THE ESSEX PARTNERSHIP

Decommissioning Report for Secord, Smallwood, Edenville and Sanford Dams

Executive Summary

Four Lakes Task Force (Four Lakes or FLTF) commissioned the Essex Partnership (Essex) to compile this planning level report on the scope and cost of decommissioning the Secord, Smallwood, Edenville and Sanford dams. This was to provide an indicative comparison with the alternative of a no-lake restoration scenario. As publicly stated, FLTF does not have the authority for, a contract with the counties, or by its bylaws, contemplated removal of the dams.

Decommissioning entails not only the release of water, removal of dams and keeping former dam sites in a safe condition for the public, it also requires complying with federal, state and local regulations, ordinances, and laws. Sound engineering and environmental practices also must be adhered to, and by doing so the cost of decommissioning can be quite considerable. The total estimated cost to decommission the Four Lakes projects individually and collectively are:

Secord Project	$37 million
Smallwood Project	$18 million
Wixom Lake Project	$44 million
Sanford Project	$26 million
All Projects	$125 million

The Secord and Smallwood dams were damaged, but not destroyed, during the May 2020 flood that occurred upstream of Midland, Michigan, and still impound water. If these two projects were decommissioned, the lake environments would be converted to riverine systems with the release of the impounded water. The loss of water in the lakes would cause impacts (both positive and negative) to wetlands, fisheries, threatened/endangered species, aquatic plants, invasive species and other species. The failure of the Edenville Dam, damage to the Tobacco spillway, and subsequently the Sanford Dam, coupled with May 2020 high flood flows, created new riverine environments that will continue to alter the bottomlands until the lakes are restored or the dams are removed and the streambeds are stabilized. A similar situation can be expected at Secord and Smallwood lakes if the dams were removed, except under much more controlled circumstances. The mass wasting of sediments that occurred at Edenville and Sanford would not occur at Secord and Smallwood since releases would follow State of Michigan permit protocols and be implemented properly to prevent impacts to key environmental resources.

Future impacts at all sites could include riverbank erosion upstream of the former dams as the river carves out its new path through the bottomlands, the creation of newly exposed bottomlands that would need stabilization and the need to restore river reaches and tributary streams. Decommissioning is a regulated activity by the State of Michigan and federal agencies; therefore, it would be necessary to obtain environmental permitting to address the changes and impacts discussed above. The environment/ecosystem section of the Decommissioning Report briefly discusses studies any typical permitting that would likely be required, along with probable restoration and mitigation efforts and determinations of planning level cost estimates for specific streams for the Four Lakes (Secord, Smallwood, Edenville and Sanford). The dam removal section of the report also includes planning level estimates for each project while discussing typical aspects of dam removals.

Experiences from Other Decommissioning Projects

1. Decommissioning Drivers

Dam removal projects are common throughout the United States as many dams are approaching 100 years of age or greater and have situations that have caused the public, dam owners and resource agencies to prioritize and fund these expensive projects. Typical issues that trigger dam removal are:

- The build-up of sediments in reservoir impoundments
- Contaminated sediments needing remediation
- Floods breaching dam sections
- Power market economics
- Major repair costs or required construction enhancements outstripping power benefits or being greater than the cost of dam removal
- Ecological public benefit (fishway construction costs)
- Restore access to habitat for migratory fisheries

2. Cost of Decommissioning

The construction of a dam is unique due to its site location, accessibility, topography, soil type, size of the river, electricity demand at that point in time, the evolution of the power grid to transmit power, the availability of funds to construct the project, environmental considerations and other factors. Therefore, the cost for dam removal is also unique to each site.

The cost of decommissioning is not only driven by the actual dam removal but also the cost of complying with environmental permitting and restoration requirements, which can demand a significant amount of project funds. Permitting requirements are generally well "spelled out" considering project impacts during the removal of the dam, spillway and powerhouse, but environmental, recreational, cultural/historic, scenic and other valued public resources must also be considered. Dams collect sediments over time, which may significantly reduce the volume effectiveness of their reservoirs, causing a need to remove the sediments. Though dams helped businesses and our country grow before, during and after the Industrial Revolution, the sediments in these reservoirs often contain heavy metals, toxins and other harmful wastes that require removal and proper handling and disposal under federal and state regulations. These clean-up costs are not included in the planning level estimates.

The desire to restore unimpeded historic fish migration has been a significant driver in the decommissioning of dams, as demonstrated from the Penobscot and Androscoggin rivers in Maine to our Pacific Coast states of California, Oregon and Washington. In Michigan, dams on the Boardman River were removed to promote the return of a vibrant prized trout stream and new forms of recreation along the river's edge. Other Michigan dam removal projects were more water quality-based as dams on the Kalamazoo River impounded toxic sediments that required remediation to improve the health of the river and its watershed. Table 1, below, shows a list of recent significant decommissioning projects from locations within the United States, the characteristics of the dams that were removed and the cost of dam removal and decommissioning for each site.

Table 1. Past Decommissioning Projects

Name	State	River	Cost ($ Million)	Height (feet)	Length (feet)	Construction Type	Year	Reservoir Size (acre)
Boardman**	MI	Boardman	8.5	56	921	Earthen and Concrete	2017	104
Brown Bridge	MI	Boardman	5.7	46	2400	Earthen and Concrete	2013	191
Sabin	MI	Boardman	4.2	32	921	Earthen and Concrete	2018	40
Otsego	MI	Kalamazoo	3.5/35*	9	190	Stone & Concrete	2018	1,972
Trowbridge	MI	Kalamazoo	3.0/55*	11	650	Earthen and Concrete	2020	59
Edwards	ME	Kennebec	7.5	20	915	Timber, Rock, Concrete	1999	1,143
Great Works	ME	Penobscot	62	24	1,426	Timber, Rock, Concrete	2012	182
Veazie	ME	Penobscot		20	1,072	Concrete Ambursen	2014	390
Milltown	MO	Clark Fork/Blackfoot	120*	21	219	Timber, Rock, Concrete	2008	540
Condit	WA	White Salmon	37	125	471	Concrete Gravity	2011	92
Glines Canyon	WA	Elwha	351	210	150	Concrete Arch	2011-13	417
Elwha	WA	Elwha		108	450	Concrete Gravity	2011-13	270
Copco #1	CA	Klamath	495	132	415	Concrete Gravity	Est. 2021	1,000
Copco #2	CA	Klamath		33	278	Concrete Gravity	Est. 2022	40
John C. Boyle	CA	Klamath		68	714	Earth-filled/Concrete	Est. 2023	420
Iron Gate Dam	CA	Klamath		173	540	Earth-filled	Est. 2024	1,020
San Clemente	CA	Carmel	84	106	300	Concrete arch	2015	100
Savage Rapids	OR	Rogue	40	39	456	Concrete arches	2009	23

* Contaminated Sediments Driving Costs ** Dam has been breached.

Legal Aspects of Four Lakes Project Decommissioning

1. Rescinding Part 307 Lake Level Act

Part 307 (formally known as the Inland Lake Level Act) is the exclusive authority for establishing and maintaining the legal levels of a natural or artificial lake. The purpose of Part 307 is to provide for the control and maintenance of inland lake levels for the benefit and welfare of the public. The act essentially authorizes counties to make policy decisions as to the levels of their inland lakes, and to build and finance dams as necessary to maintain the desired lake levels. However, in Michigan, it is the county circuit court that ultimately has the authority to weigh competing factors in its determination of the normal levels of an inland lake. Moreover, once the normal levels are established and boundaries of the special assessment district approved, the county circuit court has "continuing jurisdiction" over the lake levels.

Part 307 does not *specifically* provide a process for "abandoning" or "rescinding" the normal level of an inland lake once established or for the rescinding of the special assessment district once approved by the county circuit court. However, because the county circuit court has continuing jurisdiction and, under the Michigan court rules governing civil procedure, courts have the authority to modify orders and, therefore, anything affecting the lake levels, including departures from the normal levels, would likely require a petition or motion requesting the court to abandon or rescind the lake level order and the special assessment district. The same would be the case for partial rescission of a lake level order that affects more than one lake, as in the case of the Four Lakes system.

2. Special Assessment District Payment for Decommissioning

In connection with the lake level Special Assessment District (SAD), the district could remain "as determined by the circuit court" even in the event of a partial recission of a lake level. Special assessments are based on the benefits derived, and if properties within the special assessment district do not derive a benefit, the properties cannot be assessed. Thus, for example, if it is determined that it is not financially feasible to restore the breached Edenville Dam and Wixom Lake, the counties through their delegated authority could petition the circuit court for modification of the lake level order to remove or eliminate the court-ordered lake level for Wixom. Properties that would otherwise have benefitted from the maintenance of the normal levels of Wixom Lake would not receive a benefit, and would not be assessed, or would receive an assessment showing a "$0.00" assessment, even though the properties would remain in the lake level assessment district.

Planning Level Cost Estimates of Four Lakes Project Decommissioning

Costs to decommission the dams consist of two components, dam removal and environmental mitigation. Four Lakes Task Force prepared the following planning level estimates to decommission the four dams (Wixom consists of the Tittabawassee and Tobacco spillways). Streamside Ecological Services prepared the planning level cost estimates for environmental mitigation.

Table 2. Decommissioning Planning Level Estimates

Dam	Demolition	Environmental	Subtotal	Contingency	Total
Secord	$6 million	$28 million	$34 million	$3 million	$37 million
Smallwood	$3 million	$13 million	$16 million	$2 million	$18 million
Wixom	$15 million	$25 million	$40 million	$4 million	$44 million
Sanford	$4 million	$20 million	$24 million	$2 million	$26 million

Dam	Demolition	Environmental	Subtotal	Contingency	Total
Totals	**$28 million**	**$86 million**	**$114 million**	**$11 million**	**$125 million**

Dam Removals – Four Lakes Projects

Each of the Four Lakes dams would be required to be modified to no longer meet the description of a "dam" according to Part 315, Dam Safety of the Natural Resources and Environmental Protection Act, PA 451 of 1994, as amended. Generally, this means the structures must be removed to a height of no more than six feet and reduce the ability to impound no more than five surface acres of water. This would be achieved by demolishing the powerhouses and spillway structures, removing the earthen embankments and associated appurtenances, removing or capping sediments within the construction zone and meeting federal and state construction permitting stipulations; essentially returning the sites to their former natural states.

1. Planning Level Cost Estimates (Prepared by Four Lakes)

    a. Decommissioning and demolition of the dams

Table 3. FLTF Dam Cost Estimates

Dam	Height (feet)	Length (feet)	Embankment (CY*)	Powerhouse/Spillway (CY*)	Estimate
Secord	55	2,100	100,000	6,750	$6 million
Smallwood	35	1,030	30,000	3,500	$3 million
Wixom	55	6,200	225,000	15,000	$15 million
Sanford	35	1,579	50,000	7,500	$4 million

* CY – cubic yards

The estimates above are calculated with the following assumptions:

- $25/cubic yard for embankment excavation, transportation and replacing
- $75/cubic yard for powerhouse/spillway demolition, transportation and recycle
- 5% of estimate for general conditions, mobilization and demobilization and decommissioning
- 25% of estimate for flow control during demolition
- 5% of estimate for site restoration
- 10% of estimate for engineering and project management
- 35% contingency

b. Detail studies needed
    i. Universal and hazardous waste survey (powerhouses)
    ii. Asbestos contaminated material survey (powerhouses)
    iii. Engineered demolition plans meeting regulatory approval
    iv. Detailed quantity calculations

Environmental (Prepared by Streamside Ecological Services)

1. Stream and River Stabilization

   a. Study – Any river or stream channel exposed by drawing down the impoundment will have to be stabilized through active or passive restoration. Generally, active restoration would include designing a channel (dimension, profile and plan) that will be self-sustaining and stable over the long term. Passive restoration would rely on the river to work toward stability by adjusting its dimension, profile and pattern across the landscape, with a minimum amount of stabilization work. Active restoration is expected to be required by regulators since there is so much river channel within the project area and there is so much emphasis on negative impacts associated with downstream resources, including Saginaw Bay. Detailed study of hydrology, hydraulics, geomorphology and sediment transport will be required, at a minimum, as part of this task. Restoration of the floodplain and riparian area is also included in this task. At a minimum, an estimated 69.1 miles of stream, including the Tittabawassee and Tobacco rivers and 49 tributary streams (EGLE estimates 65 tributaries in just the Edenville and Sanford impoundments), will be impacted by removal of the dams and will need to be restored/stabilized (Table 3). Cost estimates in Table 3 are based on the size and length of the river channel to be stabilized, compared to average costs of similar projects implemented in Michigan.
   b. Permitting – Permitting requirements will be substantial and will require data collection and analyses associated with hydrology, hydraulics, geomorphology and sediment transport. Basically, a plan must be presented that illustrates that stable, self-sustaining river channels with floodplains can be constructed.
   c. Restoration/Mitigation – Significant restoration work will be necessary to stabilize the 69 miles of river and stream channel that will be exposed by loss of the impoundment. In some cases, this could include a complete rebuild of the stream channel at new elevations, with excavation and stabilization of the surrounding floodplain. Based upon the detailed plan submitted for permitting, construction may require land acquisition and will require substantial engineering and stream restoration expert oversight.
   d. Alternative Restoration Measures – Stream and environmental restoration at all four dams, if designed for re-establishing a healthy and stable riverine system, will require the extensive efforts described above, with associated costs. However, permitting requirements associated with stream stabilization and restoration are likely different for Edenville and Sanford versus Secord and Smallwood. The lower two dams failed as a result of a natural disaster whereas the upper two are currently considered serviceable structures that have been drawn down for inspection and repair. Since Edenville and Sanford are currently developing into a riverine system, and decommissioning does not require a specific intent to convert the impoundments to a free-flowing river (including tributaries), permits are not required for drawdowns and as such, stream "restoration" could include a minimalist approach.

      One alternative is more passive, allowing the stream channels to carve their own path with efforts to address areas of significant erosion. Costs for those efforts could be considerably less, perhaps on the order of 20% or less of the costs associated with full, appropriate river restoration efforts. However, while FLTF and the counties may not be "required" to complete full river and associated ecosystem restoration, this is without question the desired approach and other governmental

agencies and/or special interest groups would be expected to address the restoration and bear the costs.

2. Sediment Volume/Contamination

   a. Study – Detailed study of the natural bedload and suspended sediment load being transported by unimpacted river reaches, into the project area, along with a description of how that load will continue to be transported through the project area will be required. Any sediments that may be mobilized as part of construction activities or post-removal stabilization will require testing for contaminants.
   b. Permitting – Analyses of the transport of natural bed and suspended loads are expected as part of permitting for stream restoration. Discrete sediment samples will be required from areas that soils disturbance may occur as a result of construction or river processes, at a rate of six samples for the first 10,000 cubic yard and one sample per additional 10,000 cubic yard. The samples will be run through a 200-micron sieve and if 10% or more of the sample is retained (fine sediment), chemical analyses are required for specific parameters described in the dredged sediment protocol (WRD-048). According to an EGLE press release from July 1, 2020, "The first round of dioxin test results received mid-June from the Tittabawassee River floodplain, located downstream of Midland, do not show levels of dioxins and furans above the area-specific residential clean-up level at trend-monitoring stations along the river. More trend monitoring station samples have been collected and will be reviewed by EGLE and the Michigan Department of Health and Human Services (MDHHS). EGLE has monitored these stations for dioxins after seasonal floods since 2011. Samples collected for non-dioxin contaminants did not indicate a need to change current practices."
   c. Restoration/Mitigation – Any contaminated sediment that might be mobilized as a result of the proposed project will need to be dealt with, through dredging and disposal in an approved landfill.

3. Erosion Control

The decommissioning of a dam will dewater and expose lake bottomlands that will begin to grow native and invasive vegetation. The root systems of herbaceous vegetation, shrubs and trees will help stabilize the soils and protect against erosion during high flow events. Depending on many factors such as potential contamination, the volume of possible dredging necessary and the topography of surrounding areas, it is possible that sediments can be moved upland to create new terraces to prevent high flows from cutting of sediment embankments and causing downstream sedimentation.

   a. Study – A review of potential new erosion sites along river shorelines, both upstream and downstream, along with the need for and extent of shoreline protection would need to be performed.
   b. Permitting – Permits will be required under Part 91, Soil Erosion and Sedimentation Control (SESC), of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended. As part of the permit, a certified stormwater inspector will be required to inspect the project area on an approved schedule (usually on a weekly basis and following any precipitation events).
   c. Restoration/Mitigation – Restoration of the streams and impoundment areas will be expected to eliminate/minimize excessive erosion. No mitigation, specific to erosion, is anticipated.

4. Fisheries

   a. Study – A description of the existing fish community within, upstream and downstream of the former impoundment has already been completed. A determination of desired and undesired fish species is likely to occur in consultation with the relevant resource agencies and other stakeholders.
   b. Permitting – Description of transition in the fish community associated with the change from lake to riverine conditions is needed. Shifts in the fish community associated with dam removal are not typically a concern, unless threatened and endangered species are present or if undesired fish species, e.g., lamprey eel, need to be excluded from upstream migration once the dam has been removed.
   c. Restoration/Mitigation – Typically no mitigation is required for fisheries, since dam removal is associated with ecological restoration, aquatic connectivity, etc. It is expected that the composition of the fishery would change significantly with conversion from a lentic to lotic system. Project designs should pay attention to fish species such as lake sturgeon, walleye, and suckers that could benefit from a free-flowing system.

5. Invasive Species

   a. Study – Complete documentation of all invasive species present within the impoundment, along with the up and downstream reaches of the Tittabawassee River and any tributaries, will be required. Aquatic nuisance species reports from EGLE, or permits issued for treatment of invasive species, can be reviewed for existing information. Similarly, the Michigan Invasive Species Information Network (MISIN) may contain data for the project area. Control of sea lamprey will be of significant concern and will require coordination with state and federal agencies.
   b. Permitting – Will describe the potential for introduction or spread of invasive species due to the project, and how will it be prevented or minimized, including sea lamprey.
   c. Restoration/Mitigation – A plan will be required to address the potential for spread of invasive species caused by the project. Monitoring and management of riparian lands and the initially exposed lake beds may be necessary to ensure proliferation of native plant species. Close coordination with state and federal agencies (particularly the Great Lakes Fisheries Commission) will be required to design and implement plans to control sea lamprey.

6. Water Table/Wells

When dams are removed, residents in nearby areas may suffer a loss of their well water as the water table recedes due to prior hydraulic connections to a lake. The drilling of deeper wells would likely be needed to reestablish water resources for individuals. It would be the responsibility of the well owner to make such improvements. Gladwin and Midland counties own the Four Lakes and the riparian rights to the river water, but do not have an obligation to provide water to private residences via the water table.

7. Debris Management

FLTF has witnessed the failures of the Edenville and Sanford dams and the resulting sediment and debris that was exposed as a result of the failures. Debris removal and mitigation plans are being developed to clean up the bottomlands in parallel with efforts to gain approval for reconstruction of the dams.

a. Study – Survey debris locations; develop plans to dispose of debris; identify new stream location and need to move sediments to locations above ordinary high water mark (OHWM); develop plan to dispose of excess sediments.
b. Permitting – Obtain necessary State of Michigan permits for reworking bottomlands.
c. Restoration/Mitigation – Obtain contracts for debris collection, sorting and disposal. Hire construction company to move sediments to higher ground that is higher than the OHWM and armor bottomlands to prevent erosion of remaining sediment.

8. Water Quality

a. Study – Review of existing information (e.g., agency reports, MI Corps volunteer monitoring data, lake association data, Michigan's Integrated Report) should be satisfactory. Unless there is any reason to expect differently, dam removal projects are typically assumed to improve water quality.
b. Permitting – Describe issues associated with water quality. Typically, all positive. Sediment transport will be major component of permitting.
c. Restoration/Mitigation – None anticipated.

9. Wetlands

a. Study - Wetland types/acreage/hydrology – A GIS-based wetland assessment, using available wetland, weather data, soils, Light Detection and Ranging (LiDAR) mapping and aerial photographic interpretation along with some ground-truthing should be satisfactory for documenting wetlands that could be impacted by dewatering of the impoundment. This delineation will be necessary to document the existing wetlands that may be hydrologically impacted by lower water levels and in any areas that will be directly impacted by construction activities. Wetland types (e.g., emergent, scrub-shrub, forested) must be documented and quantified including wetlands that are expected to form within the basins after the dams are removed.
b. Permitting – Wetlands
    i. Summation/Analysis of acreage and type of wetlands that could be impacted by dam removal (including any loss or a change in wetland hydrology.)
    ii. Estimate of wetland acreage and type, with justification, expected to develop along the newly exposed lakebed/river channel.
    iii. Proposed mitigation for wetlands permanently lost, at proper ratios depending on wetland type. It is likely the wetland formed in the basin can be used as compensation for wetlands drained as a result of the drawdown. Performance standards and monitoring will likely be required for a minimum of five years.
c. Restoration/Mitigation – Wetland mitigation will be required for all permanent impacts to existing wetlands. Typical mitigation ratios are a minimum of 1.5 acres of wetland mitigation for each acre of impact but are generally higher (2-to-1) for forested systems. Based on a detailed desktop analysis, over 2,000 acres of wetlands are expected to be impacted by the loss of hydrology in and surrounding Wixom and Sanford lakes and nearly 400 acres are expected to develop within the two drained basins. Wixom and Sanford lakes were drained as a result of the May 2020 disaster and will likely not require wetland mitigation for the wetlands that were impacted by loss of hydrology. However, removals of the dams at Secord and Smallwood will result in wetland mitigation requirements. Detailed analysis of wetlands surrounding Secord and Smallwood lakes

have not been completed but based on the size and configuration of the two upper lakes, wetland impacts and required mitigation are expected to be similar to that of Sanford Lake with hundreds of acres impacted. Based on costs of similar wetland mitigation projects, wetland mitigation through construction or restoration is estimated as $40,000/acre, which includes land acquisition.

10. Threatened & Endangered Species

a. Study – A full review of any state or federal threatened or endangered species must be completed. The Michigan Natural Features Inventory (MNFI) database and the U.S. Fish and Wildlife Service's Environmental Conservation Online System (ECOS) provide much of the background information on occurrences of species within the study area. Field work will likely be required to determine if any species previously documented in, or near, the project area are present, or if their preferred habitats are present. State and/or federally protected mussels will be of particular concern, and it is alleged that the federally endangered snuffbox mussel has already been documented within the project area, in association with the Tobacco River.
b. Permitting
    i. Description of any species, their status and their habitats
    ii. Identification of project impacts
    iii. Consultation with state and federal agencies
    iv. Protection/relocation plans
    v. Mitigation for a "take" of any of these species
c. Restoration/Mitigation – If any rare species are documented and will be disturbed or displaced by the project, mitigation will be necessary. Rare mussels, like the snuffbox, may need to be rescued from the impacted area and relocated to a more suitable location. Long-term monitoring of the mussel populations and relocated mussels will likely be necessary to ensure that the relocation was successful. This activity will likely involve hundreds of hours of work.

11. Long-term Monitoring

It is typical for agencies to require monitoring plans typically for five years but could be longer for issues associated with threatened and endangered species. Monitoring will be required for:

a. Wetland mitigation
b. River/stream stability
c. Threated and endangered species

12. Estimated Costs

Tabulated below are Streamside's estimated costs for stream mitigation, including engineering and construction for each of the Four Lakes.

Table 4. Secord Lake

Stream Name	Impact Area (feet)	Impact Area (miles)	Estimated Mitigation Cost
Tittabawassee River	21,300	4.0	$6,390,000
East Branch Tittabawassee River	44,000	8.3	$13,200,000
Middle Branch Tittabawassee River	20,000	3.8	$6,000,000
Elk Lake Creek	6,700	1.3	$1,005,000
Cedar Creek	6,000	1.1	$900,000
Indian Lake Creek	4,800	0.9	$720,000
Avery Creek	1,800	0.3	$135,000
Total – Secord Lake	**104,600**	**19.8**	**$28,350,000**

Table 5. Smallwood Lake

Stream Name	Impact Area (feet)	Impact Area (miles)	Estimated Mitigation Cost
Tittabawassee River	33,000	6.3	$9,900,000
Tea Creek	3,100	0.6	$232,500
Sugar River	4,500	0.9	$1,350,000
Unnamed 13 (Rivers Terrace)	2,600	0.5	$195,000
Little Tobacco River	5,500	1.0	$825,000
Unnamed 14 (M61)	2,200	0.4	$165,000
Unnamed 15 (M30)	750	0.1	$56,250
VanHorn Drain	2,000	0.4	$150,000
Unnamed 16 (Spencer)	550	0.1	$41,250
Unnamed 17 (Birchwood)	2,300	0.4	$172,500
Unnamed 18 (Oren Ct)	1,800	0.3	$135,000
Total – Smallwood Lake	**58,300**	**11.0**	**$13,222,500**

Table 6. Wixom Lake

Stream Name	Impact Area (feet)	Impact Area (miles)	Estimated Mitigation Cost
Tittabawassee River	57,552	10.9	$17,265,600
Tobacco River	11,088	2.1	$2,772,000
Hess Drain	1,800	0.3	$135,000
Fowley Drain	1,500	0.3	$112,500
David's Drain	5,500	1.0	$412,500
Luenberger Drain	3,000	0.6	$225,000
Unnamed 1 (Anderson)	1,500	0.3	$112,500
Denton Creek	4,000	0.8	$300,000
Guernsey Creek	3,700	0.7	$277,500
Molasses River	3,700	0.7	$555,000
Robbins Drain	1,600	0.3	$120,000
Larrabee Creek	5,280	1.0	$396,000
Unnamed 2 (Burling)	1,900	0.4	$142,500
Pary Drain	3,200	0.6	$240,000
Ortner Drain	6,800	1.3	$510,000
Treman Drain	900	0.2	$67,500
Little Cedar River	4,300	0.8	$645,000
Bear Creek	2,100	0.4	$315,000
Unnamed 3 (Highland Cove)	820	0.2	$61,500
Unnamed 4 (Rock Trail)	500	0.1	$37,500
Nestor Drain	3,500	0.7	$262,500
Coolidge Drain	2,400	0.5	$360,000
Total – Wixom Lake	**126,640**	**24.0**	**$25,325,100**

Table 7. Sanford Lake

Stream Name	Impact Area (feet)	Impact Area (miles)	Estimated Mitigation Cost
Tittabawassee River	59,294	11.2	$17,788,200
Unnamed 5 (W. Adams)	150	0.0	$11,250
Unnamed 6 (Baker)	280	0.1	$21,000
Unnamed 7 (Campbell Ct)	1,100	0.2	$82,500
Unnamed 8 (Blakely)	150	0.0	$11,250
Ditmar Drain	1,000	0.2	$75,000
Mason Drain	650	0.1	$48,750
Meridian Drain	650	0.1	$48,750
Varity Creek	4,300	0.8	$645,000
Black Creek	2,900	0.5	$435,000
Unnamed 9 (Dague)	1,200	0.2	$90,000
Unnamed 10 (Shaffer)	3,000	0.6	$225,000
Unnamed 11 (Clarence Ct)	680	0.1	$51,000
Unnamed 12 (Branscomb)	120	0.0	$9,000
Total – Sanford Lake	**75,474**	**14.3**	**$19,541,700**

Table 8. Impact and Cost Summary of Four Lakes

Lake	Impact (feet)	Impact Area (miles)	Cost
Secord	104,600	19.8	$28,350,000
Smallwood	58,300	11.0	$13,222,500
Wixom	126,640	24.0	$25,325,100
Sanford	75,474	14.3	$19,541,700
Grand Total	**365,014**	**69.1**	**$86,439,300**

Future Property Management

1. Bottom Lands

The failures of the Edenville and Sanford dams created large expanses of land between the previous OHWM and the river's edge. These newly exposed bottomlands are owned by Gladwin and Midland counties and are open to public access, as permitted or restricted by the counties. The removal of the Secord and Smallwood dams would expose additional land surrounding the Tittabawassee River and its backwatered tributaries that would be subject to similar access rights. The broader land can be managed as open space with field-like characteristics or be wooded. A new OHWM will be established based on the reestablished river.

2. Dam Sites

The decommissioning of dams creates opportunities to create historic features for the public to visit and enjoy. Powerhouses and spillway structures can be retained for historic purposes while reducing costs of decommissioning. Consultation with the State of Michigan for cultural/historic permitting is part of the overall decommissioning related permitting process. The location for the siting of dams was selected based on the surrounding topography; in particular, narrow river reaches with sharp changes in elevation were selected to reduce the cost of construction while maximizing the power potential of the project. This means that when a dam has been removed there is a strong potential for steep gradients in and around the river. Some dams promote recreation opportunities while others are hazardous for the visiting public.

3. Counties and the SAD

The section titled, "Legal Aspects of Four Lakes Decommissioning" refers to the dissolution of the SAD due to decommissioning of the dams and related property. In this case, Gladwin and Midland counties may have the responsibility to manage the transformation of their former lake lands into their future states. The SAD would no longer have financial responsibility for the redevelopment of the sites; however, county residents may be required to pay for part or all of the effort with the balance coming from federal and/or state resources or from non-governmental organizations, corporate and/or private donations.

4. Loss of fisheries

Based on this dataset, it would be reasonable to estimate total economic expenditures for fishing activity on the four impoundments to be approximately $3.4 million annually. A creel study of Sanford Lake and similar southern Michigan lakes is discussed in the main body of the Four Lakes Feasibility Study. The decommissioning of the dams would reduce boat fishing and introduce more open land surrounding the Tittabawassee and its tributaries for trails and shoreline fishing.

Literature cited U.S. Department of the Interior (USDI), U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2016 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

5. Recreation Changes

Each of the Four Lakes have been important to the availability, quality and type of recreation experiences that upland property owners and the greater public have enjoyed for over 90 years. With the removal of the dams, there is typically a change from powerboating to kayak, canoeing and paddle-boarding. The

newly dewatered bottomlands are often used for riverside hiking/biking trails, river fishing access, sightseeing and bird watching. Communities understand the changes in lands and often seek to create new recreation activities and features along the length of the rivers. Homeowners who live upland of the Four Lakes would most likely prefer to return to the lake as they have attracted thousands of residents to the lakes where they now live.

Summary

Decommissioning is an alternative to that of repair and reconstruction of the Four Lakes projects and the re-establishment of the Four Lakes themselves. This report indicates the decommissioning alternative would be expensive and result in a much different future for the public, including those who reside immediately upland of the lakes or who have rights of access to the lake. Bottomlands would be exposed and become open spaces; lake environments would shift to riverine environments; recreation activities that existed for nearly 100 hundred years would no longer be available, being replaced by different opportunities; the character of the land and development along the shoreline will change, as will access to and through the bottomlands. With the different types of available recreation comes a different group of visitors seeking to meet their recreation needs. The magnitude and value of user-trips to the Four Lakes region would be expected to decrease dramatically.

This Preliminary Decommissioning Report discusses the studies, permits and restoration/mitigation activities and their costs at a planning level. These costs are preliminary estimates based on other decommissioning projects, estimates of streambed lengths, sediment quantities, lengths and types of materials for dams and the experience that engineers and biologists have accumulated from comparative projects that they were involved in. The estimates are somewhat conservative, however, a basic assumption is that the sediments have a low level of contamination as there is no knowledge of substantial industry that would have contributed to the contamination of these sediments. These sediments would be tested as part of the decommissioning project and then remediated per federal and state law if they are contaminated. The remediation (neutralizing or properly disposing) of contaminated sediments would be quite expensive and could significantly increase the cost of decommissioning.