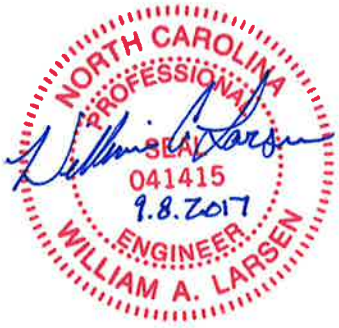
East Water Street Stormwater Evaluation

Town of Edenton, NC

September 2017

TWC 2478-FW



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1.0 INTRODUCTION

The Town of Edenton operates an existing regional stormwater pumping station located on the north side of E. Water Street near its intersection with Hayesfarm Road. This pumping station receives runoff from a large portion of downtown Edenton, which is fully developed. The runoff is primarily carried through a closed drainage system into the pumping station, which discharges directly to Queen Anne Creek before flowing into Edenton Bay

Recently, the Town and citizens have noted an increase in the frequency of localized flooding in and adjacent to the pump station. This flood has resulted in citizen complaints and concerns over the risks of property damage and public health. The Town of Edenton has retained the engineering services of The Wooten Company to evaluate the operation of the station and any potential improvements that may be implemented to mitigate the risks of flooding.

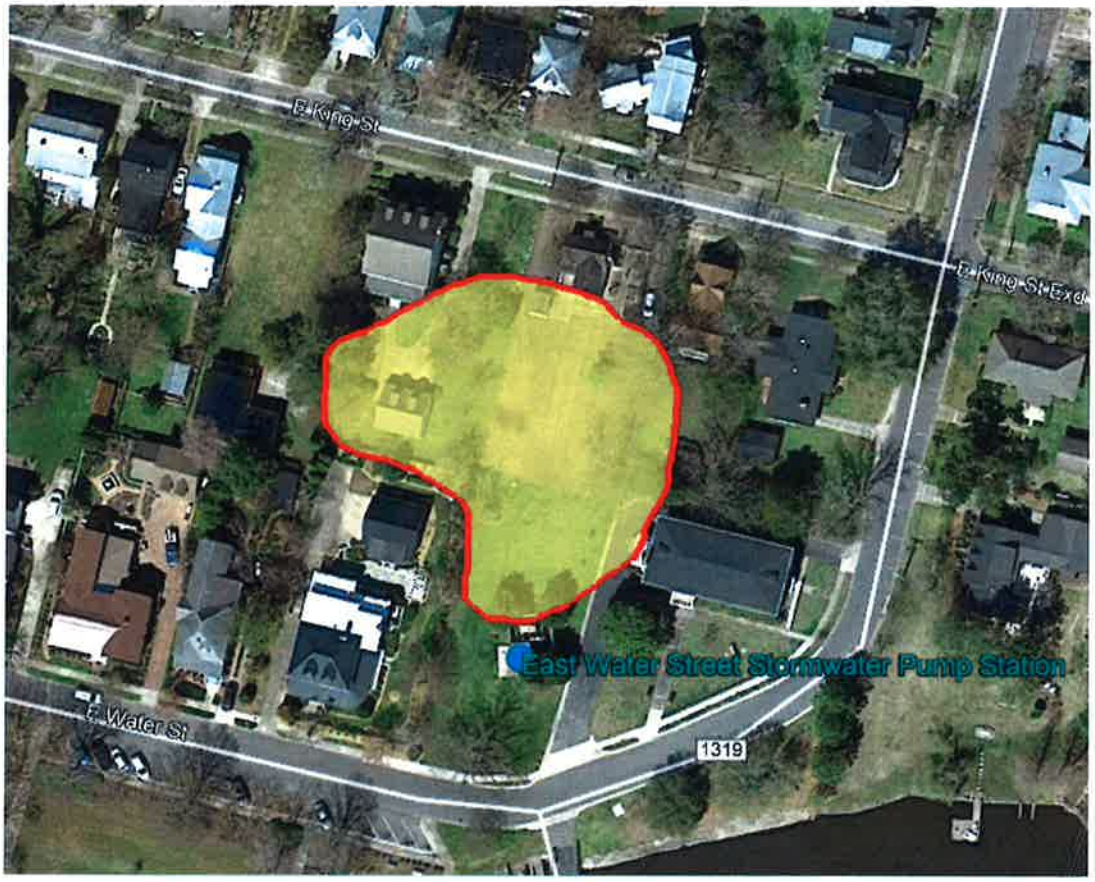
2.0 EXISTING CONDITIONS

Approximately 74 acres of downtown Edenton drain to the existing regional stormwater pumping station through the stormwater collection system. The existing stormwater pump station is comprised of an axial flow pump with a capacity of 15,000 gallons per minute (gpm) and outlets directly into Queen Anne Creek. The station was design by the United States Department of Agriculture Soil Conservation Service in 1981. The station was designed with two (2) primary influent pipes, a 36-inch RCP and a 48-inch VCP. In addition, the station was also outfitted with stub-out connections for a future 36-inch and two (2) 15-inch influent pipes. At some point since its initial construction, the Town staff installed one of the 15-inch inlets.

Recently, the Town staff and adjacent citizens have noticed an increase in the frequency of localized flooding in and adjacent to the pump station. Complaints and individual mitigation efforts have been documented showing the scale and impacts of these flooding events. In addition to temporary road closures the flooding is also impacting personal property, creating sanitary sewer overflows and creating a potential public health risk.

The terrain of this region creates a natural "bowl" located north of the East Water Street pump station. During significant rainfall events, stormwater water collected through the watershed is conveyed through street gutters, catch basins, gravity mains and swales. According to local accounts, as the station becomes overwhelmed, stormwater begins to backup within the system to the point of overtopping structures creating situations of sheet flow across properties along East King Street. Figure 2.1 indicates the area showing the greatest frequency of flooding events.

Figure 2.1



In addition to flooding of the East Water Street area, the station is also experiencing several operational concerns including a developing sink hole on the western side of the station, a leak in the discharge force main, electrical concerns, and complete station shut off during storm surge events.

As will be outlined in the following sections, the goal of this report is to evaluate options to reduce flooding of properties adjacent to the East Water Street Stormwater Pump Station.

3.0 DISCUSSION

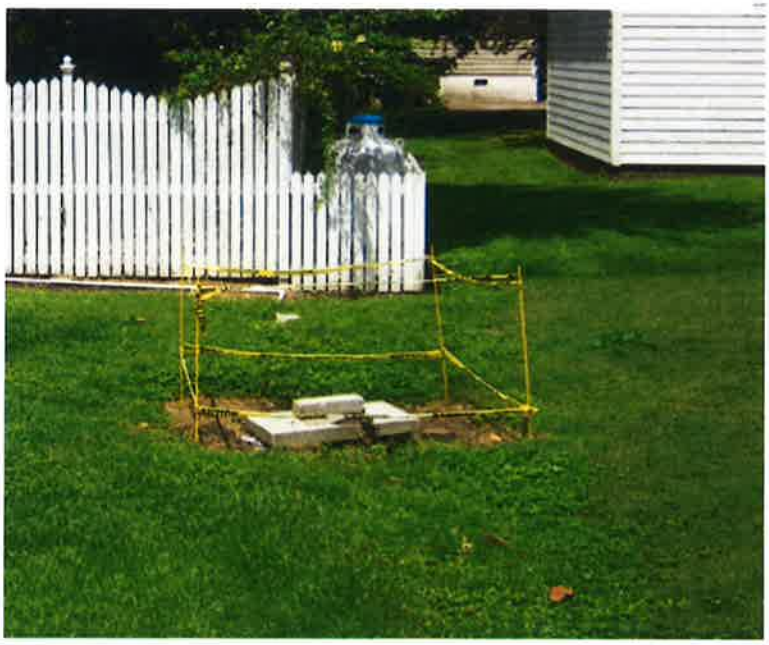
3.1 PUMP STATION CAPACITY

3.1.1 PUMP AND PIPE CAPACITY

The existing stormwater pump station is outfitted with a single 15,000 GPM axial-driven pump. The collected flow is then conveyed by a 23-inch steel force main to a discharge in Queen Anne Creek before flowing into Edenton Bay. The wet well has a capacity of 1,350 gallons per vertical foot and is currently served by three (3) influent pipes including 15-inch, 36-inch and 48-inch gravity fed pipes.

An integral component of the stormwater system is the conveyance of stormwater to the station. As mentioned above, the station currently has three (3) influent lines and when combined, these lines provide approximately 80,000 gpm capacity under full flow conditions. As such, the existing influent lines are sized to approximately carry the peak flow from the 50-year storm. To assist in the stormwater conveyance, it is recommended to replace an existing drop inlet located adjacent to the stormwater pump station. The inlet, situated over the 36-inch and 48-inch mains, provides a collection point for surface runoff currently conveyed by grassed swales in the adjacent properties to the pump station. Per citizen reports, currently this inlet is operating as the first overflow point for the system during heavy rainfalls. As improvements are implemented in and around the station, this drop inlet will become a pinch point in the system. The existing inlet appears to be a non-standard inlet with a concrete block placed on top of bricks (**Figure 3.1**). This presents an in-efficient flow pattern as well as creates a safety hazard for small children and wildlife.

FIGURE 3. 1



The station is designed to serve a watershed of 74 acres comprised of downtown Edenton, roughly bounded by South Oakum Street to South Broad Street and Phillips Street to

Water Street. The watershed has a mix of business and residential uses and is assumed to have 68% percent impervious area with a run-off factor of 0.50. Analyzing the watershed for the 2, 10, and 50 year storms results in a peak watershed discharge ranging from 46,700 GPM to 82,250 GPM as shown in **Table 3.1**.

Table 3.1: Watershed Analysis

Design Storm	Peak Flow (cfs)	Peak Flow (gpm)
2-Year	104.086	46,717.04
10-Year	142.569	63,989.19
50-Year	183.250	82,248.32

While the station's pump capacity is limited to 15,000 GPM, the station can utilize the "storage capacity" of the influent lines in addition to the storage within the wetwell to allow the station to absorb the periods of overage until the influent flow and pump capacity return to equality. If thought of as an underground basin, the approximate storage of the 48-inch line is 56,400 gallons while the capacity of the 36-inch line is 31,700 gallons, thus representing a combined storage of 88,000 gallons. As discussed in 3.1.2, the existing 60" x 60" flap valve is in need of replacement. Replacement of this valve will restore a true "bypass" to the system.

3.1.2 Flap Valve

Review of the station's original plan sheets shows that a 60" x 60" flap valve was installed in the station to act as an overflow or emergency by-pass for the station. The valve, manufactured by Rodney Hunt Series FV-AR, is designed to prevent backflow of the bay into the station while allowing for a safe, controlled release of water once sufficient pressure is established upstream of the valve.

Based on the observations during the on-site visit, it appears the valve is original to the station, constructed in 1981. The valve appears to be corroded and possibly shut. Therefore, the valve is approaching its useful service life and should be replaced with a like-for-like component.

Returning this valve into operation will allow for the station to drain through two (2) means during periods of high flow. Once flow enters the station and activates the pump, the pump will remove flow at a constant rate and if the water elevation continues to rise, the flap valve will engage thereby allowing water to exit the station via gravity flow into the sound.

It is also recommended that the existing steel access cover be replaced with an aluminum, traffic rated grate. This will allow Town staff to more easily inspect the flap valve to ensure the valve is operating during storms and is not impeded by floating debris thus leaving the valve in the "open" position.

3.2 Pump Station Operation and Maintenance

3.2.1 Pump Floats

During a site visit to the station in July 2017, it was observed that the "Pump-On" water level in the stormwater pump station was set to an elevation that allowed water to collect and back feed into the influent lines. This results in a loss of storage volume and carrying capacity in the influent lines. Standing water in the influent lines also creates a situation where the pump is operating under short pump cycles. At 15,000 GPM, the pump requires a period of ramp up and ramp down time to avoid damaging the pump. The combination of ramp up and short cycle time prevents the pump from reaching its peak pumping capacity thus reducing the station's ability to keep up with storms and increases the likely-hood of upstream flooding.

Therefore, it is recommended to adjust the station's float levels to allow for the "pump-off" water level to allow for full draining of the influent lines, thus restoring the carrying and storage capacity of these mains. Given the pump is an axial driven pump operating via suction-lift, it is important to leave a sufficient level of water in the wetwell to guard against allowing the pump to pull air which can create inefficient operation and cavitation resulting in pump damage. The floor to rim of wetwell is 12 feet. With the "pump off" depth set to 8.5 feet from the rim (or 3.5 feet from the floor) this will leave approximately 2.5 feet of water above the suction lift intake preventing the line from pumping air as well as preventing floating debris from entering the pump. More importantly, this should lower the pump off water level to approximately 1 foot below the inlet of the 48 inch inlet pipe.

3.2.2 Control Panel

The existing control panel to operate pump station presents a dangerous challenge to Town Staff. During the site visit, it was requested that the pump station be manually cut on to see how the pump was operating. In doing so, Town staff indicated that the current configuration of the panel did not allow the station to be manually operated without opening the control panel with live electrical connections, thus placing staff in the position of possible electrocution to operate the station. A new control panel should be installed to remove the risk of placing staff, water, and electricity in close proximity.

3.2.3 Sink Hole

Also during the site visit it was observed that a significant sinkhole was developing at the location of the 15-inch influent line. Town staff has already addressed this issue and discovered that a bad junction between the influent line and the wetwell was allowing surrounding sediment to erode. Not only did this create a safety hazard, but this also increased the risk of compromising the structural integrity of the pump station.

3.2.4 Force Main Leak

In addition to the sink hole created adjacent to the station, it was also documented that the station's force main was pulling air after the pump was shut-down. Town staff also reported seeing leaks in the force main allowing pump water to escape the system and return to the wetwell. It is recommended that the force main leak be repaired thus returning efficiency to the station, removing a safety hazard of Town staff near a leaking, pressurized pipe, and a reduction of double-pumping of collected stormwater.

3.2.5 Influent Lines

One of the critical items in the proper operation of a gravity fed station is the ability of the influent lines to adequately carry the influent flow to the station. Because the stormwater system is exposed to surface runoff during storm events, the influent flow often carries a higher percentage of trash and debris when compared to a typical sanitary sewer system. This debris ranges from yard waste, to soil, to trash. As discussed above, the storage capacity of the influent lines is a critical mitigation piece to preventing upstream flooding and overtopping of the catch basins and yard inlets. In discussion with Town staff, it is unclear as to the last cleaning event on the influent lines to the station.

It is recommended to clean and visual inspect the 36 and 48-inch lines to return the main's carrying capacity as well as confirm/rule-out any structural or operational issues present in the lines.

3.3 Flow Diversion

In addition to the proposed improvements and operational modifications to the stormwater pump station, an alternative to reducing the risk of flooding within the basin is the redirection of water from this sub-basin to another basin. The likely candidate for this consideration is the area around Court Street. The Town of Edenton is located within one of North Carolina's twenty coastal counties under the direct jurisdiction of CAMA. Edenton's waterfront is predominately lined with coastal bulkheads and already has approximately 12 outlets discharging directly into Edenton Bay or Queen Anne Creek.

The available area to be captured by this partition would be limited and costly to construct. East King Street is one (1) block from Edenton Bay and represents a natural ridgeline separating the East Street drainage area from those draining directly to the Bay. To construct a new line within existing rights-of-ways would only allow for the capture of approximately 2 acres or 2.5% of the overall watershed. To redirect flow from Court Street would require the new line to "buck-grade" to pass water from one side of the ridge to the other. Given the proximity to Edenton Bay, a new line would be difficult to install while achieving sufficient fall and keep the required minimum burry depth between the road surface and the top of the pipe.

Edenton Bay is classified as C:NSW, meaning the water body's best use is secondary recreation and it is a nutrient sensitive water. Currently, the runoff originating within the basin is untreated before being discharged into Edenton Bay, which likely contributes to high nutrient levels in the bay. Edenton Bay is also situated upstream of the Albemarle Sound which is considered Impaired. Because of the CAMA jurisdiction, downstream impairment and existing direct outfalls into the Bay, the permitting of a new outfall could present a difficult and timely process for little benefit or relief to the East Water Street pump station.

3.4 Bulk-Head Extension

As previously discussed, the East Water Street pump station is situated adjacent to Queen Anne Creek and Edenton Bay. Currently the waterfront surrounding this portion of the Town is a mix of vertical bulk-head beginning at Hayes Farm Road and extending westward around Queen Anne Park and continuing around Edenton's Downtown proper. East of Hayes Farm Road the waterfront boundary changes from vertical bulk-head to rip-rap with poured concrete and vegetated yards with gentle slopes. The vertical bulk-head has approximately 40-inches of freeboard above mean sea level (MSL) while the adjacent properties have approximately 6-inches of freeboard.

As typical of inner-banks communities, changing wind patterns and storm surges during tropical storms or "nor-easters" can push water upstream against the inner banks of the bay resulting in rapid increases to the sea level which can easily overtop bulk-heads or shorelines. In Edenton's case, during these events, water is pushed up Queen Anne Creek and is able to travel around the edge of bulk-head where it historically overtops the lower bank and floods the area of Water Street and the surrounding pump station. To prevent the station from re-pumping bay water during these events, a second set of floats has been installed by Town staff at the station to act as "kill-switches" and takes the station off-line until the water recedes.

While this method protects the equipment within the station, it allows the flooding problem to compound with water inflow from both the bay and the watershed. To mitigate this risk, it is recommended to extend the bulk-head to mitigate the frequency of storm surges creating localized flooding. In a typical coastline setting, this type of improvement could lead to an extensive coastline re-lining; however, Edenton has a recently abandoned rail bed that may be utilized to create a natural break point in the bulk-head extension. Two (2) properties are situated between the existing bulk-head and the rail bed. The first is a parcel owned by the Town and the second is owned by a private citizen. This project will require significant permitting and negotiations with both the private citizen and the owner of the abandoned rail bed.

4.0 ESTIMATE OF PROBABLE COST

While each of the improvements listed above is recommended to improve the operation of the stormwater lift station and reduce the frequency and risk of flooding in the Water Street area, each has an independent cost estimate, priority and schedule. For the purposes of this report, the adjustment to the pump station floats and the correction of the sink hole will not be considered as the Town staff has already taken action to addressing these concerns.

Priority 1 items are suggested to be addressed during FY 2017-18 and 2018-19. Priority 1 items represent immediate needs of the Town's infrastructure. Priority 2 items are suggested to be addressed between FY 2019-20 through 2022-23. Priority 2 items represent important items that are not critical at this time, but budgetary efforts should be considered now. Priority 3 items are suggested to be addressed during FY 2023-40. Priority 3 items represent long-term goals for the infrastructure of the Town of Edenton. The costs shown are preliminary and are based on 2017 dollars.

4.1 PRIORITY 1: PROPOSED IMPROVEMENTS NEEDS (0 TO 2 YEARS)

4.1.1 STORMWATER SYSTEM IMPROVEMENTS

Replace Drop Inlet Upstream Of Pump Station	$ 10,000.00
Replace Pump Station Control Panel	$ 60,000.00
Replace Flap Valve and Access Hatch	$ 50,000.00
Clean and CCTV 36 and 48-inch Influent Lines	$ 60,000.00
Repair Stormwater Forcemain	$ 5,000.00
Sub-Total Construction Costs	$ 185,000.00
Contingency Cost (10%)	$ 18,500.00
Engineering Cost (15%)	$ 27,750.00
Total Project Cost	**$ 231,250.00**

Total Proposed Improvements (0 to 2 years)	**$ 231,250.00**

Annualized Cost per Year ($231,250.00/2 Years) ~$ 115,625.00

4.2 Priority 2: Proposed Improvements Needs (2 to 6 years)

4.2.1 Stormwater System Improvements

Extend Bulkhead (Total Project Costs)	$ 425,000.00
Total Project Cost	**$ 425,000.00**

4.2.2 GPS/GIS Mapping Improvements

Stormwater System Mapping	$ 150,000.00
Total Project Cost	**$ 150,000.00**

Total Proposed Improvements (2 to 6 years)	**$ 575,000.00**

Annualized Cost per Year ($575,000.00/6 Years) ~$ 95,800.00

5.0 ENVIRONMENTAL IMPACTS

No significant negative environmental concerns are associated with improvements of the pump station and stormwater utilities. The project area is primarily within property currently owned by the Town of Edenton or public right-of-ways.

Direct impacts associated with the project may include temporary increases in soils disturbance, air quality and noise levels during construction. These will be mitigated with erosion and sedimentation control devices, proper machinery exhaust equipment and construction operations during daylight hours only.

No direct impacts are expected to occur with respect to topography and floodplains; prime and unique farmland; land use; forest resources; wetlands and streams; water resources; shellfish and fish; wildlife and natural vegetation; public land, scenic recreational and State natural areas; areas of archaeological or historical value; toxic substances; or, environmental justice.

A direct positive impact resulting from these improvements will be the lower risk and frequency of flooding events in and adjacent to the East Water Street pump station. This benefit will reduce the risk of cross contamination between the sewer and storm systems as well as limit the potential for exposure to flood waters by the general public and local environment.

The downtown region of Edenton is largely developed leaving little room or potential for future development. Therefore, no secondary and cumulative impacts are expected to occur with respect to prime and unique farmland; forest resources; wetlands and streams; water resources; shellfish and fish; public land, scenic recreational and State natural areas; areas of archaeological or historical value; toxic substances; or, environmental justice.

6.0 CONCLUSIONS

The Town of Edenton currently maintains a regional stormwater pumping station. Heavy rainfall events have created several flooding events in and adjacent to the pump station. This localized flooding is creating concerns and complaints from local residents over the risk and potential damage to property and local environmental health. Based on the findings of an on-site visit and the hydraulic analysis it is recommended that several improvements and operational modifications be made to increase the efficiency of the system and create a safer environment for Town staff and the general public.

Appendix A

2017 Edenton Stormwater Improvements Schedule and Costs

	Project	Project Fiscal Years						
		2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023	2023-2040
	Stormwater Improvements	Priority 1		Priority 2				Priority 3
	Stormwater Improvements							
1	Replace Drop Inlet	$10,000						
2	Replace Pump Station Control Panel		$60,000					
3	Replace Flap Valve and Access Grate		$50,000					
4	Clean and TV 36 & 48-inch Influent Lines	$60,000						
5	Repair Stormwater Forcemain	$5,000						
6	Extend Bulk-Head				$425,000			
	Stormwater Sub-Total:	*$75,000*	*$110,000*	*$0*	*$425,000*	*$0*	*$0*	*$0*
	GPS/GIS Mapping Improvements	Priority 1		Priority 2				Priority 3
7	Stormwater System Mapping & Modeling					$150,000		
	GPS/GIS Mapping Sub-Total:	*$0*	*$0*	*$0*	*$0*	*$150,000*	*$0*	*$0*
	2017 Total Improvement Cost	**$75,000**	**$110,000**	**$0**	**$425,000**	**$150,000**	**$0**	**$0**
	Inflation Factor (CPI Factor) [2]	**1.0000**	**1.0214**	**1.0428**	**1.0642**	**1.0856**	**1.1070**	**1.1284**
	Estimated Inflation Cost	**$75,000**	**$112,354**	**$0**	**$452,285**	**$162,840**	**$0**	**$0**
						Estimated Total 2017 Cost:		**$760,000**
						Estimated Inflation Cost:		**$802,479**

Notes:

1) Prices corrected for inflation values.
Inflation values found at: http://inflationdata.com/inflation/inflation_rate/historicalinflation.aspx

2) 20 Year (August 1997-July 2017) average annual inflation increase: 2.14%/Year
Inflation values found at:http://inflationdata.com/inflation/Inflation_Calculators/Inflation_Calculator.asp#calcresults

Appendix B

Town of Edenton

East Water Street StormWater Drainage Basin

September 11, 2017

Legend

- Discharge Point
- Storm Water Basin

Storm Water Structures

- Pump Station
- Yard Inlet
- Junction Box
- Drop Inlet
- Curb Inlet
- Catch Basin
- Storm Water Manhole

Storm Water Line Type

- Ditch
- Stream or Shoreline
- Underground Storm Water
- US Route
- NC Route
- Street
- Water
- Parcels

N

0 100 200

Feet

GPS STANDARDS

PDOP OF 6.0 OR LESS
ELEVATION MASK - 10.0
OCCUPATION TIME - 5 SEC
NUMBER OF MEASUREMENTS - 3

DATA COLLECTED WITH TRIMBLE R8 GPS
RTKNET ON NC VRS NETWORK
BASE STATION - NCCR

GIS DATA

STREAM CENTERLINES HAVE BEEN ADJUSTED BY COMPARING USGS TOPOGRAPHIC QUADS, ORTHOPHOTOGRAPHS, NC DWQ HYDROGRAPHY DATA, AND FIELD SURVEY DATA. STREAM DATA IS SOLELY INTENDED FOR SCHEMATIC USE.

THE US FISH AND WILDLIFE SERVICE, NATIONAL WETLANDS INVENTORY IS THE SOURCE OF THE WETLANDS DATA.

THE WOOTEN COMPANY

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