

**EDENVILLE DAM PERMIT APPLICATION  
- STREAM IMPACTS AND PROPOSED OFFSETTING PROJECTS -**

**INTRODUCTION**

Subsequent to the failure of the Edenville Dam and draining of its impoundment, approximately 10.9 miles of the Tittabawassee River and 2.1 miles of the Tobacco River have returned to a free-flowing condition for the first time in nearly 100 years. In addition, many tributaries enter the Tittabawassee and Tobacco rivers in the former Wixom Lake impoundment. As part of the permitting for the restoration of the Edenville Dam and the refilling of Wixom Lake, regulatory status (Part 301) of all rivers and streams must be considered and discussed.

**METHODS**

In August 2022 and February 2023, the entire perimeter of the Wixom Lake shoreline was assessed via aerial photography and on-the-ground inspection. Each stream was walked and assessed for stream function from the approximate location of the summer full pool elevation of Wixom Lake (675.2 ft NAVD88) downstream to the Tittabawassee and Tobacco rivers. Upstream areas were also assessed at available road crossings.

Site assessments were based on professional judgement; looking at indicators that determine stream function such as volume and rate of flow, biological use including accessibility for fish, stream connectivity, functional floodplain, riparian areas, bank and bed erosion, soil stability, sediment transport, length and area of proposed impact were calculated based on site observations and review of high-resolution aerial photography. Pertinent photographs were taken, and notes and observations were recorded. Because these streams will be converted to a different aquatic environment, each was assessed for general functional values in an effort to compare existing conditions to proposed conditions, and to determine what might be done to offset any impacts.

The elevation of culvert inverts and streambeds were also obtained upstream of elevation 675.2 ft (NAVD88), summer legal lake level, to determine what positive or negative impacts could be reasonably identified after the lake is refilled. Most elevations were obtained at the next upstream road crossing. The overall intent was to identify the approximate length of stream that could reasonably be assumed to see benefits from increased soil saturation and ground water input. LiDAR was also used to identify elevations in upper reaches where access to survey was not possible. The limits of upstream benefit identified did not reach beyond four feet above the summer lake level elevation.

**RESULTS**

For purposes of permitting, 22 defined streams were identified based on the criteria set forth in Part 301 which states, in pertinent part, "...may or may not be serving as a drain as defined by the Drain Code of 1956, 1956 PA 40, MCL 280.1 to 280.630; or any other body of water that has definite banks, a bed, and visible evidence of a continued flow or continued occurrence of water, ...". For the most part, these sites can be described under three categories:

- 1) A defined channel with flowing water
- 2) A defined channel with pockets of standing water, or
- 3) A defined channel with a completely dry bed.

The 22 regulated streams are mapped in Appendix A. A total of 80,638 feet of these streams will be converted from a lotic to lentic environment by refilling Wixom Lake to the legally established summer elevation. Table 1 provides a description of findings for each stream and their estimated impact length and area. Appendix B provides representative photographs of the streams. In addition to these tributary

streams, 10.9 miles of the mainstem of the Tittabawassee River will be impacted and 2.1 miles of the Tobacco River will be impacted.

The Tittabawassee River and the Tobacco River meander across the width of the former lake bottom. The Edenville Dam appears to be holding the river channels at a higher than historic elevation, as the main elevation change was observed at the dam itself. While smaller headcuts do exist, the riverbed elevations are more like that of the surrounding lands, reducing potential, at this time, for further incision. Much of the riparian area and bottomland of the lake is vegetated. If the Edenville Dam is not restored, it is likely that the Tittabawassee River and the Tobacco River could take decades to stabilize on their own. The natural process will be for the channels to adjust their profile, pattern, and dimension until they are capable of transporting the water and the sediment load provided by the watershed. A change to one of these variables requires a change to the other two to eventually reach equilibrium.

Currently, many headcuts exist from the channels working to adjust to the slope of the valley. Each of these headcuts will continue to migrate upstream until they encounter a soil layer that the streams' power cannot erode, or until the reach slopes stabilize. Each adjustment in channel slope will result in a corresponding change in cross section and meander pattern, meaning another period of erosion and deposition. At the same time, the channels are working to transport an unnaturally high sediment load from years of deposition on the bottom of the impoundment, from unnaturally high sediment input from unstable tributary streams and from sediment from ongoing erosion of the streambanks and streambed. While many fish, mussels and other aquatic organisms are present, there is no doubt that the biological community is depressed by the impaired functions of the rivers.

Other than the Tittabawassee River and Tobacco River, only five of the sites; Sites 8 (Pary Drain), 9 (Denton Creek), 11 (Luenberger Drain), 19 (Molasses River) and 21 (Larabee Creek), contain what would be considered a perennial stream, with flowing water during the entire year. In August of 2022, with the exception of the Molasses River which was moving a relatively large volume of water, only a trickle of water was observed in each of these streams. However, in February of 2023 they were all running at approximately bankfull due to recent precipitation and a winter of snow cover followed by rapid melting.

Site 8, Pary Drain, is relatively well-adjusted to the landscape, with a small stream channel surrounded by an accessible, vegetated floodplain. Sediment transport appears to be compromised, as evidenced by sand deposits with a braided channel in some areas. The stream channel itself does not reach the Tittabawassee River but, rather, flows into a large, ponded wetland area that overflows into the main river. Biological function is likely negatively impacted by the mobile sand bedload, lack of volume during dry periods and the fragmentation of habitats caused by the wetland area on the downstream end and impassable barrier at the upstream end; however, no biological survey has been completed.

Site 9, Denton Creek, has function that is severely impacted by excessive bank and bed erosion. Beginning at the edge of the Tittabawassee River, the streambed has head cut all the way to the first upstream crossing at Dague Road, where the culvert is perched approximately two feet. The streambed has eroded down to a hard clay layer in the downstream reaches. The stream is deeply incised and signs of past and ongoing erosion of the banks are clearly evident. While northern pike have been known to travel several miles up the stream in the past, very little biological function would be expected given the existing physical condition of the stream.

At Site 11, Luenberger Drain, the channel is incised and actively eroding. The defined stream channel is interrupted by ponded water and dense vegetation. The culvert at the edge of the former Wixom Lake is perched. Biological function is severely impacted by sedimentation of the bed, lack of instream cover and

fragmentation of stream habitats caused by ponded areas and the perched culvert. In addition, upstream of the perched culvert, approximately 300 feet of the drain is enclosed. Upstream of the enclosure, the stream runs parallel to the road (roadside ditch) and is interrupted by culverts at many locations.

Site 19, Molasses River, is the most substantial tributary to Wixom Lake, in terms of volume of flow and stream function. Presently, the bed is dominated by shifting sand and the water depth is mostly uniform with no natural riffle, run, or pool sequencing. However, the channel has mostly adjusted to the new landscape, no headcuts or incision were observed, and the floodplain appears to relate approximately to the bankfull discharge. The floodplain has become well-vegetated. Minnows and one live native freshwater mussel were observed during miscellaneous visits to the site.

Site 21, Larabee Creek, is a small (5-6 foot wide with discharge estimated to be 2-3 cfs at baseflow) stream that winds through a vegetated floodplain. The stream channel has become well-adjusted to the landscape, though head-cutting is still present in several locations. Common carp and numbers of minnows were observed in the plunge pool on the downstream side of E. Pointe Drive.

The remaining 17 sites are currently intermittent and may only flow during heavy precipitation or runoff events. Several of the channels only exist due to concentrated runoff that sculpted the erosion-prone lakebed following dam failure while other sites have indicators of being perennial but appear to have lost permanent flow due to the dam failure and loss of groundwater input. At all these sites, erosion of the streambanks and streambed is common, and the substrates are still mostly unstable. All these streams are small, averaging only a few feet in width and several inches in depth when water is present. Aquatic habitat for fish, macroinvertebrates, amphibians, or reptiles is severely limited.

*Table 1. Wixom Lake - Part 301 Impacted Streams*

Site ID	Notes	Length Impacted (feet)	Area Impacted (acres)	Estimated Existing Function	Length Improved (feet)	Type
1	Bear Creek; 10-12 ft wide channel. Minor perch at Freeman Road. No flow but standing pools during summer inspection. Small fish/minnows, in pools. Rapid flowing, near bankfull flow in March 2023. Appears to be significant drop in elevation between Freeman Road and Tobacco River; fast current over coarse substrate. Significant incision and bank erosion in lower reaches which were inundated at full pool.	1,989	0.55	Functioning at Risk		Intermittent
2	Dry streambed during summer. 18-24" wide. Heavy vegetation. Flowing water in March 2023. Most of channel is adjusting to new landscape, with accessible floodplain. Lower reaches have experienced headcutting.	464	0.02	Not Functioning		Intermittent

Site ID	Notes	Length Impacted (feet)	Area Impacted (acres)	Estimated Existing Function	Length Improved (feet)	Type
3	Small, dry streambed in summer of 2022. Flowing water during March 2023 inspection. Relatively well-adjusted.	471	0.08	Not Functioning		Intermittent
4	Narrow, deep channel about two feet wide. Very little standing water. No flow at mouth. At Hunter Road, more water but less than one cfs through culvert. Perched about 4". In March 2023, flowing water reached the Tobacco River. Stream running less than bankfull. Relatively well-adjusted to floodplain, but headcutting still active and present.	4,153	0.19	Not Functioning	2,397	Intermittent
5	Coolidge Drain; Standing water at Hunter Road. Pretty wide, deep plunge pool, approx. 20x20 ft. No flow. Culvert not perched. In March 2023, flowing water reached Tobacco River. Channel connected to floodplain along most of length. Some headcutting present.	2,550	0.23	Not Functioning	2,212	Intermittent
6	Standing water but no flow. Dale Road crossing has bridge. A lot of water in pools. Small fish. Water flowing and reaching Tobacco River in March 2023. Developing into a nice, well-functioning channel.	5,748	1.58	Functioning at Risk		Intermittent
7	Ortner Drain; water in channel but no flow. Minnows in pools downstream of culvert on Red Oak Street. Flow was present in March 2023. Stream channel intermixed with wetland areas with no defined channel. Lack of sediment transport is suspected but not confirmed due to high water. Upstream of Red Oak, the drain is an agricultural ditch with trapezoidal cross section and little buffer.	6,087	1.26	Functioning at Risk	3,251	Intermittent
8	Pary Drain; Trickle of flow at Red Oak Street. Culvert perched about three feet. In March 2023, water was	3,904	0.90	Functioning at Risk	4,790	Perennial

Site ID	Notes	Length Impacted (feet)	Area Impacted (acres)	Estimated Existing Function	Length Improved (feet)	Type
	present and flowing. Culvert had been replaced.					
9	Denton Creek; lake would have backed up north of Estey Road. Small, flowing channel under Estey and to lake, but large, stagnant pools interspersed. In March 2023, heavy flow was present and pouring out of perched culvert at Denton Creek Road.	2,597	0.42	Functioning at Risk	3,437	Perennial
10	Small, dry streambed. Culvert perched 6". In March 2023, running near bankfull. Headcutting and incision present but had been addressed by installation of rock structures.	1,589	0.26	Not Functioning	365	Intermittent
11	Leuenberger Drain; About 0.5 cfs. Minnows visible in plunge pool. Culvert perched about 18" at Jones Road. Flowing water reaching Tittabawassee in March 2023.	3,139	0.36	Functioning at Risk	904	Perennial
12	Culvert perched about 12". No flow. Small, defined stream channel.	3,656	0.42	Not Functioning		Intermittent
13	Ponded upstream of Middle Road. Upstream end of culvert perched about 12". Dry downstream. Downstream end of culvert perched about 6".	549	0.09	Not Functioning		Intermittent
14	Dry streambed. Rock grade control installed in old lake bed/channel. Culvert under Middle Road is dry.	3,095	0.14	Not Functioning		Intermittent
15	No flow. Culvert at Middle Road is perched about 18". Painted and musk turtles and great blue heron in plunge pool. Completely dry streambed. Lake backfloods entire area at full pool. Boat ramp downstream of culvert.	9,648	2.88	Not Functioning	594	Intermittent
16	Dry on downstream end of culvert, which is perched about 6". Ponded water upstream of culvert.	2,743	0.25	Not Functioning	1,187	Intermittent
17	Dry. Culvert perched on downstream end about ten feet. Ponded water upstream.	2,429	0.11	Not Functioning		Intermittent

Site ID	Notes	Length Impacted (feet)	Area Impacted (acres)	Estimated Existing Function	Length Improved (feet)	Type
18	Guernsey Creek; Would be backwatered from lake at Whitney Beach Road. About one foot wide channel through wetland/floodplain. Water present but no flow. Culvert about six ft CMP. Carp stranded in plunge pool, sipping air. Painted turtle.	6,040	2.36	Not Functioning	2,187	Intermittent
19	Molasses River; At Maple Point Road, Little Molasses and Molasses converge just upstream of bridge. Bridge being replaced. Nice, clear flow. Est. 10 cfs. At end of S. Whitney Road, stream is about 15 ft wide. Minor downcutting. Stable with vegetation. Minnows and live mussel observed. Most sand bed.	10,358	7.13	Functioning at Risk	7,305	Perennial
20	Robbins Drain; Dry bed at Andy's Lane. Channel about four ft wide and six inches deep	1,728	0.52	Not Functioning	1,227	Intermittent
21	Larabee Creek; Twin approx. 6 ft x 8 ft CMPs. Flowing about 2-3 cfs. Nice channel upstream of E. Pointe Drive. All would be flooded at full pool. Carp and minnows in plunge pool.	5,491	3.03	Functioning at Risk	3,173	Perennial
22	Water but no flow off Burling Drive. Landowner said it used to be a nice stream. Lot of sediment came down and filled the valley.	2,210	0.61	Not Functioning		Intermittent
	<b>Total</b>	<b>80,638</b>	<b>23.4</b>		<b>33,029</b>	

### STREAM IMPACT SUMMARY

Approximately 10.9 miles of the Tittabawassee River, 2.1 miles of the Tobacco River and 22 streams, totaling 80,638 feet of stream length, will be impacted by inundation when the Edenville Dam is rebuilt, and the lake is refilled. As discussed above, neither the Tittabawassee River, the Tobacco River nor any of these 22 streams are functioning properly, in terms of hydrology, hydraulics, morphology, physiochemical parameters or biology. Still, Four Lakes Task Force recognizes that these streams are regulated features, and that the restoration of Wixom Lake will replace these streams with a different aquatic environment. As such, projects will be completed to offset impacts to the Tittabawassee River, the Tobacco River and these 22 streams and to improve water quality, hydrology, hydraulics and ecosystem functions within Wixom Lake, its surrounding landscape, and its downstream receiving waters. The existing conditions at each site, along with proposed mitigation, is discussed below:

- Tittabawassee River: 10.9 miles of the river was exposed after the failure of the Edenville Dam. The river has begun the process of adjusting to the valley slope that is still controlled by the stabilized dam remnants, but a tremendous sediment load and continuously eroding banks continue to be issues. The unstable habitat associated with shifting sand, turbid water, and lack of bedform diversity is affecting the aquatic community. FLTF has completed several interim bank stabilization projects to protect infrastructure and to reduce sediment input. If the Edenville Dam is not rebuilt and the remnants are removed, the valley slope will increase and an enormous effort, or many years of natural adjustment, will be required to stabilize the river channel.
- Tobacco River: 2.1 miles of the river was exposed after the failure of the Edenville Dam. The river has begun the process of adjusting to the valley slope that is still controlled by the stabilized dam remnants, but a tremendous sediment load and continuously eroding banks continue to be issues. The unstable habitat associated with shifting sand, turbid water, and lack of bedform diversity is affecting the aquatic community. FLTF has completed several interim bank stabilization projects to protect infrastructure and to reduce sediment input. If the Edenville Dam is not rebuilt and the remnants are removed, the valley slope will increase and an enormous effort, or many years of natural adjustment, will be required to stabilize the river channel.
- Site 1 (Bear Creek): 1,989 feet of Bear Creek was dewatered downstream of Freeman Road following the failure of the Edenville Dam. Bear Creek is intermittent and the culvert beneath Freeman Road is slightly perched. The stream makes a relatively steep descent from Freeman Road to the Tobacco River. The lower reach of the stream is experiencing severe bank and bed erosion.
- Site 2: This site contains a small, intermittent channel about one to two feet in width, flowing through a densely vegetated floodplain. The channel was completely dry during summer inspection. Headcutting is ongoing.
- Site 3: This is a small, intermittent stream channel that experienced a rapid drop in elevation between the Highland Cove Road crossing and the Tobacco River. The channel is quite well-adjusted to the landscape but offers little in terms of ecological value.
- Site 4: This intermittent stream passes beneath Hunter Road, where the crossing is perched about four inches. During the summer period, there was a trickle of flow at Hunter Road, but the streambed was completely dry by the time it reached the Tobacco River. The channel is relatively well-adjusted to the surrounding floodplain, but headcutting is still present and active.
- Site 5 (Coolidge Drain): This site is very similar in nature to Site 4, with an intermittent channel flowing through the exposed bottomland floodplain. The channel is adjusting well to the landscape but still contains active headcuts.
- Site 6 (Little Cedar River): This is one of the larger tributaries to enter Wixom Lake, but the flow is intermittent as evidenced by the lack of flowing water between standing pools of water in the summer. Small fish were observed in the pools. During spring flows, the channel was running near bankfull and had the appearance of a nice, functioning stream.

- Site 7 (Ortner Drain): The Ortner Drain is a trapezoidal ditch flowing through open cropland upstream of Red Oak Street. During initial inspections, there were small pools of standing water but no flow, making this an intermittent channel. Small fish were observed in pools. Downstream of Red Oak Street, the channel disappears into dense wetland vegetation in several areas.
- Site 8 (Pary Drain): The Pary Drain appeared to be perennial during initial inspections, though the baseflow was a trickle of water estimated to be less than one cubic feet per second (cfs). Like the Ortner Drain, the Pary Drain is an agricultural ditch upstream of Red Oak Street.
- Site 9 (Denton Creek): Denton Creek is perennial but the first upstream crossing, at Bayview Drive, is severely perched. During baseflow conditions, the stream contains large, stagnant pools of standing water linked by a tiny band of flowing water.
- Site 10: This is a small, intermittent stream that was eroding and headcutting until FLTF installed rock grade control structures to stabilize the channel. The culvert at Charlebois Drive is perched approximately six inches.
- Site 11 (Luenberger Drain): This stream is perennial with an estimated baseflow of 0.5 cfs during the summer of 2022. The culvert at Jones Road is perched about 18 inches. Minnows were present in the plunge pool during initial site inspections. The channel is adjusting to the landscape but still contains areas of erosion.
- Site 12: This is a small, intermittent stream with a perched culvert at the first upstream crossing, Poplar Drive. The channel has adjusted to the landscape but offers little ecological value.
- Site 13: This small, intermittent stream passes between wetland areas. The culvert at Middle Road is perched about one foot; Middle Road acts as a dam and backs up a small pond measuring about 2.5 acres in surface area.
- Site 14: This is an intermittent channel with a completely dry streambed during the summer inspection. The channel was flowing near bankfull in March of 2023. A rock grade control structure was constructed by FLTF to reduce the amount of erosion that was occurring during high flows.
- Site 15: This site consists of an intermittent main channel fed by three smaller, intermittent tributaries that merge near Narraganet Drive. The channel alternates between reaches that are narrow and deep and others that are wide and shallow; adjustment is still ongoing. The streambed was almost completely dry during summer inspections but the plunge pool beneath the perched culvert at Middle Road contained painted and common musk turtles and a blue heron (presumably hunting fish).
- Site 16 (Fowley Drain): The Fowley Drain is intermittent and the reach downstream of E. Lakeshore Drive was completely dry during the summer inspection. The culvert is perched and impounds a small pond on the upstream side. At full pool, the pond would be separated from the lake by the culvert, but aquatic organisms would pass freely through the culvert. On the upstream end of the pond, additional stream channel was exposed after the dam failure.



- Site 17: Similar to Site 16, the stream reach downstream of the road (N. Meridian) is dry and intermittent, while the road creates a pond on the upstream side of the crossing. This site has a culvert that is perched about ten feet.
- Site 18 (Guernsey Creek): Guernsey Creek is only about one foot wide, with a dry, intermittent channel bisecting a floodplain during summer inspection. Common carp were stranded in a plunge pool beneath the culvert at Whitney Beach Road.
- Site 19 (Molasses River): As discussed previously, the Molasses River is probably the highest quality tributary to Wixom Lake; it has what appears to be a stable perennial flow, is well-adjusted to the floodplain and has some ecological value within the impacted reach. However, the streambed consists of shifting sand that has not allowed formation of bed features.
- Site 20 (Robbins Drain): The Robbins Drain is intermittent and contained a completely dry bed (four feet wide and six inches deep) during summer inspection. At high flow, the stream channel is interrupted by wetland areas in which the channel disappears.
- Site 21 (Larabee Creek): Larabee Creek is perennial, with an estimated baseflow of two-three cfs. Upstream of E. Pointe Drive, the channel is stable and aesthetically appealing. Common carp and minnows were observed in the stream.
- Site 22: This is an intermittent stream that contained standing pools of water during summer inspection. The adjacent landowner suggested, anecdotally, that a large volume of sediment washed down the valley and significantly changed the function of the stream. There is no doubt that the function is severely compromised.

## PROPOSED IMPROVEMENTS

### *Stream Rehydration*

A total of 10.9 miles of the Tittabawassee River, 2.1 miles of the Tobacco River and a total of 80,638 feet of state regulated stream channel will be converted to a lotic environment when the Edenville Dam is reconstructed, and Wixom Lake is refilled. However, an estimated 33,029 feet of stream is expected to see functional lift through hydrologic restoration. Specifically, refilling of Wixom Lake is expected to result in functional lift at 13 sites (Appendix A). These streams have lost much of the hydrology necessary to provide a stable flow, and restoration of the lake levels will reconnect segmented tributaries with the lake, provide for aquatic animal movement between the lake and the tributaries, replenish groundwater and raise the local water table to the benefit of nearby stream reaches. Restoration of hydrology would stabilize base flow, improving conditions for fish, macroinvertebrates, and riparian vegetation. It should be noted that while area of stream impact (vs. length) is important with respect to impacts, improvements, and overall stream function, stream length is used here comparing improvements to impacts on the same streams.

The remaining 47,609 feet of stream, plus 10.9 miles of the Tittabawassee River and 2.1 miles of the Tobacco River, of stream impact will be mitigated with the following compensatory mitigation:

- Culvert Replacement:
  - Culvert replacement of the 5 Mile Road crossing of the Fowley Drain
  - Culvert replacement of the Saiko Road crossing of the Fowley Drain

- Natural Shoreline Enhancement:
  - Wixom Lake, upstream embankment of Edenville Dam
  - West of M-30 along Wixom Lake, upstream of the Edenville Dam (Tobacco Spillway)
  - Natural shoreline stabilization education and outreach
  
- Fish Habitat:
  - Downstream of Edenville Dam along the Tobacco River
  - Within Wixom Lake Bottomlands
    - Preservation of woody growth to serve as vertical structure on the lake bed.
  
- Low-impact Development

### *Culvert Replacement*

Undersized and/or inappropriately aligned (vertically and horizontally) culverts on streams result in significant negative impacts to flow, stream morphology and stream connectivity. These impacts can result in increased bank and bed erosion, downstream sedimentation, increased flood stages upstream of the culvert, and can create impediments for movement of fish and other aquatic organisms.

As part of proposed compensation for stream impacts, FLTF proposes to replace one culvert at 5 Mile Road that is currently resulting in negative stream impacts to the Fowley Drain, a Midland County designated county drain. The new culvert will be designed to span bankfull width of the stream, and will be appropriately sized and placed, with the focus of improving stream function. The current culvert is perched, is in poor condition and does not meet bankfull width. Coordination with the Midland County Road Commission and the Midland County Drain Commissioner on the project is ongoing. The location map, field photos, and construction details/plans of the culvert replacement can be found in Appendix C.

FLTF is also proposing to replace one culvert at Saiko Road that is currently resulting in negative stream impacts to the Fowley Drain, a Midland County designated county drain. The new culvert will be designed to span bankfull width of the stream, and will be appropriately sized and placed, with the focus of improving stream function. The current culvert is perched, is in poor condition and does not meet bankfull width. Coordination with the Midland County Road Commission and the Midland County Drain Commissioner on the project is ongoing. The location map, field photos, and construction details/plans of the culvert replacement can be found in Appendix C.

### *Natural Shoreline Stabilization*

Immediately northwest of the Edenville Dam, riparian restoration/enhancement will take place along the shoreline at the land/water interface, at summer full pool elevation (Appendix C). The shoreline treatment is designed to protect the shore from erosive forces, provide habitat for aquatic organisms, provide an environment for wildlife to move freely between aquatic and terrestrial environments, and provide for some level of nutrient assimilation from upslope runoff. The project is also proposed as an educational tool to inform residents of what may be the best shoreline treatment to benefit their lake and their property.

Upstream of the Edenville Dam, shoreline enhancement will take place along the Wixom Lake shoreline immediately west of M-30, pending site conditions (Appendix C). The shoreline restoration is designed to reduce sediment loading to the watershed and improve shallow water habitat. The design will implement

shoreline best management practices. Coordination for work within the MDOT parcel is ongoing, and approval will be acquired prior to the start of any work at this site.

FLTF will develop natural shoreline stabilization education and outreach materials for Wixom Lake Property Owners, host at least one natural shoreline training event for Wixom Lake Property Owners and facilitate or implement other natural shoreline projects where feasible. The training will be conducted in coordination with other appropriate organizations, such as the Michigan Natural Shoreline Partnership, or others. Education on the benefits of native vegetation buffers/soft shoreline incentive projects and recommendations for implementation are proposed to be posted on the FLTF website and will provide guidance on how private property owners can create these buffers.

### *Tailrace and Fish Habitat*

#### *Tailrace Fish Habitat*

Downstream of the Edenville Dam (west spillway) on the Tobacco River, approximately 2,200 linear feet of river improvements will be completed to improve habitat for native fish and other wildlife, including freshwater mussels (Appendix C). While the focus of the work is to provide walleye spawning habitat, the instream substrate improvements proposed are also intended to create spawning habitat for a variety of fish including, but not limited to, walleye, smallmouth bass, channel catfish, various sunfish, and important prey species such as white sucker, redhorse species and gizzard shad. Due to the location downstream of the dam and the diverse fish community, the area is also expected to be colonized by a community of native mussels.

In addition to constructing reproductive habitat for fish, the proposed project will provide stable substrates and banks that provide erosion protection, reducing sedimentation to downstream waters, and increase dissolved oxygen levels through aeration. The area will also provide angler opportunities for the public, though seasonal protection of game fish may be required through regulations.

Appendix C includes the plan proposed for the tailrace project. The basic parameters used in designing and implementing the work are based on spawning preferences by walleye. These parameters include the following:

- Riffle areas where larger substrates create hydraulic controls and produce preferred velocity–substrate combinations
- Depth of spawning substrates between 0.5 m and 1.0 m
- Water velocities best for spawning and survival are generally up to approximately 3 m/s (Range 0.7 to 3.2 m/s)
- Mean water column velocities 0.35–0.75 m/s, and nose velocities from 0.15 to 0.25 m/s
- Substrate for spawning: gravel (2–65 mm) to rubble (65–255 mm) riffle areas

It is FLTF's intent to meet most of these parameters through proper placement of appropriately sized gravel, rubble, and boulders to provide a variety of depth and flow regimes. FLTF also intends to collaborate with Michigan Department of Natural Resources (MDNR) fisheries staff prior to and during implementation.

*Fish Habitat* - *Within Wixom Lake Bottomlands (Preservation of woody growth to serve as vertical structure on the lake bed.)*

For the additional locations within Wixom Lake for the implementation of fish habitat structure, it is also understood that the vertical structure previously present within the lake prior to the dam failure was beneficial aquatic habitat. FLTF reviewed locations to restore vertical structure and implement other MDNR approved fish habitat projects. The bottomlands of Wixom Lake sprouted a dense crop of trees after the May 2020 flood, including cottonwood, willow, and aspen. Prior to the May 2020 flood, the lake had similar, but less dense vertical deep-water habitat that was very attractive to some fish species (e.g., crappie and other panfish). Shallow water areas had abundant aquatic weeds for fish habitat. The aquatic weeds have been killed by years without water. Their roots have died from exposure to freezing winter temperatures and will require time to reestablish, while the standing trees in shallow water will provide habitat to support re-establishing the fish population immediately after the lake is refilled.

FLTF does not have funds or authority to collect assessments from property owners for control of these trees, which are instead being managed by Wixom Lake Improvement Board (WLIB), Wixom Lake Association, Tobacco Township, and private citizens, typically by mechanical mowing (all) and by herbicide spray (WLIB only). FLTF proposes to coordinate with these entities to leave stands of young trees in deep water areas of the lake bottom as submerged fish habitat and in shallow areas as emergent fish habitat.

- One goal is to balance the creation of fish habitat for the benefit of anglers with the interests of other lake users who are not anglers. Areas of deep or shallow water standing tree habitat will be chosen to not interfere with historic navigation and swimming patterns or near-shore views of the lake from residential properties.
- **Deep Water Areas:**
  - Deep water areas will be at least 20 feet deep at normal summer water elevation with standing trees at least 8 feet below the normal summer water level.
  - Trees sprayed with herbicide in 2023 are dead and will be preserved from mowing in areas targeted for fish habitat. Organizations mowing the lake bottom have agreed to coordinate their activity with FLTF, private citizens will be notified to avoid mowing areas where trees are being preserved.
  - Trees will not be protected from mowing where water depth will be less than 20 feet. Managing the height of trees in such areas seems too prohibitively expensive.
  - Deep water areas that have already been mowed may not regrow significant trees before the lake is reflooded. These areas will be monitored for tree growth and may add to the amount of deep water habitat.
  - Trees along the Tittabawassee River channel were not sprayed due to permit conditions. The height of those living trees will need to be managed by cutting to avoid interference with navigation.
  - Tree height management activity will need to coordinate with plans for altering water elevations in the lake during dam construction.
  - FLTF plans to preserve at least **100 acres** of submerged habitat by advising the entities doing mowing to leave the deep habitat unmowed.
- **Shallow Water Areas:**
  - Shallow water areas will normally be near the lake summer-time shoreline in waters typically 0-6 feet deep when the lake is reflooded. Examples include undeveloped shorelines at the upper end of the Tittabawassee River side of the reservoir, areas along causeways in the lake and areas in front of swampy areas on the shoreline.
  - Some of these areas were recently mowed. If left alone, FLTF expects trees in those areas to resprout in 2024 and grow for 2-3 seasons until the lake is reflooded. Resprouted tree growth rates will depend on available soil moisture, which is quite variable in those shallow water areas.

- Fishing activity would benefit from channels cut through the shallow water emergent vegetation. Channels are best cut before the lake is refilled.
- FLTF is proposing to preserve at least **40 acres** of shallow water habitat.

The cost of creating this habitat will involve surveying the tree heights, typically along the tributary and main channels, to determine where trees must be felled or topped to allow safe navigation and swimming over deep water areas. Herbicide applied in fall 2022 and early summer 2023 stopped tree growth in the deep-water areas except where the permits did not allow herbicide application within 40 feet of the river shoreline. In these areas, FLTF will create a plan for management of the trees that exceed a safe height for boating and swimming and advise the entities managing trees on the lake bottoms. Maintenance of the habitat will be inexpensive, as once the tree roots are submerged the trees will die, while the submerged trunks/stems will continue to stand below water level.

The location maps depicting the deep water and shallow water habitat areas FLTF plans to preserve can be found in Appendix C.

#### *Low Impact Development*

Lastly, Four Lakes Task Force will develop educational resources, promote, partner, and assist stakeholders with education and activities that embody Low Impact Development (LID) principles and have the primary purpose of improving water quality. FLTF also plans to work with stakeholders and partner with EGLE, NRCS, and other state and federal agencies for LID implementation.

#### *Benefits of Interim Completed Stabilization Projects*

FLTF, to date, has completed 24 interim stabilizations projects within the watershed that have significantly reduced erosion and downstream sedimentation to the benefit of the Tittabawassee River and Tobacco River and its tributaries. Already, 8,383 feet of shoreline stabilization was completed with 15 shoreline projects and 1,299 feet of drainage systems were stabilized. These projects include the following on Wixom Lake:

1. Anderson Drive – 2,049 feet (WRP026955)
2. E Lakeshore Drive Culvert – 123 feet outlet stabilization (WRP026234)
3. Grace Court – 511 feet (WRP026643)
4. Island Drive – 203 feet (WRP027060)
5. Dundas Road – 660 feet (WRP030333)
6. Dundas Road North – 320 feet (WRP026173)
7. Arapahoe Trail – 320 feet (WRP027805)
8. E Lakeshore Drive Tributary – 200 feet (WRP031680)
9. Two outfalls were stabilized and extended under EGLE permit WRP031943

#### *Summary*

A total of 10.9 miles of the Tittabawassee River, 2.1 miles of the Tobacco River and a total of 80,638 feet of stream will be changed to a different aquatic environment by the refilling of Wixom Lake to its legal summer lake level. Mitigation is proposed through rehydration of streams impacted from the dam failure, two culvert replacements, two natural shoreline enhancement projects upstream of the Edenville Dam, natural shoreline stabilization education and outreach, fish habitat and low impact development.

Stream rehydration was measured on a linear foot basis and 33,029 feet of stream is expected to show functional lift through increased water inputs by refilling the lake. The remaining 41,654 feet of stream will be mitigated through the above compensatory mitigation. In addition, FLTF has completed 24 projects through interim stabilizations within the watershed that have provided significant benefits to downstream waters through reduction in erosion and movement of sediments.

Under Review by EGGLE

**APPENDIX A - PART 301 IMPACTED STREAM SITES MAP FOR WIXOM LAKE**

Under Review by EGLE

**APPENDIX B - IMPACTED STREAM SITE PHOTOS FOR WIXOM LAKE**

Under Review by EGGLE





Site 1 – Looking upstream near former lake edge.



Site 1 – Severe bank erosion.



Site 1 – Looking downstream toward Tobacco River; headcutting and bank erosion.



Site 2 – Looking upstream.



Site 2 – Looking downstream.



Site 3 – Looking upstream.



Site 3 – Looking downstream toward Tobacco River.



Site 4 – Looking downstream.



Site 4 – Looking upstream.



Site 4 – Looking across and downstream.



Site 5 – Looking upstream.



Site 5 – Looking downstream toward Tobacco River.



Site 5 – Looking upstream.



Site 5 – Looking downstream.



Site 5 – Looking upstream.



Site 6 – Looking downstream.





Site 6 – Looking upstream.



Site 7 – Looking downstream from Red Oak St.



Site 7 – Looking upstream from Red Oak St.



Site 7 – Looking downstream from Heron Cove Dr.



Site 7 – Looking upstream from Heron Cove Dr.



Site 8 – Looking downstream from Red Oak St.



Site 8 – Looking upstream from Red Oak St.



Site 8 – Looking downstream from Mallard Ct.



Site 8 – Looking upstream from Mallard Ct.



Site 8 – Looking downstream from S. Pine St.



Site 8 – Looking upstream from S. Pine St.



Site 9 – Looking downstream from Denton Creek Rd.



Site 9 – Crossing under Denton Creek Rd.



Site 9 – Looking upstream from Denton Creek Rd.



Site 10 – Looking upstream from Charlebois Dr.



Site 10 – Looking downstream from Charlebois Dr.





Site 10



Site 10 – Looking downstream at rock grade control.



Site 10 – Looking downstream at rock grade control and Tittabawassee River.



Site 10 – Looking downstream toward Tittabawassee River.



Site 10 – Looking upstream.



Site 12 – Upstream end of culvert under Poplar Dr.



Site 12 – Looking downstream from Poplar Dr.



Site 12 – Downstream end of culvert beneath Poplar Dr.



Site 13 – Downstream end of culvert beneath Middle Rd.



Site 13 – Stream channel disappears into wetland.



Site 14 – Looking downstream toward Tittabawassee River.



Site 14 – Looking downstream toward grade control.



Site 14 – Looking upstream from grade control.



Site 15 – View upstream from Oswegathie Lane.



Site 15 – Looking downstream from Oswegathie Lane.



Site 16 – Looking upstream from E. Lakeshore Dr.





Site 16 – Culvert on downstream side of E. Lakeshore Dr.



Site 16 – Southern culvert on E. Lakeshore Dr.



Site 16 – Branch to tributary stream.



Site 16 – Bank erosion.



Site 16 – View upstream toward culvert under E. Lakeshore Dr.



Site 17 – Looking downstream from N. Meridian Rd.



Site 17 – Looking upstream from N. Meridian Rd.



Site 18 – Looking downstream from Jones Rd.



Site 18 – Looking upstream from Jones Rd.



Site 19 – Looking upstream.



Site 19 – Looking downstream.



Site 20 – Looking downstream near Hay Rd.



Site 20 – Looking upstream near Hay Rd.



Site 21 – View from E. Pointe Dr.



Site 22 – Looking downstream from Burling Rd.



Site 22 – Looking upstream from Burling Rd.



APPENDIX C - PART 301 STREAM IMPROVEMENT EFFORTS MAP FOR WIXOM LAKE

Under Review by EGGLE

**APPENDIX D - PART 301 SUPPLEMENTARY INFORMATION OF WORK COMPLETED TO DATE**

Under Review by EGGLE