Feasibility Study

Cowan Lake Wastewater Collection System

Prepared for
Grattan Township

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1.0 INTRODUCTION

Cowan Lake is located in the northwest corner of Grattan Township (Section 6) and the southwest corner of Oakfield Township (Section 31). The location of the lake is shown in Figure 1, which is a portion of the USGS topographical map of the area.

Due to the large number of failed or failing septic systems around Cowan Lake, these Townships, along with the residents around Cowan Lake, are investigating the feasibility and costs of providing a wastewater collection and treatment system to serve the residences around Cowan Lake. This study is an update of a Feasibility Study originally conducted by WW Engineering and Science, Inc. in 1992, and subsequently updated by Prein&Newhof in 2002. Those studies followed a 1990 study by the Kent County Health Department that indicated a 28 percent failure rate of individual septic systems serving homes around the lake. In many cases, there is insufficient room within the parcels to replace these systems. Septic systems failing due to age, high groundwater tables, and poor soils for drain fields can lead to public health risks and degradation of water quality in the lake.

The 2002 Feasibility Study recommended a combination gravity/low-pressure collection system around the lake with treatment at the existing Grattan Township Wastewater Treatment facility. The purpose of this study is to re-evaluate the alternatives originally studied in 2002 and to update cost estimates associated with these alternatives. The following reports were reviewed and used in preparing this study.

1. "Cowan Lake, Grattan Township, Wastewater Collection and Treatment Feasibility Study," prepared by WW Engineering and Science, Inc., April 1992

2. "Review of Wastewater Treatment for the Cowan Lake Area," prepared by WW Engineering and Science, Inc., February 1994

3. "Grattan Township Sewer Capacity Study," prepared by Progressive Architecture, Engineering and Planning, July 1997

4. "Grattan and Oakfield Townships Cowan Lake Wastewater Feasibility Study," prepared by Prein&Newhof, Inc., June 2002

2.0 PROJECTED WASTEWATER FLOW RATE

Wastewater flow is estimated from the number of customers in the service area. The 2002 Feasibility Study envisioned a service area along Cowan Lake Drive, Ten Mile Road, and Bay Drive. The entire service area is contemplated to consist of single-family residences. The estimate of the wastewater generated by these customers is based upon the number of residential equivalent units (REUs) located within the service area. An REU is a standard usage measure that estimates wastewater flow generated by a typical residential home in a 24-hour period. Each REU factor is based on building type and density. The flow per REU, and REU factors estimated within the proposed service area, were 70 gallons per person per day, with three (3) persons per residence, which are typical numbers required by the Michigan Department of Environmental Quality (MDEQ). Based on these numbers, the flow per REU used to estimate system requirements is 210 gallons per day (gpd). This compares well with the 228 gpd estimated for each REU around Big Pine Island Lake (Progressive, 1997), which is also located in Grattan Township. While these estimated flows are from the 2002 study, flows from the Grattan Wastewater Treatment Facility, which serves the Big Pine Island area, actually appear to be lower than this 228 gpd (approx. 170 gpd). We have seen similar trends elsewhere due to both the recent recession and efforts in water use conservation.

A count of parcels around the lake in buildable areas was made based on the 2002 study from tax parcel mapping available from Kent County. Since this more than 10 years old, may not it may not represent an exact current count. The parcels included in the count are those adjacent to the lake only. Some parcels on the opposite side of the road could be included in the service area. The previous estimate found 64 existing homes and 21 vacant lots adjacent to the lake. Approximately 70% of these are in Grattan Township and 30% are in Oakfield Township. To allow for future growth, the Cowan Lake Association requested system sizing and flow rates to be determined based on 100 REUs.

Average daily flows are estimated to be approximately 13,400 gpd for the initial service area (64 REUs), which is an average of nine (9) gallons per minute (gpm). The average flow for the entire 100 REU service area is 21,000 gpd (15 gpm). Based on the 2014 edition of “Recommended Standards for Wastewater Facilities,” which is published by the Great Lakes–Upper Mississippi River, Board of State and Provincial Public Health and Environmental Managers, the design peak flow rate for sewer systems is estimated to be 3.6 times average daily flow rates. Therefore, the peak daily flow rate for the Cowan Lake community is estimated to be 48,200 gpd (34 gpm) now and 75,600 gpd (53 gpm) in the future.

Although the collection system and pumping equipment must be sized for peak flows, wastewater treatment facilities are typically sized for average daily flow. The data described above is summarized in the table below:

Cowan Lake Service Area

	Residential Equivalent Units (REUs)
Grattan Township	
Vacant Lots	11
Occupied Lots	55
Oakfield Township	
Vacant Lots	10
Occupied Lots	9
Totals	
Occupied Lots	**64**
Vacant Lots	**21**
TOTAL	**85**

	Lots Fronting Cowan Lake*		***Total***
	Existing*	***Future*****	
Population Equivalent	192	108	300
Average Daily Flows (Gals)	13,400	7,600	21,000
Peak Daily Flows (Gals)	48,200	27,400	75,600
Annual Flow (Million Gals)	4.89	2.77	7.67

Based on:

Population Equivalent (P.E.) = 3 persons/residence
Flow = 70 gal/day/P.E.
Peak Flow = 3.6 times average

Notes:

* Not including any lots on opposite side of road from Cowan Lake or those where a home occupies two lots

** Existing flows based on 64 REUs (occupied lots)

*** Future flows based on an additional 36 REUs resulting in 100 REUs total

3.0 WASTEWATER COLLECTION SYSTEM ALTERNATIVES

Several alternatives for a wastewater collection system serving the Cowan Lake area were evaluated, including the following:

- Gravity sewer
- Low-pressure force main
- Septic tank effluent pump (STEP)
- Combination gravity/low-pressure sewer system

Each alternative system is described, along with its specific advantages and disadvantages.

3.1 Gravity Sewer

Sanitary sewers transport wastewater by gravity flow to treatment facilities. They flow from high to low points, and are constructed at sufficient depth to prevent freezing and to receive wastewater flows from basements. Systems are designed with a minimum slope to maintain a self-cleaning velocity of two feet per second. Due to the depth and slopes required, gravity sewers often require lift station pumps to transport wastewater from low to high points, where it again can proceed by gravity. In flat terrain, or locations where sewer slope is inverse to ground surface slope, additional lift stations may be required to transport the wastewater. In a system design, lift stations, force mains, and sewer construction alternatives are selected to optimize capital versus operation and maintenance costs.

While a gravity system requires regular maintenance, it generally requires less maintenance than a low-pressure force main system. It can also handle large variations in flow, which is helpful if residents have roof drains or sump pumps illicitly connected into the sanitary sewer. Finally, gravity sewers are more readily adaptive for growth and change within the sewer district. This is important in communities that grow or will redevelop.

A disadvantage associated with a gravity sewer system is the cost of construction. Construction below the water table and deep construction can significantly increase capital costs. Flat or low terrain around the lake can result in the need for several lift stations in order to transport wastewater around the lake. In addition, the county road commission usually requires that gravity sewers be placed below the road. This results in high costs due to road replacement.

3.2 Low-Pressure Force Main

A low-pressure force main system is a collection system that uses pumps and force mains. Each home or business is provided with a grinder-pump unit. The pump grinds the wastewater solids, and then transports it to a common force main. Due to the limited pressure grinder pumps can produce, a low-pressure system may need a large central pumping station to pump to the treatment facility. Grinder pumps require power from the house and a control panel mounted on the outside of the house. A grinder-pump unit consists of a holding tank, pump, and controls. Only the lid of the unit is exposed above the ground surface. The force main may be installed by the directional drilling method, which minimizes restoration activities, or by trenching.

The main advantage of a low-pressure system is the cost of construction. Because the force main is small in diameter, it can be installed using a method called directional drilling. In contrast to the open-cut method, directional drilling bores under the ground surface. This method reduces the restoration costs associated with an open-cut method and helps to preserve landscaping and road pavement. An additional advantage is that a force main may not have to be located as deep as a gravity sewer; thus, reducing depth requirements and construction costs. Construction by trenching can also be cost effective for small diameter force mains.

The main disadvantage of a low-pressure force main system is the ongoing cost of maintenance. Based on data from similar systems, the average operation and maintenance cost for a grinder pump is approximately $15 per year per pump at startup, which does not include the electrical costs for running a 2 HP pump. Operation and maintenance costs will increase over the life of the unit. This cost does not take into account the operation and maintenance of the force mains, lift stations, and wastewater treatment plant.

An additional disadvantage of a low-pressure force main system is the limited expansion capacity of the system due to smaller sized force mains. If future expansion of the system is desired, the estimated flows from the expanded area must be included in the original design calculations for the low-pressure force main. However, oversizing can be a problem. If the force mains are too large to maintain a flow velocity of at least two feet per second, settling of solids, which can lead to clogging, can occur in the pipe.

3.3 Septic Tank Effluent Pump (STEP) Collection System

A Septic Tank Effluent Pump (STEP) sanitary sewer collection system is a combination of a septic tank and low-pressure force main. The system uses a septic tank to collect solids from the wastewater, and an effluent pump to transport the remaining liquid waste to the sewer system. Septic tanks are part of the existing on-site disposal systems. The STEP system eliminates the need for a drain field at each residence.

An advantage of this system is the lower costs involved in building a STEP system. A disadvantage to the STEP system is that it only addresses the liquid portion of wastewater disposal. The system still requires septic tank maintenance. Pumping out the septic tank every three to five years is critical to prevent sewer system failure. This collection system would improve on the existing system but not completely remove the existing system, thus leaving some on-site disposal issues. Due to the age of the existing septic tanks, they could be leaking and may need to be replaced. Therefore, this option will not be reviewed further.

3.4 Combination Gravity Sewer/Low-Pressure Force Main

A combination gravity/low-pressure sanitary sewer system uses the advantages of both the gravity sewer and low-pressure system. This project may benefit from using gravity sewer in certain areas, while installing a low-pressure force main system and grinder pumps for the areas where gravity sewer construction is impractical.

Easements may be necessary depending on the type of collection system selected. An easement is a limited right given by a property owner to a second party for a specific purpose. Easement types that apply to this study are access easements, which allow access through or onto a property, and permanent facility easements, which allow construction, operation, and maintenance of a system.

In most cases, easements are not required for gravity sewers as they are usually placed in the road right-of-way. Thus, the crossing of private property is minimized. Laterals are installed on private property; however, the laterals are typically owned by and are the responsibility of the property owner.

Grinder-pump units, when used, may be placed in the road right-of-way or on private property next to the residence. If the grinder-pump unit is in the road right-of-way, an easement will be needed for access to the grinder-pump controls, which are typically mounted on the side of the home. The former assumes that the Kent County Road Commission will grant permission for grinder pump placement in the road right-of-way. If permission is not granted or the design calls for grinder units to be located outside of the right-of-way, the grinder pumps are placed next to the home. In this case, it will be necessary to obtain easements that allow access to the grinder pumps, control panels, and force mains for proper system maintenance.

Easements will also be required for areas where sewer system components are to be placed outside of the road right-of-way. These areas may be dictated by design constraints, or if the desired placement minimizes project costs.

4.0 WASTEWATER TREATMENT PLANT DESIGN OPTIONS

Numerous options exist for wastewater treatment. Each option has its own benefits and limitations. Issues involved in treatment process selection include influent and effluent parameters and concentrations, land availability, site location, solids handling, capital costs, and operation and maintenance costs. In addition, there are many options for off-site issues and treated water discharge.

Five wastewater treatment options have been reviewed, and are presented as follows:

- Stabilization lagoon facility
- Mechanical plant
- North Kent Sewer Authority (NKSA) system
- Grattan Township wastewater treatment facility (WWTF)
- Constructed wetlands

Following treatment, the liquid portion of the waste stream must be discharged either to surface water or to the ground and groundwater. Multiple methods exist to discharge to the two locations.

The Michigan Department of Environmental Quality (MDEQ) controls surface water discharge into a State water body through the National Pollutant Discharge Elimination System (NPDES) permit program. The program is designed to minimize the impacts of commercial and industrial discharge on the surface waters. Typically, a wastewater discharge permit may be obtained to discharge to large or flowing bodies of water. Because there are no large or flowing water bodies in the area, a surface water discharge is not feasible.

Groundwater infiltration, or percolation, is the process of allowing treated wastewater to drain or infiltrate into groundwater. An infiltration area, like a “pond,” is created and filled with treated water. This “pond” then acts as a groundwater recharge source. Infiltration beds require soils with high porosity to allow continuous migration of water into the subsurface. Minimum normal groundwater depth and prevention of soils from flooding are additional constraints placed on the disposal system. Thus, lighter, sandier soils with a deep water table are beneficial to this disposal method.

Groundwater infiltration is strictly governed and monitored by the State of Michigan. Discharge criteria are set to protect the groundwater, maintaining its drinking water quality. A hydrogeological study is needed on a site to determine its suitability for wastewater infiltration. Continued monitoring of groundwater and discharged wastewater is required under a State of Michigan permit. Monitor wells are needed to allow sampling of the groundwater periodically. Infiltration beds have the added advantage of being able to be operated throughout the year, thus minimizing the need for large storage ponds.

Irrigation over farm fields can also be an effective way to dispose of wastewater. However, farm irrigation is a seasonal activity and thus discharge from the treatment plant is limited to the summer months. As a result, wastewater flows generated during the non-irrigation months must be stored in lagoons until irrigation is possible.

The irrigation fields are sized to accept one year’s worth of flow in four to six months, while the lagoons are sized to hold wastewater six to seven months of the year. A large buffer zone is needed to reduce potential human contact and avoid overspray to adjoining property during windy conditions. It is estimated that the total area needed is double the actual irrigation area.

One consideration for the farm fields is that the site must have enough percolation or seepage capacity to accept the irrigated wastewater. Thus, lighter, sandier soils are normally chosen for irrigation systems. In addition, irrigation may only be conducted on fields producing crops that are not used for human consumption.

Similar to the infiltration bed option, a hydrogeological study is needed on the site to determine its suitability for wastewater irrigation. The State of Michigan strictly governs and monitors irrigation. Discharge criteria are set to protect the groundwater and to maintain its drinking water quality. Monitoring of wastewater discharges and groundwater are required under State of Michigan permits to discharge to the groundwater.

Based on a review of area soil maps, it appears that there are areas that could be utilized within one mile of Cowan Lake, although, there are many wetlands and slow-draining soils in the area. An environmental impact assessment and hydrogeological study would be needed to further assess the feasibility of any particular site.

4.1 Stabilization-Lagoon Facility

Two common types of lagoon treatment facilities are stabilization lagoons and aerated lagoons. Both rely on the availability of large tracts of land upon which the treatment facility would be constructed. The main benefit of this type of facility is the minimal equipment and maintenance activities required to sustain the installation.

Lagoons are constructed by the excavation or enclosing of an area by dikes. A double-composite liner system comprised of clay and a synthetic geomembrane is required by state regulations to hold the wastewater. Natural decay of wastewater occurs during the period the wastewater is held in the lagoon.

It is anticipated that discharge from this type of treatment facility would be to groundwater through irrigation. The Michigan Department of Environmental Quality's (MDEQ's) Groundwater Quality Rules limit total inorganic nitrogen discharged to the surface of the ground to no more than five milligrams per liter (mg/L). Wastewater stabilization lagoons successfully reduce inorganic nitrogen to these levels. Phosphorous concentrations are also limited.

The size of the lagoons is dictated by the quantity of wastewater requiring storage and the ability of oxygen to be transferred into the wastewater for treatment. Stabilization lagoons are sized to limit the system loading such that natural oxygen transfer is sufficient to meet treatment needs. As a result, the depth of the lagoons is limited to about 6 feet; therefore, requiring large surface areas. Two feet of this is typically reserved for sludge storage. Based on a lagoon organic loading rate of 0.17 pounds/person/day, a total lagoon surface area of 2.6 acres is needed to meet flows generated by 100 REUs (300 people) for the existing flows. To accommodate a storage period of approximately 7 months, during which flow cannot be discharged through irrigation, additional storage would be required.

It is estimated that approximately 8–9 acres of lagoons (split between at least two lagoons) would be needed to meet the anticipated future loadings. Dividing into two lagoons is also necessary so the settled solids can be cleaned out periodically from one lagoon while the other is still in service. A site of approximately 10–12 acres would be required to support a stabilization-lagoon-treatment facility. The ponds can generate objectionable odors in the spring and the fall when the water in the ponds “turns over” due to density changes from temperature.

Aerated lagoons reduce the surface area of the lagoons mechanically by providing oxygen to the system. Typically, this is accomplished by creating an additional pond, which holds the wastewater for approximately one week. During its time in the initial pond, oxygen is introduced mechanically into the wastewater and the waste is treated. Following initial treatment, the flow is delivered to the storage lagoons. As a result of the initial treatment and reduction in oxygen demand, the subsequent lagoons may be deeper, thus reducing the acreage required for the treatment facility. The disadvantage of this system is added costs for aerators and additional costs for operation and maintenance. Enough volume for storage of flow for six or seven months is still required.

Irrigation area is also required for final disposal of the water. The allowable irrigation rate is dependent on the soil characteristics of the site. Assuming an allowable irrigation rate of 2 inches per week over a 4-month period, approximately 8 acres would be needed for existing flows and an additional 6 acres for future flows.

Based on these areas, a total area of 35–40 acres would be needed to support stabilization ponds followed by irrigation. Large buffer areas needed around the irrigation area are included in this land estimate.

4.2 Mechanical Plant

A mechanical plant is a facility that uses machinery to assist in the treatment of wastewater to meet discharge criteria. A significant difference with mechanical plants is the separation and handling of solids. Thus in addition to treating and disposing of a liquid stream, a solids waste stream is generated and requires disposal.

A wastewater treatment plant using extended aeration or sequencing batch reactors appears to be the most viable option for the Cowan Lake community. Disinfection is not required for a groundwater discharge.

The liquid portion of the extended-aeration wastewater stream typically consists of the following components:

1. Screens
2. Grit removal racks and clarifiers
3. Extended-aeration reactors
4. Clarifiers
5. Return-activated-sludge pumps

Benefits associated with extended aeration include no primary clarification and associated odor control, improved solids reduction, chemical usage minimization, and greater flexibility in handling system peaks and fluctuations. The extended-aeration process does require clarifiers to separate solids from the waste stream; however, flow equalization is not required.

The liquid portion of the sequencing batch reactor (SBR) wastewater treatment plant would likely consist of the following components:

1. Screens

2. Grit removal racks and clarifiers
3. Sequencing batch reactors

The sequencing batch reactors would function in a manner biologically similar to the extended aeration process. Benefits associated with sequencing batch reactors include no primary clarification and associated odor control, improved solids reduction, chemical usage minimization, and greater flexibility in handling loading fluctuations.

Sequencing batch reactors serve as biological reactors and clarifiers all in one unit. Therefore, no final clarifier is required. However, if disinfection were needed, flow equalization would be required to minimize the size of the disinfection equipment. Disinfection typically is not needed for discharge to groundwater.

The solids-handling portion of both wastewater treatment plant processes would be similar. For the study, it was assumed that an aerobic-sludge-digestion system would be used to reduce volume and prepare solids for final disposal, which would be by land application in accordance with State of Michigan requirements.

The major benefit of a mechanical plant compared to a lagoon system is the decrease in land area required for siting the facility. The reduction in land area is typically the result of this type of plant consolidating treatment units and then directly discharging to a surface water body. If treated wastewater storage is required, significant land area reductions may still be realized as the State permits the storage ponds to increase in depth, thus reducing land area required. Disadvantages of a mechanical plant relative to a lagoon system are the high capital costs, the need for a part- or full-time, licensed system operator, and increased operational costs.

4.3 Grattan Township Wastewater Treatment Facility (WWTF)

The Grattan Township WWTF is located approximately 3½ miles east of Cowan Lake in Section 2 of Grattan Township. The Grattan Township WWTF currently serves about 250 residences around Big Pine Island Lake. Treatment is achieved by a series of four wastewater-stabilization lagoons followed by irrigation.

Although this facility does have additional capacity for treatment, some of it is reserved for parcels already located within the service area. According to Grattan Township officials, this service area comprises about 300 REUs at this time.

In order to reach the Grattan Township WWTF a pumping station will likely be needed at Cowan Lake and a force main from there to Pump Station No. 1 (P.S. #1) near Big Pine Island Lake. A 4- to 6-inch diameter force main is needed to convey the wastewater about 23,000 feet to P.S. #1. From there all wastewater from the Big Pine Island system is pumped to the treatment facility.

Table 1 summarizes the capacities of the major components of the Grattan Township system. It also lists the available capacity of each. It is readily seen that the lagoon organic loading capacity is the limiting factor. However, it is also noted that the organic loading estimate may be too conservative. If it assumed that there are only two and one-half (2.5) persons per residence, then the capacity increases to 88 REUs, which is more than the existing 64 Cowan Lake REUs. Although the lagoons could be operated at the higher capacities, odors could develop if the organic load is too high. Aeration may be added to one or more of the lagoons to increase the capacity; however, at this time, it does not appear to be needed for the initial 64 REUs. The irrigation system was revised and upgraded in 2012 and is currently permitted for 30 million gallons per year. During the period 2009–2015, the average irrigation was about 15 million gallons annually. At present, it appears that there is capacity to add Cowan Lake residences. Grattan Township has additional acreage, and that could be used for future irrigation, if needed.

4.4 North Kent Sewer Authority (NKSA)

The North Kent Sewer Authority's collection system serves areas in Cannon and Courtland Townships, which are located west and northwest of the project area, respectively. The 1992 Feasibility Study indicated that there is some additional capacity in these systems. However, Grattan and Oakfield Townships are not currently part of the service area agreement with the NKSA, who owns the final treatment system where the North Kent system discharges. Although there is excess capacity within the PARCC Side Clean Water Plant (PSCWP), it is currently allocated on a percentage basis to the five municipalities (i.e., Plainfield, Alpine, Cannon & Courtland Townships, and the City of

Rockford) that constructed the plant. Any connection to the NKSA system would require the purchase of capacity from one or more of the five municipalities. This capacity purchase would include construction costs, adjusted for inflation, based on a pro-rata share of capacity within the treatment plant and the trunk sewer.

As indicated in the 1992 Feasibility Study, there are two possible entry points, one near M- 44 and Ramsdell Drive in Cannon Township and the second in Courtland Township near 10 Mile Road and Myers Lake Road. Because there are fewer pumping stations to address in the second entry point, the Courtland entry site appears to be the more feasible entry point. A pumping station and a 4- to 6-inch diameter force main would be required. The force main would be approximately 3.5 miles long.

4.5 Community Septic Tank/Drain Field/Sand Filter

For some small wastewater systems, a community septic tank and drain field system has been constructed in an area where soils have better treatment capabilities than those serving individual homes. Although this alternative was considered in the 1992 Feasibility Study, these systems are no longer allowed under State Regulations (Part 22, 1994 P.A. 451, as amended) for flows greater than 10,000 gallons per day. Therefore, this type of system is not feasible. A modification of the community septic tank/drain field system in recent years is the addition of a sand filter after the septic tank and prior to the final drain field. The sand filter provides additional treatment and typically allows construction of a smaller drain field area. Sand filters also are not allowed under current groundwater discharge regulations for flows greater than 10,000 gallons per day. Therefore, a sand filter also is not considered feasible for the Cowan Lake Project.

4.6 Constructed Wetland

A constructed wetland system, commonly called a Vegetated Submerged Bed (VSB) system is permitted under current groundwater discharge regulations in the State of Michigan. However, a constructed wetland must also include an additional process for nitrification. VSB wetlands consist of gravel beds below the surface. The surface is then planted with wetland vegetation. VSBs are typically surrounded with earthen berms to prevent inflow or outflow from the system and have inlet and outlet distribution piping structures for the regulation and distribution of wastewater flow. Because the system is below ground, odors are generally not a problem. The treated water can then be directed to an irrigation system, an infiltration bed, or a drain field.

Because VSBs have insufficient oxygen, nitrification (i.e., the conversion of ammonia to nitrate) is unreliable. Because there is low oxygen, however, conversion of nitrate to nitrogen gas is better. Therefore, these systems generally require some sort of nitrification process ahead of the vegetated wetland.

Modifications to these systems have included providing various anaerobic and aerobic zones along with some re-circulation of the wastewater to promote these processes. Although this option has not been permitted in Michigan yet, some systems like this are nearing permit acceptance. Therefore, it appears that this type of system may be feasible.

The operation of these systems is simple, but some mechanical equipment is needed to recirculate flow and occasionally it may be needed for discharge. In addition, a part-time operator would be needed. As with other systems discharging to groundwater, a hydrogeological study and a monitoring program will be required.

5.0 COST ESTIMATES

5.1 Wastewater Collection System

A cost estimate for each feasible wastewater-collection system option evaluated is provided in Tables 2, 3, 4, and 5. All costs for the private portion of the work are also provided at the bottom of each table. The private costs are those associated with work between the individual house and the sewer or force main or between the house and the grinder pump station. These costs can include piping, electrical modifications and abandonment of existing septic systems.

Included collection system capital costs are piping, lift stations, grinder pumps, laterals, abandonment of septic tanks and drain-fields, electrical and plumbing connections, and restoration.

5.2 Force Main to Wastewater Treatment Facility

Detailed force-main cost estimates were produced for each of the three alternatives and are provided in Tables 6, 7, and 8. Each estimate assumes that a 4-inch diameter force main will be constructed outside of the pavement area in the road right-of-way. One main lift station is also included to deliver flow to any of the sites. For a “community system,” it is assumed that the site would be about one mile from Cowan Lake. Because there is no public water supply in the area, a generator for the lift station to provide continuous system operation during power failures has not been included in the estimate.

5.3 Wastewater Treatment

Capital costs associated with the feasible wastewater treatment alternatives studied are provided in Tables 9 through 12. Land costs in the area are estimated at $5,000 per acre. Operation and maintenance activities include valve maintenance, record keeping and reporting, site monitoring, discharge monitoring, lagoon maintenance, and site maintenance. The level of effort will vary for each alternative. A mechanical plant will have the most operation and maintenance costs. In addition to the annual operation and maintenance costs, expenses for sludge removal from the lagoons will be incurred every 15–20 years.

5.4 Summary of Costs

A summary of the costs associated with the most feasible options is provided in Table 13. The cost per REU based on a 20-year loan financed at 5% is also provided in Table 13. Tables 14 and 15 show these costs based on loans for 20 years at 2.5% and for 40 years at 2.25%, respectively, as comparisons. These loan rates are available through state and federal agencies and are further discussed in the following section.

6.0 FINANCING CONSIDERATIONS

Funding for construction of a wastewater collection and treatment system to serve the Cowan Lake area could be pursued from various sources. A review of possible funding sources is presented below.

6.1 United States Department of Agriculture (USDA) – Rural Development

This agency's mission is to provide safe and sanitary housing to rural municipalities with a population of less than 10,000. This agency has funding available for sanitary sewer construction. It typically provides a combination of a grant and a loan to a community for a qualifying project. The market loan interest rate has been approximately 2.25% for a loan period of 40 years. The median income for Grattan Township is approximately $66,425 and for Oakfield Township at $66,250. In order to qualify for a *grant* from the USDA the income levels for residents around the lake would need to be below approximately $40,000. If the residents feel they may meet this criterion, an income level survey could be taken.

The application process requires that an initial application be completed. In addition to this application, a very thorough and detailed engineering report complete with environmental assessment must be prepared for the project. The detailed engineering report with environmental assessment is similar to requirements from other federal and state agencies for funding requests. Once submitted, the project would be assigned priority points and placed on the appropriate fiscal year priority list for funding. This funding source appears to be applicable as the project serves a population less than 10,000. The USDA indicates, however, it is usually a source of last resort. Applications are accepted at any time but the USDA's fiscal year starts each October.

6.2 Clean Water State Revolving Fund

The State of Michigan has a State Revolving Fund (SRF) program for providing low-interest loans to communities for wastewater collection and treatment system improvements. The interest rates charged by the State vary from year to year for the 20-year loans, but have recently been about 2.25%. A Project Plan would need to be prepared, which includes a detailed environmental assessment. A public hearing is also needed. A recording of the hearing and the completed Project Plan is then submitted to the MDEQ for review and approval. The MDEQ reviews the Project Plan and assigns priority points based upon the identified wastewater collection system needs. Each year loans are made based upon the State's Project Priority List and the amount of funding available, which is dependent on Federal and State allocations to the program. The project with the highest point total would be at the top of the list. Higher priority is given to systems that already exist and need improvements and to systems serving larger populations.

6.3 Community Funding

The final method identified is community funding. Beneficiaries of the system are assessed to cover project costs. This activity requires bonding for the project to cover its initial capital costs. Various issues also need to be reviewed prior to proceeding with the treatment plant, including bond period and interest rates.

Generally, a Special Assessment District (SAD) is established to include all parcels that will be served by the sewer system. Every parcel served in the SAD is assessed. For example, if someone owns both a home and a vacant parcel (i.e., separate from each other, but contiguous), the owner would be expected to pay two times the per-parcel fee for the system, less the cost of an individual grinder pump and only one monthly O&M charge. If the homeowner combines the lots prior to establishing the SAD then only one lot would be assessed.

For larger parcels with the potential for subdividing, one unit charge is typically applied at the time the SAD is established. For future splits or developments, each parcel or unit would be expected to pay the inflation-adjusted equivalent of the unit cost paid by the original participants in the SAD.

It is possible to plan for income from future "buy-ins" to the SAD in the bond repayment schedule to keep the initial assessments slightly lower; however, there is a risk of falling short of the projections. This method is similar to a graduated-payment mortgage.

Typically, bonds are sold after bids are taken. This method, however, requires the owner of the system to pay up-front costs of the project from another fund and repay the fund later after bonds are sold. Selling bonds prior to taking bids may result in not raising enough funds to pay the bid cost. On the other hand, some property owners will pay their assessment up-front in one or two payments. This cash flow could be used to pay up-front costs, and to reduce the original amount of the bond.

It is the project owner's call as to when bond payments begin. Since most customers do not like to pay in advance for a project of this nature, you can capitalize the first year's interest and roll it into the bond. There may also be trunkage and/or front-footage charges incorporated into the SAD set up.

7.0 SUMMARY

This report summarizes the feasibility of alternatives and costs associated with a wastewater collection and treatment system for the Cowan Lake area. Wastewater disposal currently consists of septic tank and drain field systems for each individual home around the lake. Many of these are failing, which can lead to environmental and health hazards as wastewater migrates from septic tanks and drain fields to the groundwater and, ultimately, Cowan Lake. It can also be difficult to sell a home in this situation.

The investigation of wastewater flow requirements, collection and transport alternatives, treatment plant locations, treatment options, capital costs, and operation and maintenance costs are summarized in this report.

Tables

Table 1

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Grattan Township Wastewater Treatment Facility Capacities

Item	Capacity in REUs[1]	Present REUs Allocated[5]	Additional REUs Available
Flow Capacity[2]	400	300	100
Organic Loading[3]	322 (388)[6]	300	22 (88)[6]
Irrigation Based on existing permitted capacity	391	300	91
Pump Station[3]	436	300	136
Lagoon Storage[4]	584	300	284

Notes:

1 REU = Residential Equivalent Unit
2 Based on Progressive A/E Study, 1997
3 Based on 0.17 lb/person/day, 3 persons per REU
4 Based on flow of 210 gal/REU/day
5 There are currently approximately 271 REUs connected to the system
6 Based on 0.17 lb/person/day, 2.5 persons per REU

Table 2

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for Gravity Sewer Collection System

Public Costs

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	8-inch Sanitary Sewer, Depth < 10 feet	8,000	l.f.	$60	$480,000
2.	8-inch Sanitary Sewer, Depth 10–16 feet	600	l.f.	$70	$42,000
3.	8-inch Sanitary Sewer, Depth 16–23 feet	600	l.f.	$80	$48,000
4.	Standard 4-foot Diameter Manhole, Depth 0–10 feet	29	each	$4,000	$116,000
5.	Standard 4-foot Diameter Manhole, Depth > 10 feet	60	v.f.	$100	$6,000
6.	6-inch Sanitary Lateral	3,500	l.f.	$45	$157,500
7.	4-inch Force Main, Including Air Release Valves and Clean-outs	1,800	l.f.	$35	$63,000
8.	Lift Station (No Generator)	2	each	$200,000	$400,000
9.	Gravel Base, MDOT 22A, 7 Inches	29,500	syd	$8	$221,250
10.	Bituminous Pavement Replacement	27,000	syd	$10	$270,000
11.	Topsoil, Seed, Fertilizer & Mulch	3,500	l.f.	$5	$17,500
12.	Driveway Replacements	3,100	syd	$14	$43,400
	SUB-TOTAL PUBLIC COSTS				**$1,864,650**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$560,350
	TOTAL PUBLIC COSTS				**$2,425,000**

Private Costs

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	4-inch Sanitary Lateral, Including Restoration	3,500	l.f.	$28	$98,000
2.	Abandon Existing Septic System	64	each	$500	$32,000
	SUB-TOTAL PRIVATE COSTS				**$130,000**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (10%)				$15,000
	TOTAL PRIVATE COSTS				**$145,000** *

* Existing 64 homes only at $2,266 each

Table 3

2160405

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for Gravity Sewer/Low-Pressure Force Main Collection System

Public Costs

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	8-inch Sanitary Sewer, Depth < 10 feet	4,500	l.f.	$60	$270,000
2.	Standard 4-foot Diameter Manhole, Depth 0–10 feet	23	each	$4,000	$92,000
3.	6-inch Sanitary Lateral	2,500	l.f.	$45	$112,500
4.	2-inch Low-Pressure Force Main, Including Air Release Valves and Clean-outs	4,600	l.f.	$30	$138,000
5.	1¼-inch Low-Pressure Lateral (40' each)	2,000	l.f.	$30	$60,000
6.	Lift Station (No Generator)	1	each	$200,000	$200,000
7.	Gravel Base, MDOT 22A, 7 Inches	12,500	syd	$8	$93,750
8.	Bituminous Pavement Replacement	11,000	syd	$10	$110,000
9.	Topsoil, Seed, Fertilizer & Mulch	7,100	l.f.	$5	$35,500
10.	Driveway Replacements	3,000	syd	$14	$42,000
	SUB-TOTAL PUBLIC COSTS				**$1,153,750**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$346,250
	TOTAL PUBLIC COSTS				**$1,500,000**

Private Costs

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	4-inch Sanitary Lateral, Including Restoration	3,000	l.f.	$28	$84,000
2.	Grinder Pump & Controls	50	each	$7,000	$350,000
3.	Electrical Connection (for Grinder Pump)	50	each	$850	$42,500
4.	Abandon Existing Septic System	64	each	$500	$32,000
	SUB-TOTAL PRIVATE COSTS				**$508,500**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (10%)				$51,500
	TOTAL PRIVATE COSTS				**$560,000** *

* Existing 64 homes only at $1,800–$10,400 each

Table 4

2160405

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for
Grinder Pumps/Low-Pressure Force Main Collection System

Public Costs

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	2-inch Low-Pressure Force Main, Including Air Release Valves and Clean-outs	5,600	l.f.	$30	$168,000
2.	3-inch Low-Pressure Force Main, Including Air Release Valves and Clean-outs	4,000	l.f.	$35	$140,000
3.	1¼-inch Low-Pressure Lateral (40' each site)	4,000	l.f.	$30	$120,000
4.	Topsoil, Seed, Fertilizer & Mulch	9,600	l.f.	$5	$48,000
5.	Driveway Replacements	3,000	syd	$14	$42,000
	SUB-TOTAL PUBLIC COSTS				**$518,000**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$157,000
	TOTAL PUBLIC COSTS				**$675,000**

Private Costs

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	4-inch Sanitary Lateral, Including Restoration	2,500	l.f.	$28	$70,000
2.	Grinder Pump & Controls	64	each	$7,000	$448,000
3.	Electrical Connection (for Grinder Pump)	64	each	$850	$54,400
4.	Abandon Existing Septic System	64	each	$500	$32,000
	SUB-TOTAL PRIVATE COSTS				**$604,400**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (10%)				$60,600
	TOTAL PRIVATE COSTS				**$665,000** *

* Existing 64 homes only at $10,400 each

Table 5

2160405

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for Septic Tank Effluent Pump (STEP) Collection System

Public Costs

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	2-inch Low-Pressure Force Main, Including Air Release Valves and Clean-outs	5,600	l.f.	$30	$168,000
2.	3-inch Low-Pressure Force Main, Including Air Release Valves and Clean-outs	4,000	l.f.	$35	$140,000
3.	1¼-inch Low-Pressure Lateral (40' each site)	4,000	l.f.	$30	$120,000
4.	Topsoil, Seed, Fertilizer & Mulch	9,600	l.f.	$5	$48,000
5.	Driveway Replacements	3,000	syd	$14	$42,000
	SUB-TOTAL PUBLIC COSTS				**$518,000**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$157,000
	TOTAL PUBLIC COSTS				**$675,000**

Private Costs

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	4-inch Sanitary Lateral, Including Restoration	2,500	l.f.	$28	$70,000
2.	Septic Tank, Effluent Pump, & Controls	64	each	$7,000	$448,000
3.	Electrical Connection (for Effluent Pump)	64	each	$850	$54,400
4.	Abandon Existing Septic System	64	each	$500	$32,000
	SUB-TOTAL PRIVATE COSTS				**$604,400**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (10%)				$60,600
	TOTAL PRIVATE COSTS				**$665,000** *

* Existing 64 homes only at $10,400 each

Table 6

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for Transmission to Grattan Township WWTF

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	4-inch HDPE Force Main - Open Trench, Including Restoration	20,000	l.f.	$35	$700,000
2.	4-inch HDPE Force Main - Directionally Drilled	3,500	l.f.	$45	$157,500
3.	Clean-out	47	l.f.	$3,000	$141,000
4.	Air Release Valve	7	each	$4,000	$28,000
5.	Lift Station	1	l.f.	$200,000	$200,000
	SUB-TOTAL CONSTRUCTION COSTS				**$1,226,500**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$368,500
	TOTAL CONSTRUCTION COSTS				**$1,595,000**

Table 7

2160405

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for Transmission to North Kent Sewer Authority

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	4-inch HDPE Force Main - Open Trench, Including Restoration	15,700	l.f.	$35	$549,500
2.	4-inch HDPE Force Main - Directionally Drilled	2,800	l.f.	$45	$126,000
3.	Clean-out	47	l.f.	$3,000	$141,000
4.	Air Release Valve	7	each	$4,000	$28,000
5.	Lift Station	1	l.f.	$200,000	$200,000
	SUB-TOTAL CONSTRUCTION COSTS				**$1,044,500**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$315,500
	TOTAL CONSTRUCTION COSTS				**$1,360,000**

Table 8

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for Transmission to Community Treatment System within One Mile of Cowan Lake

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	4-inch HDPE Force Main - Open Trench, Including Restoration	4,500	l.f.	$35	$157,500
2.	4-inch HDPE Force Main - Directionally Drilled	800	l.f.	$45	$36,000
3.	Clean-out	47	l.f.	$3,000	$141,000
4.	Air Release Valve	7	each	$4,000	$28,000
	SUB-TOTAL CONSTRUCTION COSTS				**$362,500**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$107,500
	TOTAL CONSTRUCTION COSTS				**$470,000** *

* Note: This estimate of probable cost assumes use of the grinder pumps/force main system. If a gravity sewer or gravity/force main system is used, then a lift station will be required. This will add approximately $200,000 to the cost.

Table 9

2160405

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for
Treatment Site Improvements at Grattan Township WWTF

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	Clear Land	0	acres	$2,500	$0
2.	Irrigation Piping	0	l.f	$35	$0
3.	Irrigation and Control Assembly	0	each	$12,000	$0
4.	Dry Wells	0	each	$3,600	$0
5.	Valves	0	each	$3,000	$0
6.	Electrical	0	lsum	$30,000	$0
7.	Underdrains	0	lsum	$70,000	$0
8.	Soil Testing/Monitor Wells	0	lsum	$6,500	$0
9.	Aeration Equipment	0	lsum	$60,000	$0
	SUB-TOTAL CONSTRUCTION COSTS				**$0**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$0
	TOTAL CONSTRUCTION COSTS				**$0** *

* Note: This estimate of probable cost assumes that no modifications to the pumping equipment will be necessary. It also assumes that the irrigation improvements made a few years ago are adequate to accept the increased flows from Cowan Lake. Additional aeration is NOT expected to be needed to handle the contributory organic loading from the Cowan Lake wastewater.

Table 10

2160405

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for Lagoon/Irrigation System

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	Land	40	acres	$7,500	$300,000
2.	Clearing and Grubbing	40	acres	$3,500	$140,000
3.	Earthwork	5.2	acres	$200,000	$1,040,000
4.	Control Sturctures, Piping, and Valves	1	lsum	$50,000	$50,000
5.	Electrical	1	lsum	$80,000	$80,000
6.	Fencing	1	lsum	$30,000	$30,000
7.	Irrigation Equipment and Pump	1	lsum	$220,000	$220,000
8.	Hydrogeologic Study	1	lsum	$40,000	$40,000
	SUB-TOTAL CONSTRUCTION COSTS				**$1,900,000**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$570,000
	TOTAL CONSTRUCTION COSTS				**$2,470,000**

Table 11

2160405

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for Constructed Wetland

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	Land	10	acres	$7,500	$75,000
2.	Clearing and Grubbing	5	acres	$3,500	$17,500
3.	Constructed Wetland, Including Septic Tanks, pumps, and drain field	23,000	sft	$60	$1,380,000
4.	Hydrogeologic Study	1	lsum	$40,000	$40,000
	SUB-TOTAL CONSTRUCTION COSTS				**$1,512,500**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$452,500
	TOTAL CONSTRUCTION COSTS				**$1,965,000**

Table 12

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Estimate of Probable Cost for Mechanical Plant

	Description	Estimated Quantity	Unit	Unit Price	Amount
1.	Land	7	acres	$7,500	$52,500
2.	Clearing and Grubbing	5	acres	$3,500	$17,500
3.	Mechanical Plant	1	lsum	$1,500,000	$1,500,000
4.	Infiltration Pond	46,000	sft	$2	$69,000
5.	Hydrogeologic Study	1	lsum	$40,000	$40,000
	SUB-TOTAL CONSTRUCTION COSTS				**$1,679,000**
	Allowances for Construction Contingencies, Administration, Legal, and Engineering (30%)				$506,000
	TOTAL CONSTRUCTION COSTS				**$2,185,000**

Table 13

2160405

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Summary of Probable Cost Estimates for 20-Year Loan @ 5%

Based on 85 REUs

Option	Collection	Transmission	Treatment	Total Cost	Cost/REU	Monthly O&M	Monthly Debt Service	Total Monthly Expense	Owner Installed Pumps & Controls per Residence
Treatment at Grattan Township WWTF*	$675,000	$1,595,000	$0	$2,270,000	$26,706	$35	$179	$214	$10,500
Community Treatment - Stabilization Ponds	$675,000	$470,000	$2,470,000	$3,615,000	$42,529	$40	$284	$324	$10,500
Community Treatment - Constructed Wetland	$675,000	$470,000	$1,965,000	$3,110,000	$36,588	$30	$245	$275	$10,500
Community Treatment - Mechanical Plant	$675,000	$470,000	$2,185,000	$3,330,000	$39,176	$65	$262	$327	$10,500
Treatment through NKSA*	$675,000	$1,360,000	???	$2,035,000	$23,941	???	$160	$160 +	$10,500

* Does not include facility-use (i.e., buy-in) costs

Table 14

2160405

COWAN LAKE WASTEWATER FEASIBILITY STUDY

Summary of Probable Cost Estimates for 20-Year Loan @ 2.5%

Based on 85 REUs

Option	Collection	Transmission	Treatment	Total Cost	Cost/REU	Monthly O&M	Monthly Debt Service	Total Monthly Expense	Owner Installed Pumps & Controls per Residence
Treatment at Grattan Township WWTF*	$675,000	$1,595,000	$0	$2,270,000	$26,706	$35	$143	$178	$10,500
Community Treatment - Stabilization Ponds	$675,000	$470,000	$2,470,000	$3,615,000	$42,529	$40	$227	$267	$10,500
Community Treatment - Constructed Wetland	$675,000	$470,000	$1,965,000	$3,110,000	$36,588	$30	$196	$226	$10,500
Community Treatment - Mechanical Plant	$675,000	$470,000	$2,185,000	$3,330,000	$39,176	$65	$209	$274	$10,500
Treatment through NKSA*	$675,000	$1,360,000	???	$2,035,000	$23,941	???	$128	$128 +	$10,500

* Does not include facility-use (i.e., buy-in) costs

Table 15

COWAN LAKE WASTEWATER FEASIBILITY STUDY

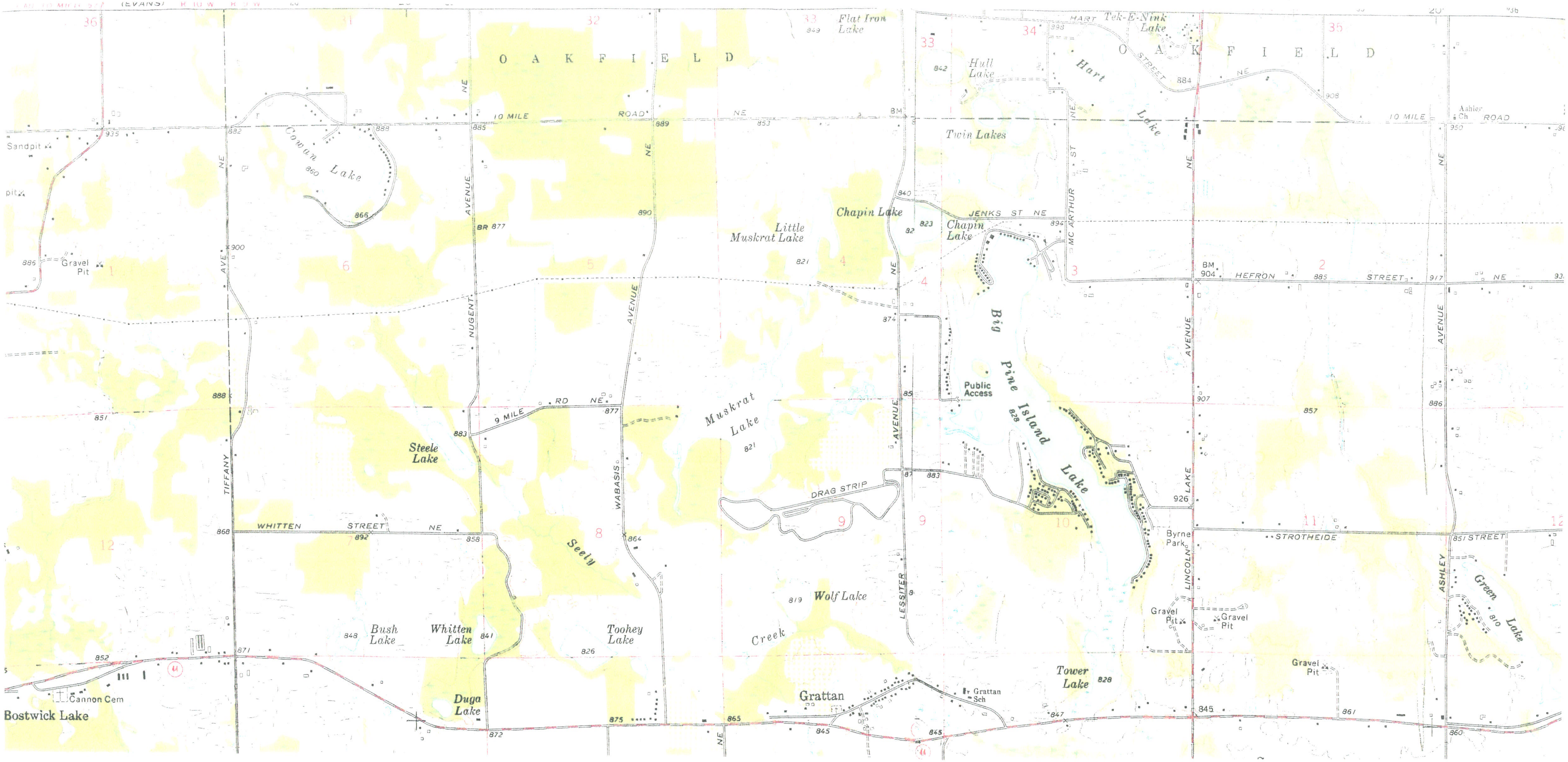
Summary of Probable Cost Estimates for 40-Year Loan @ 2.75%

Based on 85 REUs

Option	Collection	Transmission	Treatment	Total Cost	Cost/REU	Monthly O&M	Monthly Debt Service	Total Monthly Expense	Owner Installed Pumps & Controls per Residence
Treatment at Grattan Township WWTF*	$675,000	$1,595,000	$0	$2,270,000	$26,706	$35	$92	$127	$10,500
Community Treatment - Stabilization Ponds	$675,000	$470,000	$2,470,000	$3,615,000	$42,529	$40	$147	$187	$10,500
Community Treatment - Constructed Wetland	$675,000	$470,000	$1,965,000	$3,110,000	$36,588	$30	$127	$157	$10,500
Community Treatment - Mechanical Plant	$675,000	$470,000	$2,185,000	$3,330,000	$39,176	$65	$136	$201	$10,500
Treatment through NKSA*	$675,000	$1,360,000	???	$2,035,000	$23,941	???	$83	$83 +	$10,500

* Does not include facility-use (i.e., buy-in) costs

Figures



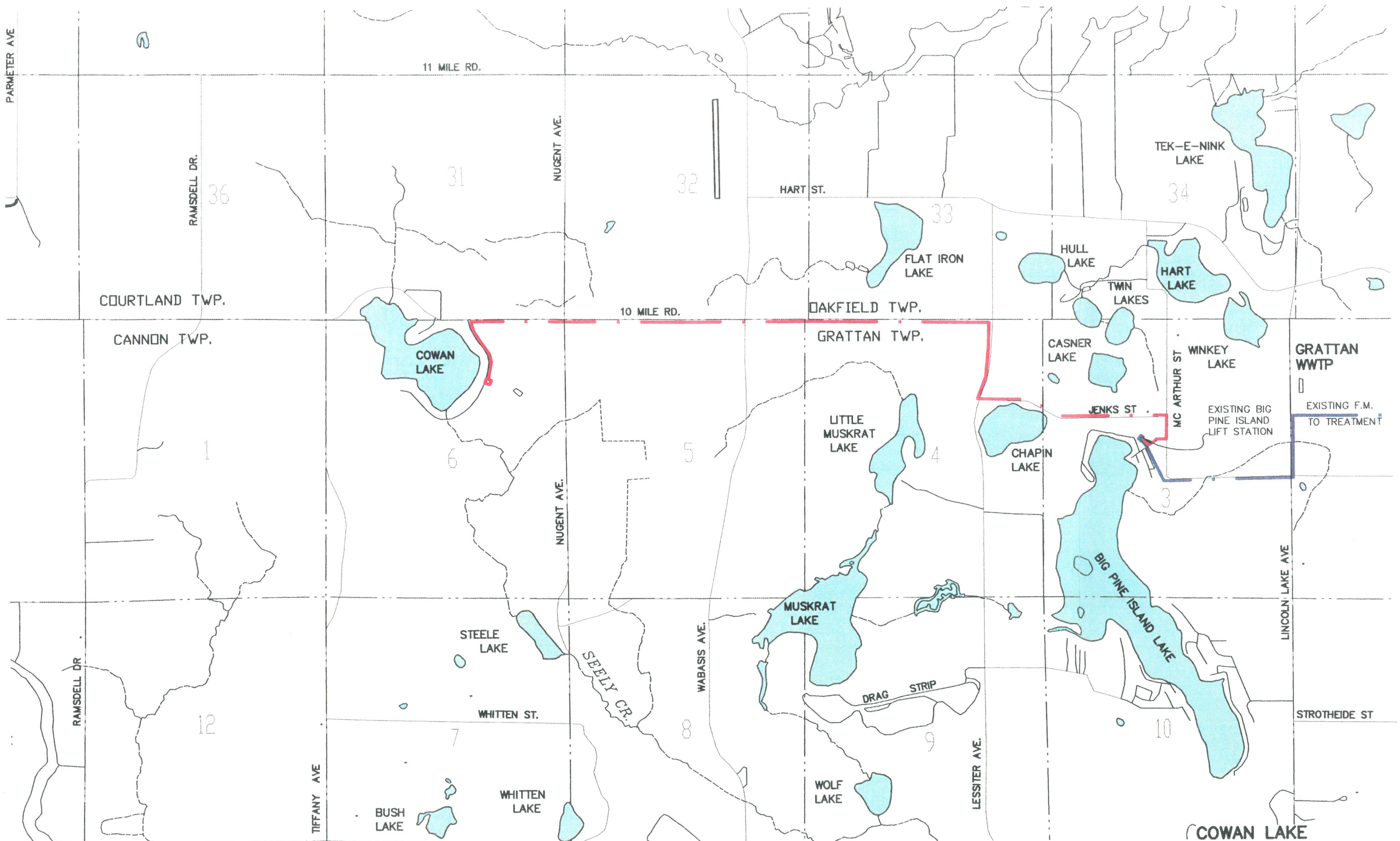
North

SCALE : 1" = 2000'

COWAN LAKE
GRATTAN TOWNSHIP, KENT COUNTY, MI

LOCATION MAP

FIGURE 1
Prein&Newhof
2011011



LEGEND

— · —	PROPOSED FORCE MAIN
— · —	EXISTING FORCE MAIN

North

SCALE : 1" = 2000'

COWAN LAKE

GRATTAN TOWNSHIP, KENT COUNTY, MI

PROPOSED FORCEMAIN ROUTE

FIGURE 2

Prein&Newhof

2011011

JUN