6 and SC6LF Configuration

The facility would consist of a 1,400 feet long, 33 feet high earthen or concrete dam (roller compacted or traditional concrete) built approximately perpendicular to Sweetwater Creek and its adjoining floodplain. The outlet works of the dam would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream of the dam. The slot was sized to allow smaller storm events to freely pass through the structure, allowing maximum storage for the larger events, and adjusted as needed for maximum potential attenuation. Depending on the alternative it is a part of, the outlet configurations for SC6 will vary to achieve maximum storage while working in combination. Therefore SC6LF is the same structure with a larger weir configuration. The slot would vary between an approximately 10-20-feet wide low-stage section extending to the top of the dam with invert of the slot sunken approximately 2 feet or more below the channel invert. The sinking of the slot below the channel invert will allow for sediment backfill, creating a more natural channel bottom through the dam supporting the unrestricted passage of various aquatic species including fish. The high-stage slot would vary between approximately 500-1000 feet wide beginning at an elevation of 914.5 feet, extending upwards to the top of dam elevation of 917 feet and would only be expected to engage when the 1% annual chance flood discharges are exceeded and is not intended to provide significant flood attenuation. The facility is estimated to provide 9,000 acre-feet of storage during the peak elevation of the 1% annual chance flood elevation of 914 feet and 12,592 acre-feet of storage at the top of dam elevation of 917 feet.

Measure MC2

Measure MC2 is a conceptual online dry detention facility on Mill Creek, located just upstream of Morningside Drive in Paulding County, creating up to 1,370 acre-feet of flood storage. The objective of the measure is to temporarily detain floodwaters from the approximately 37 square miles that drain to the facility location. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges in addition to delaying the timing of the hydrograph peak. This concept would reduce flood risk along a section of Sweetwater Creek and along the tributary of Mill Creek.

Figure 16 below illustrates the approximate location and alignment of measure MC2.

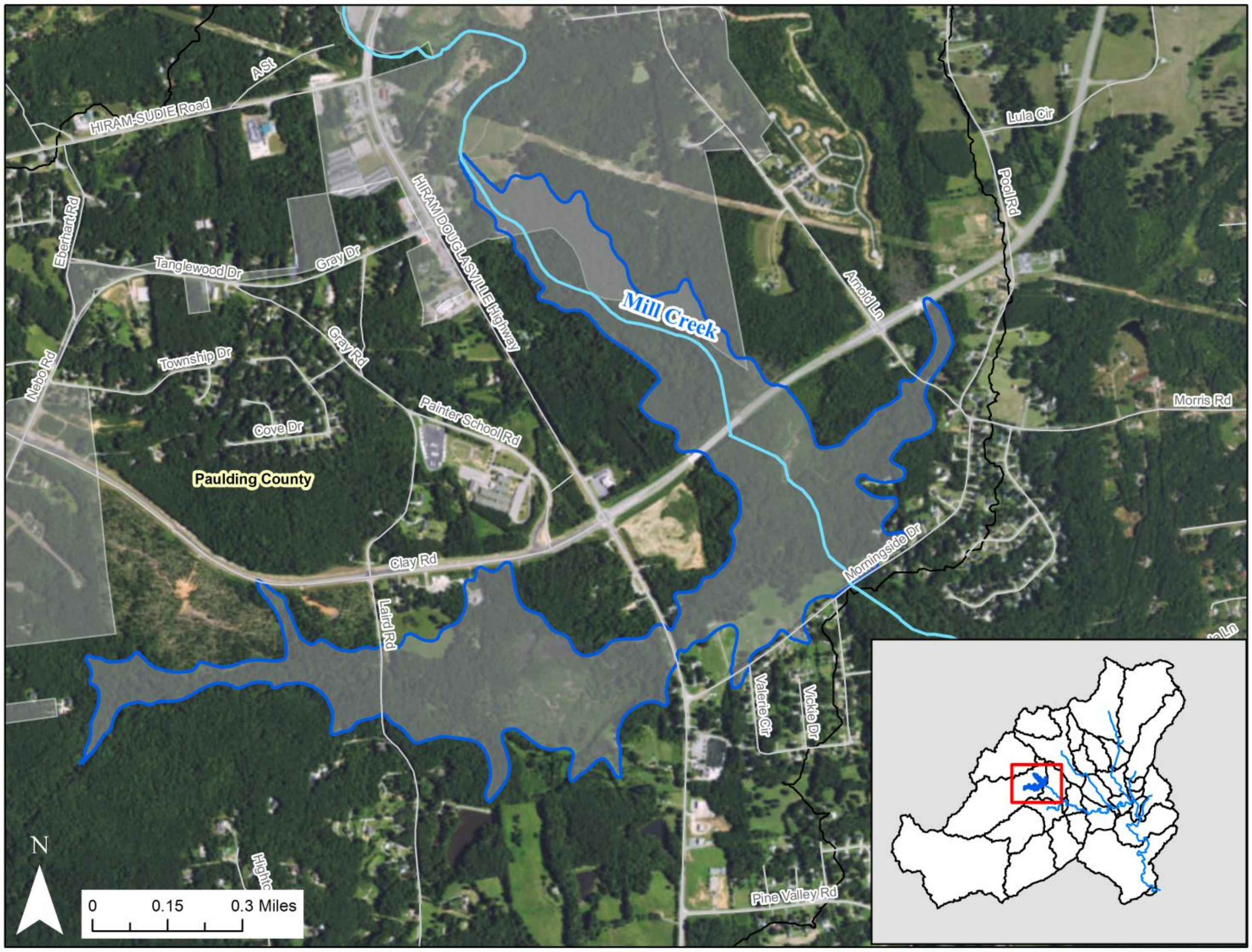


Figure 16: Approximate Location of MC2

Measure MC2 Configuration

The facility would consist of a 1,300 feet long, 19.5 feet high earthen or concrete dam (roller compacted or traditional concrete) built approximately perpendicular to Mill Creek and its adjoining floodplain. The outlet works of the dam would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream of the dam. The slot was sized to allow smaller storm events to freely pass through the structure, allowing maximum storage for the larger events, and adjusted as needed for maximum potential attenuation. The slot would begin with an approximately 25-feet wide low-stage section extending to the top of the dam with the invert of the slot sunken approximately 2 feet or more below the channel invert. The sinking of the slot below the channel invert will allow for sediment backfill, creating a more natural channel bottom through the dam supporting the unrestricted passage of various aquatic species including fish. The high-stage slot would be approximately 75-feet wide beginning at an elevation of 919 feet, extending upwards to the top of dam elevation of 925 feet and would only be expected to engage when the 1% annual chance flood discharges are exceeded and is not intended to provide significant flood attenuation.

Measure MC5

Measure MC5 is a conceptual rehabilitation and retrofit of the existing Pine Valley Lake, which is located on Mill Creek in Paulding County, approximately 250 feet upstream of the confluence with Sweetwater Creek. The dam is partially breached but retains a reduced normal pool. The objective of the measure is to structurally rehabilitate the dam and retrofit the outlet works to create a dedicated flood pool to temporarily detain floodwaters from the approximately 42 square miles that drain to the facility. This can include lowering the current normal pool to further increase the flood pool. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges. This concept would reduce flood risk along a section of Sweetwater Creek and along the tributaries of Power Springs Creek, Noses Creek and Olley Creek to name a few which experience large depths of backwater flooding as a result of Sweetwater Creek.

Figure 17 illustrates the approximate location and alignment of measure MC5.

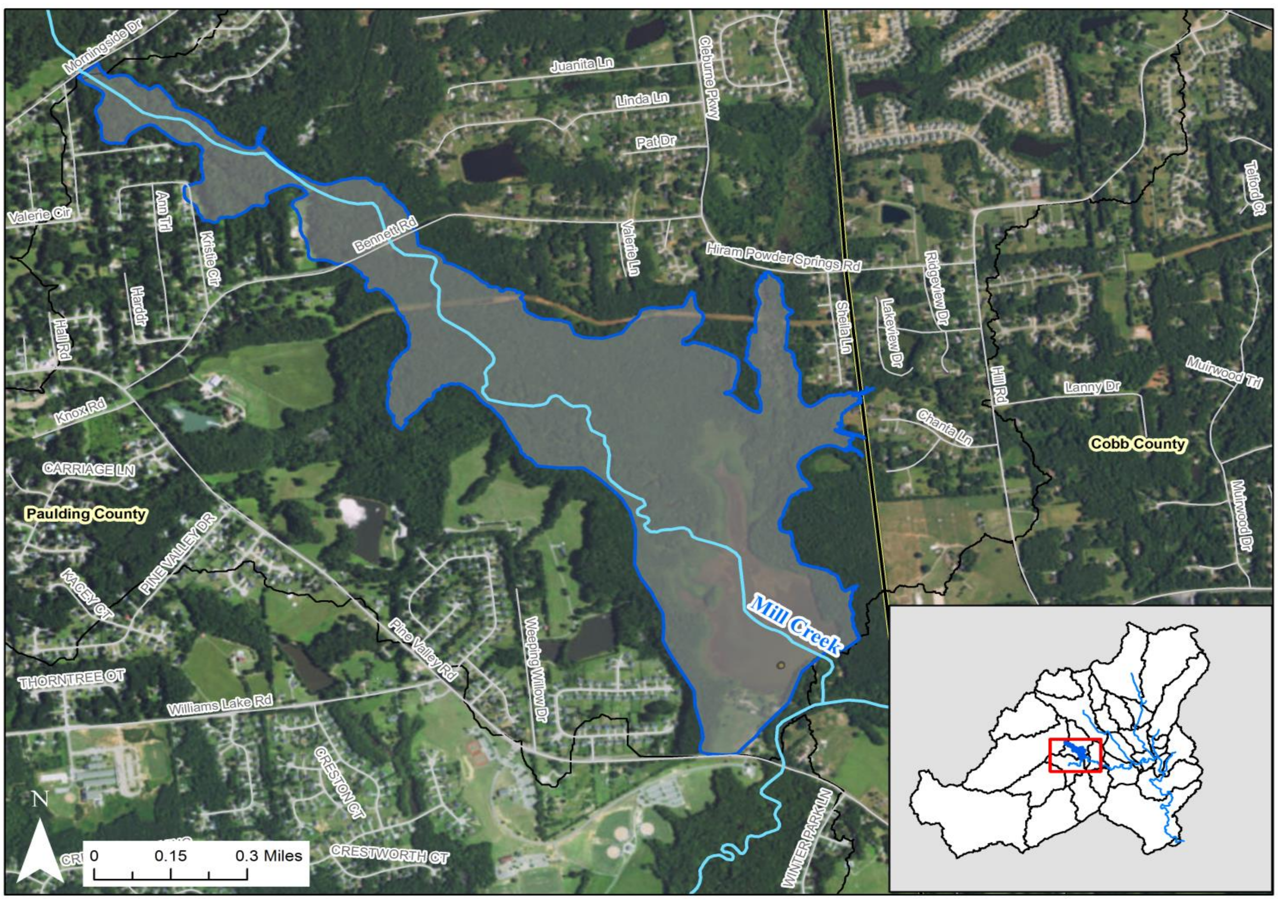


Figure 17: Approximate Location of MC5

Measure MC5 Configuration

The facility would consist of rebuilding approximately 1,000 feet of the existing dam and raising the crest elevation from approximately 911 to 917 feet. The dam section would be earthen with a concrete spillway section and possible RCC overtopping protection. The outlet works of the dam would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream on the dam. The slot was sized to allow smaller storm events to freely pass through the structure, allowing maximum storage for the larger events, and adjusted as needed for maximum potential attenuation. The slot would begin with an approximately 18 feet wide low-stage section extending to the top of the dam with the invert of the slot raised approximately 2 feet above the channel invert. This will reduce the current pool elevation while retaining a minimal amount of water to create wetlands through the former reservoir pool. Additional cross vanes could be constructed through the lake to further support the creation of wetlands without compromising flood storage. The facility is estimated to provide 2,100 acre-feet of storage during the peak elevation of the 1% annual chance flood elevation of 914 feet and 3,500 acre-feet of storage at the top of dam elevation of 917 feet.

Figure 18: Aerial Photography of MC5 (Existing Pine Valley Lake) taken on 9/7/2017

Measure PC2

Measure PC2 is a conceptual online dry detention facility on Powder Springs Creek, located just upstream of CH James Parkway in Cobb County, creating up to 2,700 acre-feet of flood storage. The objective of the measure is to temporarily detain floodwaters from the approximately 18 square miles that drain to the facility location. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges. This concept would reduce flood risk along sections of Powder Springs Creek and Sweetwater Creek.

Figure 19 below illustrates the approximate location and alignment of measure PC2.

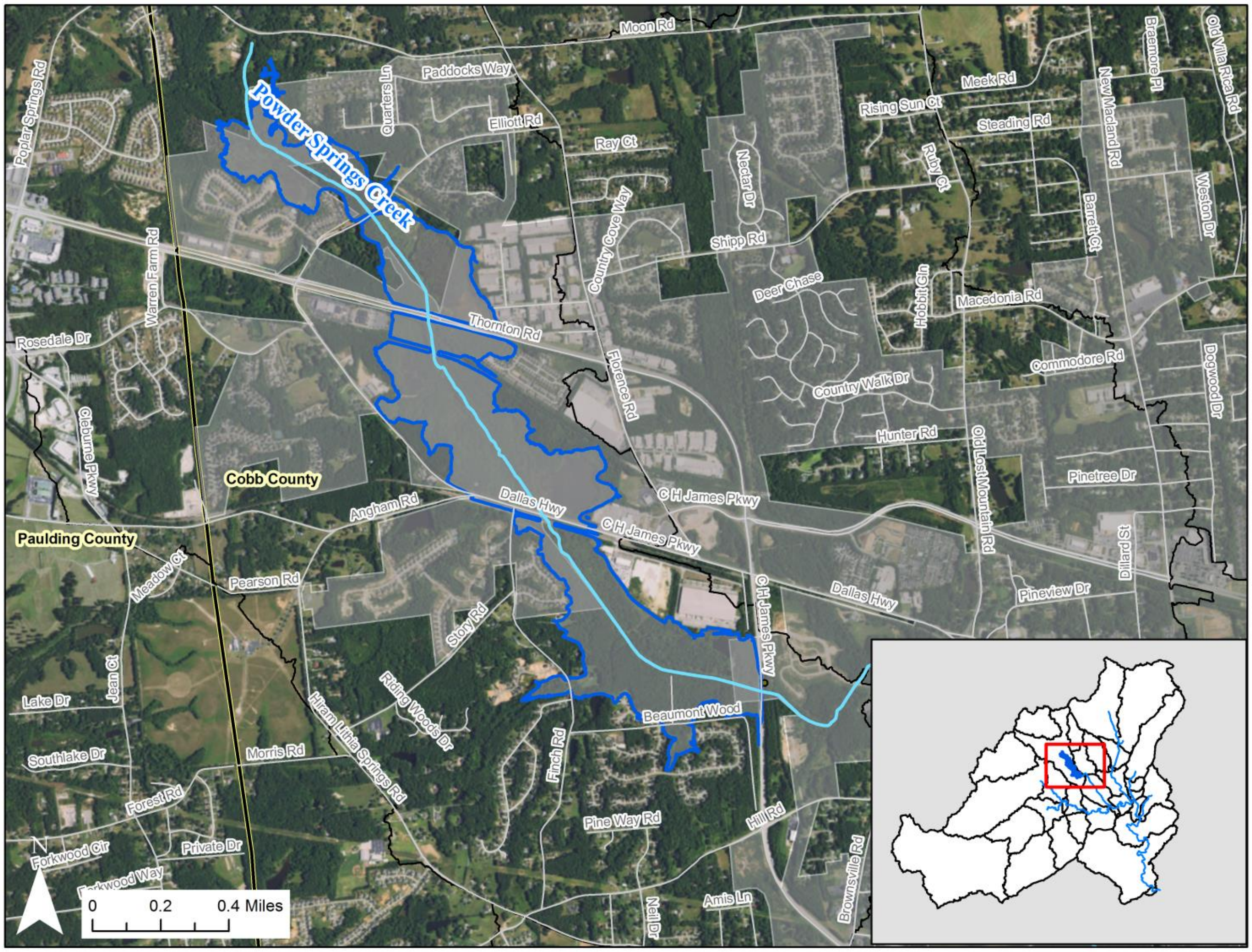


Figure 19: Approximate Location of PC2

Measure PC2 Configuration

The facility would consist of a 1,400 feet long, 25 feet high earthen or concrete dam (roller compacted or traditional concrete) built approximately perpendicular to Powder Springs Creek and its adjoining floodplain. The outlet works of the dam would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream of the dam. The slot was sized to allow smaller storm events to freely pass through the structure, allowing maximum storage for the larger events, and adjusted as needed for maximum potential attenuation. The slot would begin with an approximately 8-feet wide low-stage section extending to the top of the dam elevation with the invert of the slot sunken approximately 2 feet or more below the channel invert. The sinking of the slot below the channel invert will allow for sediment backfill, creating a more natural channel bottom through the dam supporting the unrestricted passage of various aquatic species including fish. The high-stage slot would be approximately 30 feet wide beginning at an elevation of 920 feet, extending upwards to the top of dam elevation of 925 feet and would only be expected to engage when the 1% annual chance flood discharges are exceeded and is not intended to provide significant flood attenuation. The facility is estimated to provide 2,700 acre-feet of storage during the peak elevation of the 1% annual chance flood elevation of 922 feet and 3,800 acre-feet of storage at the top of dam elevation of 925 feet.

Measure OC2

Measure OC1 is a conceptual online dry detention facility on Olley Creek, located approximately 500 feet upstream of Flint Hill Road in Cobb County, creating up to 2,050 acre-feet of flood storage. The objective of the measure is to temporarily detain floodwaters from the approximately 12 square miles that drain to the facility location. By temporarily detaining floodwaters, the facility will reduce the peak downstream discharges. This concept would reduce flood risk along sections of Olley Creek and Sweetwater Creek.

Figure 20 below illustrates the approximate location and alignment of measure OC1.

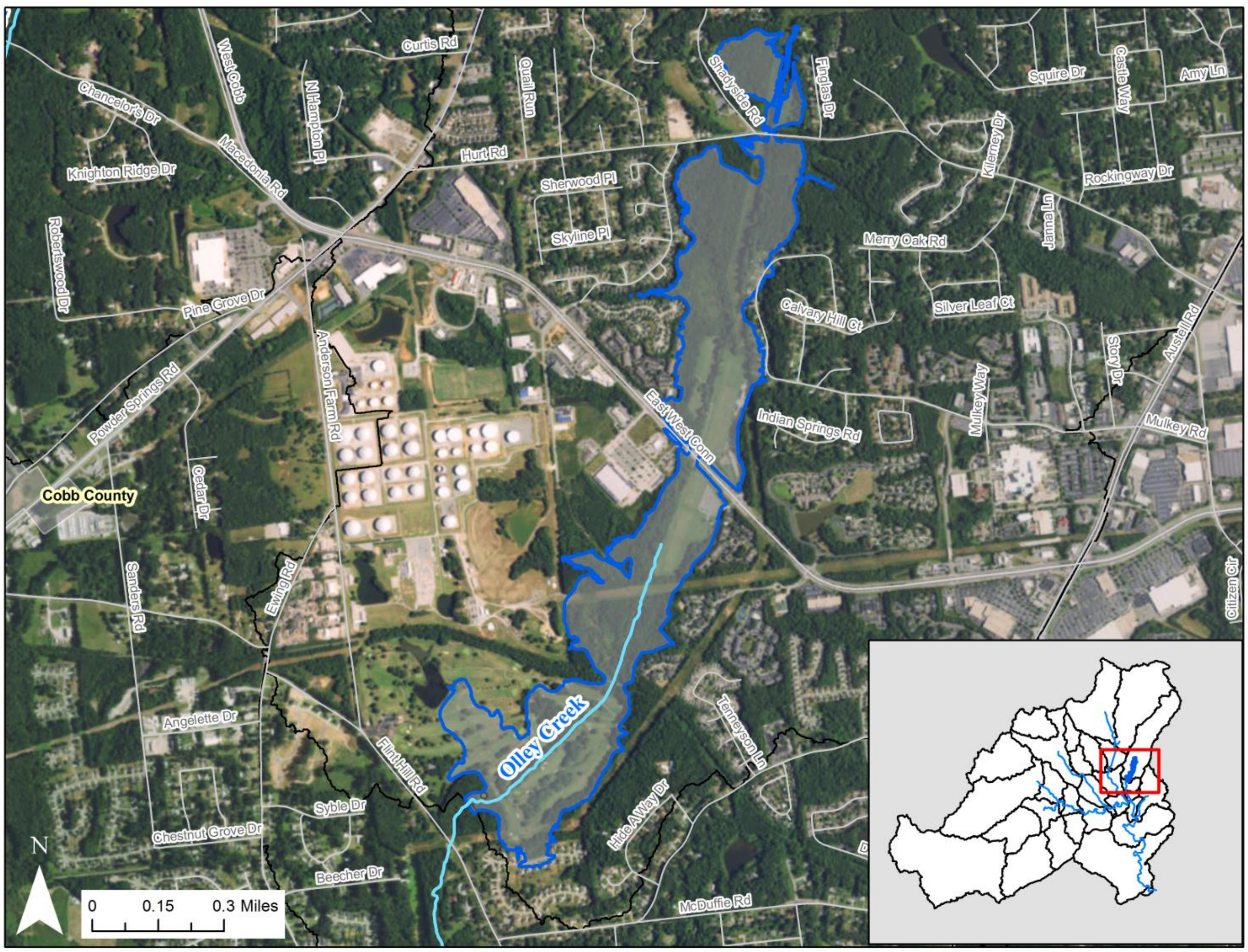


Figure 20: Approximate Location of OC1

Measure OC1 Configuration

The facility would consist of a 600 feet long, 29 feet high earthen or concrete dam (roller compacted or traditional concrete) built approximately perpendicular to Olley Creek and its adjoining floodplain. The outlet works of the dam would consist of a multi-stage concrete slot with vertical side walls discharging into a stilling basin downstream of the dam. The slot was sized to allow smaller storm events to freely pass through the structure, allowing maximum storage for the larger events, and adjusted as needed for maximum potential attenuation. The slot would begin with an approximately 8 feet wide low-stage section extending to the top of the dam elevation of 917 with the invert of the slot sunken approximately 2 feet or more below the channel invert. The sinking of the slot below the channel invert will allow for sediment backfill, creating a more natural channel bottom through the dam supporting the unrestricted passage of various aquatic species including fish. The facility is estimated to provide 2,050 acre-feet of storage during the peak elevation of the 1% annual chance flood elevation of 914 feet and 2,800 acre-feet of storage at the top of dam elevation of 917 feet.

3.4.3. Channel Modification

3.4.3.1. Modeling

Measure SC9 was modeled dynamically using HEC-RAS version 5.0.3. The concept channel was designed using the HEC-RAS Hydraulic Design – Stable Channel method.

3.4.3.2. Future Detail Design Considerations for Detention Structures

The concept of SC9 developed during the feasibility study was developed in line with the principles of SMART planning, which generally defer all detail design from the feasibility phase of a study to the preconstruction phase. Key considerations, recommendations, and requirements for detailed hydraulic and civil design include:

1. Detailed optimization of channel design throughout the channelization reach to ensure that floodplain management objectives, environmental considerations, and operation and maintenance considerations are met through:
    - Performance of a detailed stable channel design in coordination with environmental engineers that considers the geology of the channel, water quality, and habitat enhancements.
    - Consideration of sediment transport to minimize operations and maintenance needs.
2. Optimization of channelization extent by performing a sensitivity analysis
    - Varying the upstream and downstream extent of channelization to determine whether the reach can be shorted without compromising benefits.

3.4.3.3. Description

Measure SC9 is a conceptual 14-mile long channelization of Sweetwater Creek beginning from a point approximately three miles downstream of Interstate 20 and extending upstream to a point approximately 800 feet downstream of Hiram Lithia Springs Road. The objective of the measure is to increase channel conveyance through the creation of a more optimal channel design that will reduce flood elevations and concurrently provide a more stable channel. This concept would reduce flood risk along a section of Sweetwater Creek and along the tributaries of Power Springs Creek, Noses Creek, and Olley Creek to name a few which experience large depths of backwater flooding as a result of Sweetwater Creek.

Figure 21 below illustrates the approximate extent of the channelization.

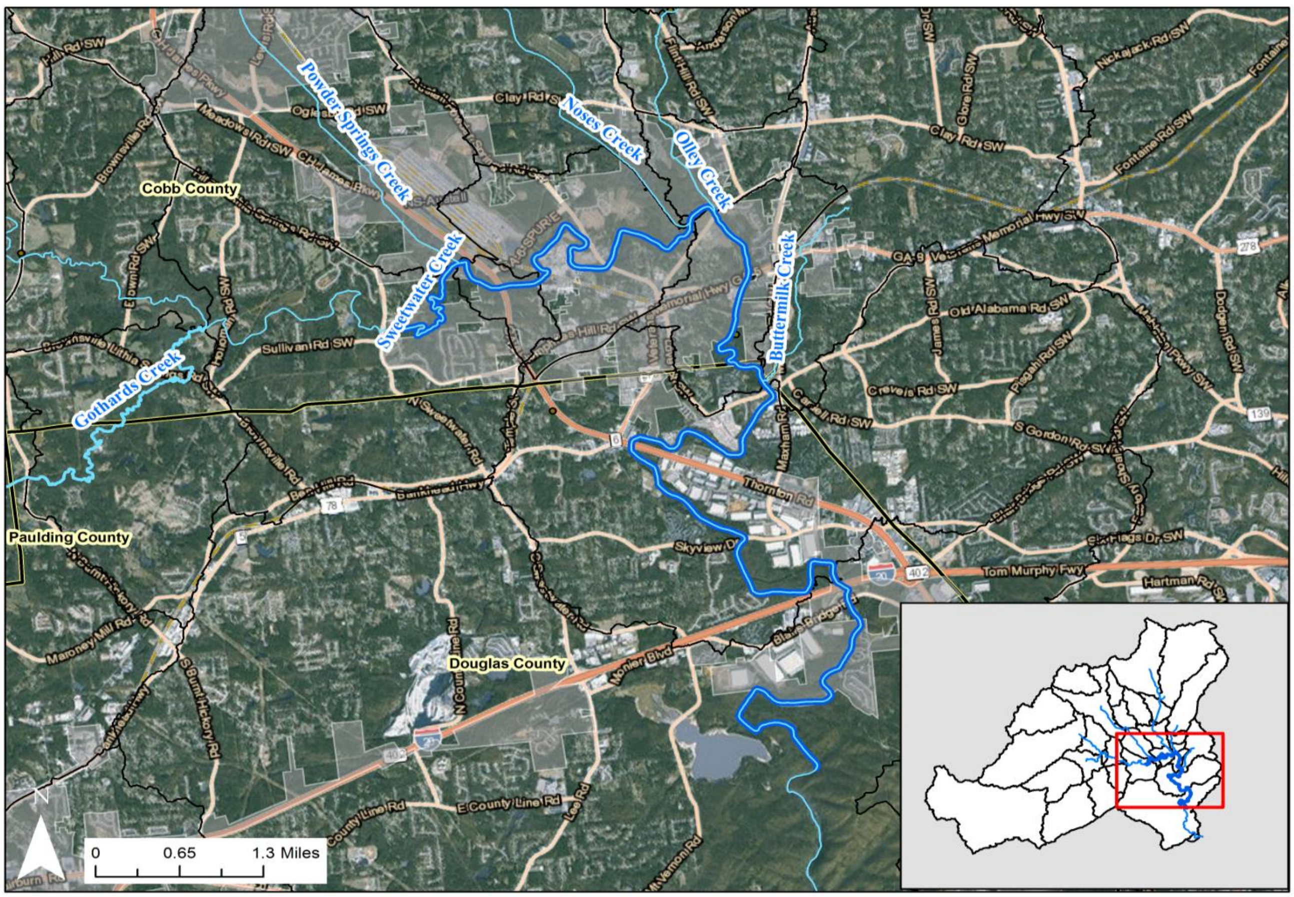


Figure 21: Approximate Channel Modification Extents

Measure SC9 Configuration

The channelization would consist of approximately 14.2 miles of improved channel with an average excavation depth of 2.2 feet and an estimated excavation volume of 2.5 million cubic yards. The improved channel is assumed trapezoidal with an 80 feet bottom width and with side slopes extending at a 2:1 angle until tied into the natural grade. Figure 22 depicts the profile view of the channelization alternative, and Figures 23 and 24 illustrate the revised channel (black) alongside the original channel geometry (pink).

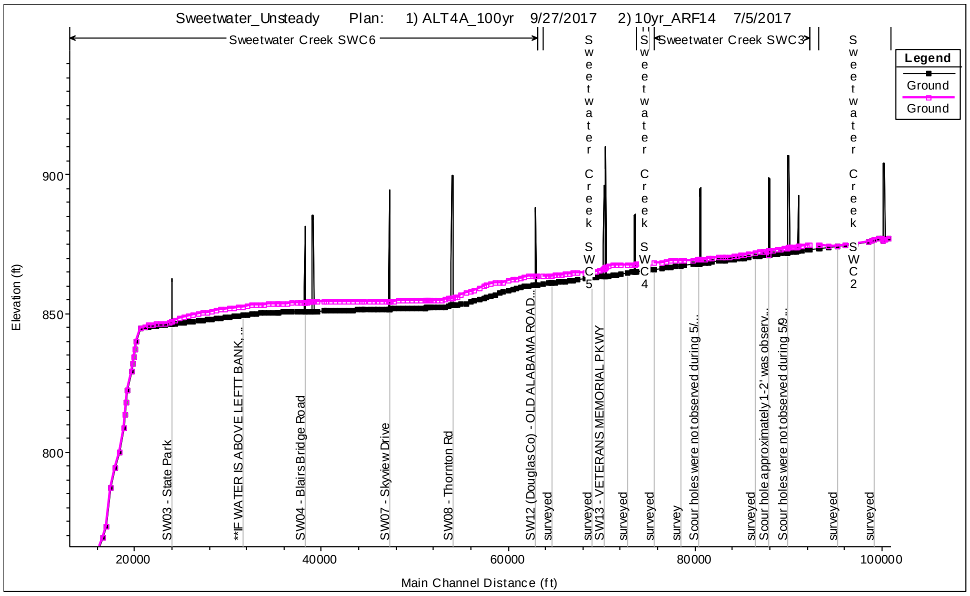


Figure 22: Profile view of Channelization Alternative

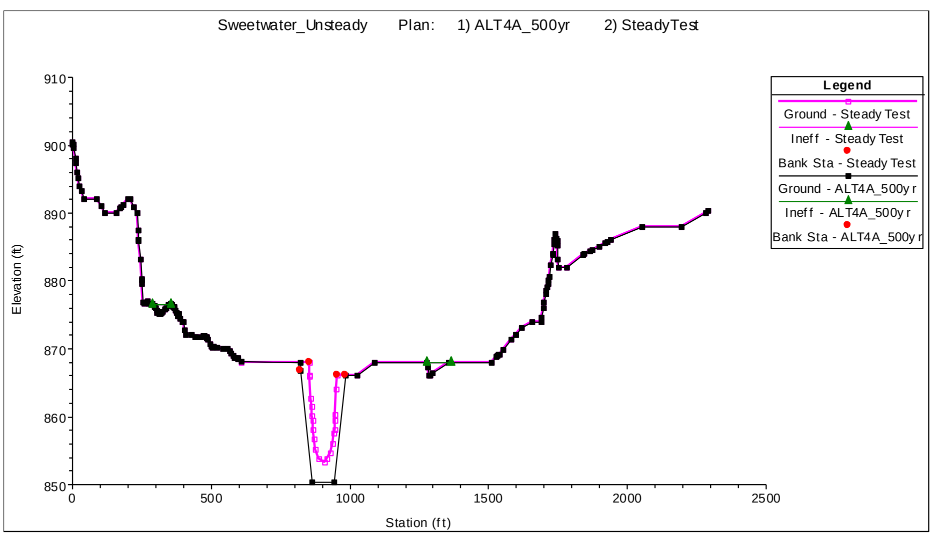


Figure 23: Sample Channel Modification Cross Section

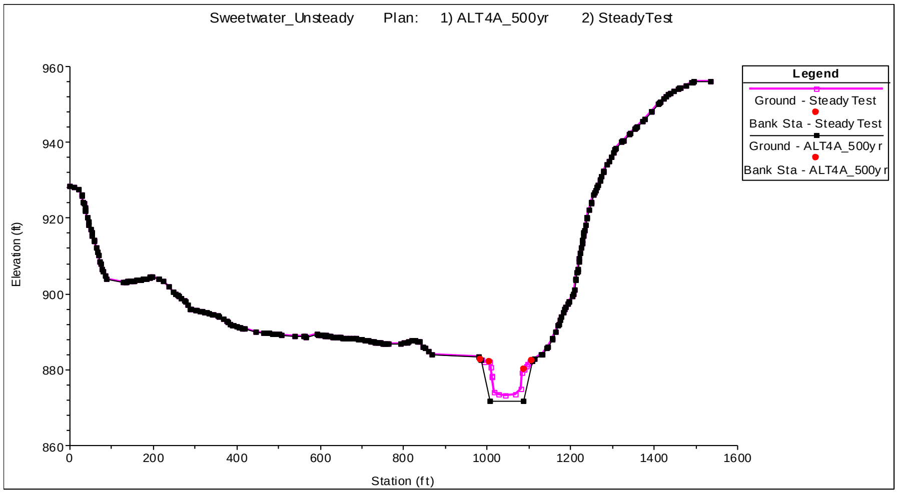


Figure 24: Sample Channel Modification Cross Section

3.5. Initial Array of Alternatives

Using the measures discussed above, an array of alternatives was created. These include standalone structures as well as combinations of structures to maximize flood attenuation in the basin. The list of initial alternatives is shown in Table 3 below. This table includes both the structural alternatives discussed in this appendix and the non-structural buyout alternatives.

Table 3. Initial Array of Alternatives

Alternative	SC1s	SC1	SC2	SC6LF	SC6	MC2	MC5	PC2	OC1	Channel Mod (SC9)	Buyouts (10-Year)	Buyouts (25-Year)	Buyouts (50-Year)	Buyouts (100-Year)
Future Without Project														
Alternative 1											✓			
Alternative 1.1												✓		
Alternative 1.2													✓	
Alternative 1.3														✓
Alternative 2					✓									
Alternative 4										✓				
Alternative 5A						✓		✓	✓					
Alternative 5B						✓	✓	✓	✓					
Alternative 5C				✓		✓	✓	✓	✓					
Alternative 5D		✓	✓	✓		✓		✓	✓					
Alternative 5E		✓	✓					✓						
Alternative 5F		✓	✓		✓									
Alternative 5G		✓	✓	✓		✓								
Alternative 5H		✓		✓										
Alternative 5I		✓												
Alternative 5J	✓													

Once the initial alternatives where developed, a first level screening was done using a rough hydraulic model to assess reductions in water surface elevation at important points along Sweetwater Creek and its tributaries. Points were chosen near the cities of Austell and Powder Springs, Georgia and the water surface elevations of each alternative was compared. Additionally, any alternative with the MC5 measure was removed. It was discovered early on that the MC5 measure, a rehab of an existing dam, was not feasible due to constraints on its ability to provide any measurable floodwave attenuation. In all, 6 structural alternatives where carried forward for detailed analysis.

3.6. Final Array of Alternatives

Using the measures discussed above, an array of alternatives was created from a single measure or, combination of a number of measures. The alternatives carried forward are listed in Table 4 below.

Table 4: Array of Alternatives Based on Measures

Alternative	SC1s	SC1	SC2	SC6LF	SC6	MC2	PC1	OC1	Channel Mod (SC9)	Buyouts (10-Year)
Future Without Project (No Action)										
Alternative 1										✓
Alternative 2					✓					
Alternative 4									✓	
Alternative 5D		✓	✓	✓		✓	✓	✓		
Alternative 5H		✓		✓						
Alternative 5J	✓									

3.7. Recommended Plan

Alternative 1 is the NED plan that reasonably maximizes net benefits. Of the two justified alternatives, it has the least uncertainty in benefits with the highest possible net benefits of all the plans. This feature consists of buying out structures whose first floor elevations are lower than the anticipated water surface elevation of the 10% ACE floodplain. This is a total of 20 structures throughout Cobb County, the City of Austell, and the City of Powder Springs. Details of the recommended plan are available in the Main Report.

3.7.1 Refinement of Recommended Plan

The recommend plan was refined further in two ways. The first concentrated on confirming the structures that would be relocated. This analysis showed that because of the local topography 9 of the original 20 structures were located outside the 1% ACE floodplain. During that analysis 2 structures found could not have benefits accrue according to the 1990 WRDA and were removed because they were constructed or received a major renovation after July 1991. This left a total of 9 structures in the refined plan.

While confirming the relocations the USACE noted that the location of three of the relocations on Hopkins Road, were adjacent to each other and provided enough space for a small community park. Furthermore, another park could be located on Clay Road at Ollie Creek, upstream of Ollie Creek's confluence with Sweetwater Creek where a relocation of two adjacent parcels occurs. The type of recreation provided would include hiking, walking, picnicking, canoeing, and kayaking. A rough estimation of the parks provided are shown in Figure 25.

Figure 25. Concept drawing of the park on Hopkins Road (left) and on Clay Road (Right)

3.8. Climate Change

3.8.1. Introduction

In 2016, USACE issued Engineering and Construction Bulletin No. 2016-25 (hereafter, ECB 2016-25), which stipulated that climate change be considered for all Federally funded projects in planning stages. A qualitative analysis of historical climate trends, as well as assessment of future projections was provisioned by ECB 2016-25. Even if climate change does not appear to be an impact for a particular region of interest, the formal analysis outlined in ECB 2016-25 results in better informed planning and engineering decisions.

In accordance with ECB 2016-25, a stationarity analysis was performed to determine if there are long-term changes in rainfall and streamflow statistics within the Sweetwater basin and its vicinity. Assessing rainfall stationarity allows for an identification of long-term climate variability and/or climate change. Meanwhile, assessing streamflow stationarity includes other components, most notably land cover changes and associated differences in impervious area as well as changes in water control structures.

3.8.2. Literature Review

A January 2015 report conducted by the USACE Institute for Water Resources summarizes the available literature for the South Atlantic-Gulf Region, which includes the Sweetwater Creek basin. The report focuses on both observed climatic trends, as well as projected future findings. While the observed trends may prove to be of some importance, it is the projected findings which are of the most significance.

The report finds a strong consensus supporting trends of increasing air temperatures. Projected increases of mean annual air temperature range from 2 to 4ºC by the latter half of the 21st century for the South Atlantic-Gulf Region. The region is expected to experience the largest increases in the summer months. There is also a consensus that there will be an increase in extreme temperature events such as more frequent, longer, hotter summer heat waves.

Projections regarding precipitation and hydrologic streamflow trends lack a clear consensus, with some models showing increases and others showing decreases. However, there is moderate consensus that future storm events may be more intense and more frequent than in the past.

3.8.3. Stationarity Assessment

Rainfall

The Global Historical Climatology Network (GHCN; Menne et al. 2012) of rain gages was used to determine long-term trends in the region. Although there are many network rain gages in the area, the following strict guidelines were established to retain long-term gages with sufficient data coverage:

- within 150 miles of the Sweetwater basin,
- less than 10 missing days in any given year,

- at least 60 qualifying years of data,
- the last qualifying year must be 2007 or later.

After imposing the guidelines above, 38 qualifying gages were found. Three stationarity tests were performed on each gage's daily rainfall data: (1) trend in Annual Maximum Series (maximum annual 24 hour rainfall event), (2) changes in the 99th percentile [roughly 2.8 – 3.1 inches per day] of daily annual rainfall between 1955-1984 and 1985-2016, and (3) trend in the number of days exceeding 1.5 inches of precipitation per year, termed the Peaks Over Threshold. The value of 1.5 inches was chosen as a reasonable threshold for the region in which a significant rainfall-runoff response would occur. For all tests, the null hypothesis was no change in the variable's value, implying that stationarity can be accepted over the historical period. For tests (1) and (3), a trend was classified as significant if it exceeded the 95% confidence level, a common but fairly arbitrary threshold for these tests. Sensitivity of the 95% confidence level was performed on the results by considering lower confidence levels, showing that changing this confidence threshold within reason has no effect on results. This showed that A rejection of the null hypothesis suggests that the stationarity assumption may be violated. In turn, a rejection of the null hypothesis also suggests that a more in-depth analysis may be warranted to attribute the reasons why the null hypothesis was rejected.

Results are shown in Figure 26. Overall, it was determined that stationarity is a reasonable assumption for the area. There were no significant spatially prevalent trends in the Annual Maximum Series. Slightly more stations showed weak decreases, compared to increases in the 99th percentile of daily rainfall, though the magnitude of the changes was not statistically significant. Finally, only 3 out of 38 stations showed significant upward trends in Peaks Over Threshold, which is not significant enough to disprove the null hypothesis of stationarity in the basin. It is important to note, however, that these trends may not hold in the future, and it is recommended that these analyses be re-assessed every few years as more data is collected and/or more gages can serve as a "qualifying" gage.

Streamflow

The USACE Non-Stationarity Tool tests were used to assess possible trends and change points in peak streamflow at the long-record USGS gage on Sweetwater Creek near Austell, Georgia. Figure 27 shows the time series of Annual Peak Streamflow (APF).

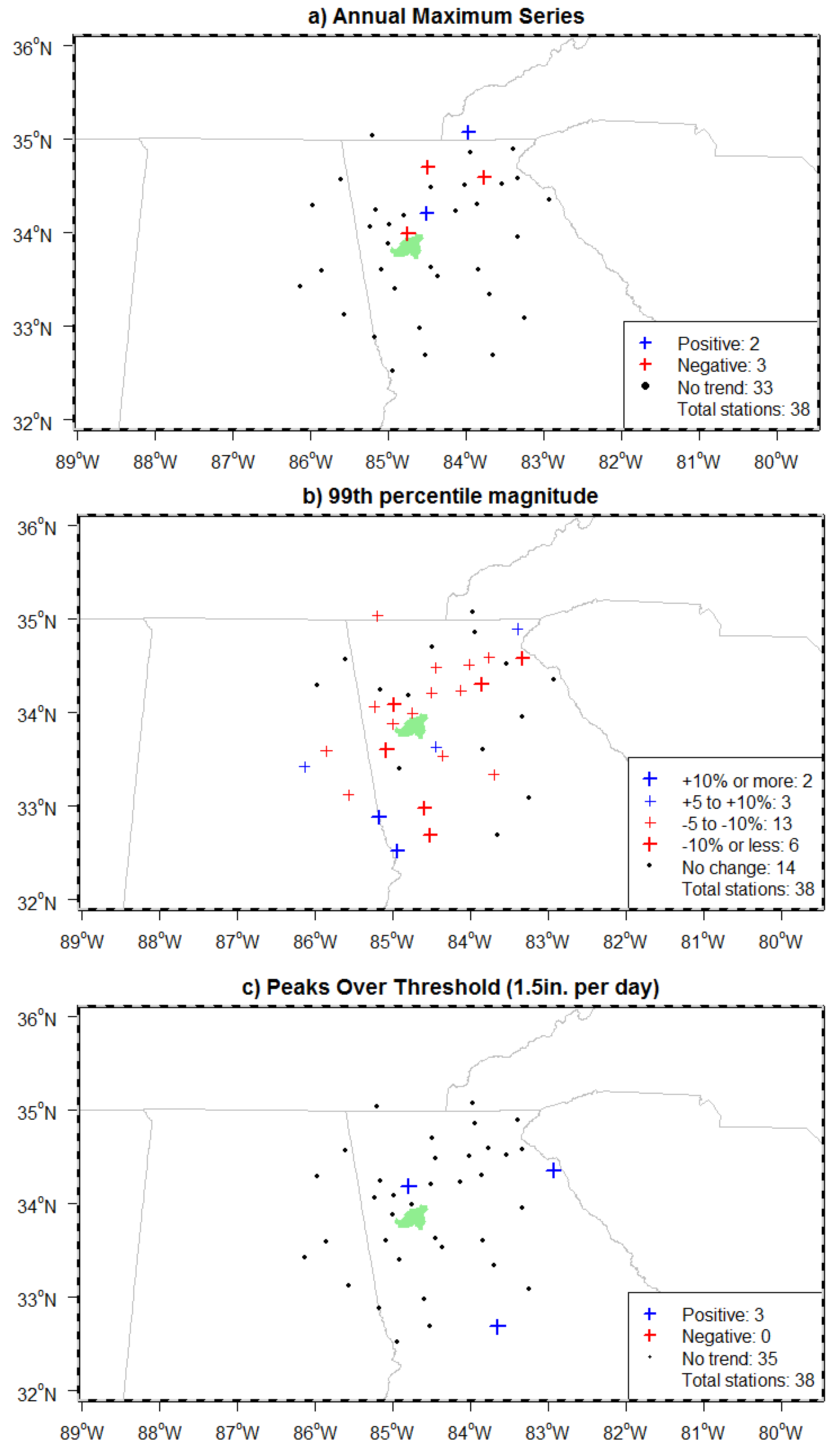


Figure 26: Stationarity test results on qualifying gages: (a) trend in Annual Maximum Series, (b) change in the 99th percentile of daily rainfall, and (c) trend in Peaks Over Threshold [1.5 inches per day]. The Sweetwater basin is shown in green.

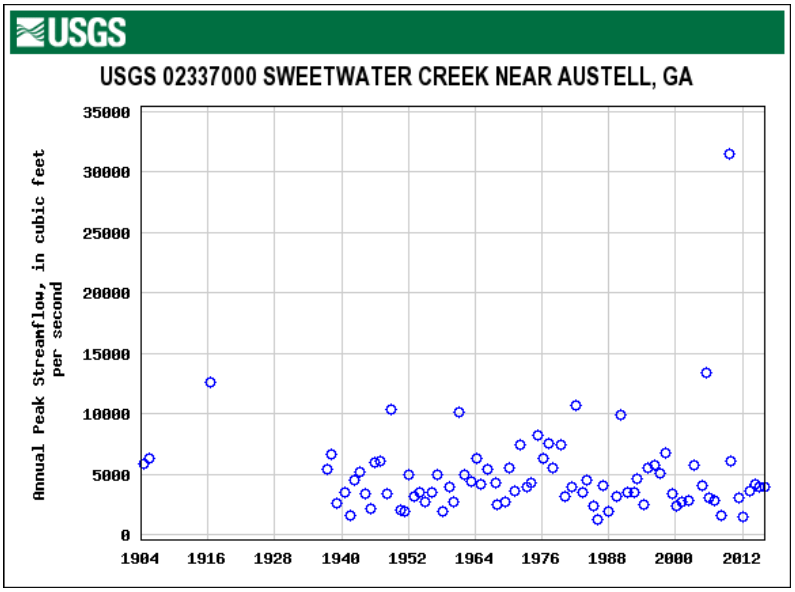


Figure 27: Water Year Peak Streamflow at the Sweetwater Creek USGS gage near Austell, Georgia.

The following 16 tests were conducted on the APF time series shown in Figure 27. Tests 1-12 are used to detect change points in the distribution, mean, and variance of the time series. These can be useful in detecting addition/removal of water control structures, as well as changes in land cover. Meanwhile, tests 13-16 are used to analyze long-term trends. As with the rainfall analysis, the null hypothesis was stationarity over the period of record. The variety of tests is essential for increasing confidence in the overall stationarity analysis. Significant findings in one or two tests are generally not enough to declare non-stationarity.

1. Cramer-von-Mises distribution
2. Kolmogorov-Smirnov distribution
3. LePage distribution
4. Energy Divisive distribution
5. Lombard (Wilcoxon) abrupt mean
6. Pettitt mean
7. Mann-Whitney mean
8. Bayesian mean
9. Lombard (Mood) abrupt variance
10. Mood variance
11. Lombard (Wilcoxon) smooth mean
12. Lombard (Mood) smooth variance
13. Mann-Kendall trend
14. Spearman rank trend
15. Parametric trend
16. Sen's slope trend

Of the 16 tests, none produced a result that rejected the null hypothesis and suggested non-stationarity. Figures 28 and 29 show the results of the Non-Stationarity Detection Tool.

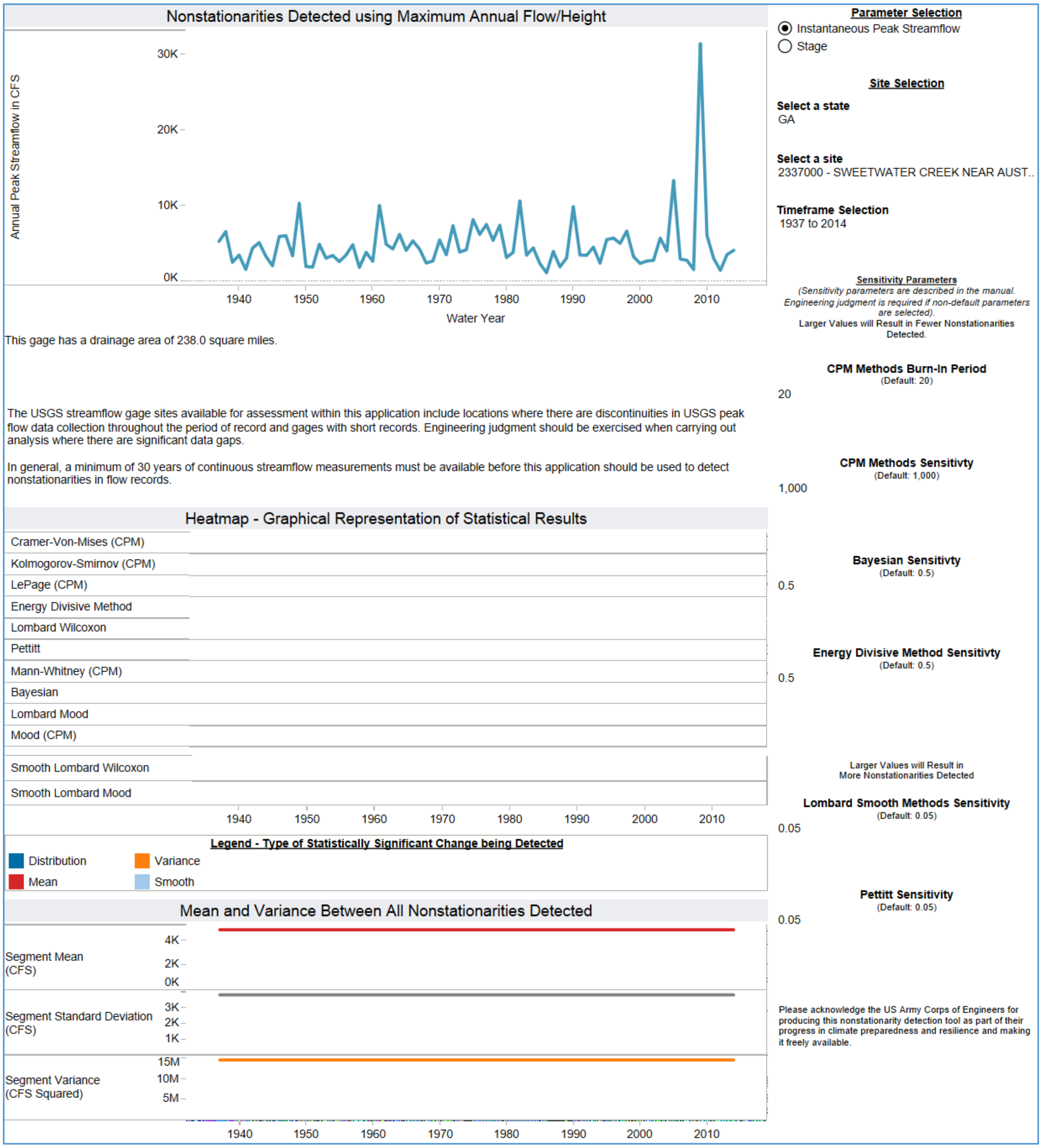
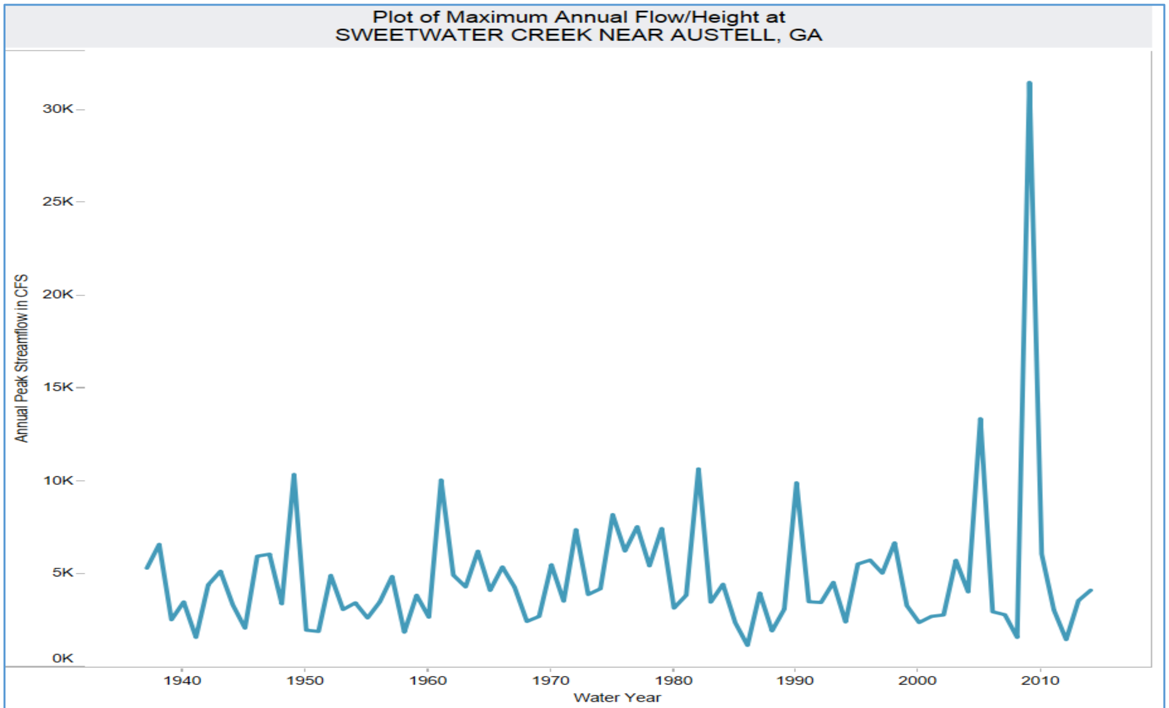


Figure 28. Results of the Non-Stationarity Tool for the Seewater Creek near Austel Gage.



Monotonic Trend Analysis

Is there a statistically significant trend?
No, using the Mann-Kendall Test at the .05 level of significance. The exact p-value for this test was 0.945.
No, using the Spearman Rank Order Test at the .05 level of significance. The exact p-value for this test was 0.970.

What type of trend was detected?
Using parametric statistical methods, **no trend** was detected.
Using robust parametric statistical methods (Sen's Slope), **no trend** was detected.

Figure 29. Additional results of the Non-Stationary tool for the Sweetwater Creek near Austel gage.

3.8.4. Climate Hydrology Assessment Tool

In addition to the stationarity assessment, the USACE Climate Hydrology Assessment Tool (PROD v1.2) was also used to assist in the determination of future streamflow conditions. This analysis indicated no statistical significance for annual peak instantaneous streamflow in the basin as indicated by a high p-value. Figure 30 shows the Climate Hydrology Assessment Tool output. A HUC-4 level analysis for mean projected annual maximum monthly streamflow indicated upward trends for the Apalachicola Basin projections, as shown in Figure 31. This finding suggests there may be potential for increased flood risk in the future.

This analysis shows an increase in mean projected annual maximum monthly streamflow of about 5,000 cfs over a 100 year period. This increase in streamflow could have a noticeable effect on the level of protection provided by the structural alternatives discussed in this appendix, causing them to provide somewhat less flood protection. However, it would not have a significant increase in the risk of failure as these structures are armored for overtopping in extreme events. Additionally, as this increase in streamflow would cause higher stages more frequently, structures and facilities in the vicinity of the river will find themselves more vulnerable to flooding. For instance, the TSP for this study addresses buyouts of the 10 year floodplain. An increase in future streamflow may find that, through a restudy of frequency events in the future, additional structures are now located within the 10 year floodplain. However, this tool is not intended to be used in a quantitative assessment and therefore only provides an indication of possible changes in future streamflow. Furthermore, given the absence of significant trends in rain and streamflow from the Stationarity assessment as well as and the annual peak instantaneous streamflow from the Climate Hydrology tool, it is acceptable to assume the potential impacts of climate change fall within the uncertainty of the hydrologic method.

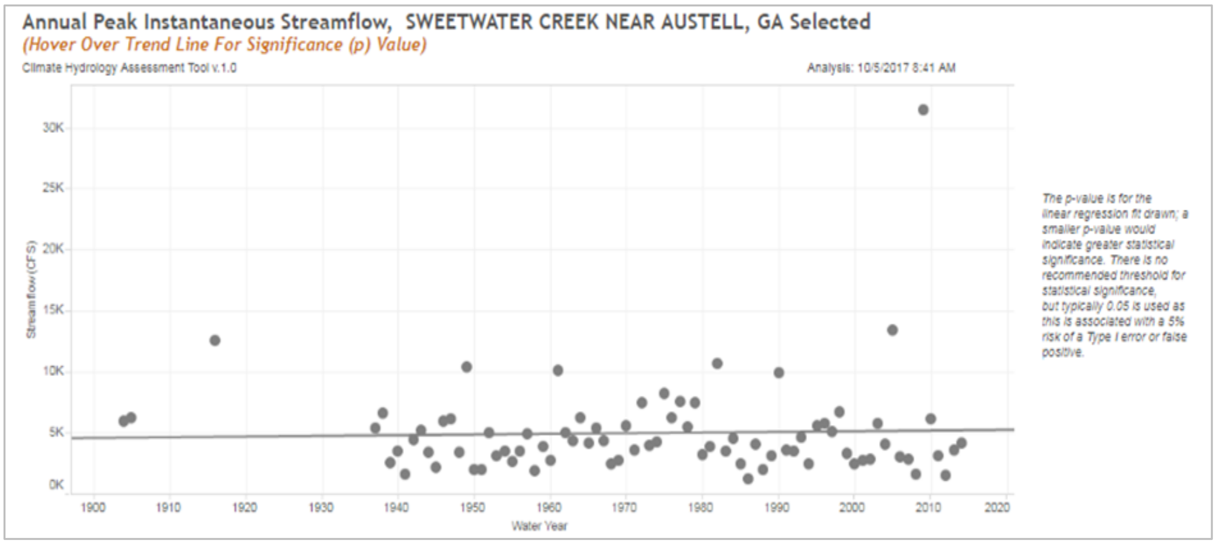


Figure 30: Annual Peak Instantaneous Streamflow for Sweetwater Creek Near Austell, GA

*Value = 5.51962*Water Year-5908.66 R-Squared: 0.0013405 P-Value: 0.745554*

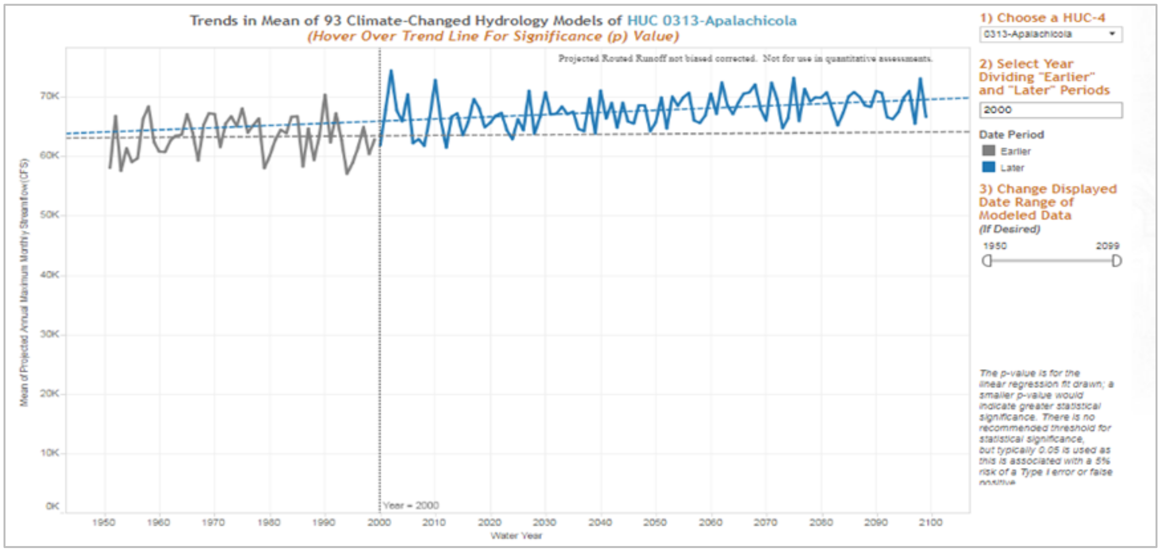


Figure 31: Mean Projected Annual Max Monthly Streamflow for HUC 0313- Apalachicola

*Monthly Flow = 36.6179*Year of Water Year-7345.69 R-Squared: 0.14232 P-Value: 0.0001085*

3.8.5 Vulnerability Assessment

To understand potential climate change effects and to increase resiliency and decrease vulnerability of flood risk management alternatives to climate change, the vulnerability of the basin to climate change factors must be analyzed. In accordance with ECB 2016-25, the USACE Watershed Climate Vulnerability Assessment tool was used to identify vulnerabilities to climate change on a watershed scale. As this an assessment or flood risk management alternatives, vulnerability with respect to the Flood Risk Reduction business line is presented in this analysis. Figure 32 shows a summary of the vulnerable HUC-4 watersheds for the wet and dry scenarios as well as the 2050 and 2085 epochs. The analysis parameters where left at the National Standard and a threshold of 20% was used for the Flood Risk Reduction business line. This means, only HUC-4s that have a vulnerability, or Weighted Ordered Weighted Average (WOWA), score in the top 20% nationally will be considered vulnerable. As depicted in figure X, the HUC-4 watershed for Sweetwater Creek does not have a vulnerability score within the top 20% of CONUS HUC-4s and therefore is not considered to have a significant vulnerability to this business line with respect to the rest of the nation.

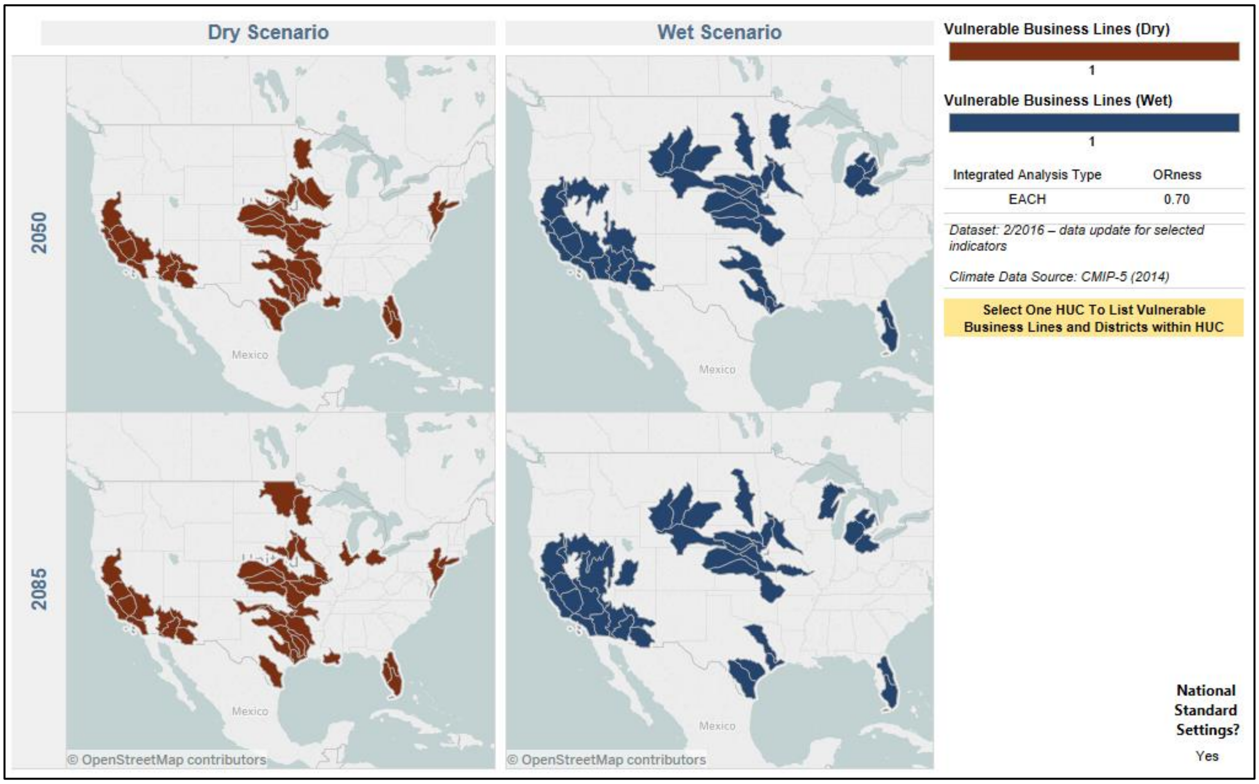


Figure 32. Summary of the vulnerable HUC-4 watersheds

Figure 33 shows are comparison of WOWA scores for HUC-4 watersheds nationally for the wet and dry scenarios as well as the 2050 and 2085 epochs. This shows that the WOWA scores in the southeast, including the Sweetwater Creek watershed, fall well below the 20% threshold and also well below the national average. This further reinforces that the Sweetwater Creek watershed does not have significant vulnerabilities to the Flood Risk Reduction business line with respect to other watersheds in the United States. Figure 34 shows a comparison on HUC-4 watersheds within the South Atlantic Divisions of USACE. Again, the HUC-4 containing the Sweetwater Creek watershed in not within the top 20 vulnerable watersheds regionally. It can be clearly stated that the Apalachicola HUC-4 watershed which contains the Sweetwater Creek watershed, is not vulnerable with respect to other watersheds both nationally and regionally.

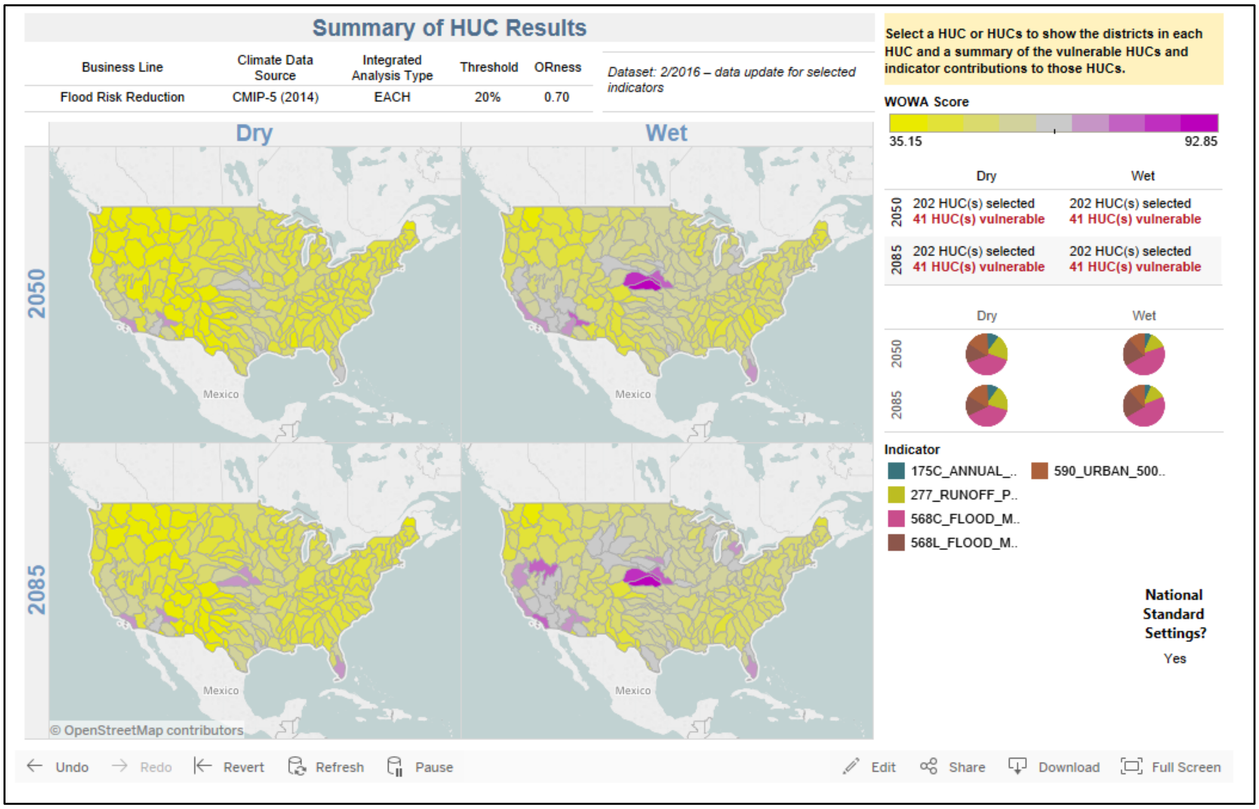


Figure 33. Comparison of WOWA scores for HUC-4 watersheds nationally

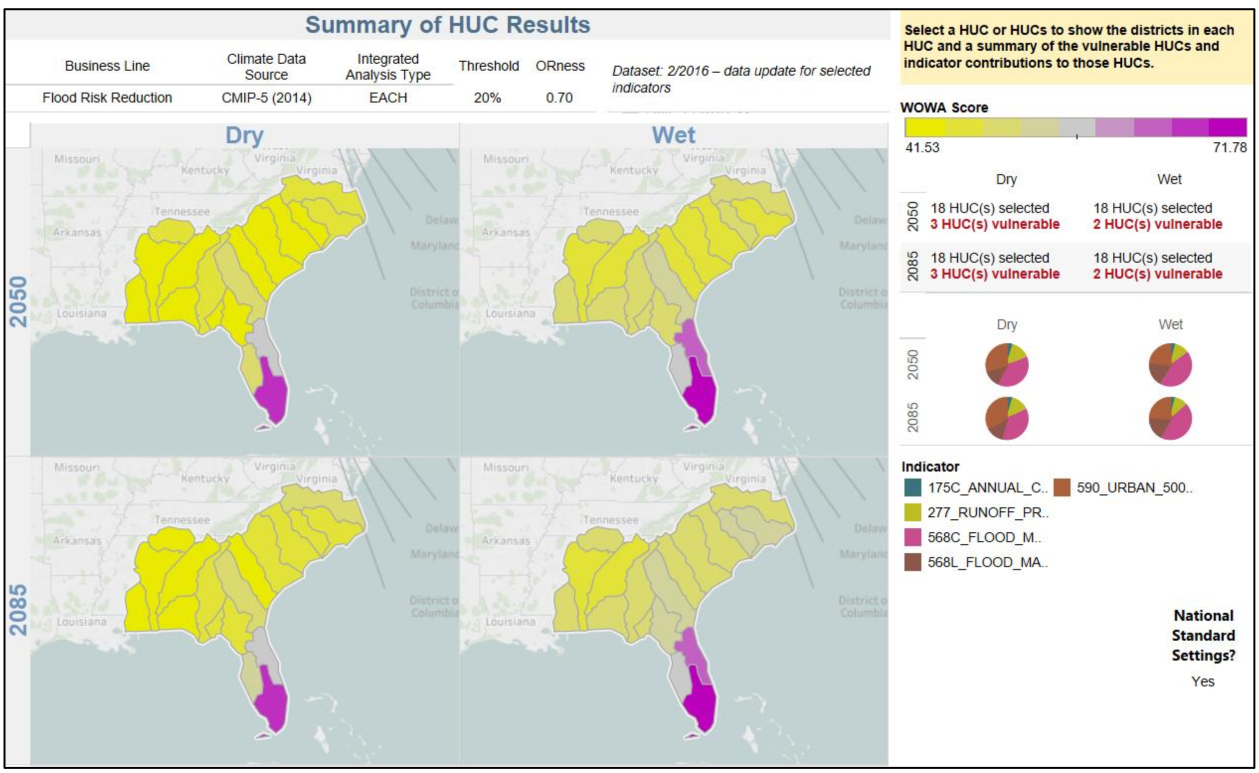


Figure 34. Comparison of WOWA scores for HUC-4 watersheds in the South Atlantic Division.

However, to the extent that vulnerabilities exist in the watershed, the main drivers and indicated by the VA tool are the 500 year urban floodplain and both local and cumulative flood magnification. This indicates that the risk associated with these factors are likely to increase overtime. Increase in these flood vulnerabilities in turn increase the risk to communities situated within or near flood prone areas. These results indicating increased flood risk further reinforce the results from the Climate Hydrology Assessment tool that indicate an increase in the mean projected annual maximum monthly streamflow for the watershed.

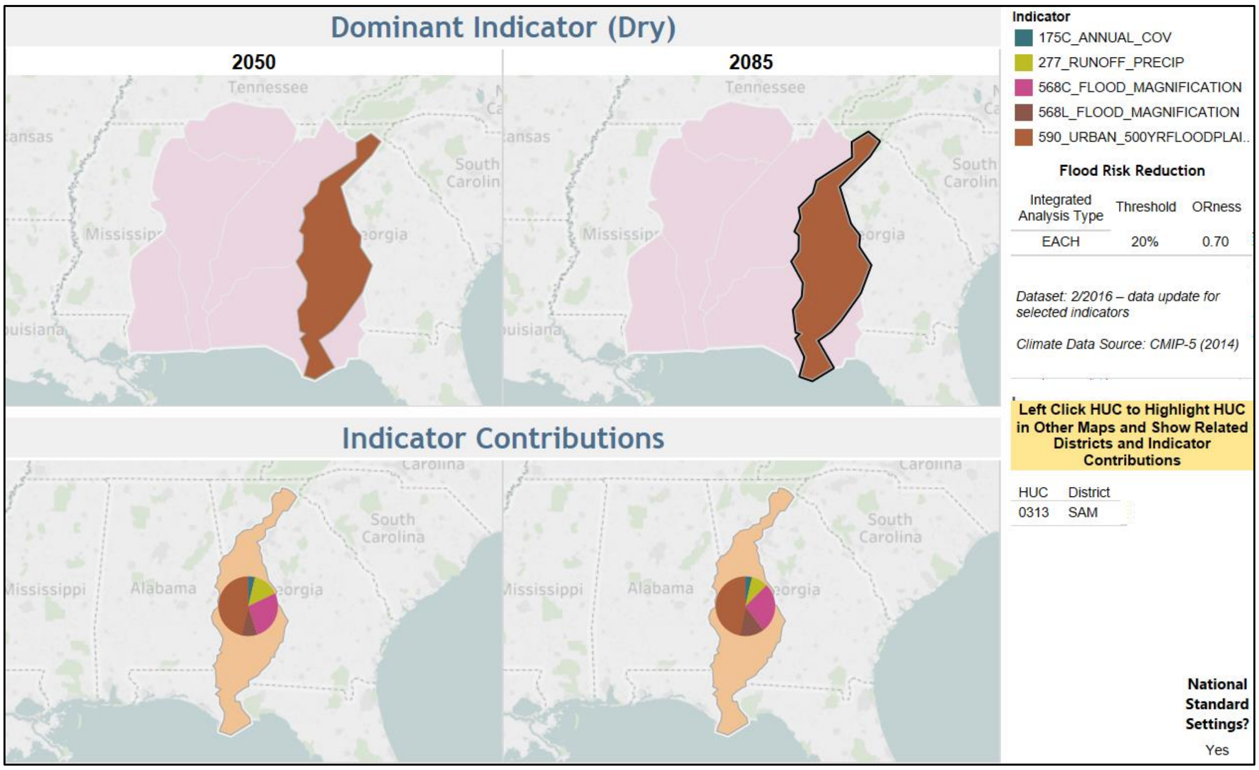


Figure 35. Dominant indicators of vulnerabilities in the Apalachicola HUC-4 (0313) watershed.

In conclusion, the results of the vulnerability assessment show that the watershed is not vulnerable with respect the other watersheds on a regional and national level, now or in future epochs. However, there are indications that the watershed may become more vulnerable to more frequent or intense flooding in the future, and in turn could increase the vulnerability with respect to other watersheds.

3.9. HTRW Analysis

Through an initial screening of parcels within the 500 year floodplain, two properties were identified with potential HTRW concerns. The first property appears to be an abandoned service station which sits adjacent to a former auto salvage business. The concern for such a property would primarily be improperly abandoned underground fuel storage tanks or improperly disposed of waste oil products, which could lead to soil and/or groundwater contamination.

The other property sits within the Olley Creek reach and appears to house a home auto repair/salvage business on the back/northern portion of the property. This property was not identified by the environmental database search, but was identified during the inspection of potential buyout properties. The concern for this property would primarily be improper disposal of waste oil products.

Each site was further inspected for the presence of HTRW substances during a Supplemental Phase I Environmental Site Assessment (Appendix E). The resulting inspections showed that a Phase II HTRW assessment is necessary.

The remaining seven residential structure would be inspected prior to demolition for signs of lead based paint, asbestos, toxic mold, or other harmful substances. Structures built prior to 1980 have a higher likelihood of containing lead based paint, asbestos, toxic mold, or other harmful substances. The removal of harmful substances would be accomplished through state licensed contractors and would abide by USEPA and OSHA requirements.

Considering the above mitigation measures, the recommended plan is likely to have no direct or indirect adverse effects on the immediate and general surrounding as a result of HTRW related substances.

4. Hydrologic and Hydraulic Modeling

4.1. Terrain and Geometric Data

4.1.1. Digital Terrain Development

A basin wide terrain was developed for the Sweetwater Creek Watershed based on best available digital terrain data sources including: Cobb County 2015 LiDAR data, Douglas County 2003 2-foot contours, and USGS National Elevation Dataset (NED) for Paulding and Carroll Counties. These three datasets were combined into a seamless terrain using USA Contiguous Albers Equal Area Conic USGS version and the North American Vertical Datum of 1988. Due to the unavailability of LiDAR data in Paulding County, USGS NED data was considered the best available data. However this topographic information is less accurate than the other sources, which may result in less accurate modeling along those reaches in Paulding County.

4.1.2. Field Reconnaissance and Survey Data

Figure 36: Field Reconnaissance collected at Bennett Road along Mill

Field reconnaissance was performed for structures located along study reaches that differed from the structures modeled in the effective studies, for any newly added structures, and for structures along new limited detail reaches. Basic dimensions were estimated and structures were updated within the hydraulic model.

Additionally, after the September 2009 flood, survey data was collected along Sweetwater Creek, which indicated large scour holes at bridges. Since the effective FEMA HEC-RAS model reflected these scour locations, field reconnaissance was performed to confirm their current existence after significant time had passed to allow for deposition of sediment and filling in of the scour holes. The effective models were updated to better reflect 2017 conditions seen during field reconnaissance.

4.2. Rainfall Data and Reconstruction

Three historic rainfall events which resulted in significant flood discharges along major sections of Sweetwater Creek were utilized to support the without-project conditions hydrologic and hydraulic model calibration. These events were selected to enable calibration to be performed for a variety of flow conditions incrementally from the smallest flood discharges to the highest flood discharges. In addition to these three observed rainfall events, smaller events which resulted in flood discharges being contained within the channel were utilized to calibrate in-channel n-values incrementally utilizing vertical variations in Manning's n value to optimize the timing and attenuation of in-channel flows. The observed hydrographs for these smaller events were input directly into the HEC-RAS model. Performing calibrations incrementally from the smallest in-channel discharges to the largest out-of-bank flooding events enabled the impacts of calibration actions to be separated for the in-channel and overbank characteristics.

Table 5 summarizes the events used for calibration and validation. While other rainfall events with significant flooding have been observed as documented by USGS gage annual maximum discharge records, more recent events were selected due to the availability of more detailed rainfall observations through a combination of ground based precipitation gages and the availability of NOAA Stage IV Radar. Additionally, the availability of full hydrographs at gages, documented highwater marks, and witness accounts were utilized to select events.

Since the September 2009 flood event was estimated to be greater than a 0.2% annual chance flood with a very large uncertainty in the 17C statistical analysis (Table 8), this event was utilized for validation and demonstration purposes only and was not used to calibrate runs.

Table 5: Summary of Calibration Events

Flood Event	Primary Purpose of Calibration Event	Peak Discharge in Austell (cfs) at Gage 02337000	Estimated Peak Flood Recurrence Interval (based on Table 8)
November 2014 storm event	Calibration of low-flow near bank-full channel routing using observed hydrograph	1,280	<50%
June 2013 storm event	Calibration of low-flow in-channel routing using observed hydrograph	1,690	<50%
February 2016 event	Calibration of low-flow near bank-full channel routing using observed hydrograph	1,960	<50%
November 2009 Flood (2010 water year)	Rainfall-runoff calibration of minor overbank flooding	6,120	20%
July 2005 Flood (2005 water year)	Rainfall-runoff calibration of major flooding	7,600*	10%
September 2009 Flood (2009 water year)	Rainfall-runoff validation of extreme flooding event	31,500*	>0.2%

*Value is estimated by USGS

4.2.1. Historical Events

Rainfall reconstructions were completed for the Annual Peak Streamflow events corresponding to the 2005, 2009, and 2010 water years. Table 6 shows the temporal extent of rainfall collection for each event.

Table 6: Historical storms used for the Sweetwater Basin study

Sweetwater Basin Storm Analysis
Event 1: July 2 (2000 EDT) - 12 (0800 EDT), 2005
Event 2: September 20 (0000 EDT) - 21 (1600 EDT), 2009
Event 3: November 9 (1900 EST) - 11 (1900 EST), 2009

The temporal extents of rainfall, of critical importance for subsequent H&H modeling, were subjectively determined using time series of rainfall and streamflow data within and in close proximity to the basin. For example, Figure 37 shows the streamflow time series from the September 2009 event. Note that despite multiple streamflow spikes over the September 15-21 period, the main event occurred from midnight of September 20th through the afternoon of September 21st. Figure 38 shows the core precipitation period used for analysis identified by the vertical black lines.

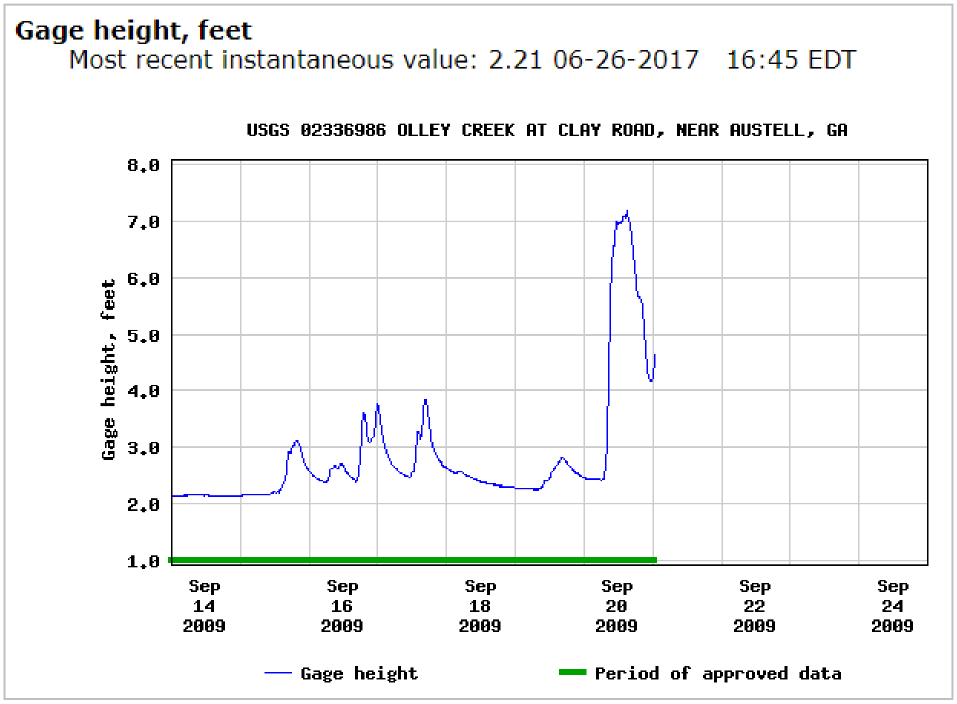


Figure 37: Stream gage height for the Olley Creek USGS station during the September 2009 event.

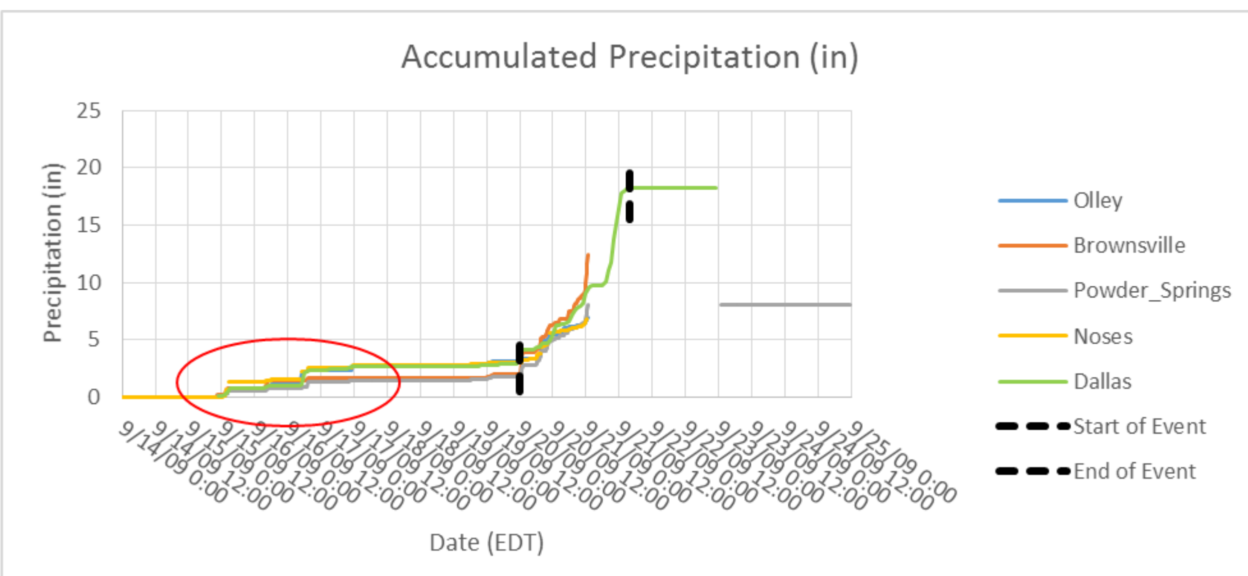


Figure 38: Accumulated precipitation at several rainfall gages within the basin (note that several gages stopped working on September 20th).

After each event's temporal period was determined, NOAA Stage IV gridded precipitation data was obtained from the UCAR data server (https://data.eol.ucar.edu/dataset/113.003). Stage IV is an hourly quality controlled rainfall product available on a 4 km (2.6 mile) grid across the United States. The hourly rainfall data was bi-linearly spatially interpolated to a 1 km grid. In addition, the hourly data was temporally linearly disaggregated to a 15-minute timestep (i.e. hourly precipitation was equally divided into four 15-minute bins). All processing was done using R statistical software (version 3.2.2).

The gridded rainfall reconstruction was quality controlled using rain gages from a variety of data streams. The primary sources are listed below, although not all sites have data for every event:

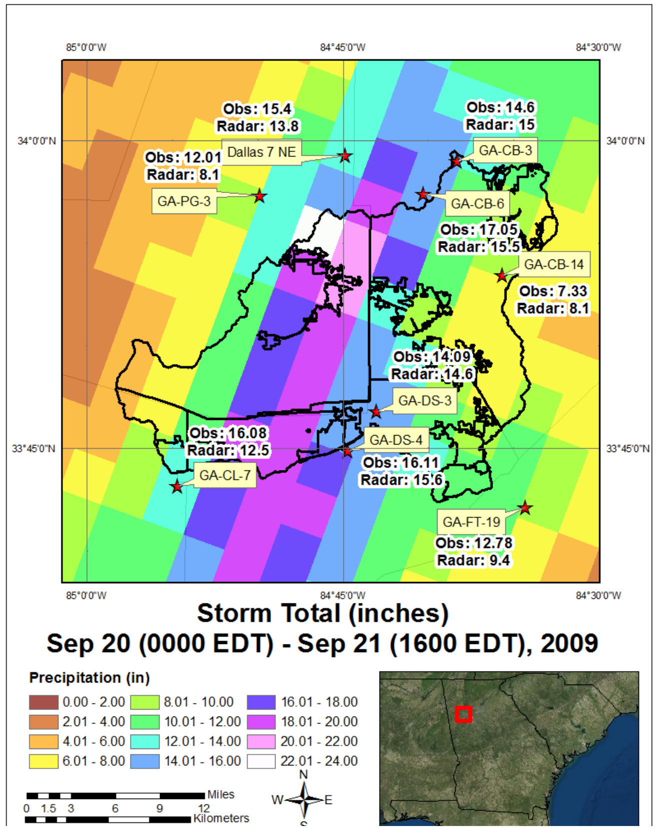


Figure 39: Comparison of observed and reconstructed rainfall for the September 2009 event

- USGS - https://waterdata.usgs.gov/ga/nwis/rt
- NCEI - https://www.ncei.noaa.gov/
- Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) - www.cocorahs.org
- Weather Underground Personal Weather Stations – http://www.wunderground.com
- MesoWest -http://www.wunderground.com/ http://mesowest.utah.edu/index.html
- RAWS - http://www.raws.dri.edu/index.html
- NADP - http://nadp.sws.uiuc.edu/

Figures 39 through 41 show the reconstructed and observed rainfall data for each event. For illustrative purposes, the September 2009 event (Figure 32) is shown on the raw Stage IV 4-km grid, while the other two events are shown on the final 1-km grid. Due to the ubiquitous highly inhomogeneous nature of heavy rainfall, along with limited rain gages, a perfect rainfall reconstruction is virtually impossible. However, a 10% error margin was used as a threshold to validate the reconstruction. As Figure 39 shows, this was attained at the majority of the rain gages used for quality control. There were some areas where underestimates were noted, though these occurred mainly in regions with strong gradients in accumulation. These underestimates were reduced after the interpolation to the 1-km grid (not shown). Thus, aside from spatial and temporal interpolation, no additional processing of Stage IV data was warranted as the interpolated grids were deemed reasonable to serve as input into the H&H modeling.

4.2.2. Design Rainfall

Because each heavy rainfall event is unique with high variability across even a small area, a “design storm” is used to create a more objective and homogenous rainfall pattern that can be used for engineering purposes. NOAA Atlas 14 (Atlas 14) was used to develop design storms for the following Annual Exceedance Probabilities: 50%, 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2%. Due to the Sweetwater basin’s relatively small area (260 sq. mi.), a single precipitation value was used over the full basin (it was confirmed that there is negligible variability in Atlas 14 guidance across the basin). Because Atlas 14 estimates are “point-specific”, an Areal Reduction Factor (ARF) was required in order to reduce the value by accounting for increasing basin area size. The following ARF equation, obtained from Allen and Degaetno, (2005) was used:

$$ARF = 1 - \exp\left(at^{b}\right) + \exp\left(at^{b} - cA\right)$$

where t is event duration (hour) and A is area (km2). The coefficients a and c as well as the exponent b are empirically fit with a=-1.1, c=2.59490E-2 and b=0.25. With t = 24 hours and A = 670 km2, an ARF of 0.91 was obtained.

Table 7 shows the design rainfall values, before and after applying aerial reduction factors (ARF), used for the 24-hour and 48-hour design storms.

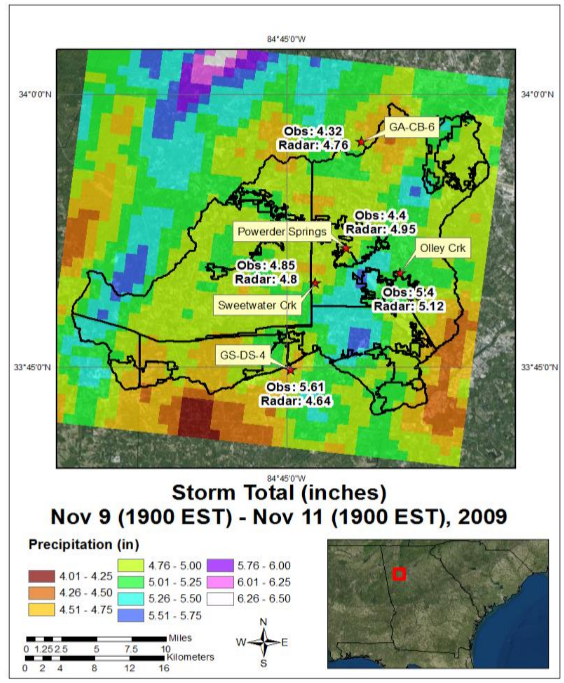


Figure 40: Comparison of observed and reconstructed rainfall for the November 2009 event

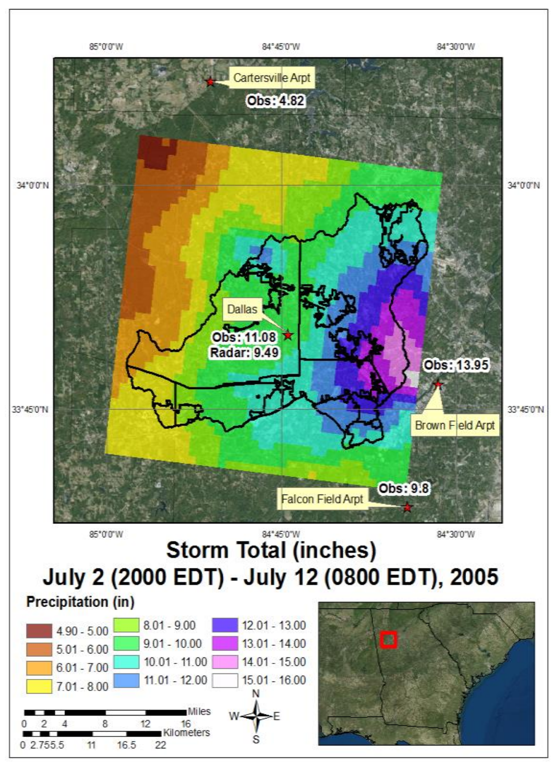


Figure 41: Comparison of observed and reconstructed rainfall for the July 2005 event

Table 7: Design rainfall values, before and after applying the ARF to the NOAA Atlas 14 rainfall amount

		24-hour		48-hour	
AEP	Return Period	Atlas 14	With ARF	Atlas 14	With ARF
50%	2 years	3.73 inches	3.39 inches	4.52 inches	4.11 inches
20%	5	4.71	4.29	5.51	5.01
10%	10	5.46	4.97	6.33	5.76
4%	25	6.45	5.87	7.46	6.79
2%	50	7.21	6.56	8.33	7.58
1%	100	7.99	7.27	9.21	8.38
0.5%	200	8.8	8.01	10.1	9.19
0.2%	500	9.93	9.04	11.3	10.28

The temporal distribution of the design storm was based on the Natural Resources Conservation Service (NRCS) hyetographs, updated for NOAA Atlas 14 data (Merkel and Moody, 2015). This categorizes the Sweetwater basin under the Midwest-Southeast (MSE) Type 4 distribution, where the ratio of the 60-minute to 24-hour rainfall intensity is between 0.43 and 0.48.

4.3. Hydrologic Model

A planning level HEC-HMS model was developed for the 264 square mile Sweetwater Creek basin using HEC-HMS version 4.2.1 within HEC-WAT, which was calibrated to three storm events.

4.3.1. Basin Delineation

Sub-basins were manually delineated using the HEC-10 sub-basins based on the terrain model developed for Cobb, Douglas, and Paulding Counties. Peak discharge locations were obtained along the study reaches considering the length of the reaches under study and at the confluence of tributaries. The watershed was divided into 33 sub-basins (shown in Figure 42) at selected critical locations along the stream to account for significant hydrologic changes due to confluences with other streams or flow attenuation at dams or existing road structures. Flow change locations were also added at gaged locations along the reaches to allow for comparison during model calibration. Additionally, basin breaks were placed at potential measure locations identified by the Project Delivery Team (PDT).

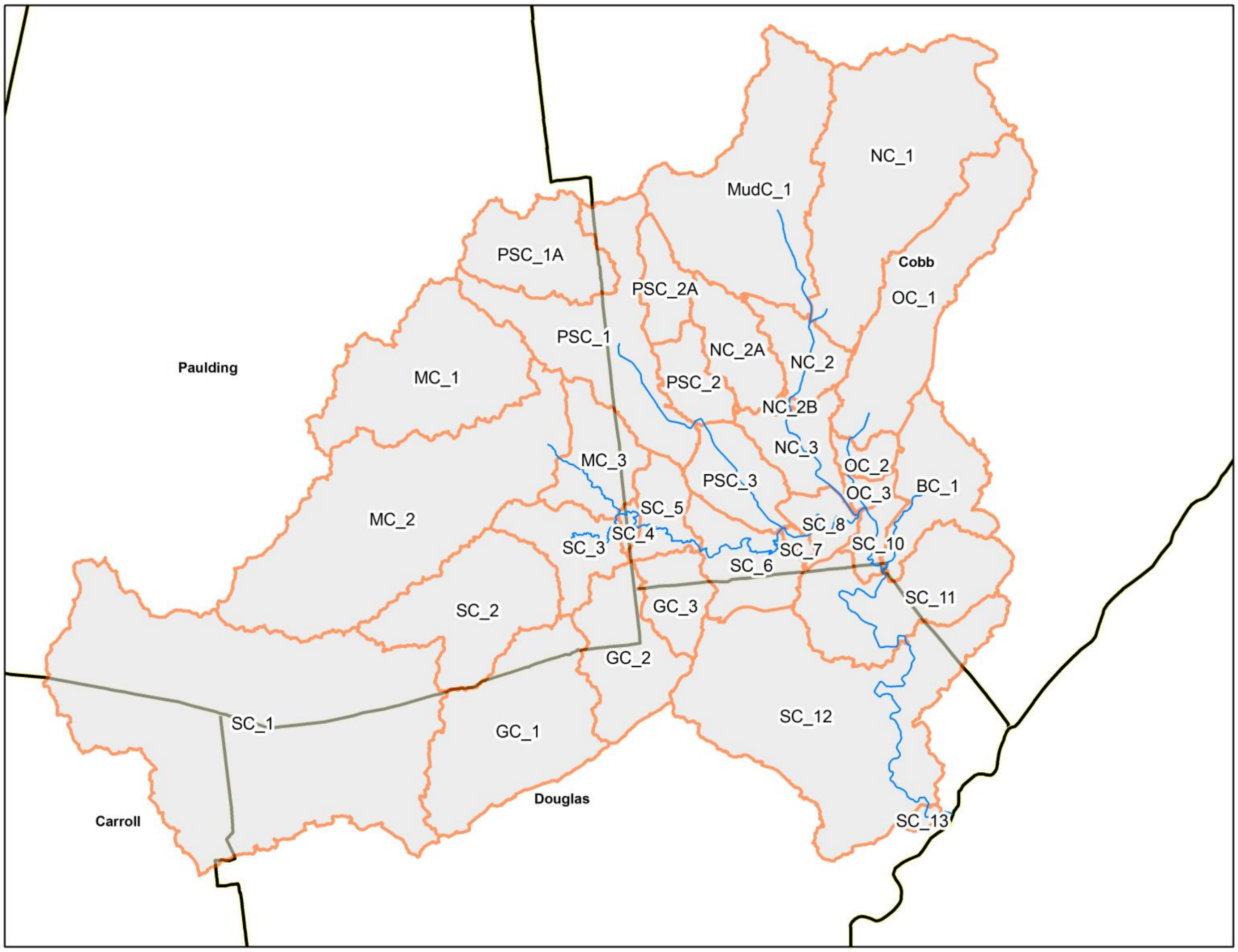


Figure 42: Sweetwater Creek Basin with subbasin delineation

4.3.2. Rainfall Losses

The Deficit and Constant methodology was used to estimate the losses from a precipitation event occurring over the Sweetwater Creek Watershed, as directed by the PDT. Initial abstraction values were estimated through trial and error, calibrating the rainfall runoff model to the calibration events and USGS regression equations. Constant loss rates were based on saturated hydraulic conductivity estimates for clay soils, and varied during model calibration. Table 8 and Table 9 summarize several basin parameters, including drainage area, initial abstraction values, and constant loss rates for each of the sub-basins.

Table 8: Initial Deficits of Calibration Events and Frequency Events

		Initial Deficit (in)										
Sub-basin	Drainage Area (sq. mi)	Nov-09	Jul-05	Sep-09	50%	20%	10%	4%	2%	1%	0.5%	0.2%
SC 1	41.8	2.4	2.4	2.4	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 2	9.7	2.4	2.4	2.4	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 3	4.3	2.4	2.4	2.4	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
MC 1	24.2	2.4	2.4	2.4	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
MC 2	12.7	2.4	2.4	2.4	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
MC 3	4.8	2.4	2.4	2.4	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 4	0.5	2.2	2.2	2.2	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 5	2.8	2.2	2.2	2.2	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
GC 1	13.2	2.2	2.2	2.2	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
GC 2	6.7	2.2	2.2	2.2	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
GC 3	3.2	2.2	2.2	2.2	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 6	4.9	2.2	2.2	2.2	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
PSC 1A	11.3	2.6	2.6	2.6	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
PSC 1	6.5	2.6	2.6	2.6	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
PSC 2A	3.3	2.6	2.6	2.6	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
PSC 2	2.6	2.6	2.6	2.6	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
PSC 3	4.2	2.6	2.6	2.6	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 7	0.4	2.6	2.6	2.6	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 8	2.0	2.6	2.6	2.6	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
NC 1	20.1	2.5	2.5	2.5	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
MudC 1	16.3	2.5	2.5	2.5	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
NC 2	3.4	2.3	2.3	2.3	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
NC 2A	4.2	2.3	2.3	2.3	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
NC 3	3.8	3	3	3	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
OC 1	12.3	2.1	2.1	2.1	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
OC 2	1.3	1.8	1.8	1.8	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
OC 3	0.8	1.8	1.8	1.8	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 9	0.02	1.8	1.8	1.8	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 10	1.5	1.8	1.8	1.8	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
BC 1	6.2	1.8	1.8	1.8	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 11	9.8	1.8	1.8	1.8	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 12	24.6	1.8	1.8	1.8	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2
SC 13	0.4	1.8	1.8	1.8	1.9	1.8	1.8	1.6	0.75	0.4	0.3	0.2

Table 9: Constant Loss Rates for Calibration Events and Frequency Events

Sub-basin	Nov-09	Jul-05	Sep-09	50% - 0.2% Design Storm Events
SC 1	0.03	0.03	0.03	0.03
SC 2	0.03	0.03	0.03	0.03
SC 3	0.03	0.03	0.03	0.03
MC 1	0.03	0.03	0.03	0.03
MC 2	0.03	0.03	0.03	0.03
MC 3	0.03	0.03	0.03	0.03
SC 4	0.03	0.03	0.03	0.03
SC 5	0.03	0.03	0.03	0.03
GC 1	0.03	0.03	0.03	0.03
GC 2	0.03	0.03	0.03	0.03
GC 3	0.03	0.03	0.03	0.03
SC 6	0.03	0.03	0.03	0.03
PSC 1A	0.07	0.07	0.07	0.03
PSC 1	0.07	0.07	0.07	0.03
PSC 2A	0.07	0.07	0.07	0.03
PSC 2	0.07	0.07	0.07	0.03
PSC 3	0.07	0.07	0.07	0.03
SC 7	0.07	0.07	0.07	0.03
SC 8	0.07	0.07	0.07	0.03
NC 1	0.1	0.1	0.1	0.03
MudC 1	0.1	0.1	0.1	0.03
NC 2	0.1	0.1	0.1	0.03
NC 2A	0.1	0.1	0.1	0.03
NC 3	0.1	0.1	0.1	0.03
OC 1	0.03	0.03	0.03	0.03
OC 2	0.03	0.03	0.03	0.03
OC 3	0.03	0.03	0.03	0.03
SC 9	0.03	0.03	0.03	0.03
SC 10	0.03	0.03	0.03	0.03
BC 1	0.03	0.03	0.03	0.03
SC 11	0.03	0.03	0.03	0.03
SC 12	0.03	0.03	0.03	0.03
SC 13	0.03	0.03	0.03	0.03

4.3.3. Sub-basin Response

The ModClark transform method was used for this study. The initial time of concentration values for each sub-basin were calculated following the methodology given in USGS Lagtime Relations For Urban Streams in Georgia (WRIR 00-4049), and were adjusted to match the observed hydrographs at gaged locations. Final times of concentration and storage coefficients for this basin are shown in Table 10.

Table 10: Transform Parameters for Subbasin Response

Sub-basin	Time of Concentration (hours)	Storage Coefficient (hours)
SC_1	10	25
SC_2	7	16.7
SC_3	5	12
MC_1	7	21.8
MC_2	8	18.2
MC_3	5	12.6
SC_4	3.8	10
SC_5	5.2	15
GC_1	9.5	20
GC_2	5.1	18
GC_3	4.1	18
SC_6	7.1	21
PSC_1A	5	10
PSC_1	4	9
PSC_2A	2	6
PSC_2	2.5	9
PSC_3	3.7	10
SC_7	1.4	9

Sub-basin	Time of Concentration (hours)	Storage Coefficient (hours)
SC_8	3.5	11
NC_1	5.1	14
MudC_1	5	14
NC_2	3.5	12
NC_2A	3	12
NC_3	3.5	12
OC_1	6.6	18
OC_2	2.1	10
OC_3	1.4	9
SC_9	1	9
SC_10	2.6	15
BC_1	4.2	15
SC_11	6.4	23
SC_12	8.7	25
SC_13	1.8	14

4.3.4. Reach Routing

Where FEMA effective models or new limited detailed models were available, Modified Puls reach routing was applied, utilizing the discharge-storage curves generated by these models. However, since these reaches were dynamically routed in HEC-RAS, modified Puls routing was only used for initial HEC-HMS model calibrations. For hydrology only reaches along upstream portions of Sweetwater Creek and Mill Creek that did not have HEC-RAS models available, sub-basin reach routings were estimated using the Muskingum-Cunge method with Eight Point cross section shape. The seamless terrain data was used to determine cross sections profile, slope, and length of the reaches for the studied streams. Aerial imagery was used to estimate the Manning's n-value for the reach routing.

4.3.5. Gage Analysis

There are seven USGS stream gages in the Sweetwater Creek Watershed, however only the gage along Sweetwater Creek near Austell, Georgia (02337000) has an adequate period of record for a frequency analysis of rare flood events with 101 years of record. The gage along Noses Creek at Powder Springs Road near Powder Springs, Georgia (02336968) has 17 years of record but the gage can only record up to 3000 cubic feet per second (cfs), which has been exceeded twice. Therefore, the data is only suitable for hydraulic model calibration, and gage analysis was only evaluated for the gage at Sweetwater Creek near Austell, Georgia (02337000).

For the Sweetwater Creek near Austell, Georgia gage, there are two gaps in the data record for this site. The record has flows for 1904, 1905, 1916 and 1937-2016, and so the analysis considered several options. When there are flow events in the record prior to the continuous record, the events can be either historical events or simply additional data points. A historical event by definition is the largest event between that date and the end of the subsequent gap. The 1904 and 1905 flows were not flagged as historical events in the USGS record. These events also extend the period of record to 113 years, resulting in frequency flow estimates that are smaller than those obtained using the shorter but continuous period of record (1937-2016). These values can be eliminated because it is not certain that there were no larger events between 1905 and 1916. The 1916 event is listed as a historical event, however, it was not an exceptionally large event, and it extends the period of record by 21 years. The net effect is a reduction in the various frequency flow estimates.

The U.S. Army Corps of Engineers (USACE) Statistical Software Package (HEC-SSP) program was used to calculate the frequency flows. Table 11 shows a comparison of 100-year peak discharges obtained by varying skew and period of record variables.

Table 11: 100-Year Frequency Flows using Multiple Methods

Program		Skew	Period	Years of Record	# of Events	Historical Events	1% Flows (cfs)
HEC-SSP	17C EMA	Station	1916-2016	101	81	0	17,845
HEC-SSP	17C EMA	Weighted	1916-2016	101	81	1	16,003
HEC-SSP	17C EMA	Station	1937-2016	80	80	0	18,300
2009-5043 Report Regression Equation (246 sq mi)	n/a	n/a	n/a	n/a	n/a		20,400

The regression equations for Georgia produce results that are very similar to the HEC-SSP analysis of the 1937-2016 systematic record with the Station skew. Therefore, the HEC-SSP result for the period 1937 to 2016 with Station skew was used as the gage estimate. The results are shown in Table 12.

Table 12: Gage Estimate of Flows at USGS Gage # 02337000

Frequency	50% Flows	20% Flows	10% Flows	4% Flows	2% Flows	1% Flows	0.5% Flows	0.2% Flows
Gage Flow, cfs	3,780	6,157	8,241	11,572	14,645	18,300	22,249	29,682

4.3.6. HMS Calibration

Hydrologic and hydraulic models were calibrated in conjunction with each other based on observed flow hydrographs as well as observed stage for the three specified events in order to consider the effects of routing in the unsteady RAS model. Within the HMS model, the initial values for the time of concentration (Tc) used in the Mod-Clark transform method were calculated from the formula given in USGS Lagtime Relations for Urban Stream in Georgia (WRIR 00-4049). The initial storage coefficients were set at two times the Tc. The Initial Soil Deficit and Constant Loss were set at two inches and 0.03 inches per hour, respectively. These parameters were then adjusted to match the observed hydrographs at the gage locations within RAS where available. Due to the unavailability of data for the July 2005 event and uncertainty in flow and stage estimates for the September 2009 event, the weight of the HMS calibration focused on the November 2009 event. Using the parameters established during the November 2009 calibration resulted in flows that matched reasonably well for the July 2005 and September 2009 events. Table 13 summarizes the calculated Nash-Sutcliffe values provided at gaged locations from the HMS model where observed hydrographs were available. Nash-Sutcliffe values provide an indication of model accuracy and can range from 0 – 1, where the closer the value is to 1, the more accurate the match is to the observed data. Figures 43 – 45 graphically display the HMS calibration model output compared to the available observed data.

Table 13: Nash-Sutcliffe Values from HEC-HMS Calibration Events

Event	Node	Nash-Sutcliffe Value
November 2009	J6	0.972
	J12	0.938
	J_18	0.946
	J_26	0.731
	J_27	0.977
July 2005	N/A	N/A
September 2009	N/A	N/A

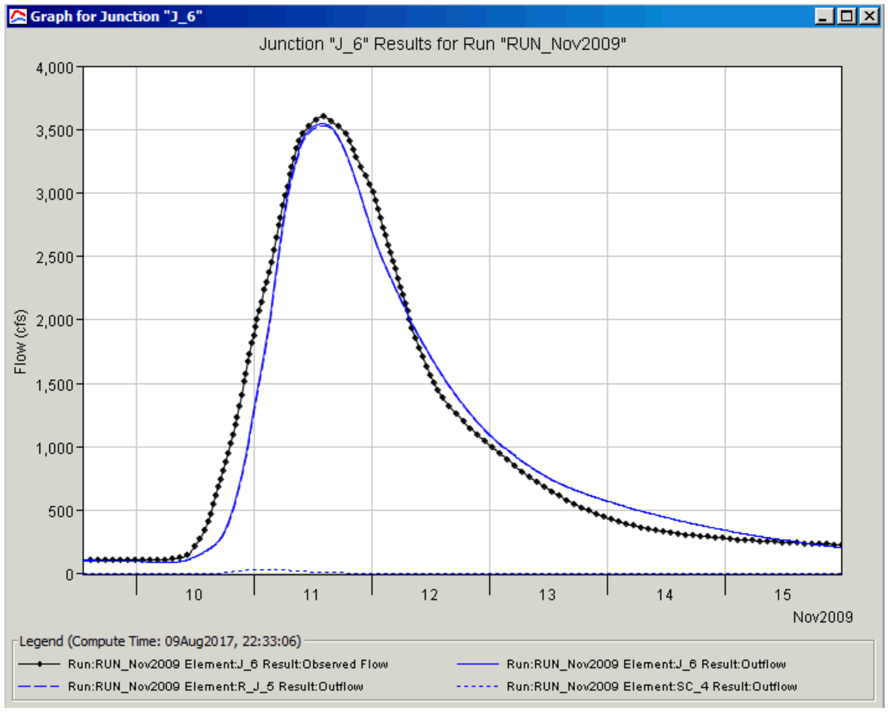


Figure 43: Calibration at USGS gage on Sweetwater Creek

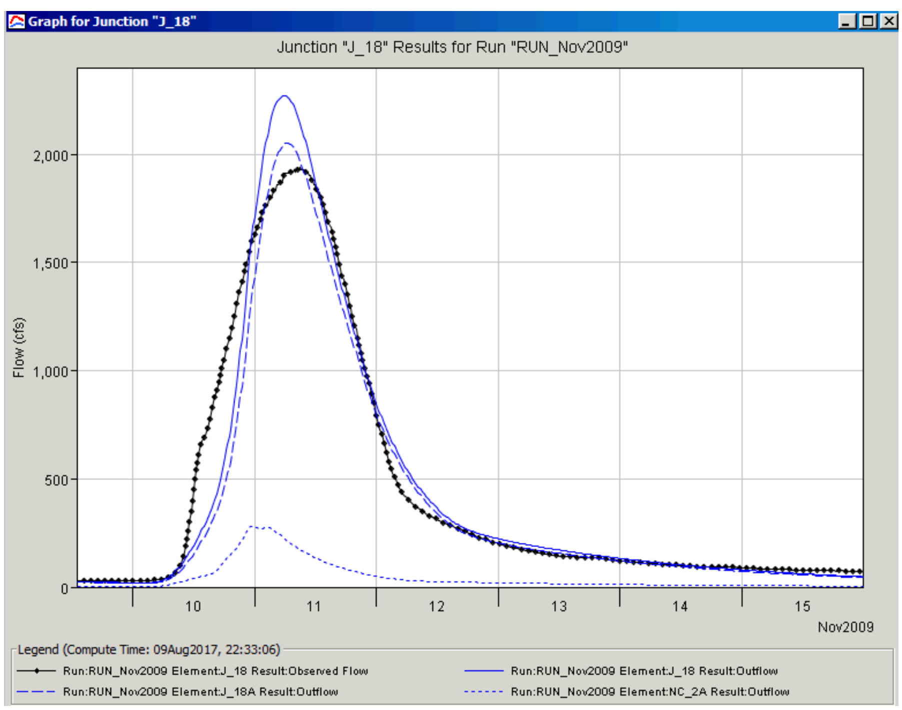


Figure 44: Calibration at USGS gage on Sweetwater Creek

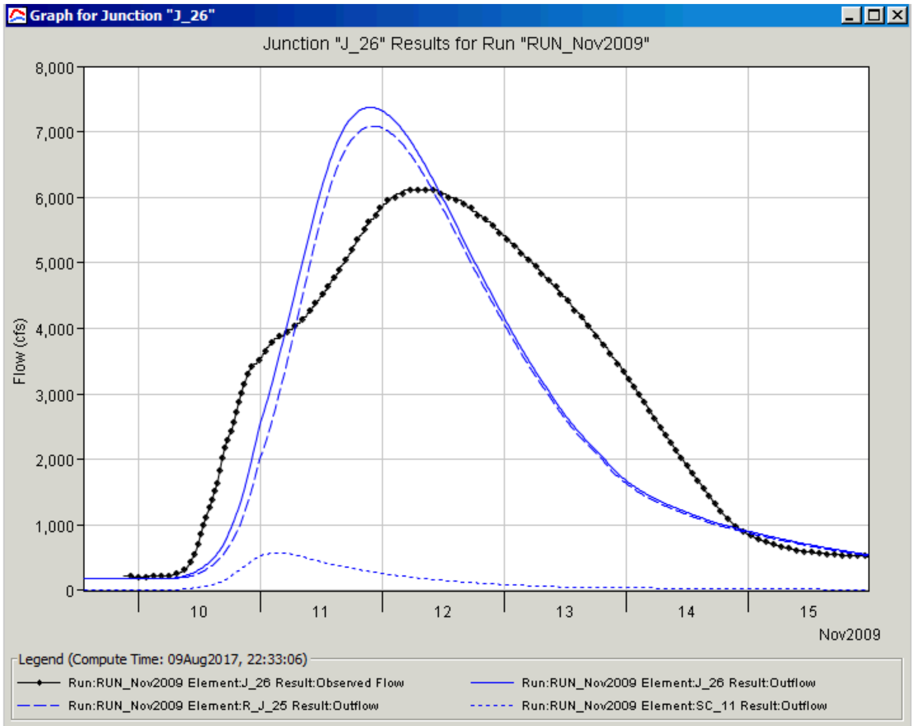


Figure 45: Calibration at USGS gage on Sweetwater Creek

4.3.7. Design Storm Events

Rain grids for the 24-hour and 48-hour storms were created for the 50%, 20%, 10%, 4%, 2%, 1%, 0.5% and 0.2% storm events. The 48-hour analysis resulted in lower flows than the 24-hour storms, and therefore the 24-hour storms were selected for further analysis. In order to calibrate the design storms to USGS regression equations and gage analysis results, initial abstraction values were varied as described in Table 4. Models were also run using grids with and without ARF applied. Results using ARF grids generated flows that were generally low compared to the USGS regression and gage analysis results, therefore the design rainfall grids for this model did not use any areal reduction factors. Table 14 and Figure 46 compare the regression equation and gage analysis results to the HEC-WAT model output. Table 15 summarizes the flows at several locations throughout the existing conditions basin after routing through HEC-RAS.

Table 14: Comparison of Frequency Flows using Various Methods

Percent chance exceedance	Regression Percent chance exceedance flow, in ft^3/s*	Regression Lower 95% prediction interval flow, in ft^3/s*	Regression Upper 95% prediction interval flow, in ft^3/s*	Gage Analysis flow, in ft^3/s	HEC-WAT flow, in ft^3/s
50	5,540	2,880	10,600	3,780	4,260
20	9,140	4,800	17,400	6,157	6,829
10	11,700	6,030	22,700	8,241	8,716
4	14,800	7,320	29,900	11,572	11,738
2	17,600	8,380	37,000	14,645	15,037
1	20,100	9,200	43,900	18,300	17,492
0.5	22,400	9,840	51,000	22,649	18,598
0.2	26,100	10,800	62,900	29,682	21,080

*Based on USGS Magnitude and Frequency of Rural Floods in Southeastern United States, 2006: Volume 1.

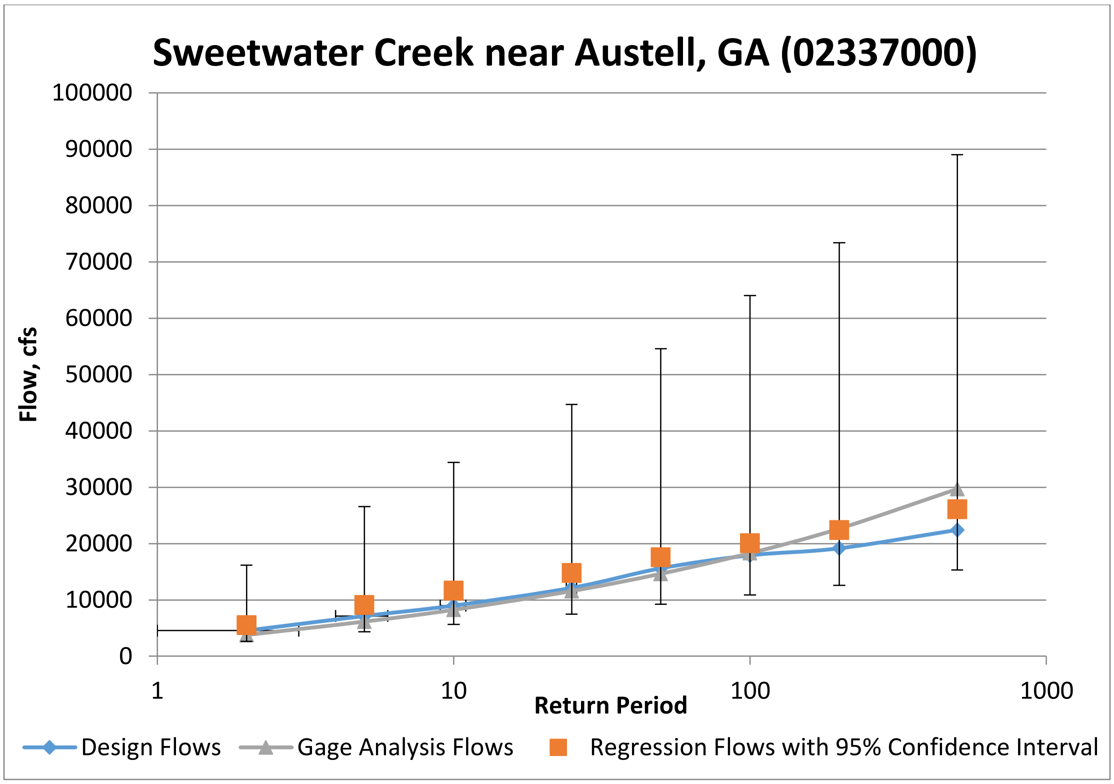


Figure 46: Flow Comparison at Sweetwater Creek near Austell, Georgia
Error bars indicate upper and lower 95% confidence intervals.

Table 15: Summary of Existing Conditions Discharges throughout Basin

Station ID & Name	XS	Area (sq. mi)	50% (cfs)	20% (cfs)	10% (cfs)	4% (cfs)	2% (cfs)	1% (cfs)	0.50% (cfs)	0.20% (cfs)
	SC 130930.8	55.75	1,312	2,374	3,149	4,310	5,846	6,958	8,250	8,880
	MC 184.7	41.74	1,086	1,747	2,259	3,281	4,189	4,727	5,088	6,048
02336840 - SC at Brownsville Rd	SC 124657.1	97.95	2,282	3,898	5,070	7,536	9,443	10,375	11,558	13,822
	SC 113107.7	100.76	1,988	3,528	4,696	6,426	7,671	9,669	11,293	12,792
	SC 93306.57	128.73	2,382	4,246	5,628	7,952	9,594	11,777	13,527	15,259
02336870 - PSC near Powder Springs	PSC 16955.77	23.78	1,541	2,436	3,003	3,952	5,066	5,696	5,906	6,501
	PSC 79.1615	27.99	1,109	2,077	2,426	3,706	4,582	4,918	5,041	5,434
02336910 - SC USRR bridge at Austell	SC 88432.13	157.09	2,634	4,551	5,936	8,823	10,886	13,107	14,781	17,059
	SC 75678.23	159.08	2,718	4,641	5,967	8,693	10,776	12,984	14,663	16,710
02336968 - NC at Powder Springs	NC 17633.95	43.94	1,636	2,846	3,710	5,097	6,675	8,468	9,472	10,545
	NC 2193.528	47.77	1,505	2,429	3,013	4,113	5,130	6,124	7,219	8,237
	OC 778.4826	14.42	420	592	753	1,006	1,155	1,200	1,350	1,352
	SC 63836.73	222.74	4,115	6,648	8,458	11,410	14,523	16,976	18,750	20,758
02337000 - SC near Austell	SC 37865.18	238.73	4,261	6,829	8,716	11,738	15,037	17,492	18,598	21,081
02337040 - SC below Austell	SC 5327.794	263.35	4,558	7,256	9,269	12,517	16,140	18,470	19,715	22,337
	SC 1538.054	263.73	4,555	7,256	9,270	12,520	16,147	18,477	19,724	22,344

4.4. Hydraulic Modeling Approach

Utilizing best available hydraulic models for the study area, a single network HEC-RAS model was developed for the study reaches. The models listed in Table 16 were upgraded to a HEC-RAS version 5.0.3 unsteady state model. Additionally, five miles of new limited detail study reaches were developed along the upstream portions of Sweetwater Creek and Mill Creek. For the hydraulic simulations, all structures were assumed to remain fully functional and have unobstructed flows.

Table 16: Best Available HEC-RAS Models

Creek Name	Model Date	Model Name/Source	HEC-RAS Version	Miles Studied
Sweetwater Creek (Cobb County)	2010	Sweetwater_Oct2010.prj/ Cobb County	4.0	12.9
Sweetwater Creek (Douglas County)	2010	SweetwaterCreekDouglasCounty.prj/ FEMA	4.0	12.3
Powder Springs Creek	2006	Powder2006.prj/ Cobb County	3.1.3	6.7
Noses Creek	2006	NosesCreek.prj/ Cobb County	3.1.3	6.3
Mud Creek	2006	MudCreek_CH06.prj/ Cobb County	3.1.3	2.9
Olley Creek	2005	Olley.prj/ Cobb County	3.1.1	2.8
Buttermilk Creek	2012	LDSTaskA.prj/ Cobb County	4.1.0	2.6
Mill Creek	2017	New Limited Detail	5.0.3	2.8
Sweetwater Creek (Paulding County)	2017	New Limited Detail	5.0.3	2.2
			Total Miles	**51.5**

Geometry was revised where necessary to better tie into the more recent topographic data. Structures were verified during field reconnaissance and new structures were added if not reflected in the effective models. Numerous structures along Powder Springs Creek appeared to be modeled using older HEC hydraulic programs and did not appear to reflect existing conditions. These structures were updated with refined cross sections and deck information estimated from aerial imagery, topographic information and field reconnaissance.

4.4.1. Boundary Conditions and Tie-ins

Reach connectivity for the individual studies was established by modeling the confluences of the study reaches as junctions. The downstream boundary condition where Sweetwater Creek confluences with the Chattahoochee River was modeled using the normal depth method, where the energy slope was estimated by measuring the channel bed slope along the downstream end of Sweetwater Creek. This will enable a direct comparison of project impacts along Sweetwater Creek without the backwater conditions of the Chattahoochee River which would have some effect on the calibration of the model below the steep rapids located at the bottom reach of the model. Backwater conditions from the Chattahoochee River for the frequency storms can be ignored for this study due to the extreme elevation change that exists in the southern end of the basin where there is a 120 foot drop in elevation over the last

20,000 feet of the river. All impact areas are above this drop and not affected by the Chattahoochee River flows.

4.4.2. Cross Sections

Cross sections from effective models were reviewed to ensure that they would be considered appropriate for an unsteady state model with updated flows. Modifications were made to the cross section layout to capture any significant storage that may occur up tributaries to the main reaches and were generated utilizing the terrain developed for this watershed. Additional cross sections were added in locations that experienced approximately 3-5 feet of vertical change in energy grade. Cross sections for new limited detail reaches were modeled with similar methodologies.

4.4.3. Structures

All hydraulic structures along the study reaches were included in the combined unsteady state model. Several structures no longer reflected the existing conditions and were revised based on field reconnaissance, aerial imagery, and updated topographic information. This was particularly evident on Powder Springs Creek, where the structures appeared to be modeled using older HEC hydraulic programs. As an example, Figure 477 and Figure 488 show the difference between unrevised and revised bridge geometry for the structure at Brownsville Road.

The contraction and expansion coefficients of 0.3 and 0.5, respectively, were used for two cross sections upstream and one cross section downstream of a hydraulic structure. All other contraction and expansion values were kept at 0.1 and 0.3, respectively.

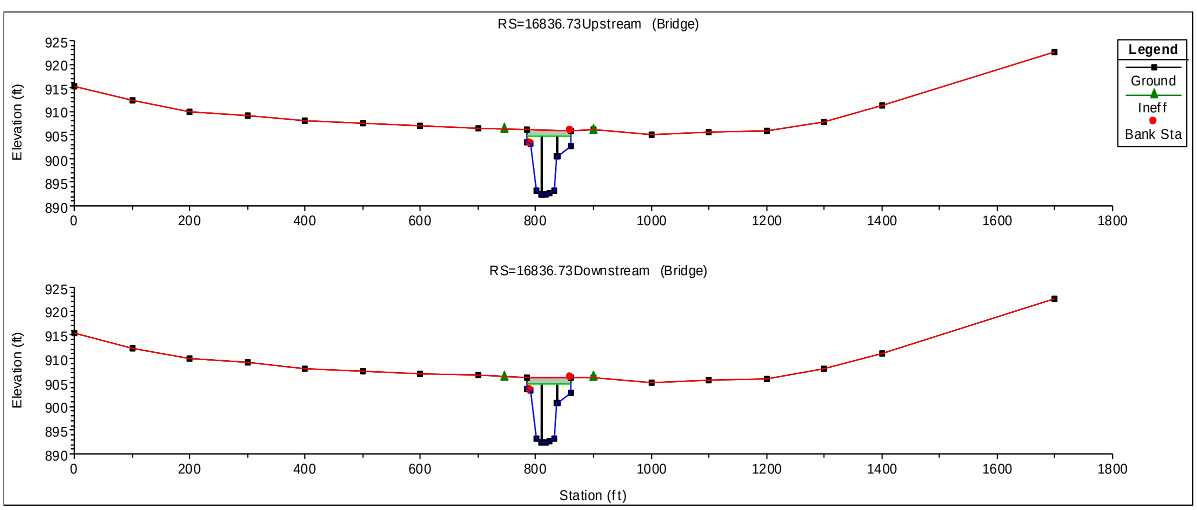


Figure 47: Brownsville Road Structure in Effective Model

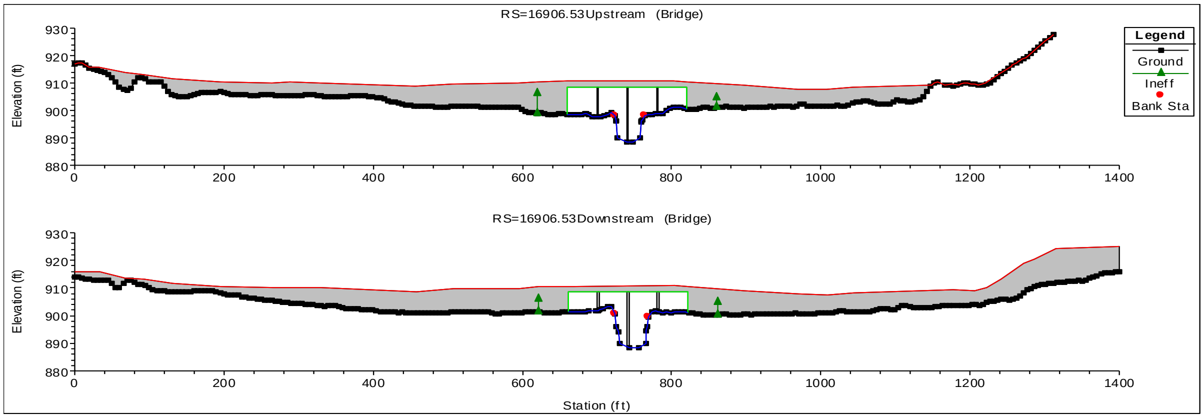


Figure 48: Brownsville Road Structure in Revised Model

4.4.4. Ineffective Flow Areas

The reduced conveyance due to expansion and contraction at structures is reflected in the HEC-RAS model by defining ineffective flow areas for the cross sections immediately upstream and downstream of the structures. The station and elevation of the ineffective flow areas were located based on the HEC-RAS Hydraulic Reference Manual (USACE, 2016).

In addition to the application of the ineffective flow areas upstream and downstream of the structures, the ineffective flow areas were also applied to the cross sections in the areas where the topography indicates that the flows may not be fully effective. These are generally the areas where the floodplain expands and contracts suddenly or where there is divided flow. The stationing of the ineffective flow areas were defined using the same flow contraction and expansion rule applied to the structures.

4.4.5. Channel Roughness Values

Manning's roughness coefficient values assigned in the effective models were verified based on aerial imagery and field reconnaissance photographs. Table 17 lists the range of Manning's n values used for streams in the study area.

Table 17: Manning's n values

Reach Name	Channel n Value	Overbank n Value
Buttermilk Creek	0.05	0.1
Mill Creek	0.035- 0.05	0.1-0.12
Mud Creek	0.05	0.15
Noses Creek	0.03-0.08	0.05-0.1
Olley Creek	0.085	0.09-0.14
Powder Springs Creek	0.05	0.07
Sweetwater Creek	0.035-0.05	0.06-0.3

In order to calibrate the HEC-RAS model to the observed storm events from November 2009, July 2005, and September 2009, flow roughness factors were applied to vertically vary the channel and overbank roughness values based on increasing flow.

4.4.6. HEC-RAS Results and Calibration

Hydrologic and hydraulic models were calibrated in conjunction with each other based on observed gage hydrographs as well as observed stage for the three specified events. Where available for the November 2009 event, observed staged hydrographs were compared to modeled hydrographs and are shown in Figure 499 - 54. Additionally, Table 18 - Table 20 summarize the observed high water mark data from USGS gages and field reconnaissance efforts compared to the model results for the three calibration events.

November 2009 Event (Minor Event)

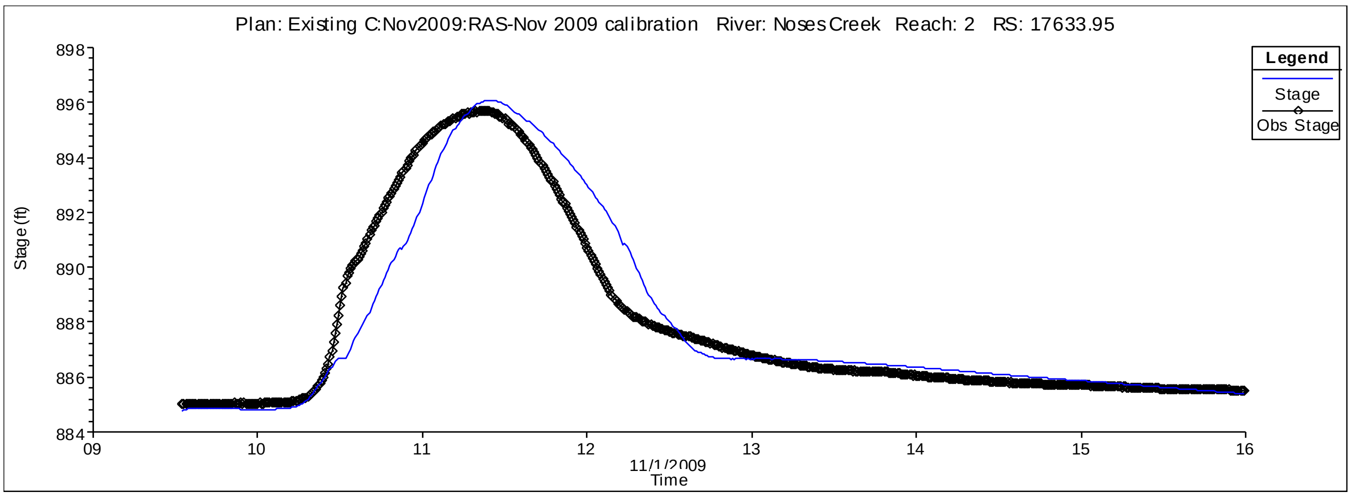


Figure 49: Observed vs. Modeled Hydrograph for Noses Creek XS 17633

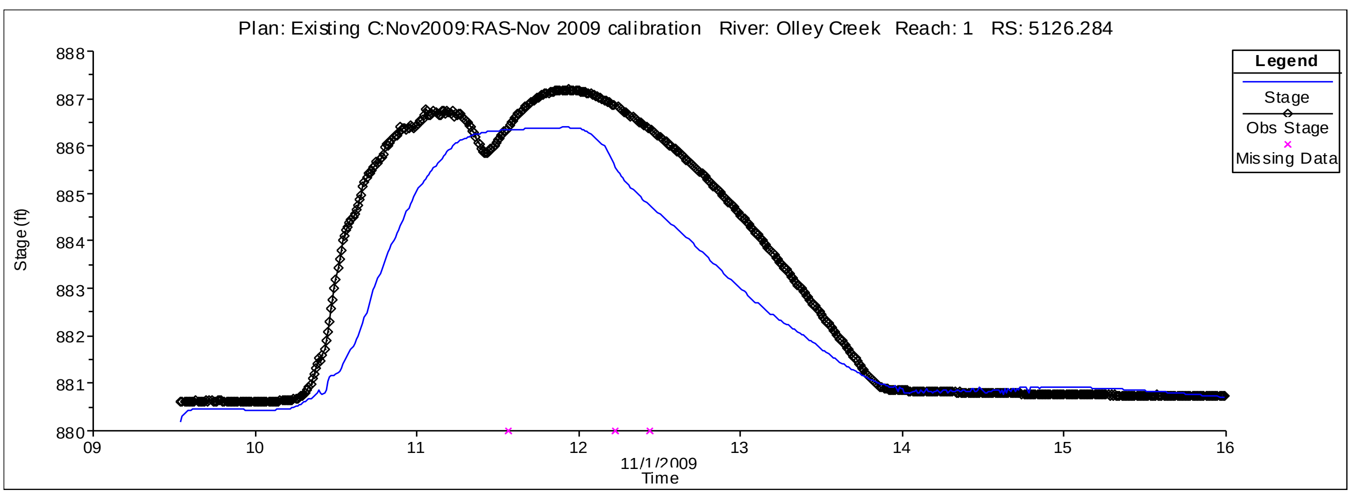


Figure 50: Observed vs. Modeled Hydrograph for Olley Creek XS 5126

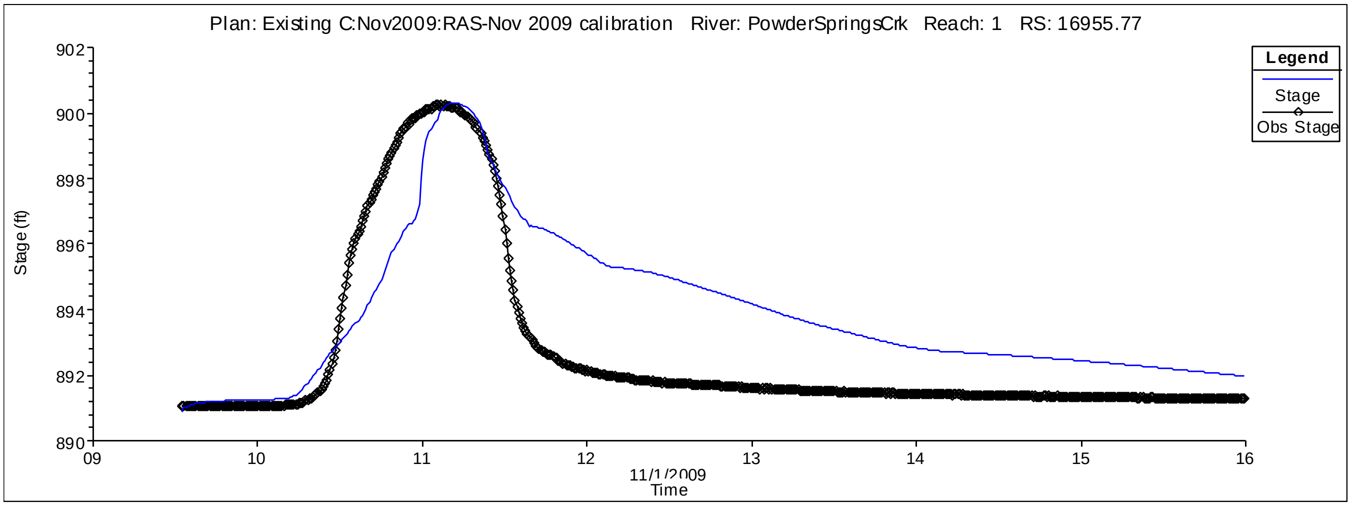


Figure 51: Observed vs. Modeled Hydrograph for Powder Springs Creek XS 16955

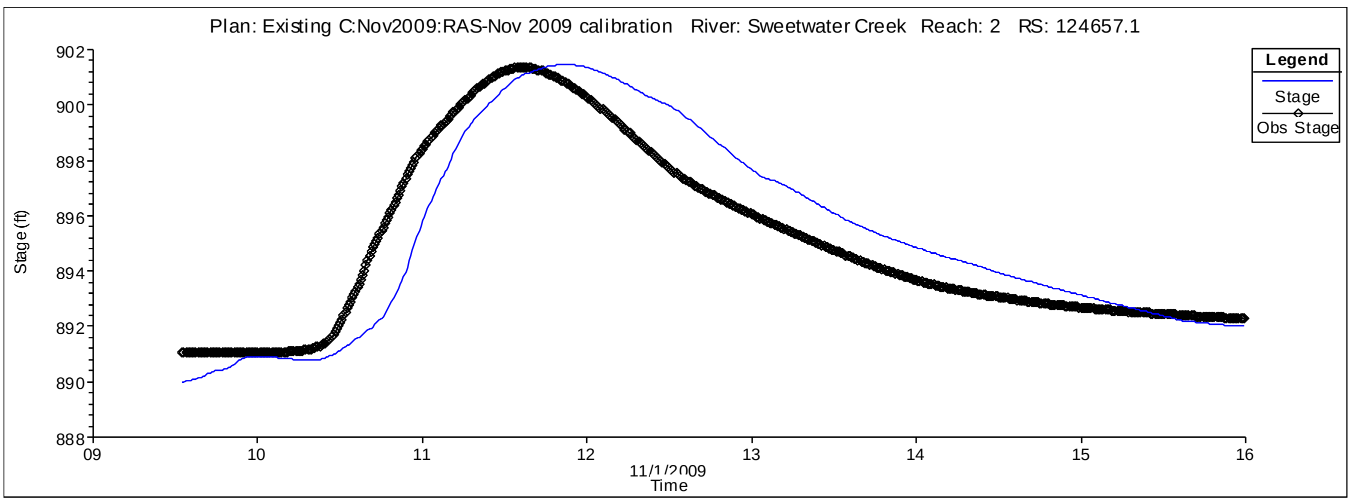


Figure 52: Observed vs. Modeled Hydrograph for Sweetwater Creek XS 124657

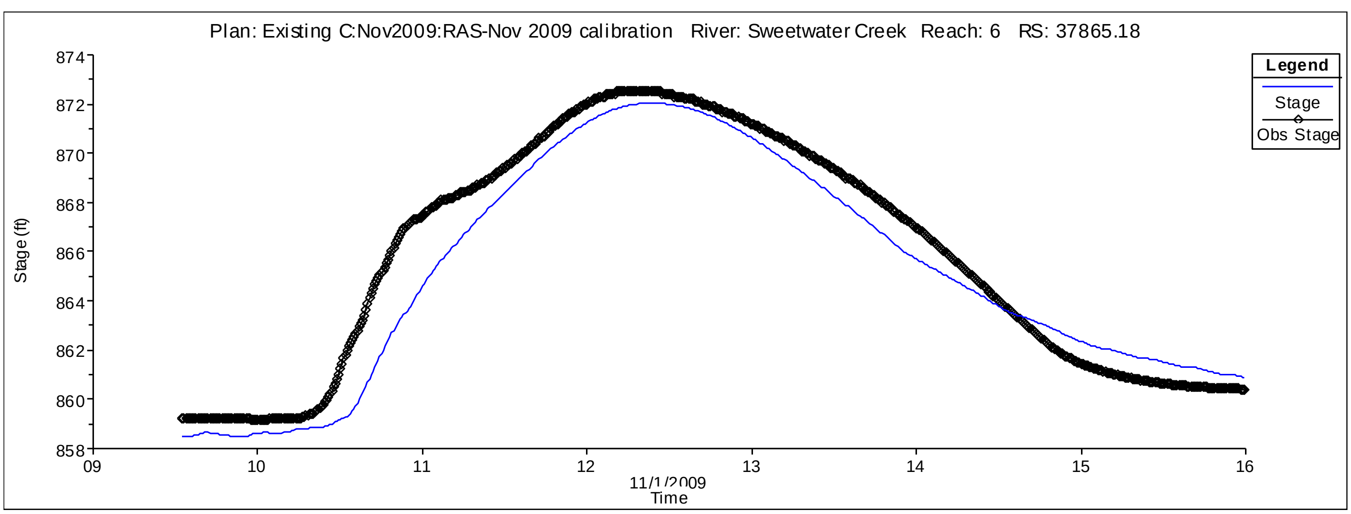


Figure 53: Observed vs. Modeled Hydrograph for Sweetwater Creek XS 37986

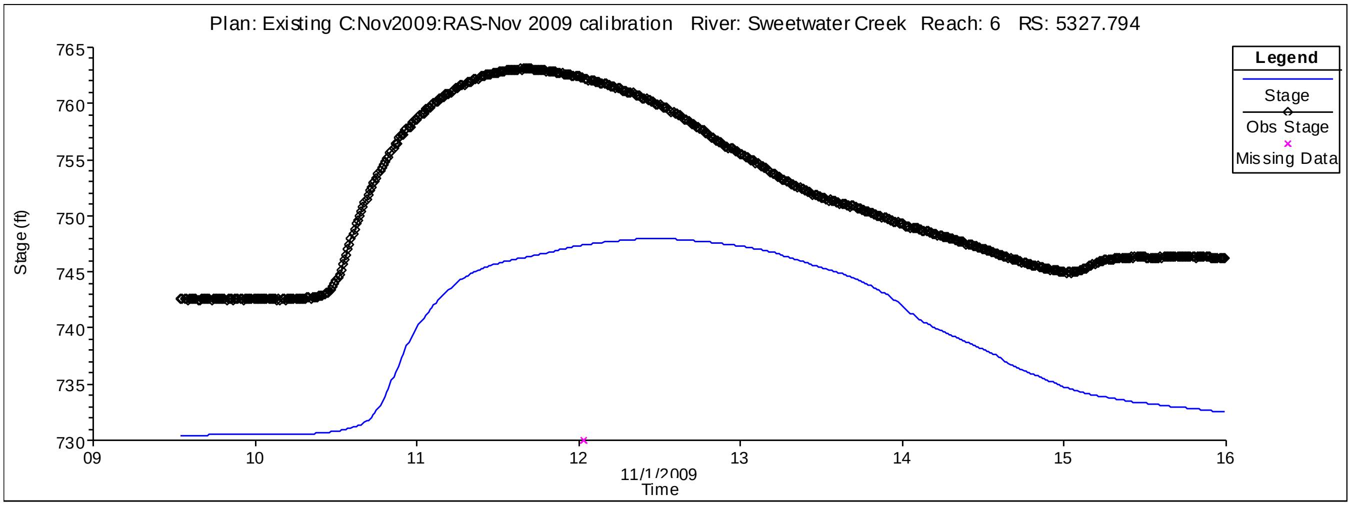


Figure 54: Observed vs. Modeled Hydrograph for Sweetwater Creek XS 5327 (Influence of Chattahoochee River backwater seen in observed data)

Table 18: November 2009 Calibration Results

River	Station	Observed Maximum WSEL	Observed WSEL Source	HEC-RAS Maximum WSEL	WSEL Difference
Noses Creek	17633	895.71	USGS 02336968	896.11	0.40
Olley Creek	5126	887.19	USGS 02336986	886.59	-0.60
Powder Springs Creek	16955	900.24	USGS 02336870	900.06	-0.18
Sweetwater Creek	124657	901.35	USGS 02336840	901.52	0.17
Sweetwater Creek	37865	872.5	USGS 02337000	872.12	-0.38

July 2005 Event (Major Event)

Table 19: July 2005 Calibration Results

River	Station	Observed Maximum WSEL	Observed WSEL Source	HEC-RAS Maximum WSEL	WSEL Difference
Noses Creek	17633	902.1	USGS 02336968	900.00	2.1
Sweetwater Creek	60527	885 (estimated from topo)	Verbal Witness, Warehouse Owner	885.59	0.59
Sweetwater Creek	39322	879.17	USGS 02337000	878.19	-0.98

September 2009 Event (Extreme Event)

Table 20: September 2009 Calibration Results

River	Station	Observed Maximum WSEL	Observed WSEL Source	HEC-RAS Maximum WSEL	WSEL Difference
Buttermilk Creek	2544	901.5	HWM	895.26	-6.24
Mill Creek	12965	923.95	HWM	921.33	-2.62
Mill Creek	9844	920.34	HWM	918.50	-1.84
Noses Creek	33120	911.62	HWM	911.70	0.08
Noses Creek	24830	907.27	HWM	904.44	-2.83
Noses Creek	19091	906.8	HWM	903.8	-3
Noses Creek	18173	906.51	HWM	903.51	-3
Noses Creek	17633	906.21	USGS 02336968	900.95	-5.26
Noses Creek	17465	905.89	HWM	900.73	-5.16
Noses Creek	8100	905.57	HWM	898.75	-6.82
Olley Creek	5126	905.69	USGS 02336986	898.64	-7.05
Powder Springs Creek	18223	912.75	HWM	910.53	-2.22
Powder Springs Creek	16829	911.52	USGS 02336870	907.15	-4.82
Powder Springs Creek	13268	911.71	HWM	907.00	-4.71
Powder Springs Creek	9235	910.39	HWM	906.41	-3.98
Powder Springs Creek	8261	910.36	HWM	905.95	-4.41
Sweetwater Creek	136255	918.57	HWM	918.02	-0.55
Sweetwater Creek	131579	917.5	HWM	916.85	-0.65
Sweetwater Creek	124657	917.4	USGS 02336840	915.59	-1.81
Sweetwater Creek	94319	910.75	HWM	905.09	-5.66
Sweetwater Creek	92326	908.28	HWM	904.64	-3.64
Sweetwater Creek	91169	909.2	HWM	904.32	-4.88
Sweetwater Creek	84556	906.15	HWM	901.12	-5.03
Sweetwater Creek	73637	905.4	HWM	898.57	-6.83
Sweetwater Creek	65820	902.14	HWM	895.62	-6.52
Sweetwater Creek	54413	896.42	HWM	891.56	-4.86
Sweetwater Creek	39322	888.21	USGS 02337000	887.84	-0.37
Sweetwater Creek	37446	885.32	HWM	883.31	-2.01

River	Station	Observed Maximum WSEL	Observed WSEL Source	HEC-RAS Maximum WSEL	WSEL Difference
Sweetwater Creek	24876	870.45	HWM	871.32	0.87
Sweetwater Creek	24108	869.17	HWM	870.56	1.39
Sweetwater Creek	1538	761.19	HWM	752.78	-8.41*

*Influence of Chattahoochee Backwater

The 2009 event was estimated by the USGS to be an event far exceeding a 500 year event in the Sweetwater Creek watershed. Due to the large uncertainty in flow estimates from the USGS for the September 2009 storm event in combination with potential blockage of structures, larger variations between observed and modeled water surface elevations are seen along the middle section of Sweetwater Creek, and the downstream reaches of tributaries near their confluences. Also, as this event is in far excess of the suite of flows the study is considering, it was not reasonable or prudent to have a well calibrated model for a storm of this magnitude. For these reasons, this event was utilized for validation and demonstration purposes only and was not used to calibrate runs.

4.5. Future Without-Project Conditions

Since the stationarity analysis based on qualifying gage data did not indicate any significant trends in rainfall or streamflow for the Sweetwater Creek basin, changes in land use and increased development will likely be the main contributor to changes in the hydrology of the basin in the future.

In order to estimate the future land use conditions of the basin, the Environmental Protection Agency’s (EPA) Integrated Climate and Land-Use Scenarios (ICLUS) percent impervious surface projections dataset (Ver 1.3.2) was used. This dataset utilizes population projections through the end of the century, reflecting different assumptions about fertility, mortality, and immigration to determine the demand for new homes, and estimates the amount of impervious surface that can be expected.

Average future impervious percentages for each sub-basin were calculated for the Sweetwater Creek basin using this ICLUS dataset, and areas of anticipated increased development were verified using aerial imagery to assess if these areas could in fact become more developed. These adjusted values were applied to the Existing Conditions hydrologic model to represent the Future Without Project Conditions model. Table 21 compares the percent impervious for the Existing and Future Without Project conditions, and Table 22 compares the flow results for each model for the 1% storm. The geometry that these flows were applied to remained unchanged between the Existing and Future Without Project conditions. Table 22 summarizes the Future Without Project Conditions flows throughout the basin.

Table 21: Percent Impervious Values

Basin	Existing	Future Without	Basin	Existing	Future Without
SC_1	10	22.6	SC_7	18	28.6
SC_2	15	26.3	SC_8	30	35.5
SC_3	15	25.4	NC_1	20	30.4
MC_2	15	29.6	MudC_1	22	27.6
MC_1	10.4	24.8	NC_2	22	28.3
MC_3	12	22	NC_2A	22	27.5
SC_4	9	16.1	NC_3	28	34.6
SC_5	14	22.4	OC_1	28	30.3
GC_1	14	27.2	OC_2	24	27.5
GC_2	16	24.7	OC_3	24	29.3
GC_3	11	18.2	SC_9	20	25.8
SC_6	17	27.4	SC_10	28	32.2
PSC_1	21	29.4	BC_1	28	34
PSC_1A	21	33.8	SC_11	31	34.5
PSC_2	23	26.6	SC_12	25	28.2
PSC_2A	23	27.6	SC_13	18	19.5
PSC_3	21	26.2			

Table 22: Comparison of Existing and Future Without Project Conditions Flows

Station ID & Name	XS	Area (sq. mi)	Existing Conditions 1% (cfs)	Future Without Project Conditions 1% (cfs)
	SC 130930.8	55.75	6,958	6,967
	MC 184.7	41.74	4,727	4,420
02336840 - SC at Brownsville Rd	SC 124657.1	97.95	10,375	10,162
	SC 113107.7	100.76	9,669	9,733
	SC 93306.57	128.73	11,777	11,856
02336870 - PSC near Powder Springs	PSC 16955.77	23.78	5,696	5,724
	PSC 79.1615	27.99	4,918	4,943
02336910 - SC USRR bridge at Austell	SC 88432.13	157.09	13,107	13,149
	SC 75678.23	159.08	12,984	13,021
02336968 – NC at Powder Springs	NC 17633.95	43.94	8,468	8,555
	NC 2193.528	47.77	6,124	6,220
	OC 778.4826	14.42	1,200	1,192
	SC 63836.73	222.74	16,976	17,003
02337000 - SC near Austell	SC 37865.18	238.73	17,492	17,526
02337040 - SC below Austell	SC 5327.794	263.35	18,470	18,499
	SC 1538.054	263.73	18,477	18,624

Table 23: Summary of Future Without Project Conditions Discharges Throughout Basin

Station ID & Name	XS	Area (sq. mi)	50% (cfs)	20% (cfs)	10% (cfs)	4% (cfs)	2% (cfs)	1% (cfs)	0.50% (cfs)	0.20% (cfs)
	SC 130930.8	55.75	1,577	2,635	3,414	4,541	5,965	6,967	8,319	8,848
	MC 184.7	41.74	1,293	1,945	2,421	3,488	4,282	4,420	5,139	6,138
02336840 - SC at Brownsville Rd	SC 124657.1	97.95	2,713	4,305	5,436	7,931	9,584	10,162	11,760	13,971
	SC 113107.7	100.76	2,417	3,736	5,055	6,573	8,117	9,733	11,470	12,895
	SC 93306.57	128.73	2,864	4,535	6,061	8,198	9,912	11,856	13,575	15,441
02336870 - PSC near Powder Springs	PSC 16955.77	23.78	1,705	2,536	3,150	4,063	5,105	5,724	5,915	6,519
	PSC 79.1615	27.99	1,212	2,162	2,457	3,793	4,583	4,943	5,043	5,472
02336910 - SC USRR bridge at Austell	SC 88432.13	157.09	3,040	4,884	6,415	9,200	11,102	13,149	14,947	17,263
	SC 75678.23	159.08	3,143	4,998	6,447	9,031	11,048	13,021	14,800	16,858
02336968 - NC at Powder Springs	NC 17633.95	43.94	1,779	3,008	3,902	5,269	6,765	8,555	9,522	10,594
	NC 2193.528	47.77	1,611	2,528	3,159	4,191	5,147	6,220	7,269	8,265
	OC 778.4826	14.42	450	598	756	1,040	1,157	1,192	1,350	1,352
	SC 63836.73	222.74	4,576	7,037	8,943	11,817	14,781	17,003	18,890	20,925
02337000 - SC near Austell	SC 37865.18	238.73	4,701	7,234	9,209	12,171	15,293	17,526	18,673	21,308
02337040 - SC below Austell	SC 5327.794	263.35	4,985	7,676	9,769	12,960	16,395	18,499	19,790	22,583
	SC 1538.054	263.73	4,981	7,677	9,771	12,964	16,402	18,624	18,506	22,590

5. Cost Estimates

The cost engineer, with support from the PDT, generated cost estimates for each alternative carried forward. The construction cost estimates were combined with the Real Estate costs, contingency costs, PED costs, and CM costs using an EXCEL workbook to determine the total cost of the project. The total project cost for each alternative is shown in Table 24 below. Details of the cost estimating approach, along with the estimates for all costs considered during the alternative screening process, are provided in the Cost Appendix.

Table 24: Total Project Cost Summary for Each Alternative

DESCRIPTION		ESTIMATED AMOUNT
Alternatives		***Project Cost***
1	**Relocations - 10% ACE**	$ 4,669,100
1.1	**Relocations - 4% ACE**	$ 5,674,100
1.2	**Relocations - 2% ACE**	$ 15,708,300
1.3	**Relocations - 1% ACE**	$ 23,028,400
2	**Retention Structure at Brown Road**	$ 22,653,000
3	**Channel Modification**	$ 134,178,600
4	**Multibasin Retention**	$ 33,141,000
5	**Multibasin Retention**	$ 152,267,600
6Short	**Retention Structure Upstream of Bakers Bridge Road**	$ 8,631,000

Notes:
Price Level, FY-18

DESCRIPTION		ESTIMATED AMOUNT
Alternatives		***Project Cost***
1	**Relocations - 10 yr Revised for Structure Locations**	$ 3,241,300
1 Rec	**Relocations - 10 yr Revised with Recreation**	$ 3,726,500

Notes:
Price Level, FY-18

6. Summary and Conclusions

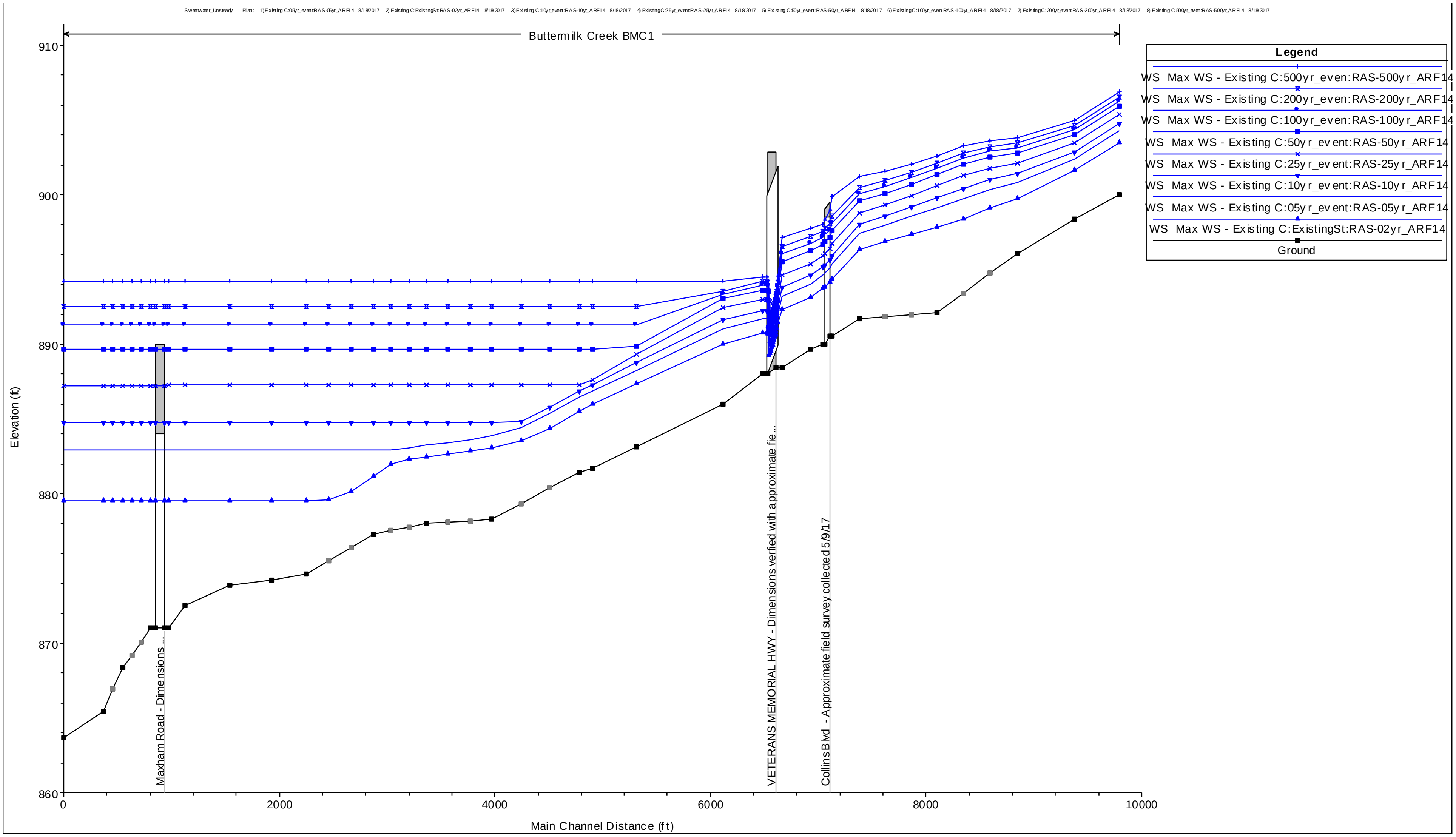
The engineering team was charged with supporting the development and evaluation of flood risk management alternatives for the Sweetwater Creek Basin Georgia. The Sweetwater Creek basin covers a 254-square mile area consisting of many small tributaries along with several other minor perennial features. The headwaters of the watershed are relatively rural while the middle and southern end of the basin contain pockets of urban sprawl and small towns.

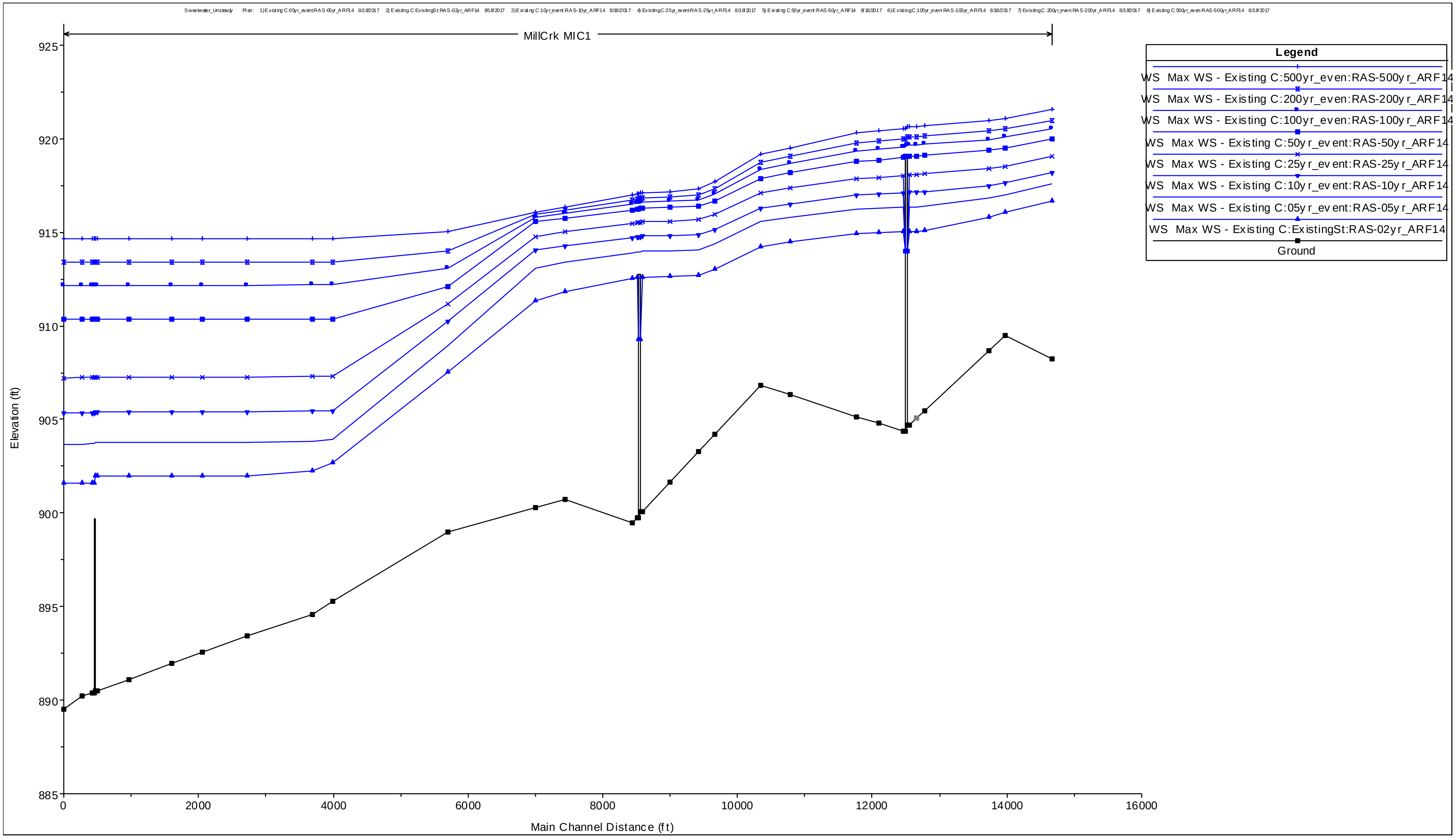
Specific tasks completed by the engineering team, as documented in this appendix, include (1) characterization of the existing and future (with- and without-project) hydraulic, hydrologic, and geologic conditions of the study area, (2) production of concept- and feasibility-level designs for the various flood risk management alternatives considered, and (3) a summation of the feasibility level cost estimates for all alternatives for use in the plan formulation process.

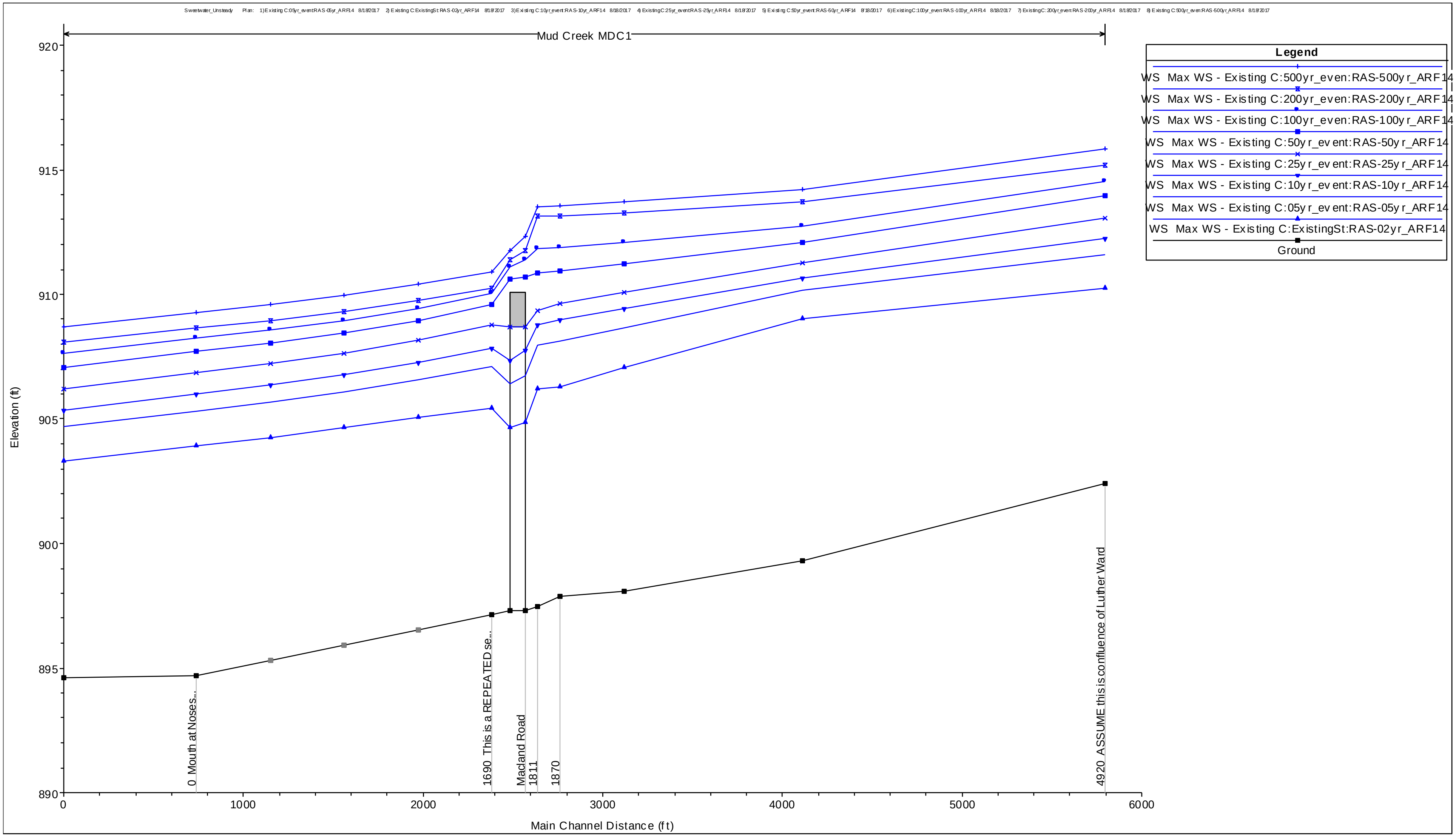
To identify the existing and future (with- and without-project) hydrologic and hydraulic conditions of the study area, the PDT utilized the latest HEC-HMS and HEC-RAS models developed by FEMA for the Flood Inundation Study (FIS) encompassing the Sweetwater Creek Watershed. These models were evaluated and updated, as necessary, to represent the current conditions within the watershed and possible future with-project conditions due to the implementation of the recommended plan. As the recommended plan consists of non-structural buyouts of the 10-year floodplain, the future-without and future-with hydrology and hydraulics models remain the same. Finally, the team produced concept level designs and cost estimates for each of the focused array of alternatives and, using this information, determined a recommended plan. The final recommended plan of buyouts of the 10-year floodplain consists of the purchase and removal of 9 structures developing recreational facilities on four bought out parcels costing $3,725,500.

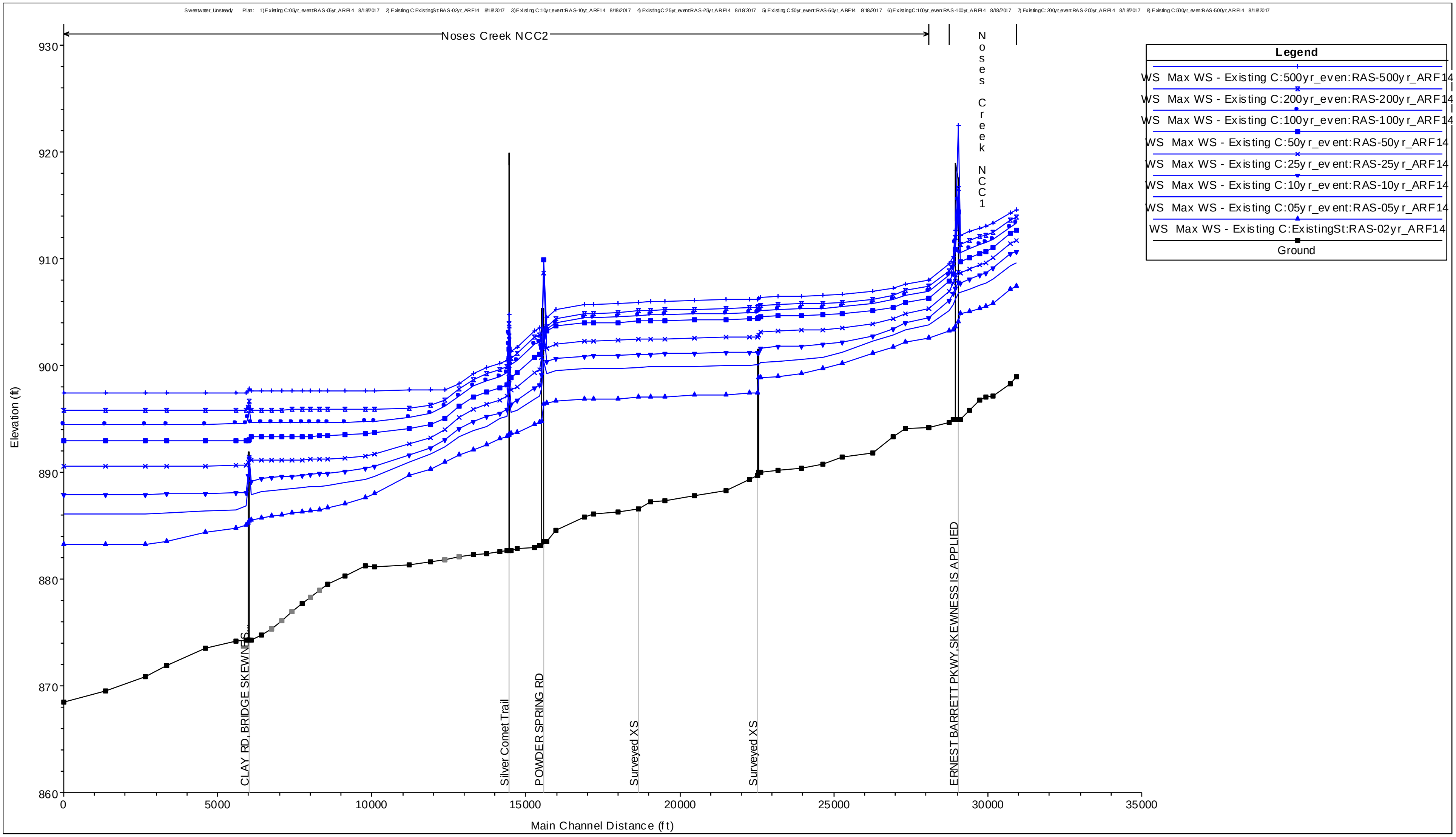
APPENDIX B1: WATER SURFACE PROFILES

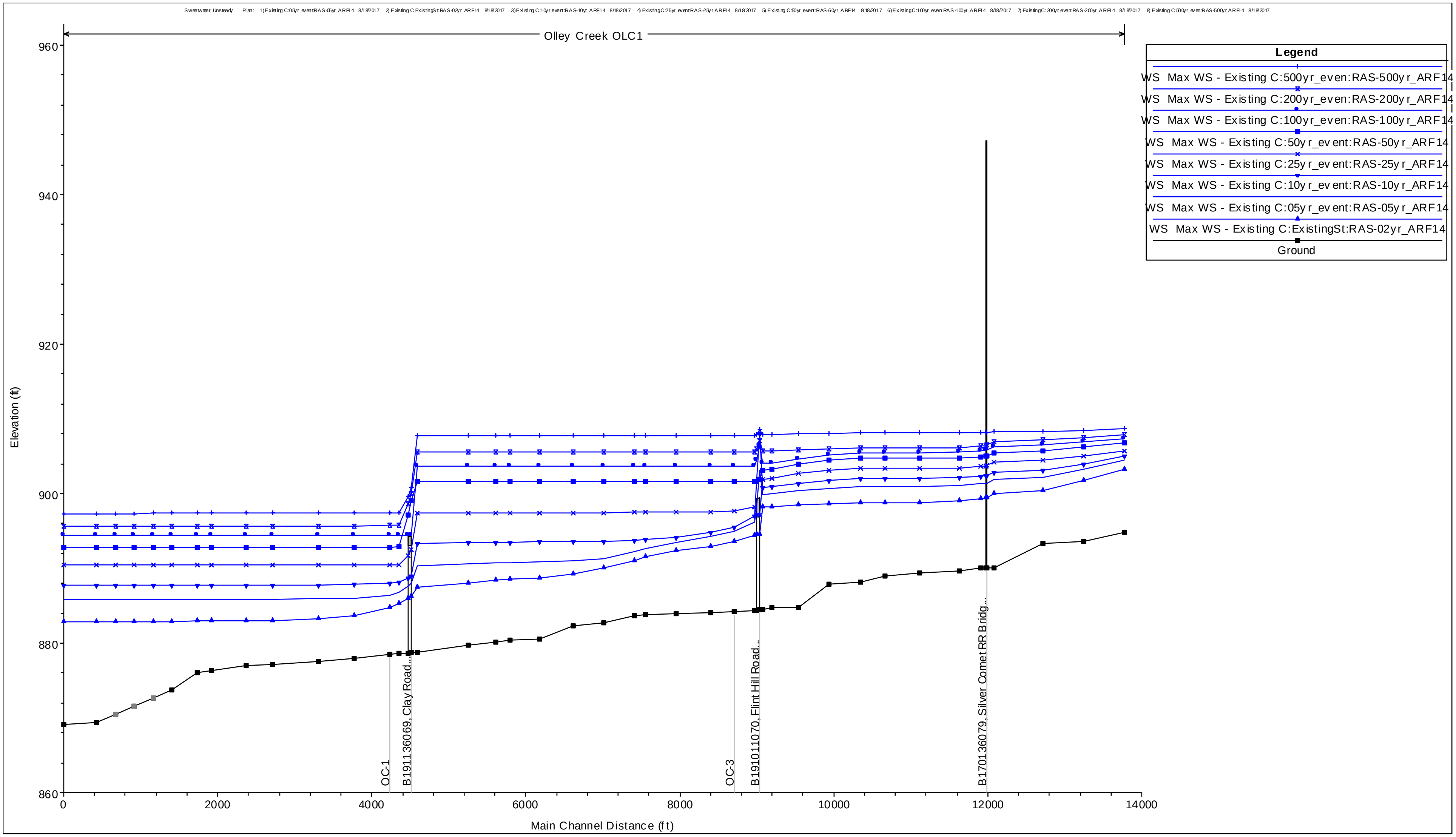
Existing Conditions

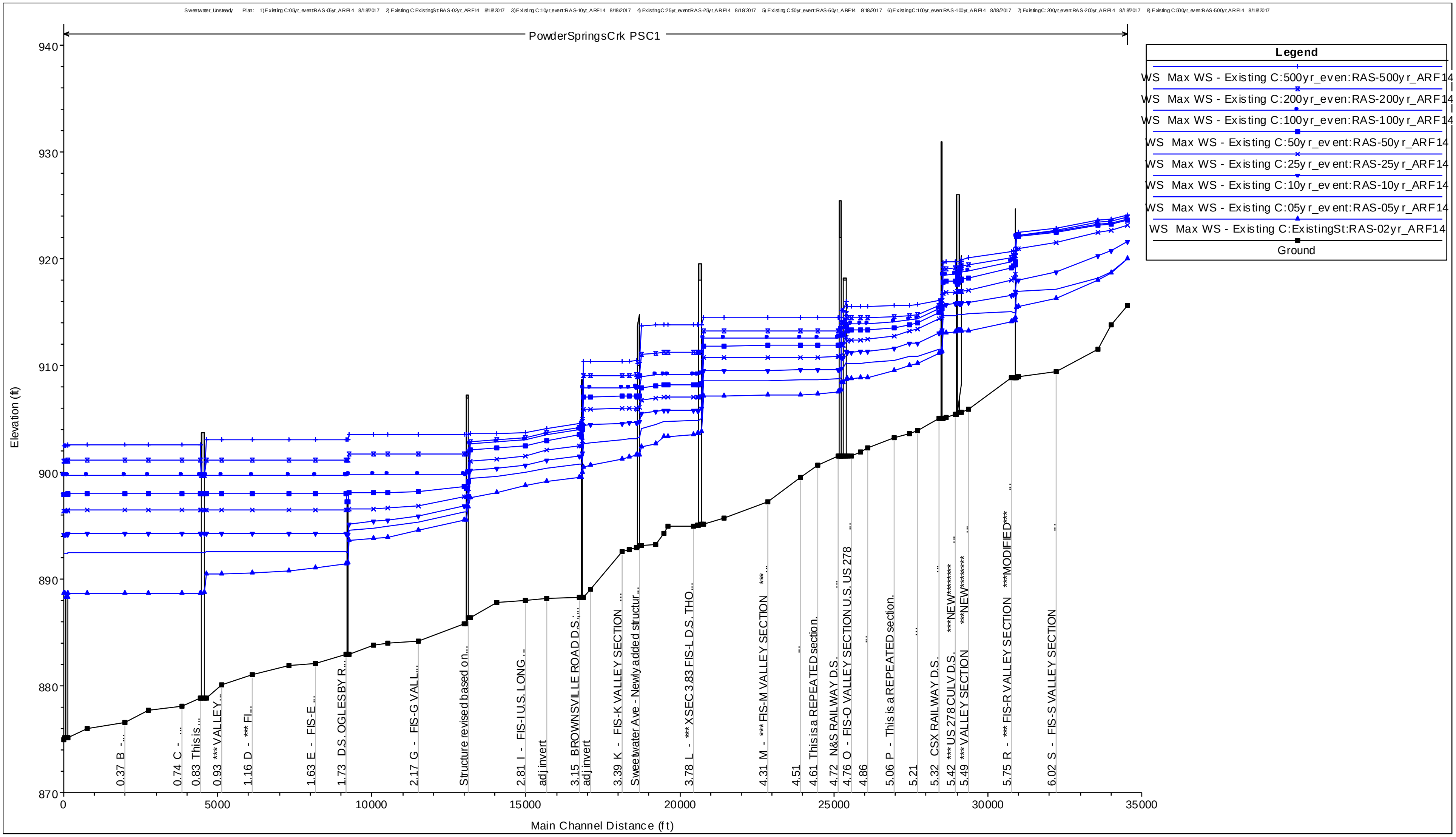


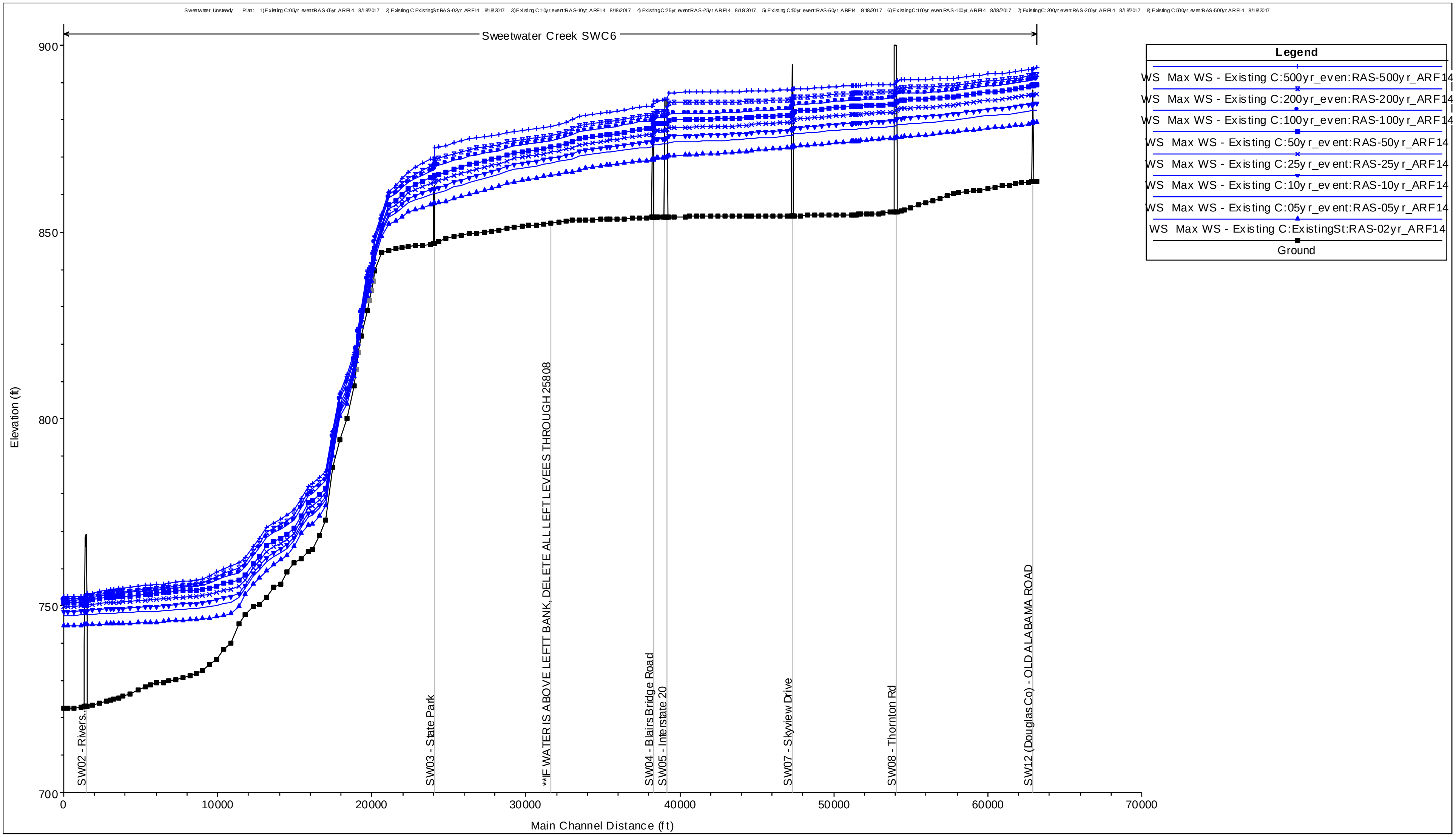

Sweetwater_Unsteady Plan: 1) Existing C:05yr_event:RAS-05yr_ARF14 8/18/2017 2) Existing C:ExistingSt:RAS-02yr_ARF14 8/18/2017 3) Existing C:10yr_event:RAS-10yr_ARF14 8/18/2017 4) ExistingC:25yr_event:RAS-25yr_ARF14 8/18/2017 5) Existing C:50yr_event:RAS-50yr_ARF14 8/18/2017 6) ExistingC:100yr_even:RAS-100yr_ARF14 8/18/2017 7) ExistingC:200yr_even:RAS-200yr_ARF14 8/18/2017 8) Existing C:500yr_even:RAS-500yr_ARF14 8/18/2017
MillCrk MIC1
Legend
WS Max WS - Existing C:500yr_even:RAS-500yr_ARF14
WS Max WS - Existing C:200yr_even:RAS-200yr_ARF14
WS Max WS - Existing C:100yr_even:RAS-100yr_ARF14
WS Max WS - Existing C:50yr_event:RAS-50yr_ARF14
WS Max WS - Existing C:25yr_event:RAS-25yr_ARF14
WS Max WS - Existing C:10yr_event:RAS-10yr_ARF14
WS Max WS - Existing C:05yr_event:RAS-05yr_ARF14
WS Max WS - Existing C:ExistingSt:RAS-02yr_ARF14
Ground
Elevation (ft)
925
920
915
910
905
900
895
890
885
0
2000
4000
6000
8000
10000
12000
14000
16000
Main Channel Distance (ft)

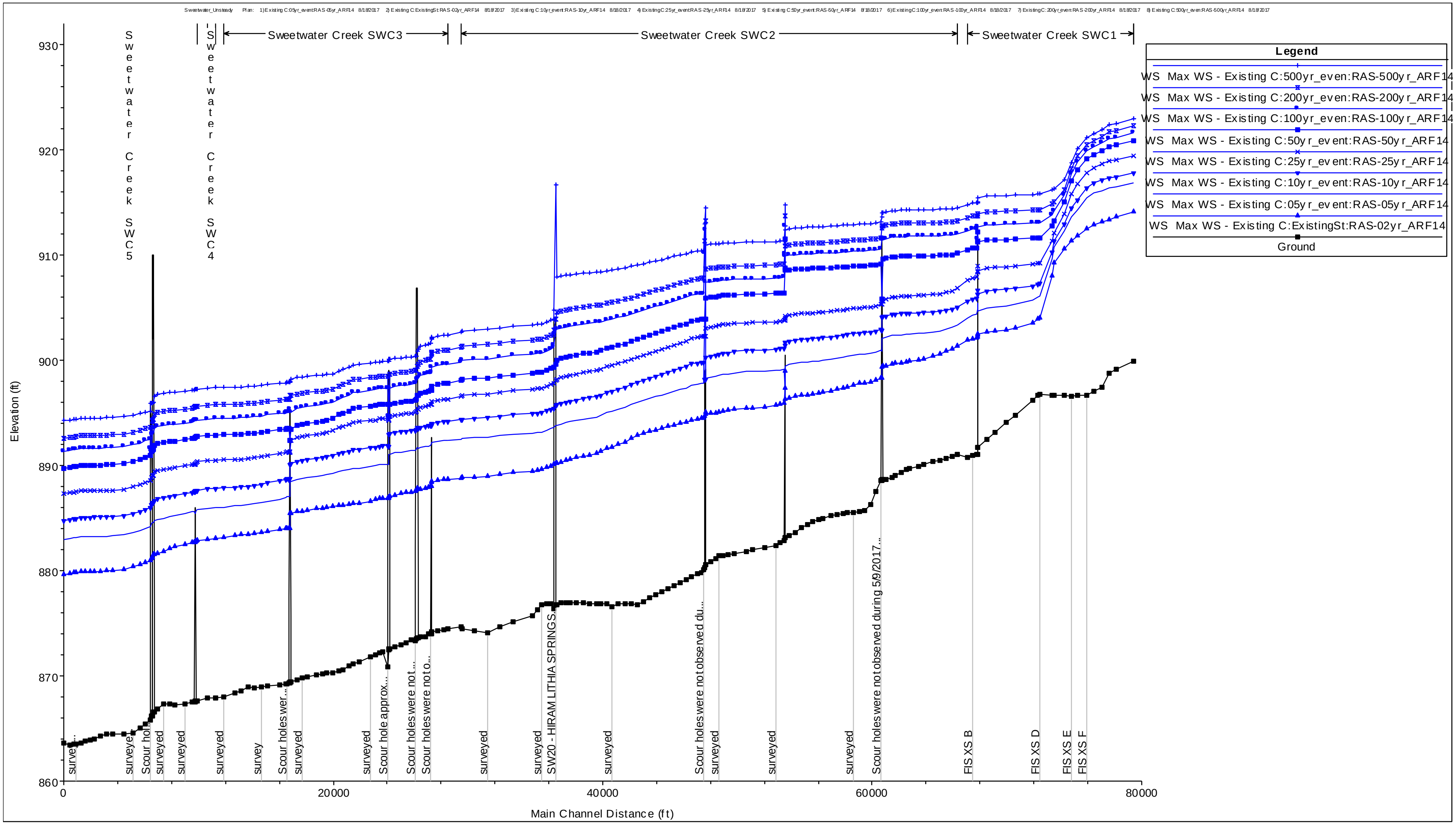

Sweetwater_Unsteady Plan: 1) Existing C:05yr_event:RAS-05yr_ARF14 8/18/2017 2) Existing C:ExistingSt:RAS-02yr_ARF14 8/18/2017 3) Existing C:10yr_event:RAS-10yr_ARF14 8/18/2017 4) Existing C:25yr_event:RAS-25yr_ARF14 8/18/2017 5) Existing C:50yr_event:RAS-50yr_ARF14 8/18/2017 6) Existing C:100yr_event:RAS-100yr_ARF14 8/18/2017 7) Existing C:200yr_event:RAS-200yr_ARF14 8/18/2017 8) Existing C:500yr_event:RAS-500yr_ARF14 8/18/2017
Mud Creek MDC1
Legend
WS Max WS - Existing C:500yr_even:RAS-500yr_ARF14
WS Max WS - Existing C:200yr_even:RAS-200yr_ARF14
WS Max WS - Existing C:100yr_even:RAS-100yr_ARF14
WS Max WS - Existing C:50yr_event:RAS-50yr_ARF14
WS Max WS - Existing C:25yr_event:RAS-25yr_ARF14
WS Max WS - Existing C:10yr_event:RAS-10yr_ARF14
WS Max WS - Existing C:05yr_event:RAS-05yr_ARF14
WS Max WS - Existing C:ExistingSt:RAS-02yr_ARF14
Ground
Elevation (ft)
920
915
910
905
900
895
890
0 Mouth at Noses...
1690 This is a REPEATED se...
Macland Road
1811
1870
4920 ASSUME this is confluence of Luther Ward
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (ft)


Sweetwater_Unsteady Plan: 1) Existing C:05yr_event:RAS-05yr_ARF14 8/18/2017 2) Existing C:ExistingSt:RAS-02yr_ARF14 8/18/2017 3) Existing C:10yr_event:RAS-10yr_ARF14 8/18/2017 4) Existing C:25yr_event:RAS-25yr_ARF14 8/18/2017 5) Existing C:50yr_event:RAS-50yr_ARF14 8/18/2017 6) Existing C:100yr_event:RAS-100yr_ARF14 8/18/2017 7) Existing C:200yr_event:RAS-200yr_ARF14 8/18/2017 8) Existing C:500yr_even:RAS-500yr_ARF14 8/18/2017
Noses Creek NCC2
Noses Creek NCC1
Legend
WS Max WS - Existing C:500yr_even:RAS-500yr_ARF14
WS Max WS - Existing C:200yr_even:RAS-200yr_ARF14
WS Max WS - Existing C:100yr_even:RAS-100yr_ARF14
WS Max WS - Existing C:50yr_event:RAS-50yr_ARF14
WS Max WS - Existing C:25yr_event:RAS-25yr_ARF14
WS Max WS - Existing C:10yr_event:RAS-10yr_ARF14
WS Max WS - Existing C:05yr_event:RAS-05yr_ARF14
WS Max WS - Existing C:ExistingSt:RAS-02yr_ARF14
Ground
Elevation (ft)
930
920
910
900
890
880
870
860
CLAY RD, BRIDGE SKEWNES
Silver Comet Trail
POWDER SPRING RD
Surveyed XS
Surveyed XS
ERNEST BARRETT PKWY,SKEWNESS IS APPLIED
0
5000
10000
15000
20000
25000
30000
35000
Main Channel Distance (ft)


Sweetwater_Unsteady Plan: 1) Existing C:05yr_event:RAS-05yr_ARF14 8/18/2017 2) Existing C:ExistingSt:RAS-02yr_ARF14 8/18/2017 3) Existing C:10yr_event:RAS-10yr_ARF14 8/18/2017 4) Existing C:25yr_event:RAS-25yr_ARF14 8/18/2017 5) Existing C:50yr_event:RAS-50yr_ARF14 8/18/2017 6) Existing C:100yr_event:RAS-100yr_ARF14 8/18/2017 7) Existing C:200yr_event:RAS-200yr_ARF14 8/18/2017 8) Existing C:500yr_even:RAS-500yr_ARF14 8/18/2017
Olley Creek OLC1
Legend
WS Max WS - Existing C:500yr_even:RAS-500yr_ARF14
WS Max WS - Existing C:200yr_even:RAS-200yr_ARF14
WS Max WS - Existing C:100yr_even:RAS-100yr_ARF14
WS Max WS - Existing C:50yr_event:RAS-50yr_ARF14
WS Max WS - Existing C:25yr_event:RAS-25yr_ARF14
WS Max WS - Existing C:10yr_event:RAS-10yr_ARF14
WS Max WS - Existing C:05yr_event:RAS-05yr_ARF14
WS Max WS - Existing C:ExistingSt:RAS-02yr_ARF14
Ground
Elevation (ft)
960
940
920
900
880
860
OC-1
B191136069, Clay Road...
OC-3
B191011070, Flint Hill Road...
B170136079, Silver Comet RR Bridg...
0
2000
4000
6000
8000
10000
12000
14000
Main Channel Distance (ft)

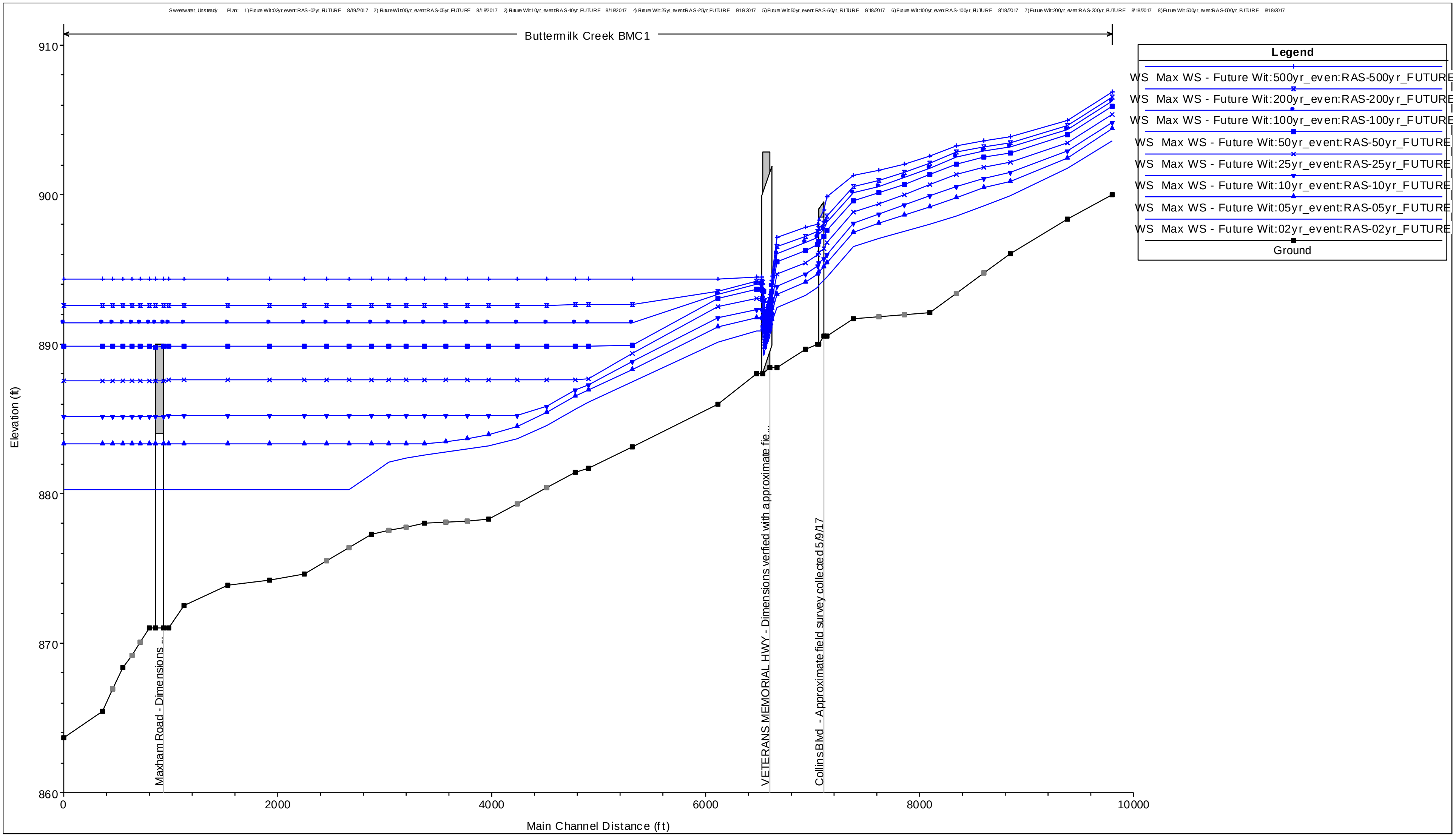

PowderSpringsCrk PSC1
Legend
WS Max WS - Existing C:500yr_even:RAS-500yr_ARF14
WS Max WS - Existing C:200yr_even:RAS-200yr_ARF14
WS Max WS - Existing C:100yr_even:RAS-100yr_ARF14
WS Max WS - Existing C:50yr_event:RAS-50yr_ARF14
WS Max WS - Existing C:25yr_event:RAS-25yr_ARF14
WS Max WS - Existing C:10yr_event:RAS-10yr_ARF14
WS Max WS - Existing C:05yr_event:RAS-05yr_ARF14
WS Max WS - Existing C:ExistingSt:RAS-02yr_ARF14
Ground
Elevation (ft)
Main Channel Distance (ft)

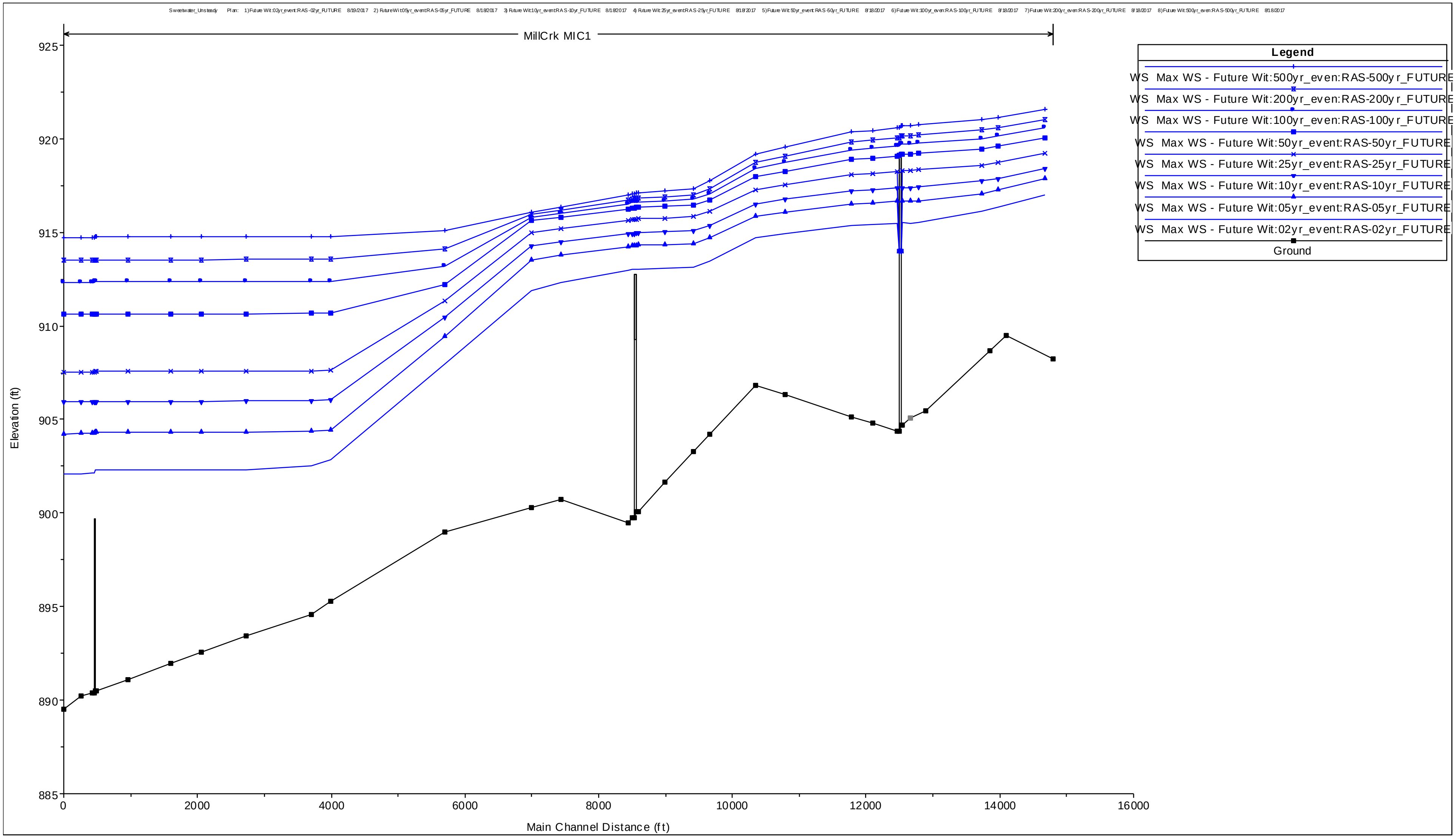

Sweetwater Creek SWC6
Legend
WS Max WS - Existing C:500yr_even:RAS-500yr_ARF14
WS Max WS - Existing C:200yr_even:RAS-200yr_ARF14
WS Max WS - Existing C:100yr_even:RAS-100yr_ARF14
WS Max WS - Existing C:50yr_event:RAS-50yr_ARF14
WS Max WS - Existing C:25yr_event:RAS-25yr_ARF14
WS Max WS - Existing C:10yr_event:RAS-10yr_ARF14
WS Max WS - Existing C:05yr_event:RAS-05yr_ARF14
WS Max WS - Existing C:ExistingSt:RAS-02yr_ARF14
Ground
Elevation (ft)
900
850
800
750
700
0
10000
20000
30000
40000
50000
60000
70000
Main Channel Distance (ft)
SW02 - Rivers...
SW03 - State Park
**IF WATER IS ABOVE LEFTT BANK, DELETE ALL LEFT LEVEES THROUGH 25808
SW04 - Blairs Bridge Road
SW05 - Interstate 20
SW07 - Skyview Drive
SW08 - Thornton Rd
SW12 (Douglas Co) - OLD ALABAMA ROAD

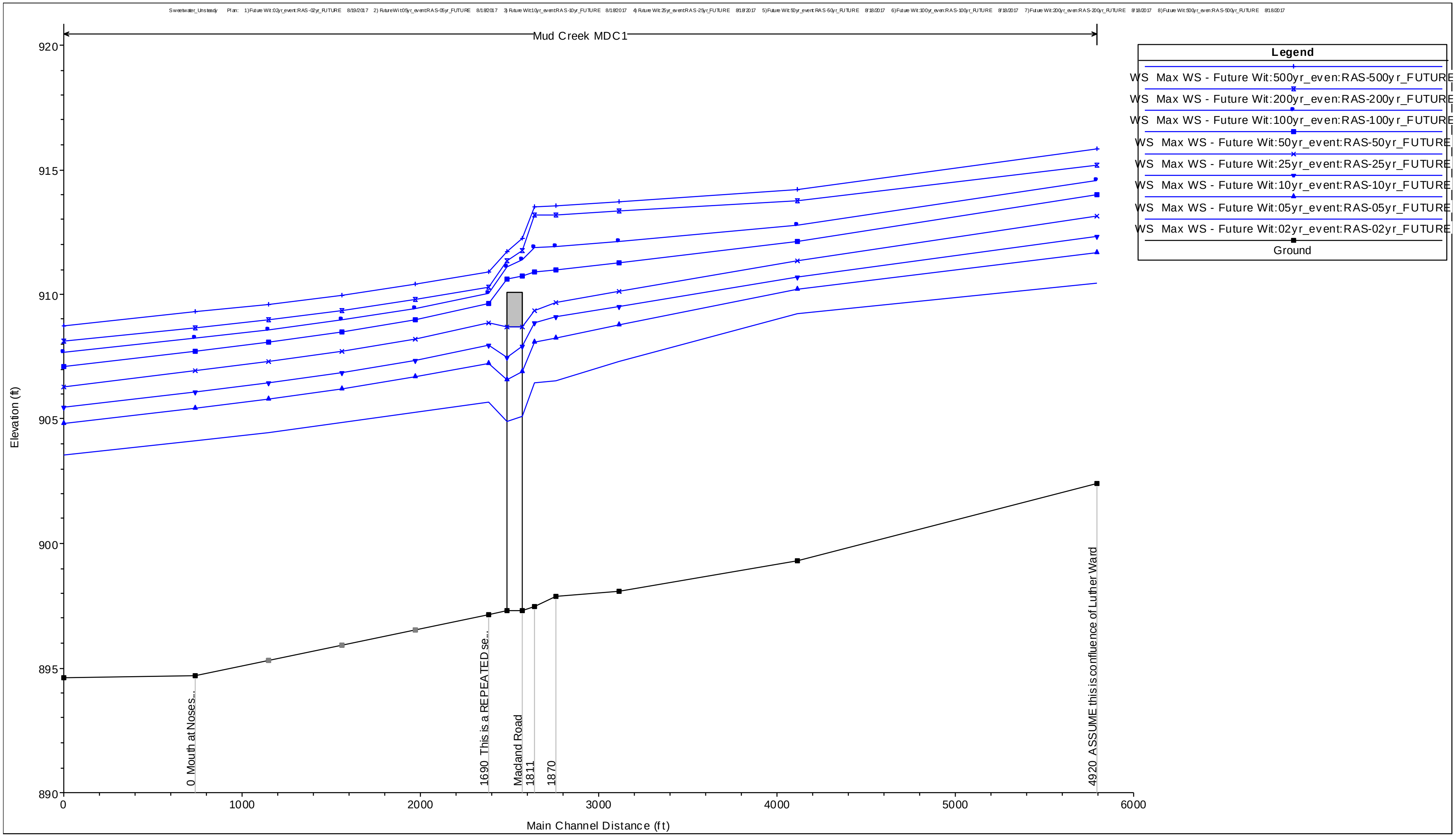


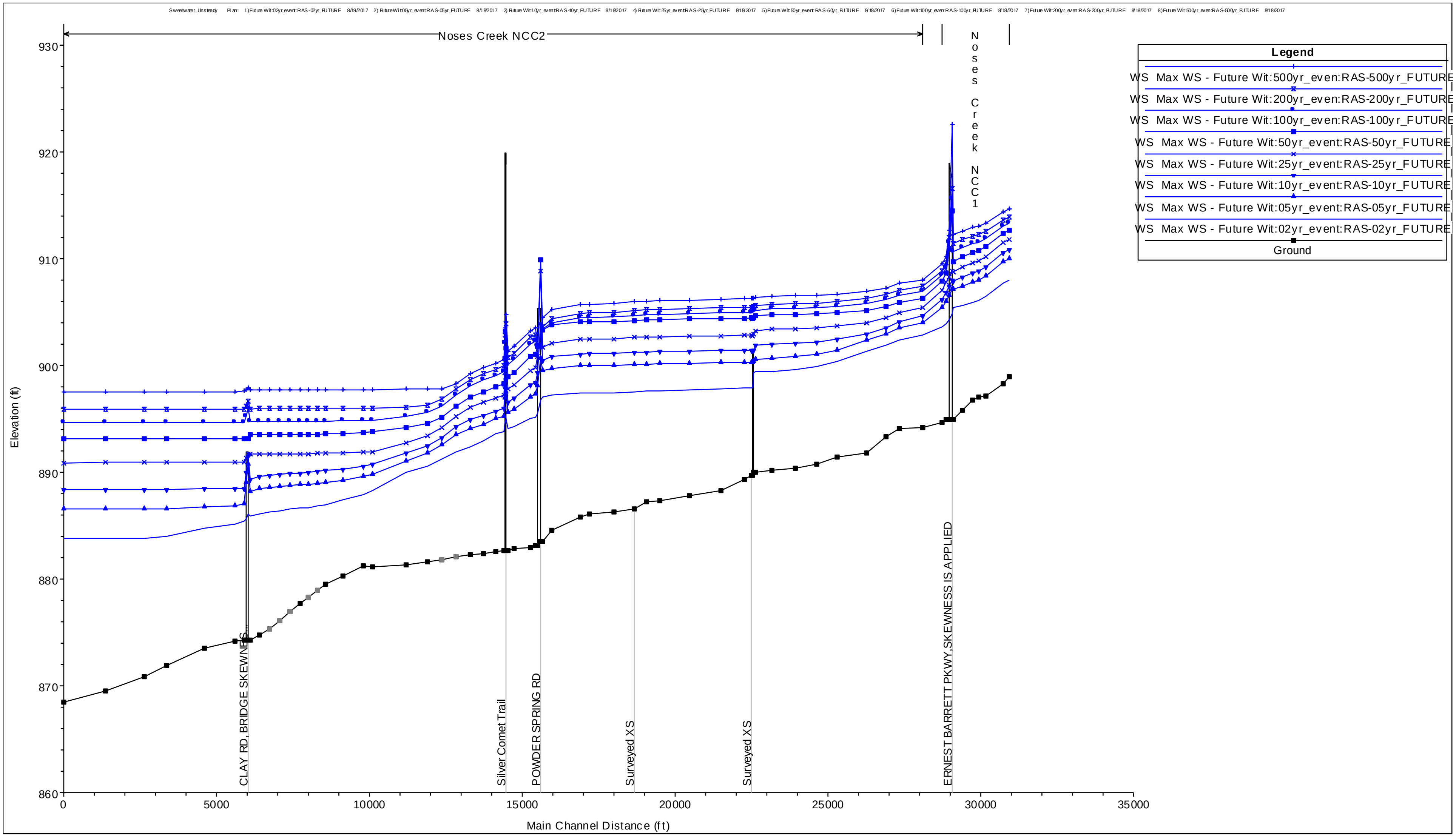
* Main Channel Distance (ft) values should be added to STA 63230 from SWC6 reach above for a continuous profile.

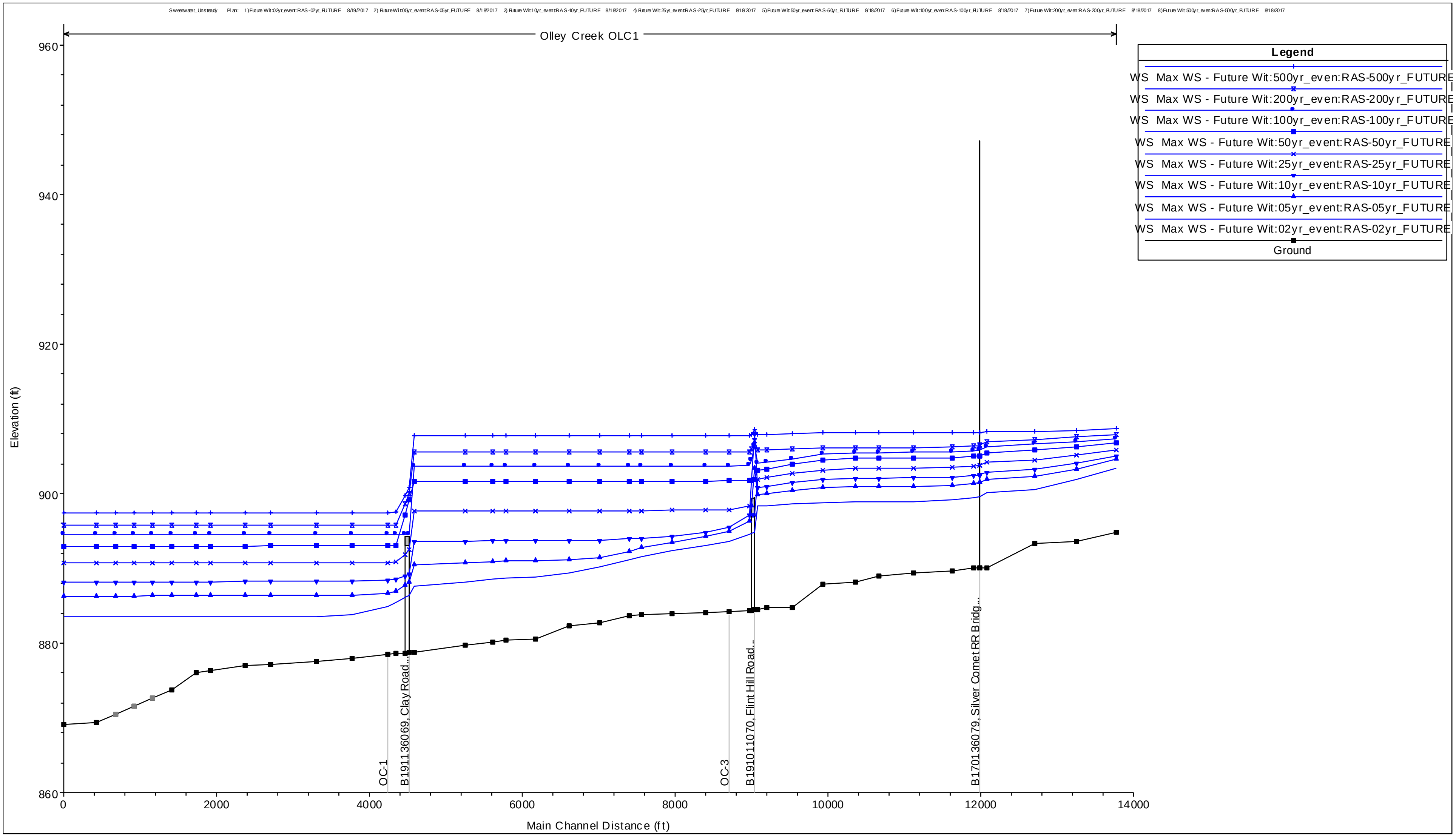
Future Without Project

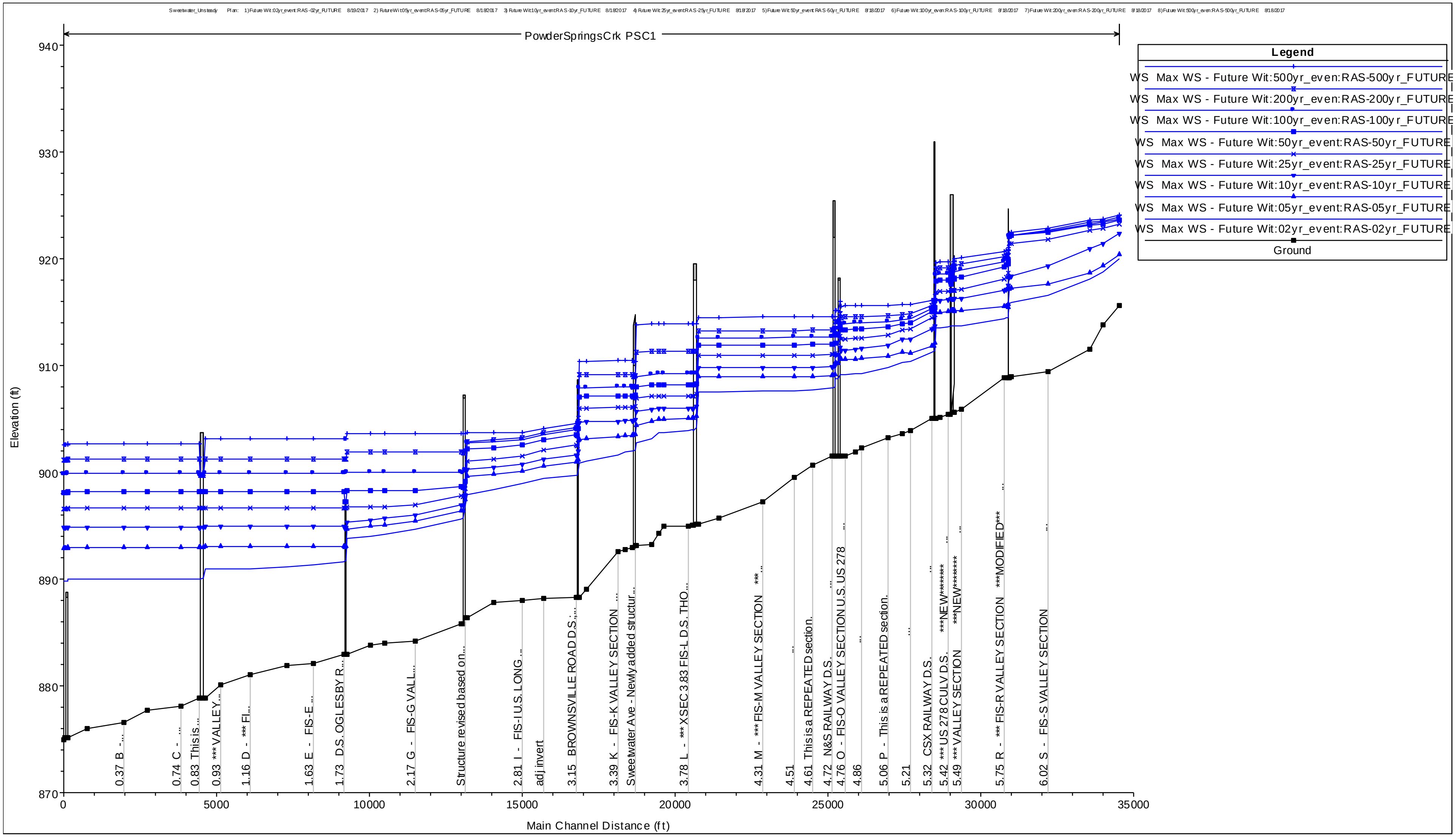


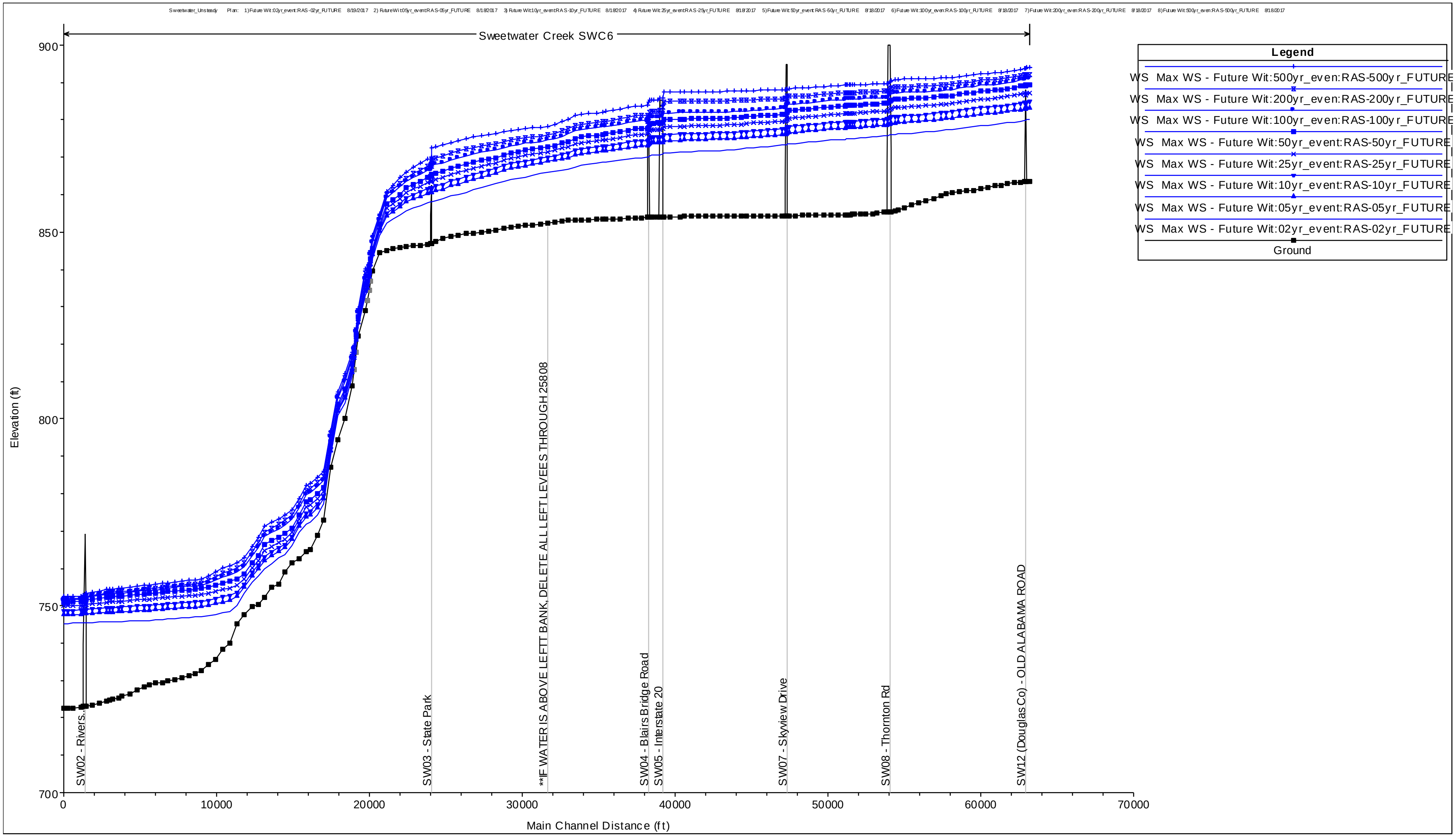

Sweetwater_Unsteady Plan: 1) Future Wit:02yr_event:RAS-02yr_FUTURE 8/19/2017 2) Future Wit:05yr_event:RAS-05yr_FUTURE 8/18/2017 3) Future Wit:10yr_event:RAS-10yr_FUTURE 8/18/2017 4) Future Wit:25yr_event:RAS-25yr_FUTURE 8/18/2017 5) Future Wit:50yr_event:RAS-50yr_FUTURE 8/18/2017 6) Future Wit:100yr_even:RAS-100yr_FUTURE 8/18/2017 7) Future Wit:200yr_even:RAS-200yr_FUTURE 8/18/2017 8) Future Wit:500yr_even:RAS-500yr_FUTURE 8/18/2017
MillCrk MIC1
Legend
WS Max WS - Future Wit:500yr_even:RAS-500yr_FUTURE
WS Max WS - Future Wit:200yr_even:RAS-200yr_FUTURE
WS Max WS - Future Wit:100yr_even:RAS-100yr_FUTURE
WS Max WS - Future Wit:50yr_event:RAS-50yr_FUTURE
WS Max WS - Future Wit:25yr_event:RAS-25yr_FUTURE
WS Max WS - Future Wit:10yr_event:RAS-10yr_FUTURE
WS Max WS - Future Wit:05yr_event:RAS-05yr_FUTURE
WS Max WS - Future Wit:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
925
920
915
910
905
900
895
890
885
0
2000
4000
6000
8000
10000
12000
14000
16000
Main Channel Distance (ft)

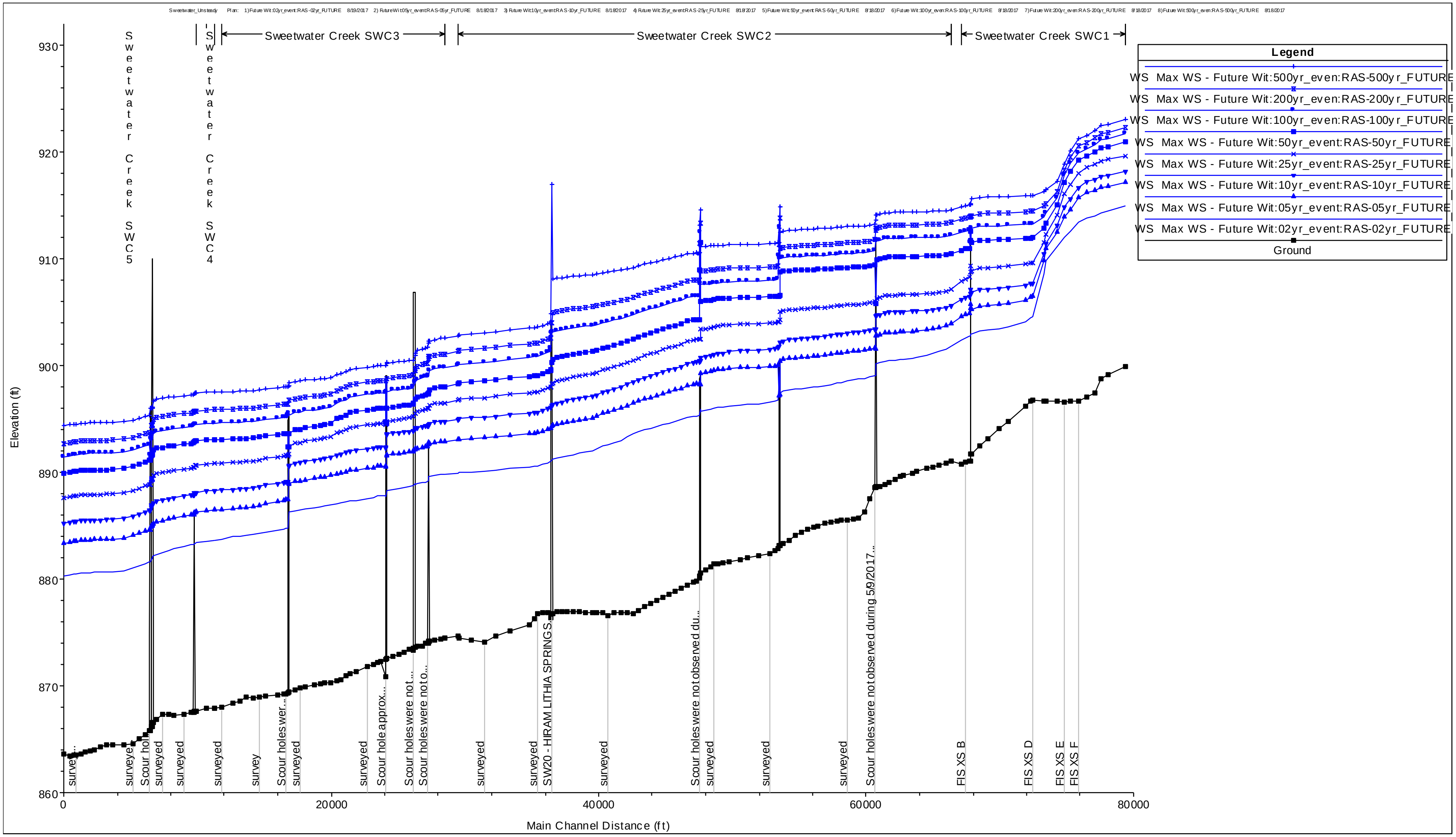

Sweetwater_Unsteady Plan: 1) Future Wit:02yr_event:RAS-02yr_FUTURE 8/19/2017 2) Future Wit:05yr_event:RAS-05yr_FUTURE 8/18/2017 3) Future Wit:10yr_event:RAS-10yr_FUTURE 8/18/2017 4) Future Wit:25yr_event:RAS-25yr_FUTURE 8/18/2017 5) Future Wit:50yr_event:RAS-50yr_FUTURE 8/18/2017 6) Future Wit:100yr_even:RAS-100yr_FUTURE 8/18/2017 7) Future Wit:200yr_even:RAS-200yr_FUTURE 8/18/2017 8) Future Wit:500yr_even:RAS-500yr_FUTURE 8/18/2017
Mud Creek MDC1
Legend
WS Max WS - Future Wit:500yr_even:RAS-500yr_FUTURE
WS Max WS - Future Wit:200yr_even:RAS-200yr_FUTURE
WS Max WS - Future Wit:100yr_even:RAS-100yr_FUTURE
WS Max WS - Future Wit:50yr_event:RAS-50yr_FUTURE
WS Max WS - Future Wit:25yr_event:RAS-25yr_FUTURE
WS Max WS - Future Wit:10yr_event:RAS-10yr_FUTURE
WS Max WS - Future Wit:05yr_event:RAS-05yr_FUTURE
WS Max WS - Future Wit:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
920
915
910
905
900
895
890
0 Mouth at Noses...
1690 This is a REPEATED se...
Macland Road
1811
1870
4920 ASSUME this is confluence of Luther Ward
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (ft)


Sweetwater_Unsteady Plan: 1) Future Wit:02yr_event:RAS-02yr_FUTURE 8/19/2017 2) Future Wit:05yr_event:RAS-05yr_FUTURE 8/18/2017 3) Future Wit:10yr_event:RAS-10yr_FUTURE 8/18/2017 4) Future Wit:25yr_event:RAS-25yr_FUTURE 8/18/2017 5) Future Wit:50yr_event:RAS-50yr_FUTURE 8/18/2017 6) Future Wit:100yr_even:RAS-100yr_FUTURE 8/18/2017 7) Future Wit:200yr_even:RAS-200yr_FUTURE 8/18/2017 8) Future Wit:500yr_even:RAS-500yr_FUTURE 8/18/2017
Noses Creek NCC2
Noses Creek NCC1
Legend
WS Max WS - Future Wit:500yr_even:RAS-500yr_FUTURE
WS Max WS - Future Wit:200yr_even:RAS-200yr_FUTURE
WS Max WS - Future Wit:100yr_even:RAS-100yr_FUTURE
WS Max WS - Future Wit:50yr_event:RAS-50yr_FUTURE
WS Max WS - Future Wit:25yr_event:RAS-25yr_FUTURE
WS Max WS - Future Wit:10yr_event:RAS-10yr_FUTURE
WS Max WS - Future Wit:05yr_event:RAS-05yr_FUTURE
WS Max WS - Future Wit:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
930
920
910
900
890
880
870
860
CLAY RD, BRIDGE SKEWNESS
Silver Comet Trail
POWDER SPRING RD
Surveyed XS
Surveyed XS
ERNEST BARRETT PKWY, SKEWNESS IS APPLIED
0
5000
10000
15000
20000
25000
30000
35000
Main Channel Distance (ft)


Sweetwater_Unsteady Plan: 1) Future Wit:02yr_event:RAS-02yr_FUTURE 8/19/2017 2) Future Wit:05yr_event:RAS-05yr_FUTURE 8/18/2017 3) Future Wit:10yr_event:RAS-10yr_FUTURE 8/18/2017 4) Future Wit:25yr_event:RAS-25yr_FUTURE 8/18/2017 5) Future Wit:50yr_event:RAS-50yr_FUTURE 8/18/2017 6) Future Wit:100yr_even:RAS-100yr_FUTURE 8/18/2017 7) Future Wit:200yr_even:RAS-200yr_FUTURE 8/18/2017 8) Future Wit:500yr_even:RAS-500yr_FUTURE 8/18/2017
Olley Creek OLC1
Legend
WS Max WS - Future Wit:500yr_even:RAS-500yr_FUTURE
WS Max WS - Future Wit:200yr_even:RAS-200yr_FUTURE
WS Max WS - Future Wit:100yr_even:RAS-100yr_FUTURE
WS Max WS - Future Wit:50yr_event:RAS-50yr_FUTURE
WS Max WS - Future Wit:25yr_event:RAS-25yr_FUTURE
WS Max WS - Future Wit:10yr_event:RAS-10yr_FUTURE
WS Max WS - Future Wit:05yr_event:RAS-05yr_FUTURE
WS Max WS - Future Wit:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
960
940
920
900
880
860
OC-1
B191136069, Clay Road...
OC-3
B191011070, Flint Hill Road...
B170136079, Silver Comet RR Bridg...
0
2000
4000
6000
8000
10000
12000
14000
Main Channel Distance (ft)

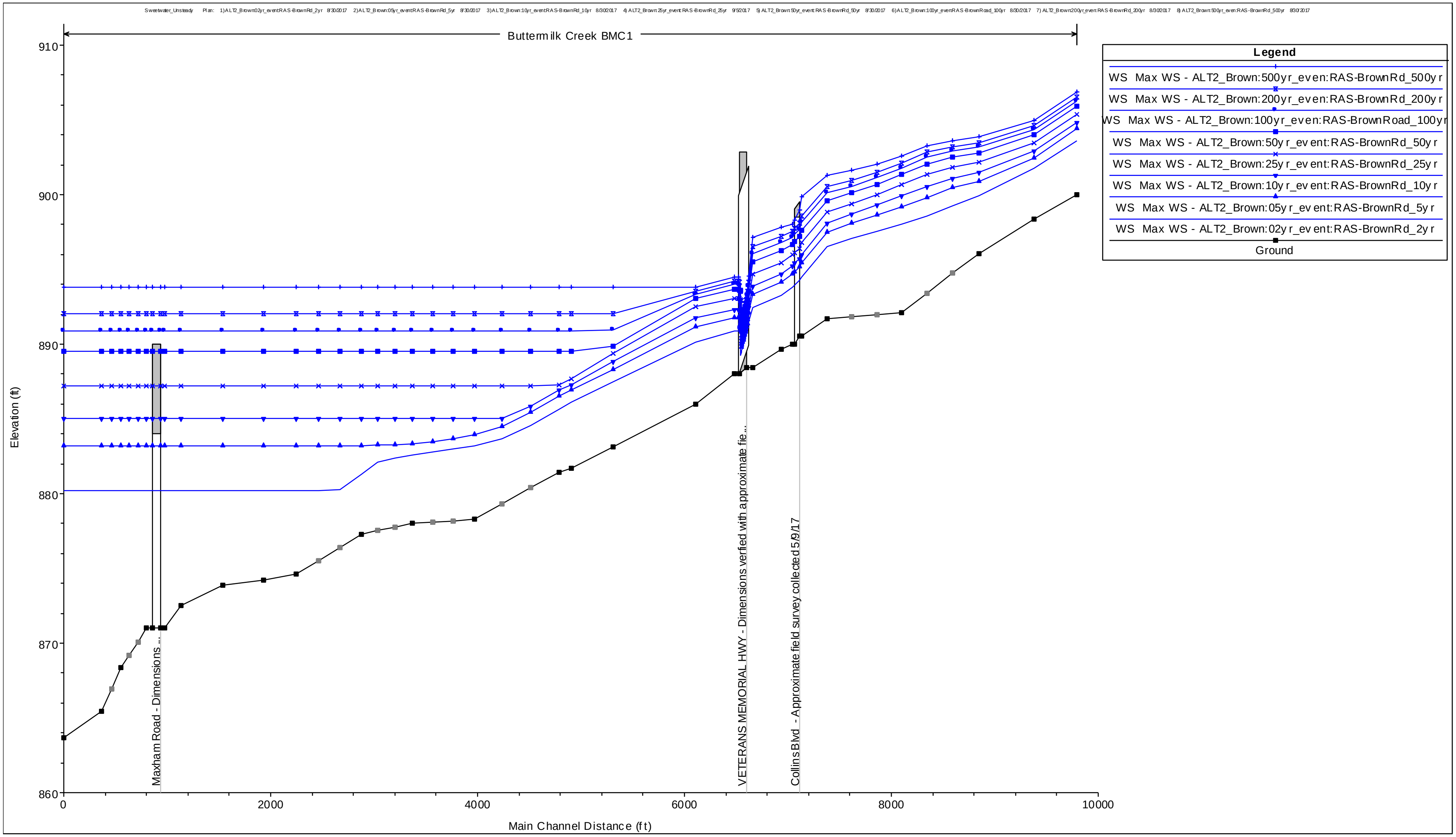

PowderSpringsCrk PSC1
Legend
WS Max WS - Future Wit:500yr_even:RAS-500yr_FUTURE
WS Max WS - Future Wit:200yr_even:RAS-200yr_FUTURE
WS Max WS - Future Wit:100yr_even:RAS-100yr_FUTURE
WS Max WS - Future Wit:50yr_event:RAS-50yr_FUTURE
WS Max WS - Future Wit:25yr_event:RAS-25yr_FUTURE
WS Max WS - Future Wit:10yr_event:RAS-10yr_FUTURE
WS Max WS - Future Wit:05yr_event:RAS-05yr_FUTURE
WS Max WS - Future Wit:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
Main Channel Distance (ft)
0.37 B - ...
0.74 C - ...
0.83 This is...
0.93 *** VALLEY...
1.16 D - *** Fl...
1.63 E - FIS-E ...
1.73 D.S. OGLESBY R...
2.17 G - FIS-G VALL...
Structure revised based on...
2.81 I - FIS-I U.S. LONG...
adj invert
3.15 BROWNSVILLE ROAD D.S. ...
3.39 K - FIS-K VALLEY SECTION ...
Sweetwater Ave - Newly added structur...
3.78 L - *** XSEC 3.83 FIS-L D.S. THO...
4.31 M - *** FIS-M VALLEY SECTION *** ...
4.51
4.61 This is a REPEATED section.
4.72 N&S RAILWAY D.S.
4.76 O - FIS-O VALLEY SECTION U.S. US 278
4.86
5.06 P - This is a REPEATED section.
5.21
5.32 CSX RAILWAY D.S.
5.42 *** US 278 CULV D.S. ***NEW*******
5.49 *** VALLEY SECTION ***NEW*******
5.75 R - *** FIS-R VALLEY SECTION ***MODIFIED***
6.02 S - FIS-S VALLEY SECTION

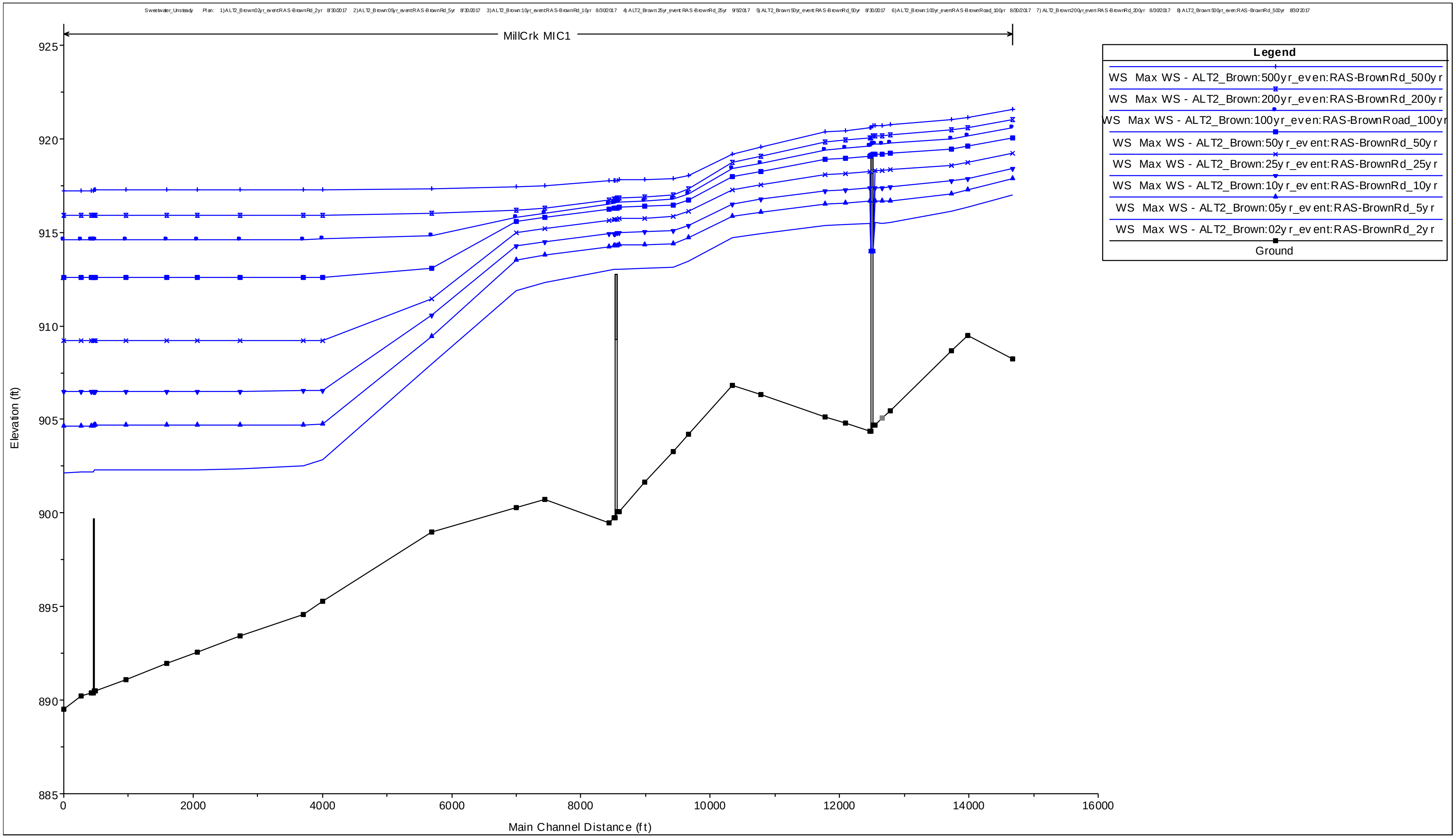

Sweetwater Creek SWC6
Legend
WS Max WS - Future Wit:500yr_even:RAS-500yr_FUTURE
WS Max WS - Future Wit:200yr_even:RAS-200yr_FUTURE
WS Max WS - Future Wit:100yr_even:RAS-100yr_FUTURE
WS Max WS - Future Wit:50yr_event:RAS-50yr_FUTURE
WS Max WS - Future Wit:25yr_event:RAS-25yr_FUTURE
WS Max WS - Future Wit:10yr_event:RAS-10yr_FUTURE
WS Max WS - Future Wit:05yr_event:RAS-05yr_FUTURE
WS Max WS - Future Wit:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
900
850
800
750
700
SW02 - Rivers.
SW03 - State Park
**IF WATER IS ABOVE LEFTT BANK, DELETE ALL LEFT LEVEES THROUGH 25808
SW04 - Blairs Bridge Road
SW05 - Interstate 20
SW07 - Skyview Drive
SW08 - Thornton Rd
SW12 (Douglas Co) - OLD ALABAMA ROAD
0
10000
20000
30000
40000
50000
60000
70000
Main Channel Distance (ft)

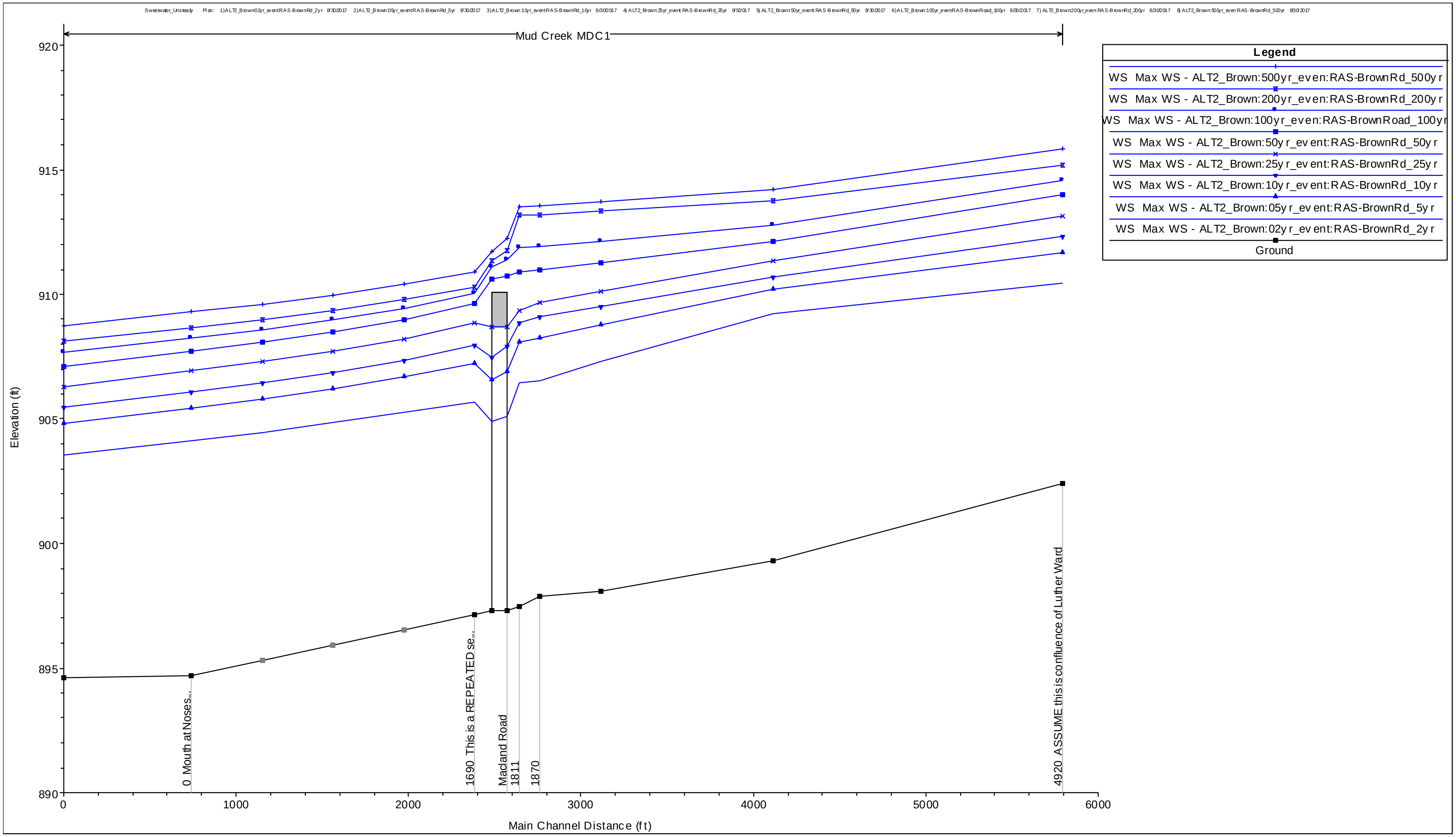


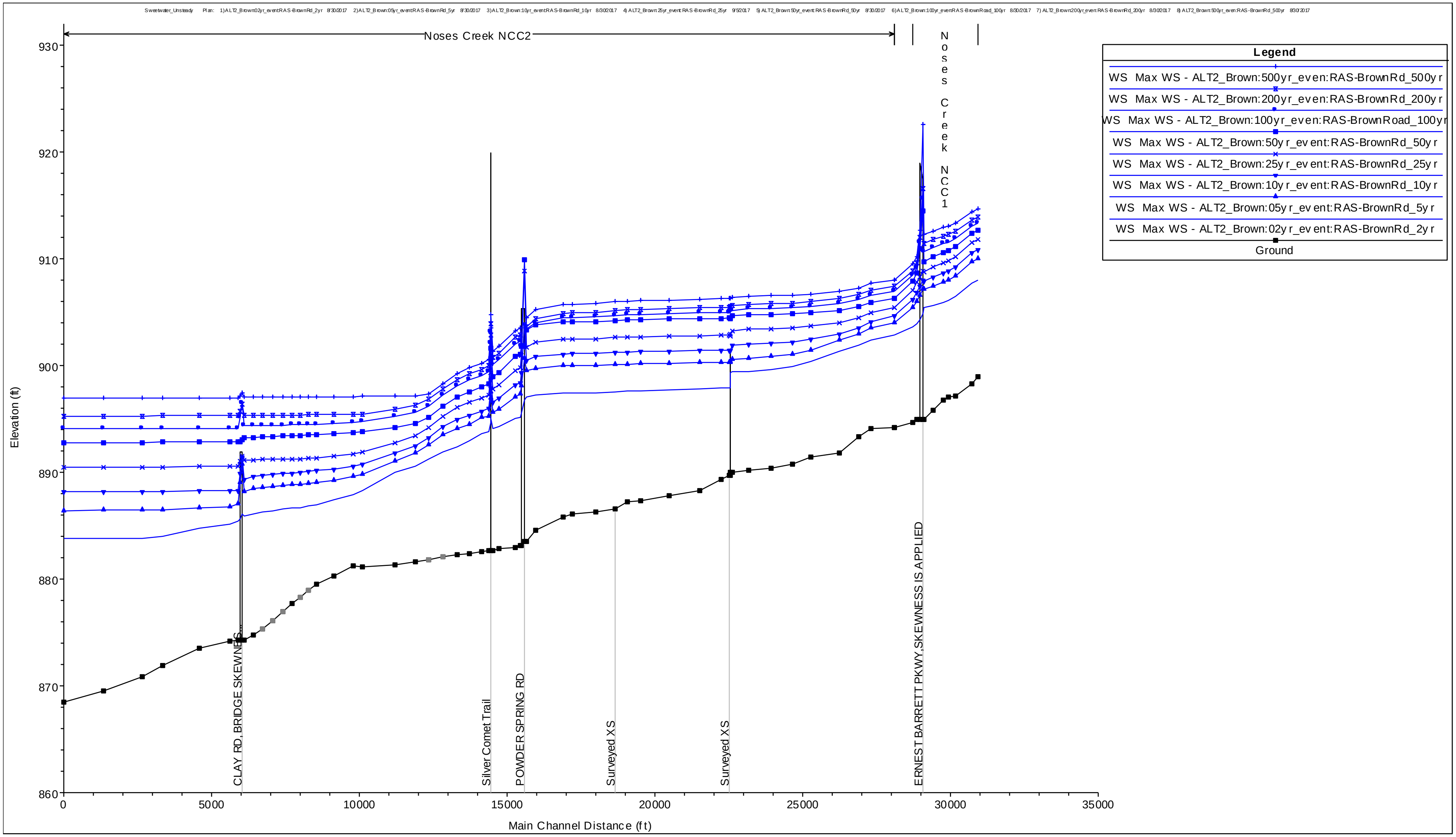
* Main Channel Distance (ft) values should be added to STA 63230 from SWC6 reach above for a continuous profile

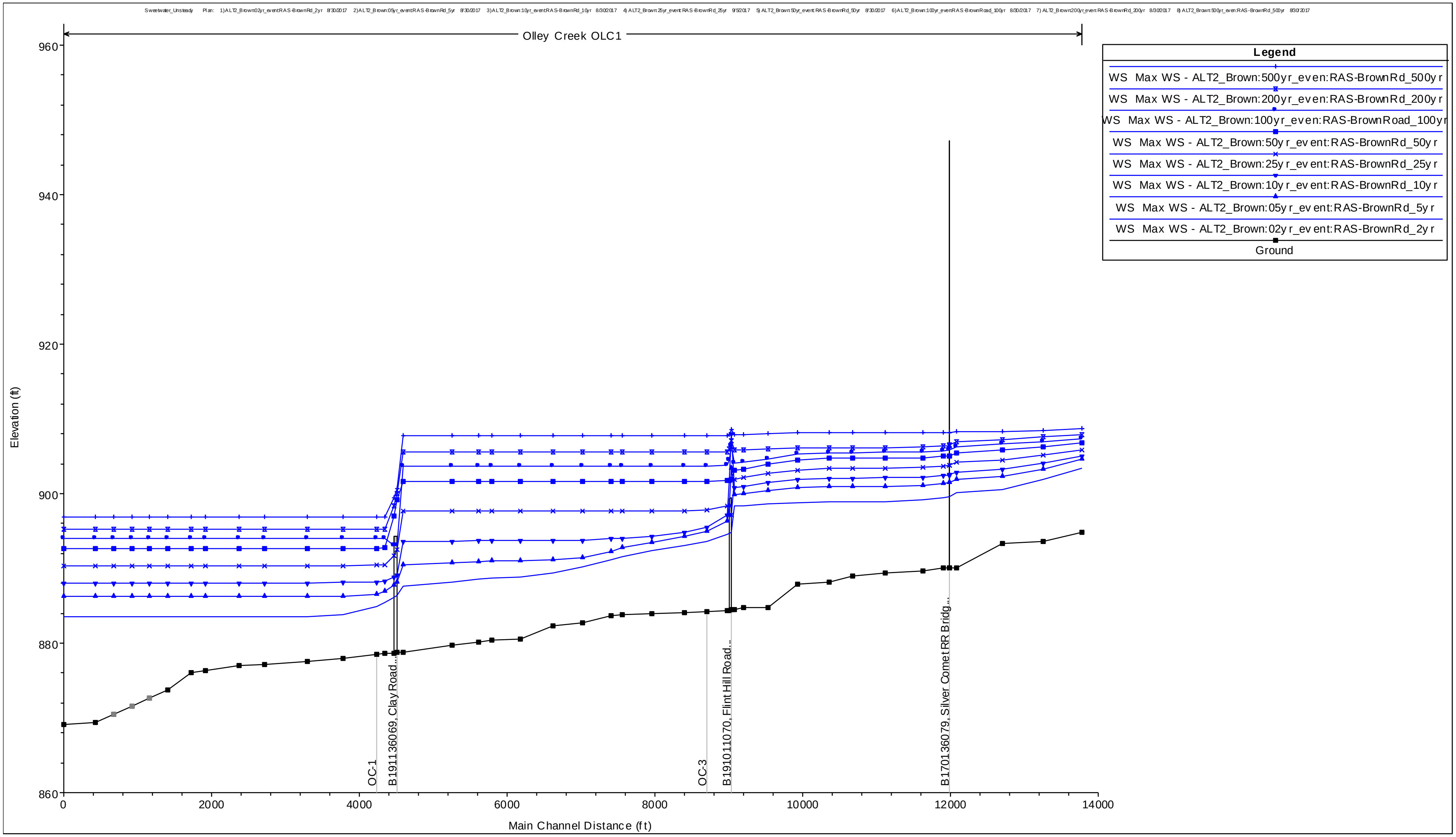
Alternative 2

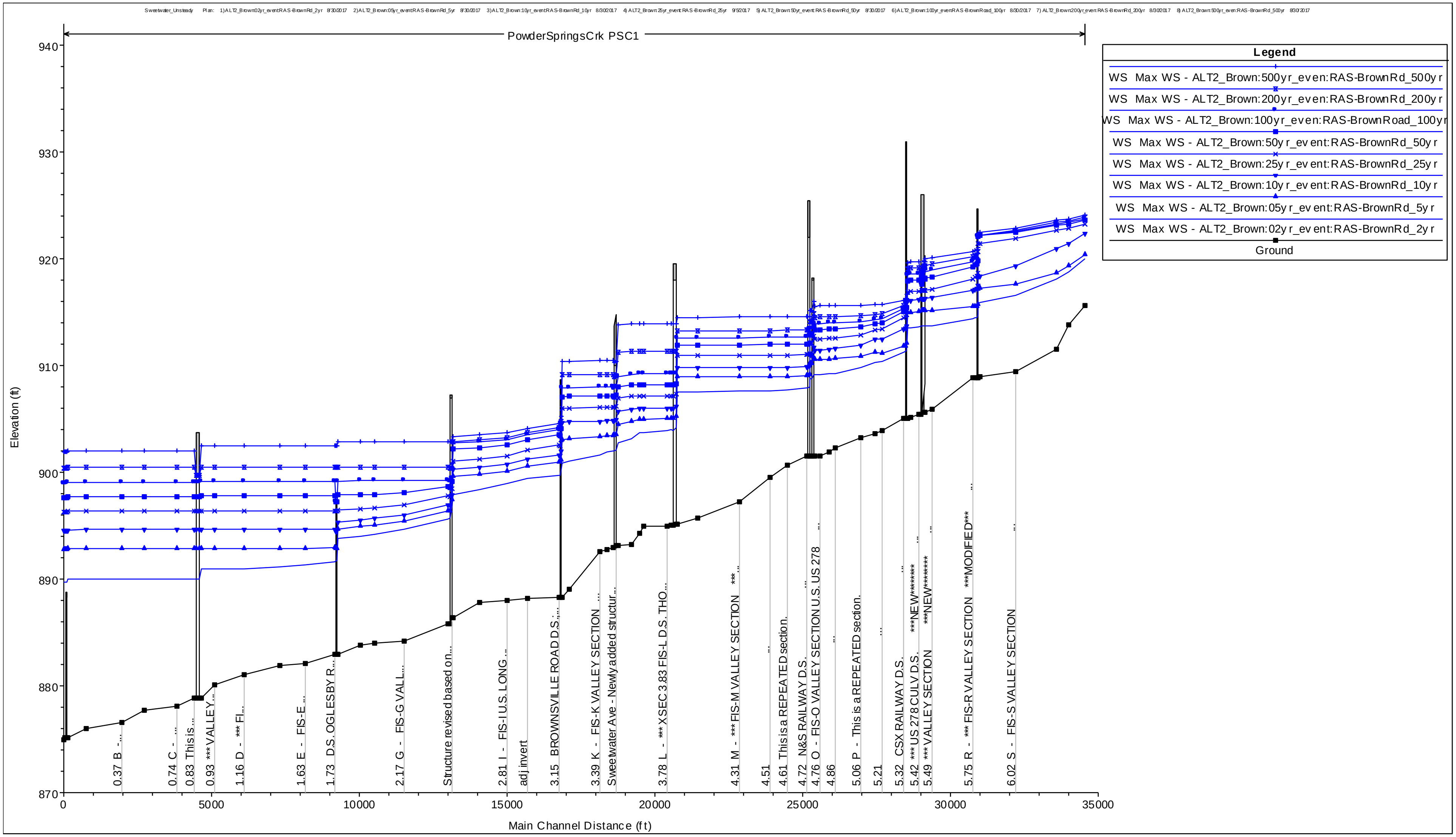


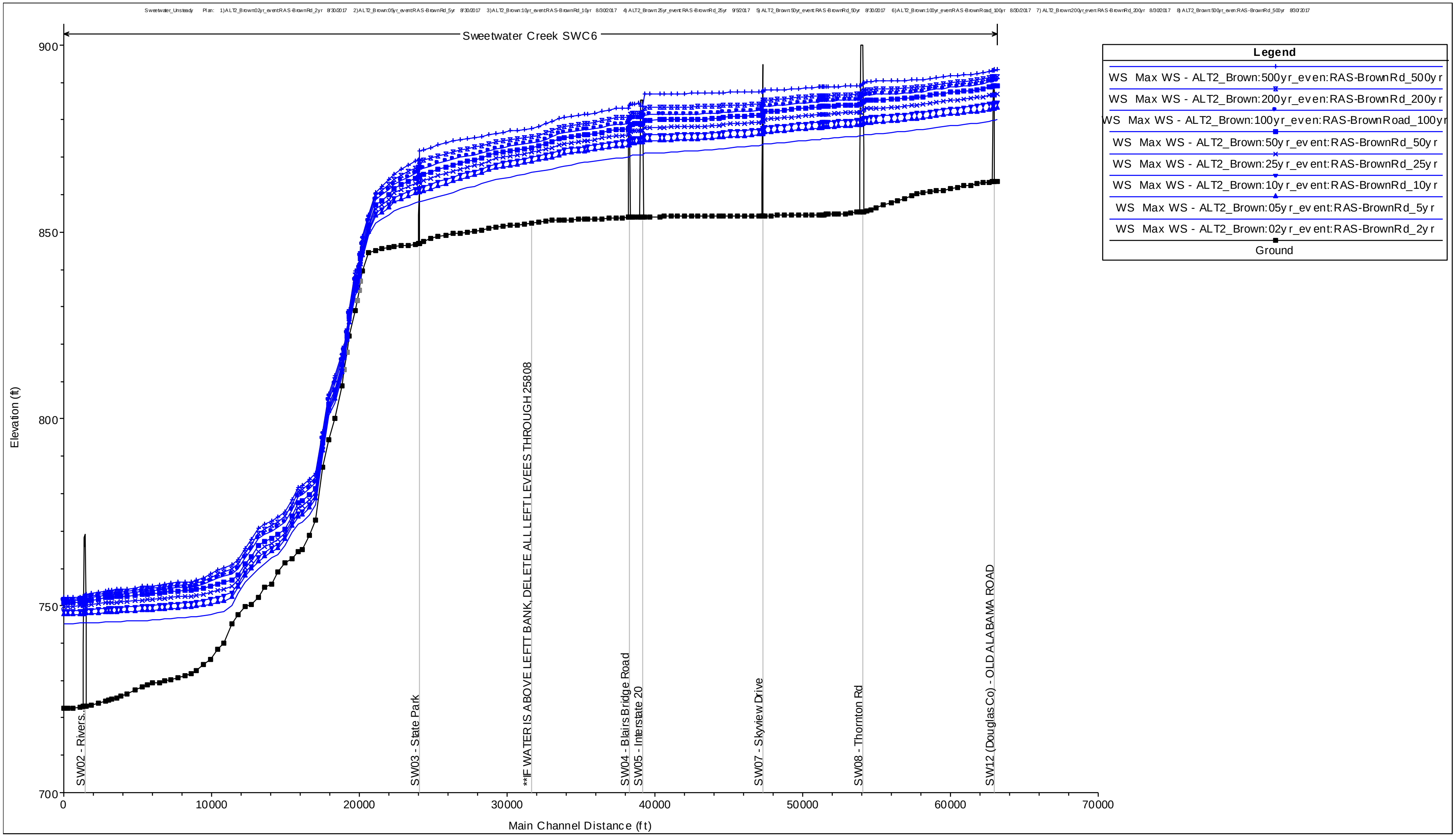

Sweetwater_Unsteady Plan: 1)ALT2_Brown:02yr_event:RAS-BrownRd_2yr 8/30/2017 2)ALT2_Brown:05yr_event:RAS-BrownRd_5yr 8/30/2017 3)ALT2_Brown:10yr_event:RAS-BrownRd_10yr 8/30/2017 4) ALT2_Brown:25yr_event:RAS-BrownRd_25yr 9/5/2017 5) ALT2_Brown:50yr_event:RAS-BrownRd_50yr 8/30/2017 6)ALT2_Brown:100yr_even:RAS-BrownRoad_100yr 8/30/2017 7) ALT2_Brown:200yr_even:RAS-BrownRd_200yr 8/30/2017 8) ALT2_Brown:500yr_even:RAS-BrownRd_500yr 8/30/2017
MillCrk MIC1
Legend
WS Max WS - ALT2_Brown:500yr_even:RAS-BrownRd_500yr
WS Max WS - ALT2_Brown:200yr_even:RAS-BrownRd_200yr
WS Max WS - ALT2_Brown:100yr_even:RAS-BrownRoad_100yr
WS Max WS - ALT2_Brown:50yr_event:RAS-BrownRd_50yr
WS Max WS - ALT2_Brown:25yr_event:RAS-BrownRd_25yr
WS Max WS - ALT2_Brown:10yr_event:RAS-BrownRd_10yr
WS Max WS - ALT2_Brown:05yr_event:RAS-BrownRd_5yr
WS Max WS - ALT2_Brown:02yr_event:RAS-BrownRd_2yr
Ground
Elevation (ft)
925
920
915
910
905
900
895
890
885
0
2000
4000
6000
8000
10000
12000
14000
16000
Main Channel Distance (ft)

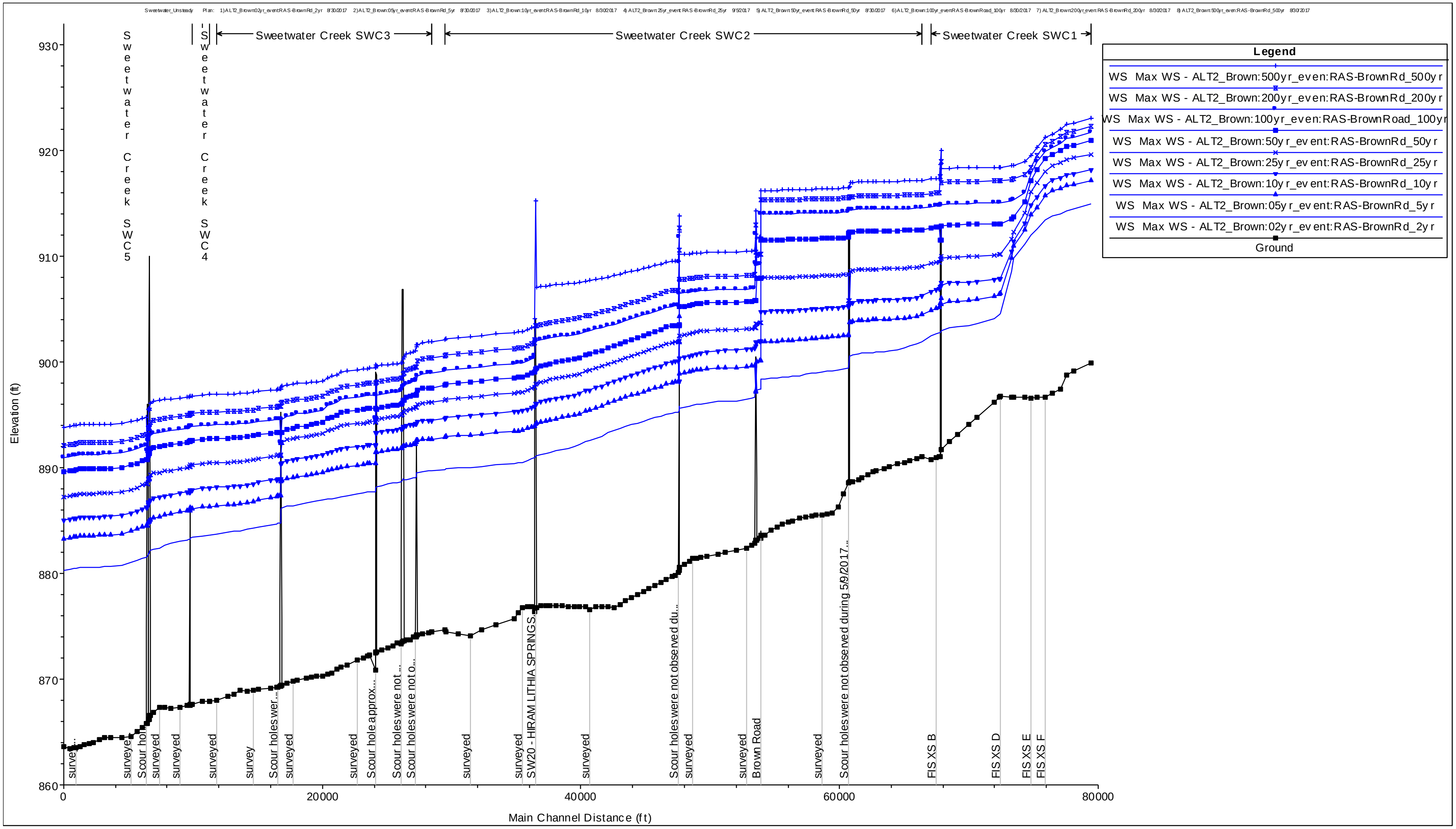

Sweetwater_Unsteady Plan: 1) ALT2_Brown:02yr_event:RAS-BrownRd_2yr 8/30/2017 2) ALT2_Brown:05yr_event:RAS-BrownRd_5yr 8/30/2017 3) ALT2_Brown:10yr_event:RAS-BrownRd_10yr 8/30/2017 4) ALT2_Brown:25yr_event:RAS-BrownRd_25yr 9/5/2017 5) ALT2_Brown:50yr_event:RAS-BrownRd_50yr 8/30/2017 6) ALT2_Brown:100yr_event:RAS-BrownRoad_100yr 8/30/2017 7) ALT2_Brown:200yr_event:RAS-BrownRd_200yr 8/30/2017 8) ALT2_Brown:500yr_even:RAS-BrownRd_500yr 8/30/2017
Mud Creek MDC1
Legend
WS Max WS - ALT2_Brown:500yr_even:RAS-BrownRd_500yr
WS Max WS - ALT2_Brown:200yr_even:RAS-BrownRd_200yr
WS Max WS - ALT2_Brown:100yr_even:RAS-BrownRoad_100yr
WS Max WS - ALT2_Brown:50yr_event:RAS-BrownRd_50yr
WS Max WS - ALT2_Brown:25yr_event:RAS-BrownRd_25yr
WS Max WS - ALT2_Brown:10yr_event:RAS-BrownRd_10yr
WS Max WS - ALT2_Brown:05yr_event:RAS-BrownRd_5yr
WS Max WS - ALT2_Brown:02yr_event:RAS-BrownRd_2yr
Ground
Elevation (ft)
920
915
910
905
900
895
890
0 Mouth at Noses...
1690 This is a REPEATED se...
Macland Road
1811
1870
4920 ASSUME this is confluence of Luther Ward
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (ft)


Noses Creek NCC2
Noses Creek NCC1
Legend
WS Max WS - ALT2_Brown:500yr_even:RAS-BrownRd_500yr
WS Max WS - ALT2_Brown:200yr_even:RAS-BrownRd_200yr
WS Max WS - ALT2_Brown:100yr_even:RAS-BrownRoad_100yr
WS Max WS - ALT2_Brown:50yr_event:RAS-BrownRd_50yr
WS Max WS - ALT2_Brown:25yr_event:RAS-BrownRd_25yr
WS Max WS - ALT2_Brown:10yr_event:RAS-BrownRd_10yr
WS Max WS - ALT2_Brown:05yr_event:RAS-BrownRd_5yr
WS Max WS - ALT2_Brown:02yr_event:RAS-BrownRd_2yr
Ground
Elevation (ft)
930
920
910
900
890
880
870
860
CLAY RD. BRIDGE SKEWNESS
Silver Comet Trail
POWDER SPRING RD
Surveyed XS
Surveyed XS
ERNEST BARRETT PKWY.SKEWNESS IS APPLIED
0
5000
10000
15000
20000
25000
30000
35000
Main Channel Distance (ft)


Sweetwater_Unsteady Plan: 1) ALT2_Brown:02yr_event:RAS-BrownRd_2yr 8/30/2017 2) ALT2_Brown:05yr_event:RAS-BrownRd_5yr 8/30/2017 3) ALT2_Brown:10yr_event:RAS-BrownRd_10yr 8/30/2017 4) ALT2_Brown:25yr_event:RAS-BrownRd_25yr 9/5/2017 5) ALT2_Brown:50yr_event:RAS-BrownRd_50yr 8/30/2017 6) ALT2_Brown:100yr_event:RAS-BrownRoad_100yr 8/30/2017 7) ALT2_Brown:200yr_event:RAS-BrownRd_200yr 8/30/2017 8) ALT2_Brown:500yr_even:RAS-BrownRd_500yr 8/30/2017
Olley Creek OLC1
Legend
WS Max WS - ALT2_Brown:500yr_even:RAS-BrownRd_500yr
WS Max WS - ALT2_Brown:200yr_even:RAS-BrownRd_200yr
WS Max WS - ALT2_Brown:100yr_even:RAS-BrownRoad_100yr
WS Max WS - ALT2_Brown:50yr_event:RAS-BrownRd_50yr
WS Max WS - ALT2_Brown:25yr_event:RAS-BrownRd_25yr
WS Max WS - ALT2_Brown:10yr_event:RAS-BrownRd_10yr
WS Max WS - ALT2_Brown:05yr_event:RAS-BrownRd_5yr
WS Max WS - ALT2_Brown:02yr_event:RAS-BrownRd_2yr
Ground
Elevation (ft)
960
940
920
900
880
860
0
2000
4000
6000
8000
10000
12000
14000
Main Channel Distance (ft)
OC-1
B191136069, Clay Road...
OC-3
B191011070, Flint Hill Road...
B170136079, Silver Comet RR Bridg...

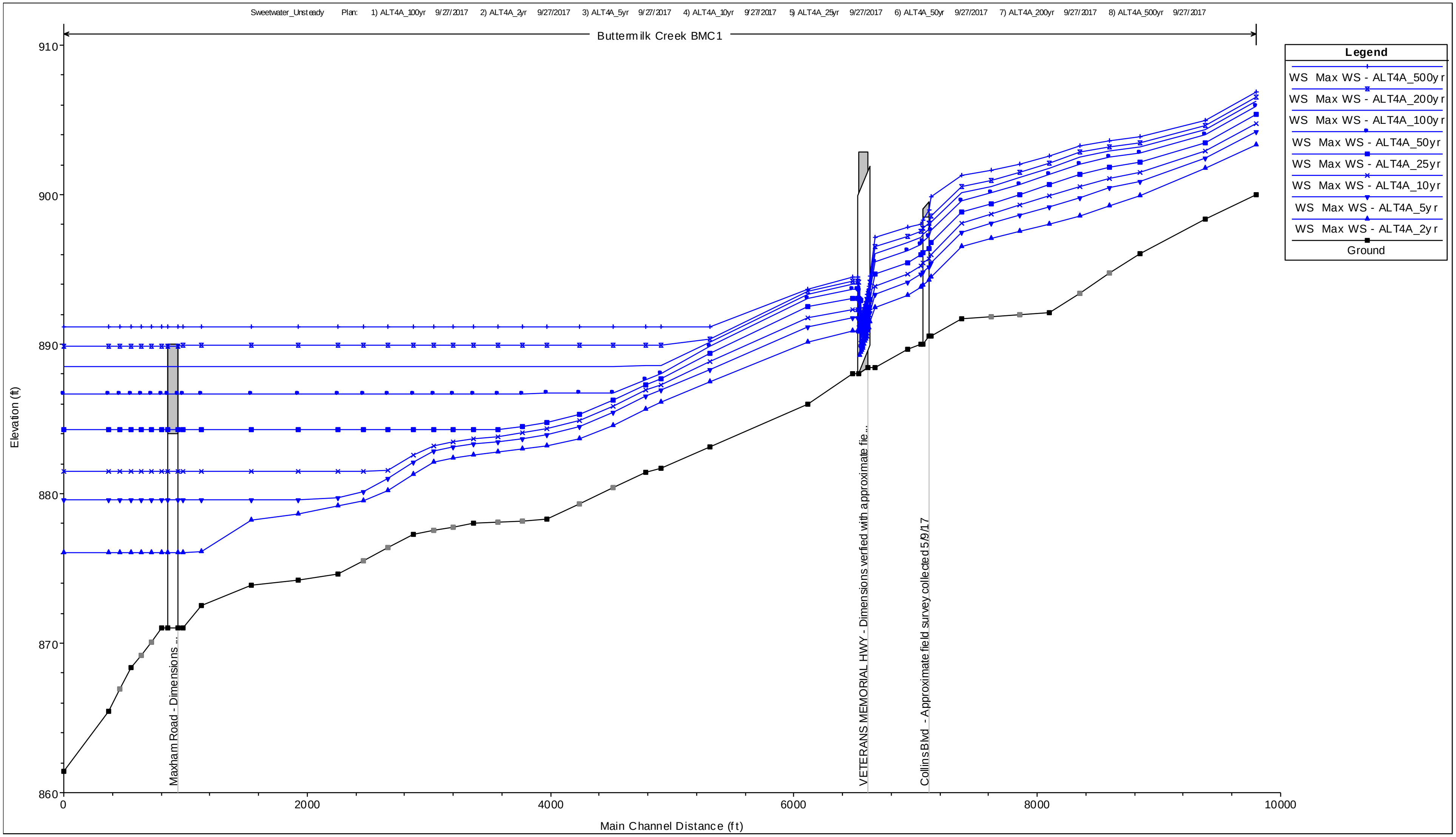

PowderSpringsCrk PSC1
Legend
WS Max WS - ALT2_Brown:500yr_even:RAS-BrownRd_500yr
WS Max WS - ALT2_Brown:200yr_even:RAS-BrownRd_200yr
WS Max WS - ALT2_Brown:100yr_even:RAS-BrownRoad_100yr
WS Max WS - ALT2_Brown:50yr_event:RAS-BrownRd_50yr
WS Max WS - ALT2_Brown:25yr_event:RAS-BrownRd_25yr
WS Max WS - ALT2_Brown:10yr_event:RAS-BrownRd_10yr
WS Max WS - ALT2_Brown:05yr_event:RAS-BrownRd_5yr
WS Max WS - ALT2_Brown:02yr_event:RAS-BrownRd_2yr
Ground
Elevation (ft)
Main Channel Distance (ft)

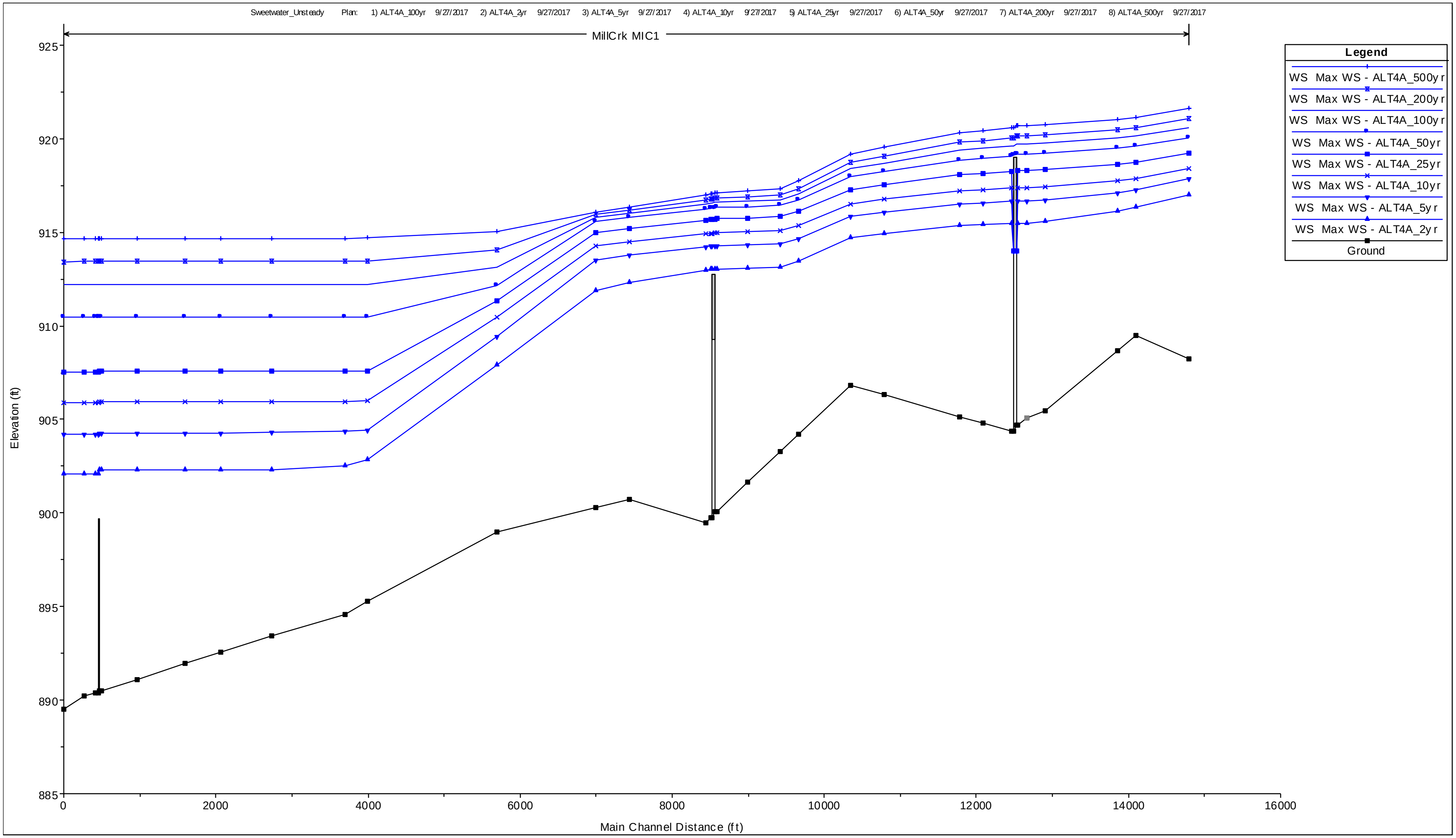

Sweetwater_Unsteady Plan: 1) ALT2_Brown:02yr_event:RAS-BrownRd_2yr 8/30/2017 2) ALT2_Brown:05yr_event:RAS-BrownRd_5yr 8/30/2017 3) ALT2_Brown:10yr_event:RAS-BrownRd_10yr 8/30/2017 4) ALT2_Brown:25yr_event:RAS-BrownRd_25yr 9/5/2017 5) ALT2_Brown:50yr_event:RAS-BrownRd_50yr 8/30/2017 6) ALT2_Brown:100yr_even:RAS-BrownRoad_100yr 8/30/2017 7) ALT2_Brown:200yr_even:RAS-BrownRd_200yr 8/30/2017 8) ALT2_Brown:500yr_even:RAS-BrownRd_500yr 8/30/2017
Sweetwater Creek SWC6
Legend
WS Max WS - ALT2_Brown:500yr_even:RAS-BrownRd_500yr
WS Max WS - ALT2_Brown:200yr_even:RAS-BrownRd_200yr
WS Max WS - ALT2_Brown:100yr_even:RAS-BrownRoad_100yr
WS Max WS - ALT2_Brown:50yr_event:RAS-BrownRd_50yr
WS Max WS - ALT2_Brown:25yr_event:RAS-BrownRd_25yr
WS Max WS - ALT2_Brown:10yr_event:RAS-BrownRd_10yr
WS Max WS - ALT2_Brown:05yr_event:RAS-BrownRd_5yr
WS Max WS - ALT2_Brown:02yr_event:RAS-BrownRd_2yr
Ground
Elevation (ft)
900
850
800
750
700
SW02 - Rivers...
SW03 - State Park
**IF WATER IS ABOVE LEFTT BANK, DELETE ALL LEFT LEVEES THROUGH 25808
SW04 - Blairs Bridge Road
SW05 - Interstate 20
SW07 - Skyview Drive
SW08 - Thornton Rd
SW12 (Douglas Co) - OLD ALABAMA ROAD
0
10000
20000
30000
40000
50000
60000
70000
Main Channel Distance (ft)

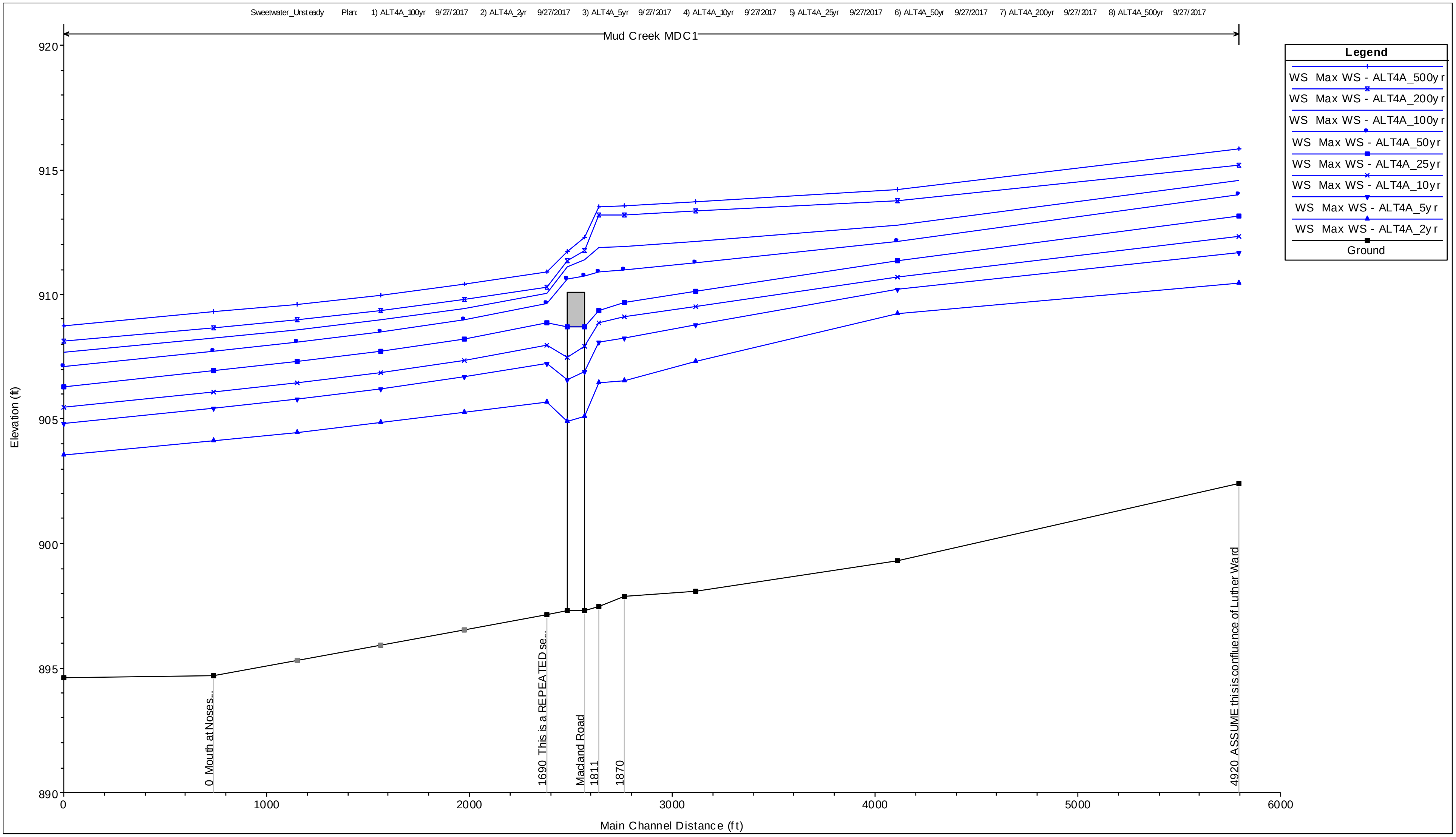


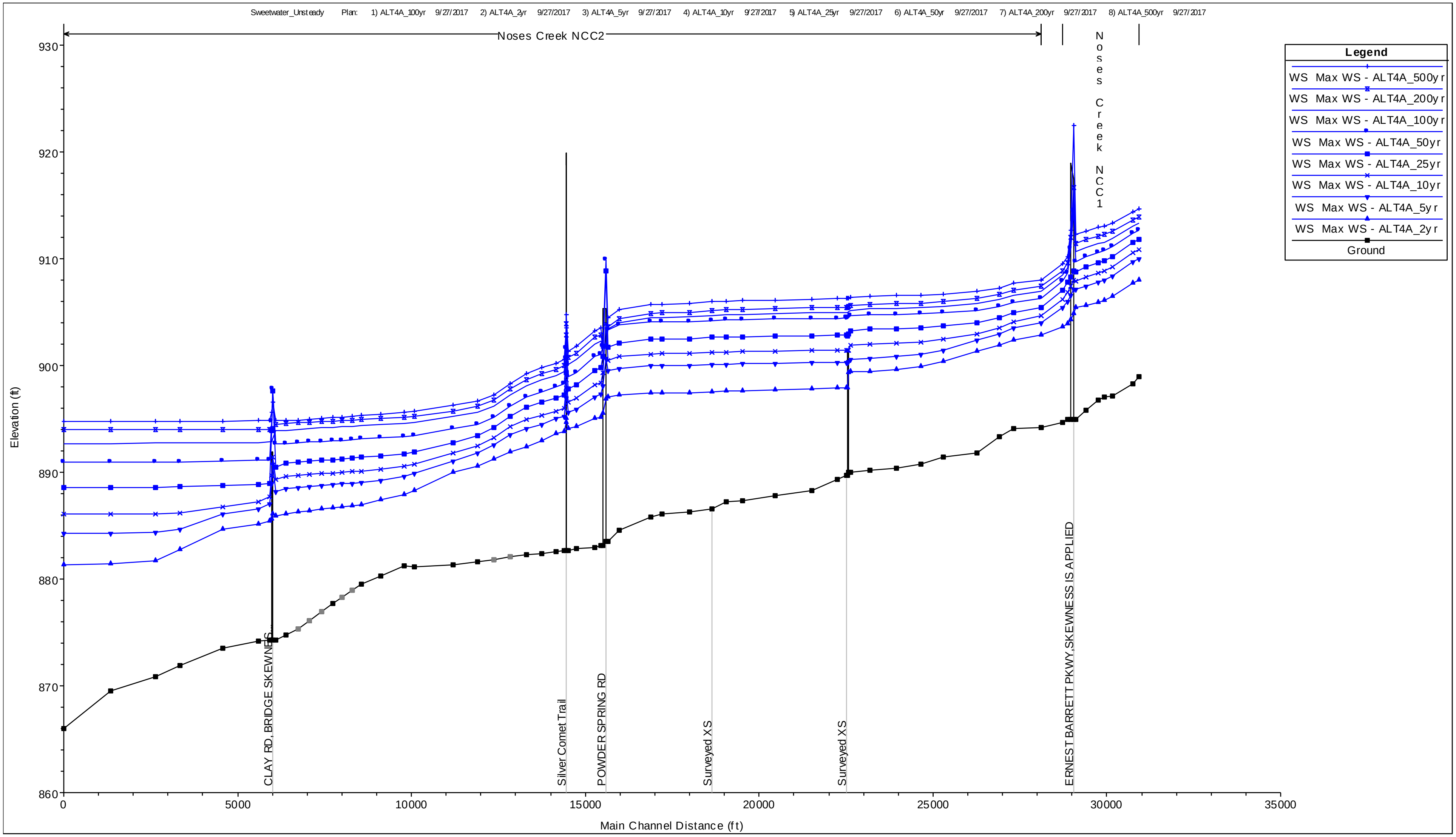
*Main Channel Distance (ft) values should be added to STA 63230 from SWC6 reach above for a continuous profile.

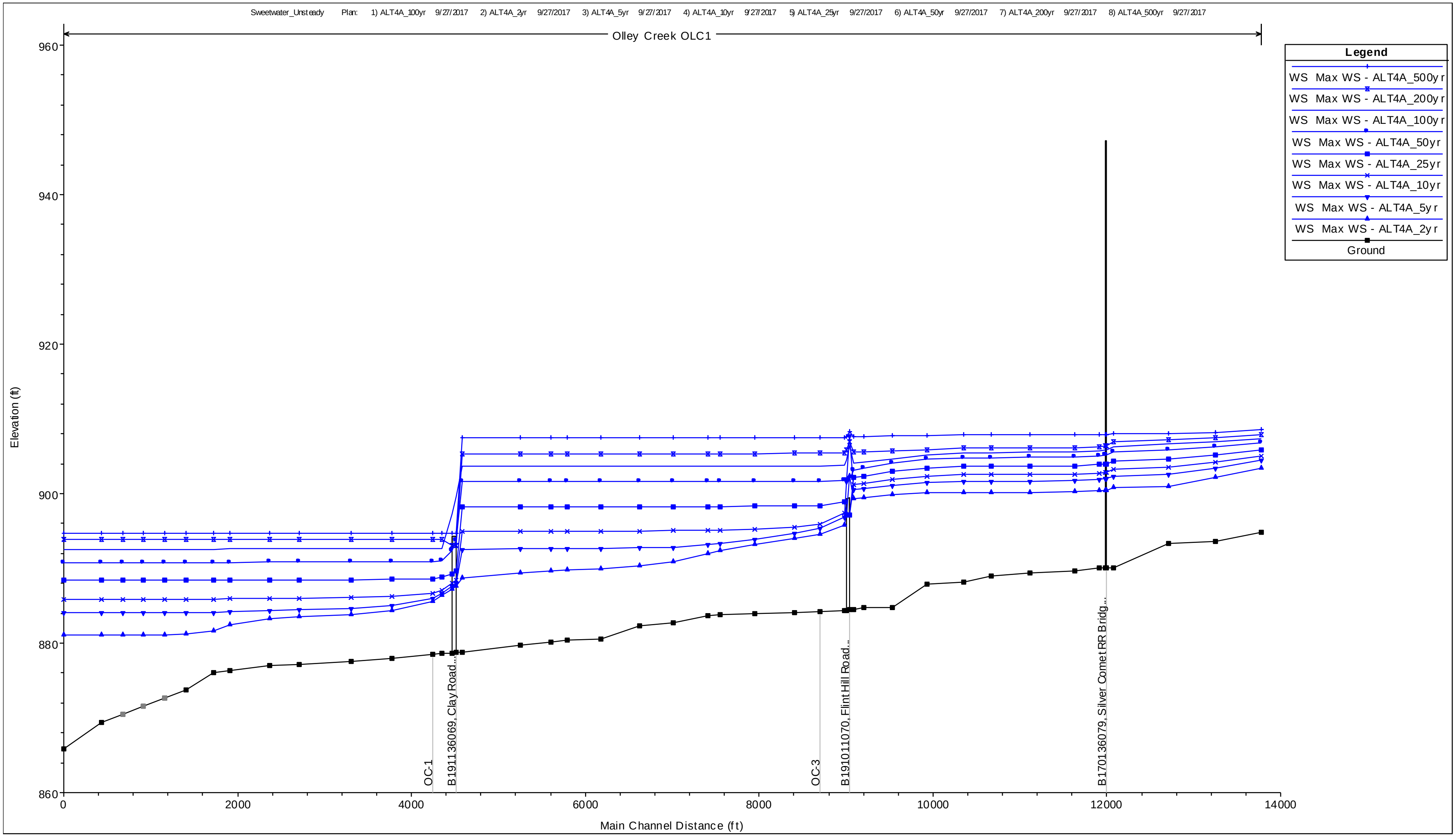
Alternative 4

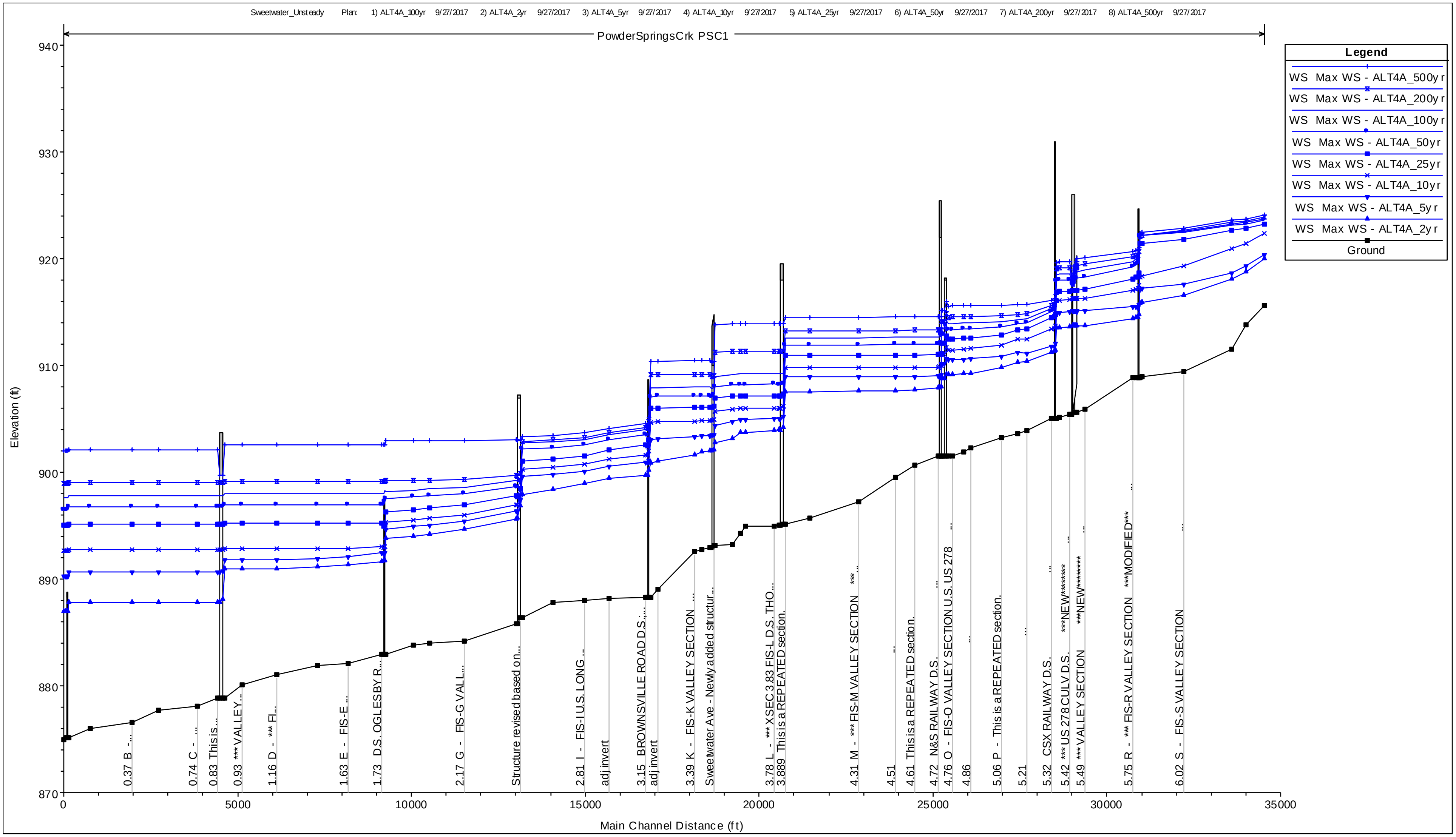


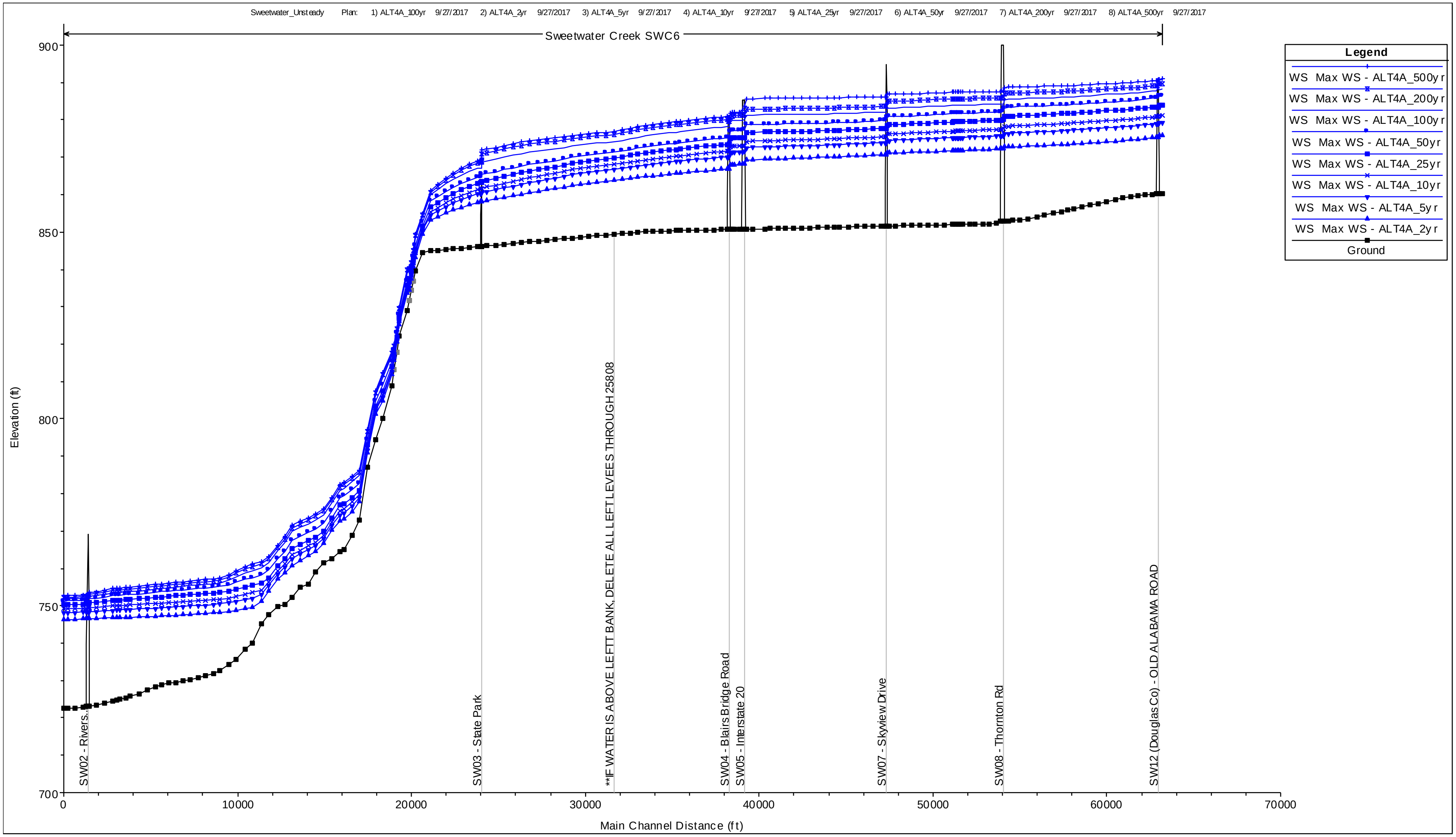

Sweetwater_Unsteady Plan: 1) ALT4A_100yr 9/27/2017 2) ALT4A_2yr 9/27/2017 3) ALT4A_5yr 9/27/2017 4) ALT4A_10yr 9/27/2017 5) ALT4A_25yr 9/27/2017 6) ALT4A_50yr 9/27/2017 7) ALT4A_200yr 9/27/2017 8) ALT4A_500yr 9/27/2017
MillCrk MIC1
Legend
WS Max WS - ALT4A_500yr
WS Max WS - ALT4A_200yr
WS Max WS - ALT4A_100yr
WS Max WS - ALT4A_50yr
WS Max WS - ALT4A_25yr
WS Max WS - ALT4A_10yr
WS Max WS - ALT4A_5yr
WS Max WS - ALT4A_2yr
Ground
Elevation (ft)
925
920
915
910
905
900
895
890
885
0
2000
4000
6000
8000
10000
12000
14000
16000
Main Channel Distance (ft)

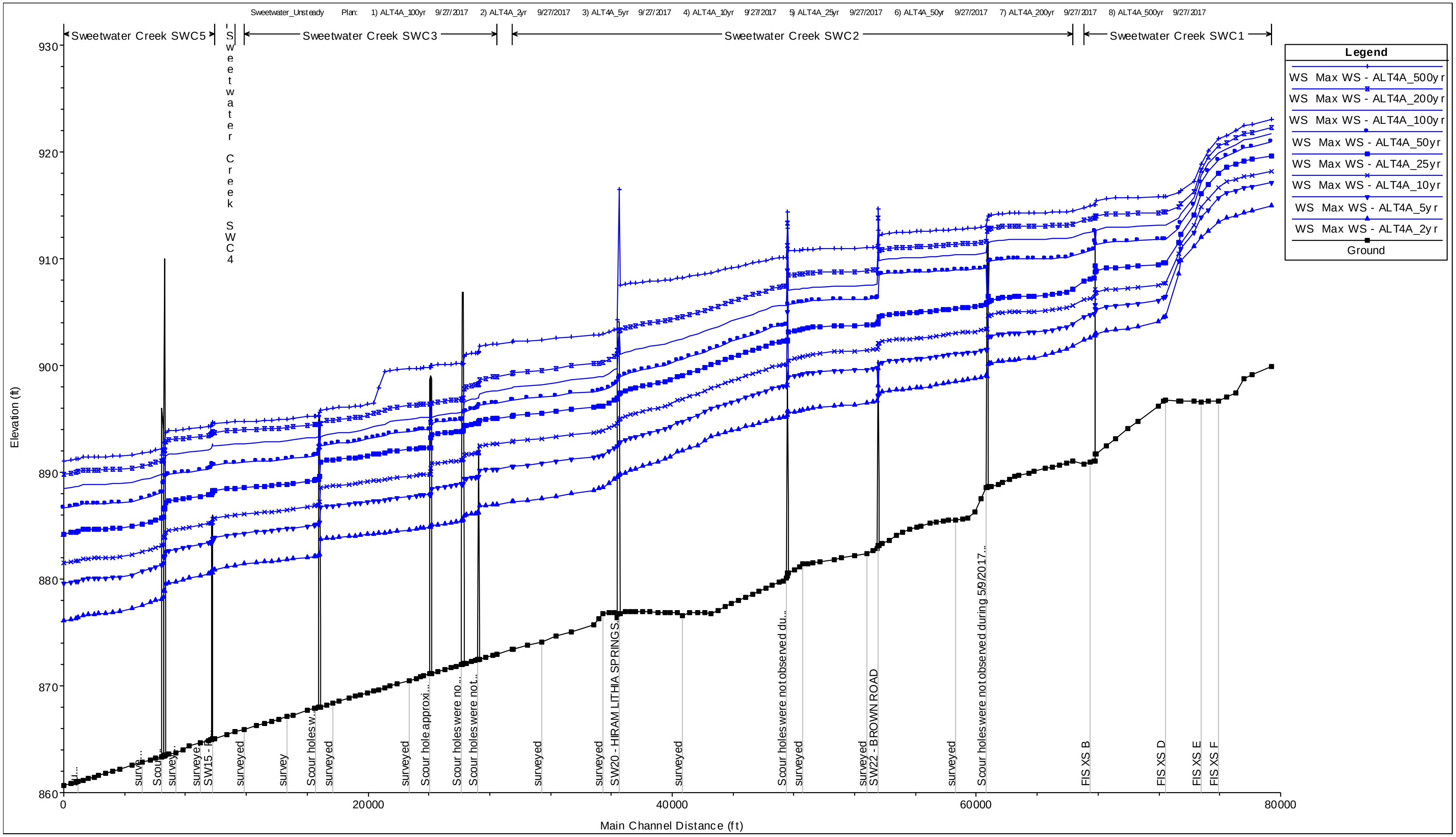

Sweetwater_Unsteady Plan: 1) ALT4A_100yr 9/27/2017 2) ALT4A_2yr 9/27/2017 3) ALT4A_5yr 9/27/2017 4) ALT4A_10yr 9/27/2017 5) ALT4A_25yr 9/27/2017 6) ALT4A_50yr 9/27/2017 7) ALT4A_200yr 9/27/2017 8) ALT4A_500yr 9/27/2017
Mud Creek MDC1
Legend
WS Max WS - ALT4A_500yr
WS Max WS - ALT4A_200yr
WS Max WS - ALT4A_100yr
WS Max WS - ALT4A_50yr
WS Max WS - ALT4A_25yr
WS Max WS - ALT4A_10yr
WS Max WS - ALT4A_5yr
WS Max WS - ALT4A_2yr
Ground
Elevation (ft)
Main Channel Distance (ft)
0 Mouth at Noses...
1690 This is a REPEATED se...
Macland Road
1811
1870
4920 ASSUME this is confluence of Luther Ward


Sweetwater_Unsteady Plan: 1) ALT4A_100yr 9/27/2017 2) ALT4A_2yr 9/27/2017 3) ALT4A_5yr 9/27/2017 4) ALT4A_10yr 9/27/2017 5) ALT4A_25yr 9/27/2017 6) ALT4A_50yr 9/27/2017 7) ALT4A_200yr 9/27/2017 8) ALT4A_500yr 9/27/2017
Noses Creek NCC2
Noses Creek NCC1
Legend
WS Max WS - ALT4A_500yr
WS Max WS - ALT4A_200yr
WS Max WS - ALT4A_100yr
WS Max WS - ALT4A_50yr
WS Max WS - ALT4A_25yr
WS Max WS - ALT4A_10yr
WS Max WS - ALT4A_5yr
WS Max WS - ALT4A_2yr
Ground
Elevation (ft)
Main Channel Distance (ft)
CLAY RD, BRIDGE SKEWNESS
Silver Comet Trail
POWDER SPRING RD
Surveyed XS
Surveyed XS
ERNEST BARRETT PKWY, SKEWNESS IS APPLIED
930
920
910
900
890
880
870
860
0
5000
10000
15000
20000
25000
30000
35000


Sweetwater_Unsteady Plan: 1) ALT4A_100yr 9/27/2017 2) ALT4A_2yr 9/27/2017 3) ALT4A_5yr 9/27/2017 4) ALT4A_10yr 9/27/2017 5) ALT4A_25yr 9/27/2017 6) ALT4A_50yr 9/27/2017 7) ALT4A_200yr 9/27/2017 8) ALT4A_500yr 9/27/2017
Olley Creek OLC1
Legend
WS Max WS - ALT4A_500yr
WS Max WS - ALT4A_200yr
WS Max WS - ALT4A_100yr
WS Max WS - ALT4A_50yr
WS Max WS - ALT4A_25yr
WS Max WS - ALT4A_10yr
WS Max WS - ALT4A_5yr
WS Max WS - ALT4A_2yr
Ground
Elevation (ft)
960
940
920
900
880
860
0
2000
4000
6000
8000
10000
12000
14000
Main Channel Distance (ft)
OC-1
B191136069, Clay Road...
OC-3
B191011070, Flint Hill Road...
B170136079, Silver Comet RR Bridg...

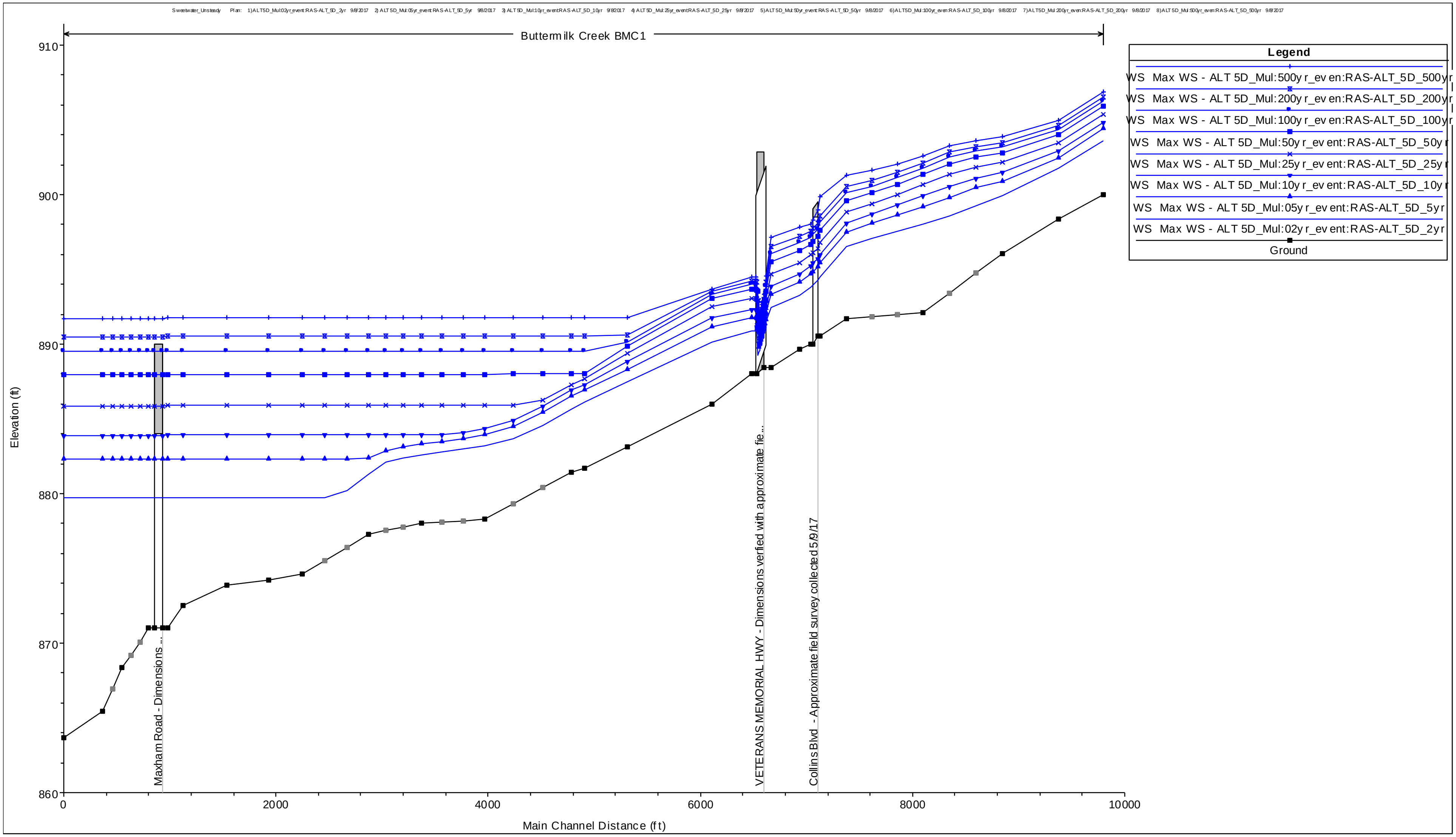

Sweetwater_Unsteady Plan: 1) ALT4A_100yr 9/27/2017 2) ALT4A_2yr 9/27/2017 3) ALT4A_5yr 9/27/2017 4) ALT4A_10yr 9/27/2017 5) ALT4A_25yr 9/27/2017 6) ALT4A_50yr 9/27/2017 7) ALT4A_200yr 9/27/2017 8) ALT4A_500yr 9/27/2017
PowderSpringsCrk PSC1
Legend
WS Max WS - ALT4A_500yr
WS Max WS - ALT4A_200yr
WS Max WS - ALT4A_100yr
WS Max WS - ALT4A_50yr
WS Max WS - ALT4A_25yr
WS Max WS - ALT4A_10yr
WS Max WS - ALT4A_5yr
WS Max WS - ALT4A_2yr
Ground
Elevation (ft)
Main Channel Distance (ft)

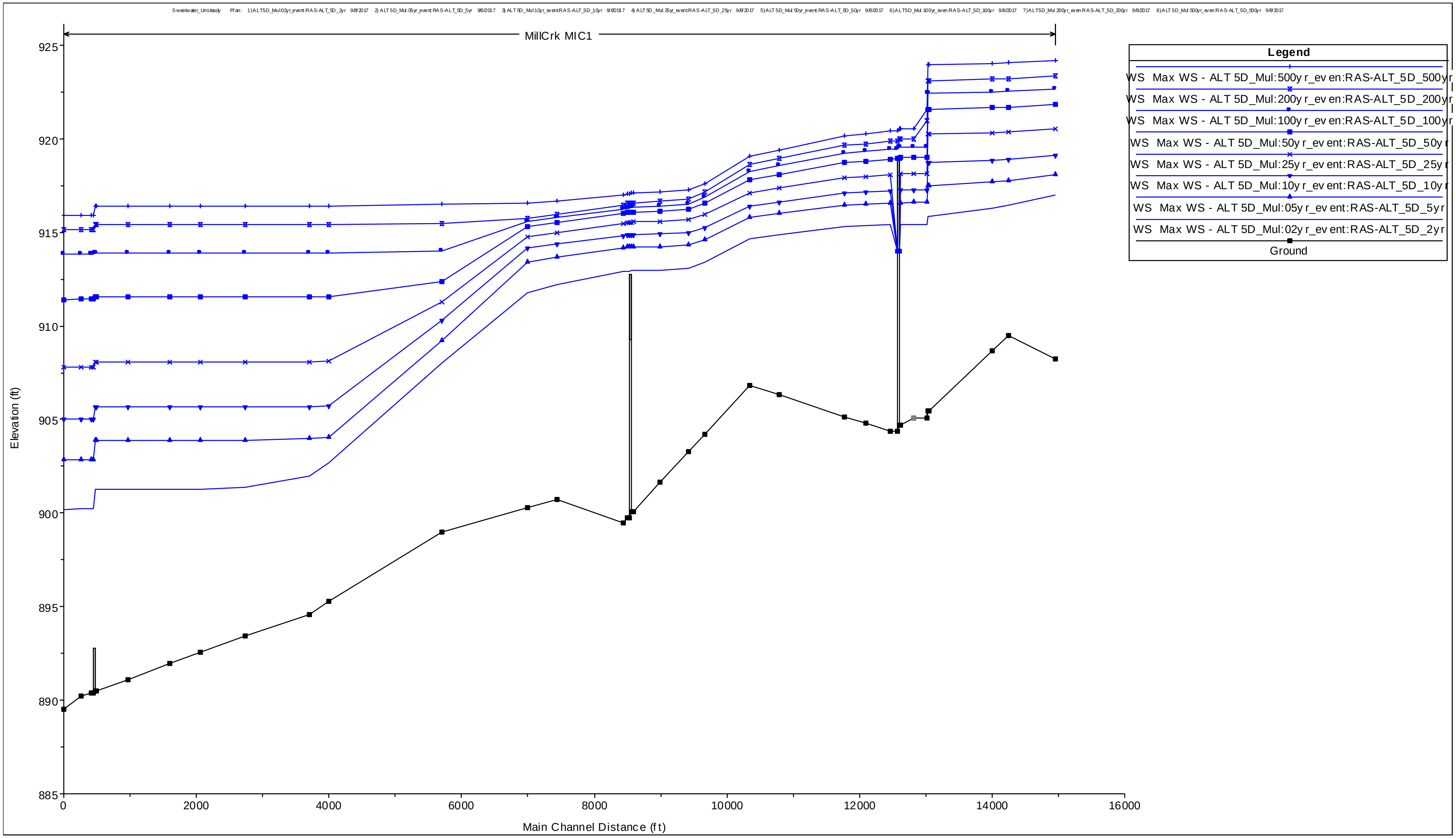

Sweetwater_Unsteady Plan: 1) ALT4A_100yr 9/27/2017 2) ALT4A_2yr 9/27/2017 3) ALT4A_5yr 9/27/2017 4) ALT4A_10yr 9/27/2017 5) ALT4A_25yr 9/27/2017 6) ALT4A_50yr 9/27/2017 7) ALT4A_200yr 9/27/2017 8) ALT4A_500yr 9/27/2017
Sweetwater Creek SWC6
Legend
WS Max WS - ALT4A_500yr
WS Max WS - ALT4A_200yr
WS Max WS - ALT4A_100yr
WS Max WS - ALT4A_50yr
WS Max WS - ALT4A_25yr
WS Max WS - ALT4A_10yr
WS Max WS - ALT4A_5yr
WS Max WS - ALT4A_2yr
Ground
Elevation (ft)
Main Channel Distance (ft)
SW02 - Rivers.
SW03 - State Park
**IF WATER IS ABOVE LEFTT BANK, DELETE ALL LEFT LEVEES THROUGH 25808
SW04 - Blairs Bridge Road
SW05 - Interstate 20
SW07 - Skyview Drive
SW08 - Thornton Rd
SW12 (Douglas Co) - OLD ALABAMA ROAD

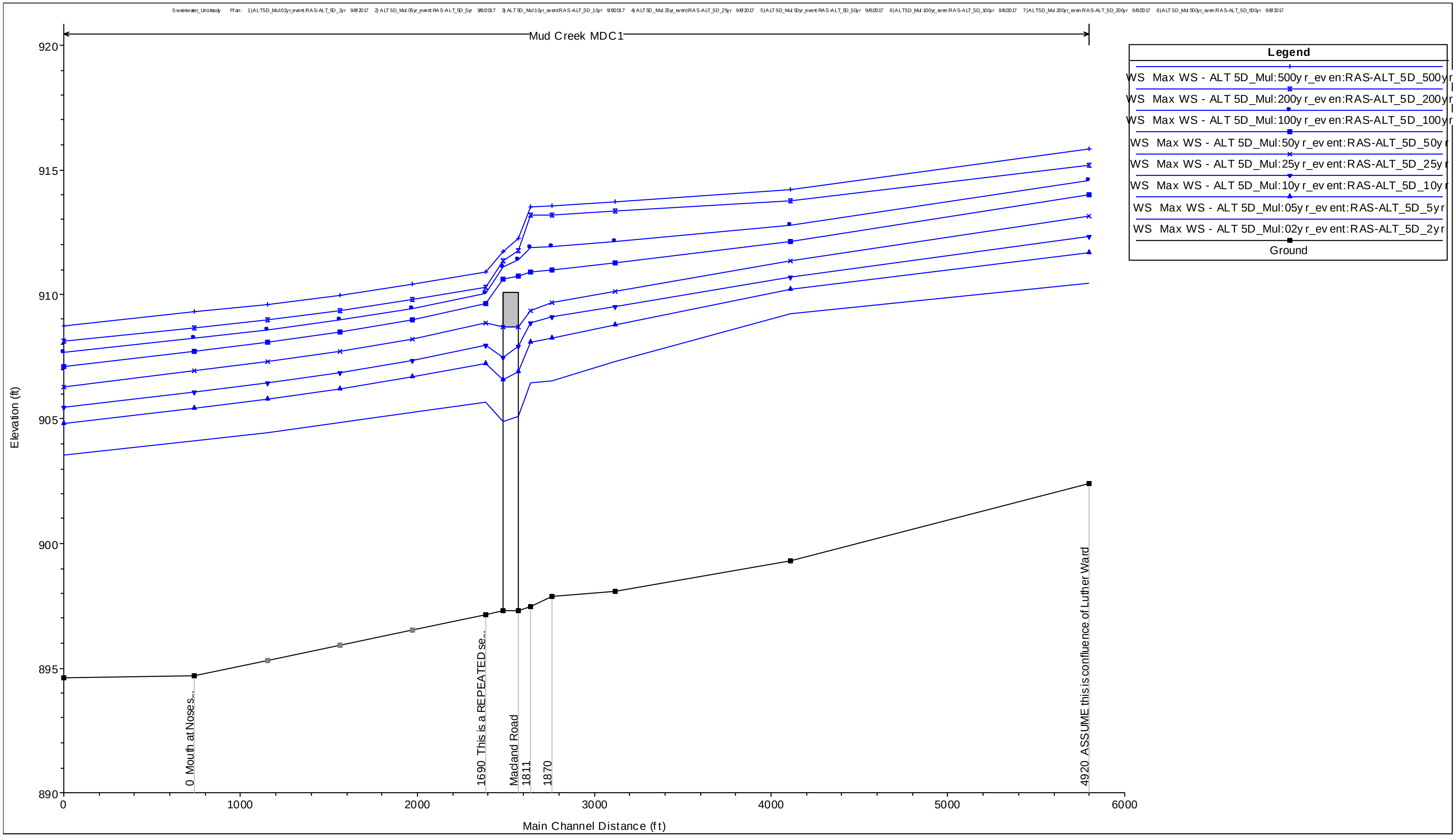


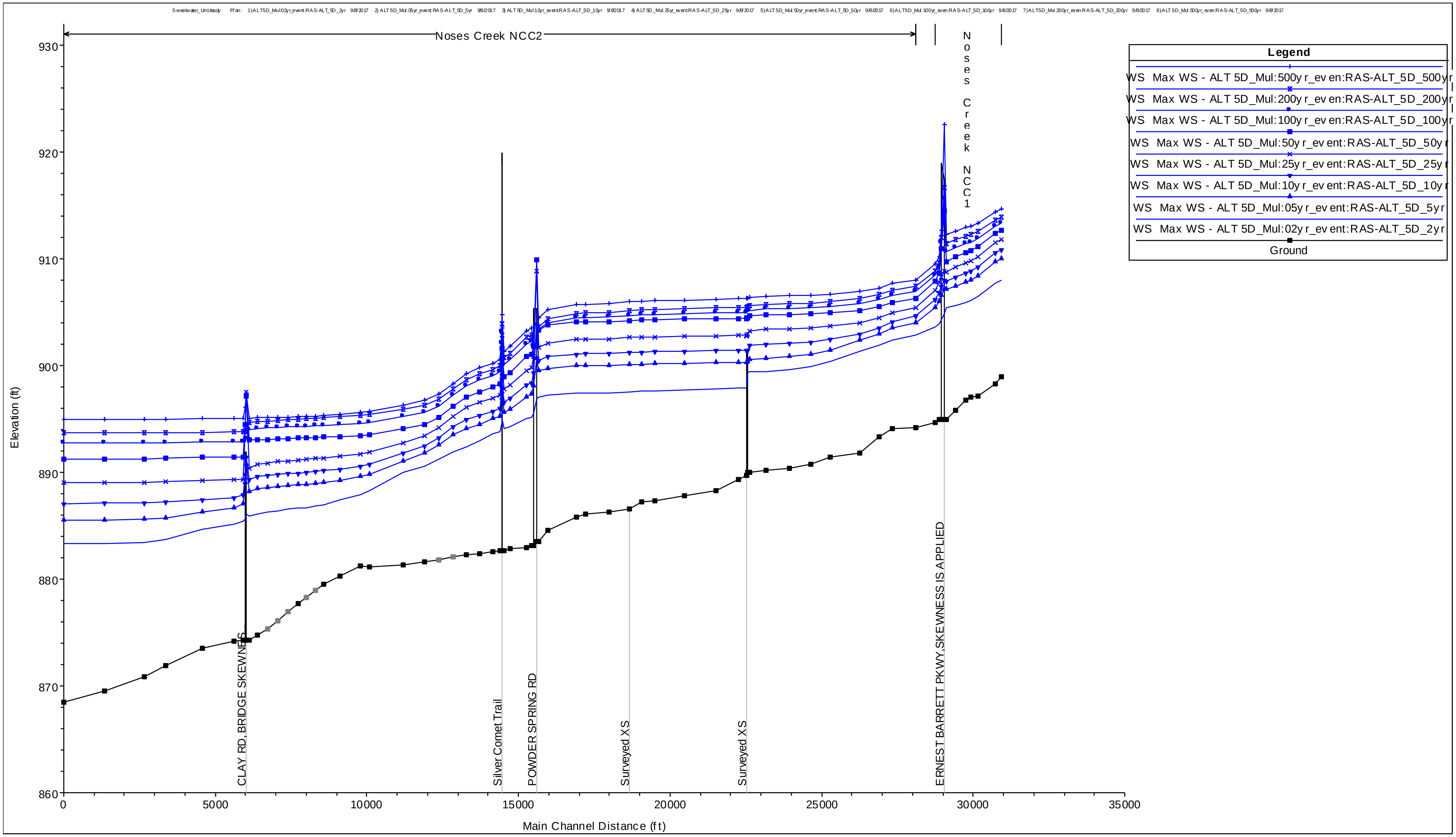
* Main Channel Distance (ft) values should be added to STA 63230 from SWC6 reach above for a continuous profile

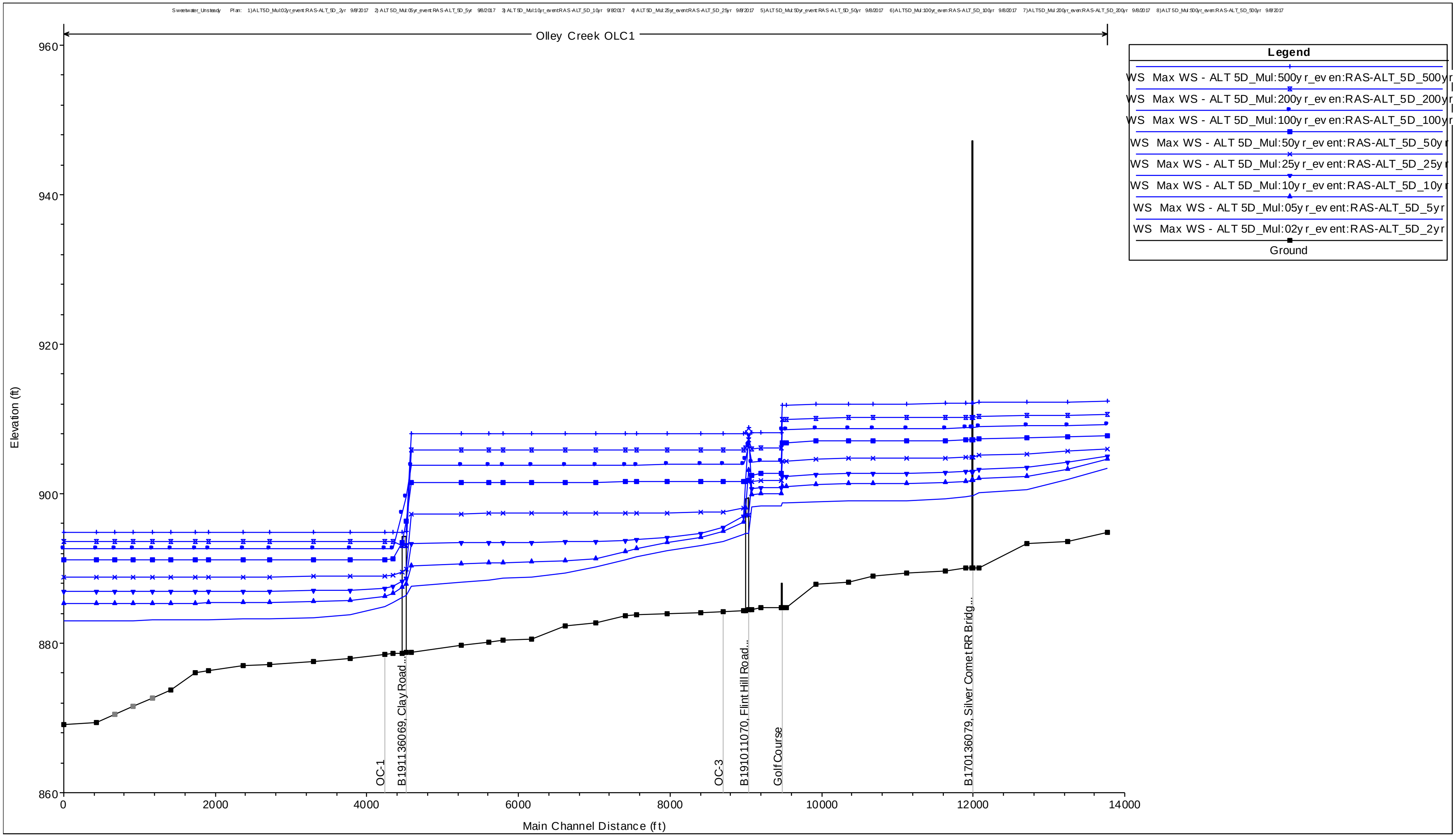
Alternative 5D

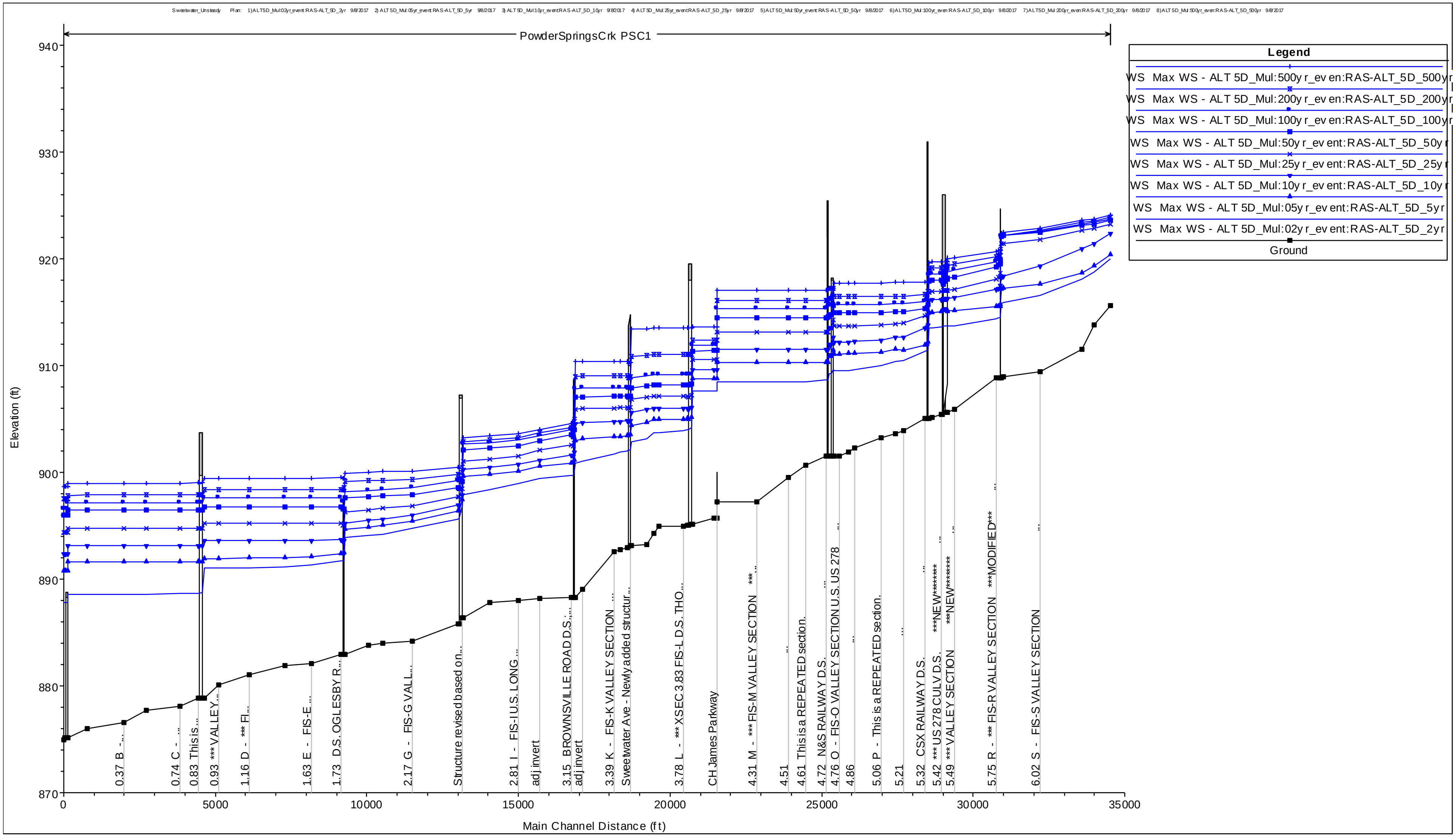


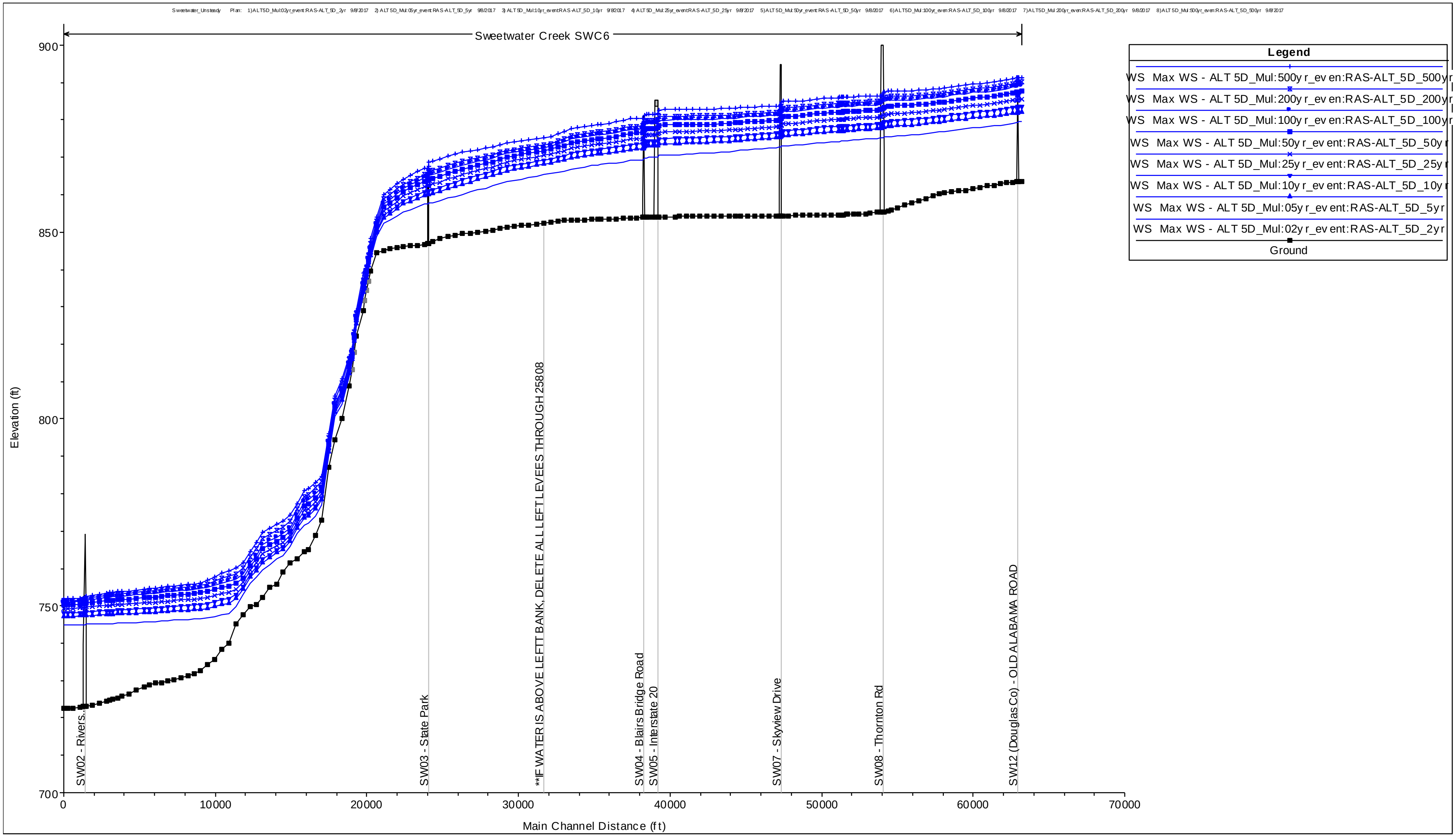

Sweetwater_Unsteady Plan: 1)ALT5D_Mul:02yr_event:RAS-ALT_5D_2yr 9/8/2017 2) ALT5D_Mul:05yr_event:RAS-ALT_5D_5yr 9/8/2017 3) ALT5D_Mul:10yr_event:RAS-ALT_5D_10yr 9/8/2017 4) ALT5D_Mul:25yr_event:RAS-ALT_5D_25yr 9/8/2017 5)ALT5D_Mul:50yr_event:RAS-ALT_5D_50yr 9/8/2017 6)ALT5D_Mul:100yr_even:RAS-ALT_5D_100yr 9/8/2017 7)ALT5D_Mul:200yr_even:RAS-ALT_5D_200yr 9/8/2017 8)ALT5D_Mul:500yr_even:RAS-ALT_5D_500yr 9/8/2017
MillCrk MIC1
Legend
WS Max WS - ALT 5D_Mul:500yr_even:RAS-ALT_5D_500yr
WS Max WS - ALT 5D_Mul:200yr_even:RAS-ALT_5D_200yr
WS Max WS - ALT 5D_Mul:100yr_even:RAS-ALT_5D_100yr
WS Max WS - ALT 5D_Mul:50yr_event:RAS-ALT_5D_50yr
WS Max WS - ALT 5D_Mul:25yr_event:RAS-ALT_5D_25yr
WS Max WS - ALT 5D_Mul:10yr_event:RAS-ALT_5D_10yr
WS Max WS - ALT 5D_Mul:05yr_event:RAS-ALT_5D_5yr
WS Max WS - ALT 5D_Mul:02yr_event:RAS-ALT_5D_2yr
Ground
Elevation (ft)
925
920
915
910
905
900
895
890
885
0
2000
4000
6000
8000
10000
12000
14000
16000
Main Channel Distance (ft)

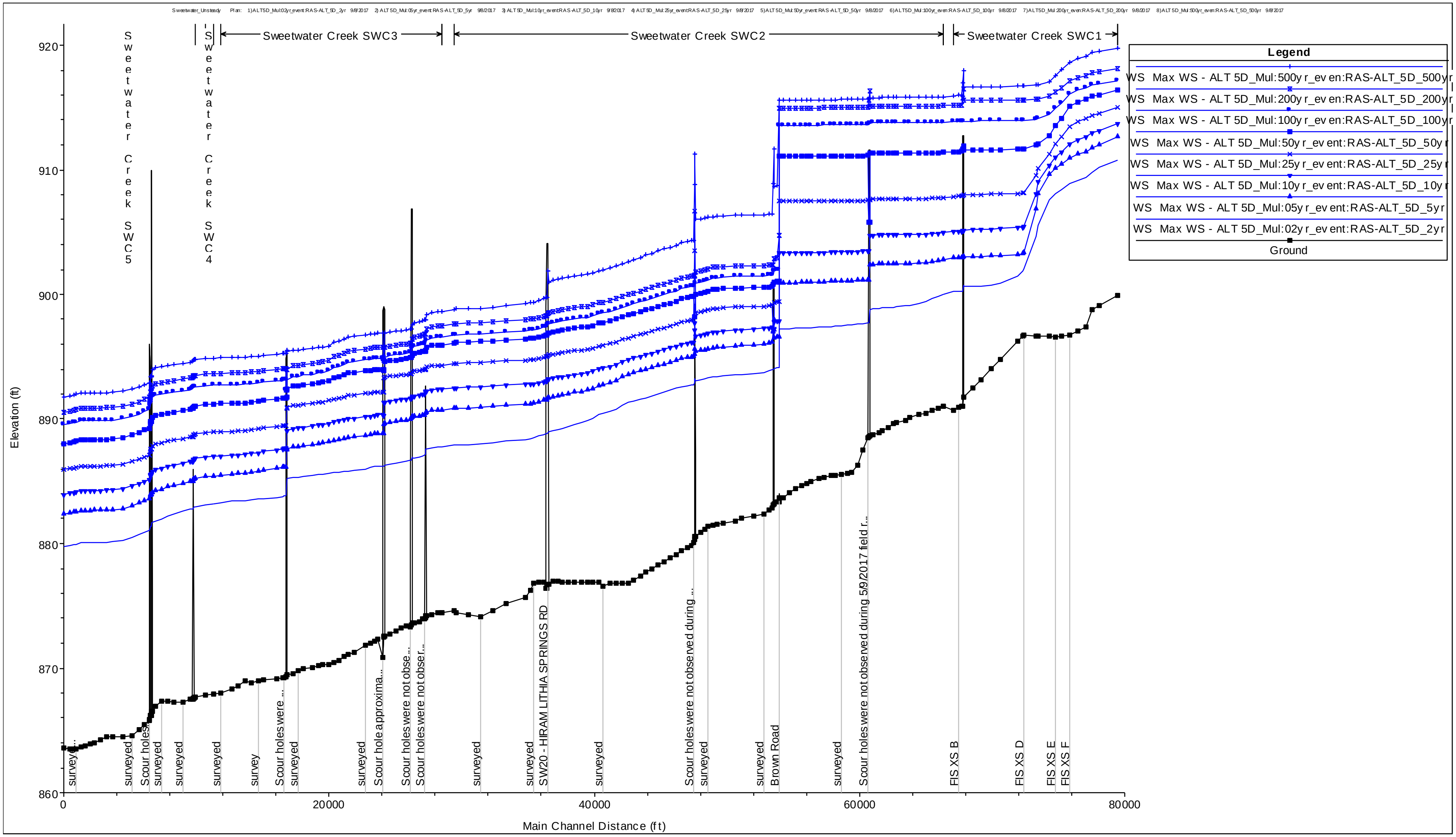

Mud Creek MDC1
Legend
WS Max WS - ALT 5D_Mul:500yr_even:RAS-ALT_5D_500yr
WS Max WS - ALT 5D_Mul:200yr_even:RAS-ALT_5D_200yr
WS Max WS - ALT 5D_Mul:100yr_even:RAS-ALT_5D_100yr
WS Max WS - ALT 5D_Mul:50yr_event:RAS-ALT_5D_50yr
WS Max WS - ALT 5D_Mul:25yr_event:RAS-ALT_5D_25yr
WS Max WS - ALT 5D_Mul:10yr_event:RAS-ALT_5D_10yr
WS Max WS - ALT 5D_Mul:05yr_event:RAS-ALT_5D_5yr
WS Max WS - ALT 5D_Mul:02yr_event:RAS-ALT_5D_2yr
Ground
Elevation (ft)
920
915
910
905
900
895
890
0 Mouth at Noses...
1690 This is a REPEATED se...
Macland Road
1811
1870
4920 ASSUME this is confluence of Luther Ward
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (ft)


Sweetwater_Unsteady Plan: 1)ALT5D_Mul:02yr_event:RAS-ALT_5D_2yr 9/8/2017 2) ALT5D_Mul:05yr_event:RAS-ALT_5D_5yr 9/8/2017 3) ALT5D_Mul:10yr_event:RAS-ALT_5D_10yr 9/8/2017 4) ALT5D_Mul:25yr_event:RAS-ALT_5D_25yr 9/8/2017 5)ALT5D_Mul:50yr_event:RAS-ALT_5D_50yr 9/8/2017 6)ALT5D_Mul:100yr_even:RAS-ALT_5D_100yr 9/8/2017 7)ALT5D_Mul:200yr_even:RAS-ALT_5D_200yr 9/8/2017 8)ALT5D_Mul:500yr_even:RAS-ALT_5D_500yr 9/8/2017
Noses Creek NCC2
Noses Creek NCC1
Legend
WS Max WS - ALT 5D_Mul:500yr_even:RAS-ALT_5D_500yr
WS Max WS - ALT 5D_Mul:200yr_even:RAS-ALT_5D_200yr
WS Max WS - ALT 5D_Mul:100yr_even:RAS-ALT_5D_100yr
WS Max WS - ALT 5D_Mul:50yr_event:RAS-ALT_5D_50yr
WS Max WS - ALT 5D_Mul:25yr_event:RAS-ALT_5D_25yr
WS Max WS - ALT 5D_Mul:10yr_event:RAS-ALT_5D_10yr
WS Max WS - ALT 5D_Mul:05yr_event:RAS-ALT_5D_5yr
WS Max WS - ALT 5D_Mul:02yr_event:RAS-ALT_5D_2yr
Ground
Elevation (ft)
930
920
910
900
890
880
870
860
CLAY RD, BRIDGE SKEWNES
Silver Comet Trail
POWDER SPRING RD
Surveyed XS
Surveyed XS
ERNEST BARRETT PKWY, SKEWNESS IS APPLIED
0
5000
10000
15000
20000
25000
30000
35000
Main Channel Distance (ft)


Sweetwater_Unsteady Plan: 1)ALT5D_Mul:02yr_event:RAS-ALT_5D_2yr 9/8/2017 2) ALT5D_Mul:05yr_event:RAS-ALT_5D_5yr 9/8/2017 3) ALT5D_Mul:10yr_event:RAS-ALT_5D_10yr 9/8/2017 4) ALT5D_Mul:25yr_event:RAS-ALT_5D_25yr 9/8/2017 5)ALT5D_Mul:50yr_event:RAS-ALT_5D_50yr 9/8/2017 6)ALT5D_Mul:100yr_even:RAS-ALT_5D_100yr 9/8/2017 7)ALT5D_Mul:200yr_even:RAS-ALT_5D_200yr 9/8/2017 8)ALT5D_Mul:500yr_even:RAS-ALT_5D_500yr 9/8/2017
Olley Creek OLC1
Legend
WS Max WS - ALT 5D_Mul:500yr_even:RAS-ALT_5D_500yr
WS Max WS - ALT 5D_Mul:200yr_even:RAS-ALT_5D_200yr
WS Max WS - ALT 5D_Mul:100yr_even:RAS-ALT_5D_100yr
WS Max WS - ALT 5D_Mul:50yr_event:RAS-ALT_5D_50yr
WS Max WS - ALT 5D_Mul:25yr_event:RAS-ALT_5D_25yr
WS Max WS - ALT 5D_Mul:10yr_event:RAS-ALT_5D_10yr
WS Max WS - ALT 5D_Mul:05yr_event:RAS-ALT_5D_5yr
WS Max WS - ALT 5D_Mul:02yr_event:RAS-ALT_5D_2yr
Ground
Elevation (ft)
960
940
920
900
880
860
OC-1
B191136069, Clay Road...
OC-3
B191011070, Flint Hill Road...
Golf Course
B170136079, Silver Comet RR Bridg...
0
2000
4000
6000
8000
10000
12000
14000
Main Channel Distance (ft)

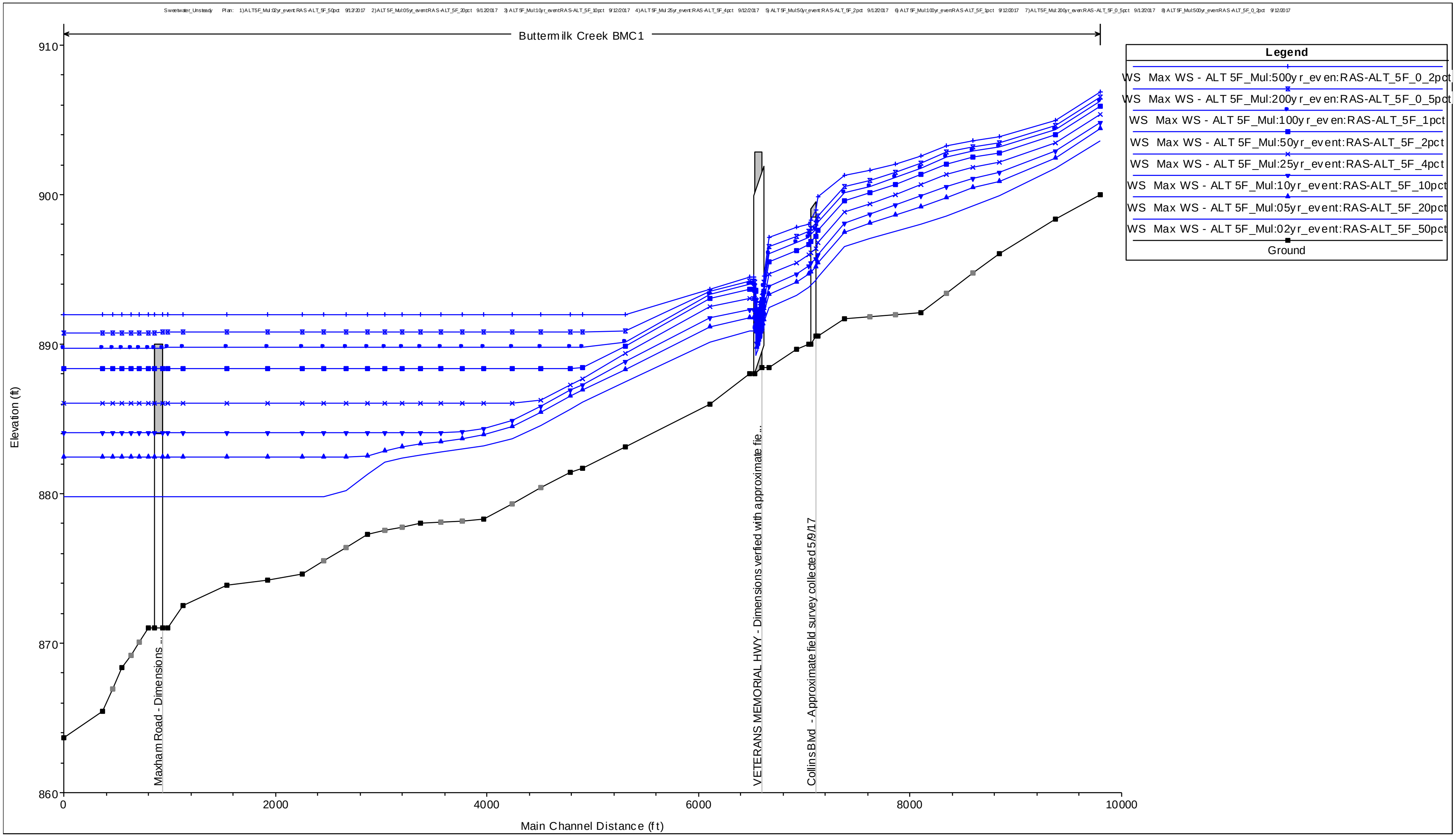

PowderSpringsCrk PSC1
Legend
WS Max WS - ALT 5D_Mul:500yr_even:RAS-ALT_5D_500yr
WS Max WS - ALT 5D_Mul:200yr_even:RAS-ALT_5D_200yr
WS Max WS - ALT 5D_Mul:100yr_even:RAS-ALT_5D_100yr
WS Max WS - ALT 5D_Mul:50yr_event:RAS-ALT_5D_50yr
WS Max WS - ALT 5D_Mul:25yr_event:RAS-ALT_5D_25yr
WS Max WS - ALT 5D_Mul:10yr_event:RAS-ALT_5D_10yr
WS Max WS - ALT 5D_Mul:05yr_event:RAS-ALT_5D_5yr
WS Max WS - ALT 5D_Mul:02yr_event:RAS-ALT_5D_2yr
Ground
Elevation (ft)
Main Channel Distance (ft)
940
930
920
910
900
890
880
870
0
5000
10000
15000
20000
25000
30000
35000
0.37 B - ...
0.74 C - ...
0.83 This is...
0.93 *** VALLEY...
1.16 D - *** FI...
1.63 E - FIS-E...
1.73 D.S. OGLESBY R...
2.17 G - FIS-G VALL...
Structure revised based on...
2.81 I - FIS-I U.S. LONG ...
adj invert
3.15 BROWNSVILLE ROAD D.S....
adj invert
3.39 K - FIS-K VALLEY SECTION ...
Sweetwater Ave - Newly added structur...
3.78 L - *** XSEC 3.83 FIS-L D.S. THO...
CH James Parkway
4.31 M - *** FIS-M VALLEY SECTION ***
4.51
4.61 This is a REPEATED section.
4.72 N&S RAILWAY D.S.
4.76 O - FIS-O VALLEY SECTION U.S. US 278
4.86
5.06 P - This is a REPEATED section.
5.21
5.32 CSX RAILWAY D.S.
5.42 *** US 278 CULV D.S. ***NEW*******
5.49 *** VALLEY SECTION ***NEW*******
5.75 R - *** FIS-R VALLEY SECTION ***MODIFIED***
6.02 S - FIS-S VALLEY SECTION

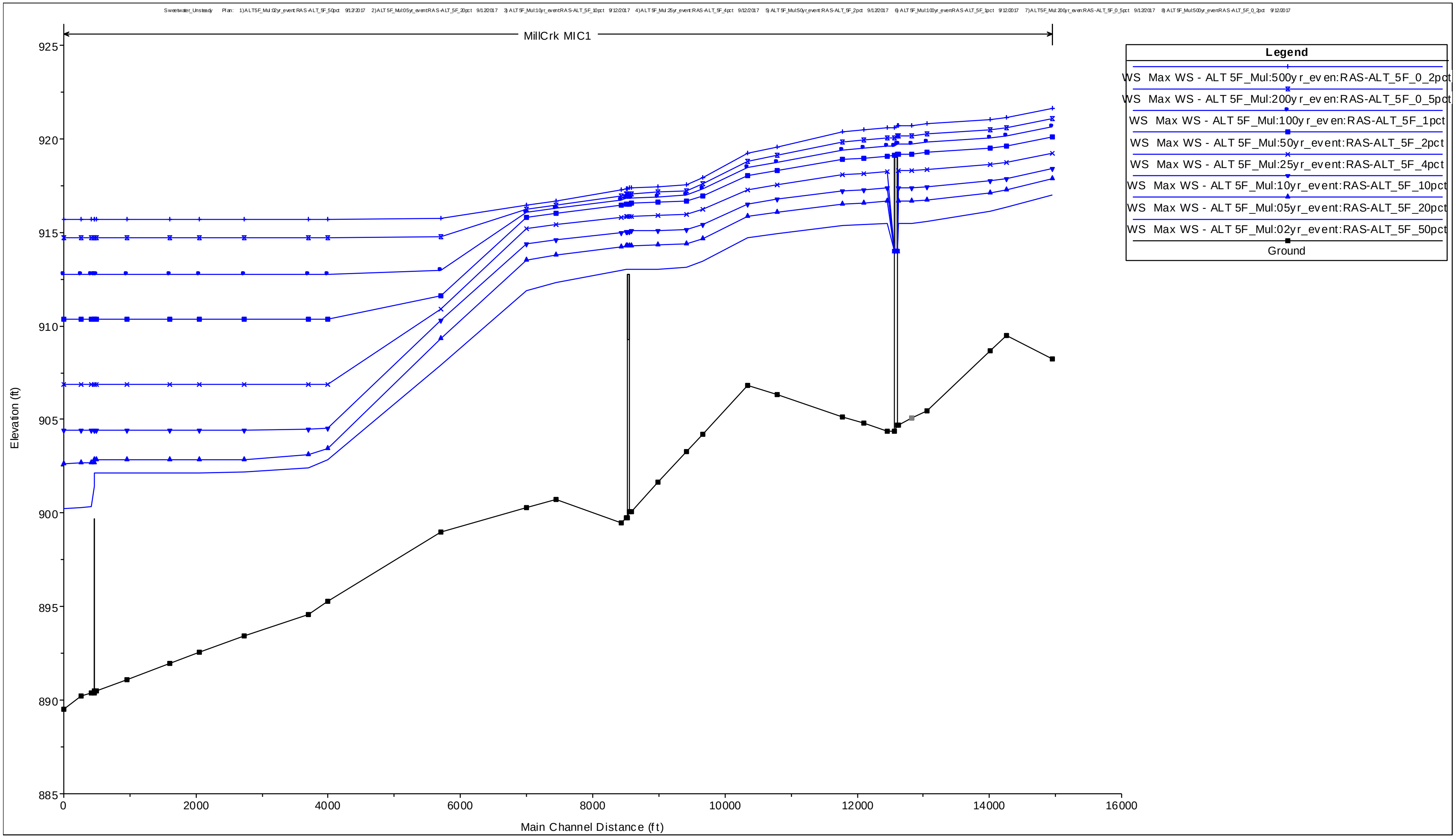

Sweetwater_Unsteady Plan: 1) ALT5D_Mul:02yr_event:RAS-ALT_5D_2yr 9/8/2017 2) ALT5D_Mul:05yr_event:RAS-ALT_5D_5yr 9/8/2017 3) ALT5D_Mul:10yr_event:RAS-ALT_5D_10yr 9/8/2017 4) ALT5D_Mul:25yr_event:RAS-ALT_5D_25yr 9/8/2017 5) ALT5D_Mul:50yr_event:RAS-ALT_5D_50yr 9/8/2017 6) ALT5D_Mul:100yr_even:RAS-ALT_5D_100yr 9/8/2017 7) ALT5D_Mul:200yr_even:RAS-ALT_5D_200yr 9/8/2017 8) ALT5D_Mul:500yr_even:RAS-ALT_5D_500yr 9/8/2017
Sweetwater Creek SWC6
Legend
WS Max WS - ALT 5D_Mul:500yr_even:RAS-ALT_5D_500yr
WS Max WS - ALT 5D_Mul:200yr_even:RAS-ALT_5D_200yr
WS Max WS - ALT 5D_Mul:100yr_even:RAS-ALT_5D_100yr
WS Max WS - ALT 5D_Mul:50yr_event:RAS-ALT_5D_50yr
WS Max WS - ALT 5D_Mul:25yr_event:RAS-ALT_5D_25yr
WS Max WS - ALT 5D_Mul:10yr_event:RAS-ALT_5D_10yr
WS Max WS - ALT 5D_Mul:05yr_event:RAS-ALT_5D_5yr
WS Max WS - ALT 5D_Mul:02yr_event:RAS-ALT_5D_2yr
Ground
Elevation (ft)
900
850
800
750
700
SW02 - Rivers.
SW03 - State Park
**IF WATER IS ABOVE LEFT BANK, DELETE ALL LEFT LEVEES THROUGH 25808
SW04 - Blairs Bridge Road
SW05 - Interstate 20
SW07 - Skyview Drive
SW08 - Thornton Rd
SW12 (Douglas Co) - OLD ALABAMA ROAD
0
10000
20000
30000
40000
50000
60000
70000
Main Channel Distance (ft)

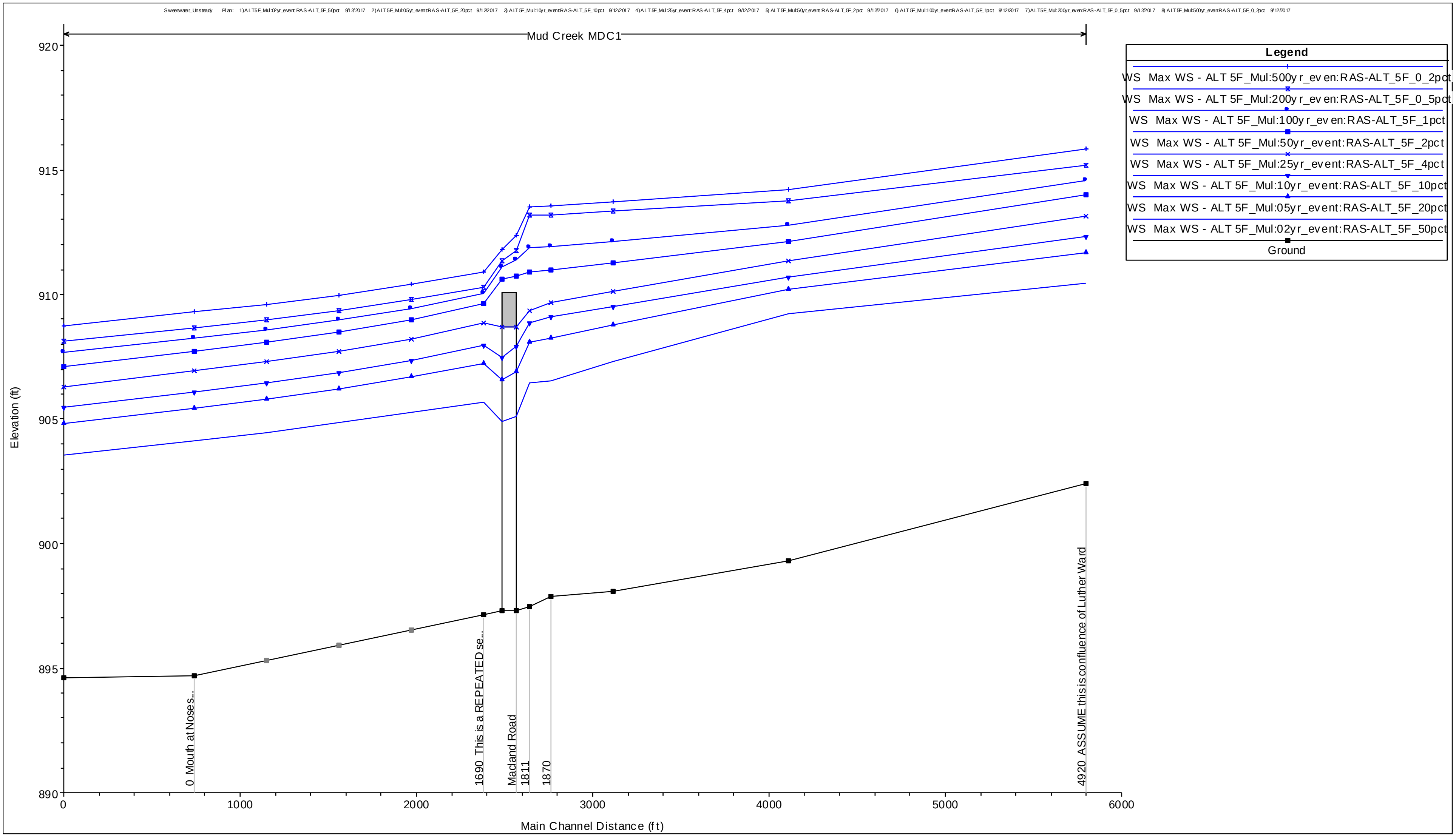


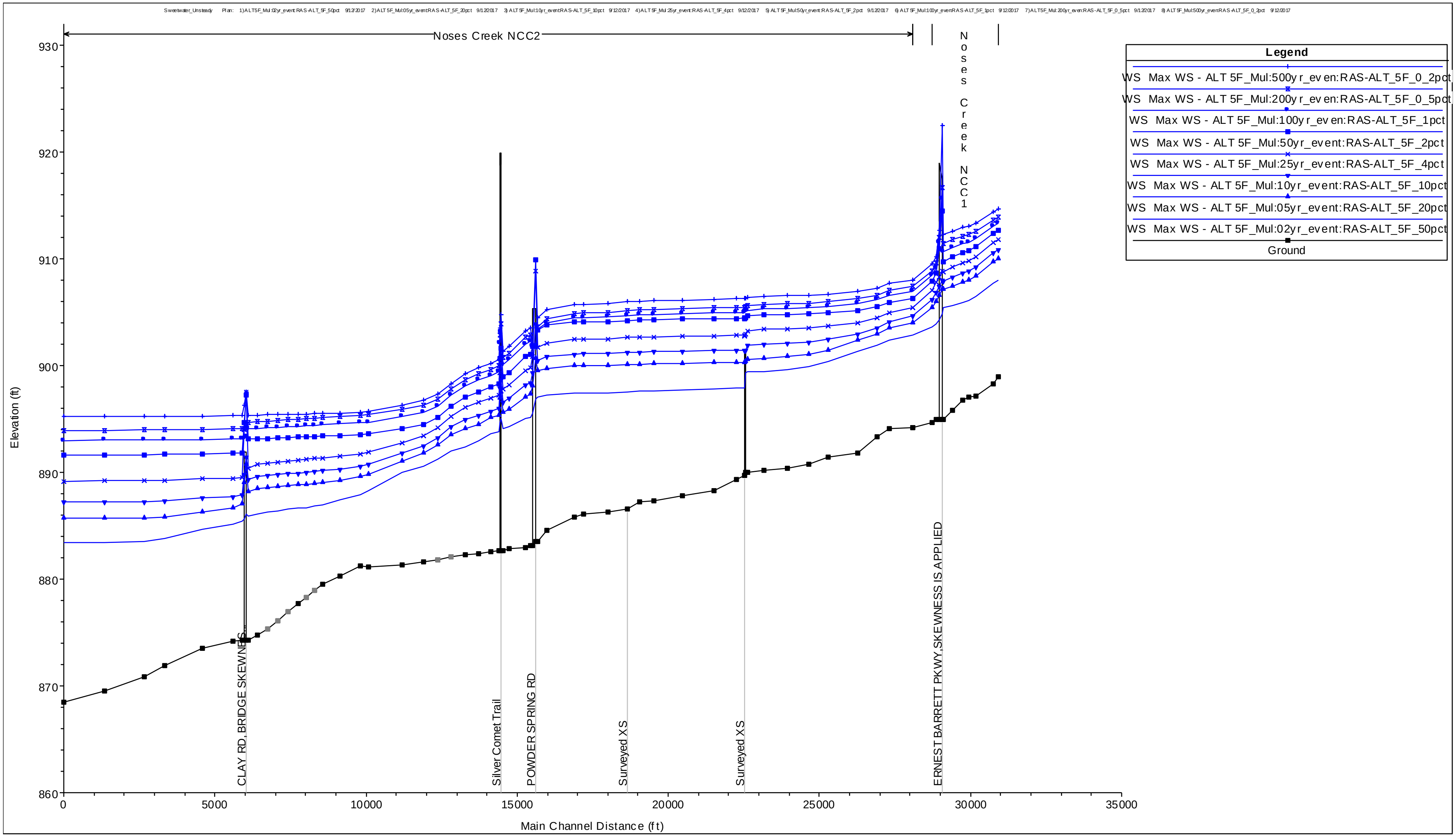
* Main Channel Distance (ft) values should be added to STA 63230 from SWC6 reach above for a continuous profile.

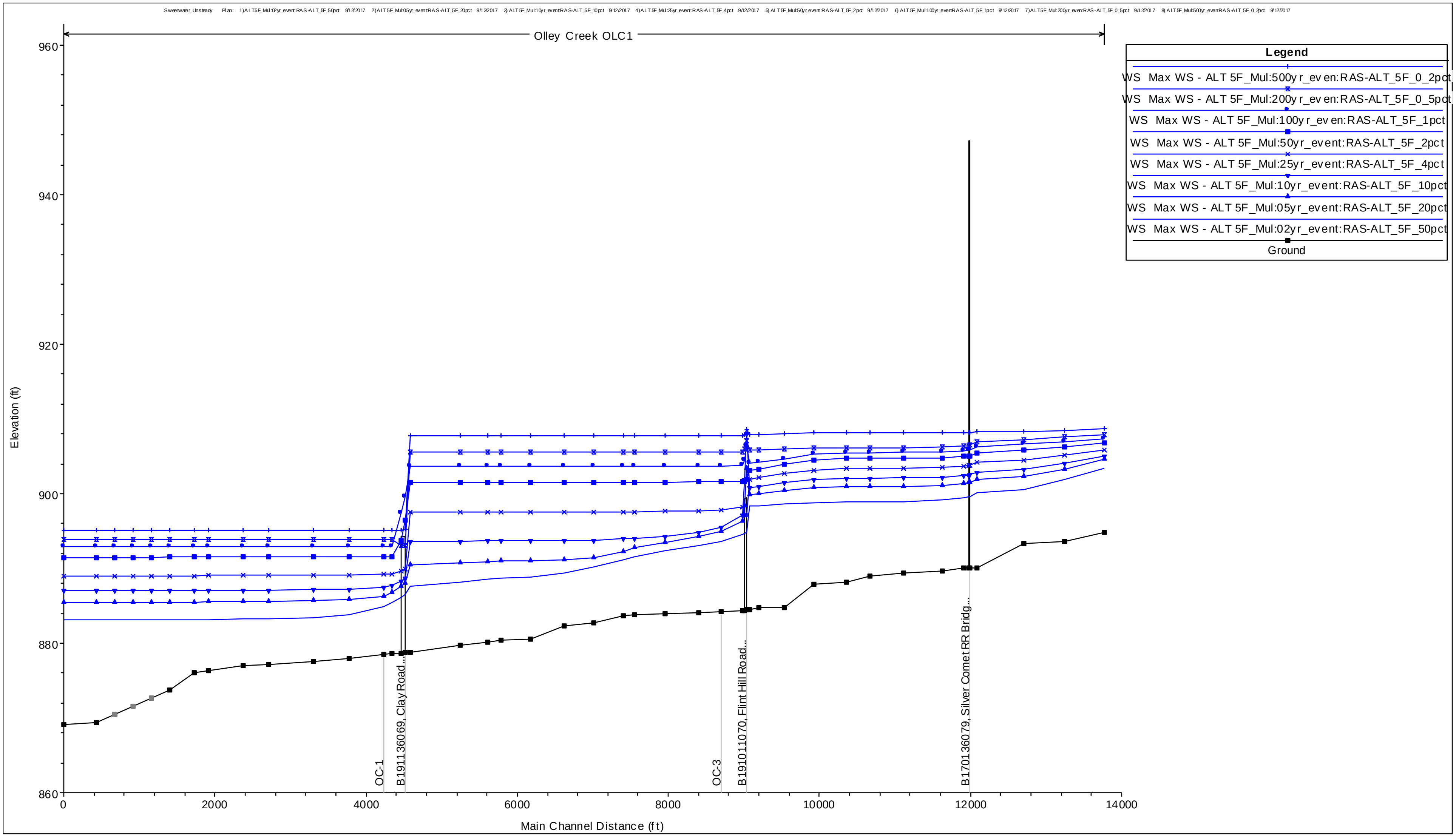
Alternative 5F

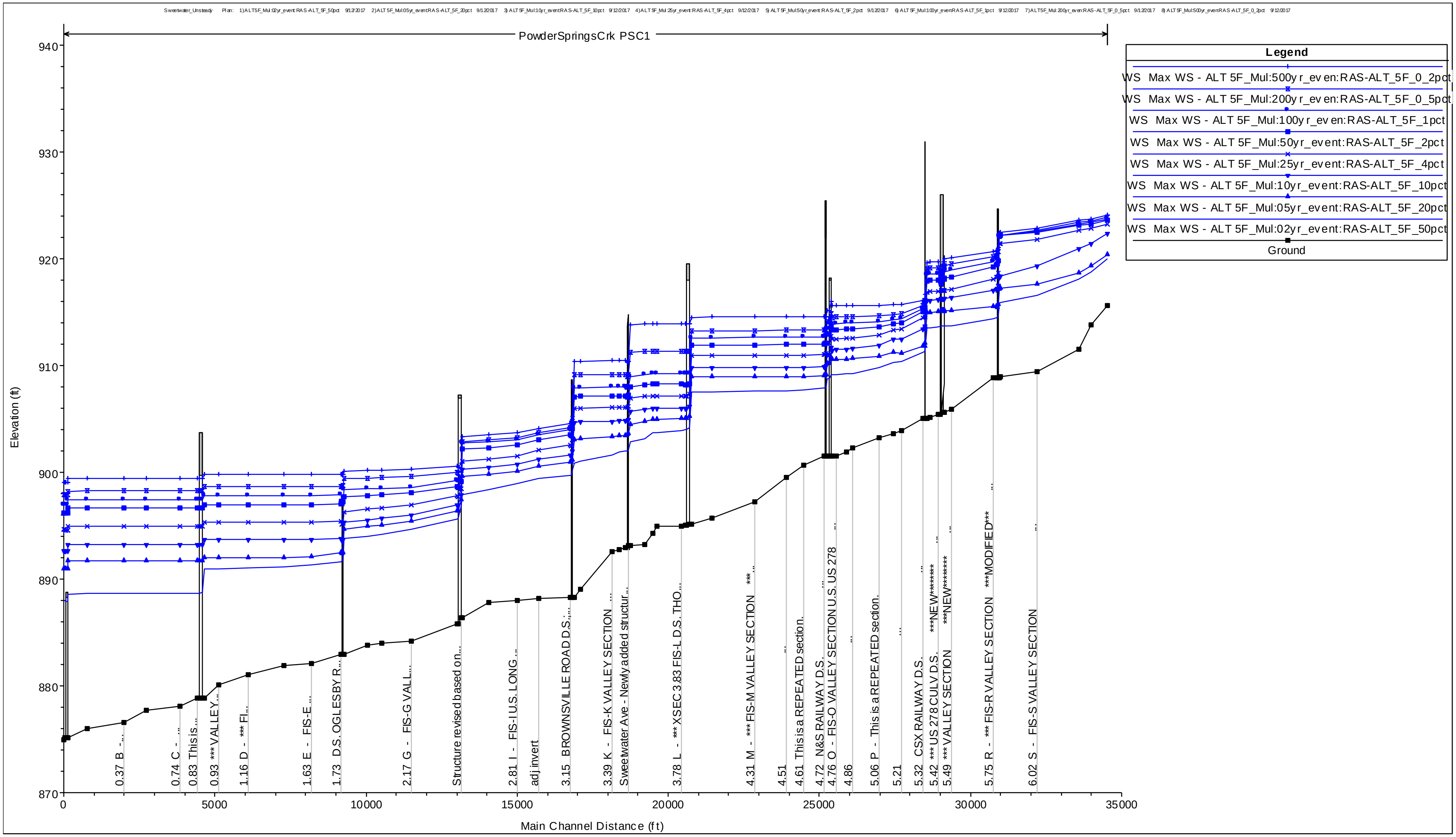


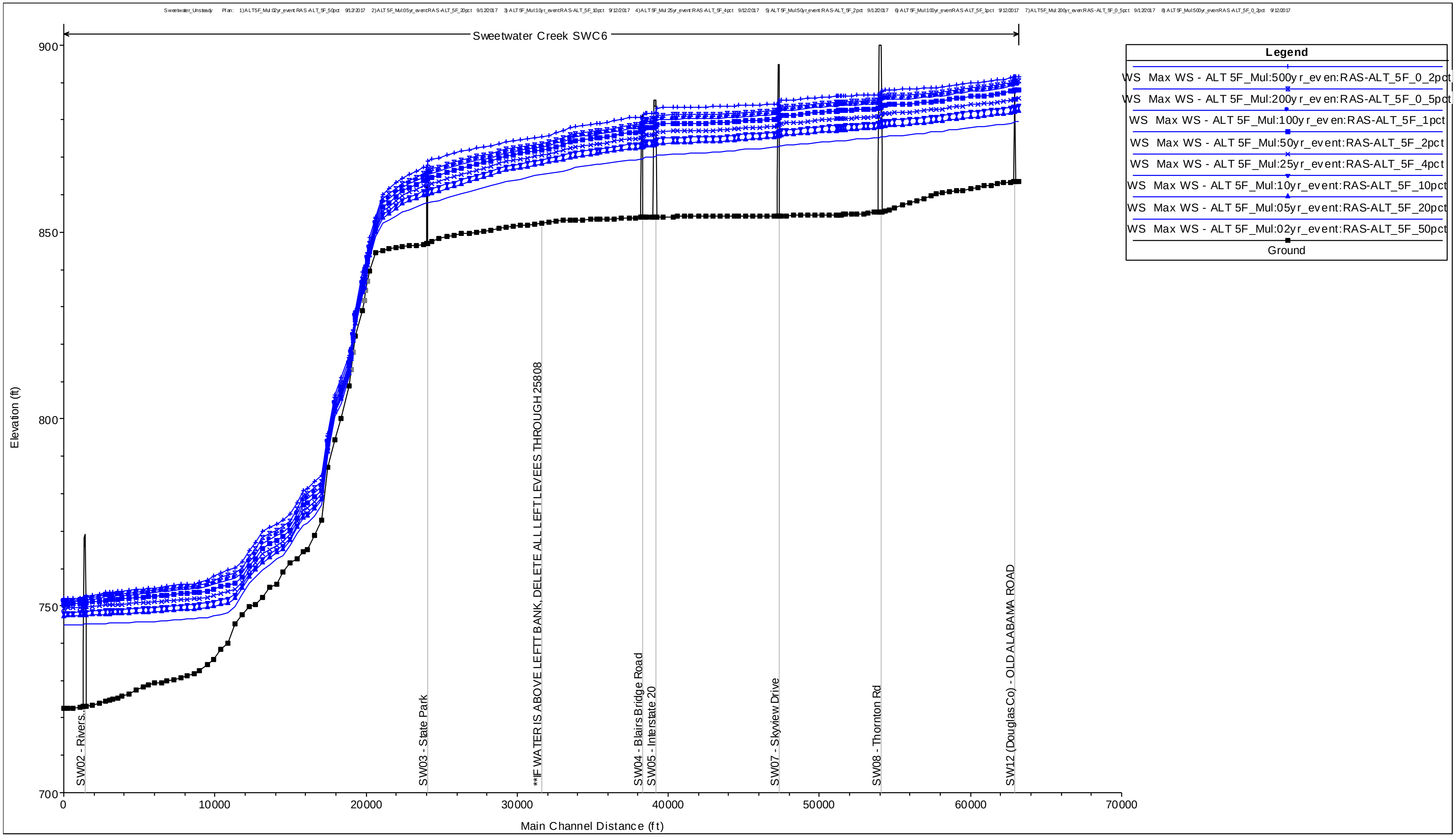

Sweetwater_Unsteady Plan: 1)ALT5F_Mul:02yr_event:RAS-ALT_5F_50pct 9/12/2017 2)ALT5F_Mul:05yr_event:RAS-ALT_5F_20pct 9/12/2017 3)ALT5F_Mul:10yr_event:RAS-ALT_5F_10pct 9/12/2017 4)ALT5F_Mul:25yr_event:RAS-ALT_5F_4pct 9/12/2017 5)ALT5F_Mul:50yr_event:RAS-ALT_5F_2pct 9/12/2017 6)ALT5F_Mul:100yr_event:RAS-ALT_5F_1pct 9/12/2017 7)ALT5F_Mul:200yr_even:RAS-ALT_5F_0_5pct 9/12/2017 8)ALT5F_Mul:500yr_event:RAS-ALT_5F_0_2pct 9/12/2017
MillCrk MIC1
Legend
WS Max WS - ALT 5F_Mul:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5F_Mul:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5F_Mul:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5F_Mul:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5F_Mul:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5F_Mul:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5F_Mul:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5F_Mul:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
925
920
915
910
905
900
895
890
885
0
2000
4000
6000
8000
10000
12000
14000
16000
Main Channel Distance (ft)

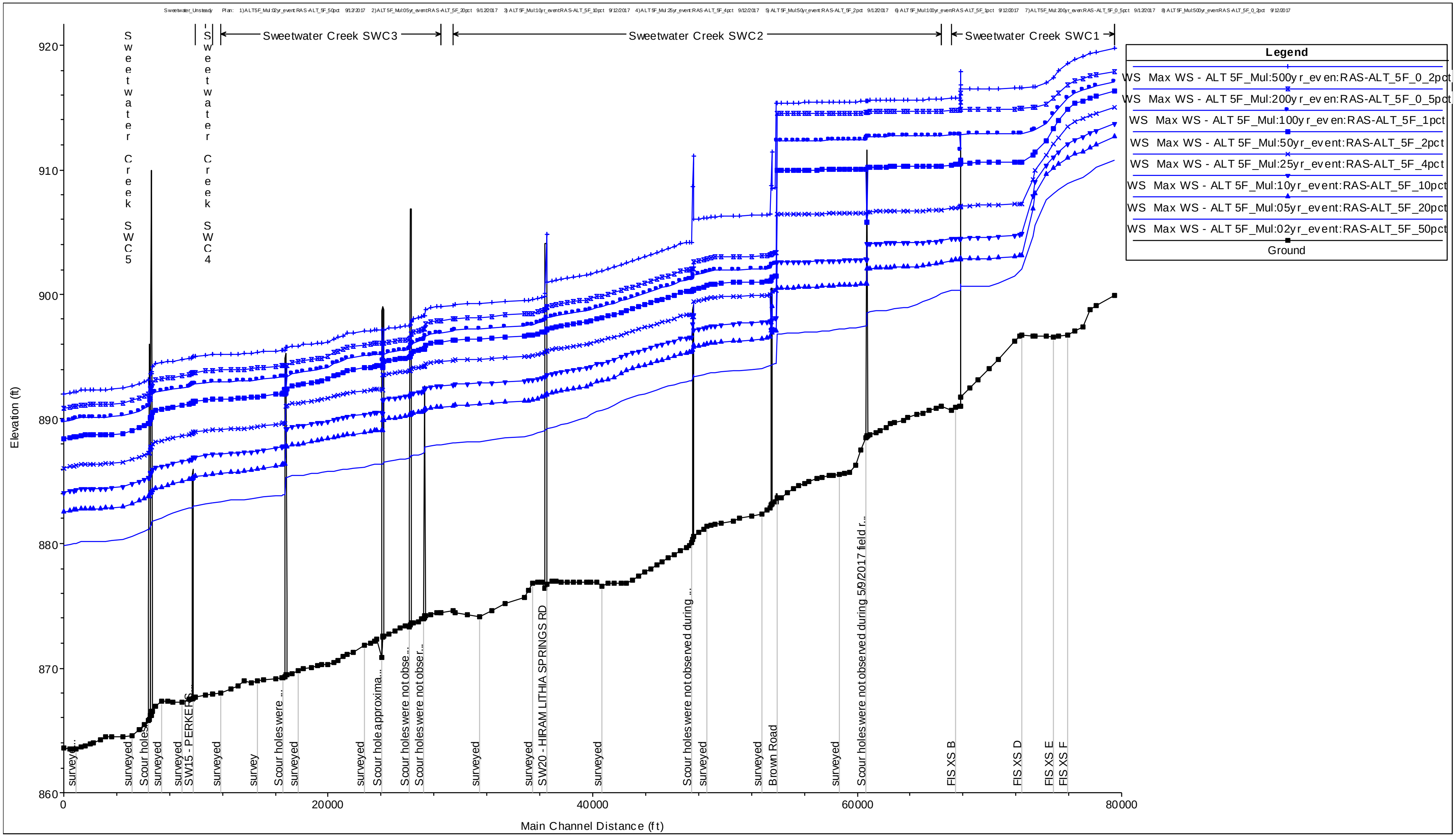

Sweetwater_Unsteady Plan: 1)ALT5F_Mul:02yr_event:RAS-ALT_5F_50pct 9/12/2017 2)ALT5F_Mul:05yr_event:RAS-ALT_5F_20pct 9/12/2017 3)ALT5F_Mul:10yr_event:RAS-ALT_5F_10pct 9/12/2017 4)ALT5F_Mul:25yr_event:RAS-ALT_5F_4pct 9/12/2017 5)ALT5F_Mul:50yr_event:RAS-ALT_5F_2pct 9/12/2017 6)ALT5F_Mul:100yr_event:RAS-ALT_5F_1pct 9/12/2017 7)ALT5F_Mul:200yr_even:RAS-ALT_5F_0_5pct 9/12/2017 8)ALT5F_Mul:500yr_event:RAS-ALT_5F_0_2pct 9/12/2017
Mud Creek MDC1
Legend
WS Max WS - ALT 5F_Mul:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5F_Mul:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5F_Mul:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5F_Mul:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5F_Mul:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5F_Mul:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5F_Mul:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5F_Mul:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
920
915
910
905
900
895
890
0 Mouth at Noses...
1690 This is a REPEATED se...
Macland Road
1811
1870
4920 ASSUME this is confluence of Luther Ward
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (ft)


Sweetwater_Unsteady Plan: 1)ALT5F_Mul:02yr_event:RAS-ALT_5F_50pct 9/12/2017 2)ALT5F_Mul:05yr_event:RAS-ALT_5F_20pct 9/12/2017 3)ALT5F_Mul:10yr_event:RAS-ALT_5F_10pct 9/12/2017 4)ALT5F_Mul:25yr_event:RAS-ALT_5F_4pct 9/12/2017 5)ALT5F_Mul:50yr_event:RAS-ALT_5F_2pct 9/12/2017 6)ALT5F_Mul:100yr_event:RAS-ALT_5F_1pct 9/12/2017 7)ALT5F_Mul:200yr_even:RAS-ALT_5F_0_5pct 9/12/2017 8)ALT5F_Mul:500yr_event:RAS-ALT_5F_0_2pct 9/12/2017
Noses Creek NCC2
Noses Creek NCC1
Legend
WS Max WS - ALT 5F_Mul:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5F_Mul:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5F_Mul:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5F_Mul:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5F_Mul:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5F_Mul:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5F_Mul:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5F_Mul:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
930
920
910
900
890
880
870
860
CLAY RD, BRIDGE SKEWNESS
Silver Comet Trail
POWDER SPRING RD
Surveyed XS
Surveyed XS
ERNEST BARRETT PKWY,SKEWNESS IS APPLIED
0
5000
10000
15000
20000
25000
30000
35000
Main Channel Distance (ft)


Sweetwater_Unsteady Plan: 1)ALT5F_Mul:02yr_event:RAS-ALT_5F_50pct 9/12/2017 2)ALT5F_Mul:05yr_event:RAS-ALT_5F_20pct 9/12/2017 3) ALT5F_Mul:10yr_event:RAS-ALT_5F_10pct 9/12/2017 4)ALT5F_Mul:25yr_event:RAS-ALT_5F_4pct 9/12/2017 5) ALT5F_Mul:50yr_event:RAS-ALT_5F_2pct 9/12/2017 6) ALT5F_Mul:100yr_even:RAS-ALT_5F_1pct 9/12/2017 7)ALT5F_Mul:200yr_even:RAS-ALT_5F_0_5pct 9/12/2017 8) ALT5F_Mul:500yr_even:RAS-ALT_5F_0_2pct 9/12/2017
Olley Creek OLC1
Legend
WS Max WS - ALT 5F_Mul:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5F_Mul:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5F_Mul:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5F_Mul:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5F_Mul:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5F_Mul:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5F_Mul:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5F_Mul:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
960
940
920
900
880
860
OC-1
B191136069, Clay Road...
OC-3
B191011070, Flint Hill Road...
B170136079, Silver Comet RR Bridg...
0
2000
4000
6000
8000
10000
12000
14000
Main Channel Distance (ft)

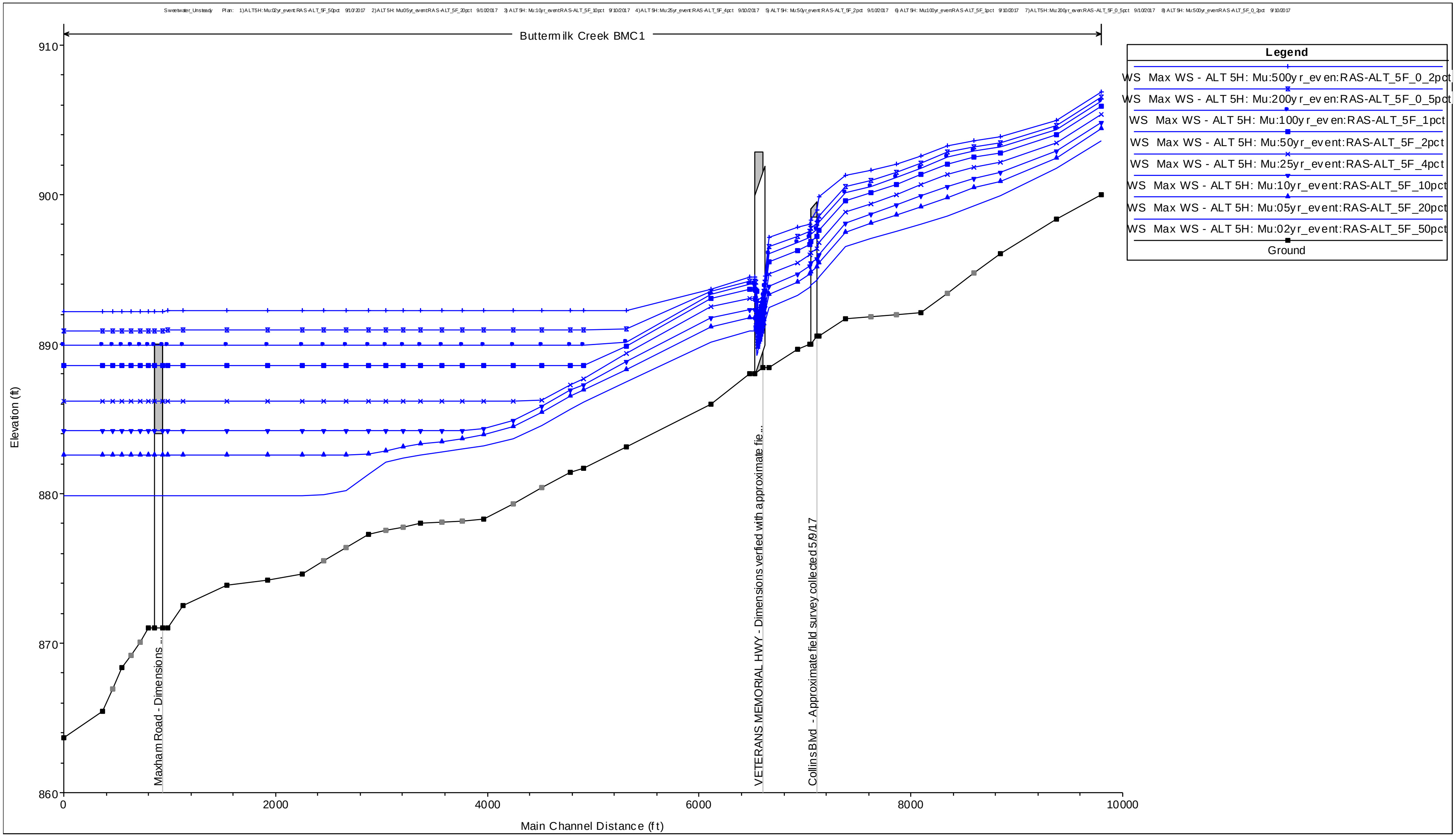

PowderSpringsCrk PSC1
Legend
WS Max WS - ALT 5F_Mul:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5F_Mul:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5F_Mul:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5F_Mul:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5F_Mul:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5F_Mul:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5F_Mul:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5F_Mul:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
Main Channel Distance (ft)

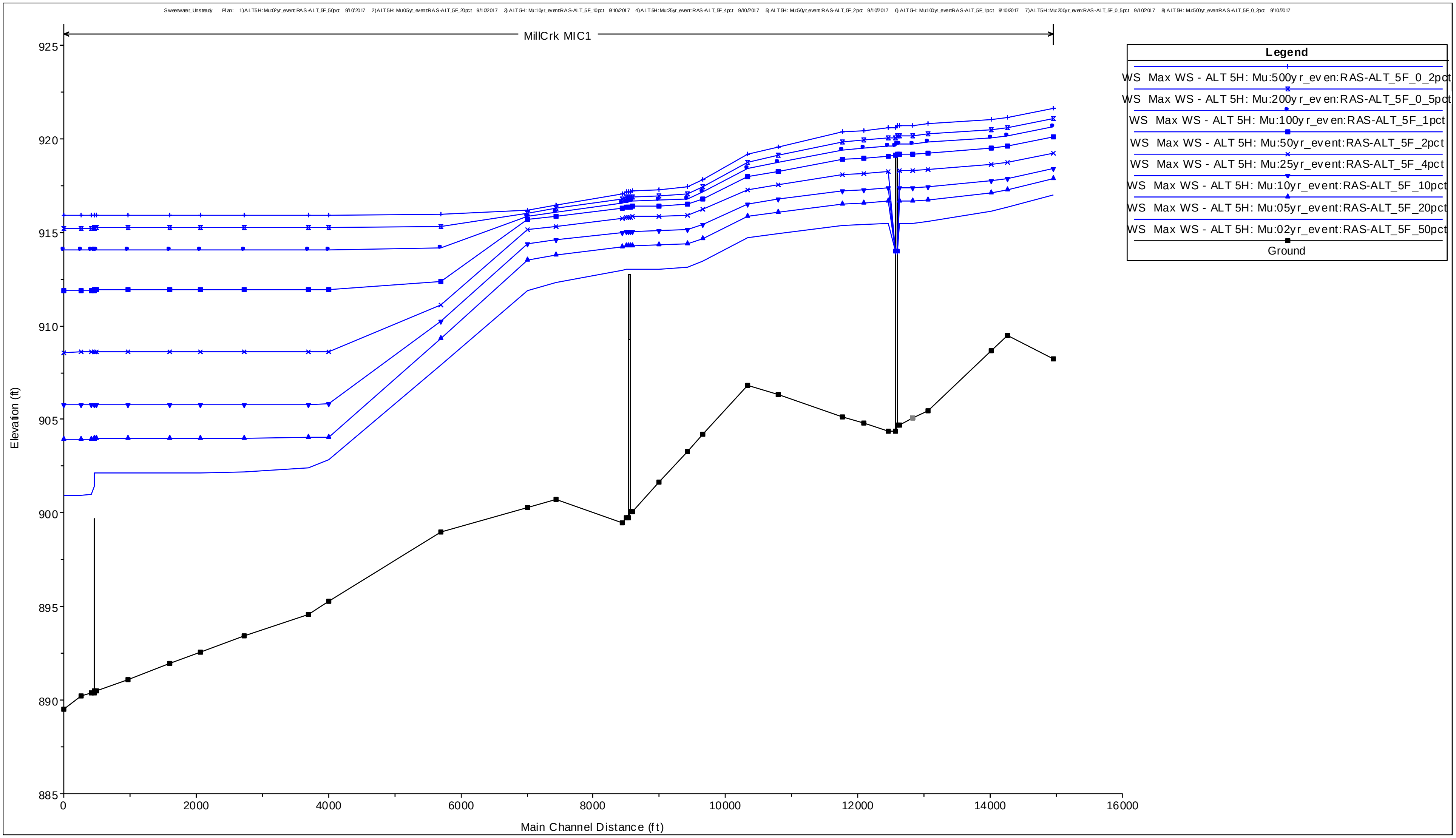

Sweetwater Creek SWC6
Legend
WS Max WS - ALT 5F_Mul:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5F_Mul:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5F_Mul:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5F_Mul:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5F_Mul:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5F_Mul:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5F_Mul:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5F_Mul:02yr_event:RAS-ALT_5F_50pct
Ground
SW02 - Rivers.
SW03 - State Park
**IF WATER IS ABOVE LEFT BANK, DELETE ALL LEFT LEVEES THROUGH 25808
SW04 - Blairs Bridge Road
SW05 - Interstate 20
SW07 - Skyview Drive
SW08 - Thornton Rd
SW12 (Douglas Co) - OLD ALABAMA ROAD
Elevation (ft)
Main Channel Distance (ft)

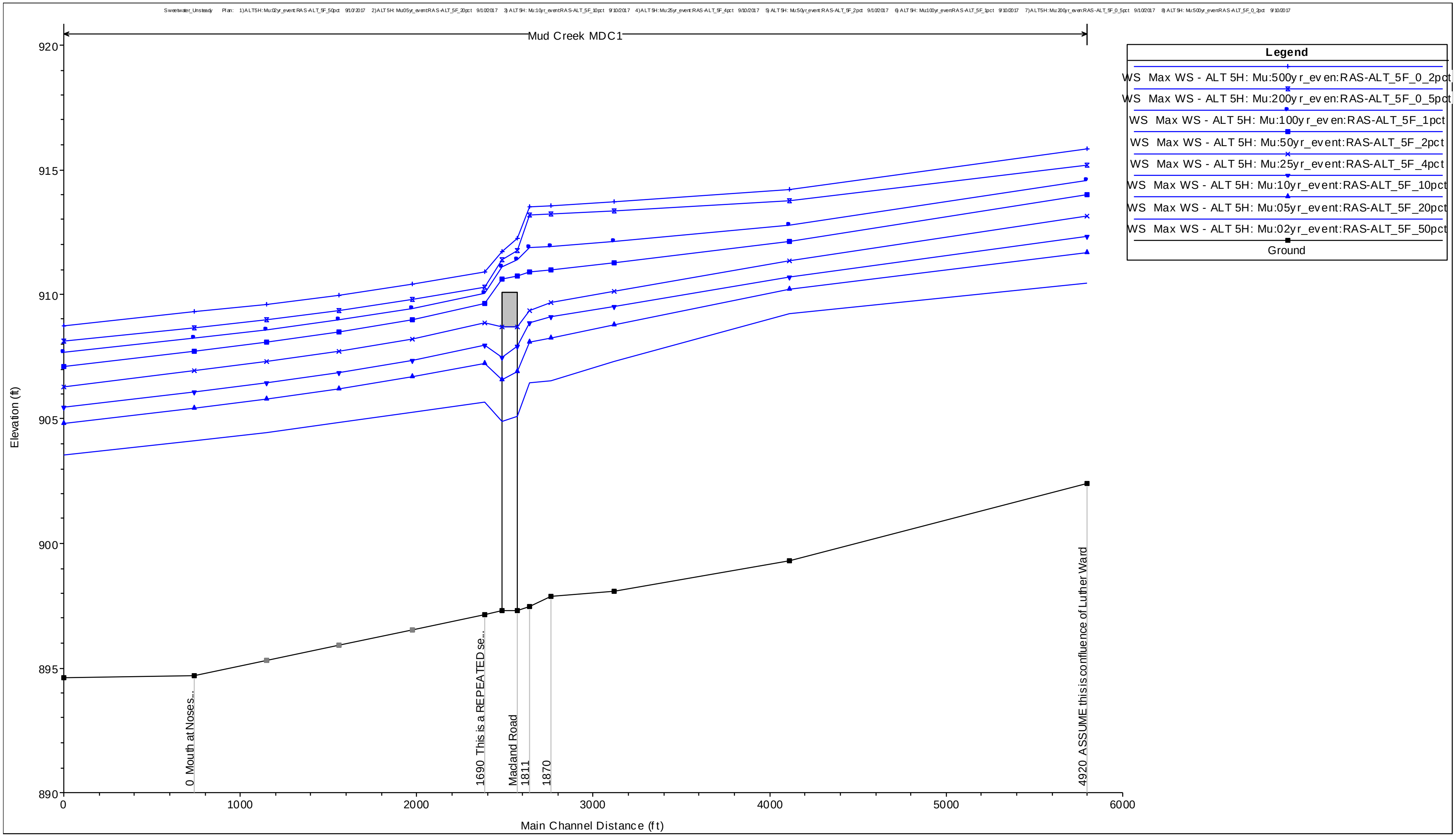


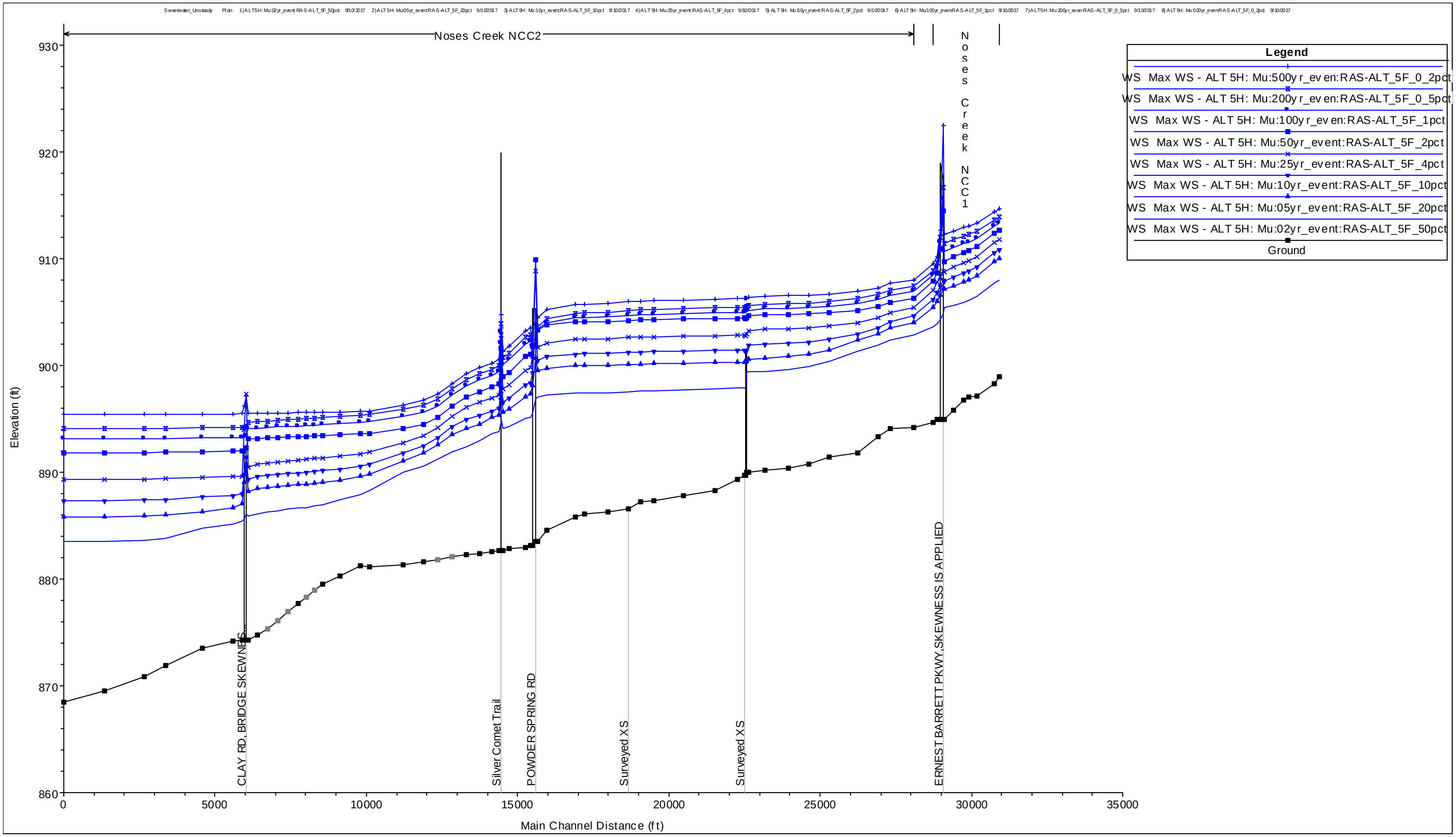
* Main Channel Distance (ft) values should be added to STA 63230 from SWC6 reach above for a continuous profile.

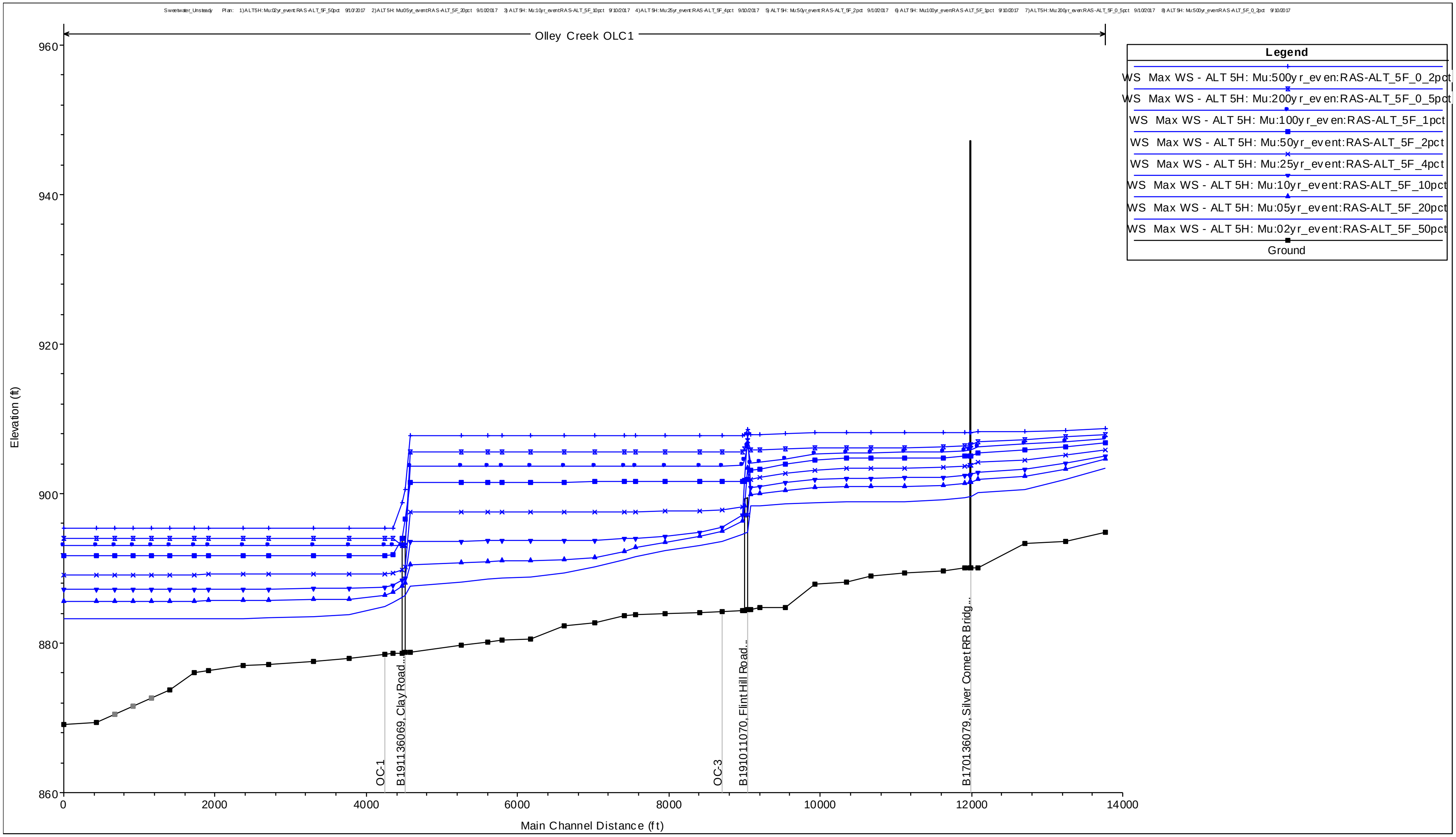
Alternative 5H

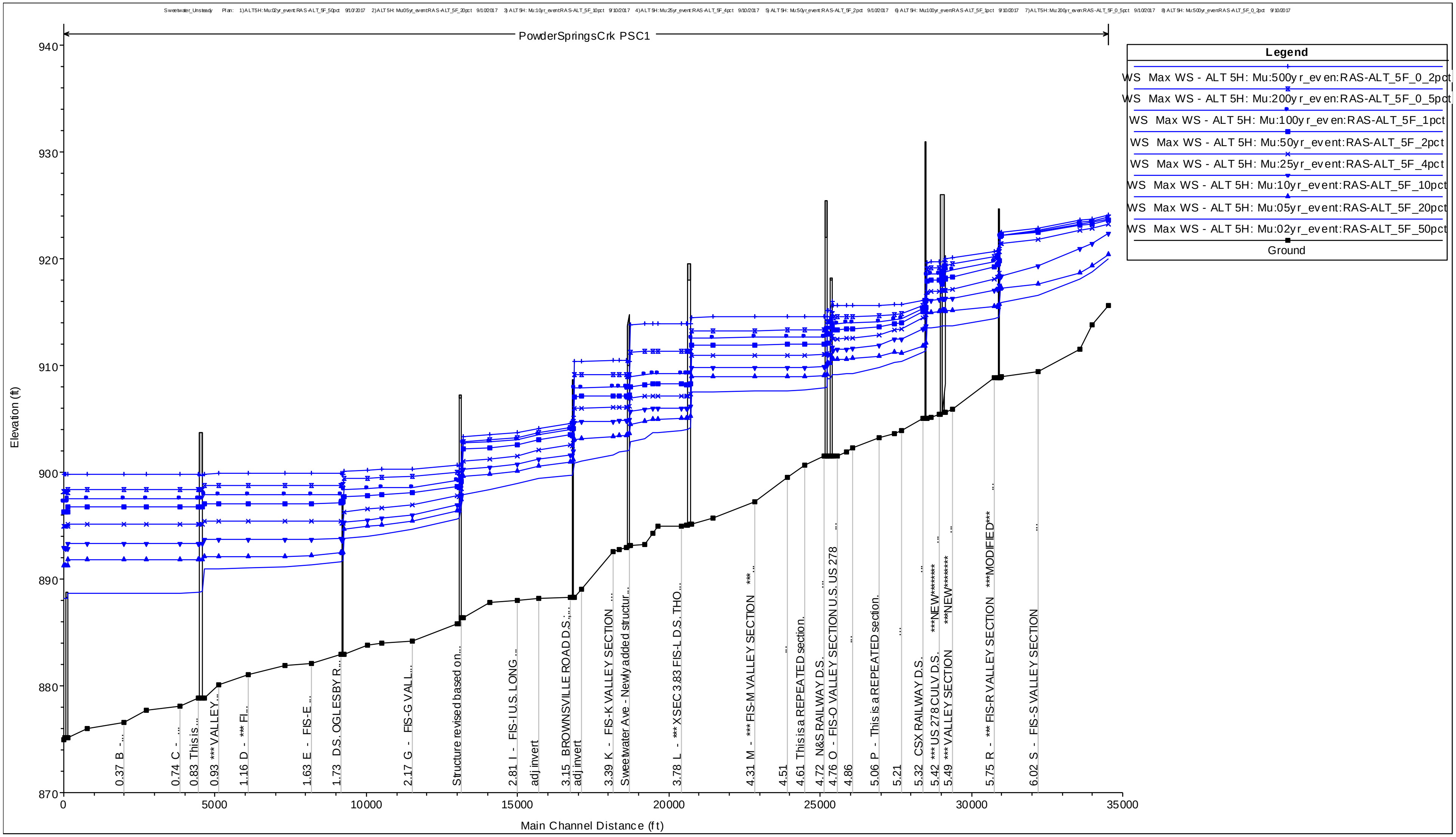


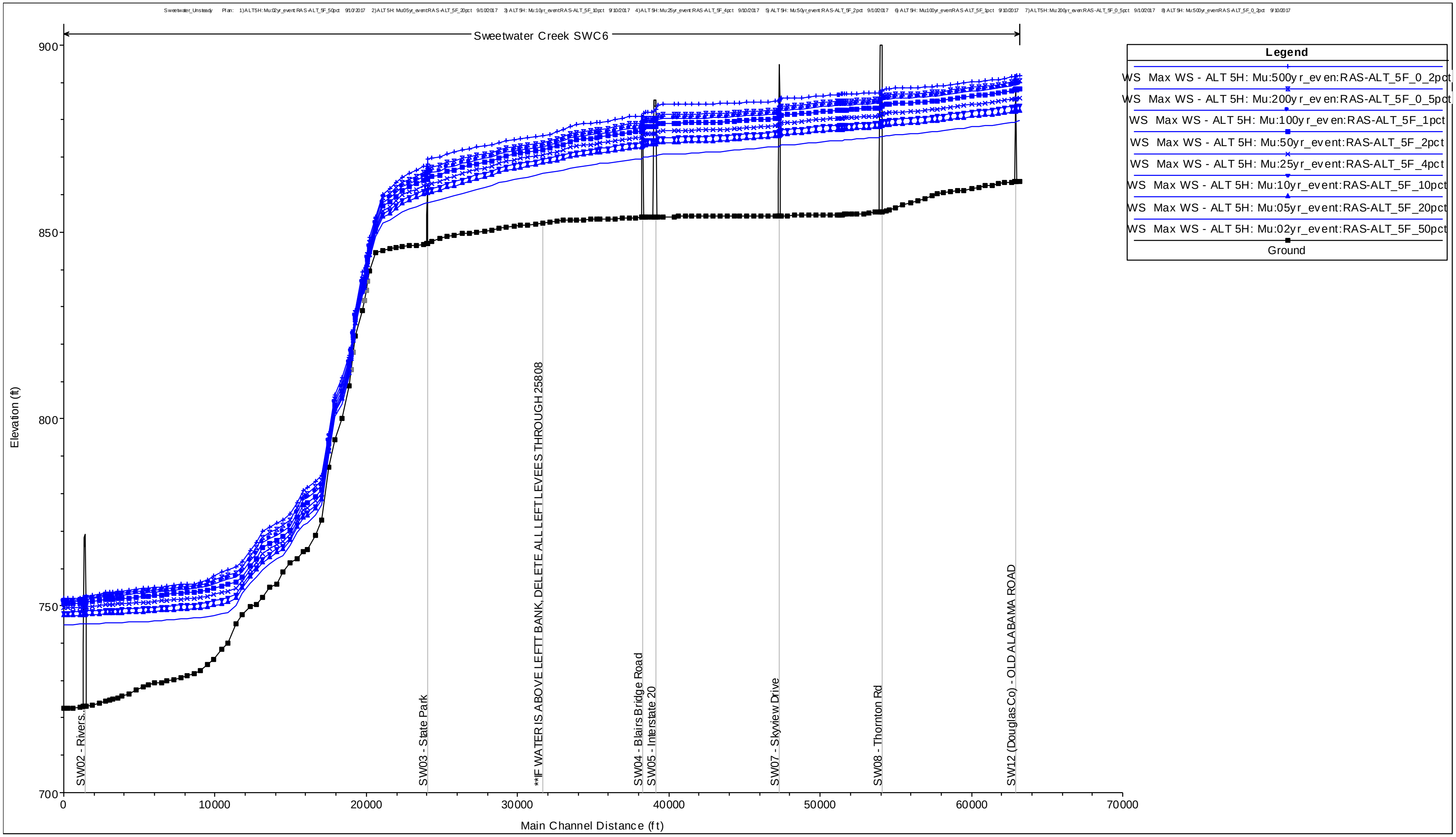

Sweetwater_Unsteady Plan: 1) ALT5H: Mu:02yr_event:RAS-ALT_5F_50pct 9/10/2017 2) ALT5H: Mu:05yr_event:RAS-ALT_5F_20pct 9/10/2017 3) ALT5H: Mu:10yr_event:RAS-ALT_5F_10pct 9/10/2017 4) ALT5H: Mu:25yr_event:RAS-ALT_5F_4pct 9/10/2017 5) ALT5H: Mu:50yr_event:RAS-ALT_5F_2pct 9/10/2017 6) ALT5H: Mu:100yr_event:RAS-ALT_5F_1pct 9/10/2017 7) ALT5H: Mu:200yr_even:RAS-ALT_5F_0_5pct 9/10/2017 8) ALT5H: Mu:500yr_event:RAS-ALT_5F_0_2pct 9/10/2017
MillCrk MIC1
Legend
WS Max WS - ALT 5H: Mu:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5H: Mu:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5H: Mu:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5H: Mu:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5H: Mu:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5H: Mu:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5H: Mu:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5H: Mu:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
925
920
915
910
905
900
895
890
885
0
2000
4000
6000
8000
10000
12000
14000
16000
Main Channel Distance (ft)

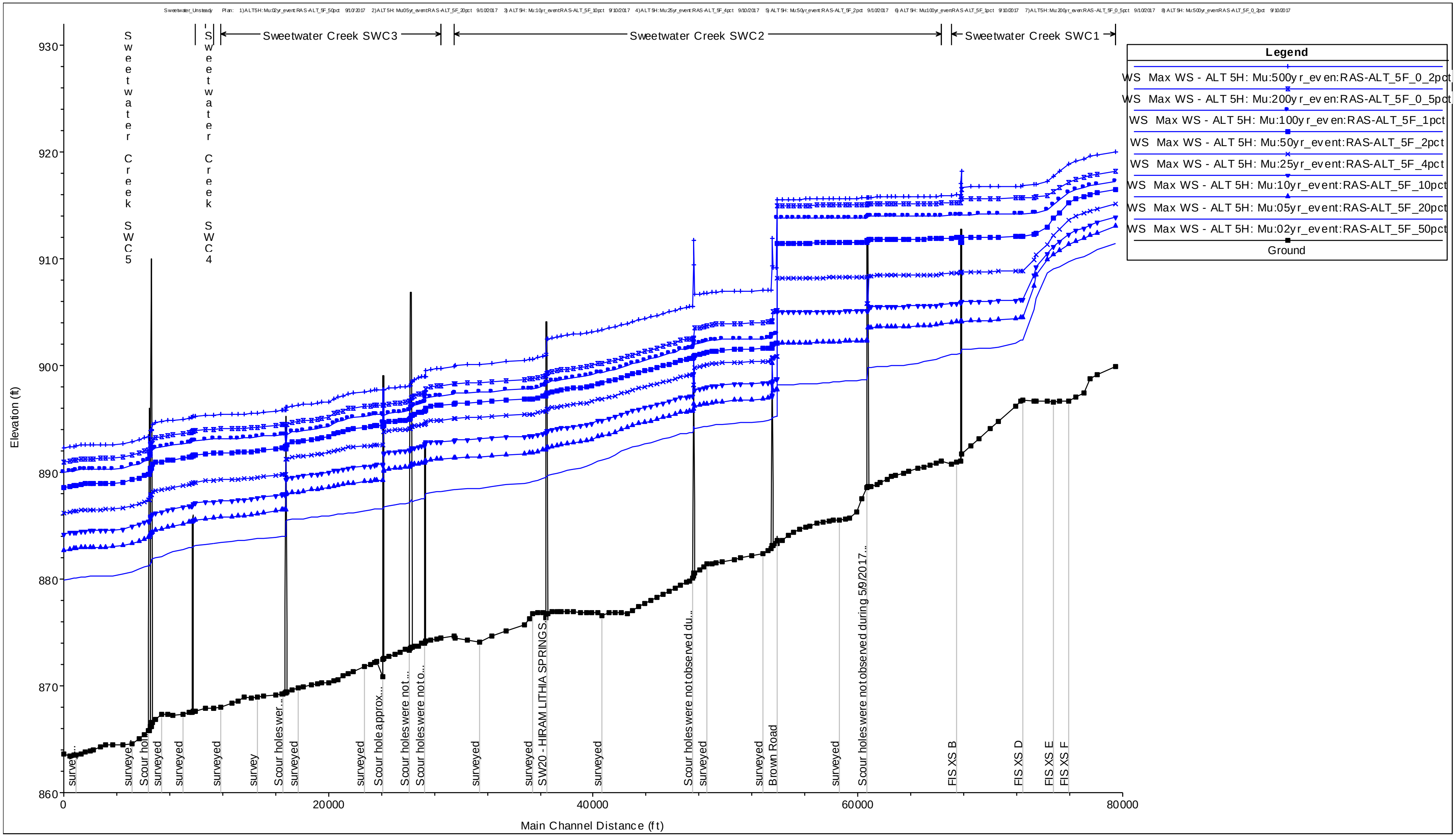

Sweetwater_Unsteady Plan: 1) ALT5H: Mu:02yr_event:RAS-ALT_5F_50pct 9/10/2017 2) ALT5H: Mu05yr_event:RAS-ALT_5F_20pct 9/10/2017 3) ALT5H: Mu:10yr_event:RAS-ALT_5F_10pct 9/10/2017 4) ALT5H: Mu:25yr_event:RAS-ALT_5F_4pct 9/10/2017 5) ALT5H: Mu:50yr_event:RAS-ALT_5F_2pct 9/10/2017 6) ALT5H: Mu100yr_event:RAS-ALT_5F_1pct 9/10/2017 7) ALT5H: Mu:200yr_even:RAS-ALT_5F_0_5pct 9/10/2017 8) ALT5H: Mu:500yr_even:RAS-ALT_5F_0_2pct 9/10/2017
Mud Creek MDC1
Legend
WS Max WS - ALT 5H: Mu:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5H: Mu:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5H: Mu:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5H: Mu:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5H: Mu:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5H: Mu:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5H: Mu:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5H: Mu:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
920
915
910
905
900
895
890
0 Mouth at Noses...
1690 This is a REPEATED se...
Macland Road
1811
1870
4920 ASSUME this is confluence of Luther Ward
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (ft)


Noses Creek NCC2
Noses Creek NCC1
Legend
WS Max WS - ALT 5H: Mu:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5H: Mu:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5H: Mu:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5H: Mu:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5H: Mu:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5H: Mu:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5H: Mu:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5H: Mu:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
Main Channel Distance (ft)
CLAY RD. BRIDGE SKEWNES
Silver Comet Trail
POWDER SPRING RD
Surveyed XS
Surveyed XS
ERNEST BARRETT PKWY SKEWNESS IS APPLIED
930
920
910
900
890
880
870
860
0
5000
10000
15000
20000
25000
30000
35000


Olley Creek OLC1
Legend
WS Max WS - ALT 5H: Mu:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5H: Mu:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5H: Mu:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5H: Mu:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5H: Mu:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5H: Mu:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5H: Mu:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5H: Mu:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
960
940
920
900
880
860
OC-1
B191136069, Clay Road...
OC-3
B191011070, Flint Hill Road...
B170136079, Silver Comet RR Bridg...
0
2000
4000
6000
8000
10000
12000
14000
Main Channel Distance (ft)

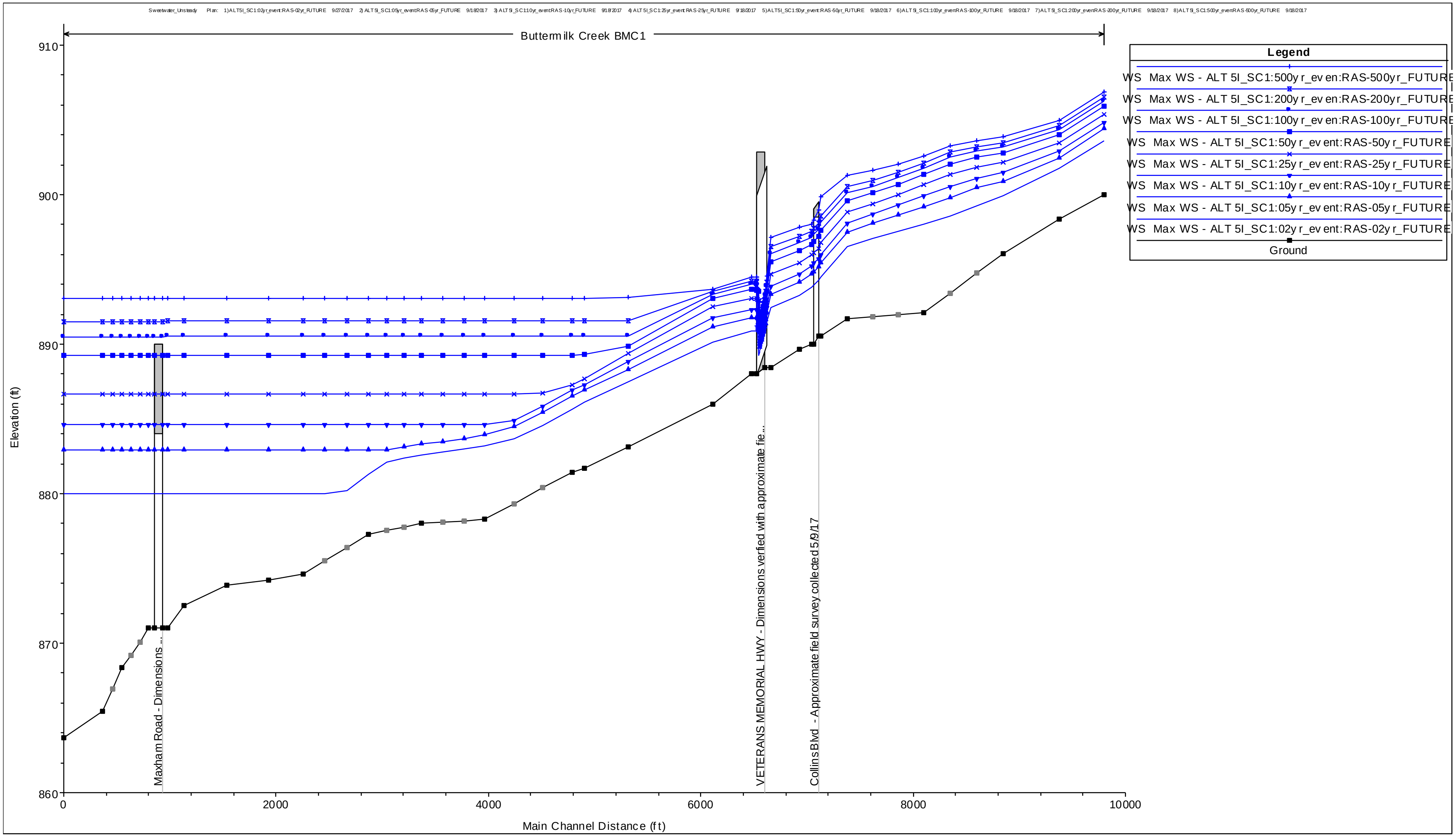

PowderSpringsCrk PSC1
Legend
WS Max WS - ALT 5H: Mu:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5H: Mu:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5H: Mu:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5H: Mu:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5H: Mu:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5H: Mu:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5H: Mu:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5H: Mu:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
Main Channel Distance (ft)
940
930
920
910
900
890
880
870
0
5000
10000
15000
20000
25000
30000
35000

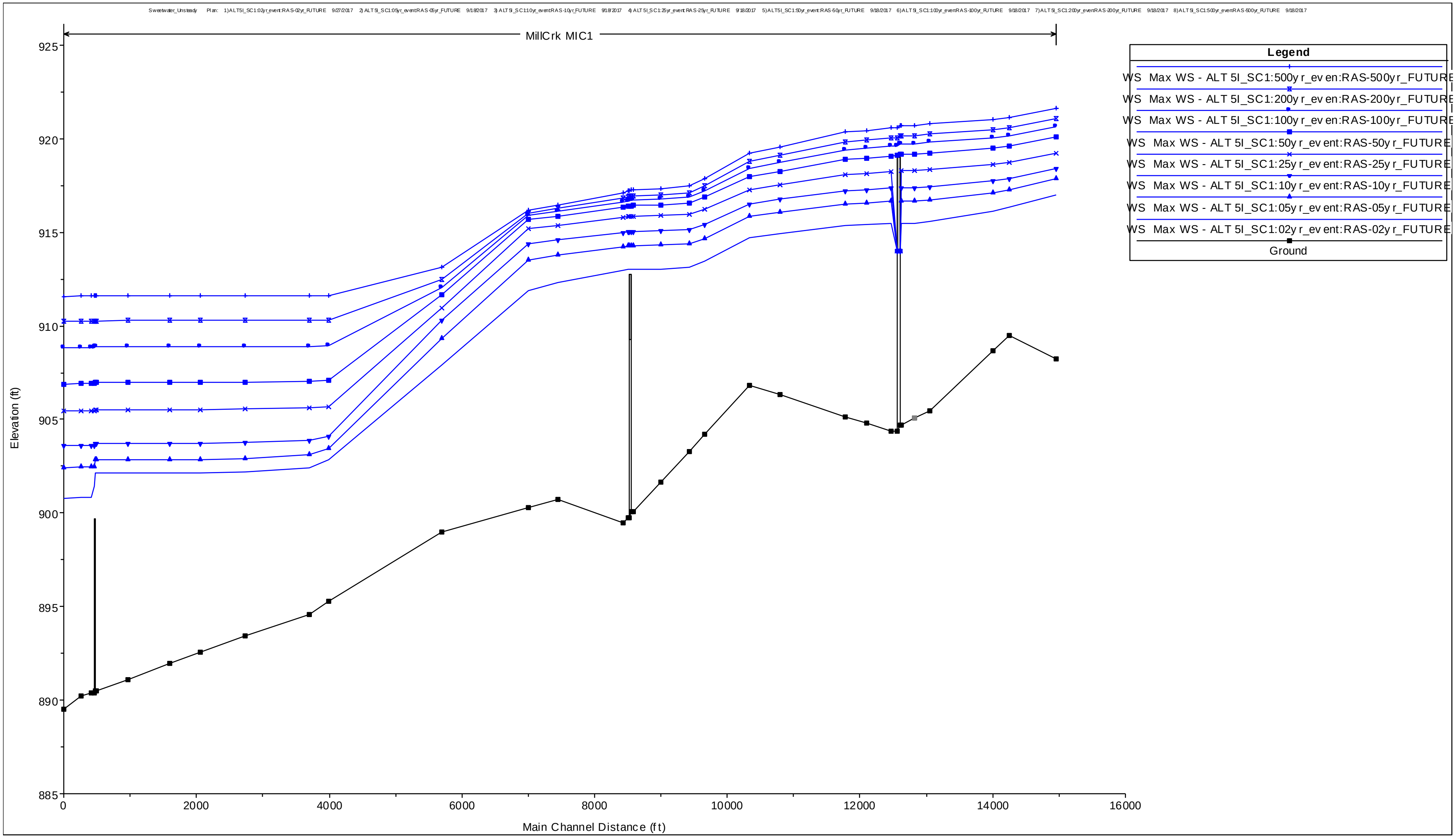

Sweetwater Creek SWC6
Legend
WS Max WS - ALT 5H: Mu:500yr_even:RAS-ALT_5F_0_2pct
WS Max WS - ALT 5H: Mu:200yr_even:RAS-ALT_5F_0_5pct
WS Max WS - ALT 5H: Mu:100yr_even:RAS-ALT_5F_1pct
WS Max WS - ALT 5H: Mu:50yr_event:RAS-ALT_5F_2pct
WS Max WS - ALT 5H: Mu:25yr_event:RAS-ALT_5F_4pct
WS Max WS - ALT 5H: Mu:10yr_event:RAS-ALT_5F_10pct
WS Max WS - ALT 5H: Mu:05yr_event:RAS-ALT_5F_20pct
WS Max WS - ALT 5H: Mu:02yr_event:RAS-ALT_5F_50pct
Ground
Elevation (ft)
900
850
800
750
700
SW02 - Rivers...
SW03 - State Park
**IF WATER IS ABOVE LEFTT BANK, DELETE ALL LEFT LEVEES THROUGH 25808
SW04 - Blairs Bridge Road
SW05 - Interstate 20
SW07 - Skyview Drive
SW08 - Thornton Rd
SW12 (Douglas Co) - OLD ALABAMA ROAD
0
10000
20000
30000
40000
50000
60000
70000
Main Channel Distance (ft)

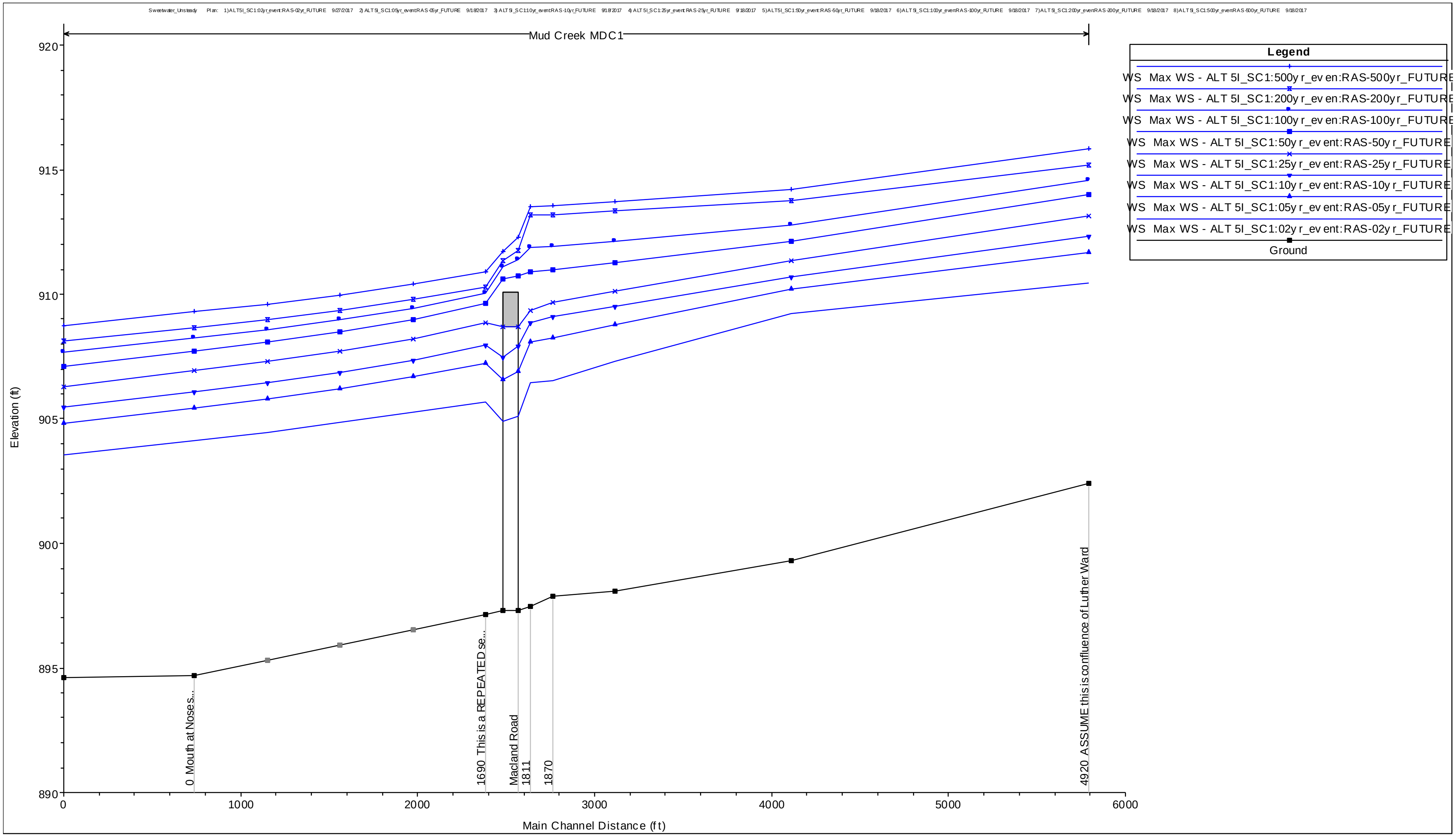


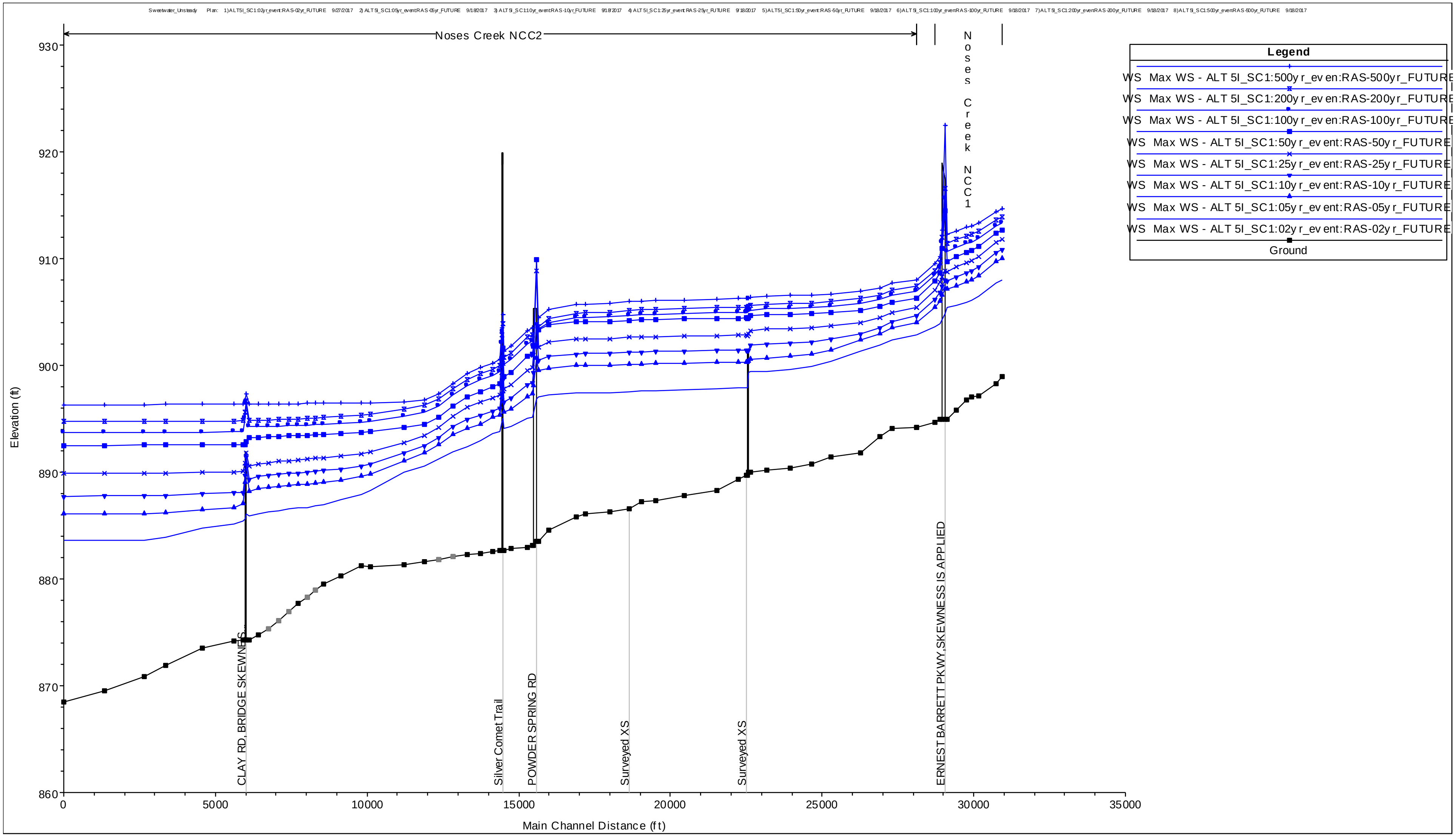
* Main Channel Distance (ft) values should be added to STA 63230 from SWC6 reach above for a continuous profile.

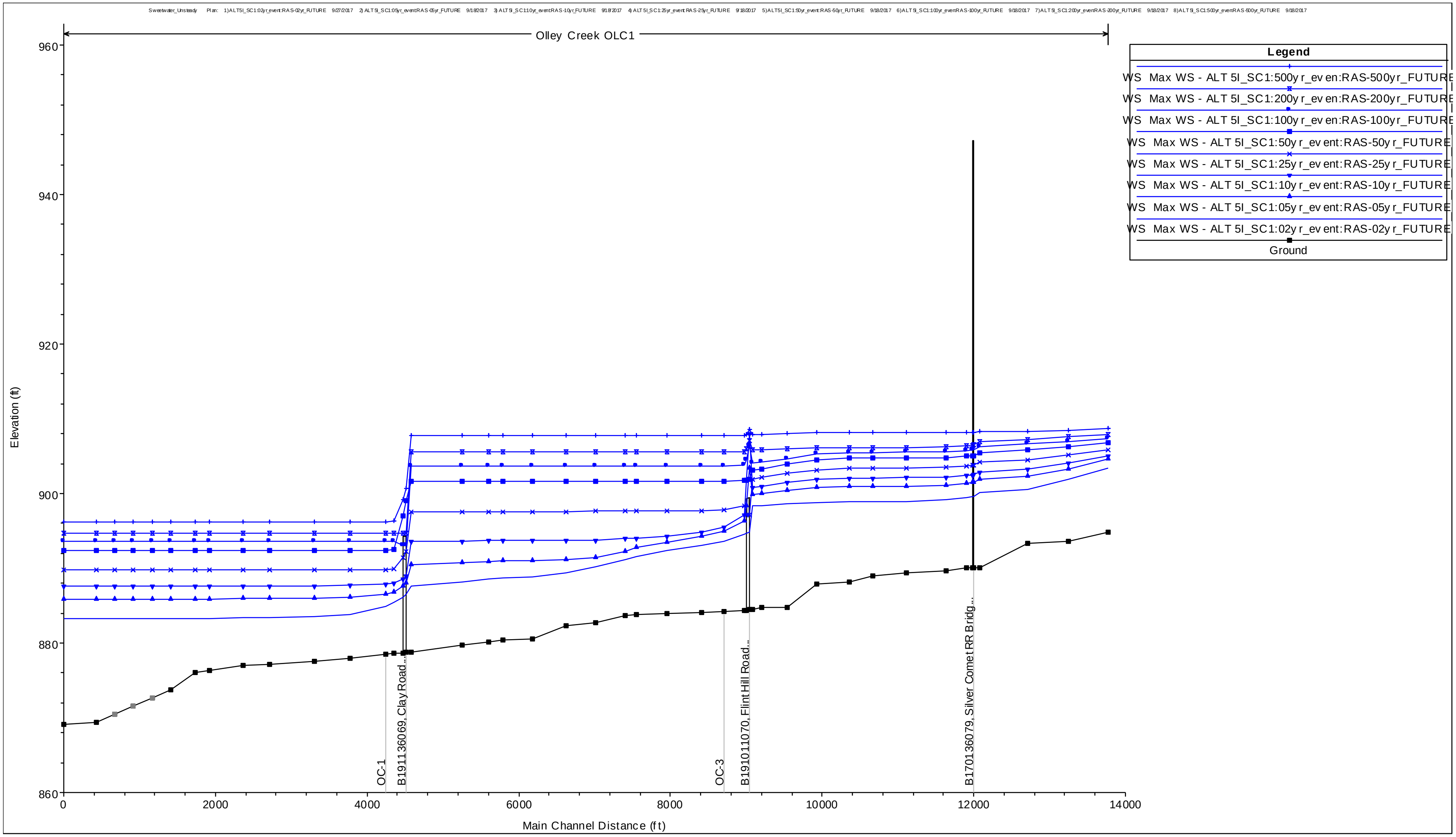
Alternative 5I

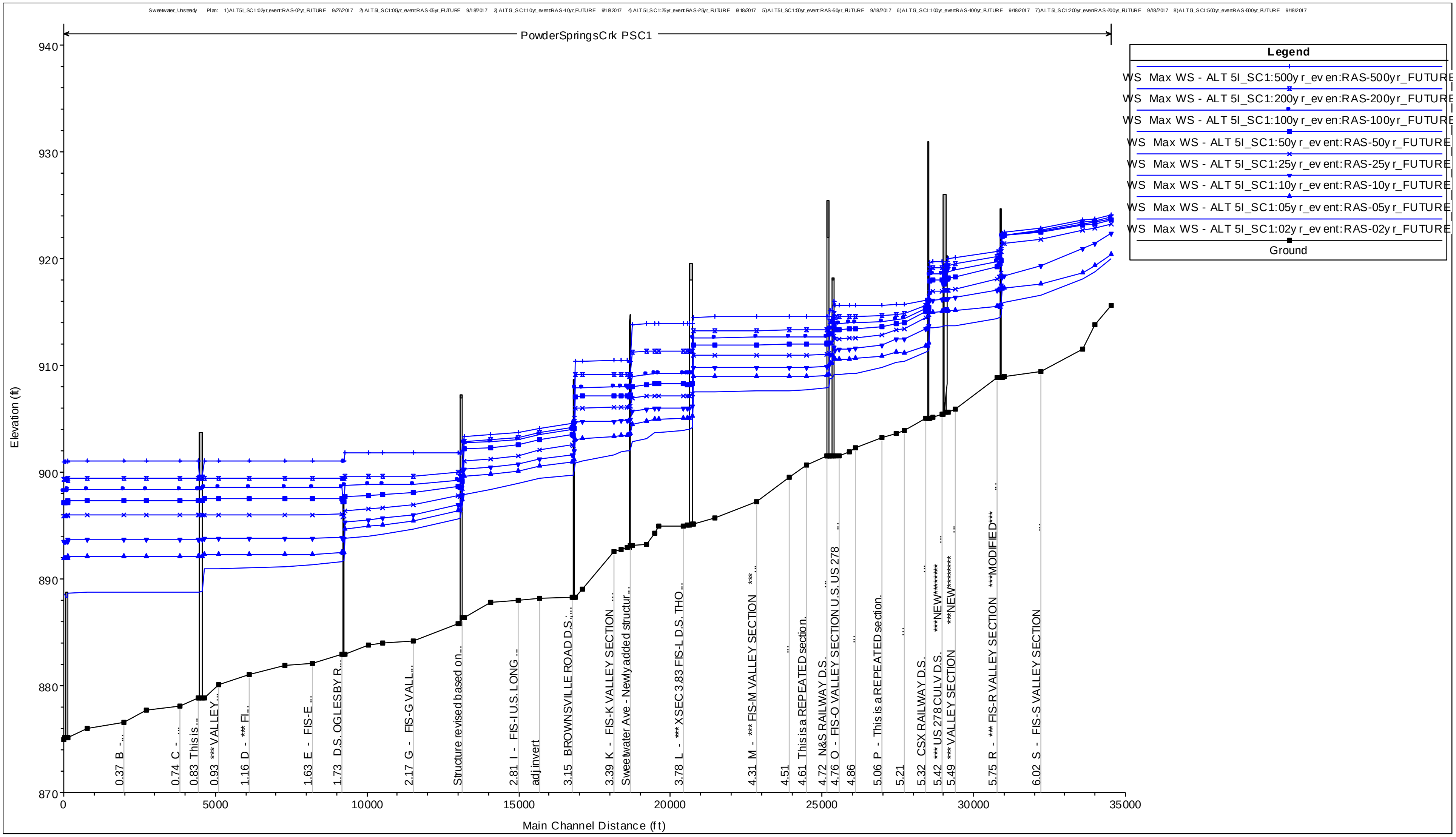


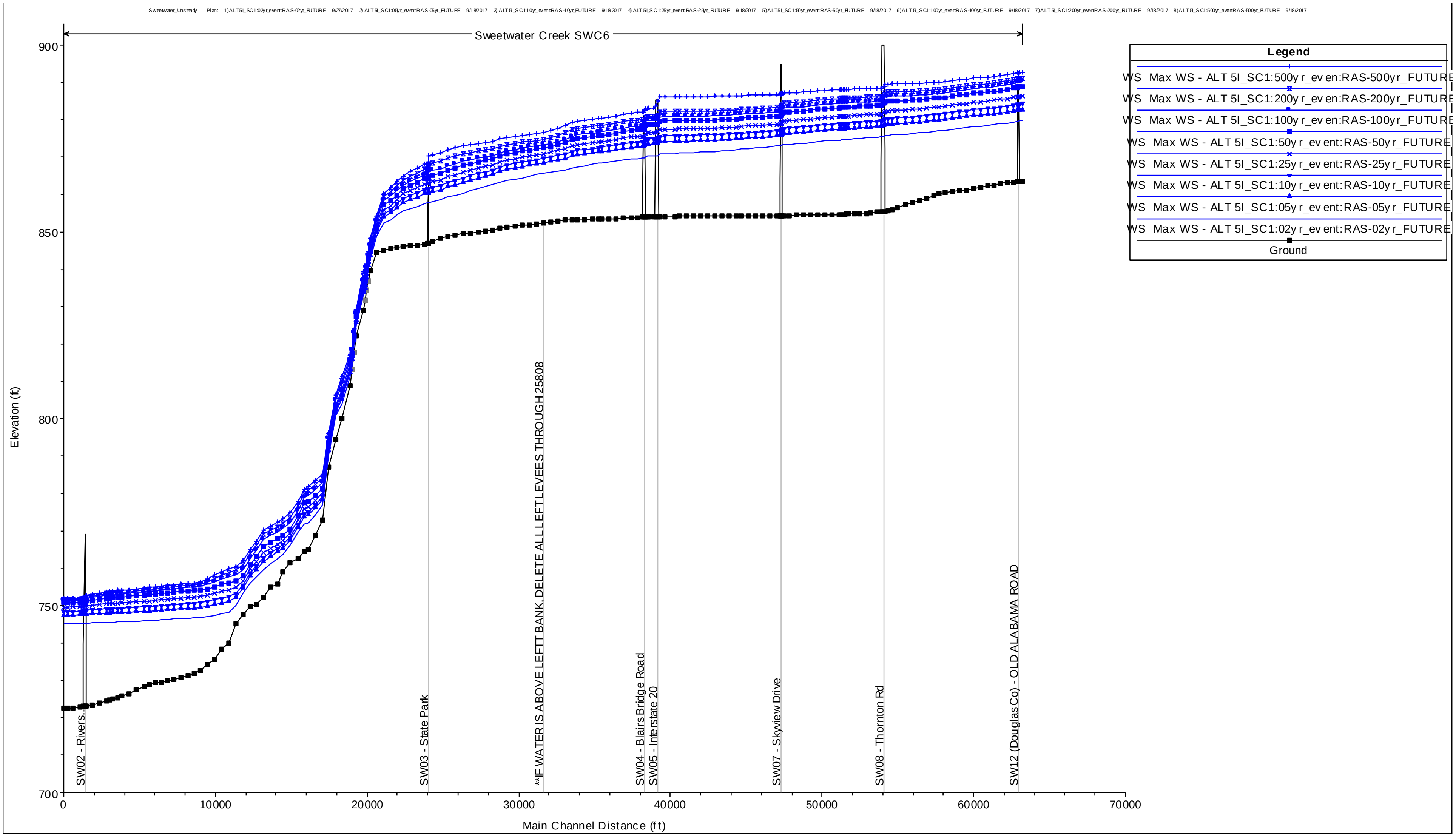

MillCrk MIC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
925
920
915
910
905
900
895
890
885
0
2000
4000
6000
8000
10000
12000
14000
16000
Main Channel Distance (ft)

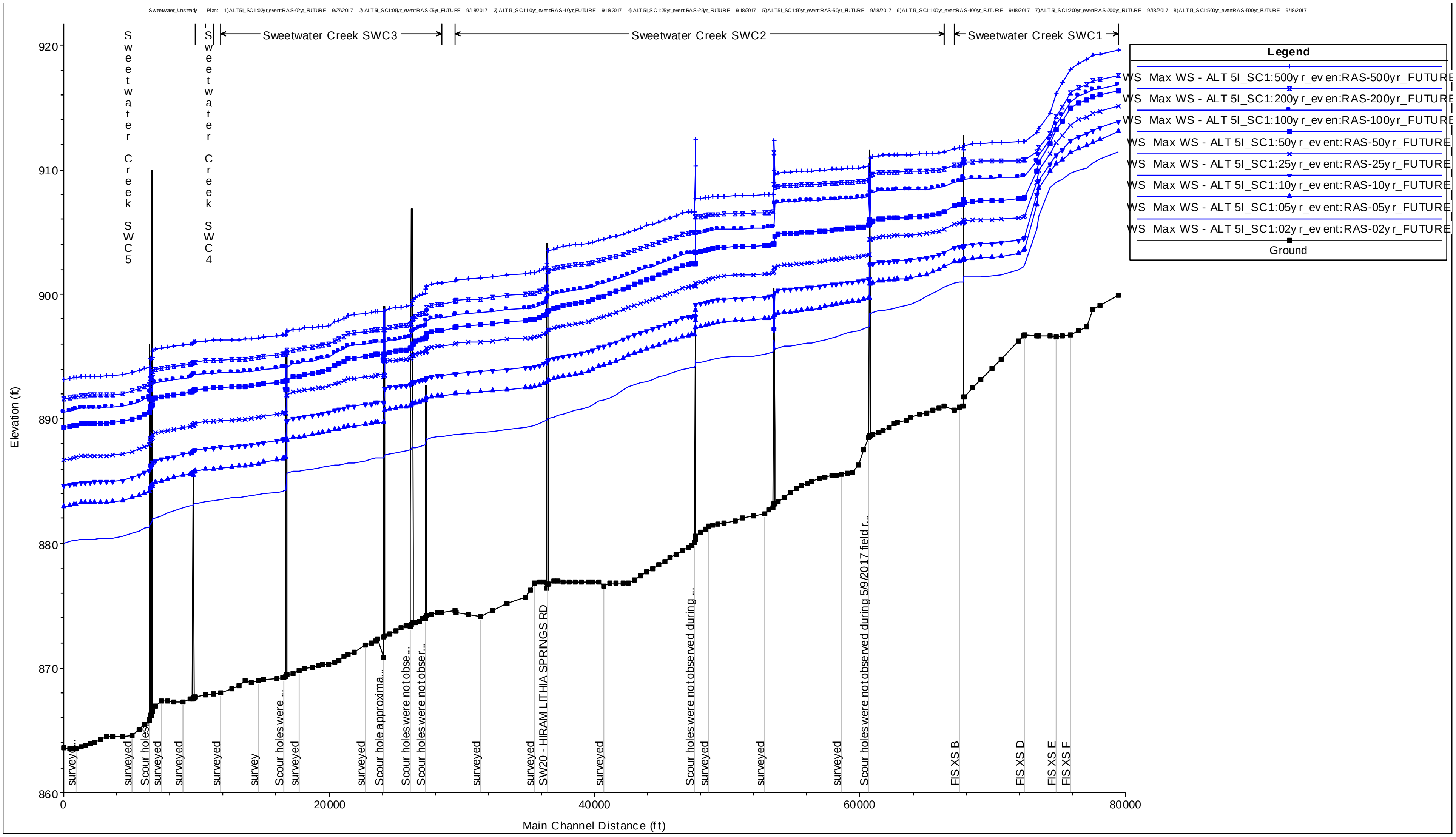

Sweetwater_Unsteady Plan: 1) ALT5I_SC1:02yr_event:RAS-02yr_FUTURE 9/27/2017 2) ALT5I_SC1:05yr_event:RAS-05yr_FUTURE 9/18/2017 3) ALT5I_SC1:10yr_event:RAS-10yr_FUTURE 9/18/2017 4) ALT5I_SC1:25yr_event:RAS-25yr_FUTURE 9/18/2017 5) ALT5I_SC1:50yr_event:RAS-50yr_FUTURE 9/18/2017 6) ALT5I_SC1:100yr_event:RAS-100yr_FUTURE 9/18/2017 7) ALT5I_SC1:200yr_event:RAS-200yr_FUTURE 9/18/2017 8) ALT5I_SC1:500yr_event:RAS-500yr_FUTURE 9/18/2017
Mud Creek MDC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
920
915
910
905
900
895
890
0 Mouth at Noses...
1690 This is a REPEATED se...
Macland Road
1811
1870
4920 ASSUME this is confluence of Luther Ward
0
1000
2000
3000
4000
5000
6000
Main Channel Distance (ft)


Sweetwater_Unsteady Plan: 1) ALT5I_SC1:02yr_event:RAS-02yr_FUTURE 9/27/2017 2) ALT5I_SC1:05yr_event:RAS-05yr_FUTURE 9/18/2017 3) ALT5I_SC1:10yr_event:RAS-10yr_FUTURE 9/18/2017 4) ALT5I_SC1:25yr_event:RAS-25yr_FUTURE 9/18/2017 5) ALT5I_SC1:50yr_event:RAS-50yr_FUTURE 9/18/2017 6) ALT5I_SC1:100yr_event:RAS-100yr_FUTURE 9/18/2017 7) ALT5I_SC1:200yr_event:RAS-200yr_FUTURE 9/18/2017 8) ALT5I_SC1:500yr_event:RAS-500yr_FUTURE 9/18/2017
Noses Creek NCC2
Noses Creek NCC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
930
920
910
900
890
880
870
860
CLAY RD, BRIDGE SKEWNESS
Silver Comet Trail
POWDER SPRING RD
Surveyed XS
Surveyed XS
ERNEST BARRETT PKWY,SKEWNESS IS APPLIED
0
5000
10000
15000
20000
25000
30000
35000
Main Channel Distance (ft)

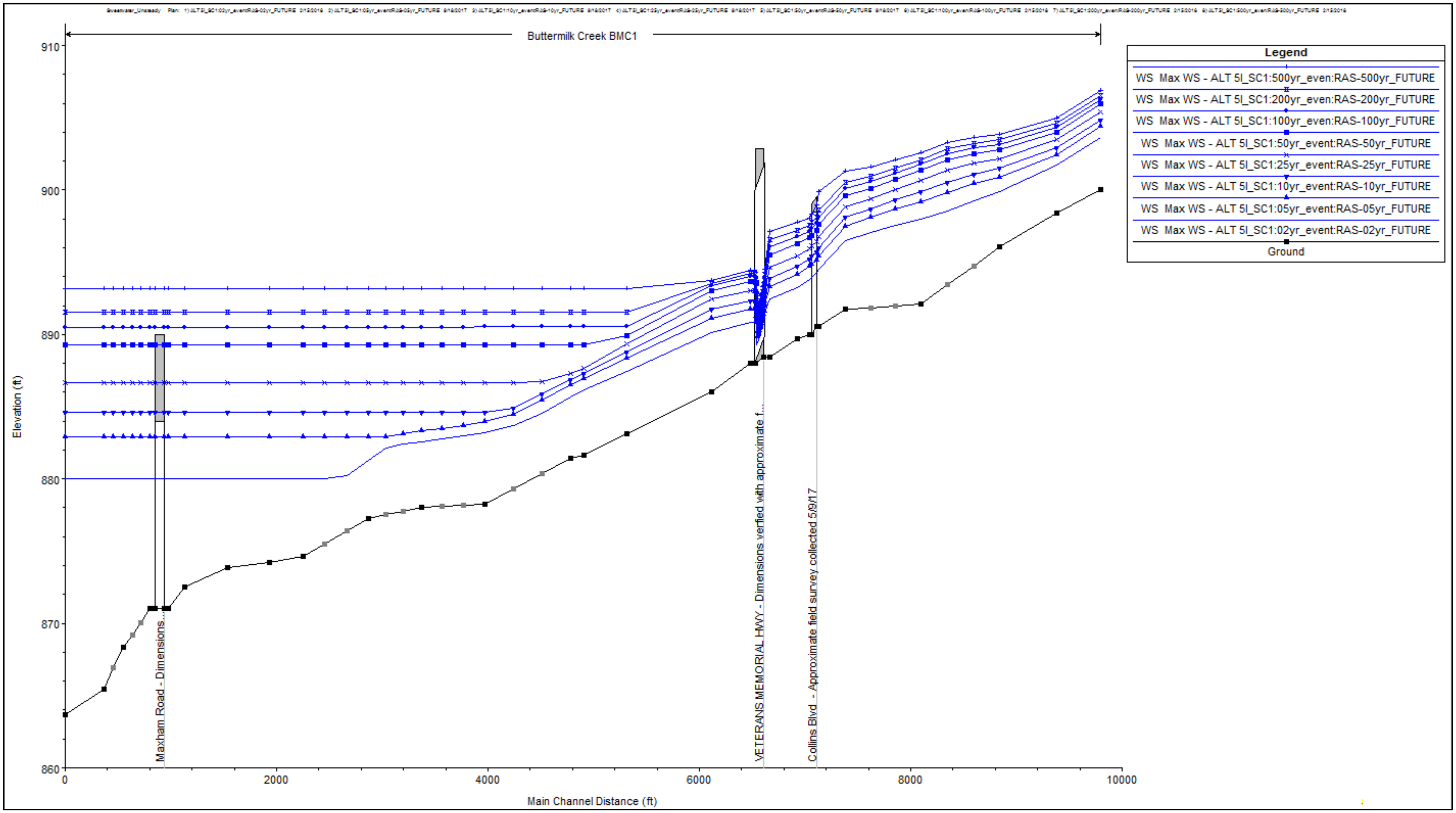

Sweetwater_Unsteady Plan: 1)ALT5I_SC1:02yr_event:RAS-02yr_FUTURE 9/27/2017 2) ALT5I_SC1:05yr_event:RAS-05yr_FUTURE 9/18/2017 3) ALT5I_SC1:10yr_event:RAS-10yr_FUTURE 9/18/2017 4) ALT5I_SC1:25yr_event:RAS-25yr_FUTURE 9/18/2017 5)ALT5I_SC1:50yr_event:RAS-50yr_FUTURE 9/18/2017 6)ALT5I_SC1:100yr_event:RAS-100yr_FUTURE 9/18/2017 7)ALT5I_SC1:200yr_event:RAS-200yr_FUTURE 9/18/2017 8)ALT5I_SC1:500yr_event:RAS-500yr_FUTURE 9/18/2017
Olley Creek OLC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
960
940
920
900
880
860
OC-1
B191136069, Clay Road...
OC-3
B191011070, Flint Hill Road...
B170136079, Silver Comet RR Bridg...
0
2000
4000
6000
8000
10000
12000
14000
Main Channel Distance (ft)

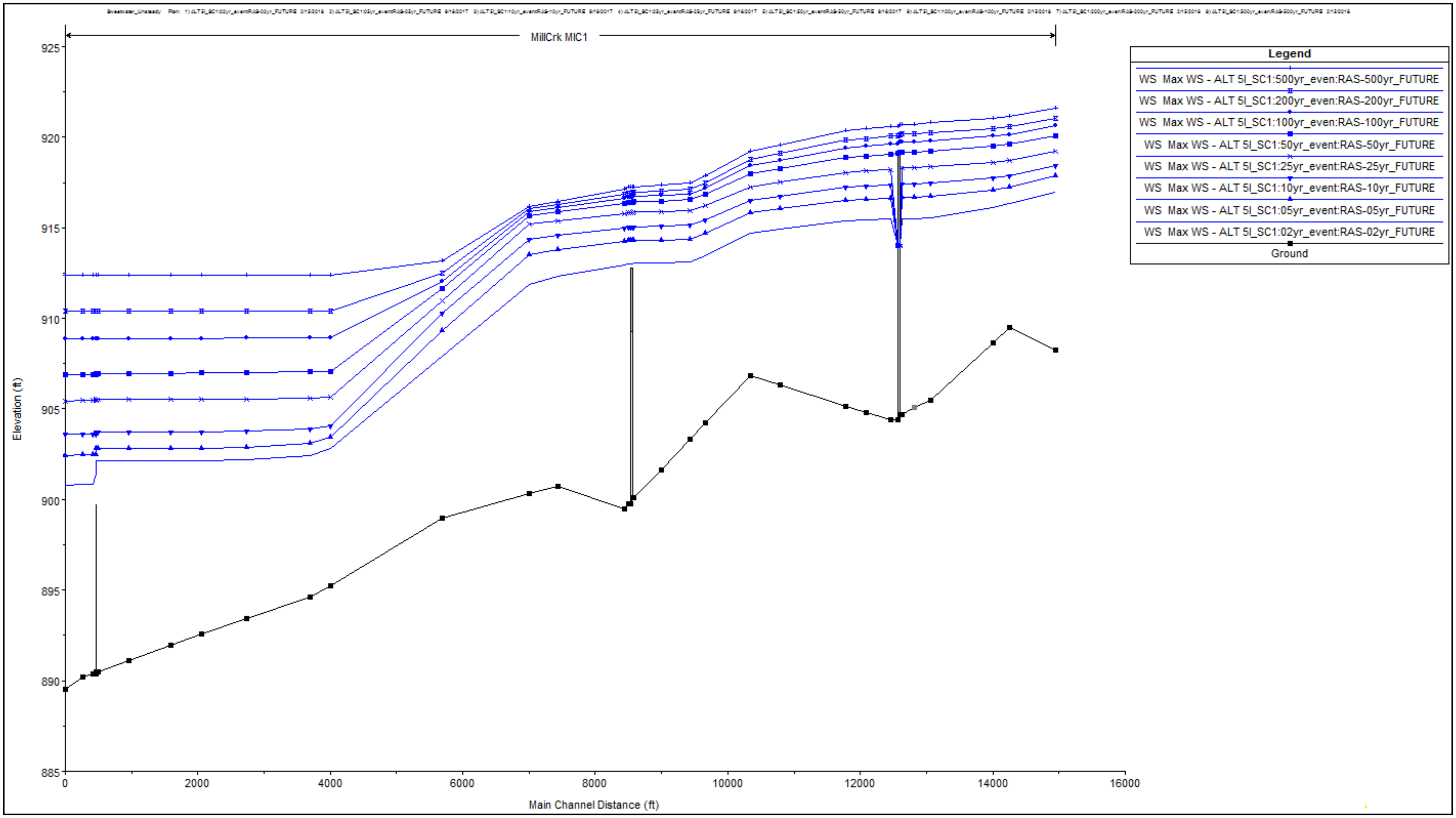

PowderSpringsCrk PSC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
Main Channel Distance (ft)
0.37 B
0.74 C
0.83 This is
0.93 ***VALLEY
1.16 D - *** FI
1.63 E - FIS-E
1.73 D.S. OGLESBY R
2.17 G - FIS-G VALL
Structure revised based on
2.81 I - FIS-I U.S. LONG
adj invert
3.15 BROWNSVILLE ROAD D.S.
3.39 K - FIS-K VALLEY SECTION
Sweetwater Ave - Newly added structur
3.78 L - *** XSEC 3.83 FIS-L D.S. THO
4.31 M - *** FIS-M VALLEY SECTION ***
4.51
4.61 This is a REPEATED section.
4.72 N&S RAILWAY D.S.
4.76 O - FIS-O VALLEY SECTION U.S. US 278
4.86
5.06 P - This is a REPEATED section.
5.21
5.32 CSX RAILWAY D.S.
5.42 *** US 278 CULV D.S. ***NEW*******
5.49 *** VALLEY SECTION ***NEW*******
5.75 R - *** FIS-R VALLEY SECTION ***MODIFIED***
6.02 S - FIS-S VALLEY SECTION

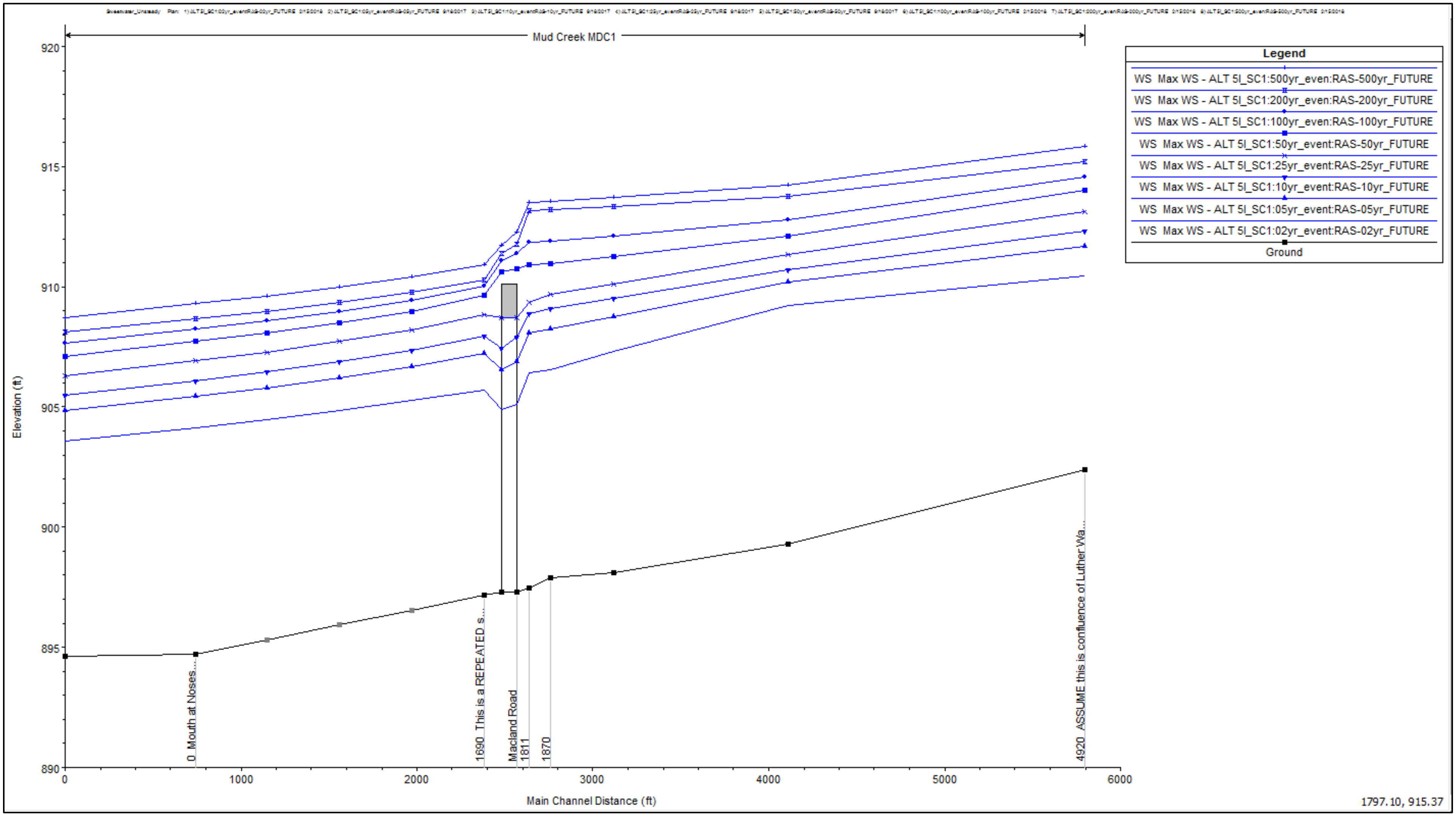

Sweetwater_Unsteady Plan: 1) ALT5I_SC1:02yr_event:RAS-02yr_FUTURE 9/27/2017 2) ALT5I_SC1:05yr_event:RAS-05yr_FUTURE 9/18/2017 3) ALT5I_SC1:10yr_event:RAS-10yr_FUTURE 9/18/2017 4) ALT5I_SC1:25yr_event:RAS-25yr_FUTURE 9/18/2017 5) ALT5I_SC1:50yr_event:RAS-50yr_FUTURE 9/18/2017 6) ALT5I_SC1:100yr_event:RAS-100yr_FUTURE 9/18/2017 7) ALT5I_SC1:200yr_event:RAS-200yr_FUTURE 9/18/2017 8) ALT5I_SC1:500yr_event:RAS-500yr_FUTURE 9/18/2017
Sweetwater Creek SWC6
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
900
850
800
750
700
SW02 - Rivers..
SW03 - State Park
**IF WATER IS ABOVE LEFTT BANK, DELETE ALL LEFT LEVEES THROUGH 25808
SW04 - Blairs Bridge Road
SW05 - Interstate 20
SW07 - Skyview Drive
SW08 - Thornton Rd
SW12 (Douglas Co) - OLD ALABAMA ROAD
0
10000
20000
30000
40000
50000
60000
70000
Main Channel Distance (ft)

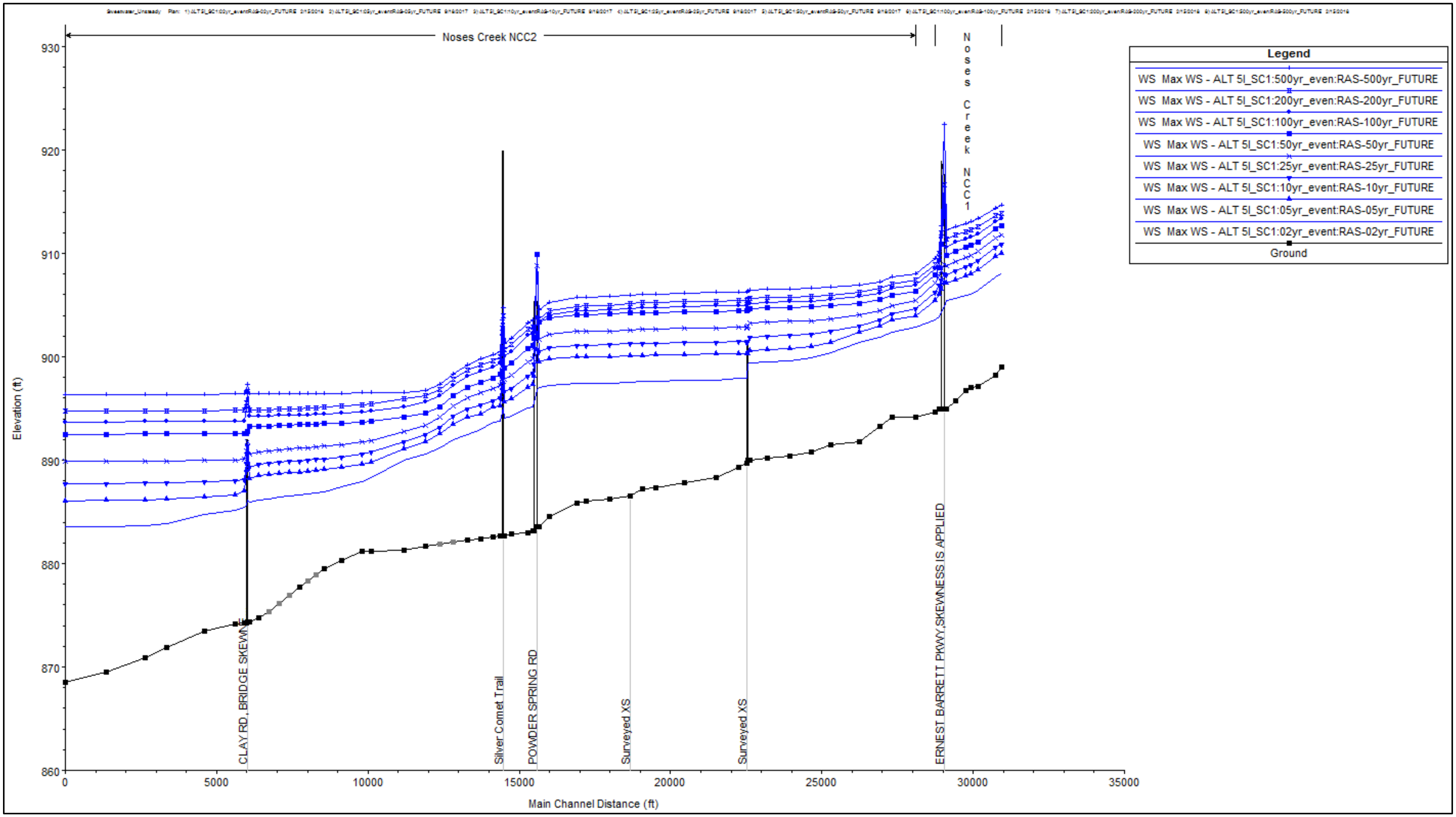


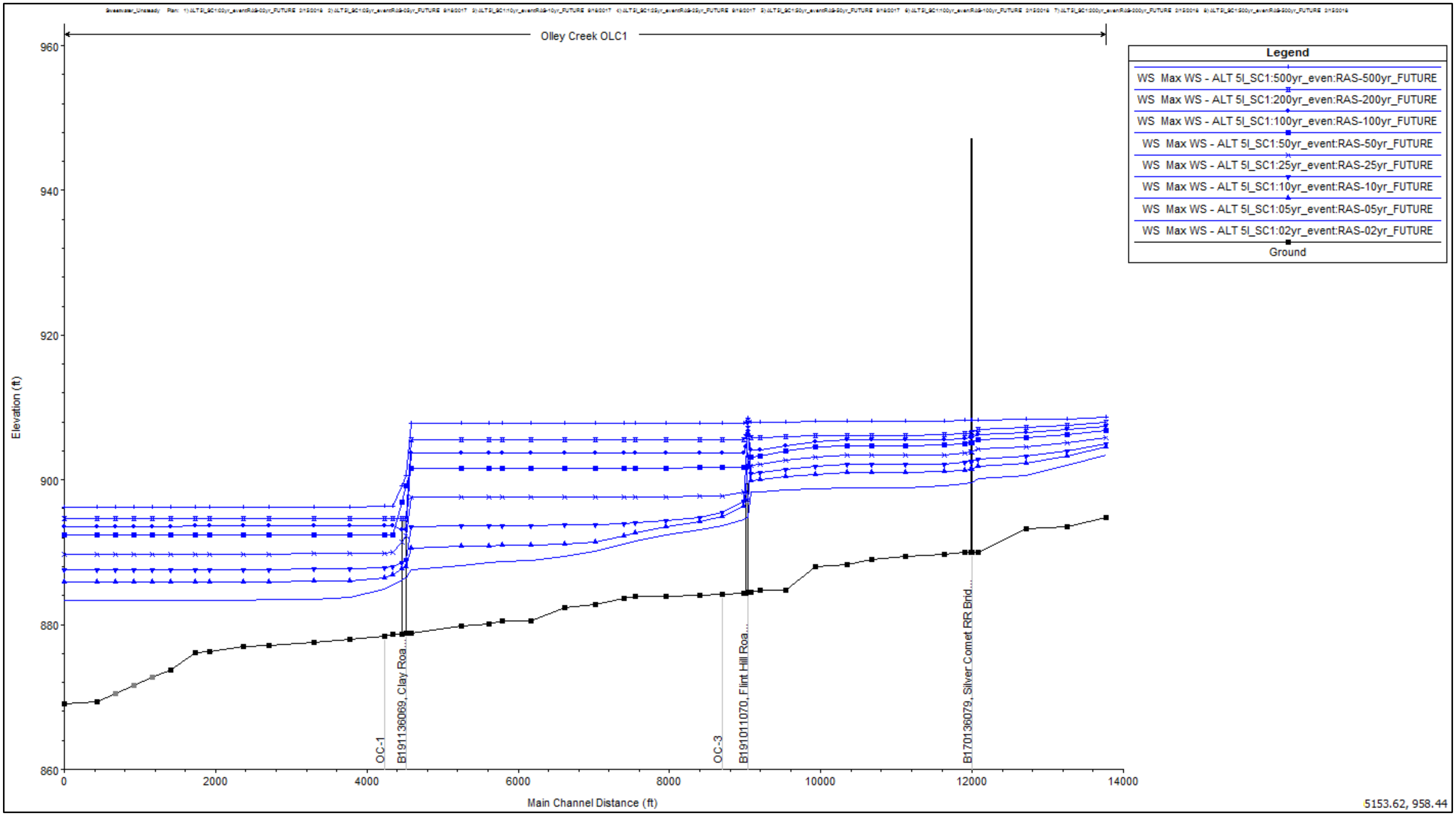
* Main Channel Distance (ft) values should be added to STA 63230 from SWC6 reach above for a continuous profile.

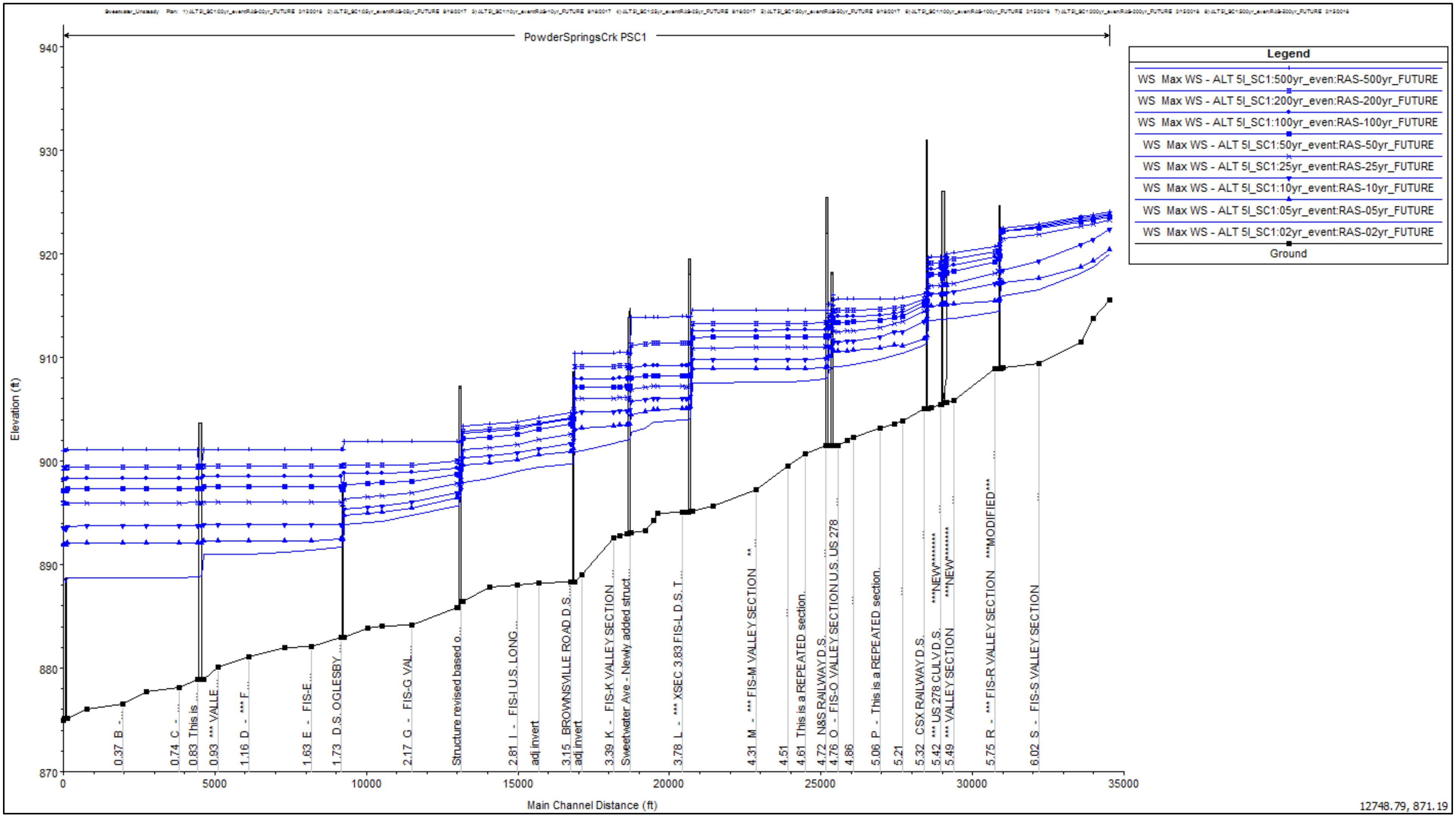

Buttermilk Creek BMC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
910
900
890
880
870
860
0
2000
4000
6000
8000
10000
Main Channel Distance (ft)
Maxham Road - Dimensions...
VETERANS MEMORIAL HWY - Dimensions verfied with approximate f...
Collins Blvd - Approximate field survey collected 5/9/17

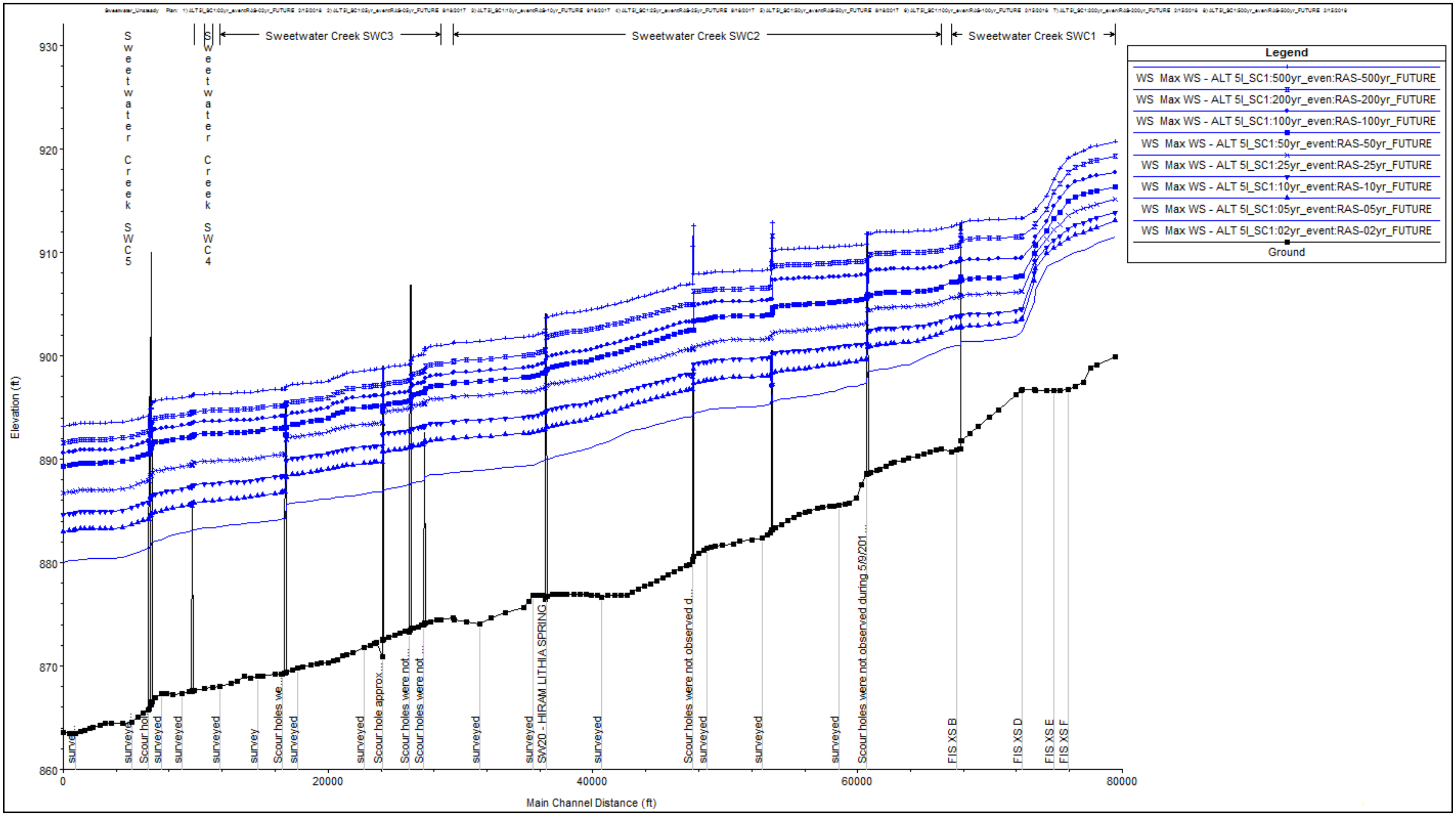

MillCrk MIC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
Main Channel Distance (ft)


Mud Creek MDC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
Main Channel Distance (ft)
0 Mouth at Noses...
1690 This is a REPEATED s...
Macland Road
1811
1870
4920 ASSUME this is confluence of Luther Wa...
1797.10, 915.37


Noses Creek NCC2
Noses Creek NCC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
Main Channel Distance (ft)
CLAY RD, BRIDGE SKEWN
Silver Comet Trail
POWDER SPRING RD
Surveyed XS
Surveyed XS
ERNEST BARRETT PKWY,SKEWNESS IS APPLIED

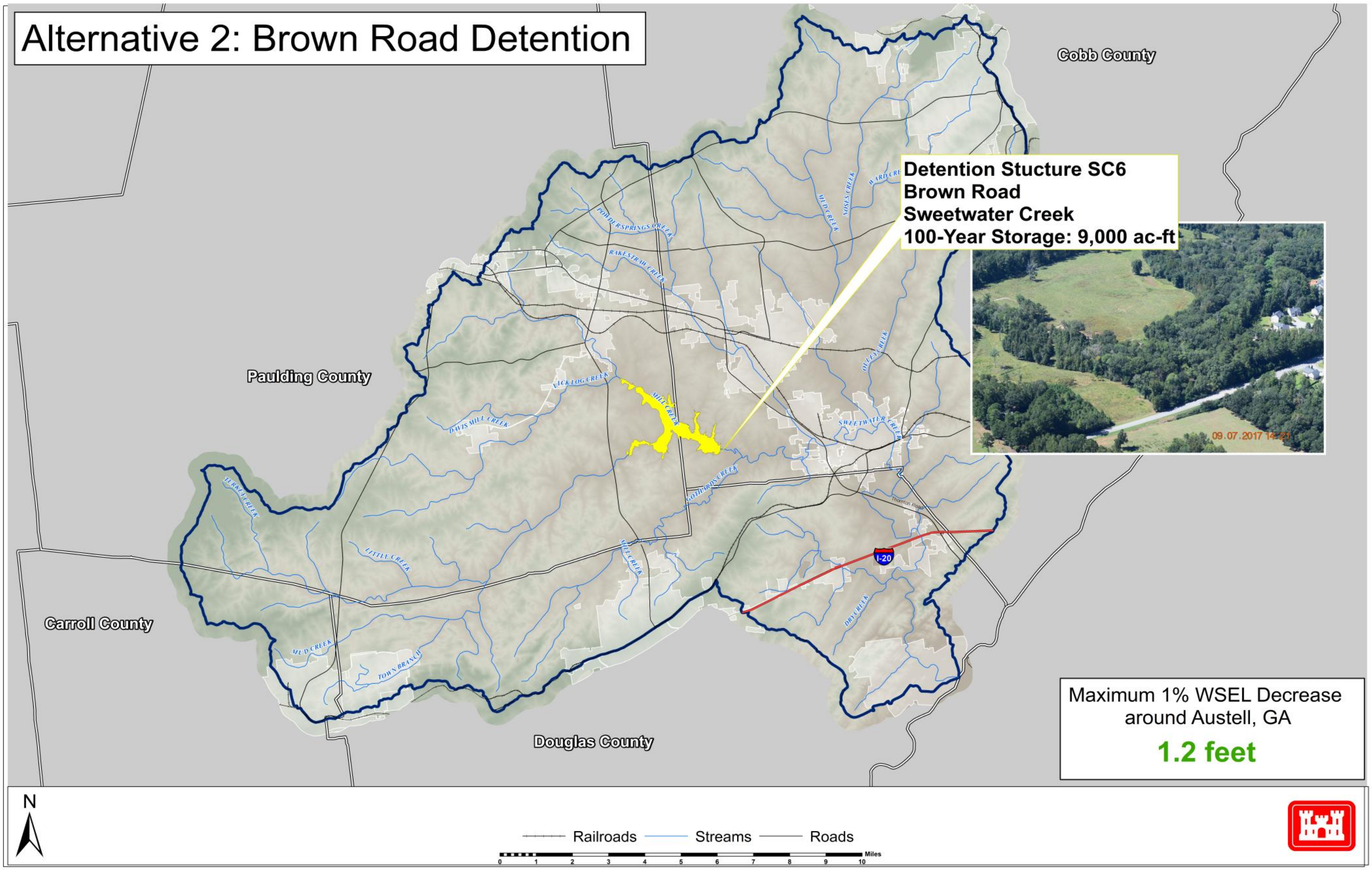

Olley Creek OLC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
Main Channel Distance (ft)
OC-1
B191136069, Clay Roa...
OC-3
B191011070, Flint Hill Roa...
B170136079, Silver Comet RR Brid...
5153.62, 958.44

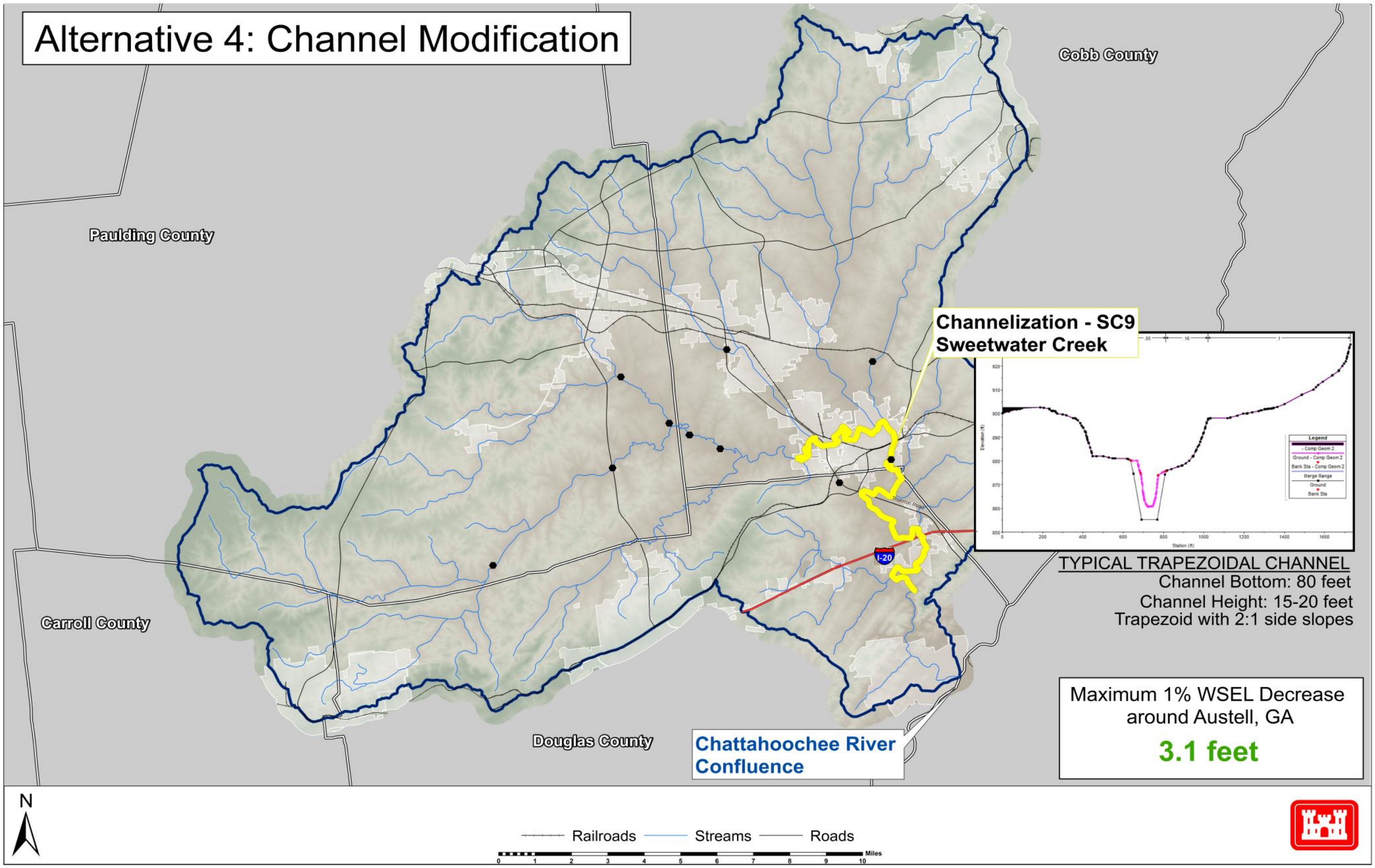

PowderSpringsCrk PSC1
Legend
WS Max WS - ALT 5I_SC1:500yr_even:RAS-500yr_FUTURE
WS Max WS - ALT 5I_SC1:200yr_even:RAS-200yr_FUTURE
WS Max WS - ALT 5I_SC1:100yr_even:RAS-100yr_FUTURE
WS Max WS - ALT 5I_SC1:50yr_event:RAS-50yr_FUTURE
WS Max WS - ALT 5I_SC1:25yr_event:RAS-25yr_FUTURE
WS Max WS - ALT 5I_SC1:10yr_event:RAS-10yr_FUTURE
WS Max WS - ALT 5I_SC1:05yr_event:RAS-05yr_FUTURE
WS Max WS - ALT 5I_SC1:02yr_event:RAS-02yr_FUTURE
Ground
Elevation (ft)
Main Channel Distance (ft)
12748.79, 871.19

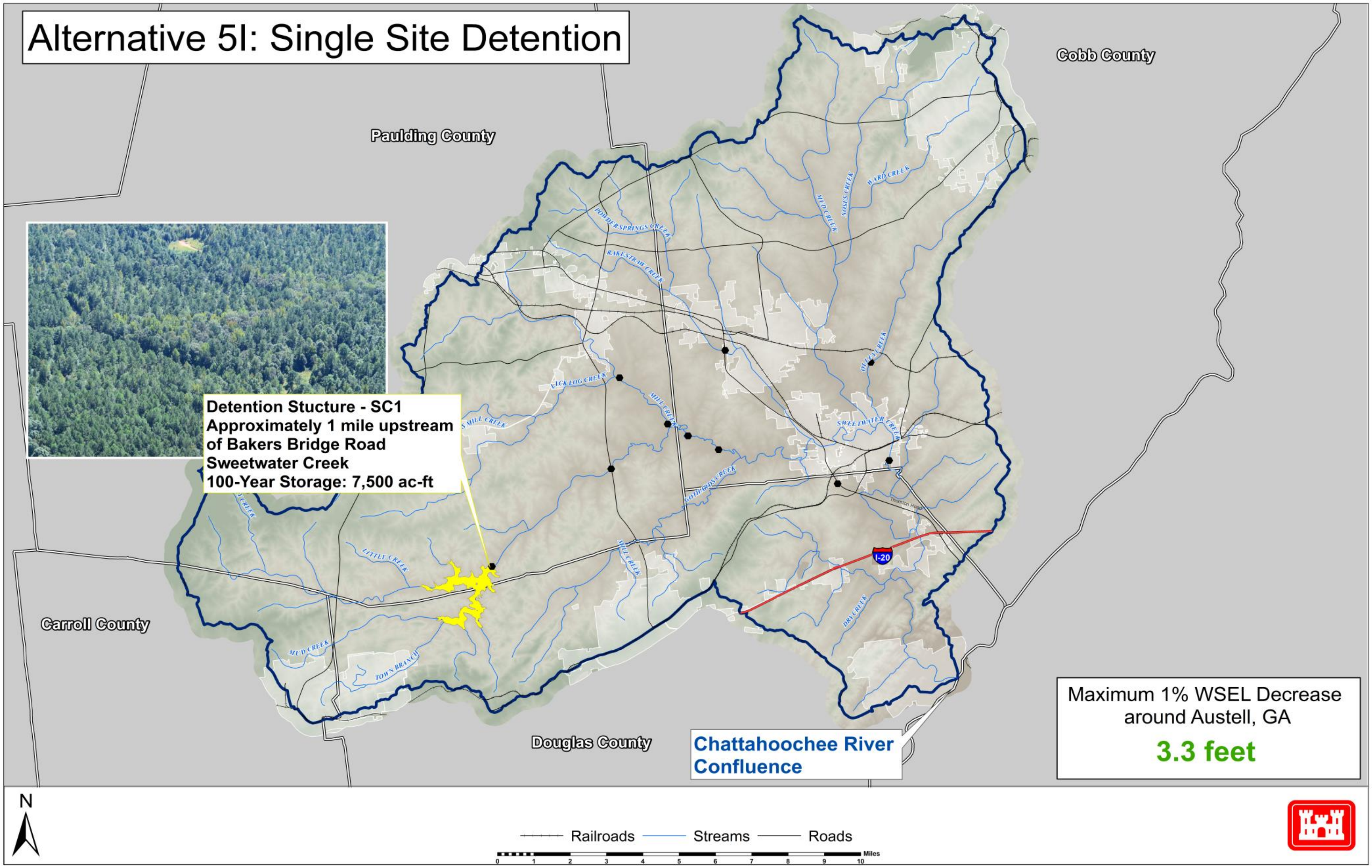


* Main Channel Distance (ft) values should be added to STA 63230 from SWC6 reach above for a continuous profile

APPENDIX B2: ALTERNATIVE SCHEMATICS


Alternative 2: Brown Road Detention
Cobb County
Paulding County
Carroll County
Douglas County
Detention Stucture SC6
Brown Road
Sweetwater Creek
100-Year Storage: 9,000 ac-ft
09.07.2017
I-20
Maximum 1% WSEL Decrease
around Austell, GA
1.2 feet
N
Railroads
Streams
Roads
Miles
0
1
2
3
4
5
6
7
8
9
10


Alternative 4: Channel Modification
Cobb County
Paulding County
Carroll County
Douglas County
Channelization - SC9
Sweetwater Creek
TYPICAL TRAPEZOIDAL CHANNEL
Channel Bottom: 80 feet
Channel Height: 15-20 feet
Trapezoid with 2:1 side slopes
Maximum 1% WSEL Decrease
around Austell, GA
3.1 feet
Chattahoochee River
Confluence
I-20
N
Railroads
Streams
Roads
Miles
0
1
2
3
4
5
6
7
8
9
10


Alternative 5I: Single Site Detention
Cobb County
Paulding County
Detention Stucture - SC1
Approximately 1 mile upstream
of Bakers Bridge Road
Sweetwater Creek
100-Year Storage: 7,500 ac-ft
Carroll County
Douglas County
Chattahoochee River
Confluence
Maximum 1% WSEL Decrease
around Austell, GA
3.3 feet
I-20
N
Railroads
Streams
Roads
Miles

APPENDIX B3: SUMMARY OF PROPOSED STRUCTURAL MEASURES

Summary of Proposed Measures

Measure ID	Type	Creek	Location	Drainage Area (sq mi)	Maximum Pool Elevation	Top of Dam Elevation	Available Storage (ac-ft)	Approximate Dam Length (ft)	Dam Height (ft)	Dam Width (ft)	Low Level Slot	Low Level Slot	High Level Slot	High Level Slot
MC2	Retention	Mill Creek	Upstream of Morningside Drive	37	922	925	1,370	1300	19.5	20	25	13.5	75	6
MC5	Retention	Mill Creek	Former Pine Lake Dam	42	914	917	2,100	2300	25	20	18	23	200	2
OC1	Retention	Olley Creek	Upstream of Flint Hill Road SW	12	914	917	2,050	600	29	20	8	29	0	0
PSC2	Retention	Powder Springs Creek	Upstream of CH James Parkway	18	922	925	2,700	1400	25	20	8	20	30	5
SC1	Retention	Sweetwater Creek	Upstream of Bakers Bridge Road	42	956	959	7,660	1500	24	20	8	19	50	5
SC1s	Retention	Sweetwater Creek	Upstream of Bakers Bridge Road	42	951	954	5,720	1500	19	20	8	19	N/A	N/A
SC2	Retention	Sweetwater Creek	Upstream of Hiram Douglasville Hwy	51	926	929	2,260	1600	15	20	10	9	100	6
SC5	Diversion	Sweetwater Creek	Along CH James Parkway	-	-	-	-	-	-	-	-	-	-	-
SC6	Retention	Sweetwater Creek	Upstream of Brown Road	101	914	917	9,000	1400	33	20	10, 11, 20*	30.5	1098	2.5
SC9	Channel Modification	Sweetwater Creek	Along Sweetwater Creek around and downstream of Austell	-	-	-	-	-	-	-	-	-	-	-

7. References

Allen, R.J. and A.T. Degaetno, 2005: Areal Reduction Factors for Two Eastern United States Regions with High Rain-Gauge Density, *JOURNAL OF HYDROLOGIC ENGINEERING*, 10, 327-335.

Douglas County, 2-ft Contours, 2010.

Federal Emergency Management Agency, Flood Insurance Study, Cobb County, Georgia and Incorporated Areas, March 4, 2013.

Federal Emergency Management Agency, Riverine High Water Marks, Disaster-1858-DR-Georgia. August 11, 2010.

Merkel, W. and H.F. Moody, 2015: NOAA Atlas 14 rainfall for Midwest and Southeast States. Accessed from NRCS on April 15, 2017.

Menne, M.J., and co-authors, 2012: An overview of the global historical climatology network-daily database. *Journal of Atmospheric and Oceanic Technology*, 29, 897-910.

Multi-Resolution Land Characteristics Consortium (MRLC) – National Land Cover Database 2011 (NLCD2011) Percent Developed Imperviousness. Retrieved on January 15, 2015 from http://www.mrlc.gov/nlcd11_data.php.

Dewberry. *Numerical Model Development and Testing for Sweetwater Creek Watershed GA,* October 2017.

Photo Science, Cobb County LiDAR, 2015.

U.S. Army Corps of Engineers, Climate Hydrology Tool, PROD 1.2, http://corpsmapu.usace.army.mil/cm_apex/f?p=313:2:0::NO:::

U.S. Army Corps of Engineers, Engineering and Construction Bulletin 2016-25. *Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects.* September 16, 2016.

U.S. Army Corps of Engineers, Hydrologic Engineering Center Hydrologic Modeling System, HEC-HMS 4.2.1, March 2017.

U.S. Army Corps of Engineers, Hydrologic Engineering Center River Analysis System, HEC-RAS 5.0.3, March 2017.

U.S. Army Corps of Engineers, Hydrologic Engineering Center River Analysis System, Hydraulic Reference Manual, February 2016.

U.S. Army Corps of Engineers, Hydrologic Engineering Center Statistical Software Package, HEC-SSP 2.1, July 2016.

U.S. Army Corps of Engineers, Hydrologic Engineering Center Watershed Analysis Tool, HEC-WAT 1.0, April 2017.

U.S. Army Corps of Engineers Institute for Water Resources, 2015. *Recent US Climate Change and Hydrology Literature Applicable to the US Army Corps of Engineers Missions* – South Atlantic-Gulf Regions 03.

U.S. EPA Office of Research & Development (ORD) - National Center for Environmental Assessment (NCEA) - Global Change Research Program (GCRP). ICLUS v1.3 Estimated Percent Impervious Surface for the Conterminous US. Retrieved on July 7, 2017 from https://www.epa.gov/iclus/iclus-downloads.

U.S. Geological Survey, 02336968 Noses Creek at Powder Springs Road, GA

U.S. Geological Survey, 02336986 Olley Creek at Clay Road, near Austell, GA

U.S. Geological Survey, 02336870 Powder Springs Creek Near Powder Springs, GA

U.S. Geological Survey, 02336910 Sweetwater CR 0.05 MI US RR BRIDGE AT AUSTELL, GA

U.S. Geological Survey, 02337040 Sweetwater Creek Below Austell, GA

U.S. Geological Survey, 02337000 Sweetwater Creek Near Austell, GA

U.S. Geological Survey, 02336840 Sweetwater Creek, Brownsville Road, Powder Springs, GA

U.S. Geological Survey, Lagtime Relations for Urban Streams in Georgia, Water Resources Investigations Report 00-4049, Atlanta, Georgia, 2000.

U.S. Geological Survey, Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume I, Georgia, Scientific Investigations Report 2009-5043, 2009.

U.S. Geological Survey, National Elevation Data, Paulding County, GA. Retrieved on May 1, 2017.

U.S. Geological Survey, National Elevation Data, Carroll County, GA. Retrieved on May 1, 2017.

Sweetwater Creek Flood Risk Management Feasibility Study

Appendix C

Cost Engineering Appendix

US Army Corps of Engineers

Mobile District

February 8, 2019

Contents

1. INTRODUCTION

The purpose of this study is to quantify flood risks and related flooding issues associated with the Sweetwater Creek Watershed, located in northwest Georgia, and to evaluate potential measures that may help reduce that risk. The purpose of this appendix is to present and document the detailed cost estimate prepared in support of the study. The goal of the estimate is to provide a reliable basis for authorizing and budgeting the recommended plan, as well as provide a basis reliable basis for comparing costs of the array of alternatives analyzed. The construction cost estimates in this report were developed to Class 4 based on the level of design for the alternatives analyzed.

2. DESCRIPTION OF ALTERNATIVES

The final array of alternatives included both structural and non-structural measures. The non-structural measure consisted of buy-outs of properties located in flood prone areas, with the different alternatives being different levels of buyouts. The buy-outs would also include demolition and removal of the bought structure. The remaining alternatives were comprised of structural measures. These measures included construction of retention structures or modification of the Sweetwater Creek Channel. Table 1 shows the final array of alternatives and indicates the measures included in each alternative. For a full description of each alternative, please refer to the main report. For a full description of the structural measures, please refer to the Engineering Appendix.

Table 1: Alternatives Array

Alternative	Description	Measures
Alternative 1	10% ACE Level Buyouts	Buyouts
Alternative 1.1	4% ACE Level Buyouts	Buyouts
Alternative 1.2	2% ACE Level Buyouts	Buyouts
Alternative 1.3	1% ACE Level Buyouts	Buyouts
Alternative 1.4	Revised 10% ACE Level Buyouts	Buyouts
Alternative 1.4Rec	Revised 10% ACE Level Buyouts with Recreation	Buyouts and Recreation
Alternative 2	Retention structure at Brown Road	SC6
Alternative 4	Channel Modification	SC9
Alternative 5D	Multibasin Retention	MC2, MC5, OC1, PC2, SC1, SC2, SC6
Alternative 5F	Multibasin Retention	SC1, SC2, SC6
Alternative 5H	Multibasin Retention	SC1, SC6
Alternative 5I	Retention structure upstream of Bakers Bridge Road	SC1
Alternative 5J	Retention structure upstream of Bakers Bridge Road	SC1s

3. FORMULATION OF ALTERNATIVE ESTIMATES

A. PRICE LEVEL

The estimated cost for each structural alternative consists of the estimated construction, including demolition, cost, the real estate cost, the Planning, Engineering, and Design(PED) cost, the Construction Management(CM) cost, and a contingency. The estimated cost for each non-structural alternative consists of the demolition costs, the real estate costs, and a contingency. PED and CM were not included for the non-structural alternatives. The price level for each alternative was set to 1st Quarter FY 2018, when the estimates were originally developed.

B. COST ESTIMATE STRUCTURE

The cost estimate for each alternative consists of multiple parts. The below paragraphs describe the structure of the estimates.

The construction cost of the structural alternatives was prepared using MCACES, 2nd generation (MII). MII cost book prices were used except as noted in the MII estimate, as modified by local wage rates (custom Labor Library) and equipment rates (2016 Region III Equipment Library). Markups were applied in MII to bring the estimate to FY 18 price levels, but escalation was not applied to the estimates. PED and CM costs were calculated as a percentage of the construction costs. An upper limit was placed on the PED costs, to more accurately reflect the design effort necessary for large cost projects. An Abbreviated Risk Analysis (ARA) was prepared for each type of structural measure being analyzed and a contingency was calculated based on the appropriate ARA was included. The estimated real estate costs, with contingency, were then added to determine a total estimate for each alternative.

For the non-structural alternatives, MII was not used. Since the only construction cost would be the demolition and removal of the existing structures on the areas to be bought, an average cost for demolition and removal was used. A cursory review of the list of structures provided by the Real Estate team indicated the quantity of structures well above the average size. For the purposes of estimating the demolition cost, these structures were counted as two. For example, the selected plan contains 20 parcels, but the estimate accounts for demolition of 25 structures.

C. COST ESTIMATE PRESENTATION

The construction cost estimates were combined with the Real Estate costs, contingency costs, PED costs, and CM costs using an EXCEL workbook. The total cost for each alternative was shared with the PDT for use in selecting a plan. The summary sheet is included as Table 2: Alternatives Estimated Costs These costs were used for the economic analysis for each alternative.

Table 2: Alternatives Estimated Costs

DESCRIPTION		ESTIMATED AMOUNT
Alternatives		***Project Cost***
1	**Relocations - 10 yr**	$ 4,669,100
1.1	**Relocations - 25 yr**	$ 5,674,100
1.2	**Relocations - 50 yr**	$ 15,708,300
1.3	**Relocations - 100 yr**	$ 23,028,400
2	**Retention Structure at Brown Road**	$ 22,784,000
4	**Channel Modification**	$ 134,178,600
5H	**Multibasin Retention**	$ 33,342,000
5D	**Multibasin Retention**	$ 152,668,600
5J	**Retention Structure Upstream of Bakers Bridge Road**	$ 8,685,700

Notes:
Price Level, FY-18

D. RISK ANALYSIS AND CONTINGENCY

For the alternatives, an Abbreviated Risk Analysis (ARA) was prepared for each type of structural alternative. The ARAs were prepared with input from the PDT on developing the risks and assigning likelihood and impact of each risk. The Risk Register for each structural alternative is included as an attachment to this appendix. For the nonstructural alternatives, an across the board contingency of 25% was applied to equal the contingency applied by the Real Estate team on the Real Estate costs. As the study progresses, an ARA will be developed for the selected plan to insure the most accurate description of the risks and contingencies is made.

4. DEVELOPMENT OF ESTIMATED SCHEDULE

A. STRUCURAL ALTERNATIVES SCHEDULES

For the structural alternatives, the MII estimate was used as the basis of schedule. For alternatives with multiple locations, concurrent work at different sites was included in the estimated schedule to an appropriate degree. The resulting schedules are included in the estimate workbook and were used by the PDT for the economic analysis of the alternatives.

B. NONSTRUCURAL ALTERNATIVES SCHEDULES

For the nonstructural alternatives, the Real Estate team was consulted to help develop a timeline for acquisition of the parcels in each alternative. The estimated schedule assumes that demolition of the structures would occur immediately after the acquisition of each parcel, therefore the construction duration would be essentially the same as the acquisition schedule. The resulting schedules are included in the estimate workbook and were used by the PDT for the economic analysis of the alternatives.

5. TENTATIVELY SELECTED PLAN

Alternative 1, relocations and structure removal up to the 10% Annual Chance of Exceedance level, was determined to be the NED plan and chosen as the TSP. Please refer to the main report or Real Estate Appendix for additional information on the TSP.

6. REFINEMENT OF THE TSP

A. REFINEMNT OF THE TSP

The TSP was refined after the TSP Milestone Meeting. This refinement included verification of location of planned structures in the floodplain, application of the real Estate Gross Appraisals to the estimate, and development of recreation features. The Engineering and Economics team, upon further refinement of the models, determined that 11 of the 20 structures in the TSP would not accrue benefits as part of the plan, leaving only 9 structures to be included for further evaluation.

The PDT, in coordination with the sponsor, also identified 2 potential areas for developing recreation features after the existing structures are removed. These recreation features are at two different sites and include picnic features, water access, and a walking trail.

B. REFINEMNT OF THE COST ESTIMATE

The estimate for the TSP was refined to include the adjusted number of relocations, the construction cost of the recreation features, including PED and CM, as well as the cost for a cultural resources survey as required to identify any unknown cultural resources eligible for listing on the NHRP. The cultural resources survey is a requirement not identified prior to the TSP Milestone. The costs for the refined TSP, both with and without the recreation features are included in Table 3. These costs were shared with the PDT and used for the Economic Analysis.

Table 3 - Refined TSP Costs

DESCRIPTION		ESTIMATED AMOUNT
Alternatives		***Project Cost***
1	**Relocations - 10 yr Revised for Structure Locations**	$ 3,241,300
1 Rec	**Relocations - 10 yr Revised with Recreation**	$ 3,726,500

Notes:
Price Level, FY-18

Additionally, an estimate of the O&M costs for the recreation features was prepared. Work included in the O&M costs include trash removal, parking lot and trail maintenance, fence maintenance, and grass cutting. Annualized costs for O&M are estimated at $3,900 at FY18 price level.

7. FEASIBILITY ESTIMATE

The Selected Plan, Alternative 1 Rec, which is Relocations to the 10% ACE level with recreation features, was confirmed by the Vertical Team and Sponsor at the Agency Decision Milestone. Because the selected plan was primarily relocations, no additional investigation or design was performed. An abbreviated risk analysis was prepared by the PDT for the relocations and the estimated costs were updated with the contingencies calculated by the ARA process. The estimated construction cost for the project as shown on the attached TPCS is $3,753,000. Annualized O&M costs remained unchanged at $3,900.

8. ATTACHMENTS

MII Summary
TPCS
Schedule

U.S. Army Corps of Engineers
Mobile District

SWEETWATER CREEK
FLOOD RISK MANAGEMENT STUDY

COBB COUNTY, GEORGIA

APPENDIX D

REAL ESTATE PLAN

September 2018

Table of Contents

Exhibits

Figures

1.0 Preamble

1.1 Project Authorization: The Study was authorized by House Resolution 2445, adopted September 28, 1994.

1.2 Official Project Designation: Sweetwater Creek Flood Risk Management Study

1.3 Study Area: The Sweetwater Creek watershed (Figure 1) encompasses 264 square miles in Paulding, Douglas, and Cobb Counties in Georgia. The main stem of Sweetwater Creek is 45.6 miles long and begins in Paulding County. As it flows eastward towards Cobb County other tributaries join the main stem before it empties into the Chattahoochee River in Douglas County at the Fulton County line. The creek passes through Sweetwater Creek State Park just before its confluence with the Chattahoochee River.

1.4 Reach Delineation: The study area encompasses the entire Sweetwater Creek watershed; however, the portion within Cobb County, Georgia is the intended area of flood risk improvement. The portion of Cobb County includes the cities of Marietta, Austell, and Powder Springs as well as a portion of unincorporated Cobb County, Georgia. The Cities of Hiram, Douglasville, and community of Lithia Springs are within the study area.

- 1.4.1 Upper Sweetwater Creek – consisting of the headwaters portion of the Sweetwater Creek main stem to the Paulding-Cobb County Line
- 1.4.2 Lick Log Creek – consisting of the headwaters of Lick Log Creek to the confluence with Upper Sweetwater Creek
- 1.4.3 Middle Sweetwater Creek – consisting of the main stem portion of Sweetwater Creek within Cobb County
- 1.4.4 Powder Springs Creek – consisting of the headwater of Powder Springs Creek to the confluence with Middle Sweetwater Creek
- 1.4.5 Noses Creek - consisting of the headwater of Noses Creek to the confluence with Middle Sweetwater Creek
- 1.4.6 Olley Creek - consisting of the headwater of Olley Creek to the confluence with Middle Sweetwater Creek
- 1.4.7 Buttermilk Creek - consisting of the headwater of Buttermilk Creek to the confluence with Middle Sweetwater Creek
- 1.4.8 Lower Sweetwater Creek – consisting of the main stem portion of Sweetwater Creek from the Douglas-Cobb County Line to its confluence with the Chattahoochee River.

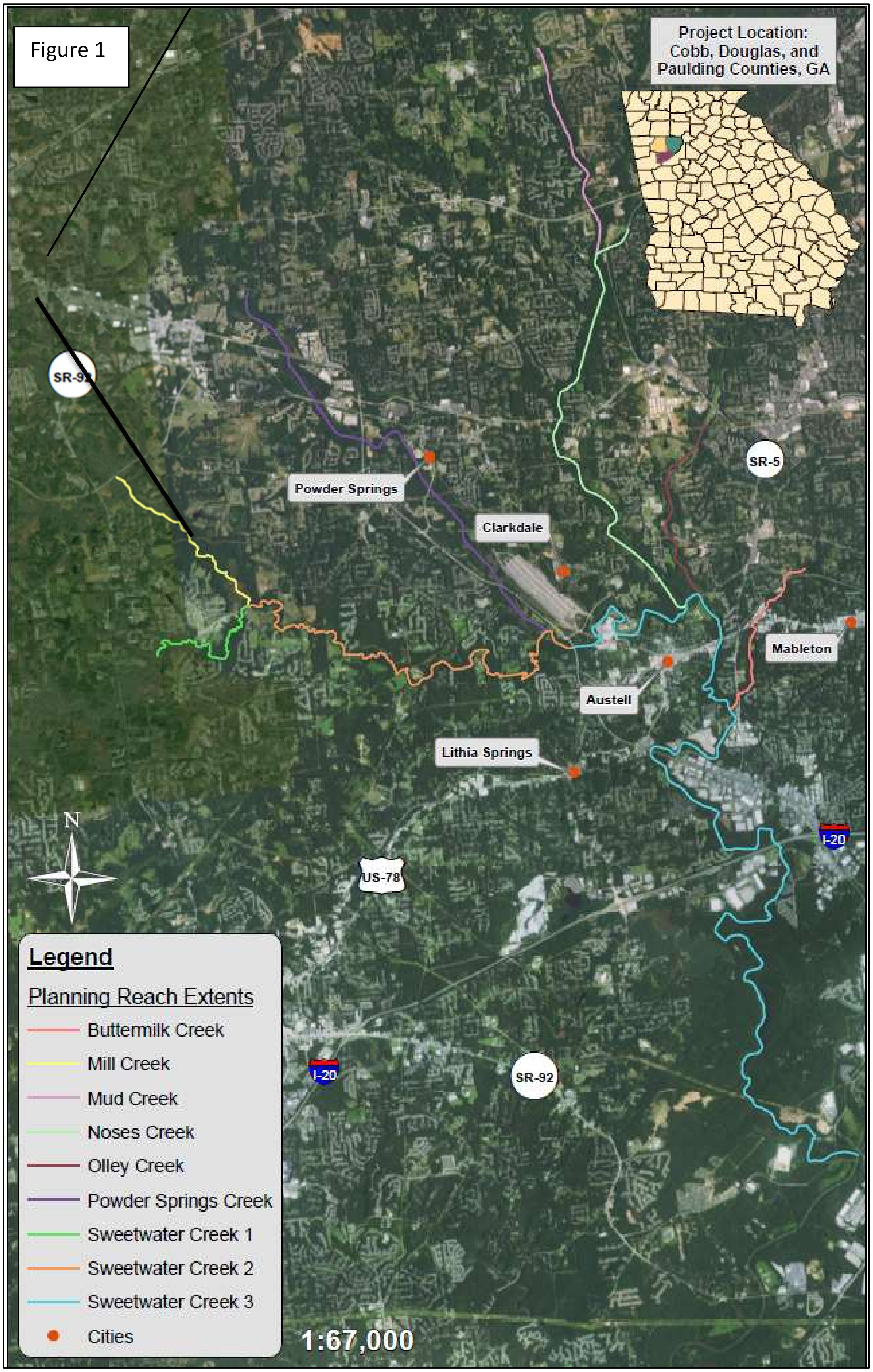


Figure 1
Project Location:
Cobb, Douglas, and
Paulding Counties, GA
SR-92
SR-5
Powder Springs
Clarkdale
Mableton
Austell
Lithia Springs
I-20
US-78
I-20
SR-92
N
Legend
Planning Reach Extents
Buttermilk Creek
Mill Creek
Mud Creek
Noses Creek
Olley Creek
Powder Springs Creek
Sweetwater Creek 1
Sweetwater Creek 2
Sweetwater Creek 3
Cities
1:67,000

1.5 Non-Federal Sponsor: The Non-Federal Sponsor is Cobb County (the "Sponsor" or "the County"). If approved, the project will be cost-shared in accordance with the terms of the PPA and Chapter 12, ER 405-1-12.

2.0 Statement of Purpose

The purpose of this Real Estate Plan (REP) is to present the overall plan describing the minimum real estate requirements for the construction, operation, maintenance, repair and rehabilitation herein referred to as the Tentatively Selected Plan (TSP).

3.0 Study Purpose and Project Features

3.1 Study Purpose: Investigate the Federal interest and feasibility of a FRM project to reduce the recurring flooding problems in the Sweetwater Creek Watershed within Cobb County, Georgia. The TSP is designed to accomplish the following objectives:

3.2 Flood Risk Management:

3.2.1 Reduce average annual flood damages
3.2.2 Reduce number of structures impacted
3.2.3 Reduce response times for emergency services during flood events
3.2.4 Increase access to emergency services during flood events

3.3 Plan of Improvements: The current proposed non-structural measures for the Sweetwater Creek study area are listed below. Please reference the main report and other appendices for information on the screening criteria utilized in the development of the TSP, which consists of the following proposed non-structural plan:

3.3.1 ***Alternative 1 - Buyout Alternative:*** This alternative would be to purchase structures in the 10-year Annual Chance of Exceedance (ACE). The majority of the parcels reside within Unincorporated areas of Cobb County but three parcels are situated within the Cities of Austell and Powder Springs. Exhibits A and B of this appendix contain further delineation of the proposed non-structural TSP.

Note: Alternative 1 also includes a proposed recreation component with preliminary design within the footprint of the recommended plan. Please reference the main report for further information.

4.0 **Required Lands, Easements, and Rights-of Way (LER):**
The parcel data and standard estates for the proposed Non-Structural acquisition are provided in Exhibits B and C, respectively. The TSP requires a total of approximately 12.06 acres of lands in Fee Simple title (Standard Estate #1), as outlined in Exhibit C. This alternative impacts a total of 9 privately-owned parcels, consisting of a combination of 7 residential dwellings and 2 commercial structures. Of the 12.06 acres, more or less proposed for acquisition, 8.23 acres, more or less consists of commercial properties

(auto service facility and former gas station repurposed as a storage building), and 3.83 acres, more or less consist of residential properties.

4.1 Appraisal Information: A gross appraisal estimate for LERRD requirements was completed on May 10, 2018, with review of May 15, 2018. The estimated market value for the TSP is outlined in Section 11. It is duly noted that the values reported in the gross appraisal reflected a substantial increase from tax assessor values, and are reflective of a dynamic real estate market in the study area. Furthermore, the current state of housing availability was taken into consideration in the development of estimated relocation expenses, to include the potential for housing of last resort.

5.0 **Non-Federal Sponsor Owned Lands**:
None of the proposed parcels are presently vested in the NFS.

6.0 **Non-Standard Estates**
There are no proposed non-standard estates for the plan inasmuch as proposed buyouts will be purchased in fee simple acquisition.

7.0 **Existing Federal Projects**
There are no known existing Federal projects which lie either fully or partially within the project footprint.

8.0 **Federally-owned Lands**
There are no Federally-owned lands included as part of the LER required for the TSP.

9.0 **Navigational Servitude**
Federal Navigational Servitude will not be utilized because it is not available along subject creek nor applicable to the scope of proposed non-structural work.

10.0 **Maps**
The draft real estate maps for the TSP are provided in Exhibit A.

11.0 **Induced Flooding**
There is no induced flooding associated with the TSP.

12.0 **Baseline Cost Estimate for Real Estate**

12.1 The following is the total estimated 01-Lands and Damages costs for the TSP, which is further delineated in **Exhibit E**:

10-Year Non-Structural ACE Zone (9 parcels)

Estimated Land Payments Cost--------------------------------------	$1,533,000
Estimated P.L. 91-646 Relocation Assistance-------------------	$481,000
Estimated Administrative Cost / Eminent Domain--------------	$356,700
Contingency--	$384,300
Total Estimated Lands and Damages---------------------------	**$2,755,000**

13.0 **Compliance with Public Law 91-646**

In the event of project approval, authorization, and appropriation, any approved relocation assistance benefits for the proposed non-structural plan will be governed by the provisions of the Uniform Relocations Assistance and Real Property Acquisition Policies Act (P.L. 91-646), as amended, 49 Code of Federal Regulations Part 24, and applicable laws and regulations for owner-occupant, non-residential and tenant-occupant residents. Until a Federal project is authorized and appropriated by Congress, and contingent upon the scope of the final authorized project, proposed relocations do not involve displaced persons under the Uniform Relocation Act.

The proposed TSP includes relocation of occupants and non-residential interests for 7 residential parcels and 2 commercial/industrial structures within the floodplain. A preliminary survey of available housing in the vicinity of proposed relocations was developed in May 2018, which determined that housing values for comparable structures generally exceeds the estimated value of the structures in the before project condition. While comparable housing is available on the market, the listing prices observed in this analysis underscored the challenges in acquiring replacement dwellings in the suburbia of Atlanta.

A full relocation plan will be developed in conjunction with the NFS after approval of the Final Feasibility Report.

14.0 **Minerals and Timber Activity**

There are no known present or anticipated mineral extraction or timber harvesting activities within the proposed project footprint. Existing USGS Mineral Data graphically depicted in Figure 2 on the vicinity of Cobb County, GA indicates an abundance of Precambrian-Paleozoic formations including quartzite, amphibolite and biotite gneiss. Furthermore, inquiry into historical mineral exploration in the state indicates that exploratory activities have been primarily limited to Conasauga shale field, situated in the Northwest corner of the state, which is outside of the area of the TSP. Based on research into current mineral exploitation endeavors in the area, the risk of third-party development of mineral activities is considered negligible, and would not impact any proposed non-structural acquisitions.

Proposed estate for fee acquisition is Standard Estate #1 (Fee Simple), outlined in Exhibit C to this document and in EC 405-1-11. During site visits, no mineral activity was observed, and no known exploratory activity is underway in this area.

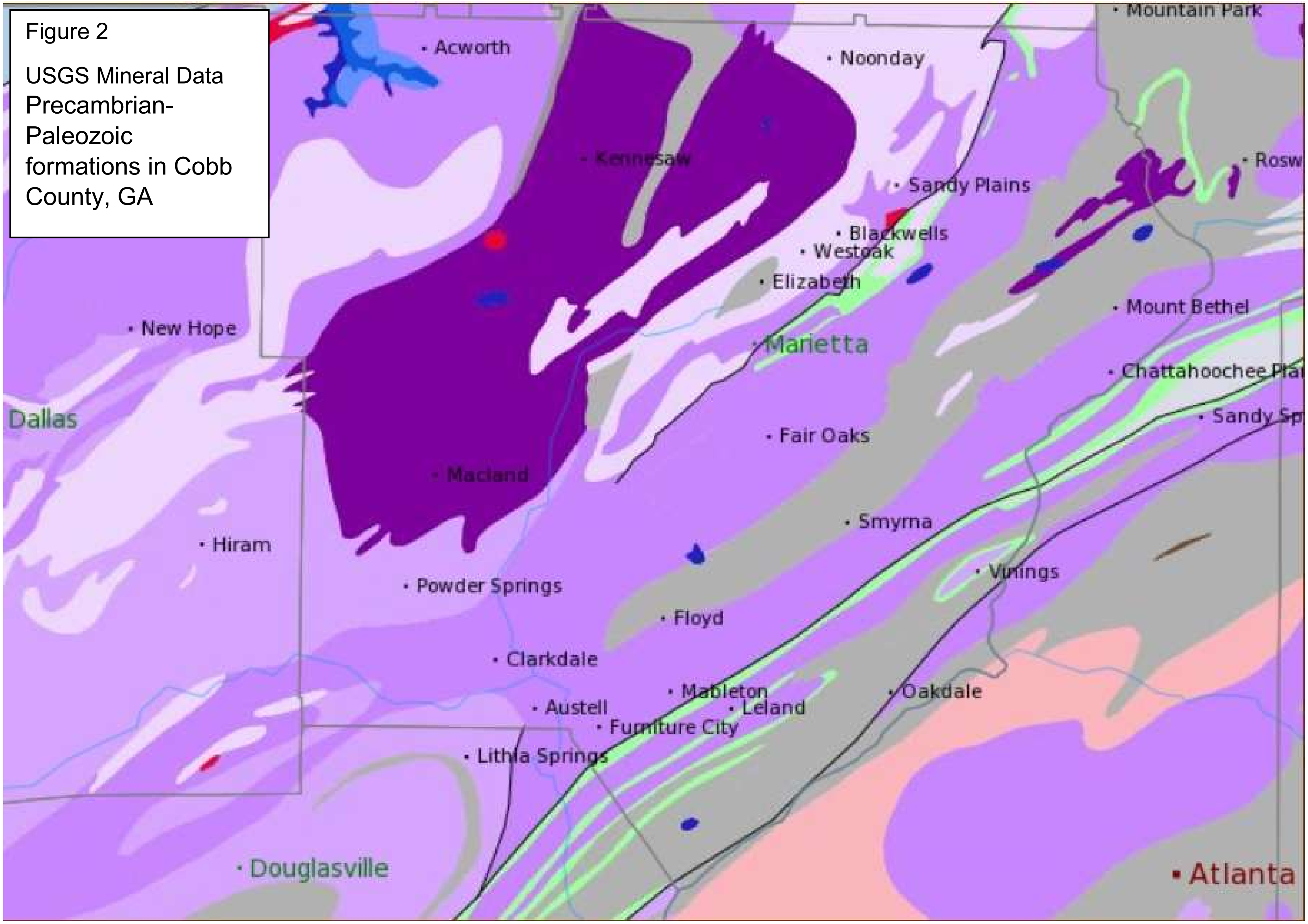


Figure 2

USGS Mineral Data Precambrian-Paleozoic formations in Cobb County, GA

15.0 **Land Acquisition Experience and Capability of the Non-Federal Sponsor**
An assessment of the Sponsor's land acquisition experience and capabilities was coordinated with the Non-Federal Sponsor and is provided in Exhibit D.

16.0 **Zoning**:

Application or enactment of zoning ordinances is not anticipated for the TSP. It is duly noted that new construction within the Special Flood Hazard Area delineated by FEMA is subject to zoning ordinance restrictions imposed in § 58-66 of the Code of Ordnances of Cobb County. Furthermore, Article II, Section 5-20 of the Code of Ordnances of the City of Austell and Article X of the Uniform Development Code of the City of Powder Springs contain similar provisions.

17.0 **Acquisition Schedule**
The following acquisition schedule will apply to the proposed alternative.

Event	Milestone Date
PPA Execution	9 months from report completion
Sponsor's Notice to Proceed with Acquisition	1 month from PPA execution
Phase 1 Authorization for Entry for Construction	18 months from NTP with Acquisition
Phase 1 Certification of Real Estate	2 months from Authorization for Entry
Phase 1 Ready to Advertise for Construction	1 month from Certification of RE

18.0 **Facility and/or Utility Relocations**
The TSP consists of proposed non-structural residential and commercial relocations. There are no relocations of public bridges or utilities anticipated.

19.0 **Hazardous, Toxic, and Radioactive Waste (HTRW)**
There is no known HTRW contamination within the proposed footprint of the TSP at this time, albeit a Phase II assessment will be required for further consideration of commercial properties. As part of its Phase I assessment, the District consulted the databases maintained by the Environmental Protection Agency (EPA), including, but not limited to, the National Priorities List (NPL), the Comprehensive Environmental Response and Liability Information System (CERCLIS), and the Resource Conservation and Recovery Information System (RCRIS). In addition, databases maintained by the Georgia Department of Environmental Management (ADEM), were also consulted. The ADEM databases include the Environmental Cleanup and Brownfields site list, the Environmental Remediation Project information, Spills Incident Database, Environmental Site Remediation database, and Petroleum Bulk Storage list.

The HTRW Environmental Site Assessment (Phase I) revealed evidence of recognized environmental conditions associated within the study areas. The screened-out measures SC1, SC2 and SC6 were the only areas investigated where no RECs were reported within the search parameters of the EDR database search or observed during the site investigation. For all other measures, including Buyouts, additional environmental assessment may be required to avoid potential assumption of any possible environmental liability associated with select properties. Reference Appendices E and F for further information on Environmental considerations.

20.0 **Project Support**

The Non-Federal Sponsor has been supportive of structural and non-structural measures to reduce flooding in the communities surrounding Sweetwater Creek. Public meetings and discussions have indicated general receptiveness to the possibility of buyout offers. Limited opposition to proposed buyouts has been noted, and the Non-Federal Sponsor continues to engage the communities and stakeholders that are impacted by flooding in the Sweetwater Creek watershed.

Pursuant to the requirements set forth in the Land Acquisition Policy Act of 1960, Public Law 86-645 (33 U.S.C. § 597), mandates landowner notification within six months after authorization, and "a reasonable time after initial appropriations."

> *Within six months after the date that Congress authorizes construction of a water resource development project under the jurisdiction of the Secretary of the Army, the Corps of Engineers shall make reasonable effort to advise owners and occupants in and adjacent to the project area as to the probable timing for the acquisition of lands for the project and for incidental rights-of-way, relocations, and any other requirements affecting owners and occupants. Within a reasonable time after initial appropriations are made for land acquisition or construction, including relocations, the Corps of Engineers shall conduct public meetings at locations convenient to owners and tenants to be displaced by the project in order to advise them of the proposed plans for acquisition and to afford them an opportunity to comment. To carry out the provisions of this section, the Chief of Engineers shall issue regulations to provide, among other things, dissemination of the following information to those affected: (1) factors considered in making the appraisals; (2) desire to purchase property without going to court; (3) legal right to submit to condemnation proceedings; (4) payments for moving expenses or other losses not covered by appraised market value; (5) occupancy during construction; (6) removal of improvements; (7) payments required from occupants of Government acquired land; (8) withdrawals by owners of deposits made in court by Government, and (9) use of land by owner when easement is acquired. The provisions of this section shall not subject the United States to any liability nor affect the validity of any acquisitions by purchase or condemnation and shall be exempt from the operations of subchapter II of chapter 5, and chapter 7, of title 5. (Land Acquisition Policy Act of 1960, Public Law 86-645, 33 U.S.C. § 597)*

21.0 **Notifications to Non-Federal Sponsor**

Based on its past sponsorship of other Corps of Engineers Civil Works projects and ongoing discussions during the study phase, the Non-Federal Sponsor is aware of the risks of acquiring real estate interests required for the project prior to the signing of the

PPA. However, upon the approval of the TSP, in accordance with paragraph 12-31, Chapter 12, ER 405-1-12, Real Estate Handbook, a formal written notice identifying the risks associated with acquiring the LER for the project prior to the full execution of the PPA was provided to the Sponsor, and was officially acknowledged per Exhibit D.

Cobb County is the Non-Federal Sponsor (NFS) for the proposed project. Upon receipt of the formal notice to proceed with acquisition, the NFS has the responsibility to acquire all real estate interests required for the project. The NFS shall accomplish all alterations and relocations of facilities, structures and improvements determined by the government to be necessary for construction of the project.

Title to any acquired real estate will be retained by the NFS and will not be conveyed to the United States Government. The government will require access rights be provided by the NFS for entry to the project. Prior to advertisement of any construction contract, the NFS shall furnish to the government an Authorization for Entry for Construction (Exhibit F) to all lands, easements and rights-of-way, as necessary. The NFS will also furnish to the government evidence supporting their legal authority to grant rights-of-way to such lands.

During the acquisition process, the NFS shall comply with applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, approved 2 January 1971, and amended by Title IV of the Surface Transportation Uniform Relocation Assistance Act of 1987, Public Law 100-17, effective 2 April 1989, in acquiring real estate interests for the proposed project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act(s).

LERRD credit will be determined in accordance with the terms of the PPA and Chapter 12, ER 405-1-12.

22.0 **Applicable Provisions of State Law**

In addition to requirements of Public Law 91-646, 49 CFR Part 24, and other applicable regulations, acquisition of property will be in accordance with the requirements of State Law, including those pertaining to employment of eminent domain. As outlined in Title 22 of Georgia Law, the acquiring entity must certify to the court that such lands being condemned are for a public use. Furthermore, this code has a provision for a special master, which would facilitate the “quick-take” requirement.

23.0 **Other Issues**

23.1 The land proposed to be acquired for the proposed relocation resides in three separate jurisdictions: Cobb County, the City of Powder Springs, and the City of Austell, as delineated in Exhibit B. The City of Powder Springs has informally discussed the possibility for property within the City’s jurisdiction to be bought by Cobb County on behalf of the City. However, Cobb County will not have authority of condemnation within the jurisdiction of the City of Powder Springs. The City of Austell has not formally or informally advised USACE of their intentions for purchasing the single parcel lying within the jurisdiction of the City of Austell.

23.2 During the time of the report, there were no known existing encumbrances (i.e., easements, rights-of-way, et cetera) that would affect, or be affected by, the project for the purposes of non-structural relocation and the removal of identified structures from the floodplain. Title for each parcel would be reviewed by the Non-Federal Sponsor upon notice to proceed with acquisition in accordance with USACE regulations.

23.3 Several structures have been identified which pre-date lead-based paint and asbestos regulation, which if removed would require Engineering plans to mitigate.

24.0 **Recommendations**:

This report has been prepared in accordance with Paragraph 12-16 of Chapter 12 of the Real Estate Handbook, Corps of Engineers Regulation (ER) 405-1-12. It is recommended that this report be approved.

Exhibit A
Real Estate Maps

SWEETWATER CREEK, GA

10 YR. NON-STRUCTURAL PLAN

INDEX BY SLIDE NUMBER

Unincorporated Cobb

4 - 2660 Clay Rd & Adjoining Parcel (Parcel #19113600550/19108500040)

6 - 3324 Hopkins Rd (Parcel #19076000290)

6 - 3334 Hopkins Rd (Parcel #19076000300)

6 - 3344 Hopkins Rd (Parcel #19076000310)

6 - 3430 Hopkins Ct (Parcel #19079400050)

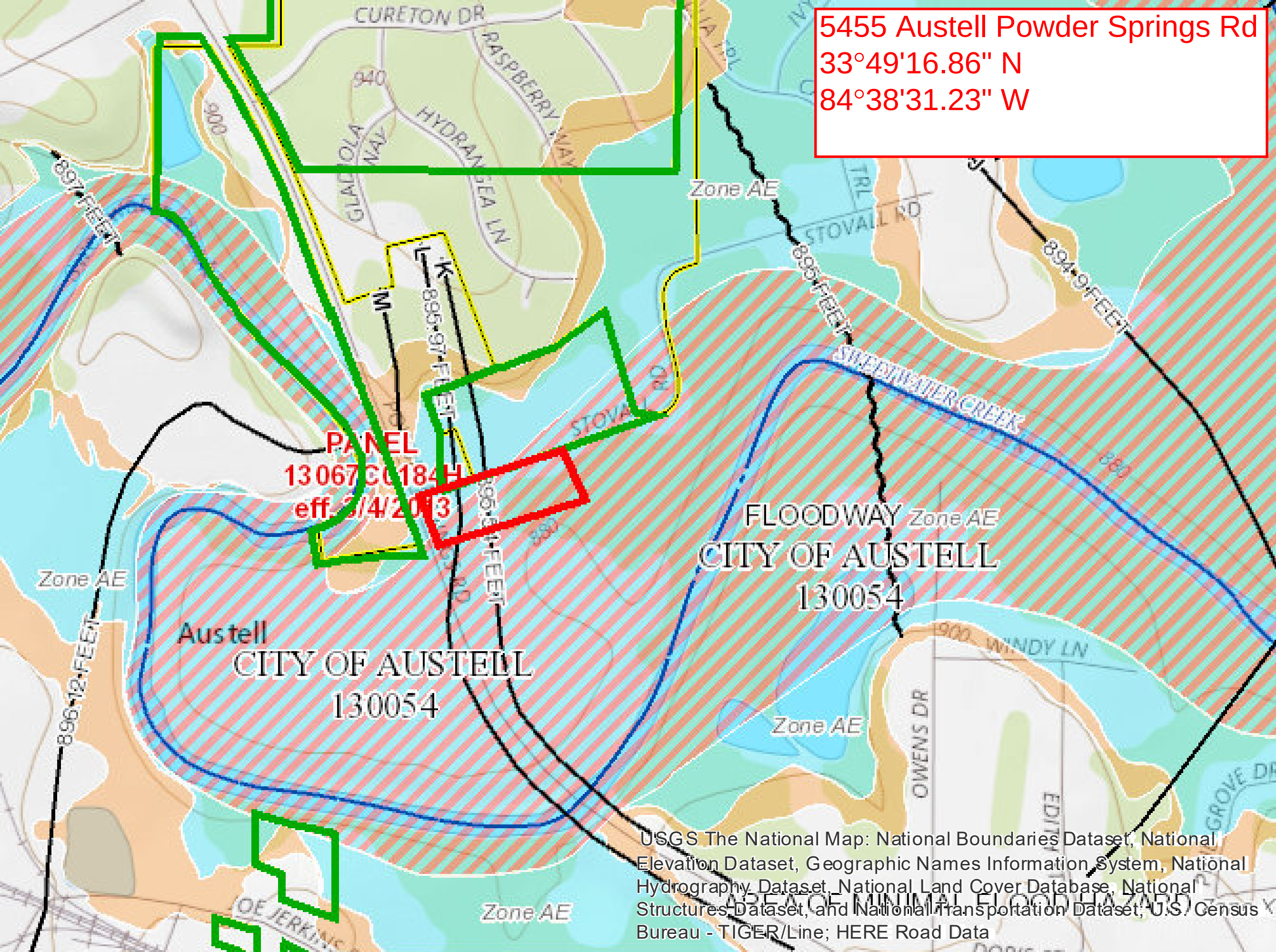
Austell

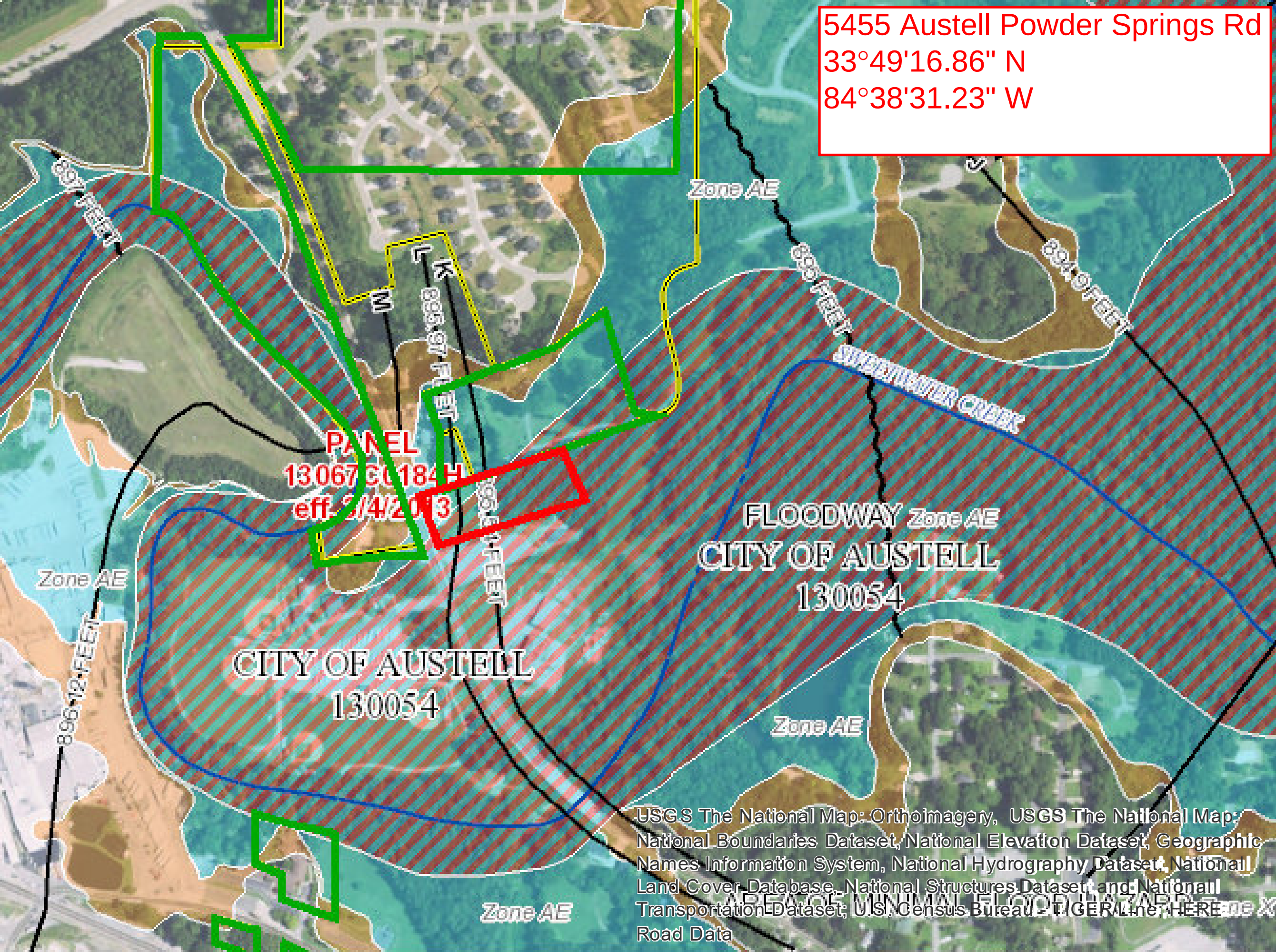
2 - 5455 Austell Powder Springs Rd (Parcel #19128100090)

Powder Springs

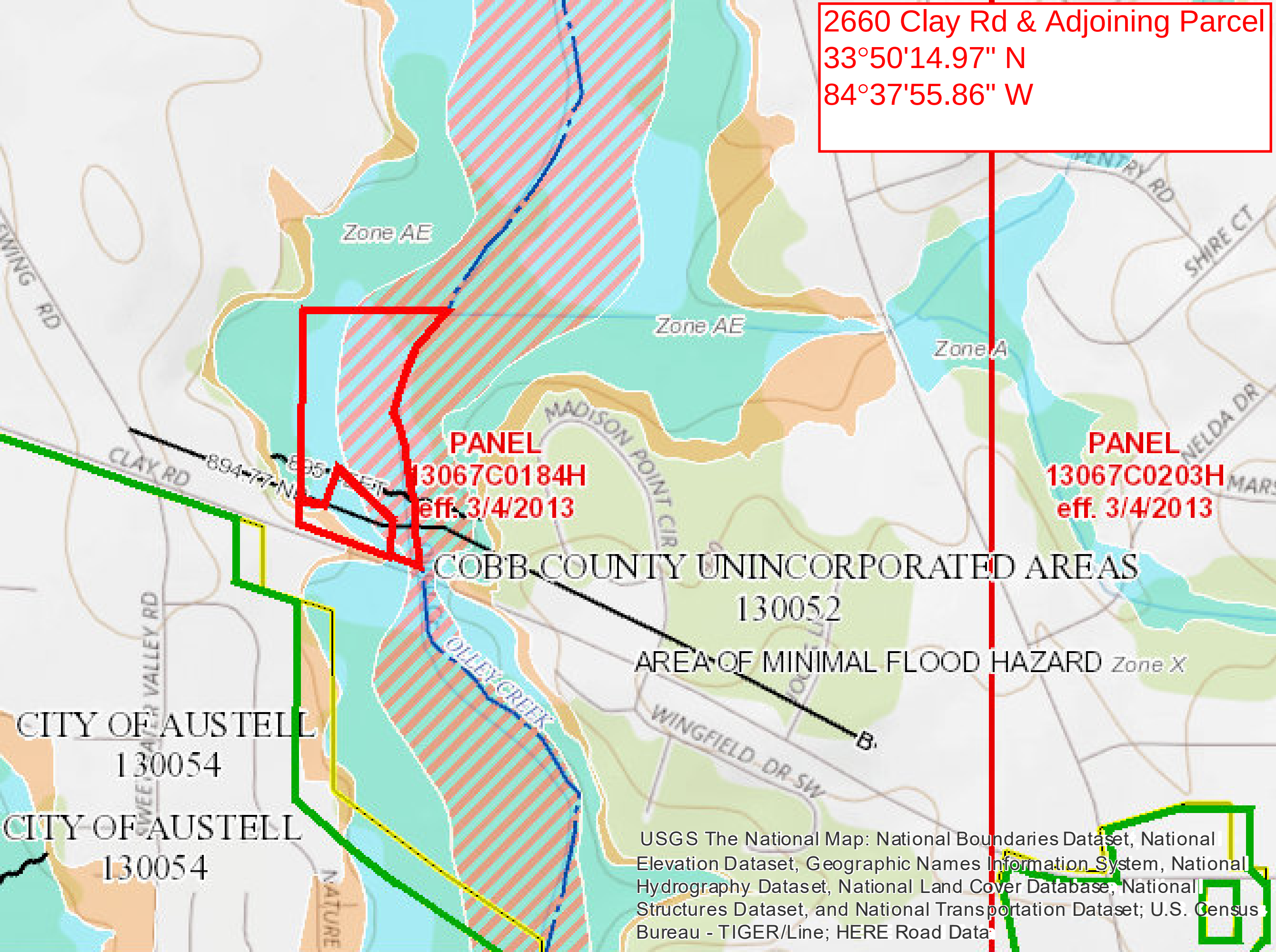
6 - 3211 Lancer Dr (Parcel #19075900100)

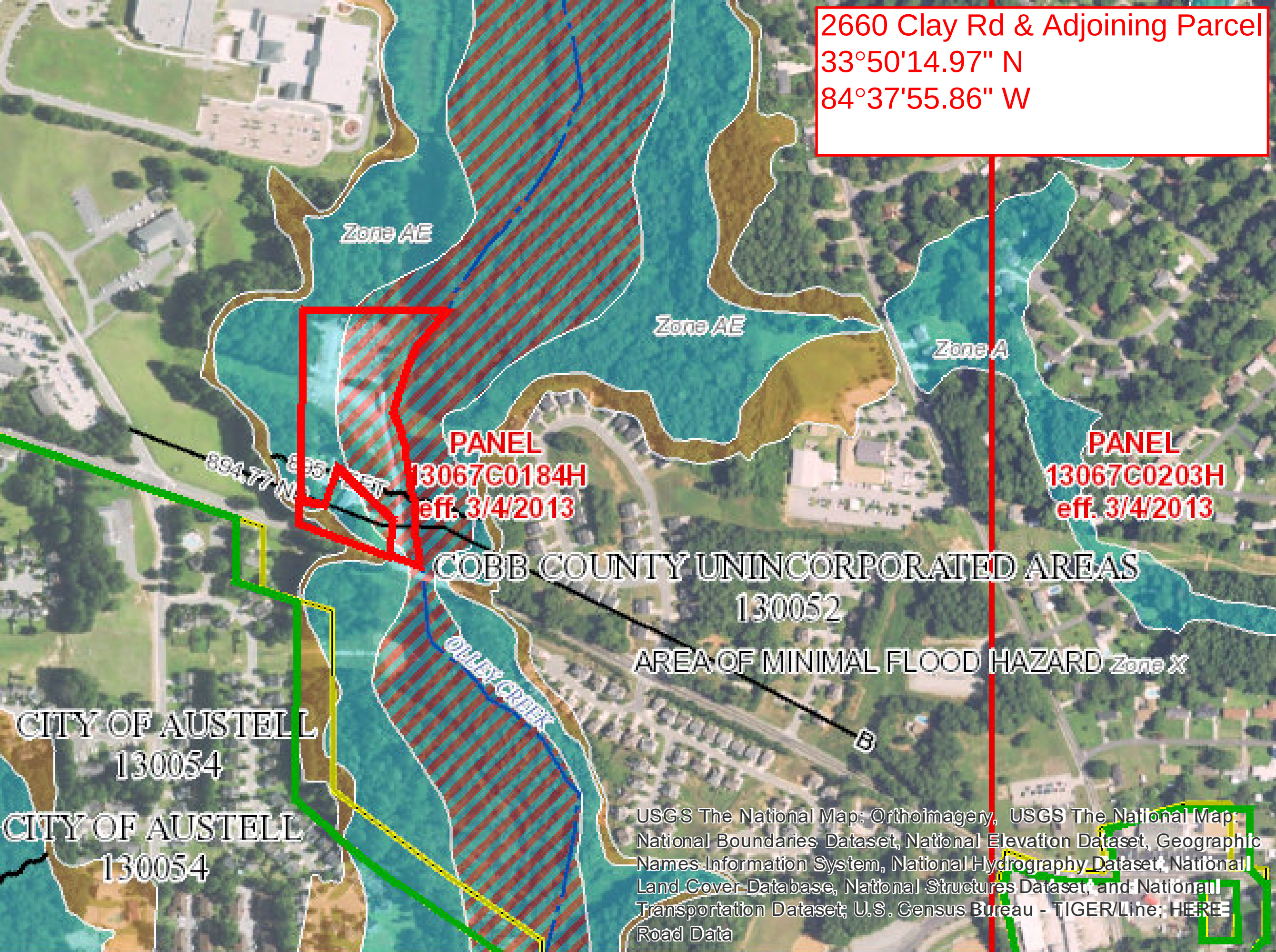
6 - 3414 Hopkins Rd (Parcel #19076000380)

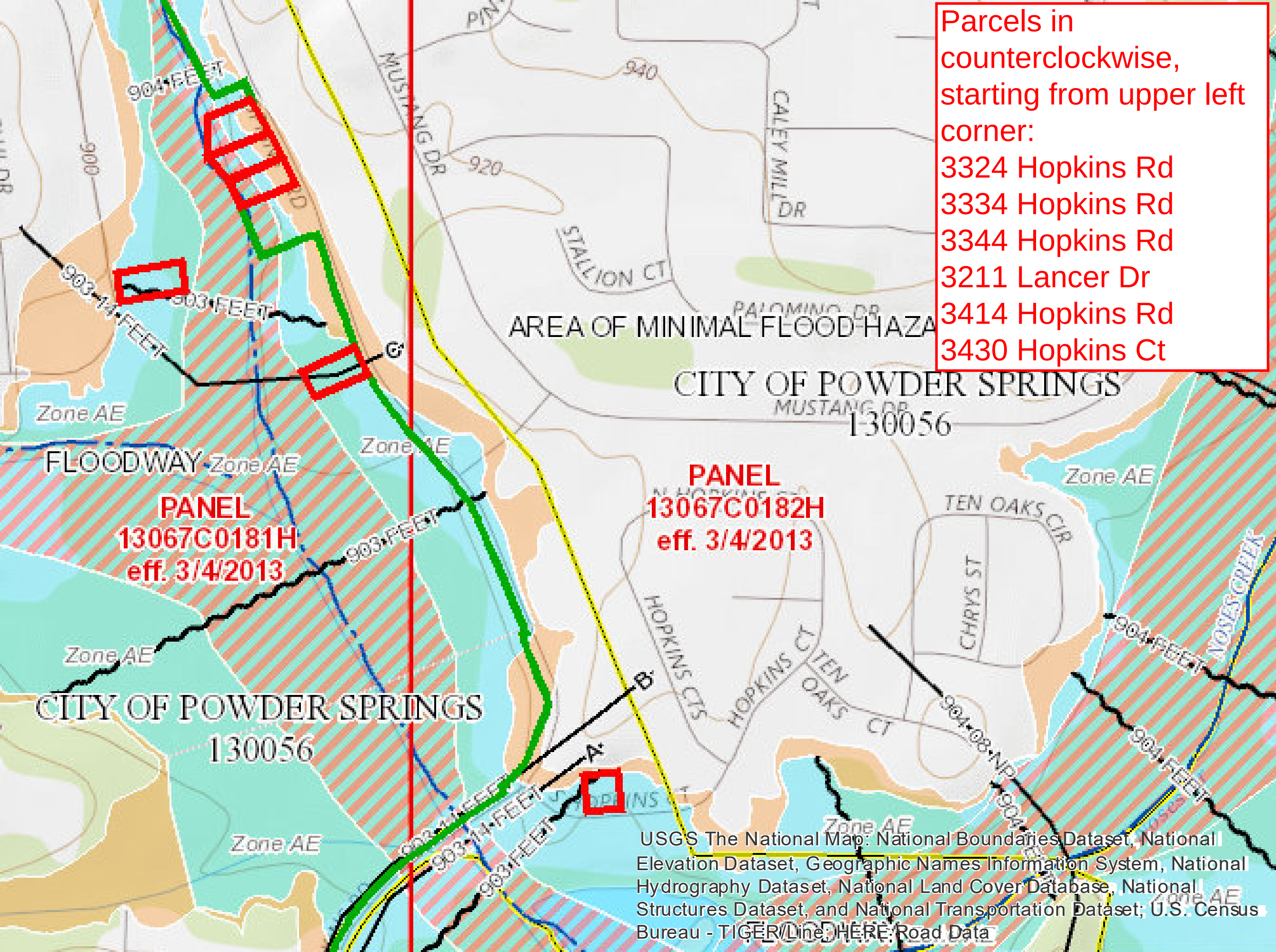

5455 Austell Powder Springs Rd
33°49'16.86" N
84°38'31.23" W
CURETON DR
RASPBERRY WAY
HYDRANGEA LN
GLADIOLA WAY
940
900
897 FEET
Zone AE
STOVALL RD
896 FEET
894.9 FEET
895.97 FEET
895.5 FEET
896.12 FEET
SWEETWATER CREEK
PANEL
13067C0184H
eff. 3/4/2013
FLOODWAY Zone AE
CITY OF AUSTELL
130054
Austell
CITY OF AUSTELL
130054
WINDY LN
OWENS DR
GROVE DR
AREA OF MINIMAL FLOOD HAZARD
USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line; HERE Road Data



5455 Austell Powder Springs Rd
33°49'16.86" N
84°38'31.23" W
Zone AE
897 FEET
L
K
M
895.97 FEET
894.9 FEET
SWEETWATER CREEK
PANEL
13067C0184H
eff. 3/4/2013
FLOODWAY Zone AE
CITY OF AUSTELL
130054
Zone AE
CITY OF AUSTELL
130054
896.12 FEET
Zone AE
Zone AE
AREA OF MINIMAL FLOOD HAZARD
USGS The National Map: Orthoimagery, USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line; HERE Road Data


2660 Clay Rd & Adjoining Parcel
33°50'14.97" N
84°37'55.86" W
Zone AE
Zone AE
Zone A
PENTRY RD
SHIRE CT
NELDA DR
MADISON POINT CIR
CLAY RD
RD
PANEL
13067C0184H
eff. 3/4/2013
PANEL
13067C0203H
eff. 3/4/2013
COBB COUNTY UNINCORPORATED AREAS
130052
AREA OF MINIMAL FLOOD HAZARD Zone X
WINGFIELD DR SW
B
CITY OF AUSTELL
130054
CITY OF AUSTELL
130054
USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line; HERE Road Data


2660 Clay Rd & Adjoining Parcel
33°50'14.97" N
84°37'55.86" W
Zone AE
Zone AE
Zone A
PANEL
13067C0184H
eff. 3/4/2013
PANEL
13067C0203H
eff. 3/4/2013
COBB COUNTY UNINCORPORATED AREAS
130052
AREA OF MINIMAL FLOOD HAZARD Zone X
OLLEY CREEK
B
CITY OF AUSTELL
130054
CITY OF AUSTELL
130054
USGS The National Map: Orthoimagery, USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line; HERE Road Data


Parcels in counterclockwise, starting from upper left corner:
3324 Hopkins Rd
3334 Hopkins Rd
3344 Hopkins Rd
3211 Lancer Dr
3414 Hopkins Rd
3430 Hopkins Ct
AREA OF MINIMAL FLOOD HAZA
CITY OF POWDER SPRINGS
130056
PANEL
13067C0182H
eff. 3/4/2013
PANEL
13067C0181H
eff. 3/4/2013
FLOODWAY
Zone AE
CITY OF POWDER SPRINGS
130056
MUSTANG DR
STALLION CT
CALEY MILL DR
PALOMINO DR
TEN OAKS CIR
CHRYS ST
HOPKINS CTS
HOPKINS CT
TEN OAKS CT
NOSES CREEK
904 FEET
903 FEET
903.14 FEET
USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line; HERE Road Data

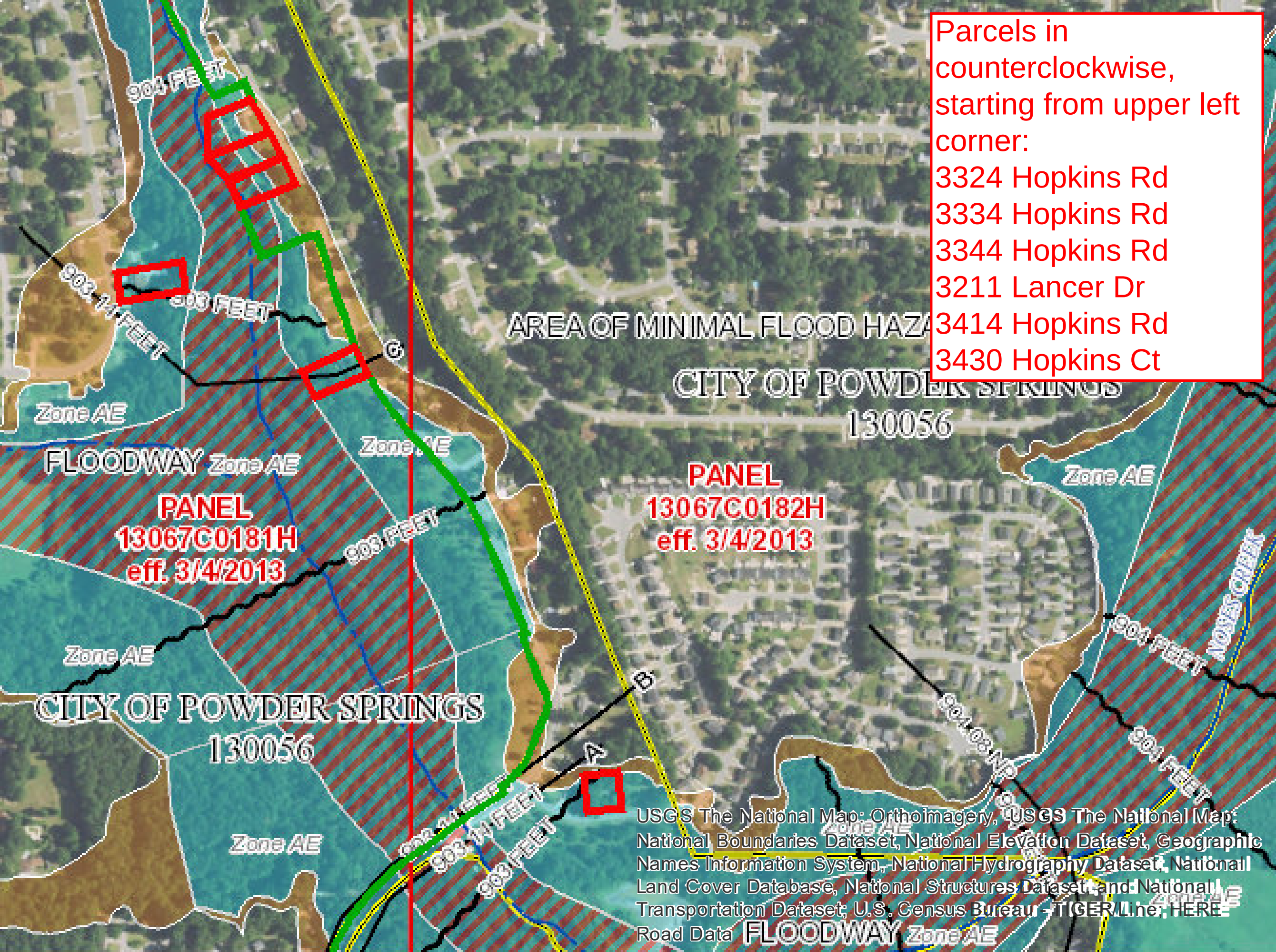

Parcels in counterclockwise, starting from upper left corner:
3324 Hopkins Rd
3334 Hopkins Rd
3344 Hopkins Rd
3211 Lancer Dr
3414 Hopkins Rd
3430 Hopkins Ct
904 FEET
903 1/4 FEET
903 FEET
G
AREA OF MINIMAL FLOOD HAZA
CITY OF POWDER SPRINGS
130056
Zone AE
FLOODWAY
Zone AE
PANEL
13067C0181H
eff. 3/4/2013
PANEL
13067C0182H
eff. 3/4/2013
903 FEET
904 FEET
NOSES CREEK
Zone AE
B
A
CITY OF POWDER SPRINGS
130056
Zone AE
904 FEET
USGS The National Map: Orthoimagery, USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line; HERE Road Data
FLOODWAY
Zone AE

Exhibit B
Parcel Data

PARCEL NO	STREET NO	STREET	JURISDICTION	ACRES
19108500040	0	CLAY RD	Cobb	5.82
19113600550	2660	CLAY RD	Cobb	1.14
19079400050	3430	HOPKINS CT	Cobb	0.32
19076000310	3344	HOPKINS RD	Cobb	0.47
19076000290	3324	HOPKINS RD	Cobb	0.56
19076000300	3334	HOPKINS RD	Cobb	0.46
19075900100	3211	LANCER DR	Powder Springs	0.46
19076000380	3414	HOPKINS RD	Powder Springs	0.42
19128100090	5455	AUSTELL POWDER SPRINGS RD	Austell	2.41

12.06 ac

Exhibit C
Standard Estates

Fee (Standard Estate No. 1)

The fee simple title to (the and described in Schedule A) (Tracts Nos. , and), Subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines, excepting and excluding from the taking all interests in the (coal) (oil and gas) which are outstanding in parties other than the surface owners and all appurtenant rights for the exploration, development and removal of said (coal) (oil and gas) so excluded.

Exhibit D
Non-Federal Sponsor Capability Assessment / Risk Notification Memorandum

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO ATTENTION OF:

USACE-SAM-RE-A

12 April 2018

SWEETWATER CREEK FLOOD RISK MANAGEMENT STUDY COBB COUNTY, GEORGIA

COBB COUNTY, GEORGIA – NON FEDERAL SPONSOR

ASSESSMENT OF NON-FEDERAL SPONSOR'S REAL ESTATE ACQUISITION CAPABILITY

1. **LEGAL AUTHORITY:**

a. **Does the sponsor have legal authority to acquire and hold title to real property for project purposes?** Yes – in Cobb County Unincorporated Areas. Sponsor has indicated that an agreement with one or both of the incorporated areas to acquire real property on behalf of that entity.

b. **Does the sponsor have the power of eminent domain for this project?** Yes – in Unincorporated Cobb County only.

Does the sponsor have "quick-take" authority for this project? O.C.G.A. Title 22 has provisions for a special master, which may be utilized for these purposes. Special Masters are attorneys who are responsible for administering the condemnation laws of Georgia. The special master sits as a judge over a land condemnation case. A Superior Court judge then approves his or her decision.

Pursuant to the Official Code of Georgia Annotated, in order to qualify to be a special master an attorney must be a competent attorney at law, be of good standing in the profession, and have at least three years of experience in the practice of law.

When requests come in for special masters the party is given several names and phone numbers in sequence from our list. The party has the option of declining an attorney if there appears to be a conflict of interest.

c. **Are any of the lands/interests in land required for the project located outside the sponsor's political boundary?** Yes – property within the jurisdiction of the Cities of Austell and Powder Springs are located outside the sponsor's political boundary and acquisition of these properties will require close coordination between USACE, the Sponsor and the Cities involved.

d. **Any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn?**

   i. **Private Property:** Properties in the Incorporated Areas cannot be condemned by the County (sponsor)
   ii. **State-Owned Property:** N/A

2. **<u>HUMAN RESOURCE REQUIREMENTS:</u>**

   a. **Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended?** Yes – USACE recommends training on matters involving Public Law 91-646 through the proponent agency of the Uniform Relocation Act, Federal Highway Administration. Online training is available at https://www.fhwa.dot.gov/real_estate/training/ and the International Right of Way Association (IRWA) also provides detailed courses on this topic. Non-Federal Sponsor's Guide to Real Estate Land Acquisition with additional information pertaining to USACE's requirements was provided to the Sponsor on April 12, 2018.

   b. **If the answer to 2(a) is "yes", has a reasonable plan been developed to provide such training?** Yes – USACE recommendations are detailed above in paragraph 2.(a)

   c. **Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?** Sponsor has indicated sufficient experience to acquire Real Estate but will require familiarization with the process required under the Uniform Relocation Act, Public Law 91-646, and 49 CFR Part 24.

   d. **Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule?** Yes

   e. **Can the sponsor obtain contractor support, if required, in a timely fashion?** Yes

f. **Will the sponsor likely request USACE assistance in acquiring real estate? (If "yes", provide description).** Not anticipated to be required. The Sponsor can acquire properties as it has done in the past, but Board of Commissioners must first authorize it.

3. **<u>OTHER PROJECT VARIABLES:</u>**

a. **Will the sponsor's staff be located within reasonable proximity to the project site?** Yes

b. **Has the sponsor approved the project/real estate schedule milestones *(answer is contingent upon whether the real estate milestones have been defined at this point in the project)*?** To be determined based on anticipated approvals, project approval, appropriation.

4. **OVERALL ASSESSMENT:**

a. **Has the sponsor performed satisfactorily on other USACE projects (if applicable)?** Yes – Mark Ave Project.

b. **With regard to this project, the sponsor is anticipated to be: Highly capable; Fully capable; Moderately capable; Marginally capable; Insufficiently capable. (If sponsor is believed to be insufficiently capable, please provide explanation).**

5. **COORDINATION:**

a. **Has this assessment been coordinated with the sponsor?** Yes

b. **Does the sponsor concur with this assessment?**

Accepted by Non-Federal Sponsor:

William J. Higgins **(Signature)**

DIVISION MANAGER STORMWATER **(Title)**

Prepared by:

_______________________ **(Signature)**
RUSSELL W. BLOUNT, III
SECTION CHIEF
TECHNICAL SERVICES BRANCH
REAL ESTATE DIVISION
U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT

Reviewed and Approved by:

_______________________ **(Signature)**
DERRICK D. MOTON
DEPUTY CHIEF
REAL ESTATE DIVISION
U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO ATTENTION OF:

USACE-SAM-RE

27 September 2017

Cobb County
Watershed Management
Attn: Mr. Bill Higgins
660 South Cobb Drive
Marietta GA 30060

Subject: Sweetwater Creek Flood Risk Management Study – Formal Risk Notification Letter to Non-Federal Sponsor

Dear Mr. Higgins,

The intent of this letter is to formally advise Cobb County, as non-Federal Sponsor for the proposed project, of the risks associated with land acquisition prior to the execution of a Project Partnership Agreement (PPA) or prior to the Government's formal notice to proceed with acquisition. If a Non-Federal Sponsor deems it necessary to commence acquisition prior to an executed PPA for whatever reason, the Non-Federal Sponsor assumes full and sole responsibility for any and all costs, responsibility, or liability arising out of the acquisition effort.

While we acknowledge that no land acquisition is expected for the subject project based on the latest engineering designs, we are still required by regulation to notify the non-Federal Sponsor of the inherent risks associated with a cost-shared projcct of this naturc.

Generally, these risks include, but may be not be limited to, the following:

(1) Congress may not appropriate funds to construct the proposed project;

(2) The proposed project may otherwise not be funded or approved for construction;

(3) A PPA mutually agreeable to the non-Federal sponsor and the Government may not be executed and implemented;

(4) The non-Federal sponsor may incur liability and expense by virtue of its ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws or regulations including liability arising out of CERCLA, as amended;

(5) The non-Federal sponsor may acquire interests or estates that are later determined by the Government to be inappropriate, insufficient, or otherwise not required for the project;

(6) The non-Federal sponsor may initially acquire insufficient or excessive real property acreage which may result in additional negotiations and/or benefit payments under P.L. 91-646 as well as the payment of additional fair market value to affected landowners which could have been avoided by delaying acquisition until after PPA execution and the Government's notice to commence acquisition and performance of Lands, Easements, Rights-of-way, Relocations, Disposal Areas and/or Borrow Areas (LERRD);

(7) The non-Federal sponsor may incur costs or expenses in connection with its decision to acquire or perform LERRD in advance of the executed PPA and the Government's notice to proceed which may not be creditable under the provisions of Public Law 99-662 or the PCA. Reference ER 405-1-12 (Change 31; 1 May 98) Section 12-31 Acquisition Prior to PCA Execution.

Please acknowledge that the Non-Federal Sponsor for the proposed project accepts these terms and conditions.

Accepted on behalf of the Non-Federal Sponsor:

William J. Higgins (Signature)

DIVISION MANAGER STORMWATER (Title)

Prepared by:

Russell W. Blount III
Section Chief
Technical Services Branch
Real Estate Division
Mobile District
U.S. Army Corps of Engineers

Exhibit E
Baseline Cost Estimate for Real Estate (BCERE)

Baseline Cost Estimate for Real Estate

Sweetwater Creek Flood Risk Management Study

Cobb County, Georgia

Exhibit F

	#	$/per	Req
0102------ ACQUISITIONS			
010201--- By Government			
010202--- By Non-Federal Sponsor (NFS)			
01020201 Survey and Legal Descriptions	9	500	4,500
01020102 Title Evidence	9	1,000	9,000
01020203 Negotiations	9	1,500	13,500
010203--- By Government on Behalf of NFS			
010204--- Review of NFS			
01020401 Survey and Legal Descriptions	9	300	2,700
01020402 Title Evidence	9	500	4,500
01020403 Negotiations	9	500	4,500
0103------ CONDEMNATIONS			
010301--- By Government			
010302--- By Non-Federal Sponsor (NFS)			
010303--- By Government on Behalf of NFS	4	15,000	60,000
010304--- Review of NFS	4	5,000	20,000
0105------ APPRAISALS			
010501--- By Government			
010502--- By Non-Federal Sponsor (NFS)			
010503--- By Government on Behalf of NFS	9	1,500	13,500
010504--- Review of NFS			
	9	500	4,500

0106------ PL 91-646 ASSISTANCE				
010601---	By Government			
010602---	By Non-Federal Sponsor (NFS)	9	10,000	90,000
010603---	By Government on Behalf of NFS			
010604---	Review of NFS	9	10,000	90,000
0107------ TEMPORARY PERMITS/LICENSES/RIGHTS-OF-WAY				
	SUBTOTAL			316700
	CONTINGENCY			79200
	TOTAL - ADMINISTRATIVE COSTS			395900

0115------ REAL ESTATE PAYMENTS			
011501--- Land Payments			
01150101	By Government		
01150102	By Non-Federal Sponsor (NFS)	9	1,533,000
01150103	By Government on Behalf of NFS		
01150104	Review of NFS (credit review)		20000
011502--- PL 91-646 Assistance Payments			
01150201	By Government		
01150202	By Non-Federal Sponsor (NFS)	9	481000
01150203	By Government on Behalf of NFS		
01150204	Review of NFS (credit review)		20000
011503--- Damage Payments			
01150301	By Government		
01150302	By Non-Federal Sponsor (NFS)		
01150303	By Government on Behalf of NFS		
01150304	Review of NFS		
	SUBTOTAL		2054000

CONTINGENCY	305100
TOTAL - REAL ESTATE PAYMENTS	2359100

Account 02 Facility/Utility Relocations (Construction	0

TOTAL LERRD **$2,755,000**

Exhibit F

Authorization for Entry for Construction and Attorney's Certification of Authority

AUTHORIZATION FOR ENTRY FOR CONSTRUCTION AND ATTORNEY'S CERTIFICATE OF AUTHORITY

I, *(name of accountable official)*, _____*(title)*_____________ for *(name of non-Federal sponsor)*___, do hereby certify that the *(name of non-Federal sponsor)* has acquired the real property interests required by the Department of the Army, and otherwise is vested with sufficient title and interest in lands to support construction of (*project name, specifically identified project features, etc.)* . Further, I hereby authorize the Department of the Army, its agents, employees and contractors, to enter upon *(identify tracts)* to construct *(project name, specifically identified project features, etc.)* as set forth in the plans and specifications held in the U. S. Army Corps Engineers' Mobile District Office, Mobile, Alabama.

WITNESS my signature as _____*(title)*__ for __*(name of non-Federal sponsor)* this ________ day of ________________, 20___.

BY: ______*(name)*_____________________________

______*(title)*_______________________________

I, ____*(name)*__________________ , ____*(title of legal officer)*____ for _(*name of non-Federal sponsor)*______, certify that __*(name of non-Federal sponsor)*_____ has authority to grant Authorization for Entry; that said Authorization for Entry is executed by the proper duly authorized officer; and that the Authorization for Entry is in sufficient form to grant the authorization therein stated.

WITNESS my signature as _________*(title)*_____ for ___*(name of non-Federal sponsor),* this _________day of_________________, 20___.

BY: ______*(name)*_____________________________

______*(title)*_______________________________

Sweetwater Creek
Flood Risk Management
Feasibility Study

Appendix E: Environmental

Cobb County...Expect the Best!

U.S. Army Corps of Engineers
South Atlantic Division
Mobile District

US Army Corps
of Engineers ®
MOBILE DISTRICT

APPENDIX E: Environmental

Section 1: Cobb County Stream Monitoring Data

Section 2: Final Rule for Revised List of Migratory Birds

Section 3: USFWS National Bald Eagle Management Guidelines

Section 4: Phase I Environmental Site Assessment for Sweetwater Creek Feasibility Study, Douglas, Paulding, and Cobb Counties, Georgia

Section 1: Cobb County Stream Monitoring Data

Cobb County Stream Monitoring Program

SWEETWATER CREEK

Date	Time	Site	Sample Bottle #	BOD Bottle #	D.O. Bottle #	Sample Temp. °C	D.O mg/L	pH S.U.	BOD mg/L	COD mg/L	TSS mg/L	Fecal Col col/100 mL	Conduct. µmho/cm	Turbidity NTU	T.Phos mg/L	TKN mg/L	NOx mg/L	CaTotal mg/L	MgTotal mg/L	KTotal mg/L	NaTotal mg/L	BTotal ug/L	AlTotal ug/L	BaTotal ug/L	FeTotal ug/L	MnTotal ug/L	CdTotal ug/L	CuTotal ug/L	PbTotal ug/L	ZnTotal ug/L	Hardness mg/L	Air Temp °C
1/21/2015	9:25	SW1	4	2	108	7.0	10.44	7.06	<2.0	<20	3.2	50	70.7	10.1	0.01	<0.50	0.46	5.80	2.10	1.44	5.10	NA	574	20.2	1654	224	<5.00	<5.00	<5.00	<10.0	23.1	
	9:45	SW2	31	491	114	7.0	10.84	7.06	<2.0	<20	3.8	150	69.3	10.5	0.02	<0.50	0.41	5.63	2.06	1.46	4.85	NA	540	19.2	1592	222	<5.00	<5.00	<5.00	<10.0	22.5	
	10:05	SW3	37	518	116	7.0	10.85	7.05	<2.0	<20	3.8	100	69.5	9.3	0.01	<0.50	0.38	5.83	2.05	1.41	4.62	NA	460	20.6	1540	231	<5.00	<5.00	<5.00	<10.0	23.0	
	10:25	SW4	48	756	118	7.0	10.70	7.07	<2.0	<20	3.2	50	71.6	9.2	0.01	<0.50	0.40	6.04	2.12	1.45	4.86	NA	449	20.9	1537	228	<5.00	<5.00	<5.00	<10.0	23.8	
	10:40	SW5	58	805	122	7.0	10.59	7.09	<2.0	<20	2.6	50	74.3	8.9	0.01	<0.50	0.37	6.33	2.15	1.46	4.74	NA	394	22.2	1387	225	<5.00	<5.00	<5.00	<10.0	24.7	
	11:00	SW6	65	806	123	7.0	11.00	7.10	<2.0	<20	2.2	150	76.1	8.9	0.01	<0.50	0.38	6.60	2.20	1.53	4.77	NA	368	22.7	1360	210	<5.00	<5.00	<5.00	<10.0	25.5	
5/6/2015	9:10	SW1	16	115	103	17.5	8.67	7.25	<2.0	<20	9.2	<50	79.9	14.0	0.02	<0.50	0.41	6.09	2.28	1.21	5.52	NA	565	19.8	2186	230	<5.00	<5.00	<5.00	<10.0	24.6	
	9:30	SW2	31	508	108	18.0	8.03	7.26	<2.0	<20	6.2	50	73.9	12.1	0.02	<0.50	0.36	5.76	2.12	1.18	5.06	NA	416	17.9	1954	219	<5.00	<5.00	<5.00	<10.0	23.1	
	9:50	SW3	37	512	107	18.0	8.12	7.23	<2.0	<20	7.6	200	75.6	12.5	0.02	<0.50	0.35	6.07	2.21	1.22	5.1	NA	438	20.4	1960	237	<5.00	<5.00	<5.00	<10.0	24.3	
	10:10	SW4	39	611	110	18.0	8.01	7.29	<2.0	<20	8.2	<50	76.7	13.4	0.02	<0.50	0.37	6.23	2.20	1.25	5.27	NA	390	20.5	1932	227	<5.00	<5.00	<5.00	<10.0	24.6	
	10:30	SW5	48	775	112	17.5	8.29	7.29	<2.0	<20	7.2	50	81.4	11.9	0.02	0.62	0.36	6.64	2.33	1.33	5.35	NA	374	22.4	1812	223	<5.00	<5.00	<5.00	<10.0	26.2	
	10:50	SW6	65	815	123	17.5	8.25	7.30	<2.0	<20	11.8	100	79.6	11.4	0.02	<0.50	0.38	6.83	2.33	1.41	5.41	NA	439	23.2	1846	209	<5.00	<5.00	<5.00	<10.0	26.6	
8/27/2015	9:05	SW1	4	77	103	22.5	6.87	7.27	<2.0	<20	4.0	<100	95.1	10.0	0.02	<0.50	0.39	6.60	2.36	1.80	7.79	NA	358	20.3	1294	181	<5.00	<5.00	<5.00	<10.0	26.2	
	9:25	SW2	8	253	108	22.0	6.55	7.45	<2.0	<20	3.8	<100	92.2	8.6	0.02	<0.50	0.30	7.04	2.41	1.96	7.71	NA	354	19.8	1409	179	<5.00	<5.00	<5.00	<10.0	27.5	
	9:50	SW3	40	411	110	22.0	6.76	7.31	<2.0	<20	4.1	100	87.1	8.8	0.02	<0.50	0.20	6.67	2.19	1.84	6.60	NA	414	20.7	1443	236	<5.00	<5.00	<5.00	<10.0	25.7	
	10:15	SW4	49	619	113	22.0	6.92	7.29	<2.0	<20	6.5	2000	88.0	9.0	0.02	<0.50	0.22	6.95	2.31	1.92	6.83	NA	486	22.2	1515	298	<5.00	<5.00	<5.00	<10.0	26.9	
	10:35	SW5	46	762	114	22.0	6.61	7.29	<2.0	<20	3.8	800	87.2	7.7	0.02	<0.50	0.21	7.10	2.29	2.00	6.36	NA	306	21.9	1240	252	<5.00	<5.00	<5.00	<10.0	27.2	
	10:55	SW6	78	921	119	22.0	6.65	7.32	<2.0	<20	2.6	300	86.4	6.9	0.02	<0.50	0.22	6.95	2.26	1.97	6.08	NA	264	20.9	1121	235	<5.00	<5.00	<5.00	<10.0	26.7	
12/7/2015	9:40	SW1	17	24	103	9.1	9.69	6.96	<2.0	<20	4.7	100	77.4	9.7	0.01	<0.50	0.42	6.01	2.09	1.46	5.70	NA	195	17.93	1779	188	<5.00	<5.00	<5.00	<10	23.6	
	10:00	SW2	25	32	107	9.3	10.18	7.01	<2.0	<20	4.5	100	78.0	9.7	0.01	<0.50	0.41	6.43	2.14	1.62	5.98	NA	133	18.78	1796	211	<5.00	<5.00	<5.00	<10	24.9	
	10:20	SW3	27	35	110	9.3	10.47	7.07	<2.0	<20	4.8	50	78.0	9.1	0.01	<0.50	0.37	6.09	2.03	1.44	5.18	NA	106	18.72	1590	206	<5.00	<5.00	<5.00	<10	23.6	
	10:40	SW4	30	100	119	9.5	10.39	6.98	<2.0	<20	4.7	100	79.5	9.1	0.01	<0.50	0.38	6.25	2.04	1.48	5.39	NA	106	18.96	1625	200	<5.00	<5.00	<5.00	<10	24.0	
	10:55	SW5	31	602	120	9.9	10.14	7.05	<2.0	<20	4.3	150	84.3	7.7	0.01	<0.50	0.35	7.17	2.28	1.66	5.77	NA	98.1	22.45	1609	226	<5.00	<5.00	<5.00	<10	27.3	
	11:15	SW6	65	604	122	9.6	10.29	6.98	<2.0	<20	4.1	100	82.8	8.6	0.01	<0.50	0.36	7.08	2.19	1.65	5.57	NA	133	21.94	1548	199	<5.00	<5.00	<5.00	<10	26.7	
4/11/2016	9:45	SW1	8	108	9	12.7	9.86	6.94	<2.0	<20	3.7	100	73.8	8.2	0.013	<0.50	0.37	6.17	2.32	1.15	5.09	NA	321	16.2	1582	156	<5.00	<5.00	<5.00	<5.00	25.0	
	10:05	SW2	32	98	110	13.4	9.77	7.01	<2.0	<20	5.6	<100	72.6	7.8	0.012	<0.50	0.39	6.29	2.31	1.26	5.51	NA	256	15.6	1523	159	<5.00	<5.00	<5.00	<5.00	25.2	
	10:25	SW3	40	158	116	12.9	9.67	6.99	<2.0	<20	4.4	<100	73.9	7.5	0.011	<0.50	0.33	6.44	2.34	1.25	5.37	NA	322	17.8	1493	168	<5.00	<5.00	<5.00	<5.00	25.7	
	10:45	SW4	46	500	118	13.9	9.38	6.99	<2.0	<20	3.9	<100	74.6	7.9	0.012	<0.50	0.33	6.52	2.32	1.24	5.24	NA	255	17.5	1434	159	<5.00	<5.00	<5.00	<5.00	25.8	
	11:10	SW5	49	506	119	12.9	9.33	7.04	<2.0	<20	3.6	<100	44.4	6.3	0.011	<0.50	0.32	6.86	2.41	1.30	5.18	NA	254	19.5	1351	158	<5.00	<5.00	<5.00	<5.00	27.1	
	11:30	SW6	78	700	121	13.1	9.18	7.02	<2.0	<20	4.1	<100	78.7	6.3	0.012	<0.50	0.34	7.04	2.47	1.37	5.21	NA	265	20.2	1330	150	<5.00	<5.00	<5.00	<5.00	27.8	
8/17/2016	9:10	SW1	12	289	289	26.4	5.58	7.14	<2.0	<20	6.0	200	166.8	6.2	0.026	*	1.28	10.8	3.22	3.22	15.5	NA	488	33.0	804	261	<5.00	<5.00	<5.00	<5.00	40.2	24.5
	9:30	SW2	14	290	166	25.8	5.92	7.25	<2.0	<20	5.2	100	151.6	5.6	0.022	*	0.82	9.90	3.13	2.78	13.7	NA	445	30.1	840	287	<5.00	<5.00	<5.00	<5.00	37.6	24.5
	9:50	SW3	15	400	291	26.2	5.43	7.20	<2.0	<20	9.0	600	126.8	8.7	0.011	*	0.39	9.34	2.91	2.3	10.3	NA	719	30.3	1342	420	<5.00	<5.00	<5.00	<5.00	35.3	25
	10:10	SW4	46	433	292	27.3	5.56	7.19	<2.0	<20	5.7	100	130.0	6.8	0.022	*	0.39	9.88	2.98	2.37	10.8	NA	302	32.6	1049	583	<5.00	<5.00	<5.00	<5.00	36.9	28
	10:30	SW5	56	750	293	26.1	5.40	7.25	<2.0	<20	10	200	114.3	9.3	0.022	*	0.32	9.49	2.78	2.38	8.77	NA	731	33.6	1442	471	<5.00	<5.00	<5.00	<5.00	35.1	27
	10:50	SW6	70	783	294	26.8	5.86	7.26	<2.0	<20	4.2	400	116.0	7.8	0.025	*	0.25	9.62	2.86	2.26	8.81	NA	302	30.0	1144	444	<5.00	<5.00	<5.00	<5.00	35.8	27.5
1/11/2017	9:20	SW1	16	28	289	6.6	13.21	7.10	<2.0	<20	3.6	100	86.1	9.7	0.004	<0.50	0.69	6.37	2.06	1.84	7.80	NA	571	23.9	1323	219	<5.00	<5.00	<5.00	5.26	24.3	12
	9:40	SW2	17	745	290	7.5	12.27	7.24	<2.0	<20	3.2	200	82.8	9.8	0.023	<0.50	0.61	6.09	1.95	1.88	7.38	NA	514	23.0	1320	204	<5.00	<5.00	<5.00	<5.00	23.1	13.5
	10:00	SW3	32	791	296	6.7	12.53	7.07	<2.0	<20	3.2	100	85.4	10.1	0.017	<0.50	0.53	6.52	1.99	1.89	7.39	NA	316	24.2	1286	214	<5.00	<5.00	<5.00	<5.00	24.4	12
	10:20	SW4	56	815	299	7.6	13.35	7.29	<2.0	<20	2.4	50	85.6	9.1	0.022	<0.50	0.56	6.53	2.00	1.90	7.46	NA	347	24.1	1304	202	<5.00	<5.00	<5.00	<5.00	24.4	15
	10:40	SW5	70	817	302	7.8	13.34	7.18	<2.0	<20	3.6	100	89.3	9.2	0.018	<0.50	0.43	7.17	2.17	2.03	7.73	NA	472	26.1	1303	211	<5.00	<5.00	<5.00	<5.00	26.7	14
	11:00	SW6	78	851	303	9.1	13.51	7.22	<2.0	<20	3.2	100	90.8	8.9	0.014	<0.50	0.47	7.30	2.15	2.06	7.73	NA	406	26.2	1240	191	<5.00	<5.00	<5.00	<5.00	27.0	14.5
3/21/2017	9:05	SW1	7	11	80	14.3	9.62	7.00	<2.0	<20	6.4	<100	79.8	9.6	0.016	<0.50	0.48	3.87	1.69	1.73	3.79	NA	106	31.9	1039	88.5	<5.00	<5.00	<5.00	8.3	16.6	15.5
	9:25	SW2	10	28	289	14.9	9.09	6.97	<2.0	<20	6.5	100	77.8	9.6	0.017	<0.50	0.41	4.96	2.04	1.80	4.23	NA	96.3	28.7	930	85.2	<5.00	<5.00	<5.00	6.7	20.7	17.5
	9:45	SW3	14	33	295	14.3	9.06	7.03	<2.0	<20	5.9	<100	77.9	8.4	0.015	<0.50	0.35	5.04	2.05	1.81	4.29	NA	51.8	28.1	936	87.3	<5.00	<5.00	<5.00	5.3	20.9	16
	10:05	SW4	20	67	297	14.5	9.14	6.90	<2.0	<20	6.3	100	80.2	8.8	0.015	<0.50	0.37	5.07	2.04	1.81	4.28	NA	62.3	28.0	1057	100	<5.00	<5.00	<5.00	5.1	21.0	20
	10:25	SW5	30	89	302	14.3	9.21	6.98	<2.0	<20	5.3	100	82.5	7.6	0.016	<0.50	0.34	5.74	2.30	1.43	6.08	NA	367	16.8	1880	212	<5.00	<5.00	<5.00	<5.00	23.7	18.5
	10:45	SW6	99	131	303	14.1	9.21	7.00	<2.0	<20	3.8	100	83.6	8.1	0.017	<0.50	0.35	5.65	2.24	1.52	6.34	NA	356	17.6	1914	212	<5.00	<5.00	<5.00	<5.00	23.2	21

Stream Site Location and Coordinates

Sweetwater Creek	SW1	Brownsville Rd	33.8272405530	-84.7198635604
Sweetwater Creek	SW2	Holloman Rd	33.8161770074	-84.6935604594
Sweetwater Creek	SW3	Westside Rd	33.8184445360	-84.6590402991
Sweetwater Creek	SW4	Austell-Powder Springs Rd	33.8184224304	-84.6411089991
Sweetwater Creek	SW5	Perkenson Mill Rd	33.8232854865	-84.6255281958
Sweetwater Creek	SW6	Old Alabama Rd	33.8010564788	-84.6215224552

Chattahoochee Basin - Buttermilk Creek

Buttermilk Creek
Collins Industrial Blvd.
January 29, 2016

Order	Family	Genus	Common Name	(No. of Individuals)
Coleoptera	Elmidae	Ancryonyx (larvae)	Riffle Beetle	2
	Elmidae	Microcylloepus (larvae)	Riffle Beetle	2
Diptera	Chironomidae		Midge	95
	Empididae	Chelifera	Aquatic Dance Fly	1
	Empididae	Hemerodromia	Aquatic Dance Fly	1
	Limoniidae	Antocha	True Fly	16
	Simuliidae	Simulium	Black Fly	46
	Tipulidae	Tipula	Crane Fly	5
Ephemeroptera	Heptageniidae	Stenonema	Flatheaded Mayfly	19
Odonata	Coengrionidae	Argia	Narrowwinged Damselfly	2
	Gomphidae	Progomphus	Dragonfly (Clubtails)	1
Trichoptera	Hydropsychidae	Cheumatopsyche	Common Netspinner Caddisfly	15
	Hydropsychidae	Hydrospyche	Common Netspinner Caddisfly	2
	Leptoceridae	Ocetis	Longhorned Case Maker Caddisfly	1
	Leptoceridae	Triaenodes	Longhorned Case Maker Caddisfly	1
	Philopotamidae	Chimarra	Fingernet Caddisfly	2
	Rhyacophilidae	Rhycophila	Free living Caddisfly	1
			Total:	212

Chattahoochee Basin - Noses Creek

Order	Family	Genus	Common Name	Noses Creek Irwin Road February 1, 2016 (No. of Individuals)	Noses Creek Macedonia Road February 15, 2016 (No. of Individuals)
Coleoptera	Elmidae	Ancryonyx	Riffle Beetle	1	
	Elmidae	Dubiraphia	Riffle Beetle		2
	Elmidae	Macronychus	Riffle Beetle	2	4
	Dytiscidae	Unknown	Predacious Diving Beetle		1
Diptera	Chironomidae		Midge	64	113
	Empididae	Chelifera	Aquatic Dance Fly		8
	Tipulidae	Tipula	Crane Fly	4	
	Simuliidae	Simulium	Black Fly	48	27
		Unknown			1
Ephemeroptera	Baetidae	Baetis	Mayfly		4
	Caenidae	Caenis	Small Squaregills Mayfly		1
	Ephemeridae	Hexagenia	Burrowing Mayfly		1
	Heptageniidae	Stenonema	Mayfly	63	30
Odonata	Coengrionidae	Argia	Narrowwinged Damselfly	2	
	Aeshnidae	Boyeria	Dragonfly	2	
	Gomphidae	Progomphus	Dragonfly (Clubtails)	2	1
Trichoptera	Hydropsychidae	Cheumatopsyche	Caddis Fly (net spinner)	5	7
	Hydropsychidae	Hydropsyche	Caddis Fly (net spinner)		1
	Philopotamidae	Chimarra	Caddis Fly	11	
	Leptoceridae	Triaenodes	Longhorned Case Maker Caddisfly	2	
	Rhyacophilidae	Rhyacophila	Free living Caddisfly	1	
Plecoptera	Perlidae	Acroneuria	Common Stonefly	1	

Total:	208	201

Chattahoochee Basin - Olley Creek

Olley Creek
Clay Road
February 12, 2016

Order	Family	Genus	Common Name	(No. of Individuals)
Coleoptera	Elmidae	Ancryonyx (larvae)	Riffle Beetle	3
Diptera	Chironomidae		Midge	103
	Empididae	Chelifera	Aquatic Dance Fly	1
	Simuliidae	Simulium	Black Fly	18
	Tipulidae	Tipula	Crane Fly	8
Ephemeroptera	Baetidae	Baetis	Mayfly	5
	Caenidae	Caenis	Small Squaregills Mayfly	1
	Heptageniidae	Stenonema	Flatheaded Mayfly	35
Odonata	Aeshnidae	Boyeria	Dragonfly (Darners)	2
	Gomphidae	Progomphus	Dragonfly (Clubtails)	10
Trichoptera	Hydropsychidae	Cheumatopsyche	Common Netspinner Caddisfly	9
	Hydropsychidae	Hydropsychidae	Common Netspinner Caddisfly	3
	Leptoceridae	Ocetis	Longhorned Case Maker Caddisfly	1
	Leptoceridae	Triaenodes	Longhorned Case Maker Caddisfly	1
	Rhyacophilidae	Rhyacophila	Free living Caddisfly	1
			Total:	201

Chattahoochee Basin - Powder Springs Creek

Powder Springs Creek
Elliott Road
February 11, 2016

Order	Family	Genus	Common Name	(No. of Individuals)
Coleoptera	Elmidae	Macronychus (larvae)	Riffle Beetle	3
Diptera	Chironomidae		Midge	118
	Empididae	Chelifera	Aquatic Dancing Fly	3
	Empididae	Hemerodromia	Aquatic Dancing Fly	1
	Simuliidae	Simulium	Black Fly	12
	Tipulidae	Tipula	Crane Fly	1
Ephemeroptera	Baetidae	Baetis	Small Minnow Mayfly	7
	Caenidae	Caenis	Small Squaregills Mayfly	1
	Heptageniidae	Stenonema	Flatheaded Mayfly	38
Odonata	Aeshnidae	Boyeria	Dragonfly (Darners)	
	Coengrionidae	Argia	Narrowwinged Damselfly	
	Coengrionidae	Enallagma	Narrowwinged Damselfly	
	Gomphidae	Progomphus	Dragonfly (Clubtails)	
Trichoptera	Hydropsychidae	Cheumatopsyche	Common Netspinner Caddisfly	8
	Leptoceridae	Triaenodes	Longhorned Case Maker Caddisfly	1
	Rhyacophilidae	Rhyacophila	Free living Caddisfly	2
Plecoptera	Perlodidae	Unknown		1
			Total:	196

Common Name	Scientific Name	Total Number	BM3	NC4	NS2	NS4	OL5	PS1	WR1
			(Chattahoochee Basin - Cobb County, Georgia)						
Snail Bullhead	Amerius brunneus	55	5	41	3	4	1	1	
Yellow Bullhead	Amerius natalis	15	1	4	2	3	2	3	
Brown Bullhead	Amerius nebulosus	1	1						
Bluefin Stoneroller	Campostoma pauciradii	75	30	18					27
White Sucker	Catostomus commersoni	2		2					
Red Shiner	Cyprinella lutrensis*	11		11					
Blacktail Shiner	Cyprinella venusta	4		4					
Southern Studfish	Fundulus stellifer	7		2	3	1	1		
Mosquitofish	Gambusia sp.	5					5		
Alabama Hog Sucker	Hypentelium etowanum	117	19	89	4	2	2	1	
Redbreast Sunfish	Lepomis auritus	322	69	124	9	29	42	49	
Green Sunfish	Lepomis cyanellus*	69	12	3	13	19	5	17	
Warmouth Sunfish	Lepomis gulosus	5			1		3	1	
Bluegill Sunfish	Lepomis macrochirus	183	5	40	32	28	25	53	
Redear Sunfish	Lepomis microlophus	4				2		2	
Spotted Sunfish	Lepomis punctatus	14			5		1	8	
Bandfin Shiner	Luxilus zonistius	39	39						
Redeye Bass	Micropterus coosae	6		2		2	2		
Largemouth Bass	Micropterus salmoides	9			2	4	1	2	
Asian Swamp Eel	Monopterus albus*	5					5		
Bluehead Chub	Nocomis leptocephalus	170	91	4	3	17	11	18	26
Golden Shiner	Notemigonus crysoleucus	6	4		2				
Spottail Shiner	Notropis hudsonius	36		30		6			
Longnose Shiner	Notropis longirostris	8			1	2	1	4	
Speckled Madtom	Noturus leptacanthus	2						2	
Blackbanded Darter	Percina nigrofasciata	368	45	187	21	42	32	41	
Black Crappie	Pomoxis nigromaculatus	1	1						
Creek Chub	Semotilus atromaculatus	89	4		3				82
		Total	326	561	104	161	139	202	135
	Total Number of Fish Collected During 2016:	1628							
Total Species Richness		28	14	15	15	14	16	14	3

Native Species	25	13	13	14	13	14	13	3

BM3	Buttermilk Creek @ Collins Industrial Boulevard	6/16/2016
NC4	Nickajack Creek @ Cooper Lake Road	6/20/2016
NS2	Noses Creek @ Irwin Road	6/14/2016
NS4	Noses Creek @ Macedonia Road	6/21/2016
OL5	Olley Creek @ Clay Road	6/16/2016
PS1	Powder Springs Creek @ Elliott Road	6/13/2016
WR1	Ward Creek @ Highland Avenue	6/14/2016

*introduced species

Abundance Rank
9th
12th
27th
7th
25th
14th
23rd
17th
20th
5th
2nd
8th
20th
3rd
23rd
13th
10th
18th
15th
20th
4th
18th
11th
16th
25th
1st
27th
6th

Section 2: Final Rule for Revised List of Migratory Birds

FEDERAL REGISTER

Vol. 78 Friday,

No. 212 November 1, 2013

Part III

Department of the Interior

Fish and Wildlife Service

50 CFR Parts 10 and 21

General Provisions; Revised List of Migratory Birds; Final Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Parts 10 and 21

[Docket No. FWS–R9–MB–2010–0088, FF09M21200–134–FXMB1231099BPP0]

RIN 1018–AX48

General Provisions; Revised List of Migratory Birds

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service, revise the List of Migratory Birds by both adding and removing species. Reasons for the changes to the list include adding species based on new taxonomy and new evidence of occurrence in the United States or U.S. territories, removing species no longer known to occur within the United States, and changing names to conform to accepted use. The net increase of 19 species (23 added and 4 removed) brings the total number of species protected by the Migratory Bird Treaty Act (MBTA) to 1,026. We regulate most aspects of the taking, possession, transportation, sale, purchase, barter, exportation, and importation of migratory birds. An accurate and up-to-date list of species protected by the MBTA is essential for public notification and regulatory purposes.

DATES: This rule is effective December 2, 2013.

FOR FURTHER INFORMATION CONTACT: George Allen at 703–358–1825.

SUPPLEMENTARY INFORMATION:

Background

What statutory authority does the service have for this rulemaking?

We have statutory authority and responsibility for enforcing the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703–712), the Fish and Wildlife Improvement Act of 1978 (16 U.S.C. 742l), and the Fish and Wildlife Act of 1956 (16 U.S.C. 742a–j). The MBTA implements Conventions between the United States and four neighboring countries for the protection of migratory birds, as follows:

(1) Canada: Convention between the United States and Great Britain [on behalf of Canada] for the Protection of Migratory Birds, August 16, 1916, 39 Stat. 1702 (T.S. No. 628);

(2) Mexico: Convention between the United States and Mexico for the Protection of Migratory Birds and Game Mammals, February 7, 1936, 50 Stat. 1311 (T.S. No. 912);

(3) Japan: Convention between the Government of the United States of America and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction, and Their Environment, March 4, 1972, 25 U.S.T. 3329 (T.I.A.S. No. 7990); and

(4) Russia: Convention between the United States of America and the Union of Soviet Socialist Republics Concerning the Conservation of Migratory Birds and Their Environment (Russia), November 19, 1976, 29 U.S.T. 4647 (T.I.A.S. No. 9073).

What is the purpose of this rulemaking?

Our purpose is to inform the public of the species protected by the MBTA and its implementing regulations. These regulations are found in Title 50, Code of Federal Regulations (CFR), Parts 10, 20, and 21. We regulate most aspects of the taking, possession, transportation, sale, purchase, barter, exportation, and importation of migratory birds. An accurate and up-to-date list of species protected by the MBTA is essential for regulatory purposes.

Why is this amendment of the list of migratory birds necessary?

The amendment is needed to: (1) Add five species previously overlooked from a family protected under the MBTA; (2) correct the spelling of six species on the alphabetized list; (3) correct the spelling of three species on the taxonomic list; (4) add 11 species based on new distributional records documenting their natural occurrence in the United States since April 2007; (5) add one species from a family now protected under the MBTA as a result of taxonomic changes; (6) add six species newly recognized as a result of recent taxonomic changes; (7) remove four species not known to occur within the boundaries of the United States or its territories as a result of recent taxonomic changes; (8) change the common (English) names of nine species to conform with accepted use; and (9) change the scientific names of 36 species to conform to accepted use.

The List of Migratory Birds (50 CFR 10.13) was last revised on March 1, 2010 (75 FR 9282). These amendments were necessitated by three published supplements to the 7th (1998) edition of the American Ornithologists' Union's (AOU's) *Check-list of North American birds* (AOU 2008, AOU 2009, and AOU 2010).

In addition, we correct the legal authorities citations at 50 CFR 10.13(a).

We also make a small change to a definition in 50 CFR 21.3. We update the definition of ''raptor'' to also include the Order Accipitriformes, corresponding to recent taxonomic changes reflected in the List of Migratory Birds.

What scientific authorities are used to amend the list of migratory birds?

Although bird names (common and scientific) are relatively stable, staying current with standardized use is necessary to avoid confusion in communications. In making our determinations, we primarily relied on the American Ornithologists' Union's *Check-list of North American birds* (AOU 1998), as amended (AOU 1999, 2000, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, and 2010), on matters of taxonomy, nomenclature, and the sequence of species and other higher taxonomic categories (orders, families, subfamilies) for species that occur in North America. The AOU Checklist contains all bird species that have occurred in North America from the Arctic through Panama, including the West Indies and the Hawaiian Islands, and includes distributional information for each species, which specifies whether the species is known to occur in the United States. For the 39 species that occur outside the geographic area covered by the *Check-list* (28 that occur in the Pacific island territories and 11 listed in the Japanese and/or Russian conventions that have not occurred in the AOU area), we relied primarily on Clements (2007). Although we primarily rely on the above checklists, when informed taxonomic opinion is inconsistent or controversial, we evaluate available published and unpublished information and come to our own conclusion regarding the validity of taxa.

What criteria are used to identify individual species protected by the MBTA?

A species qualifies for protection under the MBTA by meeting one or more of the following four criteria:

(1) It is covered by the Canadian Convention of 1916, as amended in 1996, by virtue of meeting the following three criteria: (a) It belongs to a family or group of species named in the Canadian Convention, as amended; (b) specimens, photographs, videotape recordings, or audiotape recordings provide convincing evidence of natural occurrence in the United States or its territories; and (c) the documentation of such records has been recognized by the AOU or other competent scientific authorities.

(2) It is covered by the Mexican Convention of 1936, as amended in

1972, by virtue of meeting the following three criteria: (a) It belongs to a family or group of species named in the Mexican Convention, as amended; (b) specimens, photographs, videotape recordings, or audiotape recordings provide convincing evidence of natural occurrence in the United States or its territories; and (c) the documentation of such records has been recognized by the AOU or other competent scientific authorities.

(3) It is listed in the annex to the Japanese Convention of 1972, as amended.

(4) It is listed in the appendix to the Russian Convention of 1976.

In accordance with the Migratory Bird Treaty Reform Act of 2004 (MBTRA) (Pub. L. 108–447, 118 Stat. 2809, 3071–72), we include all species native to the United States or its territories, which are those that occur as a result of natural biological or ecological processes (see 70 FR 12710, March 15, 2005). We do not include nonnative species whose occurrences in the United States are solely the result of intentional or unintentional human-assisted introduction(s).

How do the changes affect the list of migratory birds?

Several taxonomic changes were made at the Order and Family level by the AOU since our 2010 publication of the list (75 FR 9282, March 1, 2010). These changes affect the inclusion and taxonomic order of species on this list. Specifically, the Orders Phaethontiformes and Suliformes were split from the Pelecaniformes. Phaethontiformes now includes the Family Phaethontidae (tropicbirds); Suliformes now includes the Families Fregatidae (frigatebirds), Sulidae (boobys), Phalacrocoracidae (cormorants), and Anhingidae (anhingas). In addition, the Order Accipitriformes was split from the Falconiformes and now include the Families Cathartidae (vultures), Pandionidae (Osprey), and Accipitridae (hawks and eagles). At the Family level, the Ardeidae (herons and egrets) and Threskiornithidae (ibis and spoonbills) were moved from the Ciconiiformes to the Pelecaniformes Order, the Pandionidae (Osprey) was split from the Accipitridae (hawks and eagles), and the Stercorariidae (jaegers and skuas) was split from the Laridae (gulls, terns, and skimmers). The Polioptilidae (gnatcatchers), Phylloscopidae (*Phylloscopus* warblers), Acrocephalidae (*Acrocephalus* warblers), and Megaluridae (*Locustella* warblers) were split from the Sylviidae, and the Calcariidae (longspurs and snow buntings) was split from the Emberizidae (buntings and sparrows). The euphonias were put into their own Subfamily (Euphoniinae) and moved from the Thraupidae to the Fringillidae Family. All species within these newly created Families continue to be protected under the MBTA. In addition, the Wrentit was moved from the Timaliidae (babblers) to the Sylviidae and is now in a Family protected by the MBTA.

The amendments (23 additions, 4 removals, and 54 name changes) affect a grand total of 79 species and result in a net addition of 19 species to the List of Migratory Birds, increasing the species total from 1,007 to 1,026. Of the 23 species that we add to the list, 6 were previously covered under the MBTA as subspecies of listed species. These amendments can be logically arranged in the following 9 categories:

(1) Add five species from the family Muscicapidae, a family specifically listed in the 1996 protocol amending the 1916 convention with Canada. The omission of these species on the previous list was an oversight. All are considered accidental or casual in Alaska. The species and relevant AOU publication(s) are:

Mugimaki Flycatcher, *Ficedula mugimaki* (AOU 1987, 1997, 1998);

Taiga Flycatcher, *Ficedula albicilla* (AOU 1982, 1983, 1998, 2006);

Dark-sided Flycatcher, *Muscicapa sibirica* (AOU 1982, 1983, 1998, 2004);

Asian Brown Flycatcher, *Muscicapa dauurica* (AOU 1987, 1989, 1998); and

Spotted Flycatcher, *Muscicapa striata* (AOU 2004).

(2) Correct the spelling of six scientific names on the alphabetized list:

Nesofregata fuliginosa (Polynesian Storm-Petrel), becomes *Nesofregetta fuliginosa;*

Thalleseus maximus (Royal Tern), becomes *Thalasseus maximus;*

Thalleseus sandvicensis (Sandwich Tern), becomes *Thalasseus sandvicensis;*

Vireo atricapillus (Black-capped Vireo), becomes *Vireo atricapilla;*

Phylloscopus siilatrix (Wood Warbler), becomes *Phylloscopus sibilatrix;* and

Locustella lanceoloata (Lanceolated Warbler), becomes *Locustella lanceolata.*

(3) Correct the spelling of three scientific names on the taxonomic list:

Nesofregetta fuiginosa (Polynesian Storm-Petrel), becomes *Nesofregetta fuliginosa;*

Vireo atricapillus (Black-capped Vireo), becomes *Vireo atricapilla;* and

Tiaris olivacea (Yellow-faced Grassquit), becomes *Tiaris olivaceus.*

(4) Add 11 species based on review and acceptance by AOU (since April 2007) of new distributional records documenting their occurrence in the United States, Puerto Rico, or the U.S. Virgin Islands. These species belong to families covered by the Canadian and/or Mexican Conventions, and all are considered to be of accidental or casual occurrence. For each species, we list the State in which it has been recorded plus the relevant publication:

Parkinson's Petrel, *Procellaria parkinsoni*—California (AOU 2008);

Swinhoe's Storm-Petrel, *Oceanodroma monorhis*—North Carolina (AOU 2010);

Swallow-tailed Gull, *Creagrus furcatus*—California (AOU 2008);

Brown Hawk-Owl, *Ninox scutulata*—Alaska (AOU 2009);

White-crested Elaenia, *Elaenia albiceps*—Texas (AOU 2010);

Crowned Slaty Flycatcher, *Empidonomus aurantioatrocristatus*—Louisiana (AOU 2010);

Sinaloa Wren, *Thryothorus sinaloa*—Arizona (AOU 2010);

Pallas's Leaf-Warbler, *Phylloscopus proregulus*—Alaska (AOU 2008);

Sedge Warbler, *Acrocephalus schoenobaenus*—Alaska (AOU 2009);

Rufous-tailed Robin, *Luscinia sibilans*—Alaska (AOU 2010); and

Yellow-browed Bunting, *Emberiza chrysophrys*—Alaska (AOU 2009).

(5) Add one species because of recent taxonomic changes transferring a species in a family formerly not protected by the MBTA (Timaliidae) into a family protected under the MBTA (Sylviidae). We reference the AOU publication supporting the change:

Wrentit, *Chamaea fasciata* (AOU 2010).

(6) Add six species because of recent taxonomic changes in which taxa formerly treated as subspecies have been determined to be distinct species. Given that each of these species was formerly treated as subspecies of a listed species, these additions will not change the protective status of any of these taxa, only the names by which they are known. In each case, we reference the AOU publication supporting the change:

Eastern Spot-billed Duck, *Anas zonorhyncha*—formerly considered a subspecies of *Anas poecilorhyncha,* Spot-billed Duck (AOU 2008);

Black Scoter, *Melanitta americana*—formerly treated as a subspecies of *Melanitta nigra,* Common [Black] Scoter (AOU 2009);

Mexican Whip-poor-will, *Caprimulgus arizonae*—formerly treated as a subspecies of *Caprimulgus vociferus,* Whip-poor-will (AOU 2010);

Pacific Wren, *Troglodytes pacificus*—formerly treated as a subspecies of

Troglodytes troglodytes, Eurasian [Winter] Wren (AOU 2010);

Winter Wren, *Troglodytes hiemalis*—formerly treated as a subspecies of *Troglodytes troglodytes,* Eurasian [Winter] Wren (AOU 2010); and

Puerto Rican Oriole, *Icterus portoricensis*—formerly treated as a subspecies of *Icterus dominicensis,* Hispaniolan [Greater Antillean] Oriole (AOU 2010).

(7) Remove four species based on revised taxonomic treatments and distributional evidence confirming that their known geographic ranges lie entirely outside the political boundaries of the United States and its territories. In each case, we reference the AOU publication supporting these changes:

Spot-billed Duck, *Anas poecilorhyncha* (AOU 2008);

Common [Black] Scoter, *Melanitta nigra* (AOU 2009);

Eurasian [Winter] Wren, *Troglodytes troglodytes* (AOU 2010); and

Hispaniolan [Greater Antillean] Oriole, *Icterus dominicensis* (AOU 2010).

(8) Revise the common (English) names of nine species to conform to the most recent nomenclatural treatment. These revisions do not change the protective status of any of these taxa, only the names by which they are known. In each case, we reference the published source for the name change:

Greater Flamingo, *Phoenicopterus ruber,* becomes American Flamingo (AOU 2008);

Greater Shearwater, *Puffinus gravis,* becomes Great Shearwater (AOU 2010);

Whip-poor-will, *Caprimulgus vociferus,* becomes Eastern Whip-poor-will (AOU 2010);

Green Violet-ear, *Colibri thalassinus,* becomes Green Violetear (AOU 2008);

Blue Rock Thrush, *Monticola solitarius,* becomes Blue Rock-Thrush (Clements 2007);

Clay-colored Robin, *Turdus grayi,* becomes Clay-colored Thrush (AOU 2008);

White-throated Robin, *Turdus assimilis,* becomes White-throated Thrush (AOU 2008);

Nelson's Sharp-tailed Sparrow, *Ammodramus nelsoni,* becomes Nelson's Sparrow (AOU 2009); and

Saltmarsh Sharp-tailed Sparrow, *Ammodramus caudacutus,* becomes Saltmarsh Sparrow (AOU 2009).

(9) Revise the scientific names of 36 species to conform to the most recent nomenclatural treatment. These revisions do not change the protective status of any of these taxa, only the names by which they are known. In each case, we reference the AOU publication documenting the name change:

Larus philadelphia (Bonaparte's Gull) becomes *Chroicocephalus philadelphia* (AOU 2008);

Larus cirrocephalus (Gray-hooded Gull) becomes *Chroicocephalus cirrocephalus* (AOU 2008);

Larus ridibundus (Black-headed Gull) becomes *Chroicocephalus ridibundus* (AOU 2008);

Larus minutus (Little Gull) becomes *Hydrocoloeus minutus* (AOU 2008);

Larus atricilla (Laughing Gull) becomes *Leucophaeus atricilla* (AOU 2008);

Larus pipixcan (Franklin's Gull) becomes *Leucophaeus pipixcan* (AOU 2008);

Cyanocorax morio (Brown Jay) becomes *Psilorhinus morio* (AOU 2010);

Poecile hudsonica (Boreal Chickadee) becomes *Poecile hudsonicus* (AOU 2009);

Poecile cincta (Gray-headed Chickadee) becomes *Poecile cinctus* (AOU 2009);

Calcarius mccownii (McCown's Longspur) becomes *Rhynchophanes mccownii* (AOU 2010);

Vermivora pinus (Blue-winged Warbler) becomes *Vermivora cyanoptera* (AOU 2010);

Vermivora peregrina (Tennessee Warbler) becomes *Oreothlypis peregrina* (AOU 2010);

Vermivora celata (Orange-crowned Warbler) becomes *Oreothlypis celata* (AOU 2010);

Vermivora ruficapilla (Nashville Warbler) becomes *Oreothlypis ruficapilla* (AOU 2010);

Vermivora virginiae (Virginia's Warbler) becomes *Oreothlypis virginiae* (AOU 2010);

Vermivora crissalis (Colima Warbler) becomes *Oreothlypis crissalis* (AOU 2010);

Vermivora luciae (Lucy's Warbler) becomes *Oreothlypis luciae* (AOU 2010);

Parula superciliosa (Crescent-chested Warbler) becomes *Oreothlypis superciliosa* (AOU 2010);

Seiurus noveboracensis (Northern Waterthrush) becomes *Parkesia noveboracensis* (AOU 2010);

Seiurus motacilla (Louisiana Waterthrush) becomes *Parkesia motacilla* (AOU 2010);

Pipilo fuscus (Canyon Towhee) becomes *Melozone fusca* (AOU 2010);

Pipilo crissalis (California Towhee) becomes *Melozone crissalis* (AOU 2010);

Pipilo aberti (Abert's Towhee) becomes *Melozone aberti* (AOU 2010);

Aimophila carpalis (Rufous-winged Sparrow) becomes *Peucaea carpalis* (AOU 2010);

Aimophila botterii (Botteri's Sparrow) becomes *Peucaea botterii* (AOU 2010);

Aimophila cassinii (Cassin's Sparrow) becomes *Peucaea cassinii* (AOU 2010);

Aimophila aestivalis (Bachman's Sparrow) becomes *Peucaea aestivalis* (AOU 2010);

Aimophila quinquestriata (Five-striped Sparrow) becomes *Amphispiza quinquestriata* (AOU 2010);

Carduelis flammea (Common Redpoll) becomes *Acanthis flammea* (AOU 2009);

Carduelis hornemanni (Hoary Redpoll) becomes *Acanthis hornemanni* (AOU 2009);

Carduelis spinus (Eurasian Siskin) becomes *Spinus spinus* (AOU 2009);

Carduelis pinus (Pine Siskin) becomes *Spinus pinus* (AOU 2009);

Carduelis psaltria (Lesser Goldfinch) becomes *Spinus psaltria* (AOU 2009);

Carduelis lawrencei (Lawrence's Goldfinch) becomes *Spinus lawrencei* (AOU 2009);

Carduelis tristis (American Goldfinch) becomes *Spinus tristis* (AOU 2009); and

Carduelis sinica (Oriental Greenfinch) becomes *Chloris sinica* (AOU 2009).

For ease of comparison, changes are summarized in the following table (numbers reference the categories treated above). Species whose names have been revised (categories 2, 3, 8, and 9) appear in both the left-hand column (old name removed) and right-hand column (new name added), as are species that have been added based on taxonomic splits (category 6) of extralimital species that have been removed (category 7).

Removed (taxonomically)	Added (taxonomically)
Spot-billed Duck, *Anas poecilorhyncha* (7)	Eastern Spot-billed Duck, *Anas zonorhyncha* (6).
Common [Black] Scoter, *Melanitta nigra* (7)	Black Scoter, *Melanitta americana* (6).
Greater Flamingo, *Phoenicopterus ruber* (8)	American Flamingo, *Phoenicopterus ruber* (8).
	Parkinson's Petrel, *Procellaria parkinsoni* (4).
Greater Shearwater, *Puffinus gravis* (8)	Great Shearwater, *Puffinus gravis* (8).
Polynesian Storm-Petrel, *Nesofregata fuliginosa* (2)	Polynesian Storm-Petrel, *Nesofregetta fuliginosa* (2).

Removed (taxonomically)	Added (taxonomically)
Polynesian Storm-Petrel, *Nesofregetta fuiginosa* (3)	Polynesian Storm-Petrel, *Nesofregetta fuliginosa* (3).
	Swinhoe's Storm-Petrel, *Oceanodroma monorhis* (4).
	Swallow-tailed Gull, *Creagrus furcatus* (4).
Bonaparte's Gull, *Larus philadelphia* (9)	Bonaparte's Gull, *Chroicocephalus philadelphia* (9).
Gray-hooded Gull, *Larus cirrocephalus* (9)	Gray-hooded Gull, *Chroicocephalus cirrocephalus* (9).
Black-headed Gull, *Larus ridibundus* (9)	Black-headed Gull, *Chroicocephalus ridibundus* (9).
Little Gull, *Larus minutus* (9)	Little Gull, *Hydrocoloeus minutus* (9).
Laughing Gull, *Larus atricilla* (9)	Laughing Gull, *Leucophaeus atricilla* (9).
Franklin's Gull, *Larus pipixcan* (9)	Franklin's Gull, *Leucophaeus pipixcan* (9).
Royal Tern, *Thalleseus maximus* (2)	Royal Tern, *Thalasseus maximus* (2).
Sandwich Tern, *Thalleseus sandvicensis* (2)	Sandwich Tern, *Thalasseus sandvicensis* (2).
	Brown Hawk-Owl, *Ninox scutulata* (4).
Whip-poor-will, *Caprimulgus vociferus* (8)	Eastern Whip-poor-will, *Caprimulgus vociferus* (8).
	Mexican Whip-poor-will, *Caprimulgus arizonae* (6).
Green Violet-ear, *Colibri thalassinus* (8)	Green Violetear, *Colibri thalassinus* (8).
	White-crested Elaenia, *Elaenia albiceps* (4).
	Crowned Slaty Flycatcher, *Empidonomus aurantioatrocristatus* (4).
Black-capped Vireo, *Vireo atricapillus* (2, 3)	Black-capped Vireo, *Vireo atricapilla* (2, 3).
Brown Jay, *Cyanocorax morio* (9)	Brown Jay, *Psilorhinus morio* (9).
Boreal Chickadee, *Poecile hudsonica* (9)	Boreal Chickadee, *Poecile hudsonicus* (9).
Gray-headed Chickadee, *Poecile cincta* (9)	Gray-headed Chickadee, *Poecile cinctus* (9).
	Sinaloa Wren, *Thryothorus sinaloa* (4).
	Pacific Wren, *Troglodytes pacificus* (6).
Eurasian [Winter] Wren, *Troglodytes troglodytes* (7)	Winter Wren, *Troglodytes hiemalis* (6).
Wood Warbler, *Phylloscopus siilatrix* (2)	Wood Warbler, *Phylloscopus sibilatrix* (2).
	Pallas's Leaf-Warbler, *Phylloscopus proregulus* (4).
Lanceolated Warbler, *Locustella lanceoloata* (2)	Lanceolated Warbler, *Locustella lanceolata* (2).
	Wrentit, *Chamaea fasciata* (5).
	Sedge Warbler, *Acrocephalus schoenobaenus* (4).
	Mugimaki Flycatcher, *Ficedula mugimaki* (1).
	Taiga Flycatcher, *Ficedula albicilla* (1).
	Dark-sided Flycatcher, *Muscicapa sibirica* (1).
	Asian Brown Flyctcher, *Muscicapa dauurica* (1).
	Spotted Flycatcher, *Muscicapa striata* (1).
Blue Rock Thrush, *Monticola solitarius* (8)	Blue Rock-Thrush, *Monticola solitarius* (8).
	Rufous-tailed Robin, *Luscinia sibilans* (4).
Clay-colored Robin, *Turdus grayi* (8)	Clay-colored Thrush, *Turdus grayi* (8).
White-throated Robin, *Turdus assimilis* (8)	White-throated Thrush, *Turdus assimilis* (8).
McCown's Longspur, *Calcarius mccownii* (9)	McCown's Longspur, *Rhynchophanes mccownii* (9).
Blue-winged Warbler, *Vermivora pinus* (9)	Blue-winged Warbler, *Vermivora cyanoptera* (9).
Tennessee Warbler, *Vermivora peregrina* (9)	Tennessee Warbler, *Oreothlypis peregrina* (9).
Orange-crowned Warbler, *Vermivora celata* (9)	Orange-crowned Warbler, *Oreothlypis celata* (9).
Nashville Warbler, *Vermivora ruficapilla* (9)	Nashville Warbler, *Oreothlypis ruficapilla* (9).
Virginia's Warbler, *Vermivora virginiae* (9)	Virginia's Warbler, *Oreothlypis virginiae* (9).
Colima Warbler, *Vermivora crissalis* (9)	Colima Warbler, *Oreothlypis crissalis* (9).
Lucy's Warbler, *Vermivora luciae* (9)	Lucy's Warbler, *Oreothlypis luciae* (9).
Crescent-chested Warbler, *Parula superciliosa* (9)	Crescent-chested Warbler, *Oreothlypis superciliosa* (9).
Northern Waterthrush, *Seiurus noveboracensis* (9)	Northern Waterthrush, *Parkesia noveboracensis* (9).
Louisiana Waterthrush, *Seiurus motacilla* (9)	Louisiana Waterthrush, *Parkesia motacilla* (9).
Yellow-faced Grassquit, *Tiaris olivacea* (3)	Yellow-faced Grassquit, *Tiaris olivaceus* (3).
Canyon Towhee, *Pipilo fuscus* (9)	Canyon Towhee, *Melozone fusca* (9).
California Towhee, *Pipilo crissalis* (9)	California Towhee, *Melozone crissalis* (9).
Abert's Towhee, *Pipilo aberti* (9)	Abert's Towhee, *Melozone aberti* (9).
Rufous-winged Sparrow, *Aimophila carpalis* (9)	Rufous-winged Sparrow, *Peucaea carpalis* (9).
Botteri's Sparrow, *Aimophila botterii* (9)	Botteri's Sparrow, *Peucaea botterii* (9).
Cassin's Sparrow, *Aimophila cassinii* (9)	Cassin's Sparrow, *Peucaea cassinii* (9).
Bachman's Sparrow, *Aimophila aestivalis* (9)	Bachman's Sparrow, *Peucaea aestivalis* (9).
Five-striped Sparrow, *Aimophila quinquestriata* (9)	Five-striped Sparrow, *Amphispiza quinquestriata* (9).
Nelson's Sharp-tailed Sparrow, *Ammodramus nelsoni* (8)	Nelson's Sparrow, *Ammodramus nelsoni* (8).
Saltmarsh Sharp-tailed Sparrow, *Ammodramus caudacutus* (8)	Saltmarsh Sparrow, *Ammodramus caudacutus* (8).
	Yellow-browed Bunting, *Emberiza chrysophrys* (4).
Hispaniolan [Greater Antillean] Oriole, *Icterus dominicensis* (7)	Puerto Rican Oriole, *Icterus portoricensis* (6).
Common Redpoll, *Carduelis flammea* (9)	Common Redpoll, *Acanthis flammea* (9).
Hoary Redpoll, *Carduelis hornemanni* (9)	Hoary Redpoll, *Acanthis hornemanni* (9).
Eurasian Siskin, *Carduelis spinus* (9)	Eurasian Siskin, *Spinus spinus* (9).
Pine Siskin, *Carduelis pinus* (9)	Pine Siskin, *Spinus pinus* (9).
Lesser Goldfinch, *Carduelis psaltria* (9)	Lesser Goldfinch, *Spinus psaltria* (9).
Lawrence's Goldfinch, *Carduelis lawrencei* (9)	Lawrence's Goldfinch, *Spinus lawrencei* (9).
American Goldfinch, *Carduelis tristis* (9)	American Goldfinch, *Spinus tristis* (9).
Oriental Greenfinch, *Carduelis sinica* (9)	Oriental Greenfinch, *Chloris sinica* (9).

How do the changes implemented here differ from those discussed in the proposed rule?

The scientific name of one species spelled erroneously in the proposed rule is corrected to conform to the AOU Check-list (1998) and supplements:

Black-capped Vireo, *Vireo atricapillus* becomes *Vireo atricapilla*.

How is the list of migratory birds organized?

The species are listed in two formats to suit the needs of different segments of the public: alphabetically in 50 CFR 10.13(c)(1) and taxonomically in 50 CFR 10.13(c)(2). In the alphabetical listing, species are listed by common (English) group names, with the scientific name of each species following the English group name. This format, similar to that used in modern telephone directories, is most useful to members of the lay public. In the taxonomic listing, species are listed in phylogenetic sequence by scientific name, with the English name following the scientific name. To help clarify species relationships, we also list the higher-level taxonomic categories of Order, Family, and Subfamily. This format follows the sequence adopted by the AOU (1998, 2010) and is most useful to ornithologists and other scientists.

What species are not protected by the Migratory Bird Treaty Act?

The MBTA does not apply to:

(1) Nonnative species introduced into the United States or its territories by means of intentional or unintentional human assistance that belong to families or groups covered by the Canadian, Mexican, or Russian Conventions, in accordance with the MBTRA. See 70 FR 12710 (March 15, 2005) for a partial list of nonnative, human-introduced bird species in this category. Note, though, that native species that are introduced into parts of the United States where they are not native are still protected under the MBTA regardless of where they occur in the United States or its territories.

(2) Nonnative, human-introduced species that belong to families or groups not covered by the Canadian, Mexican, or Russian Conventions, including Tinamidae (tinamous), Cracidae (chachalacas), Megapodiidae (megapodes), Phasianidae (grouse, ptarmigan, and turkeys), Turnicidae (buttonquails), Odontophoridae (New World quail), Pteroclididae (sandgrouse), Psittacidae (parrots), Dicruridae (drongos), Rhamphastidae (toucans), Musophagidae (turacos), Bucerotidae (hornbills), Bucorvidae (ground-hornbills), Pycnonotidae (bulbuls), Pittidae (pittas), Irenidae (fairy-bluebirds), Timaliidae (babblers), Zosteropidae (white-eyes), Sturnidae (starlings; except as listed in the Japanese Convention), Passeridae (Old World sparrows), Ploceidae (weavers), Estrildidae (estrildid finches), and numerous other families not currently represented in the United States or its territories.

(3) Native species that belong to families or groups represented in the United States, but which are not expressly mentioned by the Canadian, Mexican, or Russian Conventions, including the Megapodiidae (megapodes), Phasianidae (grouse, ptarmigan, and turkeys), Odontophoridae (New World quail), Burhinidae (thick-knees), Glareolidae (pratincoles), Psittacidae (parrots), Todidae (todies), Meliphagidae (honeyeaters), Monarchidae (monarch flycatchers [elepaios]), Zosteropidae (white-eyes), and Coerebidae (bananaquit). It should be noted that this rule supersedes the 70 FR 12710 notice to the extent that they are inconsistent. Specifically, the 1996 amendment to the Canadian Convention included the family Muscicapidae (Old World flycatchers). Thus, all members of the Muscicapidae family are now included on this list. In addition, the Wrentit is now considered a member of the Sylviidae family rather than the Timaliidae family and is now included on this list.

Partial lists of the species included in categories 2 and 3 are available at *http://www.fws.gov/migratorybirds/RegulationsPolicies/mbta/MBTAProtectedNonprotected.html*.

Responses to Public Comments

On April 26, 2011, we published in the **Federal Register** (76 FR 23428) a proposed rule to revise the list of migratory birds at 50 CFR 10.13. We solicited public comments on the proposed rule for 90 days, ending on July 25, 2011.

We received 7 comments in response to the proposed rule; 5 were from agencies, and 2 were from private individuals. The following text discusses the substantive comments we received and provides our responses to them.

Comment: One individual indicated that Brown Hawk-Owl, and the 10 other species we proposed to add based on new distributional records (Category 4), should not be added because they are either extremely rare vagrants or were moved by humans. The commenter further pointed out that the MBTA loses biological and ecological credibility when species are added that do not naturally occur in the United States or its territories, and pointed to the Eurasian Kestrel as one example.

Response: In 2004, the Migratory Bird Treaty Reform Act (MBTRA; Pub. L. 108–447) amended the MBTA. While the primary purpose of the MBTRA was to eliminate protection for introduced species, it also defined native species as those ‘‘occurring in the United States or its territories as a result of natural biological or ecological processes.’’ Vagrancy is a natural biological process, so these species are protected under the MBTA.

There is credible evidence to support our contention that these species have occurred in the United States as natural vagrants unhindered by human intervention. The AOU and other bird record committees take human intervention into account whenever they evaluate such records. Several of these species, including the Brown Hawk-Owl, have occurred in some of the remotest parts of Alaska, and are most unlikely to have been moved there by humans. Furthermore, multiple records of Eurasian Kestrel have been accepted from Western Alaska, and at scattered locations across North America, by the AOU and other competent scientific authorities.

Comment: The Arkansas Game and Fish Commission urged the Service to carefully consider the implications to State regulations when making recommendations, and ensure that they do not occur so frequently as to become burdensome. Specifically, they point out that the split of the order Accipitriformes from the Falconiformes will necessitate a change in State falconry regulations.

Response: The Service appreciates the State’s concern regarding changes to Federal regulations that affect States, and we make a concerted effort to work closely with the States through the Flyway Councils. To comply with the intent of the migratory bird treaties and the MBTA, we are obligated to update the list at intervals. However, the List of Migratory Birds has been updated only twice since 1985, which is not frequently enough to stay current with changes in bird taxonomy. Consequently, we intend to update this list on a 5-year cycle to coincide with updates to the Birds of Conservation Concern, thus balancing the frequency of updates with the frequency of changes in bird taxonomy. In this update, taxonomic changes at the Order level did not change which species are protected under the MBTA, as the species within those families were previously protected. Furthermore, this is the first change we have made to the

Falconiformes since the families within that Order were first protected in 1972.

Comment: The Indiana Division of Fish and Wildlife (IDFW) was pleased that the Service intends to continue to treat cackling geese as Canada geese, pointing out that hunting management of white-cheeked geese could become more difficult if they were split. The IDFW also pointed out that the Mississippi Flyway Council is trying to simplify hunting regulations for Canada geese, and splitting them into two species for management purposes could cause progress toward simplification to stall.

Response: The Service recognizes the management concerns referred to by the commenter. While we appreciate the complexities of white-cheeked goose management, our decision to continue to include the Cackling Goose within the listing for Canada Goose is based on lingering uncertainty regarding their taxonomic relationship. Work is currently being conducted in Alaska and northern Canada to resolve that uncertainty. We will consider new information when it is available, at which time we may reconsider our decision. In any case, regardless of name, goose subspecies identified as Cackling Goose by the AOU are currently protected under the MBTA as Canada Goose.

Required Determinations

Regulatory Planning and Review (Executive Order 12866)

Executive Order (EO) 12866 provides that the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget will review all significant rules. OIRA has determined that this rule is not significant.

EO 13563 reaffirms the principles of EO 12866, while calling for improvements in the nation's regulatory system to promote predictability, to reduce uncertainty, and to use the best, most innovative, and least burdensome tools for achieving regulatory ends. EO 13563 directs agencies to consider regulatory approaches that reduce burdens and maintain flexibility and freedom of choice for the public where these approaches are relevant, feasible, and consistent with regulatory objectives.

EO 13563 emphasizes further that regulations must be based on the best available science and that the rulemaking process must allow for public participation and an open exchange of ideas. We have developed this rule in a manner consistent with these requirements.

Regulatory Flexibility Act (5 U.S.C. 601 et seq.)

Under the Regulatory Flexibility Act (5 U.S.C. 601 et seq., as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 (Pub. L. 104–121)), whenever an agency is required to publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rule on small entities (i.e., small businesses, small organizations, and small government jurisdictions). However, no regulatory flexibility analysis is required if the head of an agency certifies the rule does not have a significant economic impact on a substantial number of small entities.

SBREFA amended the Regulatory Flexibility Act to require Federal agencies to provide the statement of the factual basis for certifying that a rule will not have a significant economic impact on a substantial number of small entities. We have examined this rule's potential effects on small entities as required by the Regulatory Flexibility Act, and have determined that this action will not have a significant economic impact on a substantial number of small entities, because we are simply updating the list of migratory bird species protected under the Conventions. Consequently, we certify that because this rule does not have a significant economic effect on a substantial number of small entities, a regulatory flexibility analysis is not required.

This rule is not a major rule under SBREFA (5 U.S.C. 804(2)). It does not have a significant impact on a substantial number of small entities.

a. This rule does not have an annual effect on the economy of $100 million or more.

b. This rule does not cause a major increase in costs or prices for consumers, individual industries, Federal, State, or local government agencies, or geographic regions.

c. This rule does not have significant adverse effects on competition, employment, investment, productivity, innovation, or the ability of U.S.-based enterprises to compete with foreign-based enterprises.

Unfunded Mandates Reform Act

In accordance with the Unfunded Mandates Reform Act (2 U.S.C. 1501 et seq.), we have determined the following:

a. This rule does not ''significantly or uniquely'' affect small governments. A small government agency plan is not required. Actions under the regulation do not affect small government activities in any significant way.

b. This rule does not produce a Federal mandate of $100 million or greater in any year; i.e., it is not a ''significant regulatory action'' under the Unfunded Mandates Reform Act.

Takings

In accordance with Executive Order 12630, the rule does not have significant takings implications. This rule does not contain a provision for taking of private property. Therefore, a takings implication assessment is not required.

Federalism

This rule does not have sufficient Federalism effects to warrant preparation of a Federalism summary impact statement under Executive Order 13132. It does not interfere with the States' ability to manage themselves or their funds. No significant economic impacts are expected to result from the updating of the list of migratory bird species.

Civil Justice Reform

In accordance with Executive Order 12988, the Office of the Solicitor has determined that the rule does not unduly burden the judicial system and meets the requirements of sections 3(a) and 3(b)(2) of the Order.

Paperwork Reduction Act

We examined this rule under the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*). There are no new information collection requirements associated with this rule. We do not require any new permits, reports, or recordkeeping in this rule.

National Environmental Policy Act (NEPA)

Given that the revision of 50 CFR 10.13 is strictly administrative in nature and will have no or minor environmental effects, it is categorically excluded from further NEPA requirements (43 CFR 46.210(i)).

Endangered Species Act (ESA)

Seventy-four of the species on the List of Migratory Birds are also designated as endangered or threatened in all or some portion of their U.S. range under provisions of the Endangered Species Act of 1973 (16 U.S.C. 1531–44; 50 CFR 17.11). No legal complications arise from the dual listing as the two lists are developed under separate authorities and for different purposes. Because the rule is strictly administrative in nature, it has no effect on threatened or endangered species. It does not require ESA consultation.

Government-to-Government Relationship With Tribes

In accordance with the President's memorandum of April 29, 1994, ''Government-to-Government Relations with Native American tribal Governments'' (59 FR 22951), Executive Order 13175, and 512 DM 2, we have evaluated potential effects on federally recognized Indian tribes and have determined that there are no potential effects. The revisions to existing regulations in this rule are purely administrative in nature and do not interfere with the tribes' ability to manage themselves or their funds or to regulate migratory bird activities on tribal lands.

Energy Supply, Distribution, or Use (Executive Order 13211)

On May 18, 2001, the President issued Executive Order 13211 addressing regulations that significantly affect energy supply, distribution, and use. Executive Order 13211 requires agencies to prepare Statements of Energy Effects when undertaking certain actions. Because this rule only affects the listing of protected species in the United States, it is not a significant regulatory action under Executive Order 12866, and does not significantly affect energy supplies, distribution, or use. Therefore, this action is not a significant energy action and no Statement of Energy Effects is required.

References Cited

A complete list of all references cited is available upon request (see **FOR FURTHER INFORMATION CONTACT** above).

List of Subjects

50 CFR Part 10

Exports, Fish, Imports, Law enforcement, Plants, Transportation, Wildlife.

50 CFR Part 21

Exports, Hunting, Imports, Reporting and recordkeeping requirements, Transportation, Wildlife.

Regulation Promulgation

For the reasons discussed in the preamble, we amend title 50, chapter I, subchapter B, parts 10 and 21 of the Code of Federal Regulations, as follows:

PART 10—[AMENDED]

■ 1. The authority citation for part 10 continues to read as follows:

Authority: 18 U.S.C. 42; 16 U.S.C. 703–712; 16 U.S.C. 668a–d; 19 U.S.C. 1202; 16 U.S.C. 1531–1543; 16 U.S.C. 1361–1384, 1401–1407; 16 U.S.C. 742a–742j–l; 16 U.S.C. 3371–3378.

■ 2. Revise § 10.13 to read as follows:

§ 10.13 List of Migratory Birds.

(a) *Legal authority for this list.* The legal authorities for this list are the Migratory Bird Treaty Act (MBTA; 16 U.S.C. 703–712), the Fish and Wildlife Improvement Act of 1978 (16 U.S.C. 742l), and the Fish and Wildlife Act of 1956 (16 U.S.C. 742a–742j). The MBTA implements Conventions between the United States and four neighboring countries for the protection of migratory birds, as follows:

(1) *Canada:* Convention between the United States and Great Britain [on behalf of Canada] for the Protection of Migratory Birds, August 16, 1916, 39 Stat. 1702 (T.S. No. 628), as amended;

(2) *Mexico:* Convention between the United States and Mexico for the Protection of Migratory Birds and Game Mammals, February 7, 1936, 50 Stat. 1311 (T.S. No. 912), as amended;

(3) *Japan:* Convention between the Government of the United States of America and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction, and Their Environment, March 4, 1972, 25 U.S.T. 3329 (T.I.A.S. No. 7990); and

(4) *Russia:* Convention between the United States of America and the Union of Soviet Socialist Republics Concerning the Conservation of Migratory Birds and Their Environment, November 19, 1976, 20 U.S.T. 4647 (T.I.A.S. No. 9073).

(b) *Purpose of this list.* The purpose is to inform the public of the species protected by regulations that enforce the terms of the MBTA. These regulations, found in parts 10, 20, and 21 of this chapter, cover most aspects of the taking, possession, transportation, sale, purchase, barter, exportation, and importation of migratory birds.

(c) *What species are protected as migratory birds?* Species protected as migratory birds are listed in two formats to suit the varying needs of the user: Alphabetically in paragraph (c)(1) of this section and taxonomically in paragraph (c)(2) of this section. Taxonomy and nomenclature generally follow the 7th edition of the American Ornithologists' Union's *Check-list of North American birds* (1998, as amended through 2010). For species not treated by the AOU *Check-list,* we generally follow *The Clements Checklist of Birds of the World* (Clements 2007).

(1) *Alphabetical listing.* Species are listed alphabetically by common (English) group names, with the scientific name of each species following the common name.

ACCENTOR, Siberian, *Prunella montanella*
AKEKEE, *Loxops caeruleirostris*
AKEPA, *Loxops coccineus*
AKIALOA, Greater, *Hemignathus ellisianus*
AKIAPOLAAU, *Hemignathus munroi*
AKIKIKI, *Oreomystis bairdi*
AKOHEKOHE, *Palmeria dolei*
ALAUAHIO, Maui, *Paroreomyza montana*
Oahu, *Paroreomyza maculata*
ALBATROSS, Black-browed, *Thalassarche melanophris*
Black-footed, *Phoebastria nigripes*
Laysan, *Phoebastria immutabilis*
Light-mantled, *Phoebetria palpebrata*
Short-tailed, *Phoebastria albatrus*
Shy, *Thalassarche cauta*
Wandering, *Diomedea exulans*
Yellow-nosed, *Thalassarche chlororhynchos*
AMAKIHI, Hawaii, *Hemignathus virens*
Kauai, *Hemignathus kauaiensis*
Oahu, *Hemignathus flavus*
ANHINGA, *Anhinga anhinga*
ANI, Groove-billed, *Crotophaga sulcirostris*
Smooth-billed, *Crotophaga ani*
ANIANIAU, *Magumma parva*
APAPANE, *Himatione sanguinea*
AUKLET, Cassin's, *Ptychoramphus aleuticus*
Crested, *Aethia cristatella*
Least, *Aethia pusilla*
Parakeet, *Aethia psittacula*
Rhinoceros, *Cerorhinca monocerata*
Whiskered, *Aethia pygmaea*
AVOCET, American, *Recurvirostra americana*
BEAN-GOOSE, Taiga, *Anser fabalis*
Tundra, *Anser serrirostris*
BEARDLESS–TYRANNULET, Northern, *Camptostoma imberbe*
BECARD, Rose-throated, *Pachyramphus aglaiae*
BITTERN, American, *Botaurus lentiginosus*
Black, *Ixobrychus flavicollis*
Least, *Ixobrychus exilis*
Schrenck's, *Ixobrychus eurhythmus*
Yellow, *Ixobrychus sinensis*
BLACK–HAWK, Common, *Buteogallus anthracinus*
BLACKBIRD, Brewer's, *Euphagus cyanocephalus*
Red-winged, *Agelaius phoeniceus*
Rusty, *Euphagus carolinus*
Tawny-shouldered, *Agelaius humeralis*
Tricolored, *Agelaius tricolor*
Yellow-headed, *Xanthocephalus xanthocephalus*
Yellow-shouldered, *Agelaius xanthomus*
BLUEBIRD, Eastern, *Sialia sialis*
Mountain, *Sialia currucoides*
Western, *Sialia mexicana*
BLUETAIL, Red-flanked, *Tarsiger cyanurus*
BLUETHROAT, *Luscinia svecica*
BOBOLINK, *Dolichonyx oryzivorus*

BOOBY, Blue-footed, *Sula nebouxii*
Brown, *Sula leucogaster*
Masked, *Sula dactylatra*
Red-footed, *Sula sula*
BRAMBLING, *Fringilla montifringilla*
BRANT, *Branta bernicla*
BUFFLEHEAD, *Bucephala albeola*
BULLFINCH, Eurasian, *Pyrrhula pyrrhula*
Puerto Rican, *Loxigilla portoricensis*
BUNTING, Blue, *Cyanocompsa parellina*
Gray, *Emberiza variabilis*
Indigo, *Passerina cyanea*
Little, *Emberiza pusilla*
Lark, *Calamospiza melanocorys*
Lazuli, *Passerina amoena*
McKay's, *Plectrophenax hyperboreus*
Painted, *Passerina ciris*
Pallas's, *Emberiza pallasi*
Pine, *Emberiza leucocephalos*
Reed, *Emberiza schoeniclus*
Rustic, *Emberiza rustica*
Snow, *Plectrophenax nivalis*
Varied, *Passerina versicolor*
Yellow-breasted, *Emberiza aureola*
Yellow-browed, *Emberiza chrysophrys*
Yellow-throated, *Emberiza elegans*
BUSHTIT, *Psaltriparus minimus*
CANVASBACK, *Aythya valisineria*
CARACARA, Crested, *Caracara cheriway*
CARDINAL, Northern, *Cardinalis cardinalis*
CARIB, Green-throated, *Eulampis holosericeus*
Purple-throated, *Eulampis jugularis*
CATBIRD, Black, *Melanoptila glabrirostris*
Gray, *Dumetella carolinensis*
CHAFFINCH, Common, *Fringilla coelebs*
CHAT, Yellow-breasted, *Icteria virens*
CHICKADEE, Black-capped, *Poecile atricapillus*
Boreal, *Poecile hudsonicus*
Carolina, *Poecile carolinensis*
Chestnut-backed, *Poecile rufescens*
Gray-headed, *Poecile cinctus*
Mexican, *Poecile sclateri*
Mountain, *Poecile gambeli*
CHUCK–WILL'S–WIDOW, *Caprimulgus carolinensis*
CONDOR, California, *Gymnogyps californianus*
COOT, American, *Fulica americana*
Caribbean, *Fulica caribaea*
Eurasian, *Fulica atra*
Hawaiian, *Fulica alai*
CORMORANT, Brandt's, *Phalacrocorax penicillatus*
Double-crested, *Phalacrocorax auritus*
Great, *Phalacrocorax carbo*
Little Pied, *Phalacrocorax melanoleucos*
Neotropic, *Phalacrocorax brasilianus*
Pelagic, *Phalacrocorax pelagicus*
Red-faced, *Phalacrocorax urile*
COWBIRD, Bronzed, *Molothrus aeneus*
Brown-headed, *Molothrus ater*
Shiny, *Molothrus bonariensis*
CRAKE, Corn, *Crex crex*
Paint-billed, *Neocrex erythrops*
Spotless, *Porzana tabuensis*
Yellow-breasted, *Porzana flaviventer*
CRANE, Common, *Grus grus*
Sandhill, *Grus canadensis*
Whooping, *Grus americana*
CREEPER, Brown, *Certhia americana*
Hawaii, *Oreomystis mana*
CROSSBILL, Red, *Loxia curvirostra*
White-winged, *Loxia leucoptera*
CROW, American, *Corvus brachyrhynchos*
Fish, *Corvus ossifragus*
Hawaiian, *Corvus hawaiiensis*
Mariana, *Corvus kubaryi*
Northwestern, *Corvus caurinus*
Tamaulipas, *Corvus imparatus*
White-necked, *Corvus leucognaphalus*
CUCKOO, Black-billed, *Coccyzus erythropthalmus*
Common, *Cuculus canorus*
Mangrove, *Coccyzus minor*
Oriental, *Cuculus optatus*
Yellow-billed, *Coccyzus americanus*
CURLEW, Bristle-thighed, *Numenius tahitiensis*
Eskimo, *Numenius borealis*
Eurasian, *Numenius arquata*
Far Eastern, *Numenius madagascariensis*
Little, *Numenius minutus*
Long-billed, *Numenius americanus*
DICKCISSEL, *Spiza americana*
DIPPER, American, *Cinclus mexicanus*
DOTTEREL, Eurasian, *Charadrius morinellus*
DOVE, Inca, *Columbina inca*
Mourning, *Zenaida macroura*
White-tipped, *Leptotila verreauxi*
White-winged, *Zenaida asiatica*
Zenaida, *Zenaida aurita*
DOVEKIE, *Alle alle*
DOWITCHER, Long-billed, *Limnodromus scolopaceus*
Short-billed, *Limnodromus griseus*
DUCK, American Black, *Anas rubripes*
Eastern Spot-billed, *Anas zonorhyncha*
Falcated, *Anas falcata*
Harlequin, *Histrionicus histrionicus*
Hawaiian, *Anas wyvilliana*
Laysan, *Anas laysanensis*
Long-tailed, *Clangula hyemalis*
Masked, *Nomonyx dominicus*
Mottled, *Anas fulvigula*
Muscovy, *Cairina moschata*
Pacific Black, *Anas superciliosa*
Ring-necked, *Aythya collaris*
Ruddy, *Oxyura jamaicensis*
Tufted, *Aythya fuligula*
Wood, *Aix sponsa*
DUNLIN, *Calidris alpina*
EAGLE, Bald, *Haliaeetus leucocephalus*
Golden, *Aquila chrysaetos*
White-tailed, *Haliaeetus albicilla*
EGRET, Cattle, *Bubulcus ibis*
Chinese, *Egretta eulophotes*
Great, *Ardea alba*
Intermediate, *Mesophoyx intermedia*
Little, *Egretta garzetta*
Reddish, *Egretta rufescens*
Snowy, *Egretta thula*
EIDER, Common, *Somateria mollissima*
King, *Somateria spectabilis*
Spectacled, *Somateria fischeri*
Steller's, *Polysticta stelleri*
ELAENIA, Caribbean, *Elaenia martinica*
Greenish, *Myiopagis viridicata*
White-crested, *Elaenia albiceps*
EMERALD, Puerto Rican, *Chlorostilbon maugaeus*
EUPHONIA, Antillean, *Euphonia musica*
FALCON, Aplomado, *Falco femoralis*
Peregrine, *Falco peregrinus*
Prairie, *Falco mexicanus*
Red-footed, *Flaco vespertinus*
FIELDFARE, *Turdus pilaris*
FINCH, Cassin's, *Carpodacus cassinii*
House, *Carpodacus mexicanus*
Laysan, *Telespiza cantans*
Nihoa, *Telespiza ultima*
Purple, *Carpodacus purpureus*
FLAMINGO, American, *Phoenicopterus ruber*
FLICKER, Gilded, *Colaptes chrysoides*
Northern, *Colaptes auratus*
FLYCATCHER, Acadian, *Empidonax virescens*
Alder, *Empidonax alnorum*
Ash-throated, *Myiarchus cinerascens*
Asian Brown, *Muscicapa dauurica*
Brown-crested, *Myiarchus tyrannulus*
Buff-breasted, *Empidonax fulvifrons*
Cordilleran, *Empidonax occidentalis*
Crowned Slaty, *Empidonomus aurantioatrocristatus*
Dark-sided, *Muscicapa sibirica*
Dusky, *Empidonax oberholseri*
Dusky-capped, *Myiarchus tuberculifer*
Fork-tailed, *Tyrannus savana*
Gray, *Empidonax wrightii*
Gray-streaked, *Muscicapa griseisticta*
Great Crested, *Myiarchus crinitus*
Hammond's, *Empidonax hammondii*
La Sagra's, *Myiarchus sagrae*
Least, *Empidonax minimus*
Mugimaki, *Ficedula mugimaki*
Narcissus, *Ficedula narcissina*
Nutting's, *Myiarchus nuttingi*
Olive-sided, *Contopus cooperi*
Pacific-slope, *Empidonax difficilis*
Piratic, *Legatus leucophalus*
Puerto Rican, *Myiarchus antillarum*
Scissor-tailed, *Tyrannus forficatus*
Social, *Myiozetetes similis*
Spotted, *Muscicapa striata*
Sulphur-bellied, *Myiodynastes luteiventris*
Taiga, *Ficedula albicilla*
Tufted, *Mitrephanes phaeocercus*
Variegated, *Empidonomus varius*
Vermilion, *Pyrocephalus rubinus*

Willow, *Empidonax traillii*
Yellow-bellied, *Empidonax flaviventris*
FOREST-FALCON, Collared, *Micrastur semitorquatus*
FRIGATEBIRD, Great, *Fregata minor*
Lesser, *Fregata ariel*
Magnificent, *Fregata magnificens*
FROG–HAWK, Gray, *Accipiter soloensis*
FRUIT–DOVE, Crimson-crowned, *Ptilinopus porphyraceus*
Many-colored, *Ptilinopus perousii*
Mariana, *Ptilinopus roseicapilla*
FULMAR, Northern, *Fulmarus glacialis*
GADWALL, *Anas strepera*
GALLINULE, Azure, *Porphyrio flavirostris*
Purple, *Porphyrio martinica*
GANNET, Northern, *Morus bassanus*
GARGANEY, *Anas querquedula*
GNATCATCHER, Black-capped, *Polioptila nigriceps*
Black-tailed, *Polioptila melanura*
Blue-gray, *Polioptila caerulea*
California, *Polioptila californica*
GODWIT, Bar-tailed, *Limosa lapponica*
Black-tailed, *Limosa limosa*
Hudsonian, *Limosa haemastica*
Marbled, *Limosa fedoa*
GOLDEN-PLOVER, American, *Pluvialis dominica*
European, *Pluvialis apricaria*
Pacific, *Pluvialis fulva*
GOLDENEYE, Barrow's, *Bucephala islandica*
Common, *Bucephala clangula*
GOLDFINCH, American, *Spinus tristis*
Lawrence's, *Spinus lawrencei*
Lesser, *Spinus psaltria*
GOOSE, Barnacle, *Branta leucopsis*
Canada, *Branta canadensis* (including Cackling Goose, *Branta hutchinsii*)
Emperor, *Chen canagica*
Greater White-fronted, *Anser albifrons*
Hawaiian, *Branta sandvicensis*
Lesser White-fronted, *Anser erythropus*
Ross's, *Chen rossii*
Snow, *Chen caerulescens*
GOSHAWK, Northern, *Accipiter gentilis*
GRACKLE, Boat-tailed, *Quiscalus major*
Common, *Quiscalus quiscula*
Great-tailed, *Quiscalus mexicanus*
Greater Antillean, *Quiscalus niger*
GRASSHOPPER-WARBLER, Middendorff's, *Locustella ochotensis*
GRASSQUIT, Black-faced, *Tiaris bicolor*
Yellow-faced, *Tiaris olivaceus*
GREBE, Clark's, *Aechmophorus clarkii*
Eared, *Podiceps nigricollis*
Horned, *Podiceps auritus*
Least, *Tachybaptus dominicus*
Pied-billed, *Podilymbus podiceps*
Red-necked, *Podiceps grisegena*
Western, *Aechmophorus occidentalis*
GREENFINCH, Oriental, *Chloris sinica*
GREENSHANK, Common, *Tringa nebularia*
Nordmann's, *Tringa guttifer*
GROSBEAK, Black-headed, *Pheucticus melanocephalus*
Blue, *Passerina caerulea*
Crimson-collared, *Rhodothraupis celaeno*
Evening, *Coccothraustes vespertinus*
Pine, *Pinicola enucleator*
Rose-breasted, *Pheucticus ludovicianus*
Yellow, *Pheucticus chrysopeplus*
GROUND-DOVE, Common, *Columbina passerina*
Friendly, *Gallicolumba stairi*
Ruddy, *Columbina talpacoti*
White-throated, *Gallicolumba xanthonura*
GUILLEMOT, Black, *Cepphus grylle*
Pigeon, *Cepphus columba*
GULL, Belcher's, *Larus belcheri*
Black-headed, *Chroicocephalus ridibundus*
Black-tailed, *Larus crassirostris*
Bonaparte's, *Chroicocephalus philadelphia*
California, *Larus californicus*
Franklin's, *Leucophaeus pipixcan*
Glaucous, *Larus hyperboreus*
Glaucous-winged, *Larus glaucescens*
Gray-hooded, *Chroicocephalus cirrocephalus*
Great Black-backed, *Larus marinus*
Heermann's, *Larus heermanni*
Herring, *Larus argentatus*
Iceland, *Larus glaucoides*
Ivory, *Pagophila eburnea*
Kelp, *Larus dominicanus*
Laughing, *Leucophaeus atricilla*
Lesser Black-backed, *Larus fuscus*
Little, *Hydrocoloeus minutus*
Mew, *Larus canus*
Ring-billed, *Larus delawarensis*
Ross's, *Rhodostethia rosea*
Sabine's, *Xema sabini*
Slaty-backed, *Larus schistisagus*
Swallow-tailed, *Creagrus furcatus*
Thayer's, *Larus thayeri*
Western, *Larus occidentalis*
Yellow-footed, *Larus livens*
Yellow-legged, *Larus michahellis*
GYRFALCON, *Falco rusticolus*
HARRIER, Northern, *Circus cyaneus*
HAWFINCH, *Coccothraustes coccothraustes*
HAWK, Broad-winged, *Buteo platypterus*
Cooper's, *Accipiter cooperii*
Crane, *Geranospiza caerulescens*
Ferruginous, *Buteo regalis*
Gray, *Buteo nitidus*
Harris's, *Parabuteo unicinctus*
Hawaiian, *Buteo solitarius*
Red-shouldered, *Buteo lineatus*
Red-tailed, *Buteo jamaicensis*
Roadside, *Buteo magnirostris*
Rough-legged, *Buteo lagopus*
Sharp-shinned, *Accipiter striatus*
Short-tailed, *Buteo brachyurus*
Swainson's, *Buteo swainsoni*
White-tailed, *Buteo albicaudatus*
Zone-tailed, *Buteo albonotatus*
HAWK-CUCKOO, Hodgson's, *Cuculus fugax*
HAWK-OWL, Brown, *Ninox scutulata*
HERON, Gray, *Ardea cinerea*
Great Blue, *Ardea herodias*
Green, *Butorides virescens*
Little Blue, *Egretta caerulea*
Tricolored, *Egretta tricolor*
HOBBY, Eurasian, *Falco subbuteo*
HOOPOE, Eurasian, *Upupa epops*
HOUSE-MARTIN, Common, *Delichon urbicum*
HUMMINGBIRD, Allen's, *Selasphorus sasin*
Anna's, *Calypte anna*
Antillean Crested, *Orthorhyncus cristatus*
Berylline, *Amazilia beryllina*
Black-chinned, *Archilochus alexandri*
Blue-throated, *Lampornis clemenciae*
Broad-billed, *Cynanthus latirostris*
Broad-tailed, *Selasphorus platycercus*
Buff-bellied, *Amazilia yucatanensis*
Bumblebee, *Atthis heloisa*
Calliope, *Stellula calliope*
Cinnamon, *Amazilia rutila*
Costa's, *Calypte costae*
Lucifer, *Calothorax lucifer*
Magnificent, *Eugenes fulgens*
Ruby-throated, *Archilochus colubris*
Rufous, *Selasphorus rufus*
Violet-crowned, *Amazilia violiceps*
White-eared, *Hylocharis leucotis*
Xantus's, *Hylocharis xantusii*
IBIS, Glossy, *Plegadis falcinellus*
Scarlet, *Eudocimus ruber*
White, *Eudocimus albus*
White-faced, *Plegadis chihi*
IIWI, *Vestiaria coccinea*
IMPERIAL-PIGEON, Pacific, *Ducula pacifica*
JABIRU, *Jabiru mycteria*
JACANA, Northern, *Jacana spinosa*
JAEGER, Long-tailed, *Stercorarius longicaudus*
Parasitic, *Stercorarius parasiticus*
Pomarine, *Stercorarius pomarinus*
JAY, Blue, *Cyanocitta cristata*
Brown, *Psilorhinus morio*
Gray, *Perisoreus canadensis*
Green, *Cyanocorax yncas*
Mexican, *Aphelocoma ultramarina*
Pinyon, *Gymnorhinus cyanocephalus*
Steller's, *Cyanocitta stelleri*
JUNCO, Dark-eyed, *Junco hyemalis*
Yellow-eyed, *Junco phaeonotus*
KAKAWAHIE, *Paroreomyza flammea*
KAMAO, *Myadestes myadestinus*
KESTREL, American, *Falco sparverius*
Eurasian, *Falco tinnunculus*
KILLDEER, *Charadrius vociferus*
KINGBIRD, Cassin's, *Tyrannus vociferans*
Couch's, *Tyrannus couchii*
Eastern, *Tyrannus tyrannus*
Gray, *Tyrannus dominicensis*
Loggerhead, *Tyrannus caudifasciatus*

Thick-billed, *Tyrannus crassirostris*
Tropical, *Tyrannus melancholicus*
Western, *Tyrannus verticalis*
KINGFISHER, Belted, *Megaceryle alcyon*
Collared, *Todirhamphus chloris*
Green, *Chloroceryle americana*
Micronesian, *Todirhamphus cinnamominus*
Ringed, *Megaceryle torquata*
KINGLET, Golden-crowned, *Regulus satrapa*
Ruby-crowned, *Regulus calendula*
KISKADEE, Great, *Pitangus sulphuratus*
KITE, Black, *Milvus migrans*
Hook-billed, *Chondrohierax uncinatus*
Mississippi, *Ictinia mississippiensis*
Snail, *Rostrhamus sociabilis*
Swallow-tailed, *Elanoides forficatus*
White-tailed, *Elanus leucurus*
KITTIWAKE, Black-legged, *Rissa tridactyla*
Red-legged, *Rissa brevirostris*
KNOT, Great, *Calidris tenuirostris*
Red, *Calidris canutus*
LAPWING, Northern, *Vanellus vanellus*
LARK, Horned, *Eremophila alpestris*
Sky, *Alauda arvensis*
LEAF-WARBLER, Pallas's, *Phylloscopus proregulus*
LIMPKIN, *Aramus guarauna*
LIZARD-CUCKOO, Puerto Rican, *Coccyzus vieilloti*
LONGSPUR, Chestnut-collared, *Calcarius ornatus*
Lapland, *Calcarius lapponicus*
McCown's, *Rhynchophanes mccownii*
Smith's, *Calcarius pictus*
LOON, Arctic, *Gavia arctica*
Common, *Gavia immer*
Pacific, *Gavia pacifica*
Red-throated, *Gavia stellata*
Yellow-billed, *Gavia adamsii*
MAGPIE, Black-billed, *Pica hudsonia*
Yellow-billed, *Pica nuttalli*
MALLARD, *Anas platyrhynchos*
MANGO, Antillean, *Anthracothorax dominicus*
Green, *Anthracothorax viridis*
Green-breasted, *Anthracothorax prevostii*
MARTIN, Brown-chested, *Progne tapera*
Caribbean, *Progne dominicensis*
Cuban, *Progne cryptoleuca*
Gray-breasted, *Progne chalybea*
Purple, *Progne subis*
Southern, *Progne elegans*
MEADOWLARK, Eastern, *Sturnella magna*
Western, *Sturnella neglecta*
MERGANSER, Common, *Mergus merganser*
Hooded, *Lophodytes cucullatus*
Red-breasted, *Mergus serrator*
MERLIN, *Falco columbarius*
MILLERBIRD, *Acrocephalus familiaris*
MOCKINGBIRD, Bahama, *Mimus gundlachii*
Blue, *Melanotis caerulescens*
Northern, *Mimus polyglottos*
MOORHEN, Common, *Gallinula chloropus*
MURRE, Common, *Uria aalge*
Thick-billed, *Uria lomvia*
MURRELET, Ancient, *Synthliboramphus antiquus*
Craveri's, *Synthliboramphus craveri*
Kittlitz's, *Brachyramphus brevirostris*
Long-billed, *Brachyramphus perdix*
Marbled, *Brachyramphus marmoratus*
Xantus's, *Synthliboramphus hypoleucus*
NEEDLETAIL, White-throated, *Hirundapus caudacutus*
NIGHT-HERON, Black-crowned, *Nycticorax nycticorax*
Japanese, *Gorsachius goisagi*
Malayan, *Gorsachius melanolophus*
Yellow-crowned, *Nyctanassa violacea*
NIGHTHAWK, Antillean, *Chordeiles gundlachii*
Common, *Chordeiles minor*
Lesser, *Chordeiles acutipennis*
NIGHTINGALE-THRUSH, Black-headed, *Catharus mexicanus*
Orange-billed, *Catharus aurantiirostris*
NIGHTJAR, Buff-collared, *Caprimulgus ridgwayi*
Gray, *Caprimulgus indicus*
Puerto Rican, *Caprimulgus noctitherus*
NODDY, Black, *Anous minutus*
Blue-gray, *Procelsterna cerulea*
Brown, *Anous stolidus*
NUKUPUU, *Hemignathus lucidus*
NUTCRACKER, Clark's, *Nucifraga columbiana*
NUTHATCH, Brown-headed, *Sitta pusilla*
Pygmy, *Sitta pygmaea*
Red-breasted, *Sitta canadensis*
White-breasted, *Sitta carolinensis*
OLOMAO, *Myadestes lanaiensis*
OMAO, *Myadestes obscurus*
ORIOLE, Altamira, *Icterus gularis*
Audubon's, *Icterus graduacauda*
Baltimore, *Icterus galbula*
Black-vented, *Icterus wagleri*
Bullock's, *Icterus bullockii*
Hooded, *Icterus cucullatus*
Orchard, *Icterus spurius*
Puerto Rican, *Icterus portoricensis*
Scott's, *Icterus parisorum*
Streak-backed, *Icterus pustulatus*
OSPREY, *Pandion haliaetus*
OU, *Psittirostra psittacea*
OVENBIRD, *Seiurus aurocapilla*
OWL, Barn, *Tyto alba*
Barred, *Strix varia*
Boreal, *Aegolius funereus*
Burrowing, *Athene cunicularia*
Elf, *Micrathene whitneyi*
Flammulated, *Otus flammeolus*
Great Gray, *Strix nebulosa*
Great Horned, *Bubo virginianus*
Long-eared, *Asio otus*
Mottled, *Ciccaba virgata*
Northern Hawk, *Surnia ulula*
Northern Saw-whet, *Aegolius acadicus*
Short-eared, *Asio flammeus*
Snowy, *Bubo scandiacus*
Spotted, *Strix occidentalis*
Stygian, *Asio stygius*
OYSTERCATCHER, American, *Haematopus palliatus*
Black, *Haematopus bachmani*
Eurasian, *Haematopus ostralegus*
PALILA, *Loxioides bailleui*
PALM-SWIFT, Antillean, *Tachornis phoenicobia*
PARROTBILL, Maui, *Pseudonestor xanthophrys*
PARULA, Northern, *Parula americana*
Tropical, *Parula pitiayumi*
PAURAQUE, Common, *Nyctidromus albicollis*
PELICAN, American White, *Pelecanus erythrorhynchos*
Brown, *Pelecanus occidentalis*
PETREL, Bermuda, *Pterodroma cahow*
Black-capped, *Pterodroma hasitata*
Black-winged, *Pterodroma nigripennis*
Bonin, *Pterodroma hypoleuca*
Bulwer's, *Bulweria bulwerii*
Cook's, *Pterodroma cookii*
Gould's, *Pterodroma leucoptera*
Great-winged, *Pterodroma macroptera*
Hawaiian, *Pterodroma sandwichensis*
Herald, *Pterodroma arminjoniana*
Jouanin's, *Bulweria fallax*
Juan Fernandez, *Pterodroma externa*
Kermadec, *Pterodroma neglecta*
Mottled, *Pterodroma inexpectata*
Murphy's, *Pterodroma ultima*
Parkinson's, *Procellaria parkinsoni*
Phoenix, *Pterodroma alba*
Stejneger's, *Pterodroma longirostris*
Tahiti, *Pterodroma rostrata*
White-necked, *Pterodroma cervicalis*
PEWEE, Cuban, *Contopus caribaeus*
Greater, *Contopus pertinax*
Hispaniolan, *Contopus hispaniolensis*
Lesser Antillean, *Contopus latirostris*
PHAINOPEPLA, *Phainopepla nitens*
PHALAROPE, Red, *Phalaropus fulicarius*
Red-necked, *Phalaropus lobatus*
Wilson's, *Phalaropus tricolor*
PHOEBE, Black, *Sayornis nigricans*
Eastern, *Sayornis phoebe*
Say's, *Sayornis saya*
PIGEON, Band-tailed, *Patagioenas fasciata*
Plain, *Patagioenas inornata*
Red-billed, *Patagioenas flavirostris*
Scaly-naped, *Patagioenas squamosa*
White-crowned, *Patagioenas leucocephala*
PINTAIL, Northern, *Anas acuta*
White-cheeked, *Anas bahamensis*
PIPIT, American, *Anthus rubescens*
Olive-backed, *Anthus hodgsoni*
Pechora, *Anthus gustavi*

Red-throated, *Anthus cervinus*
Sprague's, *Anthus spragueii*
Tree, *Anthus trivialis*
PLOVER, Black-bellied, *Pluvialis squatarola*
Collared, *Charadrius collaris*
Common Ringed, *Charadrius hiaticula*
Little Ringed, *Charadrius dubius*
Mountain, *Charadrius montanus*
Piping, *Charadrius melodus*
Semipalmated, *Charadrius semipalmatus*
Snowy, *Charadrius alexandrinus*
Wilson's, *Charadrius wilsonia*
POCHARD, Baer's, *Aythya baeri*
Common, *Aythya ferina*
POND–HERON, Chinese, *Ardeola bacchus*
POORWILL, Common, *Phalaenoptilus nuttallii*
POO–ULI, *Melamprosops phaeosoma*
PUAIOHI, *Myadestes palmeri*
PUFFIN, Atlantic, *Fratercula arctica*
Horned, *Fratercula corniculata*
Tufted, *Fratercula cirrhata*
PYGMY–OWL, Ferruginous, *Glaucidium brasilianum*
Northern, *Glaucidium gnoma*
PYRRHULOXIA, *Cardinalis sinuatus*
QUAIL–DOVE, Bridled, *Geotrygon mystacea*
Key West, *Geotrygon chrysia*
Ruddy, *Geotrygon montana*
QUETZEL, Eared, *Euptilotis neoxenus*
RAIL, Black, *Laterallus jamaicensis*
Buff-banded, *Gallirallus philippensis*
Clapper, *Rallus longirostris*
Guam, *Gallirallus owstoni*
King, *Rallus elegans*
Spotted, *Pardirallus maculatus*
Virginia, *Rallus limicola*
Yellow, *Coturnicops noveboracensis*
RAVEN, Chihuahuan, *Corvus cryptoleucus*
Common, *Corvus corax*
RAZORBILL, *Alca torda*
REDHEAD, *Aythya americana*
REDPOLL, Common, *Acanthis flammea*
Hoary, *Acanthis hornemanni*
REDSHANK, Spotted, *Tringa erythropus*
REDSTART, American, *Setophaga ruticilla*
Painted, *Myioborus pictus*
Slate-throated, *Myioborus miniatus*
REED–WARBLER, Nightingale, *Acrocephalus luscinia*
REEF–EGRET, Pacific, *Egretta sacra*
REEF–HERON, Western, *Egretta gularis*
ROADRUNNER, Greater, *Geococcyx californianus*
ROBIN, American, *Turdus migratorius*
Rufous-backed, *Turdus rufopalliatus*
Rufous-tailed, *Luscinia sibilans*
Siberian Blue, *Luscinia cyane*
ROCK–THRUSH, Blue, *Monticola solitarius*
ROSEFINCH, Common, *Carpodacus erythrinus*
ROSY–FINCH, Black, *Leucosticte atrata*
Brown-capped, *Leucosticte australis*
Gray-crowned, *Leucosticte tephrocotis*
RUBYTHROAT, Siberian, *Luscinia calliope*
RUFF, *Philomachus pugnax*
SANDERLING, *Calidris alba*
SANDPIPER, Baird's, *Calidris bairdii*
Broad-billed, *Limicola falcinellus*
Buff-breasted, *Tryngites subruficollis*
Common, *Actitis hypoleucos*
Curlew, *Calidris ferruginea*
Green, *Tringa ochropus*
Least, *Calidris minutilla*
Marsh, *Tringa stagnatilis*
Pectoral, *Calidris melanotos*
Purple, *Calidris maritima*
Rock, *Calidris ptilocnemis*
Semipalmated, *Calidris pusilla*
Sharp-tailed, *Calidris acuminata*
Solitary, *Tringa solitaria*
Spoon-billed, *Eurynorhynchus pygmeus*
Spotted, *Actitis macularius*
Stilt, *Calidris himantopus*
Terek, *Xenus cinereus*
Upland, *Bartramia longicauda*
Western, *Calidris mauri*
White-rumped, *Calidris fuscicollis*
Wood, *Tringa glareola*
SAND–PLOVER, Greater, *Charadrius leschenaultii*
Lesser, *Charadrius mongolus*
SAPSUCKER, Red-breasted, *Sphyrapicus ruber*
Red-naped, *Sphyrapicus nuchalis*
Williamson's, *Sphyrapicus thyroideus*
Yellow-bellied, *Sphyrapicus varius*
SCAUP, Greater, *Aythya marila*
Lesser, *Aythya affinis*
SCOPS-OWL, Oriental, *Otus sunia*
SCOTER, Black, *Melanitta americana*
Surf, *Melanitta perspicillata*
White-winged, *Melanitta fusca*
SCREECH-OWL, Eastern, *Megascops asio*
Puerto Rican, *Megascops nudipes*
Western, *Megascops kennicottii*
Whiskered, *Megascops trichopsis*
SCRUB-JAY, Florida, *Aphelocoma coerulescens*
Island, *Aphelocoma insularis*
Western, *Aphelocoma californica*
SEA-EAGLE, Steller's, *Haliaeetus pelagicus*
SEEDEATER, White-collared, *Sporophila torqueola*
SHEARWATER, Audubon's, *Puffinus lherminieri*
Black-vented, *Puffinus opisthomelas*
Buller's, *Puffinus bulleri*
Cape Verde, *Calonectris edwardsii*
Christmas, *Puffinus nativitatis*
Cory's, *Calonectris diomedea*
Flesh-footed, *Puffinus carneipes*
Great, *Puffinus gravis*
Little, *Puffinus assimilis*
Manx, *Puffinus puffinus*
Pink-footed, *Puffinus creatopus*
Short-tailed, *Puffinus tenuirostris*
Sooty, *Puffinus griseus*
Streaked, *Calonectris leucomelas*
Townsend's, *Puffinus auricularis*
Wedge-tailed, *Puffinus pacificus*
SHOVELER, Northern, *Anas clypeata*
SHRIKE, Brown, *Lanius cristatus*
Loggerhead, *Lanius ludovicianus*
Northern, *Lanius excubitor*
SILKY-FLYCATCHER, Gray, *Ptilogonys cinereus*
SISKIN, Eurasian, *Spinus spinus*
Pine, *Spinus pinus*
SKIMMER, Black, *Rynchops niger*
SKUA, Great, *Stercorarius skua*
South Polar, *Stercorarius maccormicki*
SMEW, *Mergellus albellus*
SNIPE, Common, *Gallinago gallinago*
Jack, *Lymnocryptes minimus*
Pin-tailed, *Gallinago stenura*
Swinhoe's, *Gallinago megala*
Wilson's, *Gallinago delicata*
SOLITAIRE, Townsend's, *Myadestes townsendi*
SORA, *Porzana carolina*
SPARROW, American Tree, *Spizella arborea*
Bachman's, *Peucaea aestivalis*
Baird's, *Ammodramus bairdii*
Black-chinned, *Spizella atrogularis*
Black-throated, *Amphispiza bilineata*
Botteri's, *Peucaea botterii*
Brewer's, *Spizella breweri*
Cassin's, *Peucaea cassinii*
Chipping, *Spizella passerina*
Clay-colored, *Spizella pallida*
Field, *Spizella pusilla*
Five-striped, *Amphispiza quinquestriata*
Fox, *Passerella iliaca*
Golden-crowned, *Zonotrichia atricapilla*
Grasshopper, *Ammodramus savannarum*
Harris's, *Zonotrichia querula*
Henslow's, *Ammodramus henslowii*
Lark, *Chondestes grammacus*
Le Conte's, *Ammodramus leconteii*
Lincoln's, *Melospiza lincolnii*
Nelson's, *Ammodramus nelsoni*
Olive, *Arremonops rufivirgatus*
Rufous-crowned, *Aimophila ruficeps*
Rufous-winged, *Peucaea carpalis*
Sage, *Amphispiza belli*
Saltmarsh, *Ammodramus caudacutus*
Savannah, *Passerculus sandwichensis*
Seaside, *Ammodramus maritimus*
Song, *Melospiza melodia*
Swamp, *Melospiza georgiana*
Vesper, *Pooecetes gramineus*
White-crowned, *Zonotrichia leucophrys*
White-throated, *Zonotrichia albicollis*
Worthen's, *Spizella wortheni*
SPARROWHAWK, Japanese, *Accipiter gularis*
SPINDALIS, Puerto Rican, *Spindalis portoricensis*

Western, *Spindalis zena*
SPOONBILL, Roseate, *Platalea ajaja*
STARLING, Chestnut-cheeked, *Sturnus philippensis*
White-cheeked, *Sturnus cineraceus*
STARTHROAT, Plain-capped, *Heliomaster constantii*
STILT, Black-necked, *Himantopus mexicanus*
Black-winged, *Himantopus himantopus*
STINT, Little, *Calidris minuta*
Long-toed, *Calidris subminuta*
Red-necked, *Calidris ruficollis*
Temminck's, *Calidris temminckii*
STONECHAT, *Saxicola torquatus*
STORK, Wood, *Mycteria americana*
STORM-PETREL, Ashy, *Oceanodroma homochroa*
Band-rumped, *Oceanodroma castro*
Black, *Oceanodroma melania*
Black-bellied, *Fregetta tropica*
Fork-tailed, *Oceanodroma furcata*
Leach's, *Oceanodroma leucorhoa*
Least, *Oceanodroma microsoma*
Matsudaira's, *Oceanodroma matsudairae*
Polynesian, *Nesofregetta fuliginosa*
Ringed, *Oceanodroma hornbyi*
Swinhoe's, *Oceanodroma monorhis*
Tristram's, *Oceanodroma tristrami*
Wedge-rumped, *Oceanodroma tethys*
White-faced, *Pelagodroma marina*
White-bellied, *Fregetta grallaria*
Wilson's, *Oceanites oceanicus*
SURFBIRD, *Aphriza virgata*
SWALLOW, Bahama, *Tachycineta cyaneoviridis*
Bank, *Riparia riparia*
Barn, *Hirundo rustica*
Cave, *Petrochelidon fulva*
Cliff, *Petrochelidon pyrrhonota*
Mangrove, *Tachycineta albilinea*
Northern Rough-winged, *Stelgidopteryx serripennis*
Tree, *Tachycineta bicolor*
Violet-green, *Tachycineta thalassina*
SWAMPHEN, Purple, *Porphyrio porphyrio*
SWAN, Trumpeter, *Cygnus buccinator*
Tundra, *Cygnus columbianus*
Whooper, *Cygnus cygnus*
SWIFT, Alpine, *Apus melba*
Black, *Cypseloides niger*
Chimney, *Chaetura pelagica*
Common, *Apus apus*
Fork-tailed, *Apus pacificus*
Short-tailed, *Chaetura brachyura*
Vaux's, *Chaetura vauxi*
White-collared, *Streptoprocne zonaris*
White-throated, *Aeronautes saxatalis*
SWIFTLET, Mariana, *Aerodramus bartschi*
White-rumped, *Aerodramus spodiopygius*
TANAGER, Flame-colored, *Piranga bidentata*
Hepatic, *Piranga flava*
Puerto Rican, *Nesospingus speculiferus*
Scarlet, *Piranga olivacea*
Summer, *Piranga rubra*
Western, *Piranga ludoviciana*
TATTLER, Gray-tailed, *Tringa brevipes*
Wandering, *Tringa incana*
TEAL, Baikal, *Anas formosa*
Blue-winged, *Anas discors*
Cinnamon, *Anas cyanoptera*
Green-winged, *Anas crecca*
TERN, Aleutian, *Onychoprion aleuticus*
Arctic, *Sterna paradisaea*
Black, *Chlidonias niger*
Black-naped, *Sterna sumatrana*
Bridled, *Onychoprion anaethetus*
Caspian, *Hydroprogne caspia*
Common, *Sterna hirundo*
Elegant, *Thalasseus elegans*
Forster's, *Sterna forsteri*
Gray-backed, *Onychoprion lunatus*
Great Crested, *Thalasseus bergii*
Gull-billed, *Gelochelidon nilotica*
Large-billed, *Phaetusa simplex*
Least, *Sternula antillarum*
Little, *Sternula albifrons*
Roseate, *Sterna dougallii*
Royal, *Thalesseus maximus*
Sandwich, *Thalesseus sandvicensis*
Sooty, *Onychoprion fuscatus*
Whiskered, *Chlidonias hybrida*
White, *Gygis alba*
White-winged, *Chlidonias leucopterus*
THRASHER, Bendire's, *Toxostoma bendirei*
Brown, *Toxostoma rufum*
California, *Toxostoma redivivum*
Crissal, *Toxostoma crissale*
Curve-billed, *Toxostoma curvirostre*
Le Conte's, *Toxostoma lecontei*
Long-billed, *Toxostoma longirostre*
Pearly-eyed, *Margarops fuscatus*
Sage, *Oreoscoptes montanus*
THRUSH, Aztec, *Ridgwayia pinicola*
Bicknell's, *Catharus bicknelli*
Clay-colored, *Turdus grayi*
Dusky, *Turdus naumanni*
Eyebrowed, *Turdus obscurus*
Gray-cheeked, *Catharus minimus*
Hermit, *Catharus guttatus*
Red-legged, *Turdus plumbeus*
Swainson's, *Catharus ustulatus*
Varied, *Ixoreus naevius*
White-throated, *Turdus assimilis*
Wood, *Hylocichla mustelina*
TITMOUSE, Black-crested, *Baeolophus atricristatus*
Bridled, *Baeolophus wollweberi*
Juniper, *Baeolophus ridgwayi*
Oak, *Baeolophus inornatus*
Tufted, *Baeolophus bicolor*
TITYRA, Masked, *Tityra semifasciata*
TOWHEE, Abert's, *Melozone aberti*
California, *Melozone crissalis*
Canyon, *Melozone fusca*
Eastern, *Pipilo erythrophthalmus*
Green-tailed, *Pipilo chlorurus*
Spotted, *Pipilo maculatus*
TROGON, Elegant, *Trogon elegans*
TROPICBIRD, Red-billed, *Phaethon aethereus*
Red-tailed, *Phaethon rubricauda*
White-tailed, *Phaethon lepturus*
TURNSTONE, Black, *Arenaria melanocephala*
Ruddy, *Arenaria interpres*
TURTLE-DOVE, Oriental, *Streptopelia orientalis*
VEERY, *Catharus fuscescens*
VERDIN, *Auriparus flaviceps*
VIOLETEAR, Green, *Colibri thalassinus*
VIREO, Bell's, *Vireo bellii*
Black-capped, *Vireo atricapilla*
Black-whiskered, *Vireo altiloquus*
Blue-headed, *Vireo solitarius*
Cassin's, *Vireo cassinii*
Gray, *Vireo vicinior*
Hutton's, *Vireo huttoni*
Philadelphia, *Vireo philadelphicus*
Plumbeous, *Vireo plumbeus*
Puerto Rican, *Vireo latimeri*
Red-eyed, *Vireo olivaceus*
Thick-billed, *Vireo crassirostris*
Warbling, *Vireo gilvus*
White-eyed, *Vireo griseus*
Yellow-green, *Vireo flavoviridis*
Yellow-throated, *Vireo flavifrons*
Yucatan, *Vireo magister*
VULTURE, Black, *Coragyps atratus*
Turkey, *Cathartes aura*
WAGTAIL, Citrine, *Motacilla citreola*
Eastern Yellow, *Motacilla tschutschensis*
Gray, *Motacilla cinerea*
White, *Motacilla alba*
WARBLER, Adelaide's, *Dendroica adelaidae*
Arctic, *Phylloscopus borealis*
Bachman's, *Vermivora bachmanii*
Bay-breasted, *Dendroica castanea*
Black-and-white, *Mniotilta varia*
Black-throated Blue, *Dendroica caerulescens*
Black-throated Gray, *Dendroica nigrescens*
Black-throated Green, *Dendroica virens*
Blackburnian, *Dendroica fusca*
Blackpoll, *Dendroica striata*
Blue-winged, *Vermivora cyanoptera*
Canada, *Wilsonia canadensis*
Cape May, *Dendroica tigrina*
Cerulean, *Dendroica cerulea*
Chestnut-sided, *Dendroica pensylvanica*
Colima, *Oreothlypis crissalis*
Connecticut, *Oporornis agilis*
Crescent-chested, *Oreothlypis superciliosa*
Dusky, *Phylloscopus fuscatus*
Elfin-woods, *Dendroica angelae*
Fan-tailed, *Euthlypis lachrymosa*
Golden-cheeked, *Dendroica chrysoparia*
Golden-crowned, *Basileuterus culicivorus*
Golden-winged, *Vermivora chrysoptera*

Grace's, *Dendroica graciae*
Hermit, *Dendroica occidentalis*
Hooded, *Wilsonia citrina*
Kentucky, *Oporornis formosus*
Kirtland's, *Dendroica kirtlandii*
Lanceolated, *Locustella lanceolata*
Lucy's, *Oreothlypis luciae*
MacGillivray's, *Oporornis tolmiei*
Magnolia, *Dendroica magnolia*
Mourning, *Oporornis philadelphia*
Nashville, *Oreothlypis ruficapilla*
Olive, *Peucedramus taeniatus*
Orange-crowned, *Oreothlypis celata*
Palm, *Dendroica palmarum*
Pine, *Dendroica pinus*
Prairie, *Dendroica discolor*
Prothonotary, *Protonotaria citrea*
Red-faced, *Cardellina rubrifrons*
Rufous-capped, *Basileuterus rufifrons*
Sedge, *Acrocephalus schoenobaenus*
Swainson's, *Limnothlypis swainsonii*
Tennessee, *Oreothlypis peregrina*
Townsend's, *Dendroica townsendi*
Virginia's, *Oreothlypis virginiae*
Willow, *Phylloscopus trochilus*
Wilson's, *Wilsonia pusilla*
Wood, *Phylloscopus sibilatrix*
Worm-eating, *Helmitheros vermivorum*
Yellow, *Dendroica petechia*
Yellow-browed, *Phylloscopus inornatus*
Yellow-rumped, *Dendroica coronata*
Yellow-throated, *Dendroica dominica*
WATERTHRUSH, Louisiana, *Parkesia motacilla*
Northern, *Parkesia noveboracensis*
WAXWING, Bohemian, *Bombycilla garrulus*
Cedar, *Bombycilla cedrorum*
WHEATEAR, Northern, *Oenanthe oenanthe*
WHIMBREL, *Numenius phaeopus*
WHIP-POOR-WILL, Eastern, *Caprimulgus vociferus*
Mexican, *Caprimulgus arizonae*
WHISTLING-DUCK, Black-bellied, *Dendrocygna autumnalis*
Fulvous, *Dendrocygna bicolor*
West Indian, *Dendrocygna arborea*
WHITETHROAT, Lesser, *Sylvia curruca*
WIGEON, American, *Anas americana*
Eurasian, *Anas penelope*
WILLET, *Tringa semipalmata*
WOOD-PEWEE, Eastern, *Contopus virens*
Western, *Contopus sordidulus*
WOODCOCK, American, *Scolopax minor*
Eurasian, *Scolopax rusticola*
WOODPECKER, Acorn, *Melanerpes formicivorus*
American Three-toed, *Picoides dorsalis*
Arizona, *Picoides arizonae*
Black-backed, *Picoides arcticus*
Downy, *Picoides pubescens*
Gila, *Melanerpes uropygialis*
Golden-fronted, *Melanerpes aurifrons*
Great Spotted, *Dendrocopos major*
Hairy, *Picoides villosus*
Ivory-billed, *Campephilus principalis*
Ladder-backed, *Picoides scalaris*
Lewis's, *Melanerpes lewis*
Nuttall's, *Picoides nuttallii*
Pileated, *Dryocopus pileatus*
Puerto Rican, *Melanerpes portoricensis*
Red-bellied, *Melanerpes carolinus*
Red-cockaded, *Picoides borealis*
Red-headed, *Melanerpes erythrocephalus*
White-headed, *Picoides albolarvatus*
WOODSTAR, Bahama, *Calliphlox evelynae*
WREN, Bewick's *Thryomanes bewickii*
Cactus, *Campylorhynchus brunneicapillus*
Canyon, *Catherpes mexicanus*
Carolina, *Thryothorus ludovicianus*
House, *Troglodytes aedon*
Marsh, *Cistothorus palustris*
Pacific, *Troglodytes pacificus*
Rock, *Salpinctes obsoletus*
Sedge, *Cistothorus platensis*
Sinaloa, *Thryothorus sinaloa*
Winter, *Troglodytes hiemalis*
WRENTIT, *Chamaea fasciata*
WRYNECK, Eurasian, *Jynx torquilla*
YELLOWLEGS, Greater, *Tringa melanoleuca*
Lesser, *Tringa flavipes*
YELLOWTHROAT, Common, *Geothlypis trichas*
Gray-crowned, *Geothlypis poliocephala*

(2) *Taxonomic listing.* Species are listed in phylogenetic sequence by scientific name, with the common (English) name following the scientific name. To help clarify species relationships, we also list the higher-level taxonomic categories of Order, Family, and Subfamily.

Order ANSERIFORMES
Family ANATIDAE
Subfamily DENDROCYGNINAE
Dendrocygna autumnalis, Black-bellied Whistling-Duck
Dendrocygna arborea, West Indian Whistling-Duck
Dendrocygna bicolor, Fulvous Whistling-Duck
Subfamily ANSERINAE
Anser fabalis, Taiga Bean-Goose
Anser serrirostris, Tundra Bean-Goose
Anser albifrons, Greater White-fronted Goose
Anser erythropus, Lesser White-fronted Goose
Chen canagica, Emperor Goose
Chen caerulescens, Snow Goose
Chen rossii, Ross's Goose
Branta bernicla, Brant
Branta leucopsis, Barnacle Goose
Branta canadensis, Canada Goose (including *Branta hutchinsii,* Cackling Goose)
Branta sandvicensis, Hawaiian Goose
Cygnus buccinator, Trumpeter Swan
Cygnus columbianus, Tundra Swan
Cygnus cygnus, Whooper Swan
Subfamily ANATINAE
Cairina moschata, Muscovy Duck
Aix sponsa, Wood Duck
Anas strepera, Gadwall
Anas falcata, Falcated Duck
Anas penelope, Eurasian Wigeon
Anas americana, American Wigeon
Anas rubripes, American Black Duck
Anas platyrhynchos, Mallard
Anas fulvigula, Mottled Duck
Anas wyvilliana, Hawaiian Duck
Anas laysanensis, Laysan Duck
Anas zonorhyncha, Eastern Spot-billed Duck
Anas superciliosa, Pacific Black Duck
Anas discors, Blue-winged Teal
Anas cyanoptera, Cinnamon Teal
Anas clypeata, Northern Shoveler
Anas bahamensis, White-cheeked Pintail
Anas acuta, Northern Pintail
Anas querquedula, Garganey
Anas formosa, Baikal Teal
Anas crecca, Green-winged Teal
Aythya valisineria, Canvasback
Aythya americana, Redhead
Aythya ferina, Common Pochard
Aythya baeri, Baer's Pochard
Aythya collaris, Ring-necked Duck
Aythya fuligula, Tufted Duck
Aythya marila, Greater Scaup
Aythya affinis, Lesser Scaup
Polysticta stelleri, Steller's Eider
Somateria fischeri, Spectacled Eider
Somateria spectabilis, King Eider
Somateria mollissima, Common Eider
Histrionicus histrionicus, Harlequin Duck
Melanitta perspicillata, Surf Scoter
Melanitta fusca, White-winged Scoter
Melanitta americana, Black Scoter
Clangula hyemalis, Long-tailed Duck
Bucephala albeola, Bufflehead
Bucephala clangula, Common Goldeneye
Bucephala islandica, Barrow's Goldeneye
Mergellus albellus, Smew
Lophodytes cucullatus, Hooded Merganser
Mergus merganser, Common Merganser
Mergus serrator, Red-breasted Merganser
Nomonyx dominicus, Masked Duck
Oxyura jamaicensis, Ruddy Duck
Order GAVIIFORMES
Family GAVIIDAE
Gavia stellata, Red-throated Loon
Gavia arctica, Arctic Loon
Gavia pacifica, Pacific Loon
Gavia immer, Common Loon
Gavia adamsii, Yellow-billed Loon
Order PODICIPEDIFORMES
Family PODICIPEDIDAE

Tachybaptus dominicus, Least Grebe
Podilymbus podiceps, Pied-billed Grebe
Podiceps auritus, Horned Grebe
Podiceps grisegena, Red-necked Grebe
Podiceps nigricollis, Eared Grebe
Aechmophorus occidentalis, Western Grebe
Aechmophorus clarkii, Clark's Grebe
Order PHOENICOPTERIFORMES
Family PHOENICOPTERIDAE
Phoenicopterus ruber, American Flamingo
Order PROCELLARIIFORMES
Family DIOMEDEIDAE
Thalassarche chlororhynchos, Yellow-nosed Albatross
Thalassarche cauta, Shy Albatross
Thalassarche melanophris, Black-browed Albatross
Phoebetria palpebrata, Light-mantled Albatross
Diomedea exulans, Wandering Albatross
Phoebastria immutabilis, Laysan Albatross
Phoebastria nigripes, Black-footed Albatross
Phoebastria albatrus, Short-tailed Albatross
Family PROCELLARIIDAE
Fulmarus glacialis, Northern Fulmar
Pterodroma macroptera, Great-winged Petrel
Pterodroma neglecta, Kermadec Petrel
Pterodroma arminjoniana, Herald Petrel
Pterodroma ultima, Murphy's Petrel
Pterodroma inexpectata, Mottled Petrel
Pterodroma cahow, Bermuda Petrel
Pterodroma hasitata, Black-capped Petrel
Pterodroma externa, Juan Fernandez Petrel
Pterodroma sandwichensis, Hawaiian Petrel
Pterodroma cervicalis, White-necked Petrel
Pterodroma hypoleuca, Bonin Petrel
Pterodroma nigripennis, Black-winged Petrel
Pterodroma cookii, Cook's Petrel
Pterodroma longirostris, Stejneger's Petrel
Pterodroma alba, Phoenix Petrel
Pterodroma leucoptera, Gould's Petrel
Pterodroma rostrata, Tahiti Petrel
Bulweria bulwerii, Bulwer's Petrel
Bulweria fallax, Jouanin's Petrel
Procellaria parkinsoni, Parkinson's Petrel
Calonectris leucomelas, Streaked Shearwater
Calonectris diomedea, Cory's Shearwater
Calonectris edwardsii, Cape Verde Shearwater
Puffinus creatopus, Pink-footed Shearwater
Puffinus carneipes, Flesh-footed Shearwater
Puffinus gravis, Great Shearwater
Puffinus pacificus, Wedge-tailed Shearwater
Puffinus bulleri, Buller's Shearwater
Puffinus griseus, Sooty Shearwater
Puffinus tenuirostris, Short-tailed Shearwater
Puffinus nativitatis, Christmas Shearwater
Puffinus puffinus, Manx Shearwater
Puffinus auricularis, Townsend's Shearwater
Puffinus opisthomelas, Black-vented Shearwater
Puffinus lherminieri, Audubon's Shearwater
Puffinus assimilis, Little Shearwater
Family HYDROBATIDAE
Oceanites oceanicus, Wilson's Storm-Petrel
Pelagodroma marina, White-faced Storm-Petrel
Fregetta tropica, Black-bellied Storm-Petrel
Fregetta grallaria, White-bellied Storm-Petrel
Nesofregetta fuliginosa, Polynesian Storm-Petrel
Oceanodroma furcata, Fork-tailed Storm-Petrel
Oceanodroma hornbyi, Ringed Storm-Petrel
Oceanodroma monorhis, Swinhoe's Storm-Petrel
Oceanodroma leucorhoa, Leach's Storm-Petrel
Oceanodroma homochroa, Ashy Storm-Petrel
Oceanodroma castro, Band-rumped Storm-Petrel
Oceanodroma tethys, Wedge-rumped Storm-Petrel
Oceanodroma matsudairae, Matsudaira's Storm-Petrel
Oceanodroma melania, Black Storm-Petrel
Oceanodroma tristrami, Tristram's Storm-Petrel
Oceanodroma microsoma, Least Storm-Petrel
Order PHAETHONTIFORMES
Family PHAETHONTIDAE
Phaethon lepturus, White-tailed Tropicbird
Phaethon aethereus, Red-billed Tropicbird
Phaethon rubricauda, Red-tailed Tropicbird
Order CICONIIFORMES
Family CICONIIDAE
Jabiru mycteria, Jabiru
Mycteria americana, Wood Stork
Order SULIFORMES
Family FREGATIDAE
Fregata magnificens, Magnificent Frigatebird
Fregata minor, Great Frigatebird
Fregata ariel, Lesser Frigatebird
Family SULIDAE
Sula dactylatra, Masked Booby
Sula nebouxii, Blue-footed Booby
Sula leucogaster, Brown Booby
Sula sula, Red-footed Booby
Morus bassanus, Northern Gannet
Family PHALACROCORACIDAE
Phalacrocorax penicillatus, Brandt's Cormorant
Phalacrocorax brasilianus, Neotropic Cormorant
Phalacrocorax auritus, Double-crested Cormorant
Phalacrocorax carbo, Great Cormorant
Phalacrocorax urile, Red-faced Cormorant
Phalacrocorax pelagicus, Pelagic Cormorant
Phalacrocorax melanoleucos, Little Pied Cormorant
Family ANHINGIDAE
Anhinga anhinga, Anhinga
Order PELECANIFORMES
Family PELECANIDAE
Pelecanus erythrorhynchos, American White Pelican
Pelecanus occidentalis, Brown Pelican
Family ARDEIDAE
Botaurus lentiginosus, American Bittern
Ixobrychus sinensis, Yellow Bittern
Ixobrychus exilis, Least Bittern
Ixobrychus eurhythmus, Schrenck's Bittern
Ixobrychus flavicollis, Black Bittern
Ardea herodias, Great Blue Heron
Ardea cinerea, Gray Heron
Ardea alba, Great Egret
Mesophoyx intermedia, Intermediate Egret
Egretta eulophotes, Chinese Egret
Egretta garzetta, Little Egret
Egretta sacra, Pacific Reef-Egret
Egretta gularis, Western Reef-Heron
Egretta thula, Snowy Egret
Egretta caerulea, Little Blue Heron
Egretta tricolor, Tricolored Heron
Egretta rufescens, Reddish Egret
Bubulcus ibis, Cattle Egret
Ardeola bacchus, Chinese Pond-Heron
Butorides virescens, Green Heron
Nycticorax nycticorax, Black-crowned Night-Heron
Nyctanassa violacea, Yellow-crowned Night-Heron
Gorsachius goisagi, Japanese Night-Heron
Gorsachius melanolophus, Malayan Night-Heron
Family THRESKIORNITHIDAE
Subfamily THRESKIORNITHINAE
Eudocimus albus, White Ibis
Eudocimus ruber, Scarlet Ibis
Plegadis falcinellus, Glossy Ibis
Plegadis chihi, White-faced Ibis

Subfamily PLATALEINAE
Platalea ajaja, Roseate Spoonbill
Order ACCIPITRIFORMES
Family CATHARTIDAE
Coragyps atratus, Black Vulture
Cathartes aura, Turkey Vulture
Gymnogyps californianus, California Condor
Family PANDIONIDAE
Pandion haliaetus, Osprey
Family ACCIPITRIDAE
Chondrohierax uncinatus, Hook-billed Kite
Elanoides forficatus, Swallow-tailed Kite
Elanus leucurus, White-tailed Kite
Rostrhamus sociabilis, Snail Kite
Ictinia mississippiensis, Mississippi Kite
Milvus migrans, Black Kite
Haliaeetus leucocephalus, Bald Eagle
Haliaeetus albicilla, White-tailed Eagle
Haliaeetus pelagicus, Steller's Sea-Eagle
Circus cyaneus, Northern Harrier
Accipiter soloensis, Gray Frog-Hawk
Accipiter gularis, Japanese Sparrowhawk
Accipiter striatus, Sharp-shinned Hawk
Accipiter cooperii, Cooper's Hawk
Accipiter gentilis, Northern Goshawk
Geranospiza caerulescens, Crane Hawk
Buteogallus anthracinus, Common Black-Hawk
Parabuteo unicinctus, Harris's Hawk
Buteo magnirostris, Roadside Hawk
Buteo lineatus, Red-shouldered Hawk
Buteo platypterus, Broad-winged Hawk
Buteo nitidus, Gray Hawk
Buteo brachyurus, Short-tailed Hawk
Buteo swainsoni, Swainson's Hawk
Buteo albicaudatus, White-tailed Hawk
Buteo albonotatus, Zone-tailed Hawk
Buteo solitarius, Hawaiian Hawk
Buteo jamaicensis, Red-tailed Hawk
Buteo regalis, Ferruginous Hawk
Buteo lagopus, Rough-legged Hawk
Aquila chrysaetos, Golden Eagle
Order FALCONIFORMES
Family FALCONIDAE
Subfamily MICRASTURINAE
Micrastur semitorquatus, Collared Forest-Falcon
Subfamily CARACARINAE
Caracara cheriway, Crested Caracara
Subfamily FALCONINAE
Falco tinnunculus, Eurasian Kestrel
Falco sparverius, American Kestrel
Falco vespertinus, Red-footed Falcon
Falco columbarius, Merlin
Falco subbuteo, Eurasian Hobby
Falco femoralis, Aplomado Falcon
Falco rusticolus, Gyrfalcon
Falco peregrinus, Peregrine Falcon
Falco mexicanus, Prairie Falcon
Order GRUIFORMES
Family RALLIDAE
Coturnicops noveboracensis, Yellow Rail
Laterallus jamaicensis, Black Rail
Gallirallus philippensis, Buff-banded Rail
Gallirallus owstoni, Guam Rail
Crex crex, Corn Crake
Rallus longirostris, Clapper Rail
Rallus elegans, King Rail
Rallus limicola, Virginia Rail
Porzana carolina, Sora
Porzana tabuensis, Spotless Crake
Porzana flaviventer, Yellow-breasted Crake
Neocrex erythrops, Paint-billed Crake
Pardirallus maculatus, Spotted Rail
Porphyrio porphyrio, Purple Swamphen
Porphyrio martinica, Purple Gallinule
Porphyrio flavirostris, Azure Gallinule
Gallinula chloropus, Common Moorhen
Fulica atra, Eurasian Coot
Fulica alai, Hawaiian Coot
Fulica americana, American Coot
Fulica caribaea, Caribbean Coot
Family ARAMIDAE
Aramus guarauna, Limpkin
Family GRUIDAE
Grus canadensis, Sandhill Crane
Grus grus, Common Crane
Grus americana, Whooping Crane
Order CHARADRIIFORMES
Family CHARADRIIDAE
Subfamily VANELLINAE
Vanellus vanellus, Northern Lapwing
Subfamily CHARADRIINAE
Pluvialis squatarola, Black-bellied Plover
Pluvialis apricaria, European Golden-Plover
Pluvialis dominica, American Golden-Plover
Pluvialis fulva, Pacific Golden-Plover
Charadrius mongolus, Lesser Sand-Plover
Charadrius leschenaultii, Greater Sand-Plover
Charadrius collaris, Collared Plover
Charadrius alexandrinus, Snowy Plover
Charadrius wilsonia, Wilson's Plover
Charadrius hiaticula, Common Ringed Plover
Charadrius semipalmatus, Semipalmated Plover
Charadrius melodus, Piping Plover
Charadrius dubius, Little Ringed Plover
Charadrius vociferus, Killdeer
Charadrius montanus, Mountain Plover
Charadrius morinellus, Eurasian Dotterel
Family HAEMATOPODIDAE
Haematopus ostralegus, Eurasian Oystercatcher
Haematopus palliatus, American Oystercatcher
Haematopus bachmani, Black Oystercatcher
Family RECURVIROSTRIDAE
Himantopus himantopus, Black-winged Stilt
Himantopus mexicanus, Black-necked Stilt
Recurvirostra americana, American Avocet
Family JACANIDAE
Jacana spinosa, Northern Jacana
Family SCOLOPACIDAE
Subfamily SCOLOPACINAE
Xenus cinereus, Terek Sandpiper
Actitis hypoleucos, Common Sandpiper
Actitis macularius, Spotted Sandpiper
Tringa ochropus, Green Sandpiper
Tringa solitaria, Solitary Sandpiper
Tringa brevipes, Gray-tailed Tattler
Tringa incana, Wandering Tattler
Tringa erythropus, Spotted Redshank
Tringa melanoleuca, Greater Yellowlegs
Tringa nebularia, Common Greenshank
Tringa guttifer, Nordmann's Greenshank
Tringa semipalmata, Willet
Tringa flavipes, Lesser Yellowlegs
Tringa stagnatilis, Marsh Sandpiper
Tringa glareola, Wood Sandpiper
Bartramia longicauda, Upland Sandpiper
Numenius minutus, Little Curlew
Numenius borealis, Eskimo Curlew
Numenius phaeopus, Whimbrel
Numenius tahitiensis, Bristle-thighed Curlew
Numenius madagascariensis, Far Eastern Curlew
Numenius arquata, Eurasian Curlew
Numenius americanus, Long-billed Curlew
Limosa limosa, Black-tailed Godwit
Limosa haemastica, Hudsonian Godwit
Limosa lapponica, Bar-tailed Godwit
Limosa fedoa, Marbled Godwit
Arenaria interpres, Ruddy Turnstone
Arenaria melanocephala, Black Turnstone
Aphriza virgata, Surfbird
Calidris tenuirostris, Great Knot
Calidris canutus, Red Knot
Calidris alba, Sanderling
Calidris pusilla, Semipalmated Sandpiper
Calidris mauri, Western Sandpiper
Calidris ruficollis, Red-necked Stint
Calidris minuta, Little Stint
Calidris temminckii, Temminck's Stint
Calidris subminuta, Long-toed Stint
Calidris minutilla, Least Sandpiper
Calidris fuscicollis, White-rumped

Sandpiper
Calidris bairdii, Baird's Sandpiper
Calidris melanotos, Pectoral Sandpiper
Calidris acuminata, Sharp-tailed Sandpiper
Calidris maritima, Purple Sandpiper
Calidris ptilocnemis, Rock Sandpiper
Calidris alpina, Dunlin
Calidris ferruginea, Curlew Sandpiper
Calidris himantopus, Stilt Sandpiper
Eurynorhynchus pygmeus, Spoon-billed Sandpiper
Limicola falcinellus, Broad-billed Sandpiper
Tryngites subruficollis, Buff-breasted Sandpiper
Philomachus pugnax, Ruff
Limnodromus griseus, Short-billed Dowitcher
Limnodromus scolopaceus, Long-billed Dowitcher
Lymnocryptes minimus, Jack Snipe
Gallinago delicata, Wilson's Snipe
Gallinago gallinago, Common Snipe
Gallinago stenura, Pin-tailed Snipe
Gallinago megala, Swinhoe's Snipe
Scolopax rusticola, Eurasian Woodcock
Scolopax minor, American Woodcock
Subfamily PHALAROPODINAE
Phalaropus tricolor, Wilson's Phalarope
Phalaropus lobatus, Red-necked Phalarope
Phalaropus fulicarius, Red Phalarope
Family LARIDAE
Subfamily LARINAE
Creagrus furcatus, Swallow-tailed Gull
Rissa tridactyla, Black-legged Kittiwake
Rissa brevirostris, Red-legged Kittiwake
Pagophila eburnea, Ivory Gull
Xema sabini, Sabine's Gull
Chroicocephalus philadelphia, Bonaparte's Gull
Chroicocephalus cirrocephalus, Gray-hooded Gull
Chroicocephalus ridibundus, Black-headed Gull
Hydrocoloeus minutus, Little Gull
Rhodostethia rosea, Ross's Gull
Leucophaeus atricilla, Laughing Gull
Leucophaeus pipixcan, Franklin's Gull
Larus belcheri, Belcher's Gull
Larus crassirostris, Black-tailed Gull
Larus heermanni, Heermann's Gull
Larus canus, Mew Gull
Larus delawarensis, Ring-billed Gull
Larus occidentalis, Western Gull
Larus livens, Yellow-footed Gull
Larus californicus, California Gull
Larus argentatus, Herring Gull
Larus michahellis, Yellow-legged Gull
Larus thayeri, Thayer's Gull
Larus glaucoides, Iceland Gull
Larus fuscus, Lesser Black-backed Gull
Larus schistisagus, Slaty-backed Gull
Larus glaucescens, Glaucous-winged Gull
Larus hyperboreus, Glaucous Gull
Larus marinus, Great Black-backed Gull
Larus dominicanus, Kelp Gull
Subfamily STERNINAE
Anous stolidus, Brown Noddy
Anous minutus, Black Noddy
Procelsterna cerulea, Blue-gray Noddy
Gygis alba, White Tern
Onychoprion fuscatus, Sooty Tern
Onychoprion lunatus, Gray-backed Tern
Onychoprion anaethetus, Bridled Tern
Onychoprion aleuticus, Aleutian Tern
Sternula albifrons, Little Tern
Sternula antillarum, Least Tern
Phaetusa simplex, Large-billed Tern
Gelochelidon nilotica, Gull-billed Tern
Hydroprogne caspia, Caspian Tern
Chlidonias niger, Black Tern
Chlidonias leucopterus, White-winged Tern
Chlidonias hybridus, Whiskered Tern
Sterna dougallii, Roseate Tern
Sterna sumatrana, Black-naped Tern
Sterna hirundo, Common Tern
Sterna paradisaea, Arctic Tern
Sterna forsteri, Forster's Tern
Thalasseus maximus, Royal Tern
Thalasseus bergii, Great Crested Tern
Thalasseus sandvicensis, Sandwich Tern
Thalasseus elegans, Elegant Tern
Subfamily RYNCHOPINAE
Rynchops niger, Black Skimmer
Family STERCORARIIDAE
Stercorarius skua, Great Skua
Stercorarius maccormicki, South Polar Skua
Stercorarius pomarinus, Pomarine Jaeger
Stercorarius parasiticus, Parasitic Jaeger
Stercorarius longicaudus, Long-tailed Jaeger
Family ALCIDAE
Alle alle, Dovekie
Uria aalge, Common Murre
Uria lomvia, Thick-billed Murre
Alca torda, Razorbill
Cepphus grylle, Black Guillemot
Cepphus columba, Pigeon Guillemot
Brachyramphus perdix, Long-billed Murrelet
Brachyramphus marmoratus, Marbled Murrelet
Brachyramphus brevirostris, Kittlitz's Murrelet
Synthliboramphus hypoleucus, Xantus's Murrelet
Synthliboramphus craveri, Craveri's Murrelet
Synthliboramphus antiquus, Ancient Murrelet
Ptychoramphus aleuticus, Cassin's Auklet
Aethia psittacula, Parakeet Auklet
Aethia pusilla, Least Auklet
Aethia pygmaea, Whiskered Auklet
Aethia cristatella, Crested Auklet
Cerorhinca monocerata, Rhinoceros Auklet
Fratercula arctica, Atlantic Puffin
Fratercula corniculata, Horned Puffin
Fratercula cirrhata, Tufted Puffin
Order COLUMBIFORMES
Family COLUMBIDAE
Patagioenas squamosa, Scaly-naped Pigeon
Patagioenas leucocephala, White-crowned Pigeon
Patagioenas flavirostris, Red-billed Pigeon
Patagioenas inornata, Plain Pigeon
Patagioenas fasciata, Band-tailed Pigeon
Streptopelia orientalis, Oriental Turtle-Dove
Zenaida asiatica, White-winged Dove
Zenaida aurita, Zenaida Dove
Zenaida macroura, Mourning Dove
Columbina inca, Inca Dove
Columbina passerina, Common Ground-Dove
Columbina talpacoti, Ruddy Ground-Dove
Leptotila verreauxi, White-tipped Dove
Geotrygon chrysia, Key West Quail-Dove
Geotrygon mystacea, Bridled Quail-Dove
Geotrygon montana, Ruddy Quail-Dove
Gallicolumba xanthonura, White-throated Ground-Dove
Gallicolumba stairi, Friendly Ground-Dove
Ptilinopus perousii, Many-colored Fruit-Dove
Ptilinopus porphyraceus, Crimson-crowned Fruit-Dove
Ptilinopus roseicapilla, Mariana Fruit-Dove
Ducula pacifica, Pacific Imperial-Pigeon
Order CUCULIFORMES
Family CUCULIDAE
Subfamily CUCULINAE
Cuculus fugax, Hodgson's Hawk-Cuckoo
Cuculus canorus, Common Cuckoo
Cuculus optatus, Oriental Cuckoo
Coccyzus americanus, Yellow-billed Cuckoo
Coccyzus minor, Mangrove Cuckoo
Coccyzus erythropthalmus, Black-billed Cuckoo
Coccyzus vieilloti, Puerto Rican Lizard-Cuckoo

Subfamily NEOMORPHINAE
Geococcyx californianus, Greater Roadrunner
Subfamily CROTOPHAGINAE
Crotophaga ani, Smooth-billed Ani
Crotophaga sulcirostris, Groove-billed Ani
Order STRIGIFORMES
Family TYTONIDAE
Tyto alba, Barn Owl
Family STRIGIDAE
Otus flammeolus, Flammulated Owl
Otus sunia, Oriental Scops-Owl
Megascops kennicottii, Western Screech-Owl
Megascops asio, Eastern Screech-Owl
Megascops trichopsis, Whiskered Screech-Owl
Megascops nudipes, Puerto Rican Screech-Owl
Bubo virginianus, Great Horned Owl
Bubo scandiacus, Snowy Owl
Surnia ulula, Northern Hawk Owl
Glaucidium gnoma, Northern Pygmy-Owl
Glaucidium brasilianum, Ferruginous Pygmy-Owl
Micrathene whitneyi, Elf Owl
Athene cunicularia, Burrowing Owl
Ciccaba virgata, Mottled Owl
Strix occidentalis, Spotted Owl
Strix varia, Barred Owl
Strix nebulosa, Great Gray Owl
Asio otus, Long-eared Owl
Asio stygius, Stygian Owl
Asio flammeus, Short-eared Owl
Aegolius funereus, Boreal Owl
Aegolius acadicus, Northern Saw-whet Owl
Ninox scutulata, Brown Hawk-Owl
Order CAPRIMULGIFORMES
Family CAPRIMULGIDAE
Subfamily CHORDEILINAE
Chordeiles acutipennis, Lesser Nighthawk
Chordeiles minor, Common Nighthawk
Chordeiles gundlachii, Antillean Nighthawk
Subfamily CAPRIMULGINAE
Nyctidromus albicollis, Common Pauraque
Phalaenoptilus nuttallii, Common Poorwill
Caprimulgus carolinensis, Chuck-will's-widow
Caprimulgus ridgwayi, Buff-collared Nightjar
Caprimulgus vociferus, Eastern Whip-poor-will
Caprimulgus arizonae, Mexican Whip-poor-will
Caprimulgus noctitherus, Puerto Rican Nightjar
Caprimulgus indicus, Gray Nightjar
Order APODIFORMES
Family APODIDAE
Subfamily CYPSELOIDINAE
Cypseloides niger, Black Swift
Streptoprocne zonaris, White-collared Swift
Subfamily CHAETURINAE
Chaetura pelagica, Chimney Swift
Chaetura vauxi, Vaux's Swift
Chaetura brachyura, Short-tailed Swift
Hirundapus caudacutus, White-throated Needletail
Aerodramus spodiopygius, White-rumped Swiftlet
Aerodramus bartschi, Mariana Swiftlet
Subfamily APODINAE
Apus apus, Common Swift
Apus pacificus, Fork-tailed Swift
Apus melba, Alpine Swift
Aeronautes saxatalis, White-throated Swift
Tachornis phoenicobia, Antillean Palm-Swift
Family TROCHILIDAE
Subfamily TROCHILINAE
Colibri thalassinus, Green Violetear
Anthracothorax prevostii, Green-breasted Mango
Anthracothorax dominicus, Antillean Mango
Anthracothorax viridis, Green Mango
Eulampis jugularis, Purple-throated Carib
Eulampis holosericeus, Green-throated Carib
Orthorhyncus cristatus, Antillean Crested Hummingbird
Chlorostilbon maugaeus, Puerto Rican Emerald
Cynanthus latirostris, Broad-billed Hummingbird
Hylocharis leucotis, White-eared Hummingbird
Hylocharis xantusii, Xantus's Hummingbird
Amazilia beryllina, Berylline Hummingbird
Amazilia yucatanensis, Buff-bellied Hummingbird
Amazilia rutila, Cinnamon Hummingbird
Amazilia violiceps, Violet-crowned Hummingbird
Lampornis clemenciae, Blue-throated Hummingbird
Eugenes fulgens, Magnificent Hummingbird
Heliomaster constantii, Plain-capped Starthroat
Calliphlox evelynae, Bahama Woodstar
Calothorax lucifer, Lucifer Hummingbird
Archilochus colubris, Ruby-throated Hummingbird
Archilochus alexandri, Black-chinned Hummingbird
Calypte anna, Anna's Hummingbird
Calypte costae, Costa's Hummingbird
Stellula calliope, Calliope Hummingbird
Atthis heloisa, Bumblebee Hummingbird
Selasphorus platycercus, Broad-tailed Hummingbird
Selasphorus rufus, Rufous Hummingbird
Selasphorus sasin, Allen's Hummingbird
Order TROGONIFORMES
Family TROGONIDAE
Subfamily TROGONINAE
Trogon elegans, Elegant Trogon
Euptilotis neoxenus, Eared Quetzel
Order UPUPIFORMES
Family UPUPIDAE
Upupa epops, Eurasian Hoopoe
Order CORACIIFORMES
Family ALCEDINIDAE
Subfamily HALCYONINAE
Todirhamphus cinnamominus, Micronesian Kingfisher
Todirhamphus chloris, Collared Kingfisher
Subfamily CERYLINAE
Megaceryle torquata, Ringed Kingfisher
Megaceryle alcyon, Belted Kingfisher
Chloroceryle americana, Green Kingfisher
Order PICIFORMES
Family PICIDAE
Subfamily JYNGINAE
Jynx torquilla, Eurasian Wryneck
Subfamily PICINAE
Melanerpes lewis, Lewis's Woodpecker
Melanerpes portoricensis, Puerto Rican Woodpecker
Melanerpes erythrocephalus, Red-headed Woodpecker
Melanerpes formicivorus, Acorn Woodpecker
Melanerpes uropygialis, Gila Woodpecker
Melanerpes aurifrons, Golden-fronted Woodpecker
Melanerpes carolinus, Red-bellied Woodpecker
Sphyrapicus thyroideus, Williamson's Sapsucker
Sphyrapicus varius, Yellow-bellied Sapsucker
Sphyrapicus nuchalis, Red-naped Sapsucker
Sphyrapicus ruber, Red-breasted Sapsucker
Dendrocopos major, Great Spotted Woodpecker
Picoides scalaris, Ladder-backed Woodpecker
Picoides nuttallii, Nuttall's Woodpecker
Picoides pubescens, Downy Woodpecker
Picoides villosus, Hairy Woodpecker
Picoides arizonae, Arizona Woodpecker
Picoides borealis, Red-cockaded Woodpecker

Picoides albolarvatus, White-headed Woodpecker
Picoides dorsalis, American Three-toed Woodpecker
Picoides arcticus, Black-backed Woodpecker
Colaptes auratus, Northern Flicker
Colaptes chrysoides, Gilded Flicker
Dryocopus pileatus, Pileated Woodpecker
Campephilus principalis, Ivory-billed Woodpecker
Order PASSERIFORMES
Family TYRANNIDAE
Subfamily ELAENIINAE
Camptostoma imberbe, Northern Beardless-Tyrannulet
Myiopagis viridicata, Greenish Elaenia
Elaenia martinica, Caribbean Elaenia
Elaenia albiceps, White-crested Eleania
Subfamily FLUVICOLINAE
Mitrephanes phaeocercus, Tufted Flycatcher
Contopus cooperi, Olive-sided Flycatcher
Contopus pertinax, Greater Pewee
Contopus sordidulus, Western Wood-Pewee
Contopus virens, Eastern Wood-Pewee
Contopus caribaeus, Cuban Pewee
Contopus hispaniolensis, Hispaniolan Pewee
Contopus latirostris, Lesser Antillean Pewee
Empidonax flaviventris, Yellow-bellied Flycatcher
Empidonax virescens, Acadian Flycatcher
Empidonax alnorum, Alder Flycatcher
Empidonax traillii, Willow Flycatcher
Empidonax minimus, Least Flycatcher
Empidonax hammondii, Hammond's Flycatcher
Empidonax wrightii, Gray Flycatcher
Empidonax oberholseri, Dusky Flycatcher
Empidonax difficilis, Pacific-slope Flycatcher
Empidonax occidentalis, Cordilleran Flycatcher
Empidonax fulvifrons, Buff-breasted Flycatcher
Sayornis nigricans, Black Phoebe
Sayornis phoebe, Eastern Phoebe
Sayornis saya, Say's Phoebe
Pyrocephalus rubinus, Vermilion Flycatcher
Subfamily TYRANNINAE
Myiarchus tuberculifer, Dusky-capped Flycatcher
Myiarchus cinerascens, Ash-throated Flycatcher
Myiarchus nuttingi, Nutting's Flycatcher
Myiarchus crinitus, Great Crested Flycatcher
Myiarchus tyrannulus, Brown-crested Flycatcher
Myiarchus sagrae, La Sagra's Flycatcher
Myiarchus antillarum, Puerto Rican Flycatcher
Pitangus sulphuratus, Great Kiskadee
Myiozetetes similis, Social Flycatcher
Myiodynastes luteiventris, Sulphur-bellied Flycatcher
Legatus leucophalus, Piratic Flycatcher
Empidonomus varius, Variegated Flycatcher
Empidonomus aurantioatrocristatus, Crowned Slaty Flycatcher
Tyrannus melancholicus, Tropical Kingbird
Tyrannus couchii, Couch's Kingbird
Tyrannus vociferans, Cassin's Kingbird
Tyrannus crassirostris, Thick-billed Kingbird
Tyrannus verticalis, Western Kingbird
Tyrannus tyrannus, Eastern Kingbird
Tyrannus dominicensis, Gray Kingbird
Tyrannus caudifasciatus, Loggerhead Kingbird
Tyrannus forficatus, Scissor-tailed Flycatcher
Tyrannus savana, Fork-tailed Flycatcher
Pachyramphus aglaiae, Rose-throated Becard
Tityra semifasciata, Masked Tityra
Family LANIIDAE
Lanius cristatus, Brown Shrike
Lanius ludovicianus, Loggerhead Shrike
Lanius excubitor, Northern Shrike
Family VIREONIDAE
Vireo griseus, White-eyed Vireo
Vireo crassirostris, Thick-billed Vireo
Vireo latimeri, Puerto Rican Vireo
Vireo bellii, Bell's Vireo
Vireo atricapilla, Black-capped Vireo
Vireo vicinior, Gray Vireo
Vireo flavifrons, Yellow-throated Vireo
Vireo plumbeus, Plumbeous Vireo
Vireo cassinii, Cassin's Vireo
Vireo solitarius, Blue-headed Vireo
Vireo huttoni, Hutton's Vireo
Vireo gilvus, Warbling Vireo
Vireo philadelphicus, Philadelphia Vireo
Vireo olivaceus, Red-eyed Vireo
Vireo flavoviridis, Yellow-green Vireo
Vireo altiloquus, Black-whiskered Vireo
Vireo magister, Yucatan Vireo
Family CORVIDAE
Perisoreus canadensis, Gray Jay
Psilorhinus morio, Brown Jay
Cyanocorax yncas, Green Jay
Gymnorhinus cyanocephalus, Pinyon Jay
Cyanocitta stelleri, Steller's Jay
Cyanocitta cristata, Blue Jay
Aphelocoma coerulescens, Florida Scrub-Jay
Aphelocoma insularis, Island Scrub-Jay
Aphelocoma californica, Western Scrub-Jay
Aphelocoma ultramarina, Mexican Jay
Nucifraga columbiana, Clark's Nutcracker
Pica hudsonia, Black-billed Magpie
Pica nuttalli, Yellow-billed Magpie
Corvus kubaryi, Mariana Crow
Corvus brachyrhynchos, American Crow
Corvus caurinus, Northwestern Crow
Corvus leucognaphalus, White-necked Crow
Corvus imparatus, Tamaulipas Crow
Corvus ossifragus, Fish Crow
Corvus hawaiiensis, Hawaiian Crow
Corvus cryptoleucus, Chihuahuan Raven
Corvus corax, Common Raven
Family ALAUDIDAE
Alauda arvensis, Sky Lark
Eremophila alpestris, Horned Lark
Family HIRUNDINIDAE
Subfamily HIRUNDININAE
Progne subis, Purple Martin
Progne cryptoleuca, Cuban Martin
Progne dominicensis, Caribbean Martin
Progne chalybea, Gray-breasted Martin
Progne elegans, Southern Martin
Progne tapera, Brown-chested Martin
Tachycineta bicolor, Tree Swallow
Tachycineta albilinea, Mangrove Swallow
Tachycineta thalassina, Violet-green Swallow
Tachycineta cyaneoviridis, Bahama Swallow
Stelgidopteryx serripennis, Northern Rough-winged Swallow
Riparia riparia, Bank Swallow
Petrochelidon pyrrhonota, Cliff Swallow
Petrochelidon fulva, Cave Swallow
Hirundo rustica, Barn Swallow
Delichon urbicum, Common House-Martin
Family PARIDAE
Poecile carolinensis, Carolina Chickadee
Poecile atricapillus, Black-capped Chickadee
Poecile gambeli, Mountain Chickadee
Poecile sclateri, Mexican Chickadee
Poecile rufescens, Chestnut-backed Chickadee
Poecile hudsonicus, Boreal Chickadee
Poecile cinctus, Gray-headed Chickadee
Baeolophus wollweberi, Bridled Titmouse

Baeolophus inornatus, Oak Titmouse
Baeolophus ridgwayi, Juniper Titmouse
Baeolophus bicolor, Tufted Titmouse
Baeolophus atricristatus, Black-crested Titmouse
Family REMIZIDAE
Auriparus flaviceps, Verdin
Family AEGITHALIDAE
Psaltriparus minimus, Bushtit
Family SITTIDAE
Subfamily SITTINAE
Sitta canadensis, Red-breasted Nuthatch
Sitta carolinensis, White-breasted Nuthatch
Sitta pygmaea, Pygmy Nuthatch
Sitta pusilla, Brown-headed Nuthatch
Family CERTHIIDAE
Subfamily CERTHIINAE
Certhia americana, Brown Creeper
Family TROGLODYTIDAE
Campylorhynchus brunneicapillus, Cactus Wren
Salpinctes obsoletus, Rock Wren
Catherpes mexicanus, Canyon Wren
Thryothorus sinaloa, Sinaloa Wren
Thryothorus ludovicianus, Carolina Wren
Thryomanes bewickii, Bewick's Wren
Troglodytes aedon, House Wren
Troglodytes pacificus, Pacific Wren
Troglodytes hiemalis, Winter Wren
Cistothorus platensis, Sedge Wren
Cistothorus palustris, Marsh Wren
Family POLIOPTILIDAE
Polioptila caerulea, Blue-gray Gnatcatcher
Polioptila californica, California Gnatcatcher
Polioptila melanura, Black-tailed Gnatcatcher
Polioptila nigriceps, Black-capped Gnatcatcher
Family CINCLIDAE
Cinclus mexicanus, American Dipper
Family REGULIDAE
Regulus satrapa, Golden-crowned Kinglet
Regulus calendula, Ruby-crowned Kinglet
Family PHYLLOSCOPIDAE
Phylloscopus trochilus, Willow Warbler
Phylloscopus sibilatrix, Wood Warbler
Phylloscopus fuscatus, Dusky Warbler
Phylloscopus proregulus, Pallas's Leaf-Warbler
Phylloscopus inornatus, Yellow-browed Warbler
Phylloscopus borealis, Arctic Warbler
Family SYLVIIDAE
Sylvia curruca, Lesser Whitethroat
Chamaea fasciata, Wrentit
Family ACROCEPHALIDAE
Acrocephalus luscinia, Nightingale Reed-Warbler
Acrocephalus familiaris, Millerbird
Acrocephalus schoenobaenus, Sedge Warbler
Family MEGALURIDAE
Locustella ochotensis, Middendorff's Grasshopper-Warbler
Locustella lanceolata, Lanceolated Warbler
Family MUSCICAPIDAE
Ficedula narcissina, Narcissus Flycatcher
Ficedula mugimaki, Mugimaki Flycatcher
Ficedula albicilla, Taiga Flycatcher
Muscicapa sibirica, Dark-sided Flycatcher
Muscicapa griseisticta, Gray-streaked Flycatcher
Muscicapa dauurica, Asian Brown Flycatcher
Muscicapa striata, Spotted Flycatcher
Family TURDIDAE
Monticola solitarius, Blue Rock-Thrush
Luscinia sibilans, Rufous-tailed Robin
Luscinia calliope, Siberian Rubythroat
Luscinia svecica, Bluethroat
Luscinia cyane, Siberian Blue Robin
Tarsiger cyanurus, Red-flanked Bluetail
Oenanthe oenanthe, Northern Wheatear
Saxicola torquatus, Stonechat
Sialia sialis, Eastern Bluebird
Sialia mexicana, Western Bluebird
Sialia currucoides, Mountain Bluebird
Myadestes townsendi, Townsend's Solitaire
Myadestes myadestinus, Kamao
Myadestes lanaiensis, Olomao
Myadestes obscurus, Omao
Myadestes palmeri, Puaiohi
Catharus aurantiirostris, Orange-billed Nightingale-Thrush
Catharus mexicanus, Black-headed Nightingale-Thrush
Catharus fuscescens, Veery
Catharus minimus, Gray-cheeked Thrush
Catharus bicknelli, Bicknell's Thrush
Catharus ustulatus, Swainson's Thrush
Catharus guttatus, Hermit Thrush
Hylocichla mustelina, Wood Thrush
Turdus obscurus, Eyebrowed Thrush
Turdus naumanni, Dusky Thrush
Turdus pilaris, Fieldfare
Turdus grayi, Clay-colored Thrush
Turdus assimilis, White-throated Thrush
Turdus rufopalliatus, Rufous-backed Robin
Turdus migratorius, American Robin
Turdus plumbeus, Red-legged Thrush
Ixoreus naevius, Varied Thrush
Ridgwayia pinicola, Aztec Thrush
Family MIMIDAE
Dumetella carolinensis, Gray Catbird
Melanoptila glabrirostris, Black Catbird
Mimus polyglottos, Northern Mockingbird
Mimus gundlachii, Bahama Mockingbird
Oreoscoptes montanus, Sage Thrasher
Toxostoma rufum, Brown Thrasher
Toxostoma longirostre, Long-billed Thrasher
Toxostoma bendirei, Bendire's Thrasher
Toxostoma curvirostre, Curve-billed Thrasher
Toxostoma redivivum, California Thrasher
Toxostoma crissale, Crissal Thrasher
Toxostoma lecontei, Le Conte's Thrasher
Melanotis caerulescens, Blue Mockingbird
Margarops fuscatus, Pearly-eyed Thrasher
Family STURNIDAE
Sturnus philippensis, Chestnut-cheeked Starling
Sturnus cineraceus, White-cheeked Starling
Family PRUNELLIDAE
Prunella montanella, Siberian Accentor
Family MOTACILLIDAE
Motacilla tschutschensis, Eastern Yellow Wagtail
Motacilla citreola, Citrine Wagtail
Motacilla cinerea, Gray Wagtail
Motacilla alba, White Wagtail
Anthus trivialis, Tree Pipit
Anthus hodgsoni, Olive-backed Pipit
Anthus gustavi, Pechora Pipit
Anthus cervinus, Red-throated Pipit
Anthus rubescens, American Pipit
Anthus spragueii, Sprague's Pipit
Family BOMBYCILLIDAE
Bombycilla garrulus, Bohemian Waxwing
Bombycilla cedrorum, Cedar Waxwing
Family PTILOGONATIDAE
Ptilogonys cinereus, Gray Silky-flycatcher
Phainopepla nitens, Phainopepla
Family PEUCEDRAMIDAE
Peucedramus taeniatus, Olive Warbler
Family CALCARIIDAE
Calcarius lapponicus, Lapland Longspur
Calcarius ornatus, Chestnut-collared Longspur
Calcarius pictus, Smith's Longspur
Rhynchophanes mccownii, McCown's Longspur
Plectrophenax nivalis, Snow Bunting
Plectrophenax hyperboreus, McKay's Bunting
Family PARULIDAE
Vermivora bachmanii, Bachman's Warbler
Vermivora cyanoptera, Blue-winged

Warbler
Vermivora chrysoptera, Golden-winged Warbler
Oreothlypis peregrina, Tennessee Warbler
Oreothlypis celata, Orange-crowned Warbler
Oreothlypis ruficapilla, Nashville Warbler
Oreothlypis virginiae, Virginia's Warbler
Oreothlypis crissalis, Colima Warbler
Oreothlypis luciae, Lucy's Warbler
Oreothlypis superciliosa, Crescent-chested Warbler
Parula americana, Northern Parula
Parula pitiayumi, Tropical Parula
Dendroica petechia, Yellow Warbler
Dendroica pensylvanica, Chestnut-sided Warbler
Dendroica magnolia, Magnolia Warbler
Dendroica tigrina, Cape May Warbler
Dendroica caerulescens, Black-throated Blue Warbler
Dendroica coronata, Yellow-rumped Warbler
Dendroica nigrescens, Black-throated Gray Warbler
Dendroica chrysoparia, Golden-cheeked Warbler
Dendroica virens, Black-throated Green Warbler
Dendroica townsendi, Townsend's Warbler
Dendroica occidentalis, Hermit Warbler
Dendroica fusca, Blackburnian Warbler
Dendroica dominica, Yellow-throated Warbler
Dendroica graciae, Grace's Warbler
Dendroica adelaidae, Adelaide's Warbler
Dendroica pinus, Pine Warbler
Dendroica kirtlandii, Kirtland's Warbler
Dendroica discolor, Prairie Warbler
Dendroica palmarum, Palm Warbler
Dendroica castanea, Bay-breasted Warbler
Dendroica striata, Blackpoll Warbler
Dendroica cerulea, Cerulean Warbler
Dendroica angelae, Elfin-woods Warbler
Mniotilta varia, Black-and-white Warbler
Setophaga ruticilla, American Redstart
Protonotaria citrea, Prothonotary Warbler
Helmitheros vermivorum, Worm-eating Warbler
Limnothlypis swainsonii, Swainson's Warbler
Seiurus aurocapilla, Ovenbird
Parkesia noveboracensis, Northern Waterthrush
Parkesia motacilla, Louisiana Waterthrush
Oporornis formosus, Kentucky Warbler
Oporornis agilis, Connecticut Warbler
Oporornis philadelphia, Mourning Warbler
Oporornis tolmiei, MacGillivray's Warbler
Geothlypis trichas, Common Yellowthroat
Geothlypis poliocephala, Gray-crowned Yellowthroat
Wilsonia citrina, Hooded Warbler
Wilsonia pusilla, Wilson's Warbler
Wilsonia canadensis, Canada Warbler
Cardellina rubrifrons, Red-faced Warbler
Myioborus pictus, Painted Redstart
Myioborus miniatus, Slate-throated Redstart
Euthlypis lachrymosa, Fan-tailed Warbler
Basileuterus culicivorus, Golden-crowned Warbler
Basileuterus rufifrons, Rufous-capped Warbler
Icteria virens, Yellow-breasted Chat

Family THRAUPIDAE
Nesospingus speculiferus, Puerto Rican Tanager
Spindalis zena, Western Spindalis
Spindalis portoricensis, Puerto Rican Spindalis

Family EMBERIZIDAE
Sporophila torqueola, White-collared Seedeater
Tiaris olivaceus, Yellow-faced Grassquit
Tiaris bicolor, Black-faced Grassquit
Loxigilla portoricensis, Puerto Rican Bullfinch
Arremonops rufivirgatus, Olive Sparrow
Pipilo chlorurus, Green-tailed Towhee
Pipilo maculatus, Spotted Towhee
Pipilo erythrophthalmus, Eastern Towhee
Aimophila ruficeps, Rufous-crowned Sparrow
Melozone fusca, Canyon Towhee
Melozone crissalis, California Towhee
Melozone aberti, Abert's Towhee
Peucaea carpalis, Rufous-winged Sparrow
Peucaea botterii, Botteri's Sparrow
Peucaea cassinii, Cassin's Sparrow
Peucaea aestivalis, Bachman's Sparrow
Spizella arborea, American Tree Sparrow
Spizella passerina, Chipping Sparrow
Spizella pallida, Clay-colored Sparrow
Spizella breweri, Brewer's Sparrow
Spizella pusilla, Field Sparrow
Spizella wortheni, Worthen's Sparrow
Spizella atrogularis, Black-chinned Sparrow
Pooecetes gramineus, Vesper Sparrow
Chondestes grammacus, Lark Sparrow
Amphispiza quinquestriata, Five-striped Sparrow
Amphispiza bilineata, Black-throated Sparrow
Amphispiza belli, Sage Sparrow
Calamospiza melanocorys, Lark Bunting
Passerculus sandwichensis, Savannah Sparrow
Ammodramus savannarum, Grasshopper Sparrow
Ammodramus bairdii, Baird's Sparrow
Ammodramus henslowii, Henslow's Sparrow
Ammodramus leconteii, Le Conte's Sparrow
Ammodramus nelsoni, Nelson's Sparrow
Ammodramus caudacutus, Saltmarsh Sparrow
Ammodramus maritimus, Seaside Sparrow
Passerella iliaca, Fox Sparrow
Melospiza melodia, Song Sparrow
Melospiza lincolnii, Lincoln's Sparrow
Melospiza georgiana, Swamp Sparrow
Zonotrichia albicollis, White-throated Sparrow
Zonotrichia querula, Harris's Sparrow
Zonotrichia leucophrys, White-crowned Sparrow
Zonotrichia atricapilla, Golden-crowned Sparrow
Junco hyemalis, Dark-eyed Junco
Junco phaeonotus, Yellow-eyed Junco
Emberiza leucocephalos, Pine Bunting
Emberiza chrysophrys, Yellow-browed Bunting
Emberiza pusilla, Little Bunting
Emberiza rustica, Rustic Bunting
Emberiza elegans, Yellow-throated Bunting
Emberiza aureola, Yellow-breasted Bunting
Emberiza variabilis, Gray Bunting
Emberiza pallasi, Pallas's Bunting
Emberiza schoeniclus, Reed Bunting

Family CARDINALIDAE
Piranga flava, Hepatic Tanager
Piranga rubra, Summer Tanager
Piranga olivacea, Scarlet Tanager
Piranga ludoviciana, Western Tanager
Piranga bidentata, Flame-colored Tanager
Rhodothraupis celaeno, Crimson-collared Grosbeak
Cardinalis cardinalis, Northern Cardinal
Cardinalis sinuatus, Pyrrhuloxia
Pheucticus chrysopeplus, Yellow Grosbeak
Pheucticus ludovicianus, Rose-breasted Grosbeak
Pheucticus melanocephalus, Black-headed Grosbeak

Cyanocompsa parellina, Blue Bunting
Passerina caerulea, Blue Grosbeak
Passerina amoena, Lazuli Bunting
Passerina cyanea, Indigo Bunting
Passerina versicolor, Varied Bunting
Passerina ciris, Painted Bunting
Spiza americana, Dickcissel
Family ICTERIDAE
Dolichonyx oryzivorus, Bobolink
Agelaius phoeniceus, Red-winged Blackbird
Agelaius tricolor, Tricolored Blackbird
Agelaius humeralis, Tawny-shouldered Blackbird
Agelaius xanthomus, Yellow-shouldered Blackbird
Sturnella magna, Eastern Meadowlark
Sturnella neglecta, Western Meadowlark
Xanthocephalus xanthocephalus, Yellow-headed Blackbird
Euphagus carolinus, Rusty Blackbird
Euphagus cyanocephalus, Brewer's Blackbird
Quiscalus quiscula, Common Grackle
Quiscalus major, Boat-tailed Grackle
Quiscalus mexicanus, Great-tailed Grackle
Quiscalus niger, Greater Antillean Grackle
Molothrus bonariensis, Shiny Cowbird
Molothrus aeneus, Bronzed Cowbird
Molothrus ater, Brown-headed Cowbird
Icterus portoricensis, Puerto Rican Oriole
Icterus wagleri, Black-vented Oriole
Icterus spurius, Orchard Oriole
Icterus cucullatus, Hooded Oriole
Icterus pustulatus, Streak-backed Oriole
Icterus bullockii, Bullock's Oriole
Icterus gularis, Altamira Oriole
Icterus graduacauda, Audubon's Oriole
Icterus galbula, Baltimore Oriole
Icterus parisorum, Scott's Oriole
Family FRINGILLIDAE
Subfamily FRINGILLINAE
Fringilla coelebs, Common Chaffinch
Fringilla montifringilla, Brambling
Subfamily EUPHONIINAE
Euphonia musica, Antillean Euphonia
Subfamily CARDUELINAE
Leucosticte tephrocotis, Gray-crowned Rosy-Finch
Leucosticte atrata, Black Rosy-Finch
Leucosticte australis, Brown-capped Rosy-Finch
Pinicola enucleator, Pine Grosbeak
Carpodacus erythrinus, Common Rosefinch
Carpodacus purpureus, Purple Finch
Carpodacus cassinii, Cassin's Finch
Carpodacus mexicanus, House Finch
Loxia curvirostra, Red Crossbill
Loxia leucoptera, White-winged Crossbill
Acanthis flammea, Common Redpoll
Acanthis hornemanni, Hoary Redpoll
Spinus spinus, Eurasian Siskin
Spinus pinus, Pine Siskin
Spinus psaltria, Lesser Goldfinch
Spinus lawrencei, Lawrence's Goldfinch
Spinus tristis, American Goldfinch
Chloris sinica, Oriental Greenfinch
Pyrrhula pyrrhula, Eurasian Bullfinch
Coccothraustes vespertinus, Evening Grosbeak
Coccothraustes coccothraustes, Hawfinch
Subfamily DREPANIDINAE
Telespiza cantans, Laysan Finch
Telespiza ultima, Nihoa Finch
Psittirostra psittacea, Ou
Loxioides bailleui, Palila
Pseudonestor xanthophrys, Maui Parrotbill
Hemignathus virens, Hawaii Amakihi
Hemignathus flavus, Oahu Amakihi
Hemignathus kauaiensis, Kauai Amakihi
Hemignathus ellisianus, Greater Akialoa
Hemignathus lucidus, Nukupuu
Hemignathus munroi, Akiapolaau
Magumma parva, Anianiau
Oreomystis bairdi, Akikiki
Oreomystis mana, Hawaii Creeper
Paroreomyza maculata, Oahu Alauahio
Paroreomyza flammea, Kakawahie
Paroreomyza montana, Maui Alauahio
Loxops caeruleirostris, Akekee
Loxops coccineus, Akepa
Vestiaria coccinea, Iiwi
Palmeria dolei, Akohekohe
Himatione sanguinea, Apapane
Melamprosops phaeosoma, Poo-uli

PART 21—[AMENDED]

■ 3. Revise the authority citation for part 21 to read as follows:

Authority: Pub. L. 65–186, 40 Stat. 755 (1918) (16 U.S.C. 703–712), as amended.

§ 21.3 [Amended]

■ 4. In § 21.3, amend the definition of ''Raptor'' by adding the words ''the Order Accipitriformes,'' immediately before the words ''the Order Falconiformes'' and adding a comma after ''Falconiformes''.

Dated: September 17, 2013.

Michael J. Bean,

Acting Principal Deputy Assistant Secretary for Fish and Wildlife and Parks.

[FR Doc. 2013–26061 Filed 10–31–13; 8:45 am]

BILLING CODE 4310–55–P

Section 3: USFWS National Bald Eagle Management Guidelines

NATIONAL BALD EAGLE MANAGEMENT GUIDELINES

U.S. Fish and Wildlife Service

May 2007

TABLE OF CONTENTS

INTRODUCTION

The bald eagle (*Haliaeetus leucocephalus*) is protected by the Bald and Golden Eagle Protection Act (Eagle Act) and the Migratory Bird Treaty Act (MBTA). The MBTA and the Eagle Act protect bald eagles from a variety of harmful actions and impacts. The U.S. Fish and Wildlife Service (Service) developed these National Bald Eagle Management Guidelines to advise landowners, land managers, and others who share public and private lands with bald eagles when and under what circumstances the protective provisions of the Eagle Act may apply to their activities. A variety of human activities can potentially interfere with bald eagles, affecting their ability to forage, nest, roost, breed, or raise young. The Guidelines are intended to help people minimize such impacts to bald eagles, particularly where they may constitute "disturbance," which is prohibited by the Eagle Act.

The Guidelines are intended to:

(1) Publicize the provisions of the Eagle Act that continue to protect bald eagles, in order to reduce the possibility that people will violate the law,

(2) Advise landowners, land managers and the general public of the potential for various human activities to disturb bald eagles, and

(3) Encourage additional nonbinding land management practices that benefit bald eagles (see Additional Recommendations section).

While the Guidelines include general recommendations for land management practices that will benefit bald eagles, the document is intended primarily as a tool for landowners and planners who seek information and recommendations regarding how to avoid disturbing bald eagles. Many States and some tribal entities have developed state-specific management plans, regulations, and/or guidance for landowners and land managers to protect and enhance bald eagle habitat, and we encourage the continued development and use of these planning tools to benefit bald eagles.

Adherence to the Guidelines herein will benefit individuals, agencies, organizations, and companies by helping them avoid violations of the law. However, the Guidelines themselves are not law. Rather, they are recommendations based on several decades of behavioral observations, science, and conservation measures to avoid or minimize adverse impacts to bald eagles.

The U.S. Fish and Wildlife Service strongly encourages adherence to these guidelines to ensure that bald and golden eagle populations will continue to be sustained. The Service realizes there may be impacts to some birds even if all reasonable measures are taken to avoid such impacts. Although it is not possible to absolve individuals and entities from liability under the Eagle Act or the MBTA, the Service exercises enforcement discretion to focus on those individuals, companies, or agencies that take migratory birds without regard for the consequences of their actions and the law, especially when conservation measures, such as these Guidelines, are available, but have not been implemented. The Service will prioritize its enforcement efforts to focus on those individuals or entities who take bald eagles or their parts, eggs, or nests without implementing appropriate measures recommended by the Guidelines.

The Service intends to pursue the development of regulations that would authorize, under limited circumstances, the use of permits if “take” of an eagle is anticipated but unavoidable. Additionally, if the bald eagle is delisted, the Service intends to provide a regulatory mechanism to honor existing (take) authorizations under the Endangered Species Act (ESA).

During the interim period until the Service completes a rulemaking for permits under the Eagle Act, the Service does not intend to refer for prosecution the incidental “*take*” of any bald eagle under the MBTA or Eagle Act, if such take is in full compliance with the terms and conditions of an incidental take statement issued to the action agency or applicant under the authority of section 7(b)(4) of the ESA or a permit issued under the authority of section 10(a)(1)(B) of the ESA.

The Guidelines are applicable throughout the United States, including Alaska. The primary purpose of these Guidelines is to provide information that will minimize or prevent violations only of *Federal* laws governing bald eagles. In addition to Federal laws, many states and some smaller jurisdictions and tribes have additional laws and regulations protecting bald eagles. In some cases those laws and regulations may be more protective (restrictive) than these Federal guidelines. If you are planning activities that may affect bald eagles, we therefore recommend that you contact both your nearest U.S. Fish and Wildlife Service Field Office (see the contact information on p.16) and your state wildlife agency for assistance.

LEGAL PROTECTIONS FOR THE BALD EAGLE

The Bald and Golden Eagle Protection Act

The Eagle Act (16 U.S.C. 668-668c), enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The Act provides criminal and civil penalties for persons who “take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof.” The Act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.” “Disturb’’ means:

> "Disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle=s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

A violation of the Act can result in a criminal fine of $100,000 ($200,000 for organizations), imprisonment for one year, or both, for a first offense. Penalties increase substantially for additional offenses, and a second violation of this Act is a felony.

The Migratory Bird Treaty Act
The MBTA (16 U.S.C. 703-712), prohibits the taking of any migratory bird or any part, nest, or egg, except as permitted by regulation. The MBTA was enacted in 1918; a 1972 agreement supplementing one of the bilateral treaties underlying the MBTA had the effect of expanding the scope of the Act to cover bald eagles and other raptors. Implementing regulations define “take” under the MBTA as “pursue, hunt, shoot, wound, kill, trap, capture, possess, or collect.”

Copies of the Eagle Act and the MBTA are available at: http://permits.fws.gov/ltr/ltr.shtml.

State laws and regulations
Most states have their own regulations and/or guidelines for bald eagle management. Some states may continue to list the bald eagle as endangered, threatened, or of special concern. If you plan activities that may affect bald eagles, we urge you to familiarize yourself with the regulations and/or guidelines that apply to bald eagles in your state. Your adherence to the Guidelines herein does not ensure that you are in compliance with state laws and regulations because state regulations can be more specific and/or restrictive than these Guidelines.

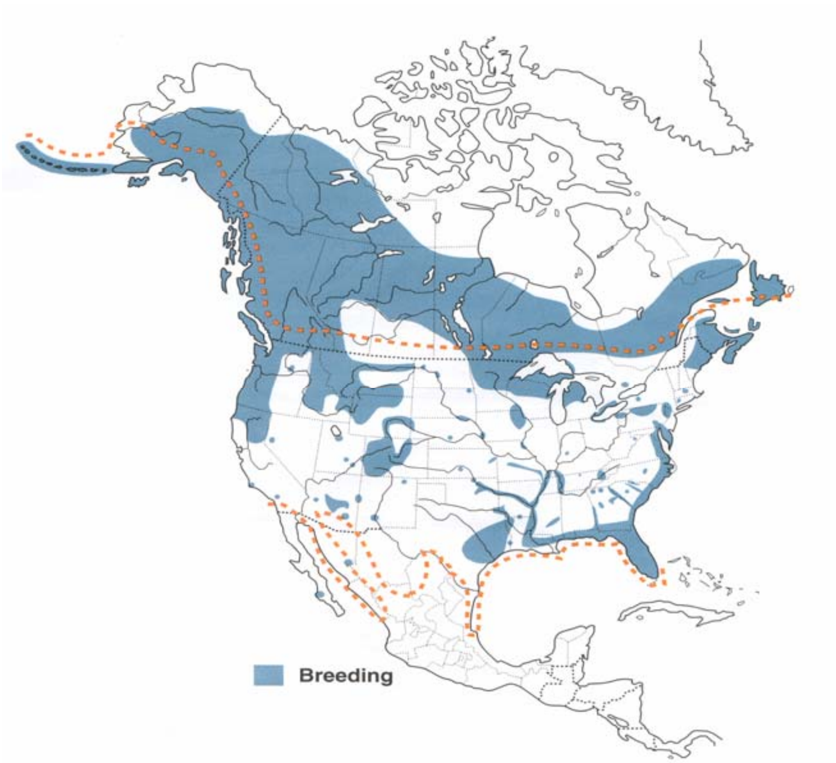
NATURAL HISTORY OF THE BALD EAGLE

Bald eagles are a North American species that historically occurred throughout the contiguous United States and Alaska. After severely declining in the lower 48 States between the 1870s and the 1970s, bald eagles have rebounded and re-established breeding territories in each of the lower 48 states. The largest North American breeding populations are in Alaska and Canada, but there are also significant bald eagle populations in Florida, the Pacific Northwest, the Greater Yellowstone area, the Great Lakes states, and the Chesapeake Bay region. Bald eagle distribution varies seasonally. Bald eagles that nest in southern latitudes frequently move northward in late spring and early summer, often summering as far north as Canada. Most eagles that breed at northern latitudes migrate southward during winter, or to coastal areas where waters remain unfrozen. Migrants frequently concentrate in large numbers at sites where food is abundant and they often roost together communally. In some cases, concentration areas are used year-round: in summer by southern eagles and in winter by northern eagles.

Juvenile bald eagles have mottled brown and white plumage, gradually acquiring their dark brown body and distinctive white head and tail as they mature. Bald eagles generally attain adult plumage by 5 years of age. Most are capable of breeding at 4 or 5 years of age, but in healthy populations they may not start breeding until much older. Bald eagles may live 15 to 25 years in the wild. Adults weigh 8 to 14 pounds (occasionally reaching 16 pounds in Alaska) and have wingspans of 5 to 8 feet. Those in the northern range are larger than those in the south, and females are larger than males.

Where do bald eagles nest?
Breeding bald eagles occupy "territories," areas they will typically defend against intrusion by other eagles. In addition to the active nest, a territory may include one or more alternate nests (nests built or maintained by the eagles but not used for nesting in a given year). The Eagle Act prohibits removal or destruction of both active and alternate bald eagle nests. Bald eagles exhibit high nest site fidelity and nesting territories are often used year after year. Some territories are known to have been used continually for over half a century.

Bald eagles generally nest near coastlines, rivers, large lakes or streams that support an adequate food supply. They often nest in mature or old-growth trees; snags (dead trees); cliffs; rock promontories; rarely on the ground; and with increasing frequency on human-made structures such as power poles and communication towers. In forested areas, bald eagles often select the tallest trees with limbs strong enough to support a nest that can weigh more than 1,000 pounds. Nest sites typically include at least one perch with a clear view of the water where the eagles usually forage. Shoreline trees or snags located in reservoirs provide the visibility and accessibility needed to locate aquatic prey. Eagle nests are constructed with large sticks, and may be lined with moss, grass, plant stalks, lichens, seaweed, or sod. Nests are usually about 4-6 feet in diameter and 3 feet deep, although larger nests exist.



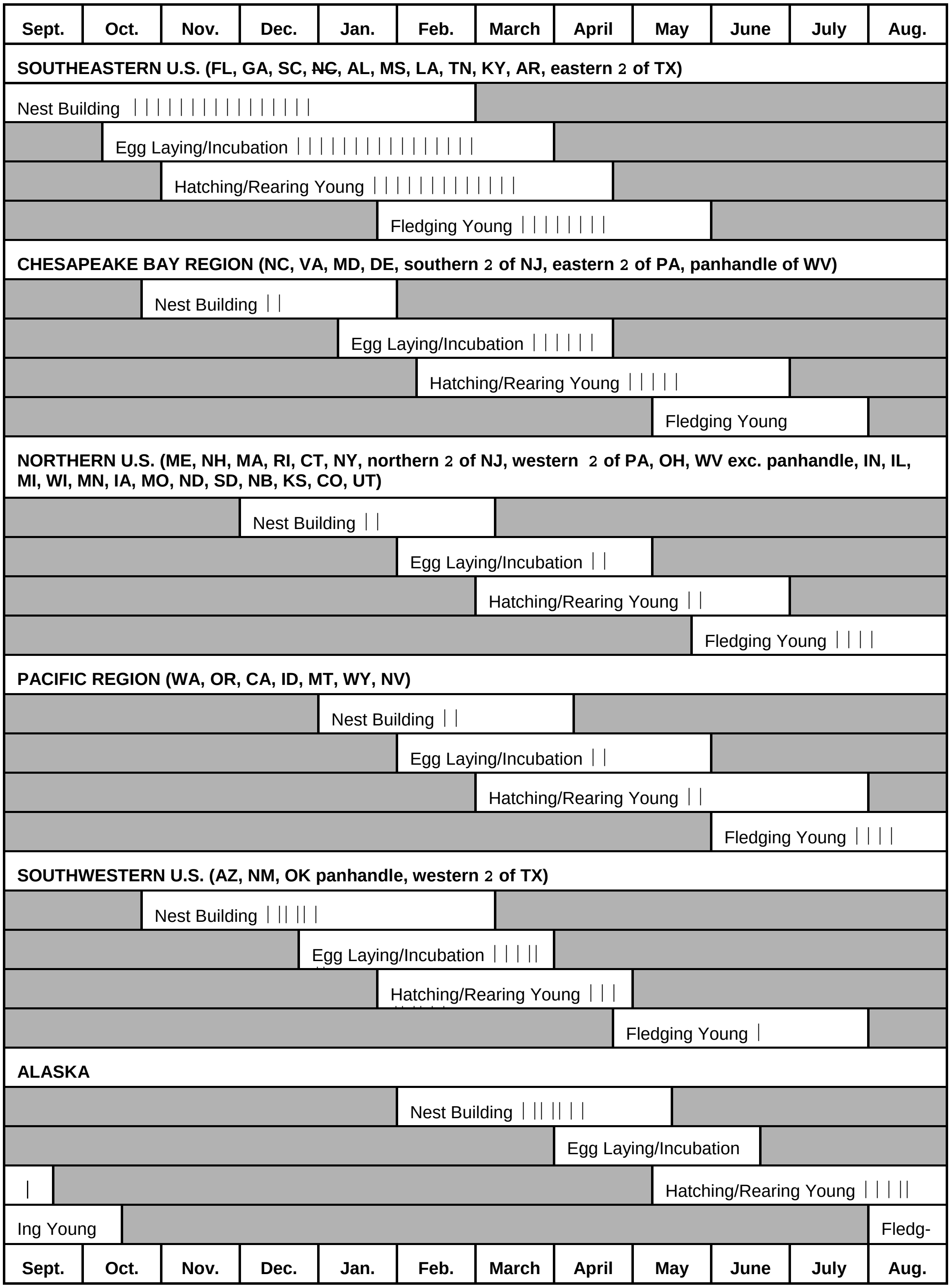
The range of breeding bald eagles in 2000 (shaded areas). This map shows only the larger concentrations of nests; eagles have continued to expand into additional nesting territories in many states. The dotted line represents the bald eagle's wintering range.

When do bald eagles nest?

Nesting activity begins several months before egg-laying. Egg-laying dates vary throughout the U.S., ranging from October in Florida, to late April or even early May in the northern United States. Incubation typically lasts 33-35 days, but can be as long as 40 days. Eaglets make their first unsteady flights about 10 to 12 weeks after hatching, and fledge (leave their nests) within a few days after that first flight. However, young birds usually remain in the vicinity of the nest for several weeks after fledging because they are almost completely dependent on their parents for food until they disperse from the nesting territory approximately 6 weeks later.

The bald eagle breeding season tends to be longer in the southern U.S., and re-nesting following an unsuccessful first nesting attempt is more common there as well. The following table shows the timing of bald eagle breeding seasons in different regions of the country. The table represents the range of time within which the majority of nesting activities occur in each region and does not apply to any specific nesting pair. Because the timing of nesting activities may vary within a given region, you should contact the nearest U.S. Fish and Wildlife Service Field Office (see page 16) and/or your state wildlife conservation agency for more specific information on nesting chronology in your area.

Chronology of typical reproductive activities of bald eagles in the United States.



How many chicks do bald eagles raise?
The number of eagle eggs laid will vary from 1-3, with 1-2 eggs being the most common. Only one eagle egg is laid per day, although not always on successive days. Hatching of young occurs on different days with the result that chicks in the same nest are sometimes of unequal size. The overall national fledging rate is approximately one chick per nest, annually, which results in a healthy expanding population.

What do bald eagles eat?
Bald eagles are opportunistic feeders. Fish comprise much of their diet, but they also eat waterfowl, shorebirds/colonial waterbirds, small mammals, turtles, and carrion. Because they are visual hunters, eagles typically locate their prey from a conspicuous perch, or soaring flight, then swoop down and strike. Wintering bald eagles often congregate in large numbers along streams to feed on spawning salmon or other fish species, and often gather in large numbers in areas below reservoirs, especially hydropower dams, where fish are abundant. Wintering eagles also take birds from rafts of ducks at reservoirs and rivers, and congregate on melting ice shelves to scavenge dead fish from the current or the soft melting ice. Bald eagles will also feed on carcasses along roads, in landfills, and at feedlots.

During the breeding season, adults carry prey to the nest to feed the young. Adults feed their chicks by tearing off pieces of food and holding them to the beaks of the eaglets. After fledging, immature eagles are slow to develop hunting skills, and must learn to locate reliable food sources and master feeding techniques. Young eagles will congregate together, often feeding upon easily acquired food such as carrion and fish found in abundance at the mouths of streams and shallow bays and at landfills.

The impact of human activity on nesting bald eagles
During the breeding season, bald eagles are sensitive to a variety of human activities. However, not all bald eagle pairs react to human activities in the same way. Some pairs nest successfully just dozens of yards from human activity, while others abandon nest sites in response to activities much farther away. This variability may be related to a number of factors, including visibility, duration, noise levels, extent of the area affected by the activity, prior experiences with humans, and tolerance of the individual nesting pair. The relative sensitivity of bald eagles during various stages of the breeding season is outlined in the following table.

Nesting Bald Eagle Sensitivity to Human Activities

Phase	Activity	Sensitivity to Human Activity	Comments
I	Courtship and Nest Building	Most sensitive period; likely to respond negatively	Most critical time period. Disturbance is manifested in nest abandonment. Bald eagles in newly established territories are more prone to abandon nest sites.
II	Egg laying	Very sensitive period	Human activity of even limited duration may cause nest desertion and abandonment of territory for the breeding season.
III	Incubation and early nestling period (up to 4 weeks)	Very sensitive period	Adults are less likely to abandon the nest near and after hatching. However, flushed adults leave eggs and young unattended; eggs are susceptible to cooling, loss of moisture, overheating, and predation; young are vulnerable to elements.
IV	Nestling period, 4 to 8 weeks	Moderately sensitive period	Likelihood of nest abandonment and vulnerability of the nestlings to elements somewhat decreases. However, nestlings may miss feedings, affecting their survival.
V	Nestlings 8 weeks through fledging	Very sensitive period	Gaining flight capability, nestlings 8 weeks and older may flush from the nest prematurely due to disruption and die.

If agitated by human activities, eagles may inadequately construct or repair their nest, may expend energy defending the nest rather than tending to their young, or may abandon the nest altogether. Activities that cause prolonged absences of adults from their nests can jeopardize eggs or young. Depending on weather conditions, eggs may overheat or cool too much and fail to hatch. Unattended eggs and nestlings are subject to predation. Young nestlings are particularly vulnerable because they rely on their parents to provide warmth or shade, without which they may die as a result of hypothermia or heat stress. If food delivery schedules are interrupted, the young may not develop healthy plumage, which can affect their survival. In addition, adults startled while incubating or brooding young may damage eggs or injure their young as they abruptly leave the nest. Older nestlings no longer require constant attention from the adults, but they may be startled by loud or intrusive human activities and prematurely jump from the nest before they are able to fly or care for themselves. Once fledged, juveniles range up to ¼ mile from the nest site, often to a site with minimal human activity. During this period, until about six weeks after departure from the nest, the juveniles still depend on the adults to feed them.

The impact of human activity on foraging and roosting bald eagles

Disruption, destruction, or obstruction of roosting and foraging areas can also negatively affect bald eagles. Disruptive activities in or near eagle foraging areas can interfere with feeding, reducing chances of survival. Interference with feeding can also result in reduced productivity (number of young successfully fledged). Migrating and wintering bald eagles often congregate at specific sites for purposes of feeding and sheltering. Bald eagles rely on established roost sites because of their proximity to sufficient food sources. Roost sites are usually in mature trees where the eagles are somewhat sheltered from the wind and weather. Human activities near or within communal roost sites may prevent eagles from feeding or taking shelter, especially if there are not other undisturbed and productive feeding and roosting sites available. Activities that permanently alter communal roost sites and important foraging areas can altogether eliminate the elements that are essential for feeding and sheltering eagles.

Where a human activity agitates or bothers roosting or foraging bald eagles to the degree that causes injury or substantially interferes with breeding, feeding, or sheltering behavior and causes, or is likely to cause, a loss of productivity or nest abandonment, the conduct of the activity constitutes a violation of the Eagle Act's prohibition against disturbing eagles. The circumstances that might result in such an outcome are difficult to predict without detailed site-specific information. If your activities may disturb roosting or foraging bald eagles, you should contact your local Fish and Wildlife Service Field Office (see page 16) for advice and recommendations for how to avoid such disturbance.

RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT NEST SITES

In developing these Guidelines, we relied on existing state and regional bald eagle guidelines, scientific literature on bald eagle disturbance, and recommendations of state and Federal biologists who monitor the impacts of human activity on eagles. Despite these resources, uncertainties remain regarding the effects of many activities on eagles and how eagles in different situations may or may not respond to certain human activities. The Service recognizes this uncertainty and views the collection of better biological data on the response of eagles to disturbance as a high priority. To the extent that resources allow, the Service will continue to collect data on responses of bald eagles to human activities conducted according to the recommendations within these Guidelines to ensure that adequate protection from disturbance is being afforded, and to identify circumstances where the Guidelines might be modified. These data will be used to make future adjustments to the Guidelines.

To avoid disturbing nesting bald eagles, we recommend (1) keeping a distance between the activity and the nest (distance buffers), (2) maintaining preferably forested (or natural) areas between the activity and around nest trees (landscape buffers), and (3) avoiding certain activities during the breeding season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. Ideally, buffers would be large enough to protect existing nest trees and provide for alternative or replacement nest trees.

The size and shape of effective buffers vary depending on the topography and other ecological characteristics surrounding the nest site. In open areas where there are little or no forested or topographical buffers, such as in many western states, distance alone must serve as the buffer. Consequently, in open areas, the distance between the activity and the nest may need to be larger than the distances recommended under Categories A and B of these guidelines (pg. 12) if no landscape buffers are present. The height of the nest above the ground may also ameliorate effects of human activities; eagles at higher nests may be less prone to disturbance.

In addition to the physical features of the landscape and nest site, the appropriate size for the distance buffer may vary according to the historical tolerances of eagles to human activities in particular localities, and may also depend on the location of the nest in relation to feeding and roosting areas used by the eagles. Increased competition for nest sites may lead bald eagles to nest closer to human activity (and other eagles).

Seasonal restrictions can prevent the potential impacts of many shorter-term, obtrusive activities that do not entail landscape alterations (e.g. fireworks, outdoor concerts). In proximity to the nest, these kinds of activities should be conducted only outside the breeding season. For activities that entail both short-term, obtrusive characteristics and more permanent impacts (e.g., building construction), we recommend a combination of both approaches: retaining a landscape buffer *and* observing seasonal restrictions.

For assistance in determining the appropriate size and configuration of buffers or the timing of activities in the vicinity of a bald eagle nest, we encourage you to contact the nearest U.S. Fish and Wildlife Service Field Office (see page 16).

Existing Uses

Eagles are unlikely to be disturbed by routine use of roads, homes, and other facilities where such use pre-dates the eagles' successful nesting activity in a given area. Therefore, in most cases *ongoing* existing uses may proceed with the same intensity with little risk of disturbing bald eagles. However, some *intermittent, occasional, or irregular* uses that pre-date eagle nesting in an area may disturb bald eagles. For example: a pair of eagles may begin nesting in an area and subsequently be disturbed by activities associated with an annual outdoor flea market, even though the flea market has been held annually at the same location. In such situations, human activity should be adjusted or relocated to minimize potential impacts on the nesting pair.

ACTIVITY-SPECIFIC GUIDELINES

The following section provides the Service=s management recommendations for avoiding bald eagle disturbance as a result of new or intermittent activities proposed in the vicinity of bald eagle nests. Activities are separated into 8 categories (A – H) based on the nature and magnitude of impacts to bald eagles that usually result from the type of activity. Activities with similar or comparable impacts are grouped together.

In most cases, impacts will vary based on the visibility of the activity from the eagle nest and the degree to which similar activities are already occurring in proximity to the nest site. Visibility is a factor because, in general, eagles are more prone to disturbance when an activity occurs in full view. For this reason, we recommend that people locate activities farther from the nest structure in areas with open vistas, in contrast to areas where the view is shielded by rolling topography, trees, or other screening factors. The recommendations also take into account the existence of similar activities in the area because the continued presence of nesting bald eagles in the vicinity of the existing activities indicates that the eagles in that area can tolerate a greater degree of human activity than we can generally expect from eagles in areas that experience fewer human impacts. To illustrate how these factors affect the likelihood of disturbing eagles, we have incorporated the recommendations for some activities into a table (categories A and B).

First, determine which category your activity falls into (between categories A – H). If the activity you plan to undertake is not specifically addressed in these guidelines, follow the recommendations for the most similar activity represented.

If your activity is under A or B, our recommendations are in table form. The vertical axis shows the degree of visibility of the activity from the nest. The horizontal axis (header row) represents the degree to which similar activities are ongoing in the vicinity of the nest. Locate the row that best describes how visible your activity will be from the eagle nest. Then, choose the column that best describes the degree to which similar activities are ongoing in the vicinity of the eagle nest. The box where the column and row come together contains our management recommendations for how far you should locate your activity from the nest to avoid disturbing the eagles. The numerical distances shown in the tables are the closest the activity should be conducted relative to the nest. In some cases we have included additional recommendations (other than recommended *distance* from the nest) you should follow to help ensure that your activity will not disturb the eagles.

Alternate nests
For activities that entail permanent landscape alterations that may result in bald eagle disturbance, these recommendations apply to both active and alternate bald eagle nests. Disturbance becomes an issue with regard to alternate nests if eagles return for breeding purposes and react to land use changes that occurred while the nest was inactive. The likelihood that an alternate nest will again become active decreases the longer it goes unused. If you plan activities in the vicinity of an alternate bald eagle nest and have information to show that the nest has not been active during the preceding 5 breeding seasons, the recommendations provided in these guidelines for avoiding disturbance around the nest site may no longer be warranted. The nest itself remains protected by other provisions of the Eagle Act, however, and may not be destroyed.

If special circumstances exist that make it unlikely an inactive nest will be reused before 5 years of disuse have passed, and you believe that the probability of reuse is low enough to warrant disregarding the recommendations for avoiding disturbance, you should be prepared to provide all the reasons for your conclusion, including information regarding past use of the nest site. Without sufficient documentation, you should continue to follow these guidelines when conducting activities around the nest site. If we are able to determine that it is unlikely the nest will be reused, we may advise you that the recommendations provided in these guidelines for avoiding disturbance are no longer necessary around that nest site.

This guidance is intended to minimize disturbance, as defined by Federal regulation. In addition to Federal laws, most states and some tribes and smaller jurisdictions have additional laws and regulations protecting bald eagles. In some cases those laws and regulations may be more protective (restrictive) than these Federal guidelines.

Temporary Impacts
For activities that have temporary impacts, such as the use of loud machinery, fireworks displays, or summer boating activities, we recommend seasonal restrictions. These types of activities can generally be carried out outside of the breeding season without causing disturbance. The recommended restrictions for these types of activities can be lifted for alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched (depending on the distance between the alternate nest and the active nest).

In general, activities should be kept as far away from nest trees as possible; loud and disruptive activities should be conducted when eagles are not nesting; and activity between the nest and the nearest foraging area should be minimized. If the activity you plan to undertake is not specifically addressed in these guidelines, follow the recommendations for the most similar activity addressed, or contact your local U.S. Fish and Wildlife Service Field Office for additional guidance.

If you believe that special circumstances apply to your situation that increase or diminish the likelihood of bald eagle disturbance, or if it is not possible to adhere to the guidelines, you should contact your local Service Field Office for further guidance.

Category A:
Building construction, 1 or 2 story, with project footprint of ½ acre or less.
Construction of roads, trails, canals, power lines, and other linear utilities.
Agriculture and aquaculture – new or expanded operations.
Alteration of shorelines or wetlands.
Installation of docks or moorings.
Water impoundment.

Category B:
Building construction, 3 or more stories.
Building construction, 1 or 2 story, with project footprint of more than ½ acre.
Installation or expansion of marinas with a capacity of 6 or more boats.
Mining and associated activities.
Oil and natural gas drilling and refining and associated activities.

	If there is no similar activity within 1 mile of the nest	***If there is similar activity closer than 1 mile from the nest***
If the activity will be visible from the nest	660 feet. Landscape buffers are recommended.	660 feet, or as close as existing tolerated activity of similar scope. Landscape buffers are recommended.
If the activity will not be visible from the nest	Category A: 330 feet. Clearing, external construction, and landscaping between 330 feet and 660 feet should be done outside breeding season. Category B: 660 feet.	330 feet, or as close as existing tolerated activity of similar scope. Clearing, external construction and landscaping within 660 feet should be done outside breeding season.

The numerical distances shown in the table are the closest the activity should be conducted relative to the nest.

Category C. Timber Operations and Forestry Practices

- Avoid clear cutting or removal of overstory trees within 330 feet of the nest at any time.

- Avoid timber harvesting operations, including road construction and chain saw and yarding operations, during the breeding season within 660 feet of the nest. The distance may be decreased to 330 feet around alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched.

- Selective thinning and other silviculture management practices designed to conserve or enhance habitat, including prescribed burning close to the nest tree, should be undertaken outside the breeding season. Precautions such as raking leaves and woody debris from around the nest tree should be taken to prevent crown fire or fire climbing the nest tree. If it is determined that a burn during the breeding season would be beneficial, then, to ensure that no take or disturbance will occur, these activities should be conducted only when neither adult eagles nor young are present at the nest tree (i.e., at the beginning of, or end of, the breeding season, either before the particular nest is active or after the young have fledged from that nest). Appropriate Federal and state biologists should be consulted before any prescribed burning is conducted during the breeding season.

- Avoid construction of log transfer facilities and in-water log storage areas within 330 feet of the nest.

Category D. Off-road vehicle use (including snowmobiles). No buffer is necessary around nest sites outside the breeding season. During the breeding season, do not operate off-road vehicles within 330 feet of the nest. In open areas, where there is increased visibility and exposure to noise, this distance should be extended to 660 feet.

Category E. Motorized Watercraft use (including jet skis/personal watercraft). No buffer is necessary around nest sites outside the breeding season. During the breeding season, within 330 feet of the nest, (1) do not operate jet skis (personal watercraft), and (2) avoid concentrations of noisy vessels (e.g., commercial fishing boats and tour boats), except where eagles have demonstrated tolerance for such activity. Other motorized boat traffic passing within 330 feet of the nest should attempt to minimize trips and avoid stopping in the area where feasible, particularly where eagles are unaccustomed to boat traffic. Buffers for airboats should be larger than 330 feet due to the increased noise they generate, combined with their speed, maneuverability, and visibility.

Category F. Non-motorized recreation and human entry (e.g., hiking, camping, fishing, hunting, birdwatching, kayaking, canoeing). No buffer is necessary around nest sites outside the breeding season. If the activity will be visible or highly audible from the nest, maintain a 330-foot buffer during the breeding season, particularly where eagles are unaccustomed to such activity.

Category G. Helicopters and fixed-wing aircraft.
Except for authorized biologists trained in survey techniques, avoid operating aircraft within 1,000 feet of the nest during the breeding season, except where eagles have demonstrated tolerance for such activity.

Category H. Blasting and other loud, intermittent noises.
Avoid blasting and other activities that produce extremely loud noises within 1/2 mile of active nests, unless greater tolerance to the activity (or similar activity) has been demonstrated by the eagles in the nesting area. This recommendation applies to the use of fireworks classified by the Federal Department of Transportation as Class B explosives, which includes the larger fireworks that are intended for licensed public display.

RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT FORAGING AREAS AND COMMUNAL ROOST SITES

1. Minimize potentially disruptive activities and development in the eagles' direct flight path between their nest and roost sites and important foraging areas.

2. Locate long-term and permanent water-dependent facilities, such as boat ramps and marinas, away from important eagle foraging areas.

3. Avoid recreational and commercial boating and fishing near critical eagle foraging areas during peak feeding times (usually early to mid-morning and late afternoon), except where eagles have demonstrated tolerance to such activity.

4. Do not use explosives within ½ mile (or within 1 mile in open areas) of communal roosts when eagles are congregating, without prior coordination with the U.S. Fish and Wildlife Service and your state wildlife agency.

5. Locate aircraft corridors no closer than 1,000 feet vertical or horizontal distance from communal roost sites.

ADDITIONAL RECOMMENDATIONS TO BENEFIT BALD EAGLES

The following are additional management practices that landowners and planners can exercise for added benefit to bald eagles.

1. Protect and preserve potential roost and nest sites by retaining mature trees and old growth stands, particularly within ½ mile from water.

2. Where nests are blown from trees during storms or are otherwise destroyed by the elements, continue to protect the site in the absence of the nest for up to three (3) complete breeding seasons. Many eagles will rebuild the nest and reoccupy the site.

3. To avoid collisions, site wind turbines, communication towers, and high voltage transmission power lines away from nests, foraging areas, and communal roost sites.

4. Employ industry-accepted best management practices to prevent birds from colliding with or being electrocuted by utility lines, towers, and poles. If possible, bury utility lines in important eagle areas.

5. Where bald eagles are likely to nest in human-made structures (e.g., cell phone towers) and such use could impede operation or maintenance of the structures or jeopardize the safety of the eagles, equip the structures with either (1) devices engineered to discourage bald eagles from building nests, or (2) nesting platforms that will safely accommodate bald eagle nests without interfering with structure performance.

6. Immediately cover carcasses of euthanized animals at landfills to protect eagles from being poisoned.

7. Do not intentionally feed bald eagles. Artificially feeding bald eagles can disrupt their essential behavioral patterns and put them at increased risk from power lines, collision with windows and cars, and other mortality factors.

8. Use pesticides, herbicides, fertilizers, and other chemicals only in accordance with Federal and state laws.

9. Monitor and minimize dispersal of contaminants associated with hazardous waste sites (legal or illegal), permitted releases, and runoff from agricultural areas, especially within watersheds where eagles have shown poor reproduction or where bioaccumulating contaminants have been documented. These factors present a risk of contamination to eagles and their food sources.

CONTACTS

The following U.S. Fish and Wildlife Service Field Offices provide technical assistance on bald eagle management:

Alabama	Daphne	(251) 441-5181
Alaska	Anchorage	(907) 271-2888
	Fairbanks	(907) 456-0203
	Juneau	(907) 780-1160
Arizona	Phoenix	(602) 242-0210
Arkansas	Conway	(501) 513-4470
California	Arcata	(707) 822-7201
	Barstow	(760) 255-8852
	Carlsbad	(760) 431-9440
	Red Bluff	(530) 527-3043
	Sacramento	(916) 414-6000
	Stockton	(209) 946-6400
	Ventura	(805) 644-1766
	Yreka	(530) 842-5763
Colorado	Lakewood	(303) 275-2370
	Grand Junction	(970) 243-2778
Connecticut	(See New Hampshire)	
Delaware	(See Maryland)	
Florida	Panama City	(850) 769-0552
	Vero Beach	(772) 562-3909
	Jacksonville	(904) 232-2580
Georgia	Athens	(706) 613-9493
	Brunswick	(912) 265-9336
	Columbus	(706) 544-6428
Idaho	Boise	(208) 378-5243
	Chubbuck	(208) 237-6975
Illinois/Iowa	Rock Island	(309) 757-5800
Indiana	Bloomington	(812) 334-4261
Kansas	Manhattan	(785) 539-3474
Kentucky	Frankfort	(502) 695-0468
Louisiana	Lafayette	(337) 291-3100
Maine	Old Town	(207) 827-5938
Maryland	Annapolis	(410) 573-4573
Massachusetts	(See New Hampshire)	
Michigan	East Lansing	(517) 351-2555
Minnesota	Bloomington	(612) 725-3548
Mississippi	Jackson	(601) 965-4900
Missouri	Columbia	(573) 234-2132
Montana	Helena	(405) 449-5225
Nebraska	Grand Island	(308) 382-6468
Nevada	Las Vegas	(702) 515-5230
	Reno	(775) 861-6300
New Hampshire	Concord	(603) 223-2541
New Jersey	Pleasantville	(609) 646-9310
New Mexico	Albuquerque	(505) 346-2525
New York	Cortland	(607) 753-9334
	Long Island	(631) 776-1401
North Carolina	Raleigh	(919) 856-4520
	Asheville	(828) 258-3939
North Dakota	Bismarck	(701) 250-4481
Ohio	Reynoldsburg	(614) 469-6923
Oklahoma	Tulsa	(918) 581-7458
Oregon	Bend	(541) 383-7146
	Klamath Falls	(541) 885-8481
	La Grande	(541) 962-8584
	Newport	(541) 867-4558
	Portland	(503) 231-6179
	Roseburg	(541) 957-3474
Pennsylvania	State College	(814) 234-4090
Rhode Island	(See New Hampshire)	
South Carolina	Charleston	(843) 727-4707
South Dakota	Pierre	(605) 224-8693
Tennessee	Cookeville	(931) 528-6481
Texas	Clear Lake	(281) 286-8282
Utah	West Valley City	(801) 975-3330
Vermont	(See New Hampshire)	
Virginia	Gloucester	(804) 693-6694
Washington	Lacey	(306) 753-9440
	Spokane	(509) 891-6839
	Wenatchee	(509) 665-3508
West Virginia	Elkins	(304) 636-6586
Wisconsin	New Franken	(920) 866-1725
Wyoming	Cheyenne	(307) 772-2374
	Cody	(307) 578-5939

National Office
U.S. Fish and Wildlife Service
Division of Migratory Bird Management
4401 North Fairfax Drive, MBSP-4107
Arlington, VA 22203-1610
(703) 358-1714
http://www.fws.gov/migratorybirds

State Agencies

To contact a state wildlife agency, visit the Association of Fish & Wildlife Agencies' website at http://www.fishwildlife.org/where_us.html

GLOSSARY

The definitions below apply to these National Bald Eagle Management Guidelines:

Communal roost sites – Areas where bald eagles gather and perch overnight – and sometimes during the day in the event of inclement weather. Communal roost sites are usually in large trees (live or dead) that are relatively sheltered from wind and are generally in close proximity to foraging areas. These roosts may also serve a social purpose for pair bond formation and communication among eagles. Many roost sites are used year after year.

Disturb – To agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

In addition to immediate impacts, this definition also covers impacts that result from human-caused alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle=s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

Fledge – To leave the nest and begin flying. For bald eagles, this normally occurs at 10-12 weeks of age.

Fledgling – A juvenile bald eagle that has taken the first flight from the nest but is not yet independent.

Foraging area – An area where eagles feed, typically near open water such as rivers, lakes, reservoirs, and bays where fish and waterfowl are abundant, or in areas with little or no water (i.e., rangelands, barren land, tundra, suburban areas, etc.) where other prey species (e.g., rabbit, rodents) or carrion (such as at landfills) are abundant.

Landscape buffer – A natural or human-made landscape feature that screens eagles from human activity (e.g., strip of trees, hill, cliff, berm, sound wall).

Nest – A structure built, maintained, or used by bald eagles for the purpose of reproduction. An **active** nest is a nest that is attended (built, maintained or used) by a pair of bald eagles during a given breeding season, whether or not eggs are laid. An **alternate** nest is a nest that is not used for breeding by eagles during a given breeding season.

Nest abandonment – Nest abandonment occurs when adult eagles desert or stop attending a nest and do not subsequently return and successfully raise young in that nest for the duration of a breeding season. Nest abandonment can be caused by altering habitat near a nest, even if the alteration occurs prior to the breeding season. Whether the eagles migrate during the non-breeding season, or remain in the area throughout the non-breeding season, nest abandonment can occur at any point between the time the eagles return to the nesting site for the breeding season and the time when all progeny from the breeding season have dispersed.

Project footprint – The area of land (and water) that will be permanently altered for a development project, including access roads.

Similar scope – In the vicinity of a bald eagle nest, an existing activity is of similar scope to a new activity where the types of impacts to bald eagles are similar in nature, and the impacts of the existing activity are of the same or greater magnitude than the impacts of the potential new activity. Examples: (1) An existing single-story home 200 feet from a nest is similar in scope to an additional single-story home 200 feet from the nest; (2) An existing multi-story, multi-family dwelling 150 feet from a nest has impacts of a greater magnitude than a potential new single-family home 200 feet from the nest; (3) One existing single-family home 200 feet from the nest has impacts of a lesser magnitude than three single-family homes 200 feet from the nest; (4) an existing single-family home 200 feet from a communal roost has impacts of a lesser magnitude than a single-family home 300 feet from the roost but 40 feet from the eagles' foraging area. The existing activities in examples (1) and (2) are of similar scope, while the existing activities in example (3) and (4) are not.

Vegetative buffer – An area surrounding a bald eagle nest that is wholly or largely covered by forest, vegetation, or other natural ecological characteristics, and separates the nest from human activities.

RELATED LITERATURE

Andrew, J.M. and J.A. Mosher. 1981. Bald eagle nest site selection and nesting habitat in Maryland. Journal of Wildlife Management 46:382-390.

Anonymous. 1977. Bald Eagle Habitat Management Guidelines, Forest Service – California Region. U.S Forest Service, San Francisco, CA.

Anthony, R.G. 2001. Low productivity of bald eagles on Prince of Wales Island, southeast Alaska. Journal of Raptor Research 35:1-8.

Anthony, R.G., R.W. Frenzel, F.B. Isaacs, and M.G. Garrett. 1994. Probable causes of nesting failures in Oregon's bald eagle population. Wildlife Society Bulletin 22:576-582.

Anthony, R.G. and F.B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. Journal of Wildlife Management 53:148-158.

Arizona Game and Fish Department. 1999. Bald Eagle Conservation Assessment and Strategy (draft).

Avian Power Line Interaction Committee (APLIC). 1996. Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996. Edison Electric Institute, Raptor Research Foundation, Washington, D.C.

Bangs, E.E., T.N. Bailey and V.D. Berns. Ecology of nesting bald eagles on the Kenai National Wildlife Refuge, Alaska. (USFWS staff)

Becker, J.M. 2002. Response of wintering bald eagles to industrial construction in southeastern Washington. Wildlife Society Bulletin 30:875-878.

Brauning, D.W. and J.D. Hassinger. 2000. Pennsylvania Recovery and Management Plan for the Bald Eagle (draft). Pennsylvania Game Commission. Harrisburg, PA.

Brown, B.T., G.S. Mills, C. Powels, W.A. Russell, G.D. Therres and J.J. Pottie. 1999. The influence of weapons-testing noise on bald eagle behavior. Journal of Raptor Research 33:227-232.

Brown, B.T. and L.E. Stevens. 1997. Winter bald eagle distribution is inversely correlated with human activity along the Colorado River, Arizona. Journal of Raptor Research31:7-10.

Buehler, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). *In* The Birds of North America, No. 506 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Buehler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seegar. 1991. Effects of human activity on bald eagle distribution on the northern Chesapeake Bay. Journal of Wildlife Management 55:282-290.

Buehler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seegar. 1991. Nonbreeding bald eagle communal and solitary roosting behavior and roost habitat on the northern Chesapeake Bay. Journal of Wildlife Management 55:273-281.

Chandler, SK., J.D. Fraser, D.A. Buehler and J.K.D. Seegar. 1995. Perch trees and shoreline development as predictors of bald eagle distribution on the Chesapeake Bay. Journal of Wildlife Management 59:325-332.

Cline, K. 1985. Bald Eagles in the Chesapeake: A Management Guide for Landowners. National Wildlife Federation. Washington, D.C.

Dell, D.D. and P.J. Zwank. 1986. Impact of a high-voltage transmission line on a nesting pair of southern bald eagles in southeast Louisiana. Journal of Raptor Research 20(3/4):117-119.

Dunwiddie, P.W. and R.C. Kuntz. 2001. Long-term trends of bald eagles in winter on the Skagit River, Washington. Journal of Wildlife Management 65(2):290-299.

Fletcher, R.J. et. al. 1999. Effects of recreational trails on wintering diurnal raptors along riparian corridors in a Colorado grassland. Journal of Raptor Research 33(3):233-239.

Fraser, J.D. 1981. The breeding biology and status of the bald eagle on the Chippewa National Forest. PhD. Dissertation, University of Minnesota.

Fraser, J.D., LD. Frenzel and J.E. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. Journal of Wildlife Management 49(3):585-592.

Garrett, M.G., J.W. Watson, and R.G. Anthony. 1993. Bald eagle home range and habitat use in the Columbia River Estuary. Journal of Wildlife Management 57(1):19-27.

Gerrard J.M. and G.R. Bortolotti. 1988. The Bald Eagle: Haunts and Habits of a Wilderness Monarch. Smithsonian Institution Press. Washington, D.C.

Grier, J.W. 1969. Bald eagle behavior and productivity responses to climbing to nests. Journal of Wildlife Management 33:961-966.

Grier, J.W. and J.E. Guinn. 2003. Bald eagle habitats and responses to human disturbance in Minnesota. Report to the Minnesota Department of Natural Resources.

Grubb, T.G. 1976. Survey and analysis of bald eagle nesting in western Washington. M.S. thesis, Univ. of Washington, Seattle.

Grubb, T.G. and R.M. King. 1991. Assessing human disturbance of breeding bald eagles with classification tree models. Journal of Wildlife Management 55:500-511.

Grubb, T.G., W.L. Robinson and W.W. Bowerman. 2002. Effects of watercraft on bald eagles nesting in Voyagers National Park, Minnesota. Wildlife Society Bulletin 30:156-161.

Grubb, T.G. and W.W. Bowerman. 1997. Variations in breeding bald eagle response to jets, light planes and helicopters. Journal of Raptor Research 31:213-222.

Grubb, T.G., W.W. Bowerman, A.J. Bath, J.P. Giesy, D.V.C. Weseloh. 2003. Evaluating Great Lakes bald eagle nesting habitat with Bayesian inference. RMRS-RP-45. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO, 10 pp.

Hansen, J.A. 1977. Population dynamics and night roost requirements of bald eagles wintering in the Nooksack River Valley, WA. Huxley College of Environmental Studies, Western Washington State College, Bellingham, WA. (Problem Series)

Hansen, J.A., M.V. Stalmaster and J.R. Newman. 1980. Habitat characteristics, function, and destruction of bald eagle communal roosts in western Washington. Huxley college of Environmental Studies, Western Washington University.

Hunt, W.G., D.E. Driscoll, E.W. Bianchi, and R.E. Jackman. 1992. Ecology of bald eagles in Arizona. Report to U.S. Bureau of Reclamation, Contract 6-CS-30-04470. BioSystems Analysis Inc., Santa Cruz, California.

Isaacs, F.B and R.G. Anthony. 1987. Abundance, foraging, and roosting of bald eagles wintering in the Harney Basin, Oregon. Northwest Science 61(2), pp. 114-121.

Juenemann, B.G. 1973. Habitat evaluations of selected bald eagle nest sites on the Chippewa National Forest. M.S. thesis, University of Minnesota, Minneapolis.

Keister, G.P., R.G. Anthony and E.J. O'Neill. 1987. Use of communal roosts and foraging area by bald eagles wintering in the Klamath Basin. Journal of Wildlife Management 51(2):415-420.

Knight, R. and S.K. Knight. 1984. Responses of wintering bald eagles to boating activity. Journal of Wildlife Management 48:999-1004.

Linscombe, J.T., T.J. Hess, Jr., and V.L. Wright. 1999. Effects of seismic operations on Louisiana's nesting bald eagles. Proceedings of the Southeastern Association of Fish and Wildlife Agencies. 54:235-242.

Maine (State of) Inland Fisheries and Wildlife Rules. Chapter 8.05 Essential Habitat for Species Listed as Threatened or Endangered.

Mathisen, J.E. 1968. Effects of human disturbance on nesting bald eagles. Journal of Wildlife Management 32(1): 1-6.

McGarigal, K., R.G. Anthony and F.B. Isaacs. 1991. Interactions of humans and bald eagles on the Columbia River estuary. Wildlife Monographs 115:1-47.

McKay, K.J., J.W. Stravers, B.R. Conklin, U. Konig, S. Hawks, C.J. Kohrt, J.S. Lundh and G.V. Swenson. 2001. Potential human impacts on bald eagle reproductive success along the Upper Mississippi River.

McKewan, L.C. and D.H. Hirth. 1979. Southern bald eagle productivity and nest site selection. Journal of Wildlife Management 43:585-594.

Millsap, B.A. Status of wintering bald eagles in the conterminous 48 States. 1986. Wildlife Society Bulletin 14:433-440.

Millsap, B.A, T. Breen, E. McConnell, T. Steffer, L. Phillips, N. Douglass, and S. Taylor. In Press. Comparative fecundity and survival of bald eagles fledged from suburban and rural natal areas in Florida. Journal of Wildlife Management 68(4).

Montana Bald Eagle Working Group. 1986. Montana Bald Eagle Management Plan. Department of the Interior, Bureau of Land Management. Billings, MT.

Nesbitt, S.A., M.J. Folk and D.A. Wood. 1993. Effectiveness of bald eagle habitat protection guidelines in Florida. Proceedings of the Annual Conference of the Southeast Association of Fish and Wildlife Agencies.

Newman, J.R., W.H. Brennan and L.M. Smith. 1977. Twelve-year changes in nesting patterns of bald eagles on San Juan Island, Washington. The Murrelet 58(2)37-39.

Postapulsky, S. 1974. Raptor reproductive success: some problems with methods, criteria, and terminology. Pages 21-31 *in* F.N. Hammerstrom, Jr., B.E. Harrell, and R.R. Olendorff, eds. Management of raptors. Raptor Res. Found., Vermillion, S.D.

Rodgers, J.A. and Schwikert, S.T. 2003. Buffer zone distances to protect foraging and loafing waterbirds from disturbance by airboats in Florida. Waterbirds 26(4): 437-443.

Russell, D. 1980. Occurrence and human disturbance sensitivity of wintering bald eagles on the Sauk and Suiattle Rivers, Washington. In R.L. Knight, G.T. Allen, M.V. Stalmaster and C.W. Servheen [eds.]. Proceedings of the Washington Bald Eagle Symposium. Nature Conservancy, Seattle, Washington, pp. 165-174.

Shapiro, A.E., F. Montalbano, and D. Mager. 1982. Implications of construction of a flood control project upon bald eagle nesting activity. Wilson Bulletin 94(1), pp. 55-63.

Skagen, S.K. 1980. Behavioral responses of wintering bald eagles to human activity on the Skagit River, Washington. In R.L.Knight, G.T. Allen, M.V. Stalmaster and C.W. Servheen [eds.]. Proceedings of the Washington Bald Eagle Symposium. Nature Conservancy, Seattle, Washington, pp. 231-241.

Skagen, S.K., R.L. Knight and G.J.H. Orians. 1991. Human disturbance of an avian scavenging guild. Ecological Applications 1:215-225. (Internet)

Stalmaster, M.V. 1976 Winter ecology and effects of human activity on bald eagles in the Nooksack River Valley, Washington. MS Thesis, Western Washington State College, Bellingham.

Stalmaster, M.V. 1980. Management strategies for wintering bald eagles in the Pacific Northwest. Proceedings of the Washington Bald Eagle Symposium, pp 49-67.

Stalmaster, M.V. and J.L. Kaiser. 1998. Effects of recreational activity on wintering bald eagles. Wildlife Monographs 137:1-46.

Stalmaster, M.V. and J.L. Kaiser. 1997. Flushing responses of wintering bald eagles to military activity. Journal of Wildlife Management 61:1307-1313.

Stalmaster, M.V. and J.R. Newman. 1978. Behavioral responses of wintering bald eagles to human activity. Journal of Wildlife Management 42:506-513.

Steenhof, K. 1978. Management of Wintering Bald Eagles. FWS/OBS-78/79. U.S. Fish and Wildlife Service, Department of the Interior, Washington D.C.

Steidl, R.J. and R.G. Anthony. 2000. Experimental Effects of Human Activity on Breeding Bald Eagles. Ecological Applications 10(1), pp. 258-268.

Therres, G.D., M.A. Byrd and D.S. Bradshaw. 1993. Effects of development on nesting bald eagles: case studies from Chesapeake Bay. Transactions of the North American Wildlife and Natural Resources Conference 58:62-69.

U.S. Fish and Wildlife Service. 1979. Bald Eagle Management Guidelines: Oregon – Washington. Portland. OR.

U.S. Fish and Wildlife Service. 1983. Northern States bald eagle recovery plan. Appendices E, F, and G. U.S. Fish and Wildlife Service, Region 6, Denver, CO.

U.S. Fish and Wildlife Service. 1987. Habitat Management Guidelines for the Bald Eagle in the Southeast Region. U.S Fish and Wildlife Service, Region 4. Atlanta, GA.

U.S. Fish and Wildlife Service. 1993. Bald Eagle Basics. Anchorage, AK.

U.S. Fish and Wildlife Service. 1993. Habitat Management Guidelines for Bald Eagles in Texas. Austin, TX.

U.S. Fish and Wildlife Service and Virginia Department of Game and Inland Fisheries. 2001. Bald Eagle Protection Guidelines for Virginia. Gloucester and Richmond, VA.

Watson, J.W. 1993. Responses of nesting bald eagles to helicopter surveys. Wildlife Society Bulletin 21:171-178.

Watson, J.W. 2004. Responses of nesting bald eagles to experimental pedestrian activity. Journal of Raptor Research 38:295-305.

Wood, P.B. 1999. Bald eagle response to boating activity in northcentral Florida. Journal of Raptor Research 33:97-101.

Wood, P.B., T.C. Edwards Jr. and M.W. Collopy. 1989. Characteristics of bald eagle nesting habitat in Florida. Journal of Wildlife Management 53(2):441-449.

Young, L.S. 1980. A quantitative evaluation of human disturbance impacts on breeding eagle ecology of bald eagles in the San Juan Islands, Washington. Washington Department of Game, Olympia.

Section 4: Phase I Environmental Site Assessment for Sweetwater Creek Feasibility Study, Douglas, Paulding, and Cobb Counties, Georgia

Phase I Environmental Site Assessment
For
Sweetwater Creek Feasibility Study
Douglas, Paulding and Cobb Counties, Georgia

U.S. Army Engineer District Mobile

ATTN: CESAM-EN-GE

109 St. Joseph Street

Mobile, Alabama 36602

December 2017

Table of Contents

Executive Summary

A Phase I Environmental Site Assessment was completed as part of the Sweetwater Creek Flood Risk Management (FRM) Feasibility Study to evaluate areas considered for flood zone reduction. The FRM study includes the assessment of six alternatives. The six alternatives are comprised of nine measures, including a combination of detention structures, channel modification and real estate buy-outs within the watershed. This Phase I Environmental Site Assessment was completed to evaluate each of the areas affected by the potential alternatives for the presence of environmental contamination as described in ASTM E 1527-05. Tasks completed for the Phase I Environmental Site Assessment include review of environmental regulatory databases, aerial photography and maps, interviews, and a site visit to each area.

Areas inspected include select non-residential properties identified within each of the nine measures (Buyout, SC1, SC2, SC6, SC9/Channelization, OC1, PC2, MC2 and MC5) (Appendix 13.1). Each Alternative area is largely comprised of residential and commercial properties, and rural undeveloped land. Increased land cover in these areas has resulted in higher runoff and degradation of the Sweetwater Creek watershed.

During the site inspection, select non-residential properties identified within each of the nine measures were visually inspected for evidence of recognized environmental conditions that may impact the project (Appendix 13.2). Photographs of each property were taken to document conditions at the time of the site inspection (Appendix 13.3), and residents/workers in the area were interviewed to document personal knowledge of the area (Appendix 13.4).

Available documentation (Appendix 13.5) and the results of the site inspection were reviewed and analyzed using the ASTM E 1527-05 guidance. Areas of recognized environmental conditions were observed, and available environmental records do indicate the presence of known adverse environmental conditions within the study area.

1 Introduction

1.1 Purpose

The purpose of this Phase I ESA is to identify, to the extent feasible pursuant to ASTM Standard E 1527-05, “Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process,” recognized environmental conditions in connection with the site. The term recognized environmental condition is defined as the presence or likely presence of any hazardous substances or petroleum products on a property. In addition, conditions must indicate that there is an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater or surface water of the property. The term hazardous substances or petroleum products include those under conditions in compliance with laws as well. The term is not intended to include de minimis conditions that generally do not present a threat to human health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be de minimis are not recognized environmental conditions.

Although performance of this investigation is in a manner that is generally consistent with the ASTM E 1527-05 Standard, it should be recognized that the Standard of "All Appropriate Inquiry" or "good commercial or customary practice" can only be made on a case-by-case basis and is subject to judicial interpretation.

This assessment includes a review of environmental database searches, aerial photography, and topographic maps to identify activities within the watershed area that may have contamination or environmental issues, a site inspection to physically verify conditions within each area, and interviews with available residences and persons familiar with the watershed area.

1.2 Detailed Scope of Services

This Phase I ESA is conducted in general accordance with ASTM Standard E 1527-05. The assessment consists of four components: records review, site reconnaissance, interviews, and report preparation. The scope of work does not include an evaluation of asbestos containing building materials, lead based paint, lead in drinking water, regulatory compliance, soil or groundwater sampling and analysis, cultural and historical resources, industrial hygiene, health and safety, ecological resources, indoor air quality, radon, geotechnical (soils, foundations, site retention, etc.), wetlands, endangered species, or construction materials testing.

1.3 Significant Assumptions

Assumptions to be made during Phase I ESA include: that the entire area of investigation be available for inspection, that pertinent information would be available in local, state, and federal databases searched during this investigation, and that the personnel completing the investigation and site inspection would have the training and experience to recognize environmental issues that affect or may affect the area of investigation.

This report was prepared based upon the information available at the time of the investigation, the observations made during site reconnaissance, and the information obtained from a review of readily available records. Given the inherent limitations of environmental assessment work, there is no guarantee that any site is free of hazardous or potentially hazardous materials or that latent or undiscovered conditions will not become evident in the future. This report was prepared within the professional conduct of the industry and in accordance with the recommended standard of practice outlined in ASTM E 1527-05.

1.4 Limitations and Exceptions

This Phase I Environmental Assessment represents a review of certain information relating to the site that was obtained by methods described above and does not include sampling or other monitoring activities at the property. This report is not a comprehensive site characterization and should not be construed as such. The opinions presented in this report are based upon the findings derived from site reconnaissance, review of specified regulatory records and historical sources, and information obtained from interviews. This report shall not be relied upon by or transferred to any other party without the express written authorization of the US Army Corps of

Engineers.

1.5 Special Terms and Conditions

This report, and the information contained herein, shall be used by the US Army Corps of Engineers to the extent possible to support the Sweetwater Creek Flood Risk Management Feasibility Study.

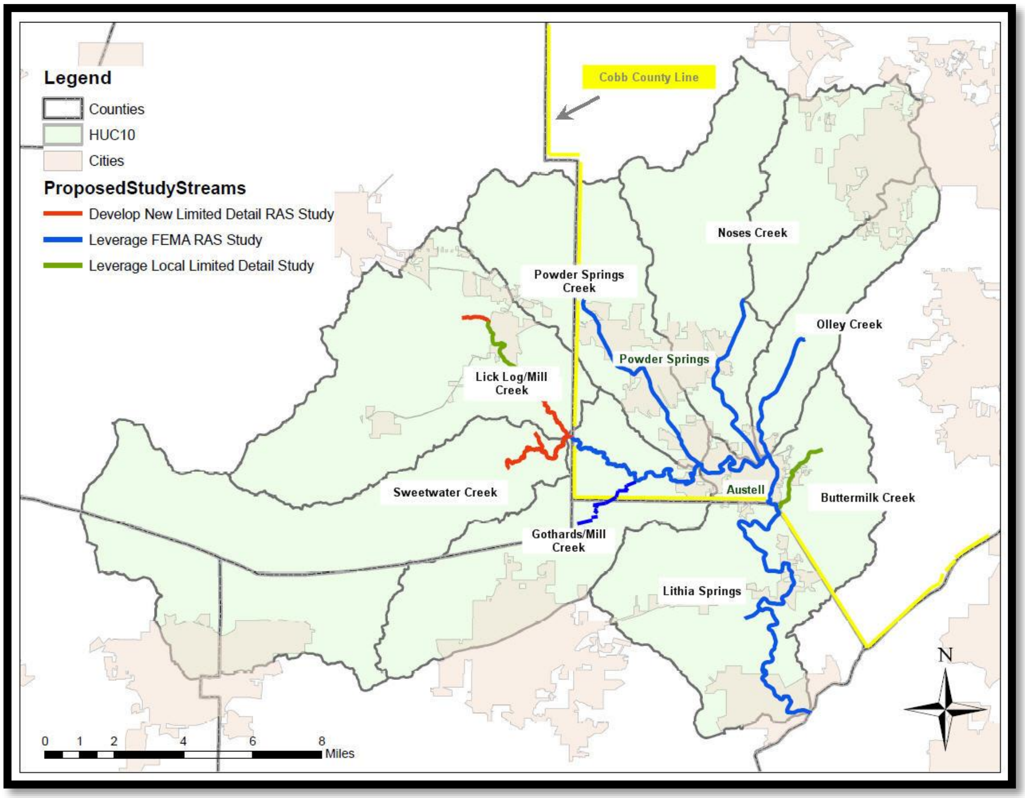
1.6 User Reliance

This report is intended for the sole use of the US Army Corps of Engineers. The contents of this report may not be relied upon by other parties without the explicit written consent of the US Army Corps of Engineers.

2 Site Description

The subject of this ESA is nine measure areas incorporated within 6 proposed alternative areas within the Sweetwater Creek Watershed, where the U.S. Army Corps of Engineers plans to implement corrective measures to address flood zone reduction. The Sweetwater Creek Watershed encompasses rural and urban settings where the ecosystem structure, function, and dynamic processes have been degraded.

The subject of this investigation includes the areas described and depicted below.



2.1 Location and Legal Description

The Sweetwater Creek watershed encompasses 264 square miles in Paulding, Douglas, and Cobb Counties in Georgia. The main stem of Sweetwater Creek is 45.6 miles long and begins in Paulding County. As it flows eastward towards Cobb County, other tributaries join the main stem before it empties into the Chattahoochee River in Douglas County at the Fulton County line. The creek passes through Sweetwater Creek State Park just before its confluence with the Chattahoochee River. The Study area encompasses the entire Sweetwater Creek watershed; however, the portion within Cobb County, Georgia is the intended area of flood risk improvement. The Cobb County portion includes the cities of Marietta, Austell and Powder Springs as well as a portion of unincorporated Cobb County, Georgia.

2.2 Site and Vicinity General Characteristics

The Sweetwater Creek Watershed is comprised of residential and commercial properties, as well as areas that are urbanized and areas that are wooded and undeveloped.

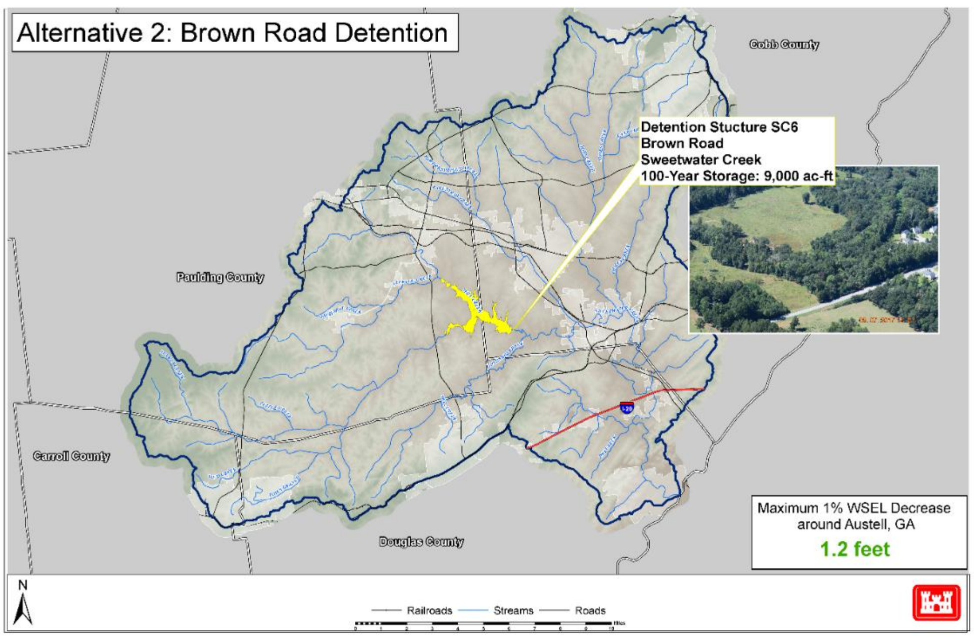
2.3 Current Use of Property

The current use and condition of the subject areas are shown on site photographs found in Appendix 13.3. Below are figures showing the location of each of the potential alternative/measure areas. Individual images depicting the location and extent of the areas physically inspected can be found in Appendix 13.3.

The following section provides a brief description of each study area.

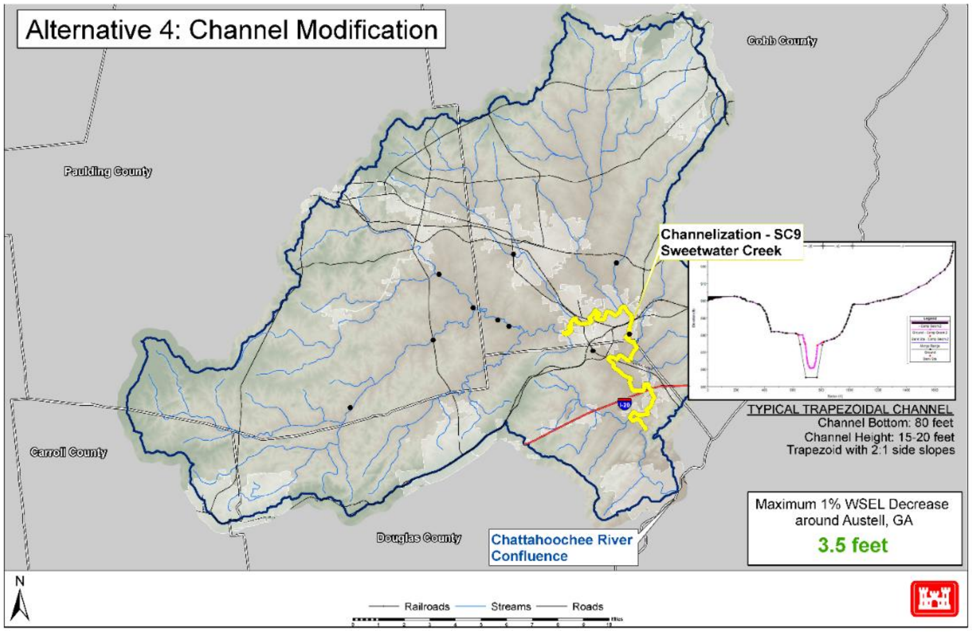
Alternative 1: Buyout Alternative: This alternative would be to purchase structures lying primarily in the floodway. The majority of the buyouts would be in the Powder Springs and Austell area, since that is where the majority of the structural flooding is located and projected to continue occurring.

Alternative 2: Brown Road Detention Alternative: This alternative consists of a 33 feet high dry detention structure that would have a slot to allow low flow through in a day-lighted channel. It would be located upstream of Brown Road in Cobb County near the Paulding county line. The structure will detain water in a 900 to 1000 acre site and would drain dry to base flow within 24 hours after an event. (Measure SC6)



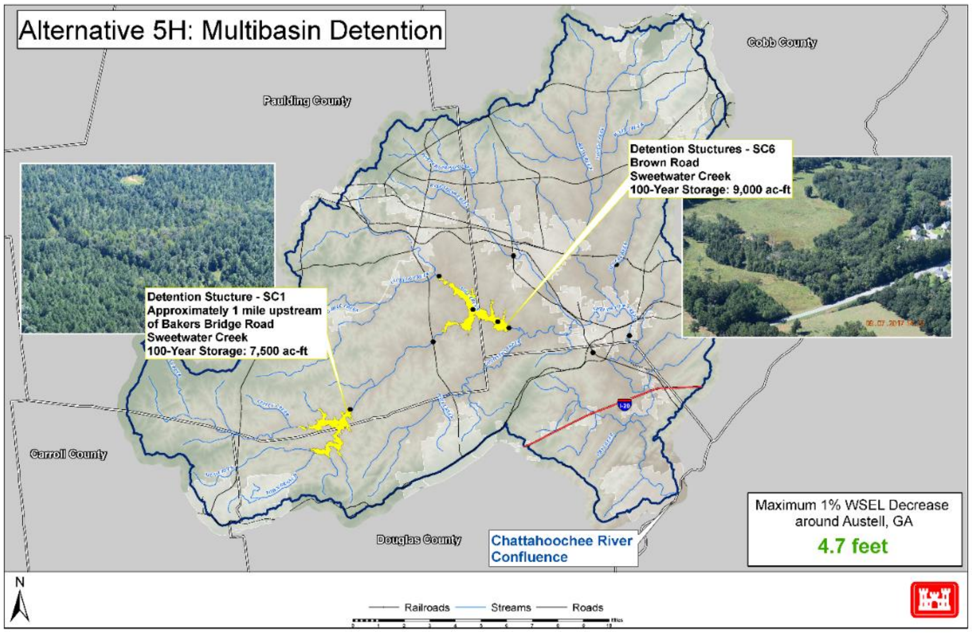
Alternative 3: Austell Channel Modification: This alternative consists of a channel modification from near the CH James Parkway to the rapids in Sweetwater Creek State park near the historic mill site. The channel would be widened to 80 feet and would have 2V:1H side slopes. The length of the channel modification is approximately 50,000 linear feet and would

remove approximately 3 Million cubic yards of material from the channel. (Measure SC9)



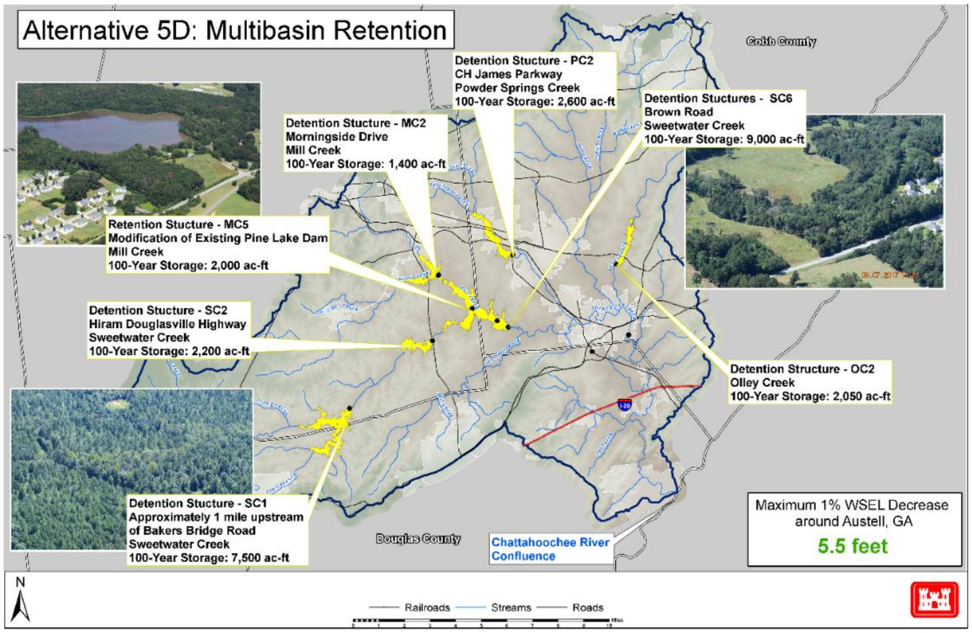
Alternative 4: Multiple Detention on Sweetwater Creek: This alternative consists of two in line dry detention structures on Sweetwater Creek. All the detention sites would drain dry to base flow within 24 hours after an event. Starting at the upstream end, the first is a 20 feet high structure 1 mile upstream of Bakers Bridge Road in Paulding County near the Douglas and Paulding County Line. This approximately 725 acre detention site would hold water in both Paulding and Douglas Counties. The second is a 33 feet high structure upstream of Brown Road in Cobb County near the Paulding county line. This approximately 900 acre detention site would

hold water in both Paulding and Cobb Counties. (Measures SC1 and SC6)



Alternative 5: Multi-subbasin Detention: This alternative consists of multiple in-line dry detention structures with three on Sweetwater Creek, one on Powder Springs Creek, one on Ollie Creek, and one on Mill Creek. There is also one retention site on Mill Creek. All the detention sites would drain dry to base flow within 24 hours after an event. Starting at the upstream end, the first on Sweetwater Creek is a 24 feet high structure 1 mile upstream of Bakers Bridge Road in Paulding County near the Douglas and Paulding County Line. This approximately 725 acre detention site would hold water in both Paulding and Douglas Counties. The second on Sweetwater Creek is a 15 feet high structure upstream of Highway 92 in Paulding County. This approximately 250 acre detention site would hold water in Paulding and Douglas Counties. The third on Sweetwater Creek is a 33 feet high structure upstream of Brown Road in Cobb County near the Paulding county line. This approximately 900 acre detention site would hold water in both Paulding and Cobb Counties The one on Powder Springs Creek is a 25 feet high structure upstream of C.H. James Parkway in Cobb County near the Cobb and Paulding County Line. This approximately 400 acre detention site would hold water in Cobb County. The one on Ollie Springs Creek is a 29 feet high structure upstream of Flint Hill Rd Southwest in Cobb County. This approximately 250 acre detention site would hold water in Cobb County. The first on Mill Creek is a 20 feet high structure upstream of Morningside Drive in Paulding County. This approximately 300 acre detention site would hold water in Paulding County. The second site on Mill Creek is a 25 feet high retention structure at Pine Valley Lake. This is a rehabilitation of the retention structure in Paulding County near the Cobb and Paulding County Line. This approximately 350 acre detention site would hold water in Paulding County. (Measures SC1,

SC2, SC6, MC2, MC5, OC1 and PC2)



Alternative 6: Upper End Sweetwater Detention: This alternative consists of a 24 feet high dry detention structure that would have a slot to allow low flow through in a day-lighted channel. It would be located 1 mile upstream of Bakers Bridge Road in Paulding County near the Douglas and Paulding County Line. This approximately 725 acre detention site would hold water in both Paulding and Douglas Counties. (Measure SC1)

USACE Number	Dewberry Number	Measures Included
Alternative 1	N/A	Buyout
Alternative 2	Alternative 2	SC6
Alternative 3	Alternative 4	Channelization
Alternative 4	Alternative 5h	SC1, SC6
Alternative 5	Alternative 5d	SC1, SC2, SC6, MC2, MC5, OC1, PC2
Alternative 6	Alternative 5i	SC1

2.4 Descriptions of Structures/Roads/Improvements on Site

The study area has numerous residential and commercial developments, roads, and improvements. Some structures, roads, or improvements do impact some of the potential alternative areas.

2.5 Current Use of Adjoining Properties

Adjoining and adjacent properties are residential, commercial, or undeveloped. Proposed Alternative locations are discussed in Section 2.3. Due to the nature of this assessment the actual proposed construction locations are not distinguished from the adjacent properties.

3 User Provided Information

3.1 Title Records

The chain-of-title report for the properties occupied by the proposed detention basin and stream reach locations was not reviewed.

3.2 Environmental Liens or Activity and Use Limitations

According to an environmental lien search provided by Environmental Data Resources, Inc. (EDR), no environmental liens are associated with the site. According to available information, the site has no activity or use limitations, such as institutional or engineering controls.

3.3 Specialized Knowledge

Limited information was obtained during the investigation with respect to any specialized knowledge or experience that may pertain to recognized environmental conditions in connection with the subject properties.

3.4 Commonly Known or Reasonably Ascertainable Information

The US Army Corps of Engineers was not aware of any commonly known or reasonably ascertainable information about the site that would indicate the presence of recognized environmental conditions associated with any of the study locations.

3.5 Valuation Reduction for Environmental Issues

No information was obtained or reviewed concerning valuation reduction for environmental issues at any of the properties.

3.6 Owner, Property Manager, and Occupant Information

Limited owner, property manager, and/or occupant information is presented in the ASTM E-1528 “Environmental Site Assessment: Transaction Screen Questionnaire”, located in Appendix

13.4.

3.7 Reason for Performing Phase I

This Phase I Environmental Site Assessment is being completed to support the Sweetwater Creek Flood Risk Management (FRM) Feasibility Study. The purpose of this study is to identify recognized environmental conditions within project study areas that may be impacted by the FRM project.

3.8 Other

No additional information was provided by the US Army Corps of Engineers

4 Records Review

4.1 Standard Environmental Record Sources

As a part of this assessment, available sources were reviewed to obtain existing information pertaining to a release of hazardous substances or petroleum products on or near the site. This includes an ASTM regulatory database search through Environmental Data Resources (EDR). A copy of the reports generated during the database search is included in Appendix 13.5.

Source	Applicable Search Distance from Stream Center Line	Within EDR Search Distance
FEDERAL RECORDS		
NPL	1000 ft	0
Proposed NPL	1000 ft	0
Delisted NPL	1000 ft	0
NPL LIENS	1000 ft	0
SEMS	1000 ft	4
SEMS-ARCHIVE	1000 ft	2
LIENS 2	1000 ft	0
CORRACTS	1000 ft	0
RCRA-TSDF	1000 ft	0
RCRA-LQG	1000 ft	1
RCRA-SQG	1000 ft	4
RCRA-CESQG	1000 ft	6
RCRA NonGen / NLR	1000 ft	33
US ENG CONTROLS	1000 ft	0
US INST CONTROL	1000 ft	0
ERNS	1000 ft	21
HMIRS	1000 ft	5
DOT OPS	1000 ft	0
US CDL	1000 ft	0
US BROWNFIELDS	1000 ft	0
DOD	1000 ft	0
FUDS	1000 ft	0
LUCIS	1000 ft	0
CONSENT	1000 ft	0
ROD	1000 ft	0
UMTRA	1000 ft	0
DEBRIS REGION 9	1000 ft	0
ODI	1000 ft	0
US MINES	1000 ft	1
TRIS	1000 ft	2

Source	Applicable Search Distance from Stream Center Line	Within EDR Search Distance
FEDERAL RECORDS		
TSCA	1000 ft	1
FTTS	1000 ft	0
HIST FTTS	1000 ft	0
SSTS	1000 ft	2
ICIS	1000 ft	8
PADS	1000 ft	0
MLTS	1000 ft	0
RADINFO	1000 ft	0
FINDS	1000 ft	161
RAATS	1000 ft	0
RMP	1000 ft	2
ABANDONED MINES	1000 ft	0
IHS OPEN DUMPS	1000 ft	0
SCRD DRYCLEANERS	1000 ft	0
US HIST CDL	1000 ft	0
PCB TRANSFORMER	1000 ft	0
US FIN ASSUR	1000 ft	0
EPA WATCH LIST	1000 ft	0
PRP	1000 ft	1
2020 COR ACTION	1000 ft	0
COAL ASH DOE	1000 ft	0
FUSRAP	1000 ft	0
UXO	1000 ft	0
DOCKET HWC	1000 ft	0
FUELS PROGRAM	1000 ft	0
ECHO	1000 ft	132
FEMA UST	1000 ft	0
FEDERAL FACILITY	1000 ft	0
LEAD SMELTERS	1000 ft	0
US AIRS	1000 ft	12

Source	Applicable Search Distance from Stream Center Line	Within EDR Search Distance
FEDERAL RECORDS		
COAL ASH EPA	1000 ft	0
STATE AND LOCAL RECORDS		
GA SHWS	1000 ft	1
GA NON-HSI	1000 ft	1
GA SWF/LF	1000 ft	1
GA AUL	1000 ft	0
GA NPDES	1000 ft	13
GA HIST LF	1000 ft	0
GA SWRCY	1000 ft	2
GA LUST	1000 ft	22
GA UST	1000 ft	42
GA DEL SHWS	1000 ft	0
GA AST	1000 ft	7
GA SPILLS	1000 ft	65
GA INST CONTROL	1000 ft	0
GA DRYCLEANERS	1000 ft	4
GA BROWNFIELDS	1000 ft	0
GA CDL	1000 ft	0
GA AIRS	1000 ft	11
GA TIER 2	1000 ft	39
AL TIER 2	1000 ft	1
GA VCP	1000 ft	0
GA COAL ASH	1000 ft	0
TRIBAL RECORDS		
INDIAN RESERV	1000 ft	0
INDIAN ODI	1000 ft	0
INDIAN LUST	1000 ft	0
INDIAN UST	1000 ft	0
INDIAN VCP	1000 ft	0

Source	Applicable Search Distance from Stream Center Line	Within EDR Search Distance
EDR PROPRIETARY RECORDS		
EDR MGP	1000 ft	0
EDR Hist Auto	1000 ft	85
EDR Hist Cleaner	1000 ft	14
GA RGA LUST	1000 ft	31
GA RGA LF	1000 ft	0
GA RGA HWS	1000 ft	0
Well Search Report	1000 ft	1

There are site/facility environmental concerns listed in the above table that meet criteria concerns for the site, adjoining sites, or within the EDR search distance of 1000 feet from the stream centerline. Therefore, there are environmental concerns associated with the areas identified in the proposed alternatives for Sweetwater Creek. Specific information on the search criteria and results are reported in the EDR database report included in Appendix 13.5.

4.2 Additional Environmental Record Sources

No additional environmental record sources were reviewed as part of this assessment.

4.3 Physical Setting Sources

The Sweetwater Creek Watershed is within the Piedmont region of Georgia. Physiographically, this area is considered the non-mountainous portion of the old Appalachians Highland; the northeast-southwest trending Piedmont region comprises a transitional area between the mostly mountainous regions of the Appalachians to the northwest and the relatively flat coastal plain to the southeast. It is a complex mosaic of Precambrian and Paleozoic metamorphic and igneous rocks with moderately dissected irregular plains and some hills. The soils tend to be fine-grained saprolite resulting from weathering of the underlying crystalline rock. Once largely cultivated, much of this region has reverted to pine and hardwood woodlands, and, more recently, spreading urban- and suburbanization.

Additional sources of information reviewed during the current assessment include an EDR Well Search Report and historical aerial photography, both located in Appendix 13.5. The following historical aerial photography was reviewed:

List of Aerial Photographs	
Year	**File Name**
1951	A007111516728
1951	A007111516730
1951	A007111516744
1951	A007112718152
1968	1VCAX00020061
1968	1VCAX00020063
1968	1VCAX00020065
1968	1VCAX00020095
1968	1VCAX00020140
1968	1VCAX00020142
1968	1VCAX00030021
1968	1VCAX00030023
1974	1VDLS00010114
1974	1VDLS00010115
1974	1VDLS00030036
1988	NP0NAPP000721114
1988	NP0NAPP000721116
1988	NP0NAPP000723063
1988	NP0NAPP000723064
1988	NP0NAPP000723138
1988	NP0NAPP000724046
1999	NP0NAPP011107115
1999	NP0NAPP011107117
1999	NP0NAPP011107159
1999	NP0NAPP011107160
1999	NP0NAPP011111181
1999	NP0NAPP011113012

4.4 Historical Use Information on Property

Based on the review of aerial photographs, historical use of the study area appears to be somewhat consistent with previous use but at a considerably higher rate of development than historical documents show. Commercial development activities could result in recognized environmental concerns.

4.5 Historical use Information on Adjoining Properties

Historical use of adjoining/adjacent properties appears to be residential, commercial, and/or undeveloped as far as records are available.

5 <u>Site Reconnaissance</u>

5.1 Methodology and Limiting Conditions

Visual and physical inspections conducted as part of this investigation included external inspection, where accessible, of various properties within the FEMA 100-year flood zone for each alternative area identified for the Feasibility Study. Observations of site conditions were noted, as well as the presence and condition of any on-site buildings, utilities, or other improvements. This visual and physical inspection of the property focused primarily on its surface features. Photographs of each alternative area are included in Appendix 13.3.

5.2 General Site Setting Exterior Observations

Evidence of use, storage, or disposal of hazardous substances was observed during the site inspection. Additionally, some areas contained minor amounts of non-hazardous debris including plastic, metal, glass, etc. Recognized environmental concerns were noted to be associated with portions of this debris.

5.3 Interior Observations

Evidence of use, storage, or disposal of hazardous substances was observed within the study area interior during the site inspection.

6 <u>Interviews</u>

A copy of the ASTM E-1528 (Environmental Site Assessment: Transaction Screen Questionnaire) form documenting the findings of interviews completed during this assessment is presented in Appendix 13.4.

6.1 Interviews with Property Owners and Workers

After the site inspection, local property owner Randall Maxwell and local worker Ken Elsberry were interviewed. The results of the interview are included in Appendix 13.4. Only Ken Elsberry had knowledge of one recognized environmental condition in the Sweetwater Creek study area. Mr. Elsberry is the Construction Manager for Paulding County School District, including South Paulding High School. He indicated the only environmental concern to his knowledge for the South Paulding High School property is a land disposal system used for sewage disposal. Mr. Maxwell is the property owner of Classic Paintball, located adjacent to Sweetwater Creek in Lithia Springs for 14 years. He indicated that during those 14 years at this location he had not observed or heard of any areas of hazardous material or waste storage or disposal. He did state that the area was prone to flooding and any improvements to the watershed would be helpful.

6.2 Interviews with Others

No other parties were interviewed during this assessment.

6.3 Transaction Screen Interview Questionnaire (ASTM E-1528)

Few questions on the interview questionnaire were answered yes. This indicates that persons interviewed had limited knowledge of environmentally-related issues in the study area. In addition, no recognized environmental conditions were observed during the site inspection of the properties associated with the questionnaire.

7 Findings

An environmental site assessment was completed for the nine measures included in the proposed alternatives for the Sweetwater Creek Flood Risk Management Feasibility Study. The objective of the assessment was to identify areas of recognized environmental conditions that may impact the project.

Available environmental records and databases were reviewed to identify known areas of hazardous material/waste storage or disposal within the entire watershed area. A site inspection was completed to visually inspect each of the alternative study areas for evidence of recognized environmental conditions. Properties within each alternative area were photographed to document conditions at the time of the inspection and interviews were completed to document conditions in the area known by local residences, officials, and workers.

Areas of recognized environmental conditions were observed during the site visit and areas of concern were noted in the database searches. Observations of recognized environmental conditions (RECs) for each measures area are available in Appendix 13.2. The EDR database search report is available in Appendix 13.5.

8 Opinion

There were on-site concerns noted for the current and historical use of the properties in the study area, and there appears to be environmental liability associated with some of the subject properties in the study area. No *de minimus* conditions were noted at the subject properties in the study area during this investigation. It is recommended that for any alternative selected that utilizes a property where a recognized environmental condition has been observed, or where there may be other hazardous, toxic or radiological waste (HTRW) concerns, additional environmental assessment be conducted. Additional assessment may be limited to additional records searches or may include a Phase II environmental investigation.

9 Conclusions

This Environmental Site Assessment has revealed evidence of recognized environmental conditions associated within the study areas. Measures SC1, SC2 and SC6 were the only areas investigated where no RECs were reported within the search parameters of the EDR database search or observed during the site investigation. For all other measures, including Buyouts, additional environmental assessment may be required to avoid potential assumption of any possible environmental liability associated with select properties.

10 Deviations

No deviations were encountered. The Environmental Site Assessment was completed in accordance with ASTM E 1527-05.

11 Additional Services

No additional services were provided as part of this Environmental Site Assessment to evaluate asbestos-containing materials; radon; lead-based paint; lead in drinking water; wetlands; regulatory compliance; cultural and historical resources; industrial hygiene; health and safety; ecological resources; endangered species; air quality; or other potential concerns not addressed in ASTM E 1527-05 and/or not identified as a potential concern during the site visit and investigation.

12 References

ASTM, E 1527-05, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process

ASTM, E 1528, Guide for Environmental Site Assessments: Transaction Screen Process

Supplement to

Phase I Environmental Site Assessment

For

Sweetwater Creek Feasibility Study

Douglas, Paulding and Cobb Counties, Georgia

U.S. Army Engineer District Mobile

ATTN: CESAM-EN-GE

109 St. Joseph Street

Mobile, Alabama 36602

April 2018

Supplement to Phase I Environmental Site Assessment
Sweetwater Creek Flood Reduction Feasibility Study
April 2018

INTRODUCTION

The following is supplemental information provided for the Phase I Environmental Site Assessment conducted for the Sweetwater Creek Flood Reduction Feasibility Study. For additional details regarding the purpose of and standards used for this assessment, please see the original Phase I Environmental Site Assessment Report for Sweetwater Creek Feasibility Study, dated December 2017.

A supplemental Phase I Environmental Site Assessment was conducted in April 2018 to investigate two commercial properties that were identified as potential properties for inclusion in a buy-out option for the Sweetwater Creek Feasibility Study. The two identified properties are:

- 2660 Clay Rd, Austell, Cobb County, GA
- 5455 Austell-Powder Springs Rd, Austell, Cobb County, GA

FINDINGS

2660 Clay Rd, Austell, Cobb County, GA – This property is located behind a residential parcel. The same individual owns both the residential and commercial parcels. This environmental assessment focused only on the commercial parcel, which operates as Tim's VW (automobile) Repair business. The area assessed is roughly 3.5 acres in size and is bordered to the east by Olley Creek, a tributary to Sweetwater Creek. The parcel is bordered to the west by an undeveloped area that includes a power line right-of-way and a natural spring, and bordered to the north by wooded, undeveloped land that includes a low-lying, wet area. A surface connection between the three water bodies was not observed at the time of this assessment, but is assumed to exist during significant rain events. The residential portion of the property borders the southern boundary of the commercial parcel.

Throughout the parcel, ground cover consists primarily of a mixture of soil (clay), gravel and unformed concrete. The eastern portion of the parcel, adjacent to Olley Creek, includes an area of approximately 0.25 acres that is covered with chunks of asphalt. The northeastern corner of the parcel contains the largest amount of automobiles in disrepair, and ground cover appears to be mostly overgrown weeds and grasses. The eastern and northeastern areas are divided by a clay and weeds ditch that runs from the center of the property towards Olley Creek. It is undetermined if the ditch was created from natural erosion or as an intentional diversion channel. The southern portion of the property consists of several piles of wood with some indication of a burn area, as well as several repaired automobiles and some VW body parts, such as fenders. Four structures and a cell phone tower consume the majority of the western half of the parcel. Per the property owner, Mr. Euell Nichols, the cell tower is currently leased (possibly to AT&T) and sits inside a 60' x 60' fenced area on the northwest corner of the property. The area inside the fence has gravel ground cover. The structures consist of the primary repair shop which is roughly 10,000 square feet, sits on a concrete foundation, has cinder block walls and a pitched tin roof. It houses an office space, work shop areas, storage, and vehicle bays. A second structure is north of the primary structure, east of the cell tower, and sits of the northern border of the property. It consists of an original building with concrete foundation, plywood walls, shingled roof and two vehicle bays, along with an additional vehicle bay on the eastern end that has a dirt floor and tin roof and walls. The third and fourth buildings are located behind the primary shop, along the western property boundary. They are both elevated wooden structures with significant signs of decay and appear to be used only for storage.

Most of the activity on the property appears to occur within or directly adjacent to the main repair building. There are numerous and various automobile batteries, tires, engines and motor parts scattered throughout the interior and exterior of the building, some clean and some covered in oily residue and automotive grime. Per Mr. Nichols, there have never been any underground storage tanks on the property, but there is one poly tote used for disposal of used motor oil. The tote is located on the exterior of the northeastern side of the building. A commercial service is contacted as needed for disposal of the waste oil product. Multiple drums, mostly 55-gallon size, were observed throughout the property. Some drums were metal, some were poly, some were empty, some were full of unknown content, some were upright and some were lying on the ground. Two empty drums lying on the ground were labeled to have contained mineral spirits. A variety of stains were observed around the main building, as well as numerous areas where kitty litter has been dispersed as an absorbent material for spilled oil products. There are also numerous erosion rills throughout the parcel, especially located on the west side of the primary repair building and leading toward the western boundary of the property.

According to the Georgia Environmental Protection Division (GAEPD) records, an anonymous complaint was issued against Mr. Nichols on August 15, 2001. The complainant alleged a 30 year history of illegal waste oil dumping into a gravel pit on the property. The GAEPD investigated on August 21, 2001and observed a wash area. Per the GAEPD Complaint Tracking System, on September 26, 2001, the GAEPD "observed receipts from clean up, saw cleaned pit area." The complaint was closed September 28, 2001. No information related to soil or groundwater samples was provided. During the U.S. Army Corps of Engineers (USACE), Hazardous, Toxic and Radiological Waste (HTRW) Phase I environmental site assessment in April 2018, Mr. Nichols indicated the pit area was located directly behind the primary repair building, on the west side. He stated a clay-type soil was excavated to a depth of approximately 6 feet and was backfilled with gravel and dirt. Currently, the area is loosely covered with several pieces of ply wood and is still being used as an area to pressure wash oil and grime from automobile parts. There is significant staining in the area, as well as erosion rills leading to the western boundary of the property.

5455 Austell-Powder Springs Rd, Austell, Cobb County, GA – This property is located at the southeast corner of the intersections of Austell-Powder Springs Rd and Stovall Rd. The lot is approximately 2.4 acres, the eastern half of which is heavily wooded and undeveloped. There is one structure on the northwest corner of the property, at the intersection of the 2 roads. The property is bounded to the east by more undeveloped land and to the south by City of Austell-owned property, most recently used for parking.

The building located on the property is single story and comprised of an original structure of approximately 800 square feet, with an addition of approximately 900 square feet. Both portions of the building have cinder block walls, a predominantly flat wooden roof, and sit on solid concrete foundation. The concrete slab foundation extends to the exterior of the building on the south side. Two additional, unstructured concrete areas are located to the south of the slab and on the east side of the building. A paved parking area is located in front of the building.

The exterior of the building resembles that of a former gas/service station. The paved area in front of the building shows evidence of something, such as fuel pumps and associated lines, having been removed and the pavement patched. Additionally, the current property owners stated they found documentation indicating the property was a Shell gas station in the mid to late 1950s. The current property owners have owned the property since the mid to late 1970s. At the time they gained ownership, no fuel pumps were located on the property and the addition to the original structure was already in place, as well as the slab extending south of the building. However, the current property owners are responsible for placing 3 garage/roll-up doors along the southern side of the building. The current property owners have only used the building for storage, primarily for their refrigerant business. At the time of this assessment, no utilities are servicing the building, having been shut off in 2009 due to extreme flooding.

Within the building, a small oil spill was observed on the slab. The spill is supposedly from a motorcycle that was previously parked inside the building. Cleanup of the spill was attempted via the use of kitty litter as an absorbent material. There were three 55-gallon metal drums of unknown content and in apparent good condition. There were also a couple of oil pans of unknown liquid product located inside the building.

There is possibly one septic tank still located underground, behind the building, in a low-lying grassy area. At this time, it is not known if there are any underground storage tanks (USTs) located on the property. However, inside the added on part of the structure, on what would have been the southwest corner of the exterior wall of the original structure, two metal vent pipes were observed. The pipes were approximately 2-3 inches in diameter and protruded from the concrete slab approximately 3 inches. The pipes were presumed to possibly be vent pipes for USTs. Therefore, it may be possible that if any USTs remain in place, they may be located underneath the slab for the added on part of the structure.

CONCLUSIONS

For the commercial parcel located at 2660 Clay Road, Austell, Cobb County, GA, a Phase II site assessment in recommended to determine the presence or absence of soil and groundwater contamination. There are no state or federal government databases documenting contamination at the property. However, there is record of a potential history of illegal discharge of used/waste oil products to the ground surface. Therefore, this recommendation is based on the recent observation of large amounts of asphalt on the property, as well as the continued existence of a wash area and stained soils. The asphalt appears to have been recycled/brought onto the property for use other than its intended purpose. Asphalt contains polyaromatic hyrocarbons (PAHs), which can result in soil contamination, as well as leach into the groundwater. The wash area is where used auto parts are pressure-washed to remove used oil and other automotive grime. The ground in this area showed significant staining. Contaminants commonly found in used and waste oils include, but are not limited to, PAHs, metals, and polychlorinated biphenyls (PCBs). These are also contaminants that can be found in both soil and groundwater. Given the historical and current use of the property, the potential history of discharges to the ground surface, the evidence of minor spills and visible soil staining, and the presence of a large area of recycled asphalt, soil and possibly groundwater samples would help determine if contamination is present on the property.

For the commercial property located at 5455 Austell-Powder Springs Road, Austell, Cobb County, GA, the use of Ground Penetrating Radar (GPR) services is recommended to determine the presence or absence of any USTs located on the property and complete the Phase I site assessment. Dependent upon the results of the GPR survey, a Phase II site assessment may be warranted to rule out the possibility of soil or groundwater contamination associated with waste oil products.

REFERENCES

USACE, Mobile District, HTRW, *Phase I Environmental Site Assessment for Sweetwater Creek Feasibility Study*, dated December 2017

Sweetwater Creek Flood Risk Management Feasibility Study

Appendix F: Federal and State Agency Coordination

Cobb County...Expect the Best!

U.S. Army Corps of Engineers
South Atlantic Division
Mobile District

US Army Corps of Engineers®
MOBILE DISTRICT

APPENDIX F: Federal and State Agency Coordination

Section 1: Fish and Wildlife Coordination Act Report

Section 2: Cultural Resources Coordination

Section 3: Cooperating Agency Letters and Invitation

Section 1: Fish and Wildlife Coordination Act Report

United States Department of the Interior

Fish and Wildlife Service
105 Westpark Drive, Suite D
Athens, Georgia 30606

West Georgia Sub Office
P.O. Box 52560
Ft. Benning, Georgia 31995-2560

Coastal Sub Office
4980 Wildlife Drive
Townsend, Georgia 31331

March 29, 2018

U.S. Army Engineer District Mobile
ATTN: CESAM-EN-GE
109 St. Joseph Street
Mobile, Alabama 36602

Dear Sir:

Attached is the US Fish and Wildlife Service's Fish and Wildlife Coordination Act report for the Mobile District's Sweetwater Creek flood reduction plan, Cobb County, Georgia. You propose to address flooding in the Sweetwater Creek watershed in Cobb County through purchase/demolation of 20 structures in the floodplain of Sweetwater Creek and tributaries. This approach reasonably maximizes net benefits with the least uncertainty, compared to six other alternatives that were evaluated that relied on extensive upstream stormwater detention or downstream channel modification.

The only trust resources that might be adversely affected by the project are bats and birds that roost or nest in the buildings to be demolished. With implementation of the conservation measures described in our report, impacts should be minimal.

Please contact staff biologist Robin Goodloe (706-613-9493 X221, robin_goodloe@fws.gov) if you have questions or require additional information.

Sincerely,

Donald W. Imm, Ph.D.
Field Supervisor

Fish and Wildlife Coordination Act Report
March 29, 2018

Mobile District, US Army Corps of Engineers
Sweetwater Creek Flood Risk Management
Cobb County, Georgia

Sweetwater Creek near Austell, Georgia 2009 (photo by USGS)

Preparer: Robin B. Goodloe, Ph.D.
Georgia Ecological Services, Athens, GA
US Fish and Wildlife Service, Southeast Region

Executive Summary

The Corps of Engineers, Mobile District, and its non-Federal partner, Cobb County, Georgia, propose to address flooding in the Sweetwater Creek watershed in Cobb County through purchase/demolition of 20 structures in Cobb County, the City of Austell, and the City of Powder Springs. This alternative reasonably maximized net benefits with the least uncertainty, compared to six other alternatives that relied on stormwater detention or channel modification.

Federally-listed species are not known to occur on or near the structures slated for demolition. The demolition is not expected to impact, and may provide limited benefit to, downstream aquatic communities. Terrestrial species that might be affected by structure removal include birds or bats that are roosting or rearing young in any of the buildings. We recommend the following conservation measures to protect bats, birds, and human health when the flood reduction project is implemented.

1. A qualified biologist should conduct surveys during summer to determine if maternity colonies or roosting bats are utilizing the structure(s) and where points of access are located. Surveys should include searching for indications of bat presence (guano and staining), as well as presence of bats.
2. If bats are found using a structure, Cobb County should contact the Georgia Department of Natural Resources (Nongame Conservation Section, 2065 US HWY 278 SE, Social Circle, GA 30025; 770-918-6411) for help in determining the species of bat present and guidance for safe bat exclusion from the structure. Maternity colonies should not be moved.
3. Contaminated soil or accumulations of bird or bat manure can contain the histoplasmosis fungus. Humans can become infected with this respiratory infection when spores are inhaled. Most infections are mild and produce either no symptoms or a minor influenza-like illness. On occasion, the disease can cause high fever, blood abnormalities, pneumonia and even death. Workers should avoid breathing dust in areas where there are animal droppings and should wear respirators that guard against particles as small as two microns if the droppings are to be disturbed.

Conclusion: With implementation of these conservation measures, the project is not likely to adversely affect fish and wildlife resources and may provide limited benefit to downstream aquatic resources.

AUTHORITY

The Army Corps of Engineers Mobile District's (Corps) involvement in the Sweetwater Creek Flood Risk Management project is authorized by House Resolution 2445 of the Committee on Public Works and Transportation, US House of Representatives, as adopted 28 September 1994. U.S. Fish and Wildlife Service (Service) involvement is authorized by the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and the Endangered Species Act of 1973 as amended (16 U.S.C. 1531 et seq.).

The FWCA requires Federal agencies that propose water resource development projects to provide equal consideration to fish and wildlife resources as to other project features. It also requires Federal agencies that construct, license or permit water resource development projects to first consult with the Service and State fish and wildlife agencies regarding project impacts on fish and wildlife resources and measures to mitigate these impacts. This report constitutes the report of the Secretary of the Interior as required by Section 2(b) of the FWCA.

The Endangered Species Act requires Federal agencies, in consultation with the Service and/or NOAA Fisheries Service to ensure that actions they authorize, fund, or carry out are not likely to jeopardize continued existence of a listed species or result in destruction or adverse modification of designated critical habitat.

PROJECT PURPOSE AND SCOPE

The Corps and its non-Federal partner, Cobb County, Georgia, propose to address flooding in the Sweetwater Creek watershed in Cobb County through purchase/demolition of 20 structures in Cobb County, the City of Austell, and the City of Powder Springs—all of the structures have first floor elevations lower than the anticipated water surface elevation of the 10% ACE floodplain.

Sweetwater Creek is a 45.6-mile-long tributary to the Chattahoochee River (Fig. 1). The Corps' study area encompassed the entire Sweetwater Creek watershed; however, the intended area of flood risk improvement is limited to the portion of the basin in Cobb County. Existing problems in the flood risk improvement area include:

- Routine rainfall events cause flooding along Sweetwater Creek, increasing flood risk and damaging residential and commercial structures throughout Cobb County. The Cities of Austell and Powder Springs and the surrounding areas experience the most extensive and frequent flooding in the study area.
- Emergency services are disrupted during routine flood events.
- Channel conveyance capacity is reduced due to continual sedimentation from erosion and run-off.

The primary goals of the project are to:

- Reduce flood damages along Sweetwater Creek and its tributaries within Cobb County.
- Reduce impacts to emergency services in Cobb County during flood events.
- Reduce stream bank erosion in the basin in Cobb County.
- Improve flood risk communication among stakeholders.

Major flooding occurred in the Sweetwater Creek basin July 2005, after Hurricanes Cindy and Dennis. The creek rose to one of its highest levels ever, flooding dozens of homes well beyond what was considered the 100-year flood plain. About 15 inches (380 mm) of rain fell at the Sweetwater Creek gage near Austell before the gage was damaged by the flood.

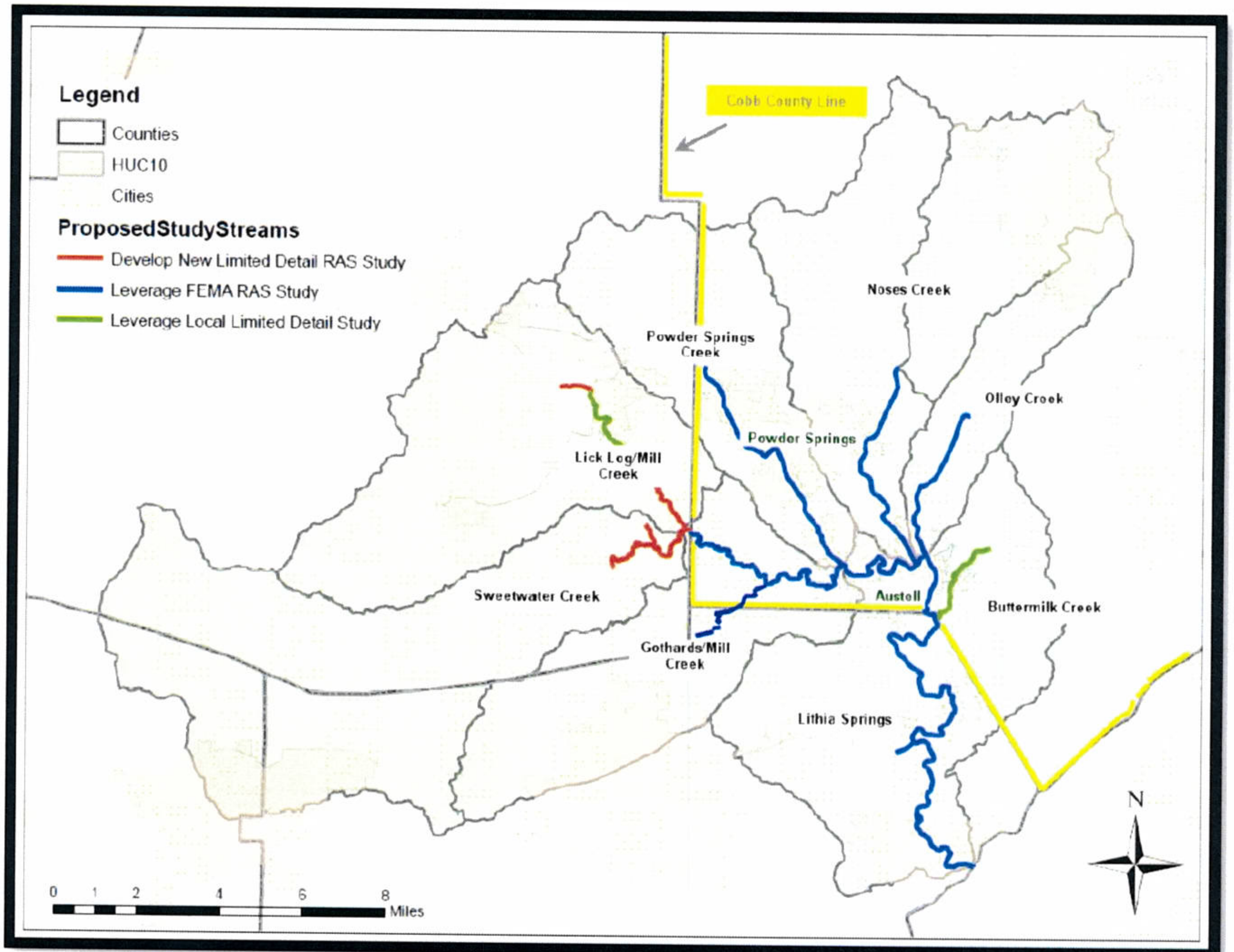


Figure 1. Map of Sweetwater Creek and major tributaries, Lick Log, Powder Springs, Noses, and Olley Creeks. The area outlined in yellow is the intended area of flood risk improvement.

Catastrophic flooding impacted much of the Atlanta metropolitan area September 15-22, 2009. At the height of the event, September 20-21, the maximum 24-hour rainfall total was 21 inches, observed at the Douglas County Water and Sewer Authority. Historic flash flooding resulted, with river basins remaining swollen for weeks. USGS estimated the storm was well above the 500-year-recurrence interval, and National Weather Service projections put it at the 10,000-year-recurrence interval. There were 79 river gages that rose above flood stage, with 35% of those cresting above major flood stage. More than a third of the gages rose to historic levels; some went underwater and stopped reporting. At Sweetwater Creek near Austell, the new record was 20 feet above flood stage and nine feet above the previous record crest (Table 1). Swollen river basins resulted in damage to 21 Category One dams. The total damage assessment was over $500,000,000, including 20,000 homes and businesses that sustained major damage. Two public schools in Austell flooded or were surrounded by water and many roads were underwater, including Interstate 20. Ten people were killed (National Weather Service https://www.weather.gov/ffc/atlanta_floods_anniv).

Table 1. Gage data for Sweetwater Creek and tributaries, September 21-22, 2009.

USGS Gage	Drainage Area (mi^2)	Flood Stage (ft)	Crest Stage (ft)	Feet Above Flood Stage
Sweetwater Creek at I-20 below Austell (02337000)	238.0	10	30.8	20.8
Sweetwater Creek at Powder Springs (02336840)	97.7	13	31.4	18.4
Noses Creek at Powder Springs (02336968)	44.5	11	23.2	12.2
Olley Creek at Clay Rd. near Austell (02336986)	13.5	12	27.4	15.4
Powder Springs Creek at Powder Springs (02336870)	23.7	12	19.8	7.8

Data from National Weather Service (https://www.weather.gov/ffc/0909epicflood) and USGS gage information (https://waterdata.usgs.gov/ga/nwis/current/?type=flow&group_key=basin_cd).

The Sweetwater Creek watershed, like much of the area around the City of Atlanta, is urbanizing. Urban development within watersheds can cause major changes to streamflow. One of the dominant impacts of urbanization is increased peak flows and stream flashiness. Researchers at Georgia State University recently examined trends in streamflow from 1986 to 2015 in eight metro Atlanta watersheds where the percentage of developed land ranged from 34-83% and percent impervious surface ranged from a low of 9% to a high of 32% (Diem et al. 2018; Table 2). The increase in developed land in the eight watersheds was almost entirely due to loss of forest land.

Table 2. Sweetwater Creek urbanization, compared to other metro Atlanta watersheds, during the peak of the area's rapid expansion.

Watershed	Drainage Area (mi^2)	Population Density (person/mi^2)			%Developed		%Impervious	
		1990	2010	%Increase	1992	2011	1992	2011
Peachtree Creek	86	3133	4244	35	80	83	31	32
Sope Creek	30	2067	2381	15	68	77	18	21
South River	184	2145	2401	12	58	67	18	21
Flint River	127	1258	1749	39	50	64	19	25
Suwanee Creek	48	336	1240	269	29	61	9	21
Big Creek	73	287	1370	377	28	55	8	17
Sweetwater Creek	238	574	1116	95	29	41	7	10
Line Creek	100	287	671	133	22	34	6	9

Data from Diem et al. (2018).

Diem et al. (2018) found that the two fastest growing/developing study areas, the Big Creek and Suwanee Creek watersheds, doubled their impervious surface and experienced a 26 percent increase in annual stream flow and a doubling of high-flow days – the basins, during a storm event, now see more runoff, more extreme flows, and more flooding than would have occurred for a similar storm event in 1986. Sweetwater Creek was one of the less urbanized watersheds studied, with 41% of the land developed and 10% impervious cover, but with a relatively rapid population increase. Diem et al. (2018) found that Sweetwater and the other lower developed watershed, Line Creek, had the lowest maximum stream flows, but noted that both basins are on trajectories to becoming majority-developed basins in the next several decades.

STUDY AREA

Sweetwater Creek's headwaters in Georgia's Paulding and Carroll Counties drain largely forested lands. As the creek flows east into Cobb County, the land becomes more urbanized (Fig.1 and 2), particularly areas drained by Sweetwater tributaries, Powder Springs, Nunes, and Olley Creeks.

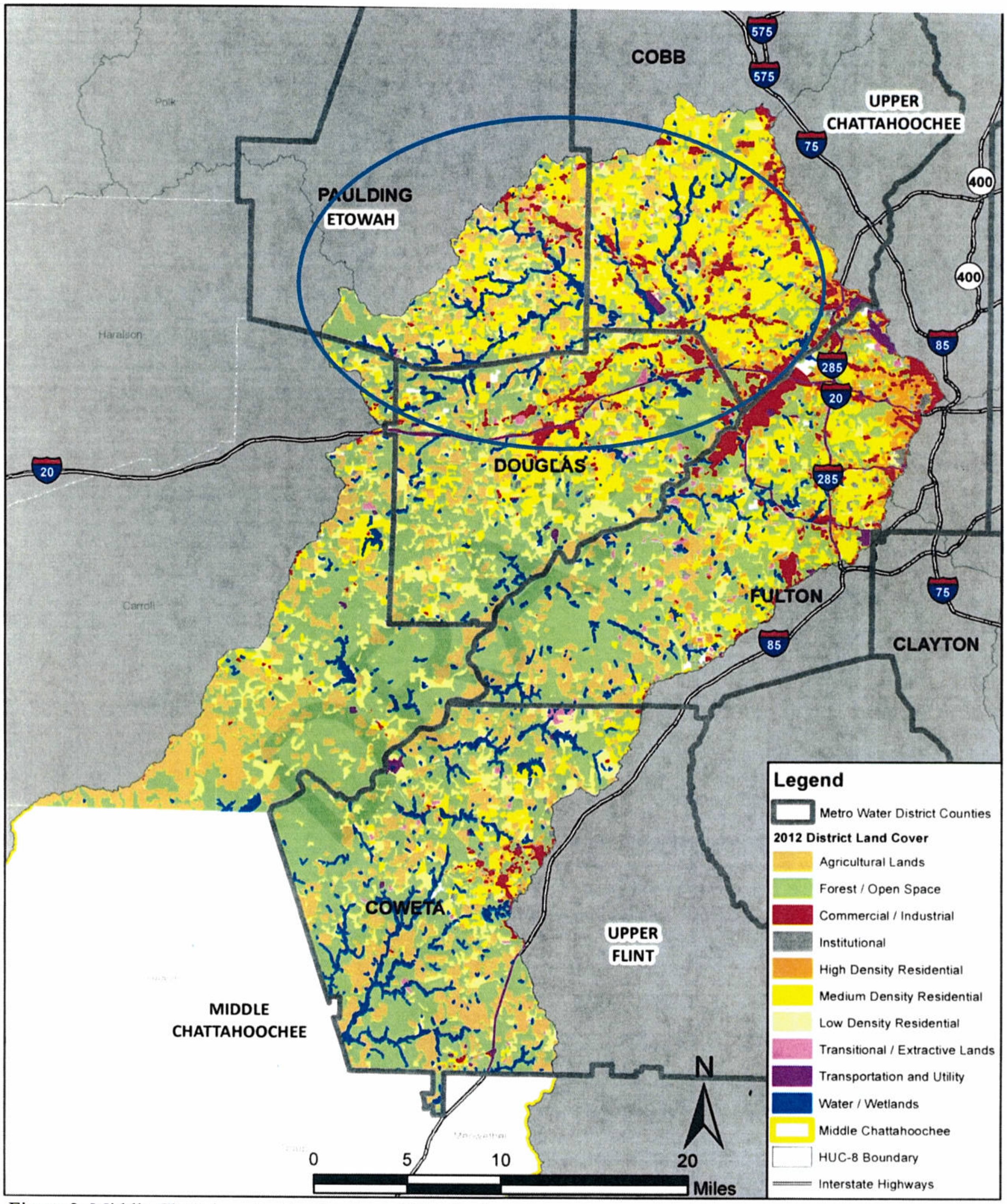


Figure 2. Middle Chattahoochee land cover, 2012. The Sweetwater Creek basin is circled.

Major Georgia municipalities in the watershed include Powder Springs, Austell, Lithia Springs, and portions of Douglasville, Mableton, Marietta, and Villa Rica. Conservation lands in the basin include Kennesaw Mountain National Battlefield Park, the Georgia Department of Natural Resources' Sweetwater Creek State Park, and several Corps of Engineers mitigation properties and county greenspace properties.

Sweetwater Creek flows across portions of the Central Uplands and Gainesville Ridge Districts of the Piedmont Physiographic Province. The boundary between these two districts serves as the approximate boundary between the east-flowing portion of Sweetwater Creek upstream of Austell, where the creek flows in broad valleys, and the south-flowing section downstream of Austell, where the creek occupies a narrow, v-shaped valley (McConnell and Abrams 1978). The eastward flow upstream of Austell is due to the influence of a geologic structure known as the Austell-Frolona Anticlinorium, an up-warped fold (Fig. 3). The Austell-Frolona is higher in elevation than the surrounding rocks, preventing Sweetwater Creek from crossing the anticlinorium and forcing the creek to flow around the nose of the structure at Austell. From Austell to its junction with the Chattahoochee River, Sweetwater Creek drops 120 feet in elevation, and falls and turbulence occur. (Abrams and McConnell 1977).

Before Sweetwater Creek joins the Chattahoochee River, it crosses a series of northeast-trending rock units. Some of these rocks, such as quartzites, are more resistant to erosion than the surrounding rocks. These quartz-rich rocks divert the creek at right angles to its southeastward direction of flow. Other rocks in the creek contain open joints and allow the creek to flow through these openings and across the rock units. This control of the creek's direction by the rocks and the structures within them gives Sweetwater Creek a rectangular drainage pattern, characterized by right angle bends in the stream and its tributaries (Fig. 3) (Abrams and McConnell 1977). At Sweetwater Creek State Park, close to the confluence with the Chattahoochee, the creek crashes over 6-foot ledges and churns through complex rock gardens for nearly a mile before hurtling over Sweetwater Falls.

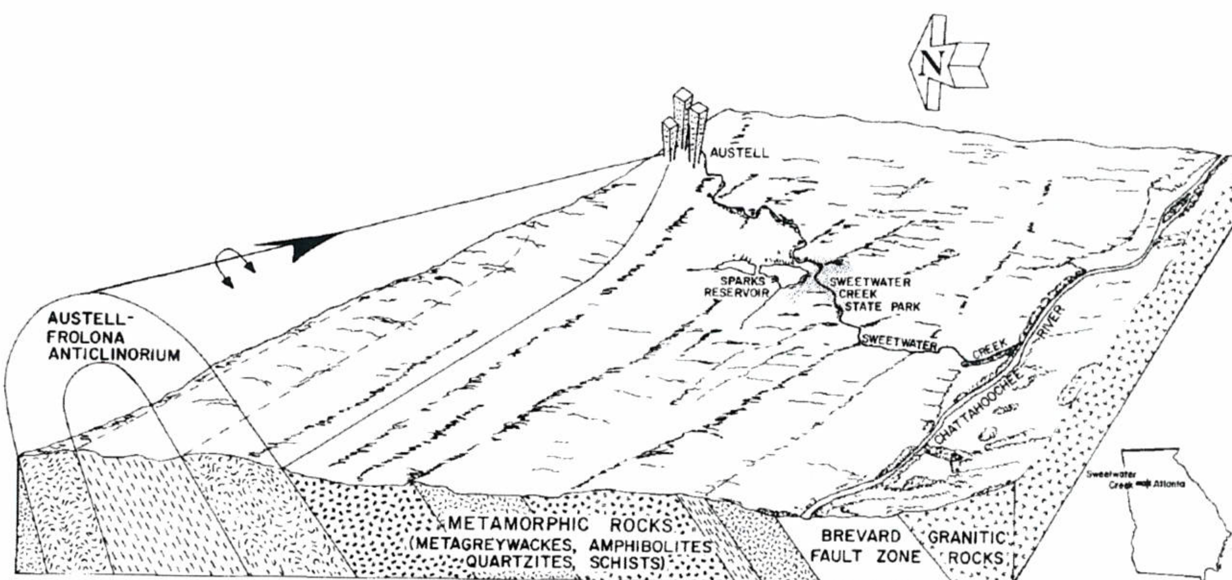


Figure 3. Geology of the Sweetwater Creek basin (figure from Abrams and Mc Connell 1977).

PREVIOUS STUDIES AND REPORTS

The Corps investigated six alternatives to provide flood risk management for Sweetwater Creek:

- Alternative 1 involves purchase and demolition of commercial and residential structures affected by flooding at various ACEs (Annual Chance of Exceedance), ranging from the 10% to the 1% ACE (aka the 10-year to 100-year flood). Under this alternative, total number of structures to be purchased/ demolished would range from 20 for the 10% ACE storm up to 117 for the 1% ACE storm. The majority of the buyouts would be in the Powder Springs and Austell area.
- Alternative 2: The Brown Road Detention Alternative consists of a 33-foot dry detention structure located upstream of Brown Road in Cobb County. The structure would impound stormwater in a 900-1000-acre site and drain dry to base flow within 24 hours after an event.
- Alternative 4: The Austell Channel Modification would increase channel conveyance of floodwaters by widening the channel of Sweetwater Creek to 80 feet between the CH James Parkway to the rapids in Sweetwater Creek State Park (14.2 miles). An estimated 3 million cubic yards of material would be removed from the channel.
- Alternative 5H consists of two in line dry detention structures on Sweetwater Creek near Bakers Bridge Road in Paulding County and upstream of Brown Road in Cobb County. Both sites would drain dry to base flow within 24 hours after an event. Collectively, they would impound 1,300 acres in Paulding, Douglas, and Cobb Counties.
- Alternative 5D consists of six dry detention structures on Sweetwater, Powder Springs, Ollie, and Mill Creeks. All would drain dry to base flow within 24 hours after an event and, collectively, would impound 2,500 acres.
- Alternative 5J: The Upper End Sweetwater Detention Alternative would consist of a dry detention structure near Bakers Bridge Road in Paulding County. The 725-acre detention site would hold water in both Paulding and Douglas Counties.

The Corps selected Alternative 1, at the 10% ACE storm level (10-year flood), as the plan that reasonably maximized net benefits with the least uncertainty. Under the 10% ACE buyout plan, a total of 20 structures on 19 parcels in Cobb County, the City of Austell, and the City of Powder Springs will be purchased and demolished to reduce the threat of flood. Seven of the structures are in the Noses Creek floodplain, seven are in the Powder Springs Creek floodplain, and six are in the Sweetwater Creek floodplain.

FISH AND WILDLIFE RESOURCES IN SWEETWATER CREEK BASIN

The endangered Indiana bat (*Myotis sodalis*) and threatened Northern long-eared bat (*Myotis septentrionalis*) may occur in the study area, but are not likely to occur in the Cobb County flood risk improvement area. Neither has been collected in multiple bat surveys in the study area over the past five years, although four other bat species have been found: the big-brown bat (*Eptesicus fuscus*), Eastern red bat (*Lasiusus borealis*), evening bat (*Nycticeius humeralis*), and Eastern pipistrelle (*Pipistrellus subflavus*).

No other species listed under the Endangered Species Act occur in the study area. An active bald eagle (*Haliaeetus leucocephalus*) nest was observed in the lower portion of Sweetwater Creek basin in 2014 – this species is protected under the Bald and Golden Eagle Protection Act. Several species listed by the State of Georgia have recently been found in the lower part of the basin, including the Chattahoochee crayfish (*Cambarus howardi*), bay star-vine (*Schisandra glabra*), pink ladyslipper

(*Cypripedium acaule*), and yellow ladyslipper (*C. parviflorum*). The state-listed highscale shiner (*Notropis hypsilepis*) historically occurred, but hasn't been collected in the basin in decades.

Our database has records from five fish surveys in Sweetwater Creek, with 16 species collected: Yellow bullhead (*Ameiurus natalis*), bluefin stoneroller (*Campostoma pauciradii),* chain pickerel (*Esox niger*), Eastern and western mosquitofish (*Gambusia holbrookii*) and *G. affinis)*, redbreast sunfish (*Lepomis auritus*), green sunfish (*Lepomis cyanellis*), warmouth (*Lepomis gulosus),* bluegill (*Lepomis macrochirus*), spotted sunfish (*Lepomis punctatus*), large-mouthed bass (*Micropterus salmoides*), bluehead chub (*Nocomis leptocephalis*), golden shiner (*Notomigonus crysoleucas*), longnose shiner (*Notropis longirostris*), black-banded darter (*Percina nigrofasciata*), and black crappie (*Pomoxis nigromaculatus*).

Other species in the study area include white-tailed deer (*Odocoileus virginianus*), eastern wild turkey (*Meleagris gallopavo silvestris*), cottontail rabbit (*Sylvilagus spp.*), raccoon (*Procyon lotor*), nine-banded armadillo (*Dasypus novemcinctus*), opossum (*Didelphis virginiana*), red fox, (*Vulpes vulpes*), fox and gray squirrel (*Sciurus niger* and *S. carolinensis*), river otter (*Lontra canadensis*), and a variety of birds, reptiles, and amphibians.

PROJECT IMPACTS AND BENEFITS

Big brown bats are known to both roost and rear pups in buildings or under bridges during the spring, summer, and fall. These bats also may roost in the eaves of buildings during winter unless the temperatures become too extreme. Eastern pipistrelles may roost and form small maternity colonies in trees, buildings, and rock crevices. Evening bats only occasionally use buildings and attics. Various bird species also may nest in buildings. The Corps proposes to inspect each structure for bats and other wildlife and will remove individuals before demolition. With implementation of the conservation measures below, impact to bats and birds should be minimized.

The demolition of 20 structures will restore a portion of the Sweetwater Creek floodplain, giving Olley, Powder Springs, and Sweetwater Creeks more space to spill over and slow down during floods. This may reduce downstream channel and bank scour and erosion, reduce sedimentation in downstream reaches, and improve water quality due to reduced input of contaminants from impervious surface at the 20 structures.

FISH AND WILDLIFE CONSERVATION MEASURES

In Georgia, all native bats are protected under Georgia state law (Official Code of Georgia § 27-1-28). The Migratory Bird Treaty Act makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations. The following conservation measures are designed to protect both bats/migratory birds and human health if any of the 20 structures to be bought out and demolished is occupied by wildlife:

1. A qualified biologist should conduct surveys during summer to determine if maternity colonies or roosting bats are utilizing the structure(s) and where points of access are located. Surveys should include searching for indications of bat presence (guano and staining), as well as presence of bats.

2. If bats are found using a structure, Cobb County should contact the Georgia Department of Natural Resources (Nongame Conservation Section, 2065 US HWY 278 SE, Social Circle, GA 30025; 770-918-6411) or our office for help in determining the species of bat present and guidance for safe exclusion of the bats. Maternity colonies should not be moved.
3. Contaminated soil or accumulations of bird or bat manure can contain the histoplasmosis fungus. Humans can become infected with this respiratory infection when spores, carried by the air, are inhaled. Most infections are mild and produce either no symptoms or a minor influenza-like illness. On occasion, the disease can cause high fever, blood abnormalities, pneumonia and even death. Workers should avoid breathing dust in areas where there are animal droppings and should wear respirators that guard against particles as small as two microns if the droppings are to be disturbed. Additional information can be found at this website on safety equipment and risk: https://www.cdc.gov/niosh/docs/2005-109/pdfs/2005-109.pdf.

OTHER RECOMMENDATIONS

The anticipated cost of the proposed buyout/demolition of 20 structures in the Sweetwater Creek basin's floodplain is $4,858,864, a large portion of which will be Federal share cost. The Corps' March 2018 Sweetwater Creek Flood Risk Management Study Integrated Feasibility Report and Environmental Assessment estimates that another 213 residential structures will be constructed in the Sweetwater Creek basin's floodplain by 2050, an almost 13% increase over the number of structures currently in the floodplain. We strongly recommend that, contingent on receiving providing this large sum of Federal money, Cobb County, at a minimum, require future development in the floodplain, including structures and utilities, be elevated to 1 foot above the 500-year flood level.

SUMMARY AND SERVICE POSITION

With implementation of the conservation measures above, the project is not likely to adversely affect fish and wildlife resources and may provide limited benefit to downstream aquatic resources.

COORDINATION WITH THE GEORGIA DEPARTMENT OF NATURAL RESOURCES

The Georgia Department of Natural Resources reviewed a draft of this report and had no additional comments (email from Trina Morris, March 20, 2018).

LITERATURE CITED

Abrams, C.E., and K.I. McConnell. 1977. Geologic guide to Sweetwater State Park. Georgia Department of Natural Resources, Geologic and Water Resources Division publication.

Diem, J.E., T.Chee Hill, and R.A. Milligan. 2018. Diverse multi-decadal changes in streamflow within a rapidly urbanizing region. J. Hydrology 556:51-61.

McConnell, K.I., and C.E. Abrams. 1978. Short contributions to the geology of Georgia. Georgia Department of Natural Resources, Geologic and Water Resources Division. Bulletin 93.

From: Goodloe, Robin
To: Bulger, Heather P CIV USARMY CESAM (US)
Subject: [Non-DoD Source] Re: [EXTERNAL] Sweetwater Creek FRM study update
Date: Tuesday, June 26, 2018 7:02:54 AM

Hi Heather,

I think the original can still stand -- our recommendations would be the same.

Will that work for you?

Robin

Robin B. Goodloe, Ph.D.
Georgia Ecological Services
US Fish and Wildlife Service
RG Stephens, Jr. Federal Building
355 East Hancock Avenue, Room 320, Box 7
Athens, GA 30601
706-613-9493

On Mon, Jun 25, 2018 at 5:12 PM, Bulger, Heather P CIV USARMY CESAM (US) <Heather.P.Bulger@usace.army.mil <mailto:Heather.P.Bulger@usace.army.mil> > wrote:

Hey Robin,

During the process of the feasibility analysis the proposed action to the Sweetwater Creek FRM study has been modified. The report you reviewed and based the FWCAR on identified 20 parcels for buyouts; however after further analysis the number of parcels has decreased to 9.

Of the nine identified parcels, five will involve the demolition of structures in order to facilitate the construction of two small municipal parks. Amenities would include parking lots, trails, park/picnic benches, and one kayak launch. Native seed and trees would be planted and bat houses would be installed at the perimeter.

I realize this is a big enough change that could affect the Service's review. We're in the process of updating the report given this information. If you would like to retract the CAR and issue a new one let me know. Regardless I'll be providing an updated version to all the federal and state agencies for another 30 day review.

Thanks,

Heather P. Bulger
Biologist, Inland Environment Team
U.S. Army Corps of Engineers, Mobile District
(251) 694-3889

Section 2: Cultural Resources Coordination

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, MOBILE DISTRICT
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

OCT 0 9 2018

Inland Environment Team
Planning and Environmental Division

Dr. David Crass
State Historic Preservation Officer
Department of Natural Resources, Historic Preservation Division
Jewett Center for Historic Preservation
2610 Georgia Highway 155, SW
Stockbridge, Georgia 30281

Dear Dr. Crass:

The U.S. Army Corps of Engineers (USACE), Mobile District has selected a Tentatively Selected Plan (TSP) for the Sweetwater Creek Watershed Flood Risk Management (FRM) Project. The project is located in Cobb County, Georgia and addresses flooding within the Sweetwater Creek Watershed, which encompasses 264 miles of mixed watershed land in Paulding, Douglas, and Cobb Counties. The mixed watershed is mostly rural undeveloped open fields and wooded areas, interspersed with multiple housing and urban development areas. The TSP consists of buying out and removing nine structures whose first floor elevations are lower than the anticipated water surface elevation of the 10% Annual Chance of Exceedance (ACE) floodplain throughout Cobb County, the City of Austell, and the City of Powder Springs.

As per the requirements outlined in Section 106 of the National Historic Preservation Act (NHPA), the lead Federal agency must consider the effects of the proposed action on historic properties. The Mobile District is also required to assess both direct and indirect effects of the action on historic and cultural resources under the National Environmental Policy Act (NEPA) as defined in 40 CFR 1508.8. The Mobile District archaeologist assessed potential impacts to historic properties (i.e., archaeological sites, buildings, structures, objects, or districts) listed on or eligible for the National Register of Historic Places (NRHP). The assessment included a complete look at the existing records for prehistoric and historic use of the area of potential affect (APE). Background research sources included Georgia's Natural, Archaeological, and Historic Resources GIS and previous project and cultural resources reports on file at the Mobile District office.

The sites identified during this background research include seven previously identified cultural resource sites or properties within a mile radius of the APE (see Enclosures 2 and 3). However, none of the historic properties or archaeological sites would be impacted by the TSP. One structure in the proposed action was constructed in 1945, is over 50 years old, has undergone modern renovations over the years, and is currently occupied. All other structures were constructed after 1971, (Enclosure 4).

The structures identified for buyout as part of the proposed action include nine modern homes (built circa 1970s) located throughout different parcels in the project area. Each structure would be demolished and the footprint of the parcel would be re-graded to match the surrounding terrain. Three relocations on Hopkins Road are adjacent to each other and provided enough space for a small community park. Another park could be located on Clay Road at Ollie Creek, which is upstream of Ollie Creek's confluence with Sweetwater Creek where a relocation of two adjacent parcels occur. The type of recreation provided would include hiking, walking, picnicking, canoeing, and kayaking; all in areas that have been previously disturbed and continuously used over a number of years.

The Mobile District proposes to fulfill the requirements of Section 106 of the NRHP and NEPA by conducting a historic architectural survey of all structures over 50 years old to be demolished and an archaeological survey of all areas that would be impacted by demolition and/or construction activities associated with the TSP. The resulting cultural resources report will be coordinated with your office and any interested Federally Recognized Native American Tribes. If any cultural resources eligible for listing on the NRHP are identified as a result of these surveys and in consultation with the State Historic Preservation Office and Tribes, a Memorandum of Agreement will be developed to mitigate adverse effects to historic properties.

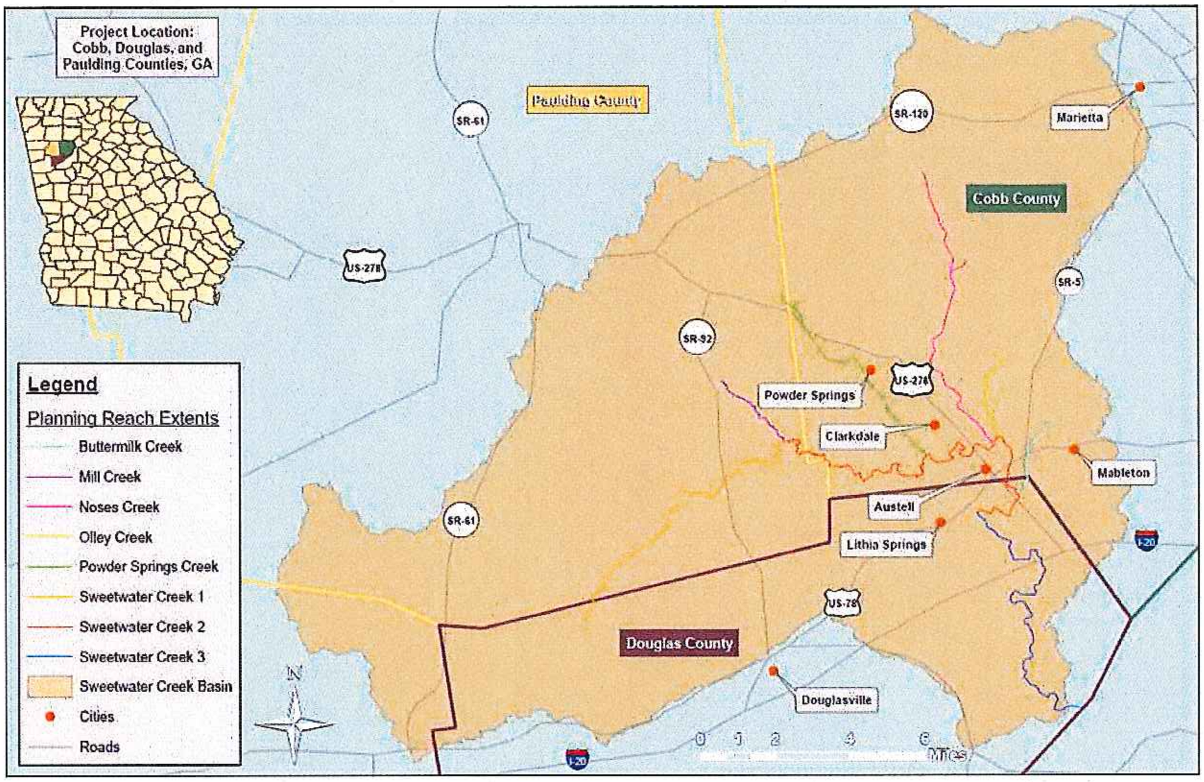
At this time, the USACE is not making a determination of effects on historic properties. If you have any information that could be used to further inform regarding this proposed action, please let us know. Should you have any questions, comments, or recommendations, please contact Ms. Alexandria Smith at (251) 690-2728 or via email at Alexandria.N.Smith@usace.army.mil.

Sincerely,

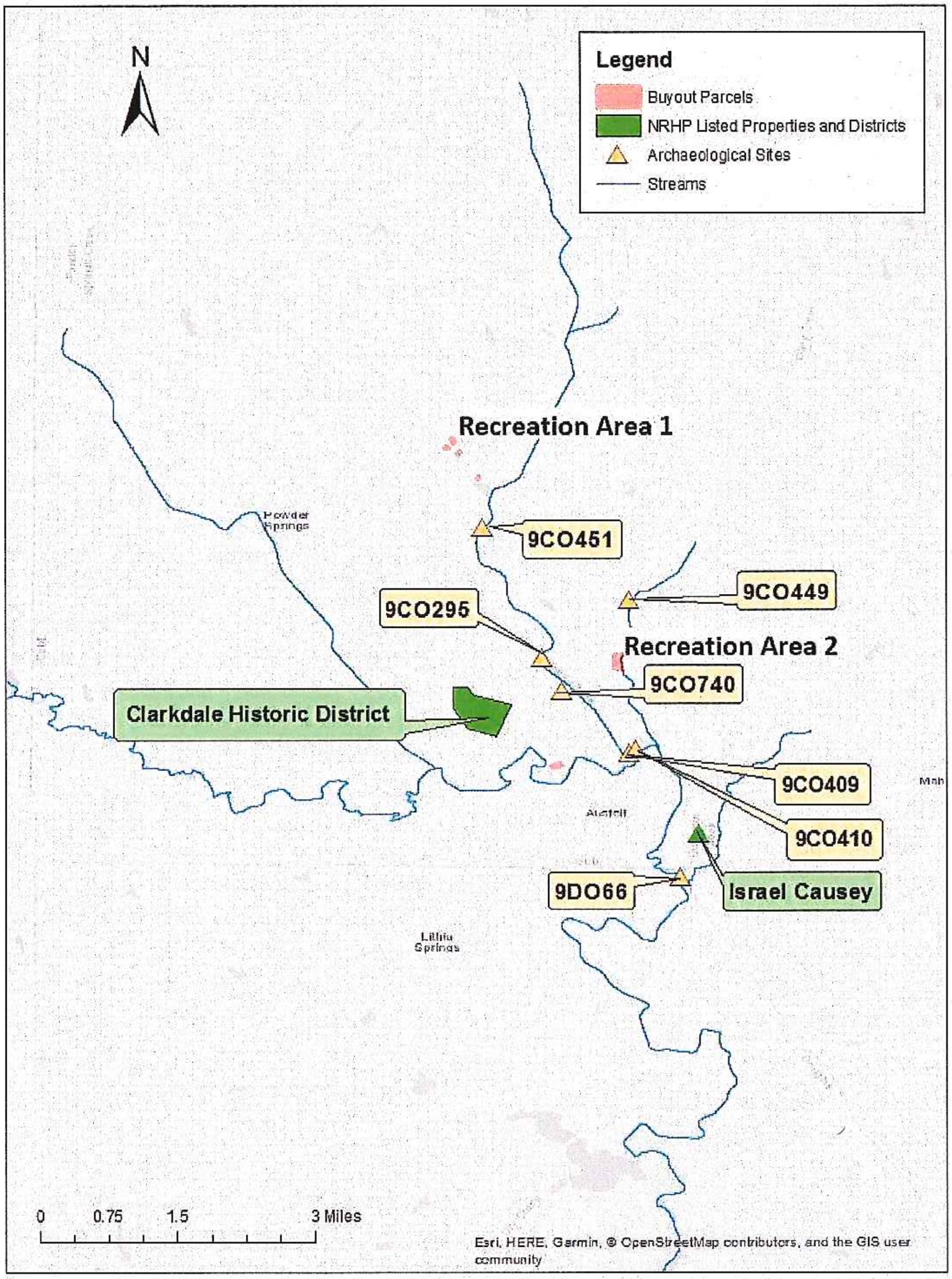
Jennifer Jacobson

Jennifer L. Jacobson
Chief, Environment and Resources
Branch

Enclosures



Enclosure 1: Map of Sweetwater Creek Watershed, study area.



Enclosure 2: Location Map of Previously Recorded Archaeological Sites and Historic Properties within a mile radius of all proposed buyout locations.

Site Number/Resource Name	Component(s)	NRHP Eligibility
9DO66	Possible village and mound site	Eligible
9CO740	Prehistoric lithic scatter	Ineligible
9CO295	Prehistoric lithic scatter	Undetermined
9CO409	Campsite, early archaic, late archaic and woodland	Undetermined
9CO410	Historic dump, 19th and 20th century	Undetermined
9CO449	Late archaic lithic scatter	Undetermined
9CO451	Archaic-woodland campsite	Undetermined
Israel Causey House	Dwelling	Listed
Clarkdale Historic District	Historic District	Listed

Enclosure 3: Table with sites and NRHP listed within a mile of the proposed buyouts.

Address	Acres	Year Constructed
5455 Austell Powder Springs Rd	2.41	1945
2660 Clay Rd SW	5.82	1971
0 Clay Rd	1.14	1971
3430 Hopkins Ct	0.33	1973
3414 Hopkins Rd	0.45	1973
3211 Lancer Dr	0.50	1984
3344 Hopkins Rd	0.46	1973
3334 Hopkins Rd	0.48	1973
3324 Hopkins Rd	0.55	1973

Enclosure 4: Table with buyout locations, acreage, and year constructed.

MARK WILLIAMS
COMMISSIONER

DR. DAVID CRASS
DIVISION DIRECTOR

October 31, 2018

Jennifer L. Jacobson
Chief, Environmental and Resources Branch
US Army Corps of Engineers, Mobile District
Post Office Box 2288
Mobile, Alabama 36628-0001
Attn: Alexandria Smith

RE: Sweetwater Creek: Flood Risk Management Plan, Lithia Springs
Douglas County et. al., Georgia
FP-160712-001

Dear Ms. Jacobson:

The Historic Preservation Division (HPD) has reviewed the information submitted concerning the above referenced project. Our comments are offered to assist the US Army Corps of Engineers (USACE) in complying with the provisions of Section 106 and 110 of the National Historic Preservation Act of 1966, as amended (NHPA).

Thank you for notifying us of this federal undertaking. We look forward to receiving Section 106 compliance documentation and working with your office as this project progresses. Regarding the historic resources survey (HRS), HPD would like to note that the HRS should include not only those structures proposed for demolition, but those proposed for any action, such as relocation, along with any structures that are 50 years of age or older that are located adjacent to the proposed project tracts that could have visual or other indirect effects from the proposed project. HPD recommends reviewing topographic maps, the county tax assessor site, and completing a field survey, in order to identify resources.

Please refer to project number **FP-160712-001** in future correspondence regarding this project. If we may be of further assistance, please contact me at (770) 389-7851 or Jennifer.dixon@dnr.ga.gov.

Sincerely,

Jennifer Dixon, MHP, LEED Green Associate
Program Manager
Environmental Review & Preservation Planning

Section 3: Cooperating Agency Coordination

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Mr. Jess D. Weaver
Regional Director, Southeast Region
U.S. Geological Survey, Leetown Science Center
1770 Corporate Drive, Suite 500
Norcoss, Georgia 30093

Dear Mr. Weaver:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Mr. Brian P. Kemp
Georgia Secretary of State
214 State Capitol
Atlanta, Georgia 30334

Dear Mr. Kemp:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Mr. Mitch Attaway
Executive Director, Georgia Soil and Water Conservation Commission
4310 Lexington Road
Athens, Georgia 30605

Dear Mr. Attaway:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Ms. Gracia B. Szczech
Regional Director
Federal Emergency Management Agency, Region 4
3003 Chamblee Tucker Road
Atlanta, Georgia 30341

Dear Ms. Szczech:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Mr. Homer Bryson
Director, Georgia Emergency Management and Homeland Security Agency
935 East Confederate Avenue, Southeast
Atlanta, Georgia 30316

Dear Mr. Bryson:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Mr. Russell McMurry
Commissioner, Georgia Department of Transportation
One Georgia Center
600 West Peachtree NW
Atlanta, Georgia 30308

Dear Mr. McMurry:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Director, Office of Environmental Policy and Compliance
Department of the Interior
Main Interior Building, MS2462
1849 C Street, Northwest
Washington, D.C. 20240

Dear Sir or Madam:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Colonel Mark McDonough
Commissioner
Georgia Department of Public Safety
959 East Confederate Avenue Southeast
Atlanta, Georgia 30316

Dear Colonel McDonough:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Ms. Heather McTeer Toney
Regional Administrator
U.S. Environmental Protection Agency, Region 4
Sam Nunn Federal Building
61 Forsyth Street South West
Atlanta, Georgia 30303

Dear Ms. Toney:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Ms. Cynthia Dohner
Southeast Regional Director
U.S. Fish and Wildlife Service
1875 Century Boulevard
Atlanta, Georgia 30345

Dear Ms. Dohner:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Mr. Richard E. Dunn
Director, Georgia Department of Natural Resources
Environmental Protection Division
2 Martin Luther King Jr. Drive, Suite 1456
Atlanta, Georgia 30334

Dear Mr. Dunn:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or via email at heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Mr. Dan Forster
Director, Georgia Department of Natural Resources
Wildlife Resource Division
2070 U.S. Highway 278 Southeast
Social Circle, Georgia 30025

Dear Mr. Forster:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or via email at heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

December 20, 2017

Inland Environment Team
Planning and Environmental Division

Mr. Mark Williams
Commissioner Southeast Regional Director
Georgia Department of Natural Resources
2 Martin Luther King Jr. Drive, Suite 1456, East Tower
Atlanta, Georgia 30334

Dear Mr. Williams:

The U.S. Army Corps of Engineers (USACE), Mobile District is preparing an Integrated Feasibility Report and Environmental Assessment (EA) for Sweetwater Creek Flood Risk Management project located in Cobb, Paulding, and Douglass Counties, Georgia.

The Sweetwater Creek Feasibility Study is a cost-share agreement between the USACE and Cobb County, Georgia that was initiated on May 25, 2016. The study has identified 10 alternatives which meet the goals and objectives. These alternatives will be compared and evaluated based on engineering, cost, and benefits in order to create a focused array of alternatives from which a tentatively selected plan will be chosen.

The Council on Environmental Quality (CEQ), Regulations on Implementing National Environmental Policy Act Procedures (NEPA) (40 CFR 1500-1508) emphasizes agency cooperation early in the NEPA process through the establishment of Cooperating Agency status. In essence any Federal or State agency which has jurisdiction over activities to be considered in the EA has the opportunity to serve as a Cooperating Agency. Responsibilities of a Cooperating Agency include but are not limited to provision of data and/or information, and review of the preliminary draft EA for completeness. Information relative to the rights and responsibilities of lead and cooperating agencies may be found in CEQ Forty Most Asked Questions Concerning CEQ's NEPA Regulations (http://ceq.eh.doe.gov/nepa/regs/40).

As lead agency in the preparation of the integrated feasibility report and EA, the USACE, Mobile District is requesting your participation as a cooperating agency in this effort and would appreciate a confirmation of your willingness to do so. We look forward to working with you on this project and if you should have any questions, please contact Ms. Heather Bulger at (251) 694-3889 or via email at heather.p.bulger@usace.army.mil.

Sincerely,

Curtis M. Flakes
Chief, Planning and Environmental
Division

From: Bulger, Heather P CIV USARMY CESAM (US)
To: "Glenn.trey@epa.gov"; "Militscher.chris@epa.gov"; "Gracia.szczech@dhs.gov"; "hsweyers@usgs.gov"; "Michael_oetker@fws.gov"; "robin_goodloe@fws.gov"; "Joyce_stanley@ios.doi.gov"; "Richard.dunn@dnr.ga.gov"; "Carol.stowe@dnr.ga.gov"; "Mark.williams@dnr.ga.gov"; "Mitch.attaway@gaswcc.ga.gov"; "Homer.bryson@gema.ga.gov"; "rmcmurry@dot.ga.gov"; "mmcdonough@gsp.net"; "rherron@sos.ga.gov"
Cc: Malsom, Michael F CIV USARMY CESAM (US); Jacobson, Jennifer L CIV USARMY CESAM (US); Flakes, Curtis M CIV (US); Grunewald, Matthew M CIV CESAM CESAD (US); Smith, Alexandria N CIV USARMY CESAM (US); Trawick, Eubie D Jr CIV USARMY CESAM (US); Jester, Thomas S CIV CESAM CESAD (US); Rooney, Katherine T CIV USARMY CESAM (US)
Subject: Sweetwater Creek Watershed, Cobb County, Georgia Flood Risk Management Feasibility Study
Date: Friday, February 09, 2018 11:02:00 AM

Good Afternoon,

The U.S. Army Corps of Engineers (USACE), Mobile District has been involved in evaluating the Sweetwater Creek Watershed predominantly in Cobb County, Georgia for potential flood risk management solutions. Coordination letters regarding this study were mailed in December 2017. The USACE is inviting you to attend our internal milestone meeting on February 23, 2018 at 13:00 Eastern Time to review the Tentatively Selected Plan (TSP), or Recommended Action, for the study area. Should you, or a representative from your agency, be interested in attending please let me know at your earliest convenience. I will schedule a pre-briefing for those who plan to attend the TSP milestone meeting to discuss USACE procedural matters and expectations of your agency.

Thank you,

Heather P. Bulger
Biologist, Inland Environment Team
U.S. Army Corps of Engineers, Mobile District
(251) 694-3889

From: Bulger, Heather P CIV USARMY CESAM (US)
To: "Glenn.trey@epa.gov"; "Militscher.chris@epa.gov"; "Gracia.szczech@dhs.gov"; "hsweyers@usgs.gov"; "Michael_oetker@fws.gov"; "robin_goodloe@fws.gov"; "Joyce_stanley@ios.doi.gov"; "Richard.dunn@dnr.ga.gov"; "Carol.stowe@dnr.ga.gov"; "Mark.williams@dnr.ga.gov"; "Mitch.attaway@gaswcc.ga.gov"; "Homer.bryson@gema.ga.gov"; "rmcmurry@dot.ga.gov"; "mmcdonough@gsp.net"; "rherron@sos.ga.gov"; "david.crass@dnr.ga.gov"
Cc: Malsom, Michael F CIV USARMY CESAM (US); Jacobson, Jennifer L CIV USARMY CESAM (US); Flakes, Curtis M CIV (US); Grunewald, Matthew M CIV CESAM CESAD (US); Smith, Alexandria N CIV USARMY CESAM (US); Trawick, Eubie D Jr CIV USARMY CESAM (US); Jester, Thomas S CIV CESAM CESAD (US); Rooney, Katherine T CIV USARMY CESAM (US)
Subject: RE: Sweetwater Creek Watershed, Cobb County, Georgia Flood Risk Management Feasibility Study
Date: Thursday, May 03, 2018 1:07:00 PM
Attachments: 04192018_CESAM_PD-EI_NOA_Sweetwater Creek.pdf

All,

The draft Integrated Report for the Sweetwater Creek FRM study has been updated in accordance with comments received during our Agency Technical Review period. The updated draft report will be posted to the website referenced in the Notice of Availability. Please let me know if your agency would require additional time to review the latest version of the document.

Thanks,

-----Original Message-----
From: Bulger, Heather P CIV USARMY CESAM (US)
Sent: Thursday, April 19, 2018 12:31 PM
To: 'Glenn.trey@epa.gov' <Glenn.trey@epa.gov>; 'Militscher.chris@epa.gov' <Militscher.chris@epa.gov>; 'Gracia.szczech@dhs.gov' <Gracia.szczech@dhs.gov>; 'hsweyers@usgs.gov' <hsweyers@usgs.gov>; 'Michael_oetker@fws.gov' <Michael_oetker@fws.gov>; 'robin_goodloe@fws.gov' <robin_goodloe@fws.gov>; 'Joyce_stanley@ios.doi.gov' <Joyce_stanley@ios.doi.gov>; 'Richard.dunn@dnr.ga.gov' <Richard.dunn@dnr.ga.gov>; 'Carol.stowe@dnr.ga.gov' <Carol.stowe@dnr.ga.gov>; 'Mark.williams@dnr.ga.gov' <Mark.williams@dnr.ga.gov>; 'Mitch.attaway@gaswcc.ga.gov' <Mitch.attaway@gaswcc.ga.gov>; 'Homer.bryson@gema.ga.gov' <Homer.bryson@gema.ga.gov>; 'rmcmurry@dot.ga.gov' <rmcmurry@dot.ga.gov>; 'mmcdonough@gsp.net' <mmcdonough@gsp.net>; 'rherron@sos.ga.gov' <rherron@sos.ga.gov>
Cc: Malsom, Michael F CIV USARMY CESAM (US) <Michael.F.Malsom@usace.army.mil>; Jacobson, Jennifer L CIV USARMY CESAM (US) <Jennifer.L.Jacobson@usace.army.mil>; Flakes, Curtis M CIV (US) <Curtis.M.Flakes@usace.army.mil>; Grunewald, Matthew M CIV CESAM CESAD (US) <Matthew.M.Grunewald@usace.army.mil>; Smith, Alexandria N CIV USARMY CESAM (US) <Alexandria.N.Smith@usace.army.mil>; Trawick, Eubie D Jr CIV USARMY CESAM (US) <Eubie.D.Trawick@usace.army.mil>; Jester, Thomas S CIV CESAM CESAD (US) <Thomas.S.Jester@usace.army.mil>; Rooney, Katherine T CIV USARMY CESAM (US) <Katherine.T.Rooney@usace.army.mil>
Subject: RE: Sweetwater Creek Watershed, Cobb County, Georgia Flood Risk Management Feasibility Study

All,

Disregard previous attachment. See the corrected Notice of Availability for the Sweetwater Creek Feasibility Study agency comment period. My apologies for any confusion.

Thanks,

Heather P. Bulger
Biologist, Inland Environment Team
U.S. Army Corps of Engineers, Mobile District
(251) 694-3889

-----Original Message-----
From: Bulger, Heather P CIV USARMY CESAM (US)
Sent: Thursday, April 19, 2018 10:43 AM
To: 'Glenn.trey@epa.gov' <Glenn.trey@epa.gov>; 'Militscher.chris@epa.gov' <Militscher.chris@epa.gov>; 'Gracia.szczech@dhs.gov' <Gracia.szczech@dhs.gov>; 'hsweyers@usgs.gov' <hsweyers@usgs.gov>; 'Michael_oetker@fws.gov' <Michael_oetker@fws.gov>; 'robin_goodloe@fws.gov' <robin_goodloe@fws.gov>; 'Joyce_stanley@ios.doi.gov' <Joyce_stanley@ios.doi.gov>; 'Richard.dunn@dnr.ga.gov' <Richard.dunn@dnr.ga.gov>; 'Carol.stowe@dnr.ga.gov' <Carol.stowe@dnr.ga.gov>; 'Mark.williams@dnr.ga.gov' <Mark.williams@dnr.ga.gov>; 'Mitch.attaway@gaswcc.ga.gov' <Mitch.attaway@gaswcc.ga.gov>; 'Homer.bryson@gema.ga.gov' <Homer.bryson@gema.ga.gov>; 'rmcmurry@dot.ga.gov' <rmcmurry@dot.ga.gov>; 'mmcdonough@gsp.net' <mmcdonough@gsp.net>; 'rherron@sos.ga.gov' <rherron@sos.ga.gov>
Cc: Malsom, Michael F CIV USARMY CESAM (US) <Michael.F.Malsom@usace.army.mil>; Jacobson, Jennifer L CIV USARMY CESAM (US) <Jennifer.L.Jacobson@usace.army.mil>; Flakes, Curtis M CIV (US) <Curtis.M.Flakes@usace.army.mil>; Grunewald, Matthew M CIV CESAM CESAD (US) <Matthew.M.Grunewald@usace.army.mil>; Smith, Alexandria N CIV USARMY CESAM (US) <Alexandria.N.Smith@usace.army.mil>; Trawick, Eubie D Jr CIV USARMY CESAM (US) <Eubie.D.Trawick@usace.army.mil>; Jester, Thomas S CIV CESAM CESAD (US) <Thomas.S.Jester@usace.army.mil>; Rooney, Katherine T CIV USARMY CESAM (US) <Katherine.T.Rooney@usace.army.mil>
Subject: RE: Sweetwater Creek Watershed, Cobb County, Georgia Flood Risk Management Feasibility Study

All,

Please see the attached Notice of Availability for the Sweetwater Creek Flood Risk Management Feasibility Study Draft Integrated Report. We are requesting your agency's review. The draft report is available online at <http://www.sam.usace.army.mil/Missions/Program-and-Project-Management/Civil-Projects/Sweetwater-Creek/> for a 30 day comment period.

Thanks,

Heather P. Bulger
Biologist, Inland Environment Team
U.S. Army Corps of Engineers, Mobile District
(251) 694-3889

-----Original Message-----
From: Bulger, Heather P CIV USARMY CESAM (US)
Sent: Friday, February 09, 2018 11:03 AM
To: 'Glenn.trey@epa.gov' <Glenn.trey@epa.gov>; 'Militscher.chris@epa.gov' <Militscher.chris@epa.gov>; 'Gracia.szczech@dhs.gov' <Gracia.szczech@dhs.gov>; 'hsweyers@usgs.gov' <hsweyers@usgs.gov>; 'Michael_oetker@fws.gov' <Michael_oetker@fws.gov>; 'robin_goodloe@fws.gov' <robin_goodloe@fws.gov>; 'Joyce_stanley@ios.doi.gov' <Joyce_stanley@ios.doi.gov>; 'Richard.dunn@dnr.ga.gov' <Richard.dunn@dnr.ga.gov>; 'Carol.stowe@dnr.ga.gov' <Carol.stowe@dnr.ga.gov>; 'Mark.williams@dnr.ga.gov' <Mark.williams@dnr.ga.gov>; 'Mitch.attaway@gaswcc.ga.gov' <Mitch.attaway@gaswcc.ga.gov>; 'Homer.bryson@gema.ga.gov' <Homer.bryson@gema.ga.gov>; 'rmcmurry@dot.ga.gov' <rmcmurry@dot.ga.gov>; 'mmcdonough@gsp.net' <mmcdonough@gsp.net>; 'rherron@sos.ga.gov' <rherron@sos.ga.gov>
Cc: Malsom, Michael F CIV USARMY CESAM (US) <Michael.F.Malsom@usace.army.mil>; Jacobson, Jennifer L CIV USARMY CESAM (US) <Jennifer.L.Jacobson@usace.army.mil>; Flakes, Curtis M CIV (US) <Curtis.M.Flakes@usace.army.mil>; Grunewald, Matthew M CIV CESAM CESAD (US) <Matthew.M.Grunewald@usace.army.mil>; Smith, Alexandria N CIV USARMY CESAM (US) <Alexandria.N.Smith@usace.army.mil>; Trawick, Eubie D Jr CIV USARMY CESAM (US)

<Eubie.D.Trawick@usace.army.mil>; Jester, Thomas S CIV CESAM CESAD (US)
<Thomas.S.Jester@usace.army.mil>; Rooney, Katherine T CIV USARMY CESAM (US)
<Katherine.T.Rooney@usace.army.mil>
Subject: Sweetwater Creek Watershed, Cobb County, Georgia Flood Risk Management Feasibility Study

Good Afternoon,

The U.S. Army Corps of Engineers (USACE), Mobile District has been involved in evaluating the Sweetwater Creek Watershed predominantly in Cobb County, Georgia for potential flood risk management solutions. Coordination letters regarding this study were mailed in December 2017. The USACE is inviting you to attend our internal milestone meeting on February 23, 2018 at 13:00 Eastern Time to review the Tentatively Selected Plan (TSP), or Recommended Action, for the study area. Should you, or a representative from your agency, be interested in attending please let me know at your earliest convenience. I will schedule a pre-briefing for those who plan to attend the TSP milestone meeting to discuss USACE procedural matters and expectations of your agency.

Thank you,

Heather P. Bulger
Biologist, Inland Environment Team
U.S. Army Corps of Engineers, Mobile District
(251) 694-3889

ofPD-ą JJ
cf PD-EI

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

JAN 09 2018

Mr. Curtis M. Flakes
Chief, Planning and Environmental Division
Department of the Army
Mobile District, Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628-0001

Re: U.S. Army Corps of Engineers' (USACE) Cooperating Agency Request for the Sweetwater Creek Flood Risk Management Integrated Feasibility Report and Environmental Assessment; Cobb, Paulding, and Douglas Counties, Georgia

Dear Mr. Flakes:

The U.S. Environmental Protection Agency (EPA) has received your letter dated December 20 15, 2017, concerning the above referenced project which was addressed to the former Regional Administrator, Ms. Heather McTeer Toney, and has been forwarded to this office for response. Thank you for offering EPA an opportunity to become a "cooperating agency" under the National Environmental Policy Act (NEPA) to the USACE in the development of the Environmental Assessment (EA) for the proposed project.

The EPA lacks the special expertise for a flood control project and does not have specific jurisdiction by law to be a cooperating agency under Title 40 Code of Federal Regulations Section 1501.6. However, we plan to fully participate in interagency teleconferences and meetings at important milestones at your request. The EPA will be a participating agency with respect to our authorities under Section 102(2)(C) of NEPA, Section 309 of the Clean Air Act and the Clean Water Act.

We appreciate the opportunity of working with the USACE as a participating agency on this project. Please contact Ms. Ntale Kajumba, as our primary agency representative for this project at (404) 562-9620, should your staff have any questions during the development of the EA.

Sincerely,

Christopher A. Militscher
Chief, NEPA Program Office
Resource Conservation and Restoration Division

Sweetwater Creek Flood Risk Management Feasibility Study

Appendix G: Public and Agency Comments

Cobb County...Expect the Best!

U.S. Army Corps of Engineers
South Atlantic Division
Mobile District

US Army Corps of Engineers®
MOBILE DISTRICT

Comment Appendix

No Federal, State, or Public comments were received during the comment review period.