Detroit Water and Sewerage Department

Wastewater Master Plan

DWSD Project No. CS-1314

Evaluation of Wastewater Treatment Plants in St. Clair County

Technical Memorandum
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Author: Tetra Tech MPS

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Evaluation of Wastewater Treatment Plants in St. Clair County

1. Introduction

1.1 Objective

The planning area of the 50-year Wastewater Master Plan for the Detroit Water and Sewerage Department (DWSD) was established as generally the watersheds of the Rouge, Clinton, and Detroit Rivers and Lake St. Clair. This area includes the southern portions of St. Clair County. St. Clair County is not currently provided sewer service by DWSD. This memorandum explores the capabilities of wastewater treatment plants within the St. Clair County portion of the planning area to treat the wastewater from the projected population growth over the next 50 years, and develops and evaluates several alternatives for providing that service. For the purposes of this memorandum, the St. Clair County planning area includes the following communities:

- China Township
- Cottrellville Township
- Clay Township
- Ira Township
- East China Township
- City of Algonac
- Marine City
- St. Clair Township
- City of St. Clair

East China Township was considered part of the DWSD planning area in St. Clair County because East China Township treats the wastewater from China Township. Casco Township was not considered part of the DWSD planning area in St. Clair County due to Casco Township being sparsely populated and rural. Sewer service is not expected to be available in Casco Township over the next 50 years.

Several options were evaluated to treat all or portions of the wastewater from the St. Clair County planning area. The option of expanding the capacities of certain wastewater treatment plants in St. Clair County was considered. The wastewater plants examined for possible expansion were:

- St. Clair County Algonac Wastewater Treatment Plant
- Marine City Wastewater Treatment Plant
- St. Clair River Sewer Authority Wastewater Treatment Plant (East China Township)
- City of St. Clair Wastewater Treatment Plant
- Americana Estates of Casco Wastewater Treatment Plant

The consolidation of wastewater treatment to serve all or part of the service area by expanding some existing wastewater plants, the construction of a new centralized wastewater treatment plant, the construction of a regional wastewater treatment plant and abandoning the existing wastewater treatment plants, and the construction of an interceptor to convey St. Clair County wastewater to the City of Detroit Wastewater Treatment Plant were other options investigated in this memorandum. The locations of the existing plants and proposed new treatment plant are shown in Figure 1.

The estimates of wastewater flows presented in this technical memorandum were developed in 2002 and were based on average daily flows from 1997 to 2000. Subsequently, the final wastewater flow projections for the Master Plan were based on final population projections and average daily flows in the year 2001, because flow data was more complete for the year 2001. Therefore, there are some minor differences in the estimates in this technical memorandum and other parts of the Master Plan.

2. Summary

Capital and annual operation and maintenance (O&M) costs were calculated for all of the options (expansion of an existing wastewater treatment plant and construction of a new wastewater treatment plant). The costs to demolish the wastewater treatment plants and construct an interceptor from St. Clair County to the Detroit WWTP were also calculated.

Table 1 shows the maximum capacity to be gained by expanding an existing wastewater treatment plant or the capacity of a newly constructed wastewater treatment plant, degree of treatment, treatment capital costs, annual treatment O&M costs, capital construction dollars per gallon / day treatment costs, conveyance capital costs, conveyance cost per gallon / day, and total construction and conveyance cost per gallon / day.

The capital, conveyance, and construction costs of either an expanded or new centralized WWTP to treat all the wastewater from the St. Clair County planning area is between $16.74 / gallon and $18.93 / gallon. The capital, conveyance, and construction costs associated with expanding a current WWTP to treat a portion of the wastewater from the St. Clair County planning area is $19.35 / gallon. The cost of conveying all of the St. Clair County planning area wastewater to the Lakeshore Interceptor for treatment at the current DWSD WWTP is $29.52 / gallon.

The St. Clair River Sewer Authority – East China Township and St. Clair County – Algonac WWTPs have enough capacity to handle flows greater than the 2050 projected flows for their service areas. The City of St. Clair and the Marine City WWTPs will be close to or above their design capacities based on the 2050 projected flows. The magnitude of the treatment needed at these two WWTPs is projected to be less than 0.2 MGD. A possible alternative to solve the capacity deficiency at these two plants is to modify the service area of each plant. As an example, the flow from the southern part of the Marine City WWTP service area could be treated at the Algonac WWTP.

The per gallon costs to consolidate and treat all or portions of the St. Clair County planning area wastewater flow and the magnitude of the treatment needed indicate that it may be best for future St. Clair County wastewater flows to be treated at local wastewater treatment plants with some alterations to the existing service area of each plant.

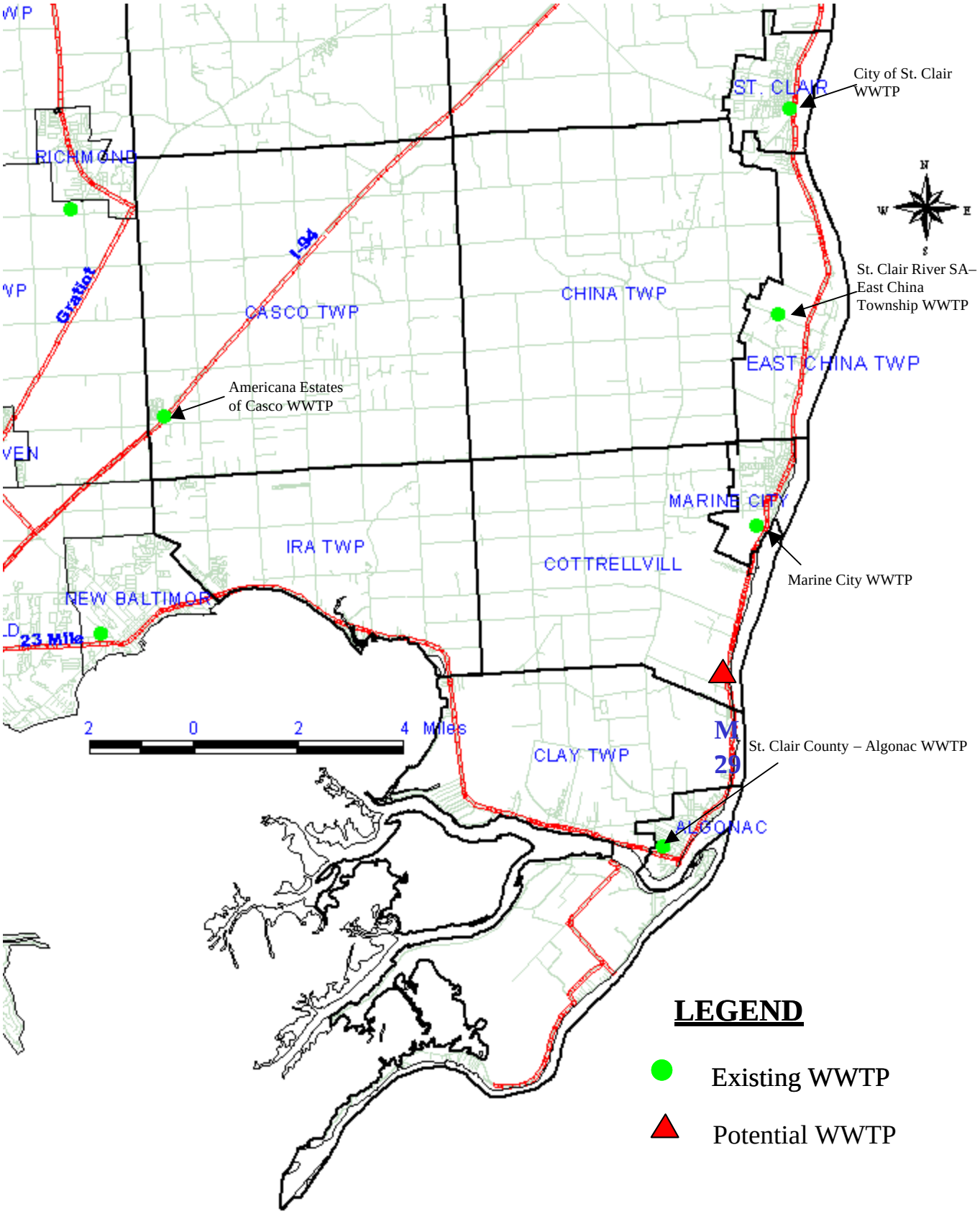

Figure 1. Locations of Existing and New Wastewater Treatment Plant Sites

Table 1. Alternatives Cost Summary

			Treatment Costs			Conveyance Costs		
Alternative	**Additional Capacity (Avg. MGD)**	**Degree of Treatment**	**Capital Costs (Million $, Apr 2002)**	**Annual O&M Costs (Million $, Apr 2002)**	**Capital Costs per gallon/day ($/gal./day)**	**Capital Costs (Million $, Apr 2002)**	**Conveyance Costs per gallon/day ($/gal./day)**	**Treatment and Conveyance Costs per gallon/day ($/gal./day)**
OPTION 1								
Expansion of St. Clair County - Algonac WWTP	7.1	Secondary	32.3	4.85	4.55	80.63	11.36	15.91
Demolition of St. Clair Area WWTPs[1]	---	---	7.8	---	1.10	---	---	1.10
TOTAL	7.1	---	40.1	4.85	5.65	80.63	11.36	**17.01**
OPTION 2								
Expansion of St. Clair River Sewer Authority – East China Township WWTP	7.1	Secondary	36.8	4.85	5.18	89.78	12.64	17.83
Demolition of St. Clair Area WWTPs[1]	---	---	7.8	---	1.10	---	---	1.10
TOTAL	7.1	Secondary	44.6	4.85	6.28	89.78	12.64	**18.93**
OPTION 3								
New WWTP discharging to St. Clair River – Cottrellville Township	7.1	Secondary	31.4	4.85	4.42	79.65	11.22	15.64
Demolition of St. Clair Area WWTPs[1]	---	---	7.8	---	1.10	---	---	1.10
TOTAL	7.1	---	39.2	4.85	5.52	79.65	11.22	**16.74**
OPTION 4								
Expansion of St. Clair River Sewer Authority – East China Township WWTP	4.0	Secondary	20.5	3.14	5.13	52.47	13.12	18.25
Demolition of St. Clair Area WWTPs[2]	---	---	7.8	---	1.10	---	---	1.10
TOTAL	4.0	Secondary	28.3	3.14	6.23	52.47	13.12	**19.35**
OPTION 5								
Interceptor to DWSD Collection System	7.1	---	---	7.69[3]	---	201.79	28.42	28.42
Demolition of St. Clair Area	---	---	7.8	---	1.10	---	---	1.10

Table 1. Alternatives Cost Summary

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WWTPs[1]								
TOTAL	7.1	---	7.8	---	1.10	201.79	28.42	**29.52**
OPTION 6								
No Action (Status Quo)	---	---	0.0	0.0	0.0	0.0	0.0	**0.0**

[1] St. Clair County-Algonac, East China Township, and City of St. Clair
[2] East China Township and City of St. Clair
[3] Includes pump station O&M and assuming a DWSD cost of $18.18/1,000 cubic feet of flow

3. Approach

This memorandum explores the capabilities of wastewater treatment plants, within the St. Clair County portion of the planning area to treat the wastewater from the projected population growth over the next 50 years. In order to accomplish this objective, several alternatives for providing that service were developed and evaluated.

Option 1 involves expanding the St. Clair County – Algonac WWTP to treat all of the flow from the St. Clair County planning area. Details of this option are in Section 4.2.

Option 2 involves expanding the St. Clair River Sewer Authority – East China Township WWTP to treat all of the flow from the St. Clair County planning area. Details of this option are in Section 4.4.

Option 3 involves the construction of a new WWTP to treat all of the flow from the St. Clair County planning area. Details of this option are in Section 4.8.

Option 4 involves expanding the St. Clair River Sewer Authority – East China Township WWTP to treat flow from Marine City and the City of St. Clair in addition to the current service area. The flows south of Marine City would be treated at the current St. Clair County – Algonac WWTP. Details of this option are in Section 4.4.

Option 5 involves conveying all of the St. Clair County planning area wastewater to DWSD's Lakeshore Interceptor for eventual treatment at the DWSD WWTP. Details of this option are in Section 4.10.

Option 6 involves having the WWTPs in the St. Clair County planning area continuing to treat the wastewater from their respective service areas. This option would maintain the current status quo.

3.1 Flow Projections

Traffic Analysis Zones (TAZs) from 2000 census blocks (SEMCOG) were used as the basis of organization determining future flow estimates. Figure 2 shows the current and projected sewered areas in St. Clair County. Only sewered areas or areas to be sewered by 2050 were included in the analysis. Values from TAZs were consolidated to determine flows from these sewer districts. If TAZs were divided between on site disposal systems (OSDS) areas and sewered areas, the population was allocated 100% to the sewer district, not based on area percentage.

Residential population flows were estimated using the DWSD service area average per capita wastewater flow rate of 77 gpd per resident. Employee population flows were estimated using 50 gpd per population unit. Flow values from the Flow Projections from Significant Industrial Users technical memorandum were not available since St. Clair County is outside the current DWSD service area. Dry weather infiltration/inflow (DWI/I) was estimated based on data for similar sized areas. These calculations are consistent with those presented in the Preliminary Flow Projections for Alternatives Analysis technical memorandum.

Total flow was then calculated by adding the provided parameters together, for each TAZ, as follows:

Total Flow = (Resident Population x 77gpcd) + (Employee Population x 50gpcd) + DWI/I Flow

Table 2 summarizes the average flow for each service area and the maximum day peaking factor based upon the SEMCOG data.

Table 2. Current, Expanded, and New WWTP Flow Information

Community	Residential Population		Maximum Day Peaking Factor*		Total Flow 2000		2050	
	2000	2050	2000	2050	Average	Max. Day	Average	Max. Day
China Township	1,331	2,010			0.38		0.63	
East China Township	3,630	4,606			0.61		1.01	
East China Twp WWTP	4,961	6,616	3.83	3.65	0.98	3.77	1.65	6.01
Marine City	4,891	5,807			0.57		0.76	
Cottrellville Township	1,987	2,437			0.26		0.31	
Marine City WWTP	6,878	8,244	3.63	3.52	0.83	3.01	1.07	3.75
Clay Township	8,523	11,318			0.91		1.27	
City of Algonac	4,613	6,126			0.50		0.64	
Ira Township	5,686	9,199			0.86		1.19	
Algonac WWTP	18,822	26,643	3.07	2.89	2.27	6.96	3.11	9.00
St. Clair Township (partial)	1,819	2,954			0.18		0.29	
City of St. Clair	5,802	6,763			0.79		0.95	
St. Clair WWTP	7,621	9,717	3.56	3.42	0.97	3.46	1.25	4.27
East China WWTP including flow from St. Clair and Marine City WWTP	19,460	24,577	3.05	2.93	2.79	8.49	3.96	11.61
TOTAL ST. CLAIR COUNTY PLANNING AREA	38,282	51,220	2.72	2.59	5.06	13.77	7.07	18.34

*Peak Factor = 5 /P^(1/6), P is population in thousand based on the ASCE curve as discussed in the "Flow Projections Technical Memorandum".

A maximum peak hourly flow ratio of 3.5 was used for this option. Due to the large difference in the peak hourly flow ratio and the maximum day flow ratio, an equalization basin was included in the design to minimize the effect of the peak hourly flow rates on the treatment processes.

Table 3 shows a comparison of the projected flow for the planning area, the actual WWTP flow, and the design capacities of the existing wastewater treatment plants.

Table 3. Comparison of Projected Flow to Design Capacity

Wastewater Treatment Plant	2000 Projected Flow (MGD)	Actual WWTP Flow (MGD)	WWTP Design Capacity (MGD)	2050 Projected Flow (MGD)
St. Clair County - Algonac	2.3	1.9	4.0	3.1
St. Clair River Sewer Authority – East China Township	1.0	0.6	2.2	1.6
Marine City	0.8	0.8	1.0	1.1
City of St. Clair	1.0	1.0	1.4	1.3
TOTAL	**5.1**	**4.3**	**8.6**	**7.1**

The totals from Table 3 show that there is enough wastewater treatment capacity within the St. Clair County planning to treat the projected demand. However, the available treatment capacity is not in the geographical area where it is needed. The 2050 projected flows for Marine City and the City of St. Clair indicate that these wastewater treatment plants will be nearing or exceed their design capacities. The small amount (0.1 MGD) that the Marine City WWTP may be over the design capacity in 2050 and the distance Marine City and the City of St. Clair are from the more populated areas of the St. Clair County planning area suggests that building a conveyance system to treat these flows elsewhere would not be practical. A design average flow of 7.1 MGD was used in developing various options for regional wastewater treatment.

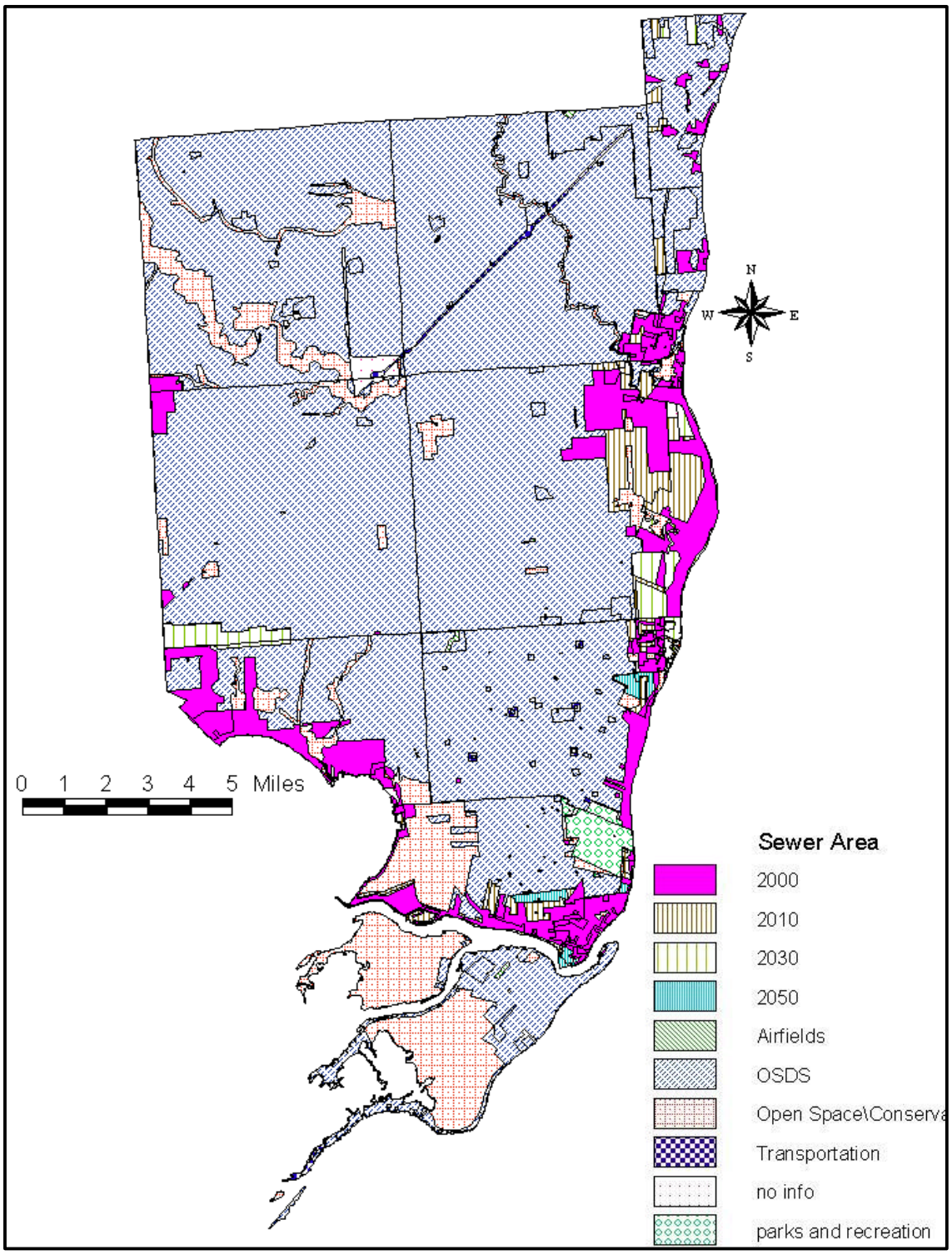


Figure 2. Current and Projected Sewered Areas in St. Clair County

3.2 Evaluation of Existing Wastewater Treatment Plants

Of the five wastewater treatment plants initially considered for possible expansion, Marine City WWTP and Americana Estates of Casco WWTP were not evaluated. The Americana Estates of Casco Wastewater Treatment Plant consists of a small lagoon system that serves a residential mobile home park. Since this wastewater treatment plant was specifically constructed to serve a single residential development that did not include commercial/industrial wastewater, it was not evaluated for future expansion. The Marine City Wastewater Treatment Plant declined to participate in this evaluation.

In order to gather the information needed to determine the possibilities of expanding the three remaining wastewater treatment plants, discussions were held with the municipalities where the treatment plants are located to explain their potential involvement in the DWSD 50-year Wastewater Master Plan. It was explained that this study is solely to determine the technical feasibility of expansion. The technical feasibility included a review of the current flow and loadings to the wastewater treatment plant, and design capacities and performance of the wastewater treatment processes and biosolids management facilities. Operation and maintenance needs and costs were also evaluated. This feasibility study in no way obligates the wastewater treatment plant or the municipality to implement the findings of this study.

3.3 Regulations

3.3.1 New and Existing Wastewater Treatment Plant Regulatory Assumptions

In order to design the new and expanded wastewater treatment plants, the following assumptions were made:

- The NPDES discharge limitations for the additional flow would be the same as those applicable to current discharges in the same area.

- The water body to which the additional flow would be discharged, in this case the St. Clair River, has the assimilative capacity to handle the increased flow and loadings.

A more detailed explanation of these assumptions is contained in the "Technical Feasibility of Satellite Treatment" memorandum. This analysis would determine if the proposed flow increase would be allowed, and if allowed, what the preliminary NPDES permit limits would be. The MDEQ analysis may change the loadings allowed to the St. Clair River.

3.3.2 Influent

The influent concentrations to the new and expanded treatment plants were assumed to be similar to the existing water quality for the planning area. Table 4 shows the influent design concentrations used.

Table 4. Design Influent Concentrations

Parameter	Concentration	Unit
BOD5 (Five Day Biochemical Oxygen Demand)	165	mg/L
TSS (Total Suspended Solids)	127	mg/L
Ammonia Nitrogen	15.8	mg/L
Total Phosphorus	3.0	mg/L

3.3.3 Discharge Limits and Effluent Quality

Table 5 shows what the expected discharge quality from the new or expanded treatment plants would be based on the treatment processes proposed in this memorandum.

Table 5. Expected Effluent Quality

Parameter	Effluent Concentration (mg/L)	Current St. Clair River Discharge NPDES Limits Monthly/7-Day (mg/L)
$CBOD_5$ (Five Day Carbonaceous Biochemical Oxygen Demand)	<20	25/40
TSS (Total Suspended Solids)	<20	30/45
Total Phosphorus	<1	1/--

3.3.4 TMDLs

The MDEQ compiles a list of water quality-limited or threatened waters requiring the establishment of pollutant Total Maximum Daily Loads (TMDLs). These TMDLs are for water bodies that are not presently attaining water quality standards and water bodies that are presently attaining water quality standards, but are expected not to meet water quality standards by April 2004. There currently are no TMDLs in effect on the St. Clair River. However, several TMDLs are scheduled to be developed affecting this water body over the next 10 years. Table 6 lists the TMDLs that could be impacted by an expansion of a current wastewater treatment plant or the construction of a new wastewater treatment plant, and the date the TMDL is scheduled to be developed.

Table 6. TMDLs

Water Body	Location	Distance	Problem	Year of TMDL Development
St. Clair River				
	Entire River	39 Miles	PCBs	2010
	Entire River	39 Miles	Mercury	2011
	Entire River	39 Miles	Pathogens	2009

3.4 Design Assumptions

3.4.1 New and Existing Wastewater Treatment Plants

The expanded and new wastewater treatment plant processes were designed based on the *Recommended Standards for Wastewater Facilities*, 1997 Edition published by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers ('Ten States Standards'). More details regarding the design

criteria used for each alternative and option are contained in Appendix A. Additionally, the expanded and new wastewater treatment plants were designed to meet Class I Reliability Criteria as defined by the EPA in the publication *Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability*.

The treatment processes considered for the expansion and building of a new wastewater treatment plant were:

A. Preliminary Treatment

1. Coarse Bar Screens
   a. Removes larger items from the wastewater
   b. Protects equipment downstream

2. Grit Chamber - Aerated
   a. Removes large and heavy solids
   b. Decreases scouring of equipment located downstream
   c. Decreases size of solids handling equipment required

Equalization Basin
Decreases peak hourly flows, lowering the design flow for the facility.

B. Primary Treatment

1. Primary Clarifiers - Circular
   a. Removes approximately 60 percent of solids and approximately 30 percent of biochemical oxygen demand

C. Secondary Treatment

1. Conventional Activated Sludge
   a. Removes biochemical oxygen demand

2. Secondary Clarifiers - Circular
   a. Settles mixed liquor suspended solids
   b. Aids in phosphorus removal when chemical addition occurs upstream of the unit

D. Ultraviolet Disinfection

E. Biosolids Dewatering and Disposal

1. Gravity Belt Thickener
   a. Assumed solids thickened to 8 percent

2. Centrifuge
   a. Feed tank provides 4 days of storage
   b. Assumed solids thickened to 20 percent

3. Landfill
    a. Solids can be stored for up to one week
    b. Assumed solids suitable for landfilling

Ten States Standards requires that most equipment be sized based on the peak hourly flow, with the exceptions being aeration basins and solids handling facilities, which are sized based on the average flow. Due to the size of the population served, the difference between the peak hourly flow and the maximum day flow is sizable. In order to decrease the sizes of the process equipment, an equalization basin will be proposed to store wastewater in excess of the maximum day flow. As the flows decrease, wastewater would be released from the equalization basin. For design purposes, the maximum daily flow will be used as the peak hourly flow for all processes located downstream of preliminary treatment.

The three wastewater treatment plants evaluated currently use either trickling filters and / or rotating biological contactors (RBCs). These treatment processes are adequate to treat flows at or below 4 MGD; however, these processes are not cost effective when treating higher wastewater flow rates. Therefore, the expanded treatment plants were designed using a conventional activated sludge process.

The solids handling process at the expanded plants would be as follows: the sludge from the secondary clarifiers would be treated in gravity belt thickeners, which would thicken the biosolids to 8 percent. The primary sludge and thickened secondary sludge would be mixed in a centrifuge feed tank. The centrifuge would thicken the sludge to about 20 percent. The dewatered sludge would then be landfilled.

3.4.2 Ten States Design Standards

A summary of the design standards used to size plant processes is provided in Table 7.

Table 7. Ten States Standards

WWTP Process	Design Standard
Raw Sewage Pumping Station	1 Minimum of two pumps
	2 Each capable of pumping peak hourly flow
Coarse Bar Screen	3 Approach velocity > 1.25 ft/sec
	4 Approach velocity < 3 ft/sec
Grit Chamber	5 Minimum of one unit with bypass
	6 Detention time between 3 and 5 minutes at peak hourly flow[1]
	7 Air rate of 3 to 8 cfm/ft of tank length[2]
Equalization Basin	8 Sized to store the flow difference between peak hourly flow and maximum day flow[3]
Primary Clarifiers	Clarifiers not accepting Waste Activated Sludge (WAS):
	9 Surface Overflow Rate (SOR) less than 1000 gpd/sf at average daily flow
	10 SOR less than 1500 gpd/sf up to 3000 gpd/sf at peak hourly flow[4,5]
Aeration Basin	Conventional Activated Sludge:

Table 7. Ten States Standards

WWTP Process	Design Standard
	11 Organic loading less than 40 lb./day/1000 cf 12 Food to Microorganism (F/M) Ratio between 0.2 and 0.5 lb. BOD/day per lb. MLVSS 13 MLSS between 1000 mg/L and 3000 mg/L[6]
Secondary Clarifiers	Conventional Activated Sludge: 14 Solids loading less than 50 lb./day at peak hourly flow[4] 15 SOR less than 1200 gpd/sf at peak hourly flow[4]
Ultraviolet Disinfection	• Transmittance greater than 65 percent • Dose at 254 nm of greater than 30,000 uW-sec/sq. cm[4] • Sized for peak hourly flow[4] • BOD and TSS less than 30 mg/L
Gravity Belt Thickener	• Specific design standards not provided
Centrifuge Feed Tank	• Provide storage for a minimum of 4 days
Centrifuges	• Specific design standards not provided
Landfill Storage Tank	• Provide storage for 7 days[7]

Notes:

1. Detention time of 4 minutes selected.
2. Air rate of 5 cfm/ft of tank length selected.
3. Not based on Ten States Standards.
4. For plants with equalization basins, maximum day flow used.
5. SOR less than 2000 gpd/sf selected.
6. MLSS of 3000 mg/L selected.
7. Not based on Ten States Standards.

3.4.2 U.S. EPA Reliability Criteria

The U.S. Environmental Protection Agency developed reliability criteria for wastewater treatment plants that were to be built using federal funds in the 1970's and 1980's. The Michigan Department of Environmental Quality has adopted the U.S. EPA Class I Reliability Criteria and has determined that they apply to all treatment plants that are subject to water quality standards. The dissolved oxygen water quality standard is used to develop permit limits for carbonaceous biochemical oxygen demand and ammonia-nitrogen. Therefore, all of the alternatives would be subject to the reliability criteria summarized in Table 8.

Table 8. Summary of Class I Reliability Criteria

WWTP Process	Reliability Criteria
Pumps	• Provide one backup pump for each set of pumps
Coarse Bar Screen	• Provide one backup screen • If only two screens, backup shall be manually cleaned
Grit Chamber	Not specifically listed
Equalization Basin	Not specifically listed
Primary Clarifiers	• With the largest unit out of service, remaining units should be able to treat 50 percent of the design flow to the unit process

Table 8. Summary of Class I Reliability Criteria

WWTP Process	Reliability Criteria
Aeration Basin	• Provide a minimum of two equally sized basins
Secondary Clarifiers	• With the largest unit out of service, remaining units should be able to treat 75 percent of the design flow to the unit process
Ultraviolet Disinfection	Not specifically listed
Gravity Belt Thickener	Not specifically listed
Centrifuge Feed Tank	• Can replace need for backup requirements of downstream equipment if sufficient storage provided for length of time required to fix process
Centrifuges	• Capable of treating the sludge design flow with one unit out of service or extending operating time of running units to make up for decreased capacity
Landfill Storage Tank	Not specifically listed

3.4.4 Sizing of New and Expanded WWTPs

The size of the new and expanded WWTPs was dependent upon two factors. The first factor considered for the expanded WWTPs was the amount of land near the current plant that could be used to expand the plant or the land available at the new WWTP site. The second factor examined was the volume of wastewater that could be delivered to the plant. The volume of dry weather flow used for the various options was based on the values and procedures presented in the Preliminary Flow Projections for Alternatives Analysis technical memorandum. Since all of the St. Clair County planning area is not currently served by an interceptor system, serving the planning area would require new interceptors and pump stations to be constructed for all of the new or expanded WWTPs. Either the land constraint or volume of wastewater flow that could be delivered would be the limiting element in the size of any of the expanded WWTPs. Land constraints were not a concern for the new WWTP site since the site was large enough to treat the dry weather flow from the entire planning area.

3.4.5. Sizes of Treatment Processes

Treatment at the new or expanded plant would consist of screening, grit removal, equalization, primary settling, aeration, secondary settling, and ultraviolet disinfection. Solids would be treated, dewatered, and disposed of in a landfill. An equalization basin was sized to decrease the flow variations to downstream equipment. All treatment processes were designed to conform to Ten States Standards.

Table 9 details the approximate sizes for the major treatment processes for the two design flows being considered.

Table 9. Expanded and New Wastewater Treatment Plant Process Sizes

Treatment Process	4.0 MGD Avg. Flow	7.1 MGD Avg. Flow
Preliminary Treatment		
Screening	Two – 4 ft. x 2 ft.	Two – 6 ft. x 3 ft.
Grit Removal	15 ft. x 15 ft. x 15 ft. deep	20 ft. x 20 ft. x 15 ft. deep
Equalization Basin	95 ft. x 95 ft. x 20 ft. deep (1.2 MG)	150 ft. x 150 ft. x 20 ft. deep (3.3 MG)
Primary Treatment		
Primary Settling	2 – 65 ft. diameter tanks	2 – 80 ft. diameter tanks
Secondary Treatment		
Aeration	2 – 35 ft. x 105 ft. x 15 ft. swd	2 – 45 ft. x 135 ft. x 15 ft. swd
Secondary Settling	4 – 60 ft. diameter tanks	4 – 70 ft. diameter tanks
Solids Treatment		
Sludge Dewatering Storage	1 cell –25 ft. x 25 ft. x 15 ft.	1 cell –30 ft. x 30 ft. x 15 ft.
Sludge Storage Basins	1 cell – 20 ft. x 20 ft. x 10 ft. each	1 cell – 30 ft. x 30 ft. x 10 ft. each

3.5 Costing

Preliminary costs for the new and expanded wastewater treatment plant options were prepared using the CAPDET Works Software developed by Hydromantis, Inc. in Ontario, Canada. The software contains icons for various wastewater treatment processes, which can be used to estimate the cost for different plant configurations. See Figure 3 for an example of the layout. The software was used to estimate both construction costs and annual maintenance, chemical, and electrical costs.

The program contains a July 2000 cost database for the treatment processes. Three cost indices are used to adjust the July 2000 costs to present day dollars. The Marshall and Swift Index; Pipe, Valve and Fitting Cost Index; and the Engineering News Record 20-City Construction Cost Index were assigned to various pieces of equipment. In addition, costs that are likely to vary regionally, such as concrete or labor, can be entered manually. The database values for the equipment were used and adjusted to April 2002 dollars. The April 2002 cost reference was used to maintain the consistency of cost

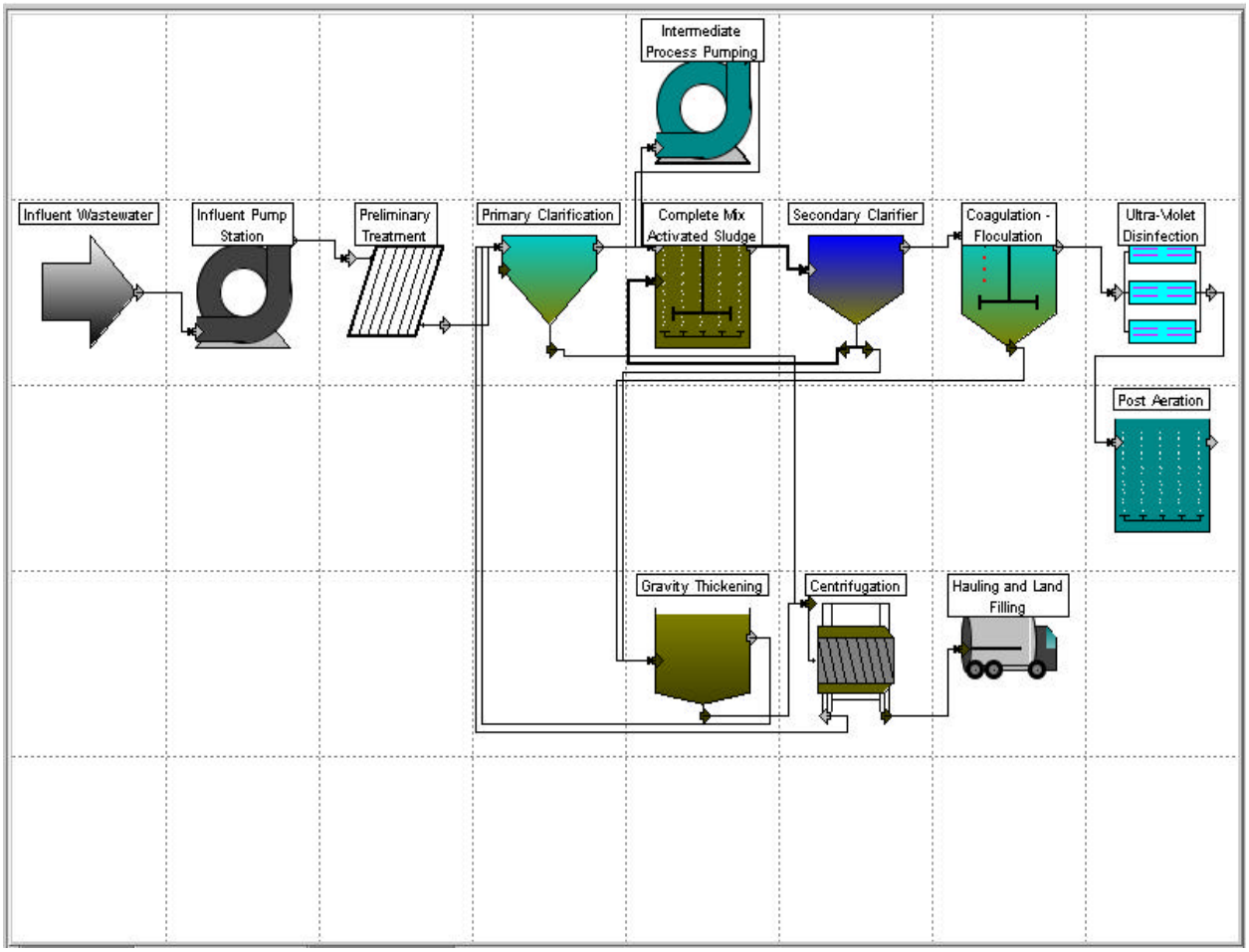


Figure 3. CAPDET Layout Example

estimates with the previously issued Technical Feasibility of Satellite Treatment technical memorandum. Typical costs for estimating concrete and chemicals were entered in the program. Equipment sizes and design parameters were manually entered to reflect Ten States Design Standards.

CAPDET includes costs associated with administration, laboratory, construction and operator labor, mobilization, site preparation, site electrical, yard piping, instrumentation and control, lab and administration buildings, equipment, and chemical use. The preliminary costs presented include a 30 percent engineering, legal, administrative and contingency fee, as well as a 15 percent confidence factor. The cost of purchasing additional land, if needed, was not included in any of the cost estimates. This was due to the wide variability in real estate prices within the planning area. However, the land cost would be a small percentage of the total cost of a plant.

The following costing variables were used to calculate capital and operation and maintenance costs:

- Life of Plant: 40 Years
- Construction: 3 Years for completion
- Interest Rate: 8%
- ENR Index: 6420 – April 2002
- Marshall and Swift Index: 1095 – April 2002
- Pipe Cost Index: 537 – April 2002
- Electrical and Instrumentation & Control: 16% of construction costs
- Mechanical: 19% of construction costs
- Labor: $50/hr including benefits
- Electricity: $0.08/kWh
- Building Cost: $90/sq. ft.
- Concrete
  - Base Slab: $300/cu. yd. Approx. 3 ft. thick
  - Wall: $550/cu. yd. Approx. 1 ft. thick
  - Suspended Cover: $650/cu. yd. Approx. 18 in. thick
- Chemical Costs
  - Lime: $0.181/lb
  - Ferric Chloride: $0.222/lb
  - Polymer: $1.300/lb

Detailed cost information for both the expansion of the current wastewater treatment plants and the new wastewater treatment plant can be found in Appendix B.

Table 10 provides a list of recently expanded wastewater treatment plants. The capital costs shown include only the construction cost of the wastewater treatment plant, not any conveyance or other associated costs. The average capital costs per gallon/day for the plants designed for secondary treatment are $4.38/gallon per day.

Table 10. Recently Expanded Wastewater Treatment Plants

Location	WWTP Name	Description	Degree of Treatment	Capital Costs (Million $)	Additional Size (MGD)	Capital Costs per gallon/day ($/gal./day)
Norman, OK	South Plant	Expansion from 12.0 MGD to 21.5 MGD	Tertiary	40.54	9.5	4.27
Longmont, CO	City of Longmont WWTP	Expansion from 11.5 MGD to 22 MGD	Tertiary	24.60	10.5	2.34
Fairfax, VA	Norman M. Cole Jr. Pollution Control Plant	Expansion from 54 MGD to 67 MGD	Tertiary	104.00	13.0	8.00
Frederick	Ballenger	Expansion from 2	Tertiary	15.5	4.0	3.88

Table 10. Recently Expanded Wastewater Treatment Plants

Location	WWTP Name	Description	Degree of Treatment	Capital Costs (Million $)	Additional Size (MGD)	Capital Costs per gallon/day ($/gal./day)
County, MD	Creek WWTP	MGD to 6 MGD				
Ypsilanti, MI	YCUA	Expansion from 28.9 MGD to 46 MGD	Tertiary	70.1	17.1	4.10
Vancouver, WA	Marine Park WWTP	Expansion from 8 MGD to 16 MGD	Secondary	30.00	8.0	3.75
Gresham, OR	City of Gresham WWTP	Expansion from 15 MGD to 20 MGD	Secondary	25.00	5.0	5.00
Detroit, MI	City of Detroit WWTP	Addition of two 180 MGD primary clarifiers	Primary	80.0	180.0	0.44

Wastewater treatment (on a $/gallon/day basis) may be slightly less at an expanded wastewater treatment plant than at a new wastewater treatment plant for several reasons. If an existing wastewater treatment plant was constructed to allow for future expansion, such things as site work, instrumentation and control, piping, filters, and building sizes could be included in the original construction to easily accommodate more capacity in the future. Since the expansions of the wastewater treatment plants studied for technical feasibility in this report were not originally constructed to allow for expansions of the sizes being considered, the $/gallon/day cost of the expanded wastewater treatment plants is similar to that of the proposed new wastewater treatment plants.

4. Analysis Of Wastewater Treatment Plants

Expansion of the St. Clair River Sewer Authority – East China Township WWTP was considered for two different service areas – one to serve the entire dry weather flow from the St. Clair County planning area and the second to serve the East China Township, China Township, Marine City, and City of St. Clair areas.

The expansion plans for the St. Clair County-Algonac WWTP and the new WWTP plant site involve treating the entire dry weather flow from the St. Clair County planning area. Therefore, these plants have been designed using the same flow values. This resulted in the expanded and new wastewater treatment plant having the same treatment process sizes. The service area to be served by these plants is shown in Figure 4.

4.1 Current St. Clair County-Algonac Wastewater Treatment Plant

St. Clair County owns and operates the Algonac Wastewater Treatment Plant. The existing treatment plant was renovated and expanded in 1980 and provides primary and secondary treatment, disinfection, and sludge handling processes. The wastewater treatment plant serves Algonac and parts of Ira and Clay townships; tributary population is approximately 18,822 people based on SEMCOG 2000 Census data.

Based on actual influent flow data, the average daily wastewater treated by the Algonac Wastewater Treatment Plant is 1.9 million gallons per day (MGD). The WWTP has a design average capacity of 2.7 MGD. The current plant provides secondary treatment by use of 12 rotating biological contactor (RBC) units. Due to operational problems, the RBC units will be replaced with plastic-media trickling filter towers. By the end of 2003, when the trickling filter towers are constructed, the biological treatment system will have a design capacity of 4.0 MGD. The remainder of the plant will continue to be rated at 2.7 MGD. As flows increase, the county plans to increase the entire plant capacity to 4.0 MGD.

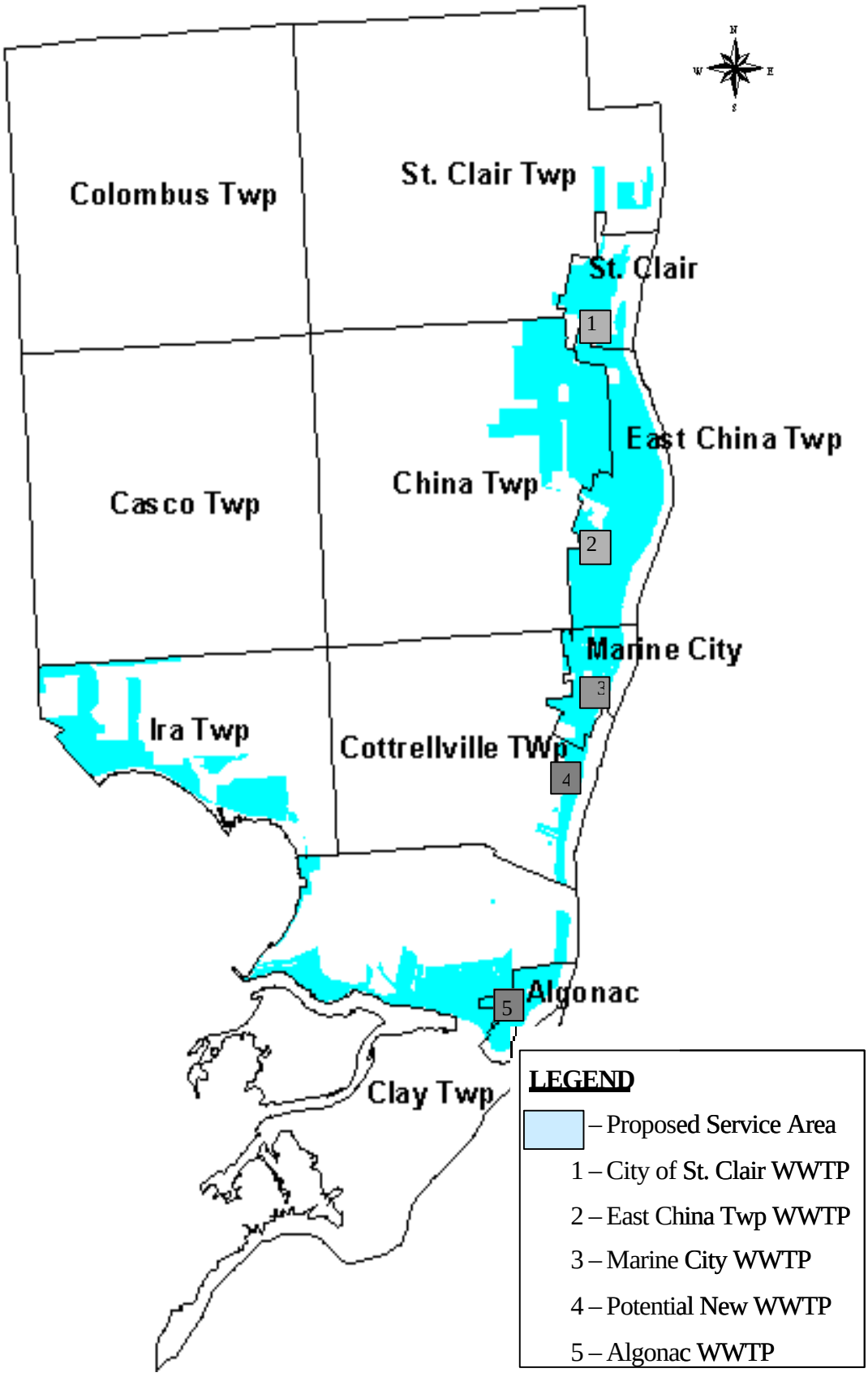


Figure 4. Areas to be Served by New or Expanded Wastewater Treatment Plant Discharging to the St. Clair River

4.1.1 Treatment Processes

The treatment process consists of grit removal, primary treatment, secondary treatment, final settling, and effluent disinfection. The flow enters the wastewater treatment system through a 30-inch pipe. At this point, the wastewater is sent through two grinders and then through the aerated grit tank. The grit tank is equipped with a bucket to remove solids. Four rectangular clarifiers provide primary treatment. Further detail is presented in Table 11.

Table 11. Preliminary and Primary Treatment Process Sizes

Preliminary and Primary Treatment Process	Description
Screening	Channel Grinders
Grit Removal	1 – 10 ft. x 15 ft.
Primary Treatment	4 – 14 ft wide x 60 ft long x 8.33 ft swd

The secondary treatment consists of RBCs followed by final settling. The process is designed to remove BOD and TSS. Table 12 shows the secondary process sizes.

Table 12. Secondary Treatment Process Sizes

Secondary Treatment Process	Description
RBCs	12 shafts - Mechanical
Final Settling	2 – 55 ft diam x 9 ft swd

Chlorine gas is used to provide disinfection of the secondary wastewater. Two jet pumps and mixers provide mixing of the chlorine gas with the settled effluent. Forty-one minutes of contact time is available in the outfall pipe at a maximum day flow of 4 MGD (15 minutes at the peak hourly flow of 7 MGD). The chlorinated effluent is discharged to the North Channel of the St. Clair River.

The biosolids generated during treatment are processed by anaerobic digestion. The digested biosolids are dewatered by vacuum filtration. The filtered biosolids are then land applied.

4.1.2 Flow Information

The average daily flow into the wastewater treatment plant, based on actual influent flow data, is currently 1.9 MGD. The daily average design flow is approximately 2.7 MGD with a maximum day flow of 4.0 MGD.

Algonac and the areas served in Ira and Clay townships have separated sewer systems. However, due to the age of the conveyance system, there is an appreciable amount of dry and wet weather inflow / infiltration (I / I).

4.1.3 Land Availability

The wastewater treatment plant currently occupies approximately five acres. There is no City owned land in the vicinity of this site. However, there is approximately 17 acres of land available northwest of the current facility.

4.1.4 Discharge Limits

The wastewater treatment plant discharges to the St. Clair River. At the discharge point into the St. Clair River, the 95% exceedance flow is 66,300 cubic feet per second. Due to the high flow of the St. Clair River, the wastewater treatment plant discharge is only required to meet secondary discharge standards.

Table 13 shows the current NPDES permit limits for the Algonac Wastewater Treatment Plant.

Table 13. Current NPDES Permit Limits

Parameter	Most Restrictive Monthly NPDES Discharge Limit (mg/L)	Most Restrictive Daily NPDES Discharge Limit (mg/L)
CBOD5 (Five Day Carbonaceous Biochemical Oxygen Demand)	25	40
TSS (Total Suspended Solids)	30	45
Ammonia Nitrogen	Not Applicable	Not Applicable
Total Phosphorus	1	--

4.1.5 Evaluation

Once the current RBCs are replaced with the trickling filters, the plant will continue to treat an average flow of 2.7 MGD. The biological process will be rated at a design average flow of 4.0 MGD. Other than the RBCs, there are no known operational problems associated with the wastewater plant and the plant consistently meets the NPDES limits. The projected future flow for the service area is 3.1 MGD. Based on this flow projection, the Algonac Wastewater Treatment Plant will be capable of handling future flows from the service area once the expansion to 4.0 MGD has been completed.

4.2 Expansion of St. Clair County-Algonac Wastewater Treatment Plant (Option 1)

4.2.1 Treatment

The expansion of the St. Clair County-Algonac WWTP was considered for the open area northwest of the current plant. Figure 5 shows the location of the current St. Clair County-Algonac WWTP and the projected land use of the surrounding area. It was assumed that the expanded plant would replace the existing treatment processes and provide treatment for the current service area as well as the entire St. Clair County planning area.

This ultimate expansion option was developed to determine an estimate of the upper limit cost to treat all the St. Clair County wastewater within the County. The details of the expanded plant design are shown in Section 3.4 *Design Assumptions.* In order to convey the discharge from this treatment plant to the St. Clair River, a 2,600 linear foot outfall pipe would need to be installed. The layout of the expanded treatment plant is shown in Figure 6.

The total cost of the treatment plant expansion including the outfall pipe is $32.3 million. The costs are presented in detail in Appendix B.

4.2.2 Conveyance System

Figure 7 illustrates the conveyance system for the expanded plant. Below is a brief description of the conveyance option for delivering wastewater to the area northwest of the existing Algonac Wastewater Treatment Plant.

This option involves intercepting the flow from the current City of St. Clair WWTP, St. Clair River Sewer Authority – East China Township WWTP, Marine City WWTP, and a gravity sanitary sewer along M-29. A profile of the proposed gravity sewer is shown in Figure 8.

A 30-inch pipe would be installed to deliver the wastewater from the City of St. Clair WWTP to a proposed lift station located in the vicinity of the St. Clair River Sewer Authority – East China Township WWTP. A 36-inch pipe would be installed to deliver the wastewater from the St. Clair River Sewer Authority – East China Township WWTP. This sewer would be enlarged to a 42-inch pipe after receiving the flow from Marine City. Flow from Marine City would be directed to the new sewer by gravity. This system would involve approximately 27,000 linear feet of 30-inch pipe, 27,000 linear feet of 36-inch pipe and 38,000 linear feet of 42-inch pipe. The conveyance cost of this option is approximately $80.63 million.

4.2.3 Cost Summary

Table 14 summarizes the cost associated with this expansion option.

Table 14. St. Clair County- Expanded Algonac WWTP Cost Summary

Costs	*Option 7.1 MGD*
Treatment Plant Expansion Capital Cost (Million $)	32.3
Treatment Plant Expansion Capital Cost per gallon/day ($/gal./day)	4.55
Annual O&M (Million $)	4.85
Conveyance (Million $)	80.63
Conveyance Capital Cost per gallon/day ($/gal./day)	11.36
Capital and Conveyance Cost per gallon/day ($/gal./day)	15.91

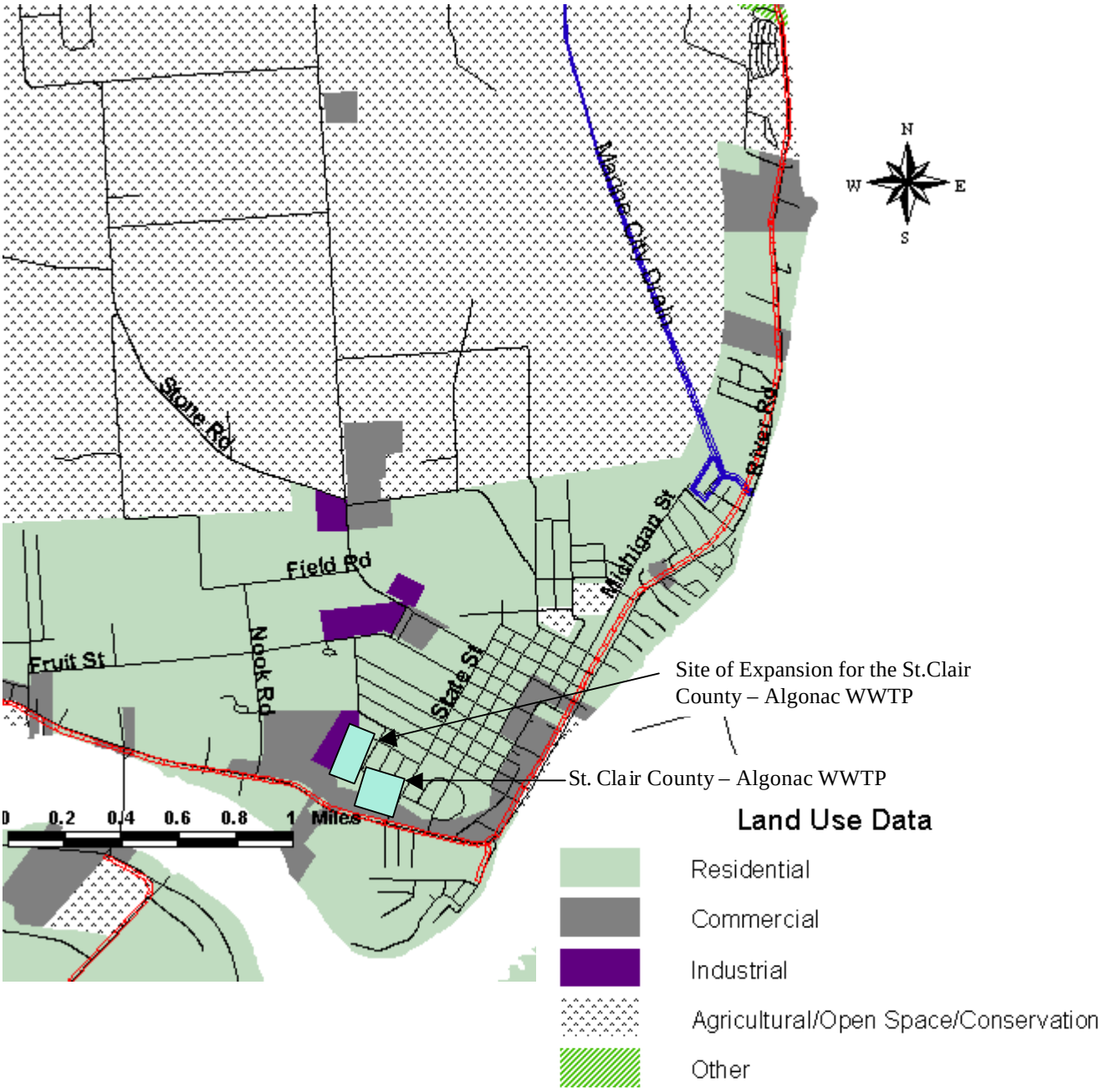


Figure 5. Detailed Site Location for the St. Clair County-Algonac WWTP

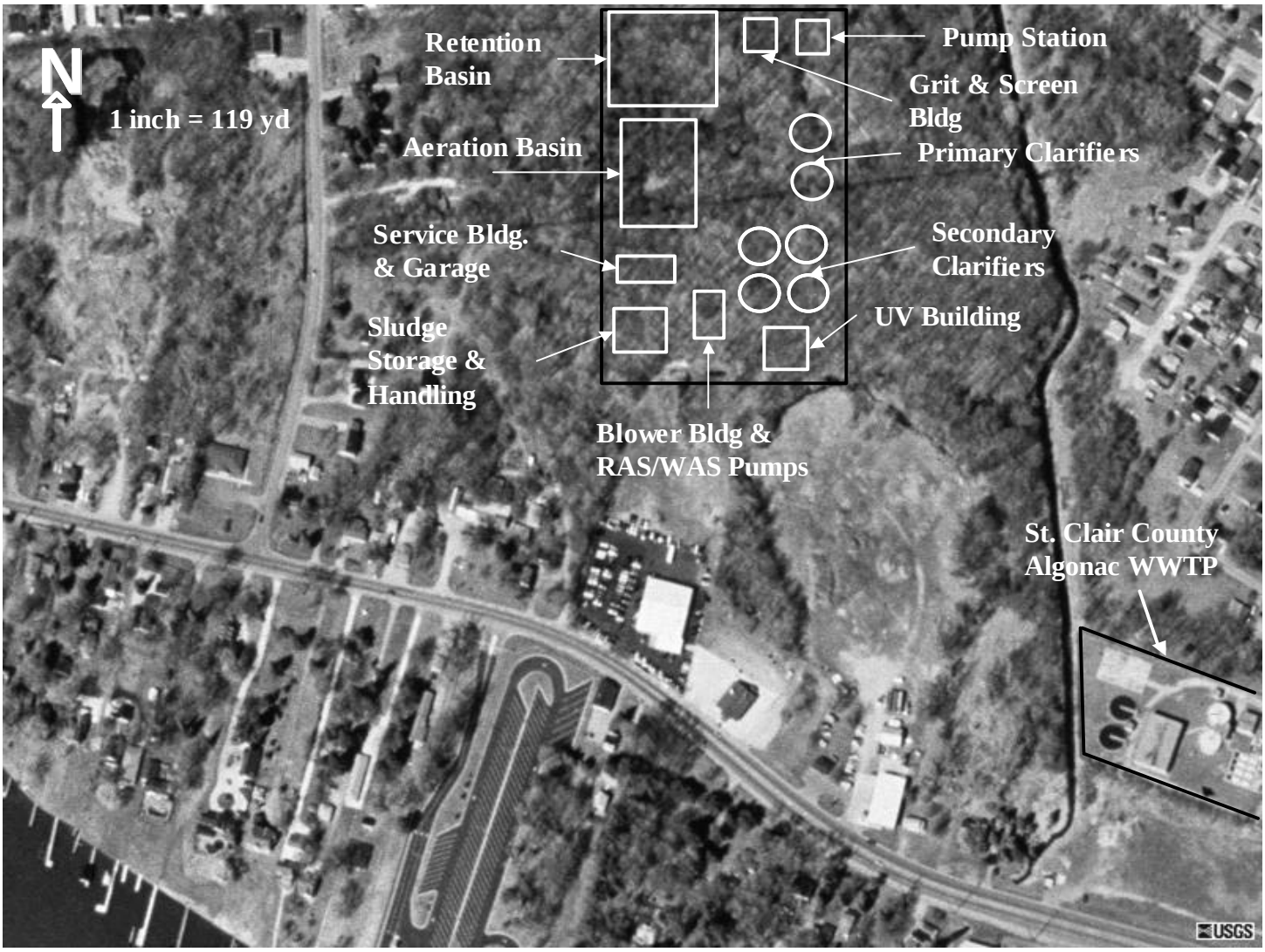


Figure 6. Layout of Expanded St. Clair County-Algonac WWTP



Figure 7. Conveyance System for the Expansion of the Algonac Wastewater Treatment Plant

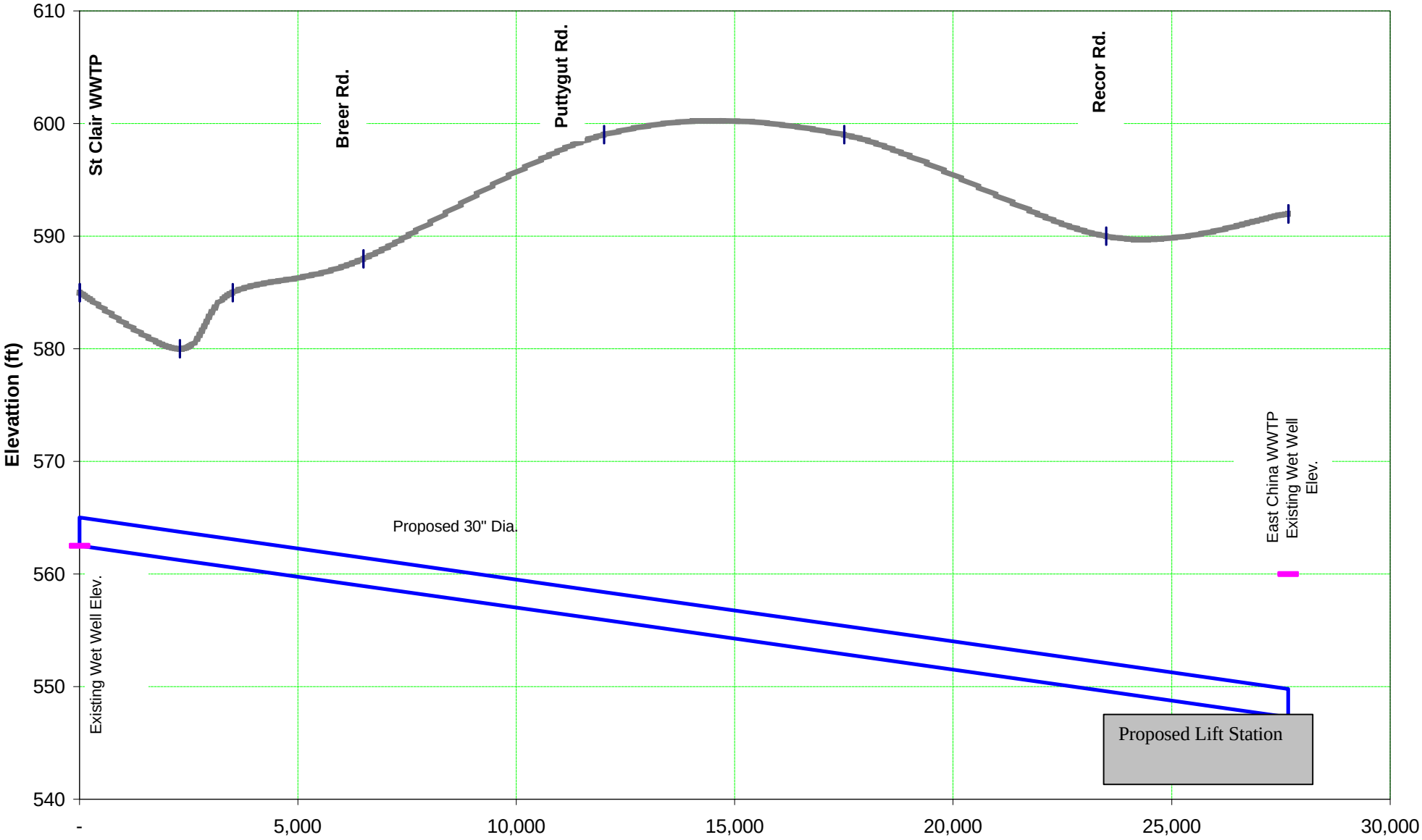


Figure 8. Sewer Profile for the Expansion of the Algonac Wastewater Treatment Plant – City of St. Clair to E. China Township

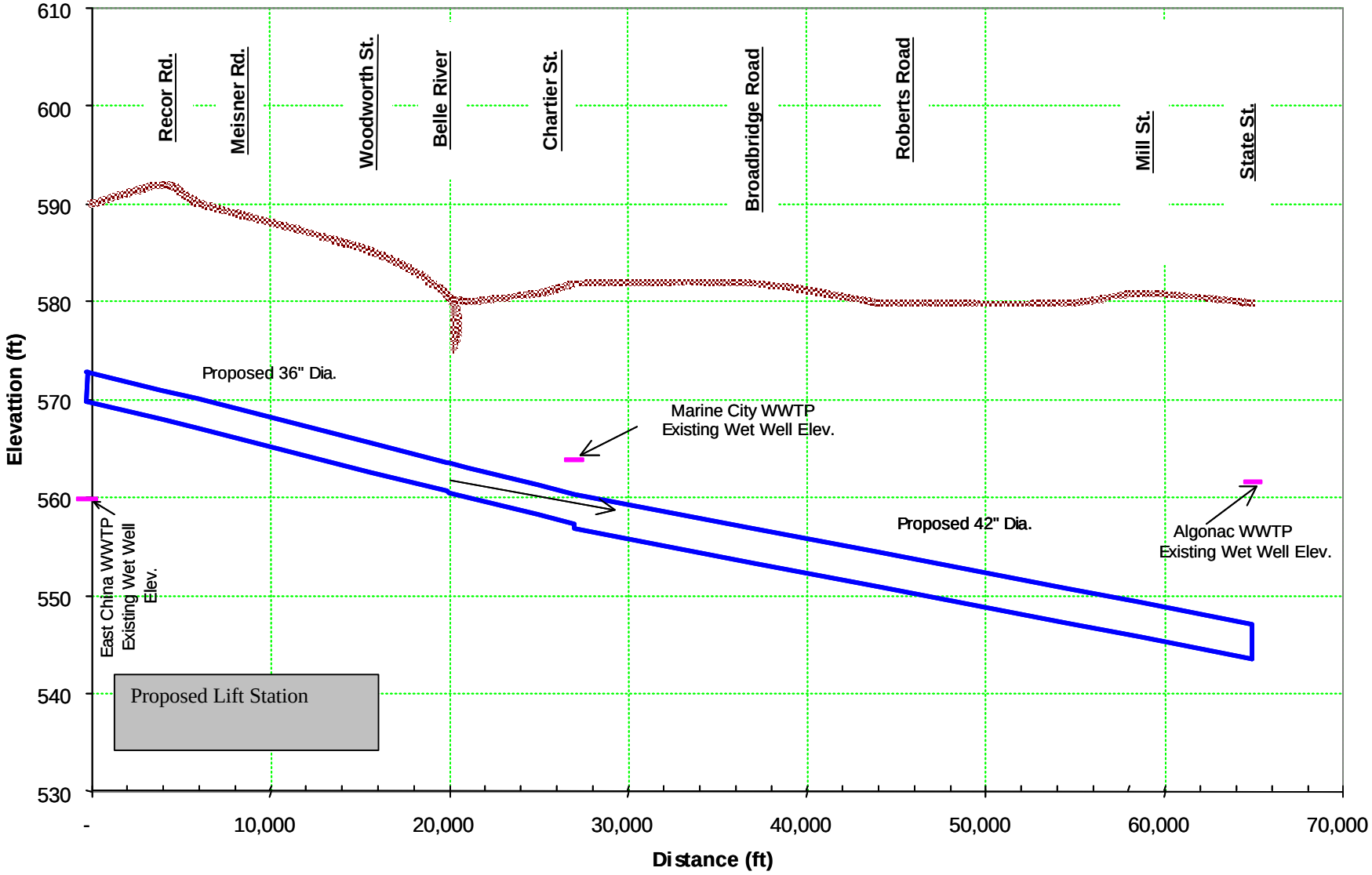


Figure 8 (cont). Sewer Profile for the Expansion of the Algonac Wastewater Treatment Plant – E. China Twp to Algonac

Current St. Clair River Sewer Authority – East China Township Wastewater Treatment Plant.

The St. Clair River Sewer Authority – East China Township Wastewater Treatment Plant collects and treats sanitary wastewater from parts of China and East China Townships. The wastewater treatment plant serves a population of approximately 5,000 people based on SEMCOG 2000 Census data.

The wastewater treatment plant is located in East China Township. The raw wastewater is brought into the plant through nine lift stations. The treated wastewater is discharged into the St. Clair River.

Treatment Processes

Treatment at the St. Clair River Sewer Authority – East China Township Wastewater Treatment Plant consists of screening, primary settling, rotating biological contactors (RBCs), secondary settling, and effluent disinfection. Process sizes for preliminary and primary treatment are shown in Table 15.

Table 15. Preliminary and Primary Treatment Sizes

Preliminary and Primary Treatment Process	Description
Screening	2 - 4 ft. x 5 ft.
Primary Settling	2 – 40 ft. diam. x 9 ft

The secondary treatment consists of the RBCs followed by final settling. The process is designed to remove BOD and TSS. Ferric chloride is added after the RBCs and polymer is added in the final clarifiers to aid in phosphorus removal. Table 16 shows the secondary process sizes.

Table 16. Secondary Treatment Process Sizes

Secondary Treatment Process	Description
RBCs	5 shafts – air driven
Final Settling	1 – 55 ft diam x 9 ft swd 1 – 40 ft diam x 9 ft swd

The secondary wastewater is chlorinated with sodium hypochlorite then sent to a lagoon for dechlorination. The wastewater is then discharged to the St. Clair River.

The sludge produced in the treatment processes is sent to aerobic sludge digesters. The digested sludge is transferred to sludge drying beds. Approximately once per year, the dried sludge is land applied.

4.3.2 Flow Information

The average daily flow, based on actual influent flow data, into the wastewater treatment plant is 0.6 MGD. The design capacity of the plant is 2.2 MGD.

The East China Township WWTP service area has a separated sewer system. However, there is an appreciable amount of dry and wet weather inflow/infiltration (I/I).

4.3.3 Land Availability

The current St. Clair River Sewer Authority – East China Township Wastewater Treatment Plant occupies approximately 40 acres. There are large areas of open land to the west and south of the current treatment plant.

4.3.4 Discharge Limits

The wastewater treatment plant discharges to the St. Clair River. At the discharge point into the St. Clair River, the 95% exceedance flow is 126,000 cubic feet per second. Due to the high flow of the St. Clair River, the wastewater treatment plant discharge is only required to meet secondary discharge standards.

Table 17 shows the current NPDES permit limits for the St. Clair River Sewer Authority – East China Township Wastewater Treatment Plant.

Table 17. Current NPDES Permit Limits

Parameter	Most Restrictive Monthly NPDES Discharge Limit (mg/L)	Most Restrictive Daily NPDES Discharge Limit (mg/L)
CBOD5 (Five Day Carbonaceous Biochemical Oxygen Demand)	25	40
TSS (Total Suspended Solids)	30	45
Ammonia Nitrogen	Not Applicable	Not Applicable
Total Phosphorus	1	--

4.3.5 Evaluation

The East China Township WWTP is currently in compliance with their NPDES permit limits. There are no known operational problems associated with the wastewater plant. The projected future flow for the service area is 1.7 MGD. The current WWTP has a design capacity of 2.2 MGD. Based on the future flow projection, the East China Township Wastewater Treatment Plant is capable of handling future flows from the current service area.

4.4 Expansion of St. Clair River Sewer Authority – East China Township Wastewater Treatment Plant (Options 2 and 4)

4.4.1 Treatment

The expansion of the St. Clair River Sewer Authority – East China Township Wastewater Treatment Plant was considered at the property located west of the current plant. Figure 9 shows the location of the current St. Clair River Sewer Authority – East China Township Wastewater Treatment Plant and the projected land use of the surrounding area It was assumed that the expanded plant would replace the existing treatment processes and provide treatment for the current service area as well as the entire St. Clair County planning area at this new wastewater treatment plant site.

One possible expansion option is to handle the flow from the current service area as well as the flows from Marine City and the City of St. Clair (Option 4). Another plant expansion would be capable of handling all of the dry weather flow from the St. Clair County planning area (Option 2). This ultimate expansion option was developed to determine an estimate of the upper limit cost to treat all the St. Clair County wastewater within the County. The details of the expanded plant design are shown in Section 3.4. *Design Assumptions*. In order to convey the effluent from the WWTP, a new 8,000 linear foot discharge pipe would need to be installed. A generic layout of the expanded treatment plant is shown in Figure 10.

The total cost of the treatment plant expansion including effluent pipe to handle all of the dry weather flow from the St. Clair County planning area is $36.8 million. The total cost of the treatment plant expansion to handle all of the dry weather flow from the current service area in addition to the flows from Marine City and the City of St. Clair is $20.5 million. The costs are presented in detail in Appendix B.

4.4.2 Conveyance System Description and Cost

The conveyance system for this expansion (see Figure 11) involves installing a gravity sewer along M-29 to collect the wastewater flows from the current Algonac WWTP, City of St. Clair WWTP, and Marine City WWTP. A very deep sewer is required to be able to convey the flow by gravity and avoid the operation and maintenance of a pumping station. A profile of the proposed gravity sewer is shown in Figure 12.

A 30-inch pipe would be installed to deliver the wastewater from the City of St. Clair Wastewater Treatment Plant. A 42-inch pipe would be installed to deliver the wastewater from the Algonac Wastewater Treatment Plant. This sewer would be upgraded to a 48-inch pipe after receiving the flow from Marine City. The flow from Marine City would be directed to the new sewer by gravity. This system would involve approximately 27,000 linear feet of 30-inch pipe, 38,000 linear feet of 42-inch pipe, and 27,000 linear feet of 48-inch sewer pipe. The cost of this option is $89.78 million.

4.4.3 Cost Summary

Table 18 summarizes the cost associated with the expansion option.

Table 18. St. Clair River Sewer Authority – East China Township Cost Summary

Costs	Option 4.0 MGD	Option 7.1 MGD
Treatment Plant Expansion Capital Cost (Million $)	20.5	36.8
Treatment Plant Expansion Capital Cost per gallon/day ($/gal./day)	5.13	5.18
Annual O&M (Million $)	3.14	4.85
Conveyance (Million $)	52.47	89.78
Conveyance Capital Cost per gallon/day ($/gal./day)	13.12	12.64
Capital and Conveyance Cost per gallon/day ($/gal./day)	18.25	17.83

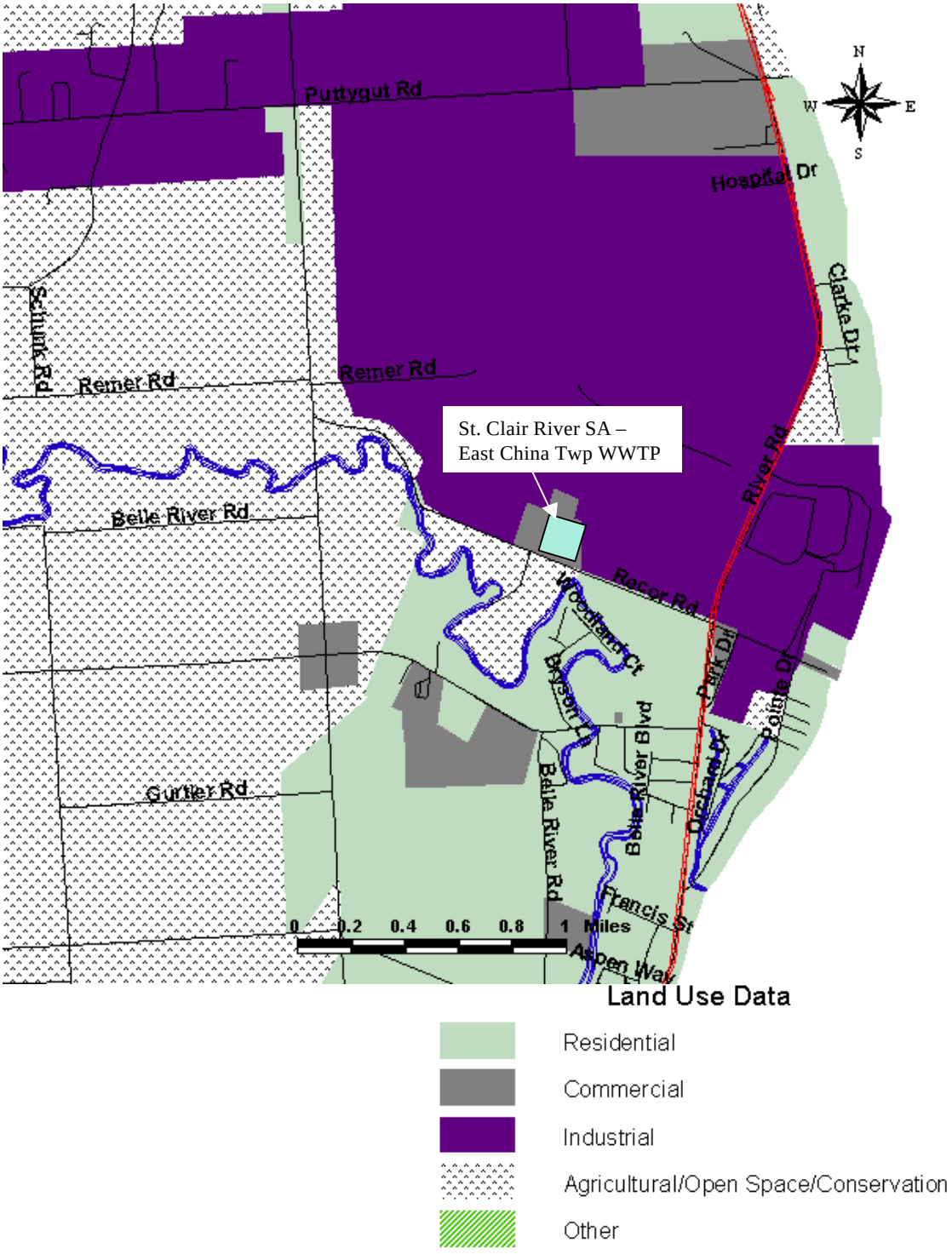


Figure 9. Detailed Site Location for the St. Clair River Sewer Authority – East China Township WWTP

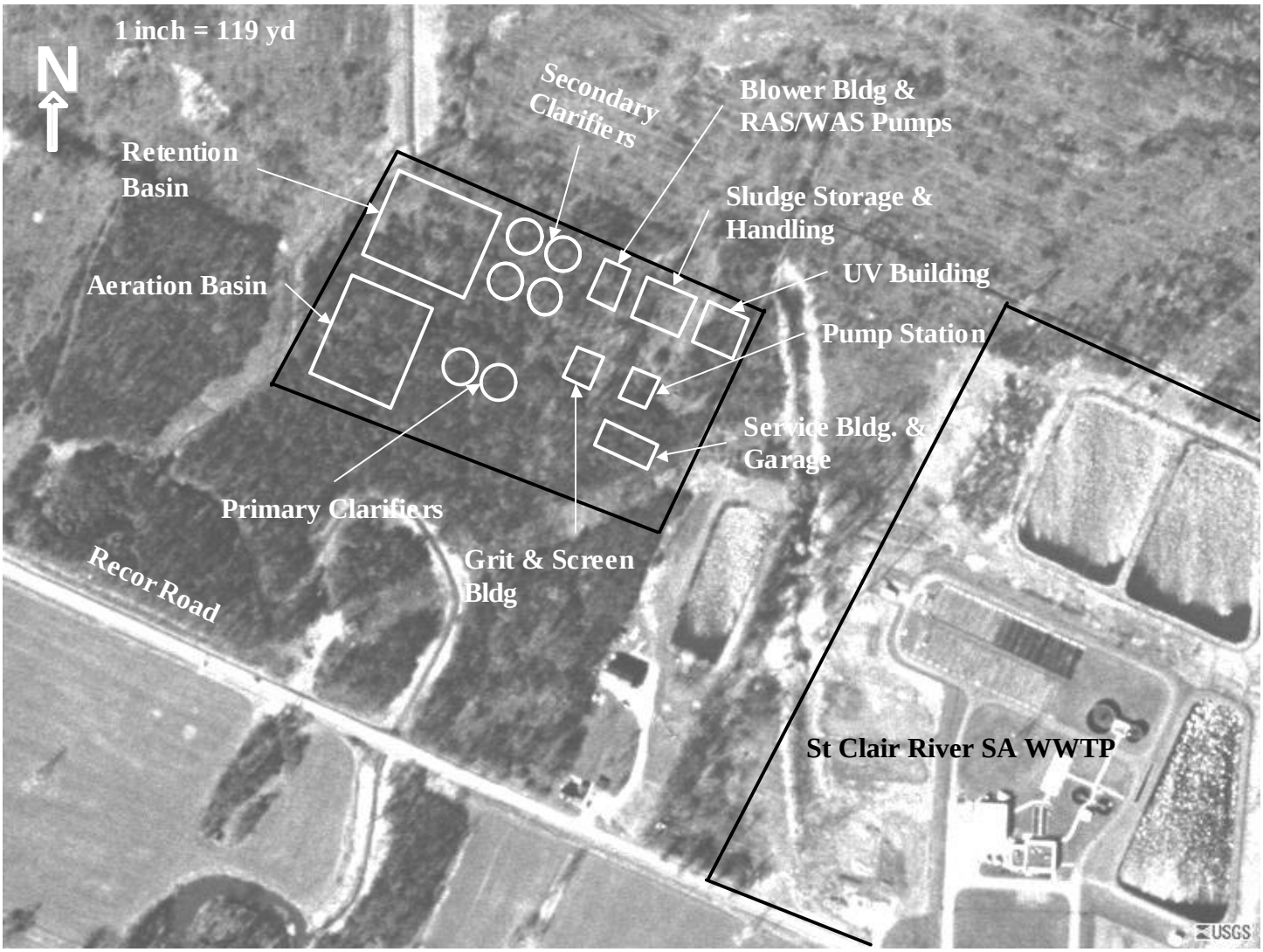


Figure 10. Layout of Expanded St. Clair River Sewer Authority – East China Township Wastewater Treatment Plant



Figure 11. Conveyance System for the Expansion of the East China Township Wastewater Treatment Plant

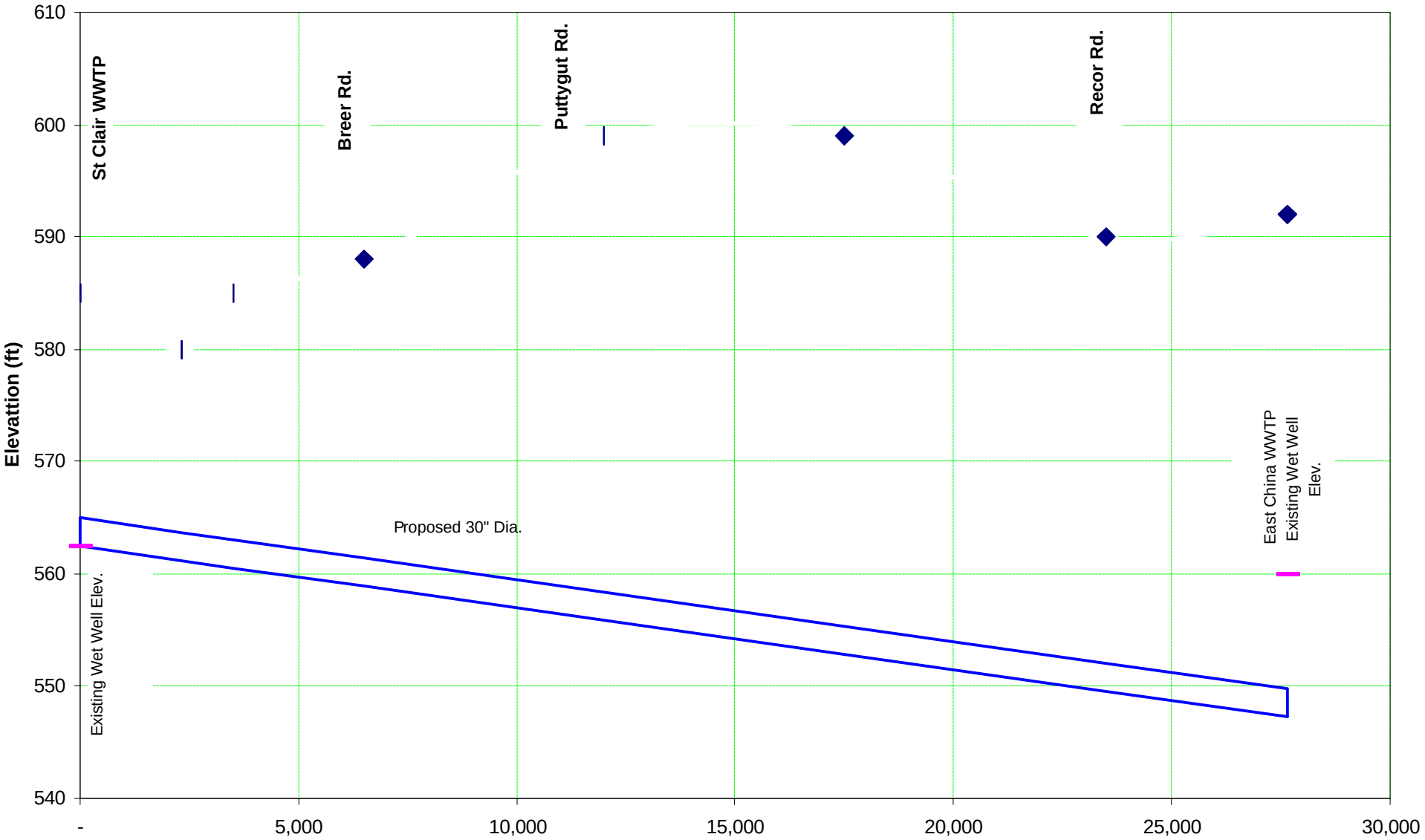
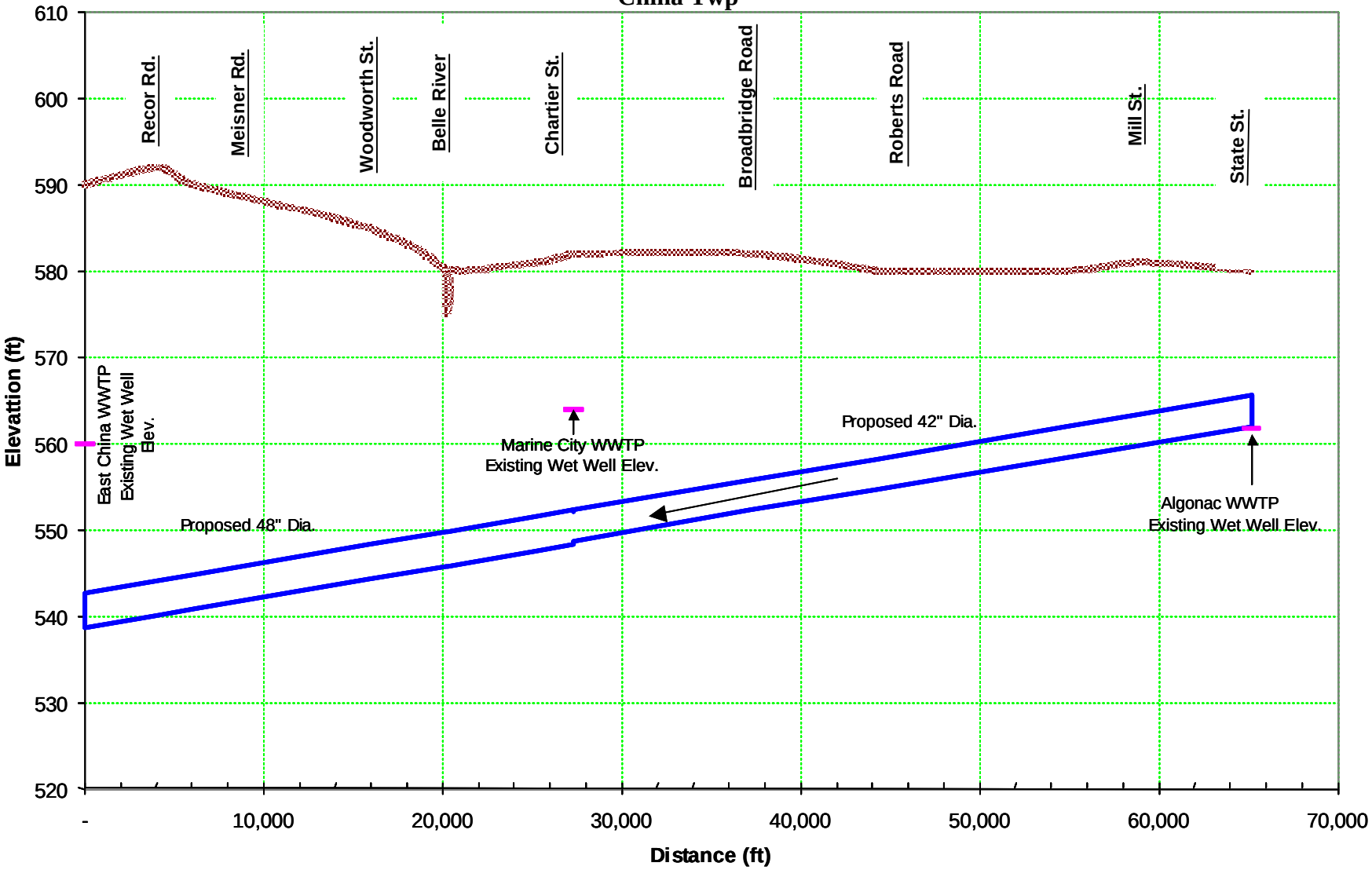


Figure 12. Sewer Profile for the Expansion of the East China Township Wastewater Treatment Plant – St. Clair to E. China Twp

Figure 12 (cont). Sewer Profile for the Expansion of the East China Township Wastewater Treatment Plant – Algonac to E. China Twp



4.5 Current City of St. Clair Wastewater Treatment Plant

The City of St. Clair Wastewater Treatment Plant was constructed in 1935 and was later upgraded in 1986 to the present maximum capacity of 4.25 MGD with an average design flow of 1.4 MGD. The wastewater treatment plant serves a population of approximately 7,621 people based on SEMCOG 2000 Census data.

The wastewater treatment plant is located on the east side of the City of St. Clair. The raw wastewater is brought into the plant through a 15-inch pipe and an 18-inch pipe. The treated wastewater is discharged to the St. Clair River.

4.5.1 Treatment Processes

Treatment at the City of St. Clair Wastewater Treatment Plant consists of screening, primary settling, trickling filters, chemical addition, secondary settling, and effluent disinfection. The City is presently in the process of installing a grit removal tank. Process sizes for preliminary and primary treatment are shown in Table 19.

Table 19. Preliminary and Primary Treatment Sizes

Preliminary and Primary Treatment Process	Description
Screening	1 – 2 ft. 6 in. x 4 ft. 8 in. 1 – 2 ft. 6 in. x 2 ft. 8 in.
Primary Settling	2 - 16 ft. x 60 ft. x 10 ft. swd

The primary effluent flows into a wet well before being pumped to the two trickling filters. The trickling filters are run in parallel. Ferric chloride and polymer is added to the effluent from the trickling filter for phosphorus removal. After chemical addition, the wastewater is sent to the three rectangular secondary clarifiers. The secondary treatment process sizes are shown in Table 20.

Table 20. Secondary Treatment Sizes

Secondary Treatment Process	Description
Trickling Filters	2 – 31 ft. diam. x 16 ft. deep
Final Settling Tanks	3 – 60 ft. x 16 ft. x 10 ft. swd

Wastewater from the secondary clarifiers is disinfected by sodium hypochlorite addition in the chlorine contact tank. The chlorinated wastewater is discharged to the St. Clair River.

Sludge from the primary and secondary clarifiers is pumped to the primary anaerobic digester. The same quantity of sludge that is pumped into the primary digester is transferred out of the digester into the secondary digester. Every two weeks, sludge from the secondary digester is transferred to the 500,000-gallon sludge holding tank. Twice a year, sludge is removed from the holding tank and land applied.

4.5.2 Flow Information

Based on actual influent flow data, the average daily flow into the wastewater treatment plant is 1.0 MGD. The average daily design flow is 1.4 MGD with a maximum daily design flow of 4.2 MGD.

In 1996, the City of St. Clair completed separation of the sanitary and storm sewer systems. A 1998 significant wet weather event occurred prompting a Sewer System Evaluation Study to be performed from 1999 to 2001. Improvements to the sanitary and storm sewer systems are currently underway.

4.5.3 Land Availability

The current City of St. Clair Wastewater Treatment Plant occupies approximately four acres. The treatment plant is bounded on the west and north by the Pine River and by commercial/industrial users to the east and south.

4.5.4 Discharge Limits

The wastewater treatment plant discharges to the St. Clair River. At the discharge point into the St. Clair River, the 95% exceedance flow is 126,000 cubic feet per second. Due to the high flow of the St. Clair River, the wastewater treatment plant discharge is only required to meet secondary discharge standards.

Table 21 shows the current NPDES permit limits for the City of St. Clair Wastewater Treatment Plant.

Table 21. Current NPDES Permit Limits

Parameter	Most Restrictive Monthly NPDES Discharge Limit (mg/L)	Most Restrictive Daily NPDES Discharge Limit (mg/L)
$CBOD_5$ (Five Day Carbonaceous Biochemical Oxygen Demand)	25	40
TSS (Total Suspended Solids)	30	45
Ammonia Nitrogen	Not Applicable	Not Applicable
Total Phosphorus	1	--

4.5.5 Evaluation

The City of St. Clair WWTP is currently in compliance with their NPDES permit limits. The treatment plant has a design average daily flow of 1.4 MGD with an average current flow to the plant of 1.0 MGD. The projected future flow for the service area is 1.3 MGD. The projected future flow to the plant is near the present design flow of the plant. Based on the projected flow, the City of St. Clair WWTP will be able to meet the future demands of the current service area.

4.6 Expansion of the City of St. Clair Wastewater Treatment Plant

There is no land available near the current wastewater plant (see Figure 13). The Pine River to the north and west and industrial/commercial users to the south and east border the wastewater treatment plant making expansion unlikely. However, since the current WWTP has enough treatment capacity to treat the future demands from the service area, expansion of the WWTP is not necessitated.



Figure 13. City of St. Clair Wastewater Treatment Plant Site

4.7 Current Marine City Wastewater Treatment Plant

The Marine City Wastewater Treatment Plant was constructed in 1958 and was later upgraded several times with the latest upgrade being completed in 1990. The present WWTP has a maximum capacity of 2.0 MGD with an average design flow of 1.0 MGD. The wastewater treatment plant serves a population of approximately 6,878 people based on SEMCOG 2000 Census data.

4.7.1 Treatment Processes

Treatment at the Marine City Wastewater Treatment Plant consists of screening, primary settling, trickling filter, chemical addition, secondary settling, and effluent disinfection. The disinfected effluent is discharged to the St. Clair River.

4.7.2 Flow Information

The average daily flow into the wastewater treatment plant is 0.8 MGD. The average daily design flow is 1.0 MGD with a maximum daily design flow of 2.0 MGD.

4.7.3 Land Availability

The current Marine City Wastewater Treatment Plant has large areas of undeveloped land nearby.

4.7.4 Evaluation

The current flow of 0.8 MGD, based on actual influent flow data to the treatment plant, is near the design average daily flow of 1.0 MGD. The projected future flow for the service area is 1.1 MGD. The plant at the current design capacity cannot treat this future flow.

The Marine City WWTP has declined to participate in this evaluation; however, the projected flow from the Marine City service area is going to be accounted for in the flow analysis for this memorandum.

4.8 Construction of New Plant Discharging to the St. Clair River (Option 3)

4.8.1 Siting of a Potential New Wastewater Treatment Plant

The St. Clair River was considered as the receiving stream for a new centralized wastewater treatment plant. This water body was chosen due to its high base flow and its proximity to areas with substantial wastewater flows. Selecting potential sites along this water body necessitated looking at several factors. The three major components of any proposed wastewater treatment system are:

- The pipelines needed to convey the wastewater to the treatment plant.
- The treatment plant.
- The outfall pipe that will convey the treated effluent to the receiving water body.

The proposed wastewater treatment plant would need to be designed to meet several goals:

Environmental
Avoid or minimize impacts to the natural environment.
Preserve and enhance water quality.
Protect public health.

Technical

- Design the wastewater treatment plant, conveyance, and disposal system to be efficient and reliable.
- Balance cost with the risk of uncertainty and the flexibility to respond to changes in growth projections, technology, and regulations.
- Ensure the wastewater system is designed and constructed to meet regulatory requirements.

To identify possible land areas for a treatment plant, an analysis was performed using GIS (Geographical Information System), topographical maps, and recent aerial photographs. The GIS provided the land use projections for the planning area through the year 2020. The land use for the planning area was divided into the following categories:

- Agricultural\Rural Residential
- Commercial
- Industrial
- Institutional
- Low Density Residential
- Medium\High Density Residential
- Office
- Open Space\Conservation
- Other
- Transportation

The potential sites were screened using the following engineering and environmental constraints that would affect the construction or operation of a wastewater treatment plant:

- Only sites that were identified as Agricultural\Rural Residential, Commercial, Industrial, or Other by the GIS were selected for further investigation.
- Sites that were not within two miles of the St. Clair River were eliminated.
- Sites had to be of sufficient area to accommodate the proposed facility and an appropriate buffer. For this study, the minimum area considered was 15 acres.
- The elevation of the sites should allow efficient conveyance of sewage to the plant and conveyance of treated effluent to the receiving water.
- Sites should have adequate vehicle access to and from major roadways.
- Sites should not have steep slopes.
- Sites should not be long and narrow in shape.

- Sites should not be in the vicinity of state parks, active airport operations, transmission towers, cemeteries, and conservation areas.

The results of the screening process produced only one site meeting all the criteria, a 21-acre undeveloped site in Cottrellville Township. The size and current land use of this site was verified by use of digitized color photographs obtained from MapQuest. The approximate location of the site considered for a new centralized wastewater treatment plant is shown on Figure 14.

The site selected was chosen only to provide a location to determine the technical feasibility of building a new centralized wastewater treatment plant in the St. Clair County planning area. A more in-depth study of this site and other potential sites would need to be performed to determine the current owner's future plans for the site, the economic / social / political impact of building a new wastewater treatment plant on the site, and the environmental impact of a new wastewater treatment plant at the site.

4.8.2 Treatment

The new plant would be capable of handling all of the flow from the St. Clair County planning area. Because of this, only one expansion flow option was considered for the wastewater treatment plant. The details of the new plant design are shown in Section 3.4. *Design Assumptions.* In order to convey the effluent from this WWTP to the St. Clair River, a 1,400 linear foot effluent pipe would need to be installed. The layout of the new treatment plant is shown in Figure 15.

The total cost of the treatment plant expansion including effluent pipe is $31.4 million. The costs are presented in detail in Appendix B.

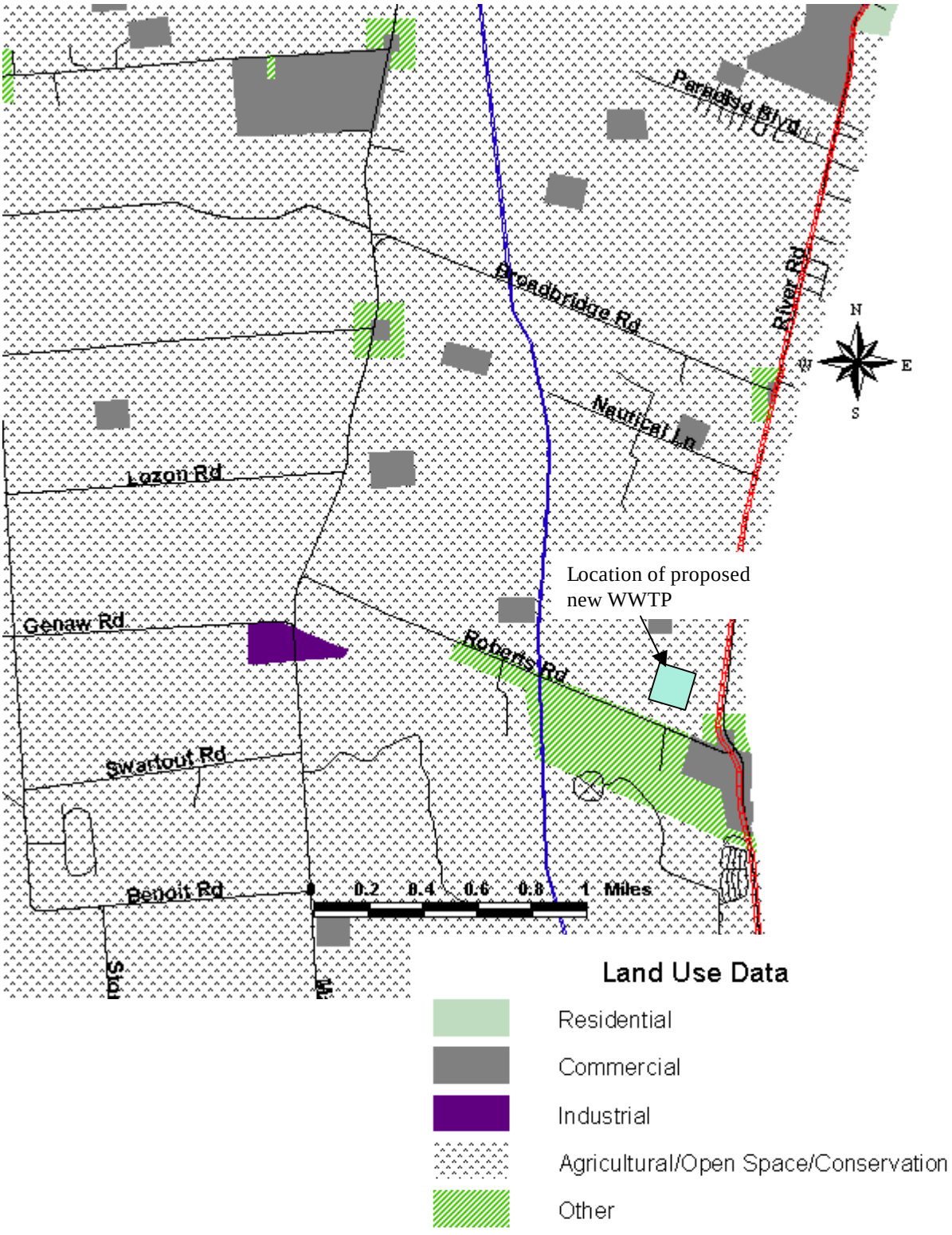


Figure 14. Detailed Site Location for New Wastewater Treatment Plant

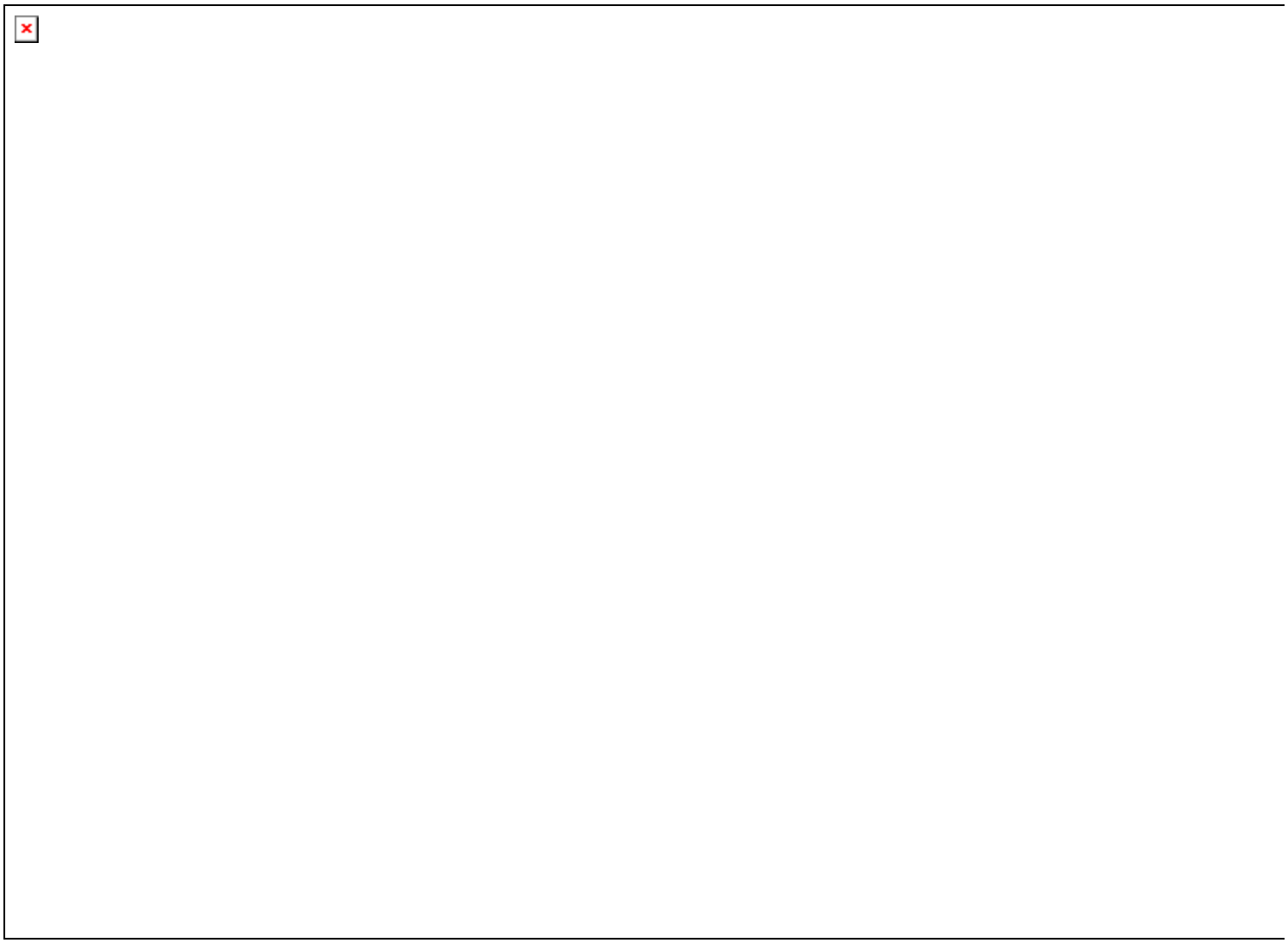


Figure 15. Layout of New Wastewater Treatment Plant

4.8.3 Conveyance System Description and Cost

The option involves combining the flows from the current Algonac WWTP, City of St. Clair WWTP, Marine City WWTP, and East China Township WWTP into a gravity sanitary sewer along M-29. This conveyance system is illustrated in Figure 16. A profile of the proposed gravity sewer is shown in Figure 17.

A 42-inch pipe would be installed to deliver the wastewater from the Algonac WWTP to the new treatment plant. A 30-inch pipe would be installed to deliver the wastewater from the City of St. Clair WWTP to a proposed lift station located in the vicinity of the St. Clair River Sewer Authority – East China Township WWTP at which point a 36-inch pipe would be installed to deliver the wastewater from the St. Clair River Sewer Authority – East China Township WWTP. This sewer would be upgraded to a 42-inch after receiving the flow from Marine City. Flow from Marine City would be directed to the new sewer by gravity. This system would involve approximately 27,000 linear feet of 30-inch pipe laid 35-50 feet deep, 27,000 linear feet of 36-inch pipe laid 20-35 feet deep, 17,000 linear feet of 42-inch pipe buried 30 feet deep, and approximately 21,000 linear feet of 42-inch sewer buried 20-30 feet deep. The cost of this option is approximately $79.65 million.

Cost Summary

Table 22 summarizes the cost associated with the new wastewater treatment plant site.

Table 22. New Wastewater Treatment Plant Cost Summary

Costs	Option 7.1 MGD
Treatment Plant Expansion Capital Cost (Million $)	31.4
Treatment Plant Expansion Capital Cost per gallon/day ($/gal./day)	4.42
Annual O&M (Million $)	4.85
Conveyance (Million $)	79.65
Conveyance Capital Cost per gallon/day ($/gal./day)	11.22
Capital and Conveyance Cost per gallon/day ($/gal./day)	15.64

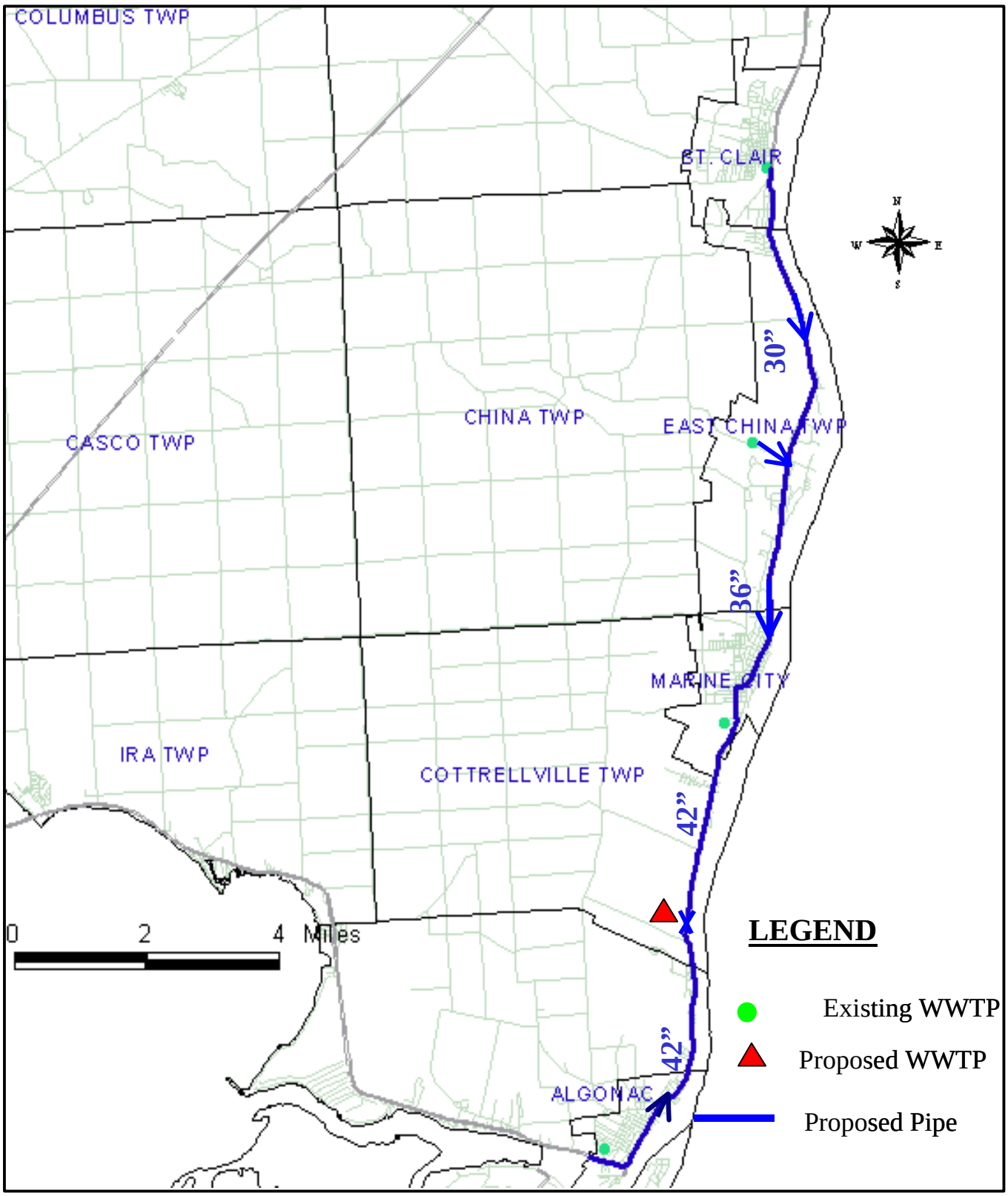


Figure 16. Conveyance System for a New Wastewater Treatment Plant Site Along the St. Clair River

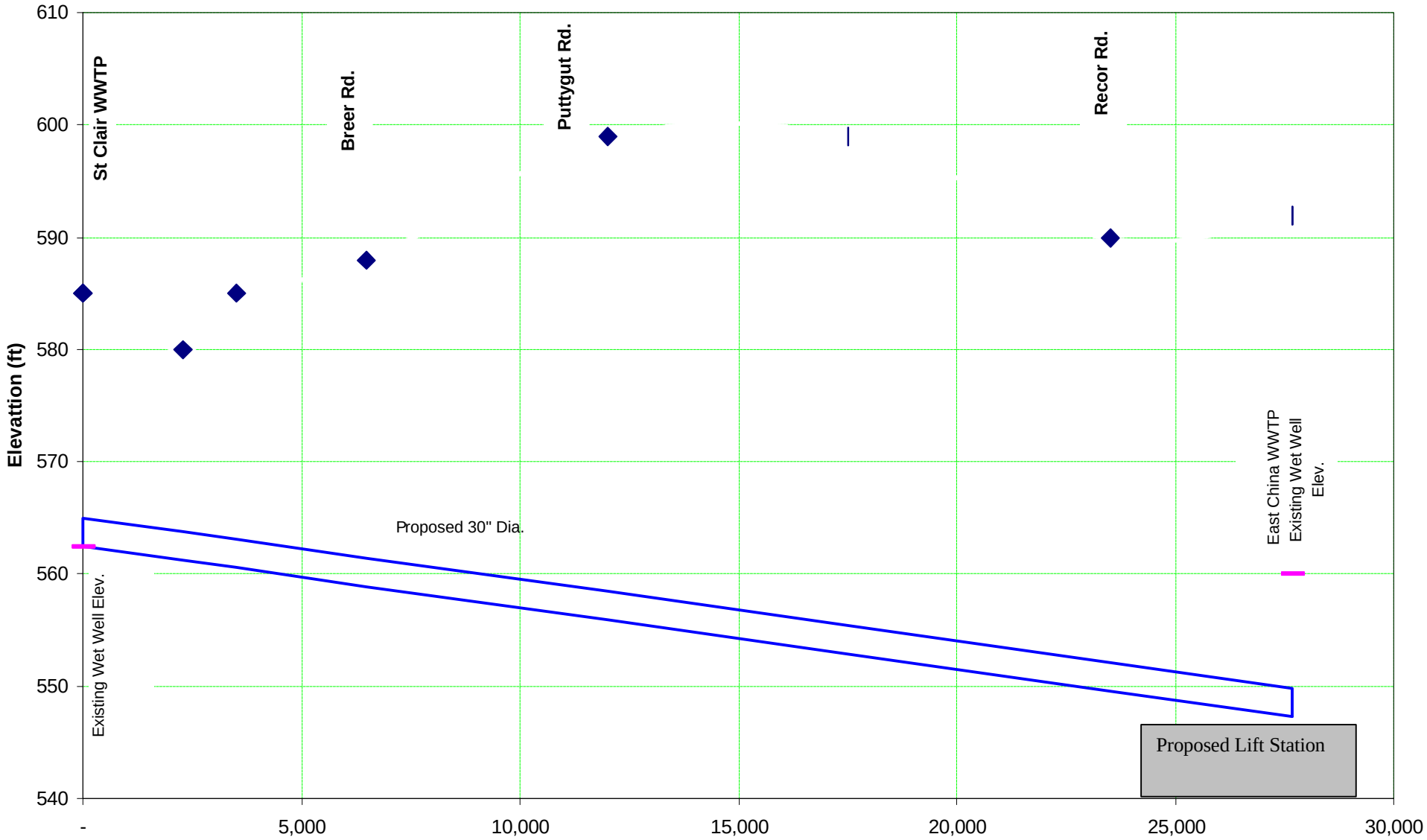


Figure 17. Sewer Profile for a New Wastewater Treatment Plant Site Along the St. Clair River – E. China Twp and Algonac to New Site

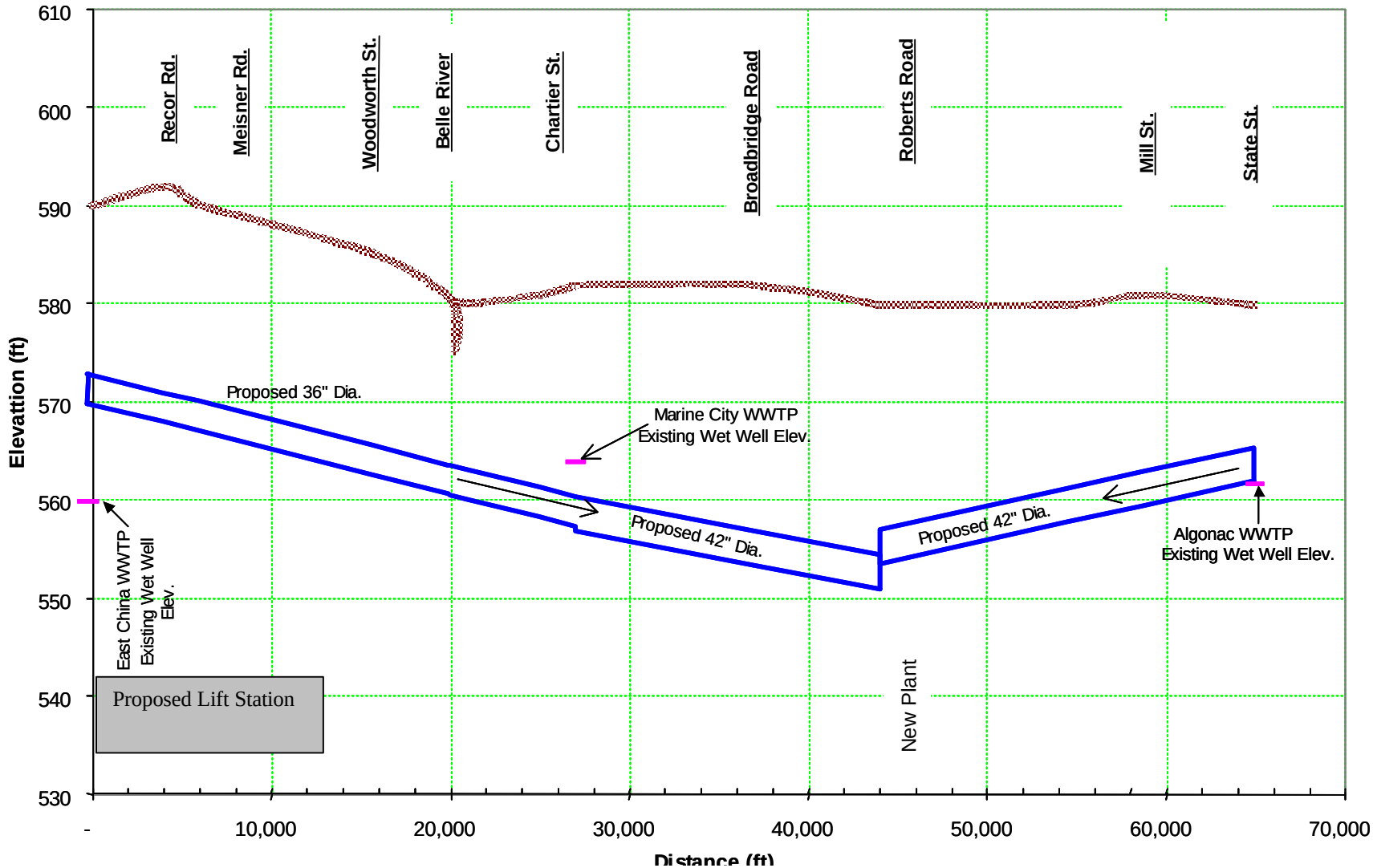


Figure 17 (cont). Sewer Profile for a New Wastewater Treatment Plant Site Along the St. Clair River – E. China Twp and Algonac to New Site

4.9 Demolition of Wastewater Treatment Plants

All of the options studied include conveying wastewater from one or more WWTPs, to another WWTP for treatment. The WWTPs that will no longer be treating wastewater can be demolished. The cost of demolishing the WWTPs was calculated in order to provide a better estimate of the total cost associated with the option. Prior to demolition of all or parts of the existing wastewater treatment plants, soil testing should be performed in order to determine if the soil has been contaminated. Since most treatment plants do not treat hazardous waste, there is little chance of contamination as a result of the sewage. Contamination may have occurred due to leaks from various chemicals stored on the treatment plant site.

The tanks at the treatment plant would need to be drained and any solids removed. The tanks may need to be disinfected prior to removal. Once the process equipment has been drained and disinfected it can be demolished and removed.

The cost for demolition of a wastewater treatment facility would include the following:

- Gutting of the buildings and process tanks.
- Demolition of the buildings and aboveground tanks.
- Demolition of the top four feet of tank and building walls.
- Filling in tanks and basements.
- Loading of rubble.
- Hauling of rubble to landfill.
- Dumping fees.

The costs associated with the demolition of the City of St. Clair, Algonac, and E. China Township WWTP's are shown below in Table 23:

Table 23. Cost of WWTP Demolition

Wastewater Treatment	Cost (Million $)
St. Clair County-Algonac WWTP	1.6
St. Clair River SA – E. China Township WWTP	3.9
City of St. Clair WWTP	2.3

The costs shown in Table 23 are for the complete demolition of the wastewater treatment plant sites and making the land available for future use. The demolition costs would be less if some of the existing buildings (such as the administration building) would continue to be utilized after the treatment processes are removed. Some of the tanks and equipment at a treatment plant to be demolished could remain in service to provide additional storage capacity in the conveyance system during high flow periods.
Construction of Interceptor from St. Clair County to DWSD Interceptor System (Option 5)

This option assumes all of the dry weather flow from the St. Clair County planning area excluding Casco Township and including East China Township would be treated at the Detroit Wastewater Treatment Plant.
A new interceptor would be needed to convey the flow from St. Clair County to the existing DWSD interceptor. Several options were considered such as taking all of the flow to the Algonac WWTP and then routing the flow to the Lake Shore Interceptor by following M-29 / I-94.

This option would involve combining the flow from the current Algonac WWTP, Marine City WWTP, City of St. Clair WWTP, and East China Township WWTP into a gravity sanitary sewer along M-29. Figure 18 illustrates the conveyance system for this option. A 42-inch pipe would be installed to deliver the wastewater from the Algonac WWTP to a new Pumping Station located in Cottrellville Township close to Robert Road and M-29. A 30-inch pipe would be installed to deliver the wastewater from the City of St. Clair WWTP to the St. Clair River Sewer Authority – East China Township WWTP, at which point a 36-inch pipe would be installed to deliver the wastewater from the St. Clair River Sewer Authority – East China Township WWTP to the new Pumping Station. This sewer would be upgraded to a 42-inch pipe after receiving the flow from Marine City. Flow from Marine City would be directed to the new sewer by gravity. A combination force main and gravity sewer would convey the flow to the Lake Shore Interceptor. The profile for this option is shown Figure 19.

This system would involve approximately 27,000 linear feet of 30-inch pipe, 27,000 linear feet of 36-inch pipe, 17,000 linear feet of 42-inch pipe, and 21,000 linear feet of 42-inch pipe. These pipes would lead to a new 22 MGD pumping station near Roberts Road in Cottrellville Township. From the pumping station, 56,000 linear feet of 48-inch force main and 63,000 linear feet of 60-inch gravity sewer would be needed to convey the wastewater to the Lakeshore Interceptor. The cost of this option is approximately $201.79 million.

The Wastewater Master Plan (WWMP) modeling team (CDM) indicated that the Lakeshore Interceptor south of Henry Joy Blvd. has a diameter of 11-feet and has a capacity in excess of 300 cfs. The existing dry weather flow at the Clintondale Pump Station is 15 cfs. The pump station's total capacity is 120 cfs with a firm capacity of 90 cfs. The team concurs that delivering St. Clair County wastewater flow to the Lakeshore Interceptor is a viable option on a technical basis, but the extra capacity may be claimed by Macomb County for its projected growth beyond what SEMCOG projections estimate.

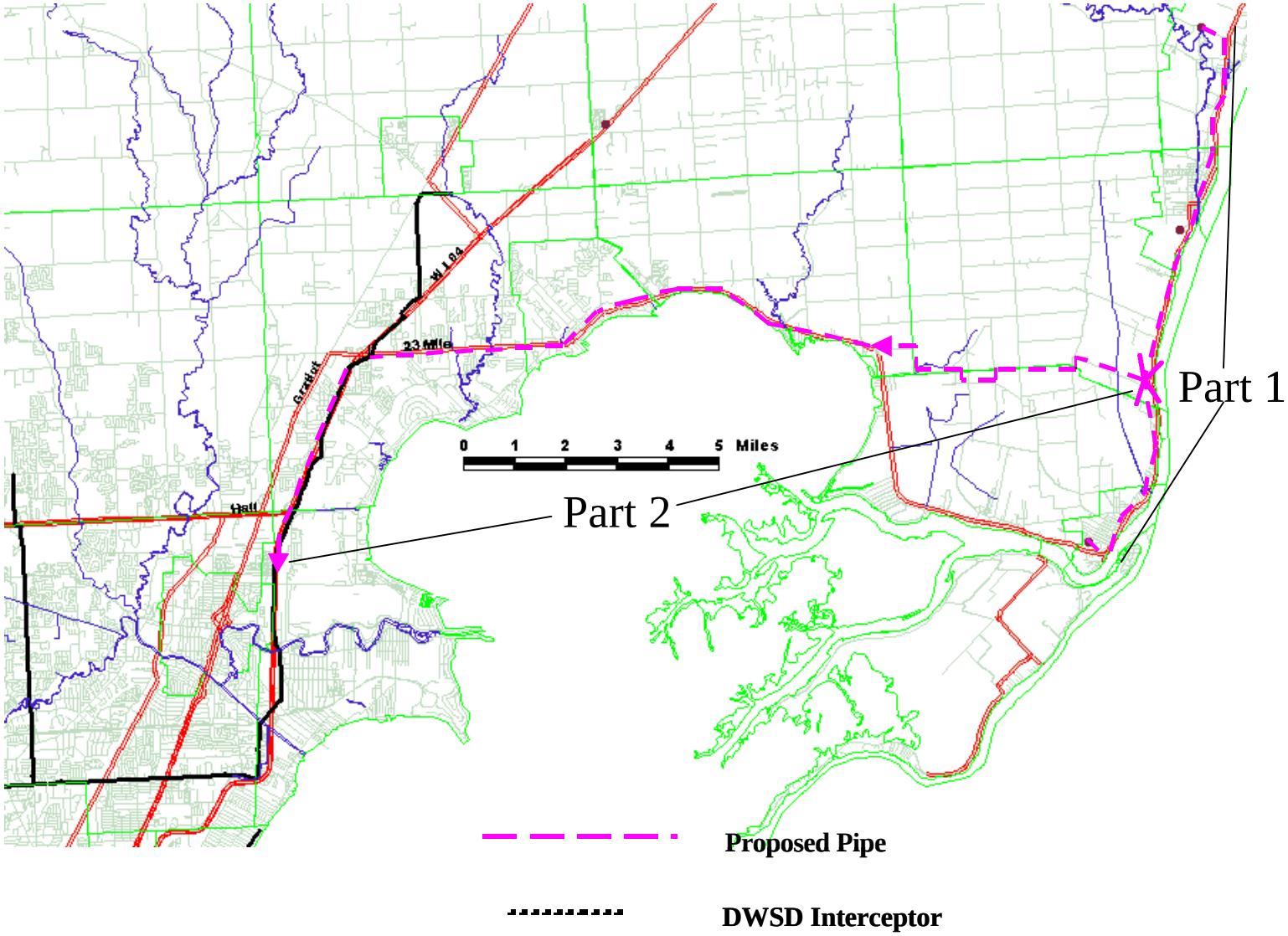


Figure 18. Conveyance System for Transporting Wastewater from St. Clair County to the Lakeshore Interceptor

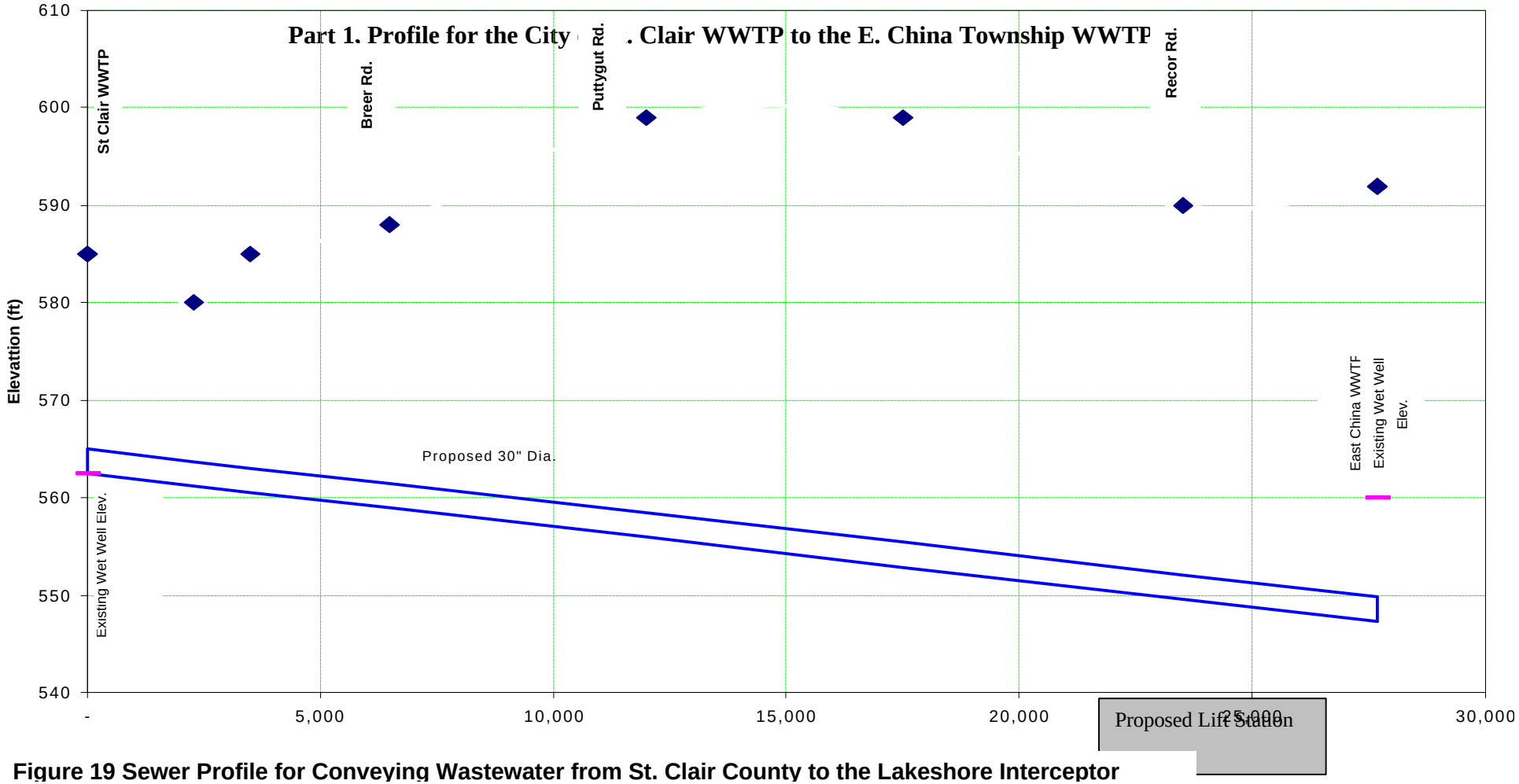


Figure 19 Sewer Profile for Conveying Wastewater from St. Clair County to the Lakeshore Interceptor

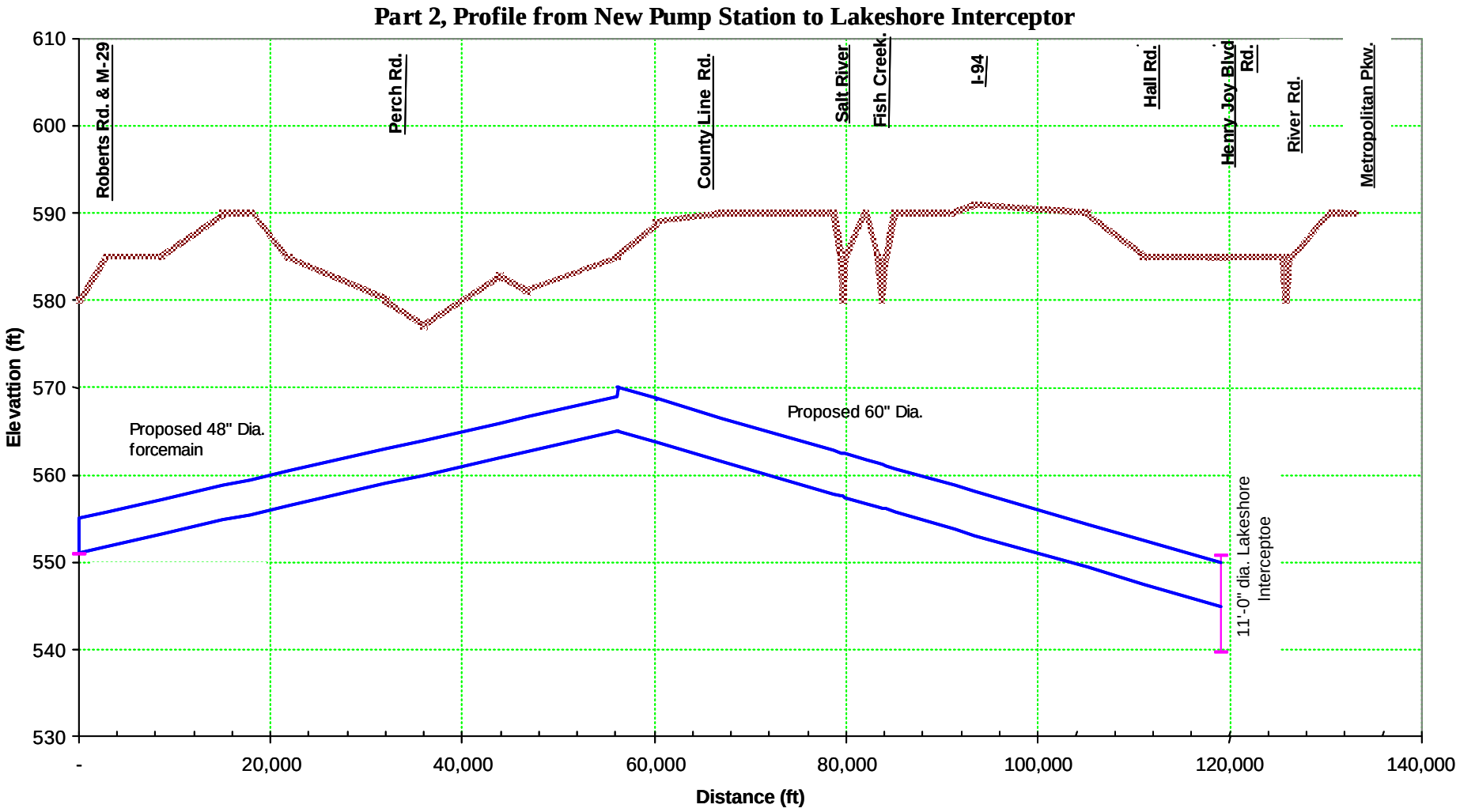


Figure 19 (cont). Sewer Profile for Conveying Wastewater from St. Clair County to the Lakeshore

Findings and Conclusion

The St. Clair County planning area currently has enough treatment capacity to handle the projected year 2050 flow for the entire area (Table 24). However, the available capacity is not located where the future deficits may be located.

Table 24. Comparison of Projected Flow to Current Design Capacity

Wastewater Treatment Plant	WWTP Design Capacity (MGD)	2050 Projected Flow (MGD)
St. Clair County - Algonac	4.0	3.1
St. Clair River Sewer Authority – East China Township	2.2	1.6
Marine City	1.0	1.1
City of St. Clair	1.4	1.3
TOTAL	**8.6**	**7.1**

The flow projections indicate that the City of St. Clair and Marine City WWTPs will be near or above their respective WWTP's design capacities. In order to evaluate possible alternatives to treat the wastewater from all or portions of the St. Clair County planning area, the options shown in Table 25 were evaluated and a $/gallon treatment and conveyance cost determined.

Table 25. Options and Associated per Gallon Costs

Option	Option Description	Treatment and Conveyance Costs per gallon/day ($/gal./day)
1	Expansion of St. Clair County – Algonac WWTP and Demolition of St. Clair Area WWTPs[1]	17.01
2	Expansion of St. Clair River Sewer Authority – East China Township WWTP (7.1 MGD) and Demolition of St. Clair Area WWTPs[1]	18.93
3	New WWTP discharging to St. Clair River – Cottrellville Township and Demolition of St. Clair Area WWTPs[1]	16.74
4	Expansion of St. Clair River Sewer Authority – East China Township WWTP (4.0 MGD) and Demolition of St. Clair Area WWTPs[2]	19.35
5	Interceptor to DWSD Collection System and Demolition of St. Clair Area WWTPs[1]	29.52

[1] St. Clair County-Algonac, East China Township, and City of St. Clair
[2] East China Township and City of St. Clair
[3] Includes pump station O&M and assuming a DWSD cost of $18.18/1,000 cubic feet of flow

The cost of building a conveyance system to transfer and treat the flow from the St. Clair County planning area at a St. Clair County WWTP or at the DWSD WWTP is high (between $16.74-$29.52/gallon).

Based on these cost findings and the small amount of wastewater from the two WWTPs that may exceed or approach their design capacities, it is better for the St. Clair County future wastewater flows to continue to be treated at small wastewater treatment plants near the areas of greatest demand.

APPENDIX A
Detailed Design Information for the Expanded and New WWTPs

E. China Township Expansion to 4 mgd
New WWTP - Secondary Treatment
Sizing Based on Ten State Standards and Reliability Criteria

Assumptions:	Average Flow	4	mgd
	Peaking Factor (Peak Hourly)	3.5	
	Maximum Day Peaking Factor	2.90	
	Influent BOD	165	mg/L
	Influent TSS	127	mg/L
	Influent Ammonia-N	15.8	mg/L
	Influent Total P	3	mg/L
	Effluent BOD	4	mg/L
	Effluent TSS	20	mg/L
	Effluent Ammonia-N	0.5	mg/L
	Effluent Total P	1	mg/L
	Reliability Class (1,2,3)	1	
	Most facilities are Class 1		
	Peak Hourly Flow at Headworks	14.0	mgd
	Peak Hourly Flow Rest of Plant	11.61	
	Maximum Day Flow	11.61	mgd
	Peak Hourly Flow to be Equalized	14.0	mgd

Calculations:

Preliminary Treatment

Coarse Bar Screen

Approach velocity greater than 1.25 ft/sec, less than 3 ft/sec at average flow

Selected approach velocity	2	ft/sec	
Selected angle from horizontal	30	degrees	
Channel Area	3.1	sf	
Channel Length and Width	2	ft, if square	
Bar Screen Dimensions	4	ft by	2 ft

Reliability Criteria Class I requires that one backup unit be provided

Raw Sewage Pumping Station

E. China Township Expansion to 4 mgd
New WWTP - Secondary Treatment
Sizing Based on Ten State Standards and Reliability Criteria

Minimum of 2 pumps capable of pumping peak hourly flow

Number of Pumps	2	minimum	4	pumps
Size of Pumps	14.0	mgd each	4.7	mgd each

Grit Chamber

Detention time of 3 to 5 minutes at peak hourly flow
Air rate of 3 to 8 cfm/ft of tank length

Number of units (exclude bypass)	2	
Selected detention time	4	minutes
Selected air rate	5	cfm/ft
Selected depth	15	ft
Volume	38,889	gal
Rounded volume	38,900	gal
Volume	5,199	cf
Rounded volume	5,250	cf
Length and width	13.2	ft, if square
Rounded legth and width	15	ft, if square
Air rate	75	cfm each

Retention Basin

Store water between peak hour and maximum day for 12 hours.

Selected Depth	20	ft
Volume	1.20	million gallons
	159,749	cf
Rounded Volume	165,000	cf
Surface Area	8,250	sf
Length and Width	90.8	ft
Rounded	95	ft

Primary Clarifiers

Minimum depth is 10 ft. SWD

Surface Overflow Rates	Design Ave. Flow	Design Peak Hourly Flow
No WAS	1000 gpd/sf	1500 to 3000 gpd/sf
Accepts WAS		1200 gpd/sf

E. China Township Expansion to 4 mgd
New WWTP - Secondary Treatment
Sizing Based on Ten State Standards and Reliability Criteria

Tank receives WAS?	n	(y or n)	
Selected Design Peak Hourly Flow	2,000	gpd/sf	
Waste Activated Sludge	0	mgd	
Recycle Streams	0	mgd	Recycled to Aeration Basins
Diameter	65	ft	

Surface area	4,000	sf at design average flow
	5,805	sf at peak hourly flow
Controlling surface area	5,805	sf
Round surface area	5,850	sf
Number of clarifiers	1.76	
Rounded number of clarifiers	2	

Reliability criteria

With largest unit out of service, should be able to treat 50 percent of the total design flow

Capable flow treatment	6.6	mgd
50% of design flow	5.805	mgd
	OK	

Secondary Treatment

Conventional Activated Sludge

Aeration Tank Organic Loading is 40 lb./day/1000 cf
Freeboard Requirements: 18 in. for diffusers
3 ft. for surface aerators

Assumed BOD percent removal in primary clar.	30	percent	
WAS BOD Concentration	3000	mg/L	
Recycle BOD Concentration	250	mg/L	Est.
Recycle Flow	0	mgd	Est.
Side Water Depth	15	ft	
Number of Basins	2		
Length to width ratio	3		
BOD Loading to Aeration Basins	3,852	lb./day	
Rounded	4,000	lb./day	
Total Volume of Basins	100,000	cf	
Rounded	100,000	cf	
Area	6,667	sf	
Length	100.0	ft	
Rounded	105	ft	
Width	33.3	ft	
Rounded	35	ft	

<u>Aeration</u>

E. China Township Expansion to 4 mgd
New WWTP - Secondary Treatment
Sizing Based on Ten State Standards and Reliability Criteria

lb. O2/hp hr	2	
Oxygen requirements	12,297	lb. oxygen at peak hour conditions
Horsepower	256	hp
Rounded	260	hp

Reliability criteria will be met as long as there are a minimum of 2 equally sized basins

RAS Pumps

RAS pumps must be able to pump between 0.5 and 1.5 times the design average flow

0.5 * Qave	2.0	mgd
1.5 * Qave	6.0	mgd

WAS Pumps

Minimum of 25 percent of average flow

0.25 * Qave	1.0	mgd

Secondary Clarifiers

Overflow rate at Design Peak Hourly Flow	1,200	gpd/sf
Peak Solids Loading Rate	50	lb./day/sf
Minimum side water depth is 12 ft		
Assumed MLSS	3,000	mg/L
Number of clarifiers	4	
Surface area	9,675	sf, based on surface overflow rate
	8,809	sf, based on solids loading rate
Controlling	9,675	sf
Rounded	9,700	sf
Diameter	55.6	ft
Rounded	60	ft

Reliability Criteria

Treatable Flow	10.2	
75% of design flow	8.7	
	OK	

Ultraviolet Disinfection

E. China Township Expansion to 4 mgd
New WWTP - Secondary Treatment
Sizing Based on Ten State Standards and Reliability Criteria

Treat flow from entire facility.

Peak Flow	11.61	mgd
Transmittance	65	percent
Dose	32,500	uW-sec/cm2

Sludge Handling

Primary and Secondary Sludge Handled Separately

Primary Sludge

Assumed solids removal	60	percent
Assumed percent solids	4	percent

Mass Solids for Primary Sludge	2,541	lb./day
Flow for Primary Sludge	7,620	gpd

Secondary Sludge

Chemical Sludge

Assumed Iron Dose Dose:	3	mg Fe/mg P
Assumed Non-Chemical P Removal	0.01	lb./ P removed per lb.. BOD removed

Assumed 2 lb. FSS produced for each lb. Iron removed

P removed prior to chemical	39	lb./day
	1.2	mg/L
Iron needed to remove 3.6 mg/L P	185	lb. Fe/day
Solids Produced	369	lb./day solids
Rounded	375	lb./day solids

Waste Activated Sludge

Assumed 1 lb. WAS produced per lb. BOD removed

Assume WAS is	0.8	percent solids

Mass Solids from WAS	3,852	lb./day

Total Secondary Sludge	4,227	lb./day
	63,373	gpd

Gravity Belt Thickener Storage

Only secondary sludge undergoes gravity belt thickener storage

E. China Township Expansion to 4 mgd
New WWTP - Secondary Treatment
Sizing Based on Ten State Standards and Reliability Criteria

Number of Gravity Feed Storage Days	2	days	
Storage Volume	126,745	gallons	
	16,943	cf	
Rounded	17,000	cf	

Centrifuge

Both primary and secondary sludge are centrifuged

Number of Centrifuge Storage Days	4	days	
Gravity Belt Thickened Solids	8	percent	
Days of Centrifuge Operation	5	days/week	
Hours of Operation per Day	8	hrs/day	
Primary Sludge Flow to Centrifuge	7,620	gpd at	4 percent solids
Secondary Sludge Flow to Centrifuge	6,337	gpd at	8 percent solids
Total Flow to Centrifuge	13,957	gpd	
Rounded	14,000	gpd	
Centrifuge Storage	56,000	gallons	
	7,486	cf	
Rounded	7,500	cf	
Centrifuge Size	41	gpm	
Rounded	45	gpm	

Landfill Storage

Assumed	7	days	
Centrifuged Sludge	20	percent	
Flow to Storage Tank	4,059	gpd	
Rounded	4,250	gpd	
Storage Volume	28,412	gallons	
	3,798	cf	
Rounded	4,000	cf	

APPENDIX B
Detailed Costing Information for the Expanded and New WWTPs

St. Clair County Wastewater Treatment Option – 7.1 MGD Conventional Activated Sludge

Cost Summary

Layout Name	Project ($)	Oper. ($/yr)	Maint. ($/yr)	Mat. ($/yr)	Chem. ($/yr)	Energy ($/yr)
St. Clair Co. Option	$30,180,000	$996,000	$232,000	$1,360,000	$91,300	$476,000

Process Summary

Process	Construction ($)	Oper. ($/yr)	Maint. ($/yr)	Mat. ($/yr)	Chem. ($/yr)	Energy ($/yr)
Influent Pump Station	$1,520,000	$41,900	$30,000	$10,600	$0	$32,200
Preliminary Treatment	$764,000	$68,800	$30,600	$0	$0	$3,170
Wastewater Splitter	$0	$0	$0	$0	$0	$0
Equalization	$1,580,000	$40,100	$30,600	$3,210	$0	$132,000
Primary Clarification	$925,000	$49,800	$23,400	$9,250	$0	$809
Intermediate Process Pumping	$513,000	$27,600	$20,100	$3,590	$0	$38,200
Complete Mix Activated Sludge	$2,150,000	$155,000	$81,700	$41,900	$0	$214,000
Iron Feed System	$152,000	$33,700	$0	$3,040	$0	$0
Coagulation - Flocculation	$0	$0	$0	$0	$385,000	$0
Secondary Clarifier	$1,830,000	$64,400	$30,400	$18,300	$0	$868
Ultra-Violet Disinfection	$1,040,000	$0	$17,900	$10,400	$3,550	$33,100
Post Aeration	$89,100	$34,100	$12,000	$1,910	$0	$6,890
Blower System	$377,000	$0	$0	$0	$0	$0
Gravity Thickening	$176,000	$17,100	$11,600	$1,760	$0	$531
Centrifugation	$1,220,000	$181,000	$26,000	$38,800	$0	$14,000
Hauling and Land Filling	$250,000	$24,500	$0	$1,220,000	$0	$0
Other Direct Costs (Labor and Construction)	$21,200,000	$0	$0	$0	$0	$0

East China Township Wastewater Treatment Expansion – 4 MGD Conventional Activated Sludge

Cost Summary

Layout Name	Project ($)	Oper. ($/yr)	Maint. ($/yr)	Mat. ($/yr)	Chem. ($/yr)	Energy ($/yr)
E. China Twp WWTP-4 MGD	$20,450,000	$791,000	$232,000	$795,000	$51,400	$254,000

Process Summary

Process	Construction ($)	Oper. ($/yr)	Maint. ($/yr)	Mat. ($/yr)	Chem. ($/yr)	Energy ($/yr)
Influent Pump Station	$958,000	$34,600	$24,300	$6,700	$0	$22,200
Preliminary Treatment	$533,000	$49,600	$22,100	$0	$0	$2,430
Wastewater Splitter	$0	$0	$0	$0	$0	$0
Equalization	$620,000	$24,300	$15,400	$1,010	$0	$47,000
Primary Clarification	$686,000	$38,800	$17,800	$6,860	$0	$755
Intermediate Process Pumping	$356,000	$25,500	$17,900	$2,490	$0	$21,600
Complete Mix Activated Sludge	$1,510,000	$124,000	$62,300	$33,500	$0	$128,000
Iron Feed System	$152,000	$29,100	$0	$3,040	$0	$0
Coagulation - Flocculation	$0	$0	$0	$0	$49,500	$0
Secondary Clarifier	$1,470,000	$53,500	$24,600	$14,700	$0	$825
Ultra-Violet Disinfection	$699,000	$0	$9,720	$6,990	$1,970	$18,400
Post Aeration	$68,100	$31,000	$9,830	$1,700	$0	$3,880
Blower System	$298,000	$0	$0	$0	$0	$0
Gravity Thickening	$92,100	$12,300	$8,640	$921	$0	$448
Centrifugation	$862,000	$136,000	$19,300	$24,600	$0	$8,250
Hauling and Land Filling	$166,000	$13,900	$0	$692,000	$0	$0
Other Direct Costs (Labor and Construction)	$14,400,000	$0	$0	$0	$0	$0

Summary of Outfall Costs

Description	Quantity	Unit	Unit Amount	Total Amount
St. Clair County Algonac WWTP – 42 inch	2,600	LF	$550	$1,430,000
St. Clair River SA – East China – 42 inch	8,000	LF	$550	$4,400,000
New WWTP – Cottrellville Twp – 42 inch	1,400	LF	$550	$770,000

CS-1314 Wastewater Master Plan - Conceptual Project Estimate for CIP

Category: Interceptors & Trunk Sewers

Estimate by: TTMPS

Project No. 1.00
Project Name Option 2 - Expansion of E. China Twp WWTP
Project Location St. Clair County
Start Year
End Year
Duration (years)
Source of Funds

No.	Item Description	Quantity	Unit	Cost Source**	Unit Amount	Total Cost
1.0	30-inch diameter sewer, RCP, open cut, est. 40' deep, including manholes (St. Clair to E.China)	27300	ft		$ 375	$ 10,237,500
1.2	48-inch diameter sewer, RCP, open cut, est. 24' deep, including manholes (Marine City to E. China)	27300	ft		$ 650	$ 17,745,000
1.3	42-inch diameter sewer, RCP, open cut, est. 40' deep, including manholes (Algonac to Marine City)	37900	ft		$ 525	$ 19,897,500
Subtotal						$ 47,880,000
	Contractor Overhead & Profit (25%)					$ 11,970,000
	Total Construction					$ 59,850,000
	Contingency (30%)					$ 17,955,000
	Engineering, Legal, Administrative, Management (20%)					$ 11,970,000
	Total Project Cost					$ 89,775,000

Notes:

** Source of cost information coded as follows:

A = Tech Memo - Cost Estimating Guideline for Conveyance Facilities: List table number.

B = Tech Memo - Cost Estimates for Treatment Facilities: List table number.

C = Other source - list source on attached page and attach supporting information.