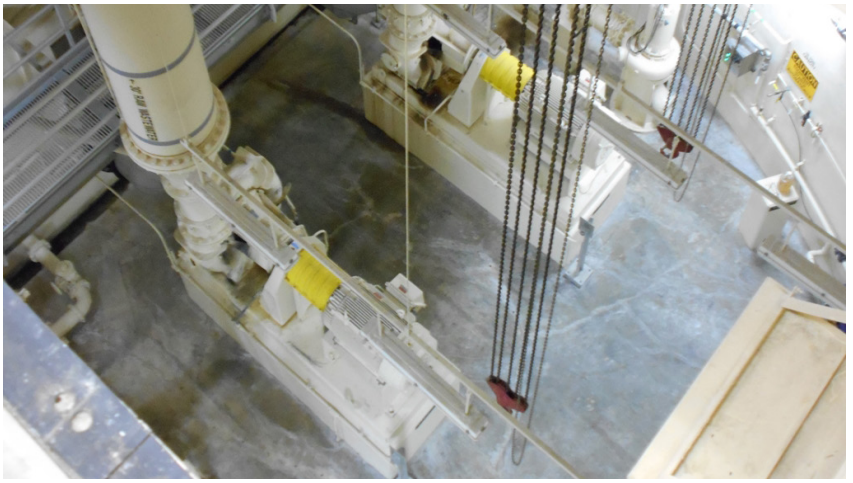
Rochester Water Reclamation Plant

2019 Facilities Plan

Technical Memorandum 12: NPDES Permitting Process

TM 12 of 13 | J4325



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Brown AND Caldwell

Technical Memorandum

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Prepared for: City of Rochester

Project Title: Water Reclamation Plant Facilities Plan

Project No.: 150811

City No.: J4325

Technical Memorandum No. 12

Subject: NPDES Permitting Process

Date: September 30, 2019

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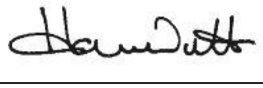
Reviewed by: 
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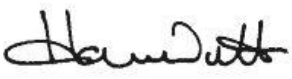
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: 

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Limitations:

This document was prepared solely for the City of Rochester in accordance with professional standards at the time the services were performed and in accordance with the contract between City of Rochester and Brown and Caldwell dated May 15, 2017. This document is governed by the specific scope of work authorized by the city of Rochester; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the City of Rochester and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Section 1: Background

This technical memorandum (TM) describes key components of the NPDES permitting process for the City of Rochester (City) Water Reclamation Plant (WRP), including topics of recent or ongoing discussions with the Minnesota Pollution Control Agency (MPCA). The City's current NPDES permit (MN0024619) was issued in 2010 with an original expiration date of April 30, 2015, but has been administratively continued. The continuance is allowing time for the City and MPCA to determine the best approach to several complex permitting issues including phosphorus and salt-related parameters. Current expectations are that the City and MPCA will maintain regular communications on the permitting process. The draft permit would be subject to review and comment both by the City, the public and USEPA Region V prior to being finalized. The TM is organized into the following major sections:

- Section 1: Background
- Section 2: Nutrients
- Section 3: Salt-Related Parameters
- Section 4: Other Constituents
- Section 5: Alternative Outfall
- Section 6: References

Section 2: Nutrients

This section summarizes the recent history and status of discussions between the City and MPCA regarding the development of phosphorus limitation, and also briefly describes the state's longer-term approach for nitrogen.

2.1 Phosphorus

The City's existing NPDES permit includes a total phosphorus loading limits of 72.2 kg/day (12-month rolling average) and a concentration limit of 1.0 mg/L (calendar month average). These phosphorus limits date to the early 1980s and were imposed for the protection of Lake Zumbro. Much of the ongoing discussion between the City and MPCA has focused on the approach for reevaluating the phosphorus limit as part of the NPDES permit renewal that considers the existing Lake Eutrophication Standards for Lake Zumbro and the River Eutrophication Standards that were adopted in 2015 that apply to the South Fork of the Zumbro River. Subsections below recap the likely water quality drivers of phosphorus limits, status of modeling efforts, and other considerations for reevaluation of the phosphorus limit.

2.1.1 Water Quality Drivers

The Rochester WRP discharges to the South Fork of the Zumbro River (Assessment Unit 07040004-507) about 18 river kilometers upstream of Lake Zumbro. Water quality standards in Lake Zumbro are likely to control the phosphorus allocations for the Rochester WRP and other point sources upstream of the lake. Lake Zumbro is listed as impaired for nutrients/eutrophication on Minnesota's 2018 303(d) list, based on the previous lake eutrophication standard for the ecoregion in which Lake Zumbro falls. However, MPCA has since adopted a site-specific water quality standard for Lake

Zumbro (MPCA, 2017a) that was approved by USEPA in August 2018. MPCA demonstrated that attainment of these standards would support the aquatic life and recreation. This is consistent with previous comments from the City that a site-specific standard was appropriate for Lake Zumbro (Brown and Caldwell, 2015) and the City's demonstration that user perceptions of recreational suitability in Lake Zumbro were largely independent of chlorophyll-a values (Brown and Caldwell, 2016a).

Recent historical data and models would indicate that Lake Zumbro currently attains the site-specific standard, but would not attain it if phosphorus loads/concentrations increases substantially above current conditions (MPCA, 2017). Therefore, although it will not be necessary to develop a total maximum daily load (TMDL) for phosphorus in Lake Zumbro, MPCA's basic watershed management approach will be to cap phosphorus loads at recent historical levels. The site-specific standard only applies at flows up to ~960 cfs (or flow below the 85th percentile of flow) as measured at the outlet of Lake Zumbro. Actual de-listing of Lake Zumbro will not occur until a future cycle of the 303(d) list because of the MPCA's monitoring frequency and minimum data requirements for assessment. Ongoing monitoring by the City could accelerate the de-listing date.

Table 2-1: Lake Eutrophication Standards

Parameter	Units	Default Regional Standard[1]	Lake Zumbro Site-Specific Standard[2]
Total phosphorus	ug/L	65	105
Chlorophyll-*a*	ug/L	22	48
Secchi depth	meter	0.9	1.4

[1]*Lake eutrophication standard for the western corn belt plains and northern glaciated plains*

[2]*These values apply up to flows of ~960 cfs as measured at the outlet of Lake Zumbro.*

In addition to goals for Lake Zumbro, Minnesota's water quality standards also include river eutrophication standards. Although the Zumbro Watershed area is split almost evenly between the central and south region, the City's WRP discharge location at the South Fork of the Zumbro River falls into Minnesota's central region for river eutrophication standards, which includes a phosphorus target of 100 ug/L and associated targets for chlorophyll-a, dissolved oxygen flux, and five-day biological oxygen demand (BOD5) (Table 2-2). The 2016 version of Minnesota's 303(d) list cited the receiving water segment impaired for nutrients/eutrophication. However, the segment was delisted in 2018 based on more recent monitoring data.

The City has recommended that a site-specific river eutrophication standard be adopted for the South Fork of the Zumbro River (Table 2-2). This technical basis for this recommendation was provided in a technical memorandum (Brown and Caldwell, 2016b) that cited the following lines of evidence: (1) the geographic characteristics of the segment's watershed indicate that the response variable targets should be intermediate between the South Region and Central Region default RES; (2) the segment exhibits a different relationship between TP and response variables than reflected in the default standards; and (3) alternative values can be shown to be fully protective of all beneficial uses including aquatic life uses, as reflected in attainment of benthic macroinvertebrate and fish metrics (Brown and Caldwell, 2016b).

Table 2-2. River Eutrophication Standards				
Region	TP (µg/L)	Response Indicator		
		Chl-*a* (µg/L)	DO flux (mg/L)	BOD_5 (mg/L)
North	≤50	≤7	≤3.0	≤1.5
Central	≤100	≤18	≤3.5	≤2.0
South	≤150	≤35	≤4.5	≤3.0
Proposed by City for SF Zumbro River	≤150	≤27	≤4.0	≤2.5

2.1.2 Modeling Status

To support watershed management planning efforts, MPCA engaged LimnoTech, Inc. to develop an HSPF model of nutrient and sediment loading in the Zumbro River watershed (LTI, 2014, LTI, 2015). The HSPF model was originally calibrated to 1996-2009 streamflow and water quality data. MPCA has performed BATHTUB modeling of the Lake Zumbro itself using nutrient loads from the HSPF model. These models were originally developed to support nutrient TMDL development in the Zumbro watershed. Although nutrient TMDLs may not be necessary, the models will still serve as important tools for nutrient planning and permitting in the watershed. The City reviewed the original HSPF modeling effort in 2015 (Brown and Caldwell, 2015). Comments included the recommendations to correct a bias in the phosphorus calibration, update the model with more recent water quality data, simulate the impact of nonpoint source BMPs on nutrient concentrations in sediment and karst groundwater, and model equitable point and nonpoint source nutrient reduction scenarios.

In 2017, LTI performed an exploration of the sensitivity of HSPF predictions to BMP-driven changes in sediment/baseflow phosphorus concentrations (LTI, 2017). The results showed that instream predictions of phosphorus concentrations were relatively insensitive to these changes under the low-to-moderate streamflow conditions that would control point source phosphorus limits. However, because even small changes to the phosphorus limit could have major attainability implications for the WRP, the City has retained the recommendation to explicitly model the effect of nonpoint source BMPs on river sediment and baseflow phosphorus concentrations. The City also recommended a specific methodology for modeling these effects in HSPF (Brown and Caldwell, 2018).

Discussions between the City and MPCA have also addressed the topic of the equitable levels of nonpoint source BMP implementation for the Zumbro River watershed. The agreed-upon concept is that nonpoint sources would be simulated at aggressive but realistic levels of reduction, consistent with the BMP types and implementation rates to which watershed stakeholders have previously agreed. Table 2-3 shows the recommended input deck for the South Fork Zumbro River watershed, and represents the "combined scenario" of previous HSPF modeling (LimnoTech, 2015) and the Zumbro River watershed WRAPS report (MPCA, 2017b).

In 2019, MPCA issued a task order to LTI to update the Zumbro HSPF model and extend the modeled period to 2018, re-calibrate as necessary, and consider recent work on phosphorus concentrations in interflow, groundwater, and bed sediments. The updated modeling would also incorporate additional river water quality data that was collected by the WRP, as there were concerns about the limited water quality data set that was available in the original calibration. The work order also includes modeling of new nonpoint source and point source phosphorus reduction scenarios. The forthcoming modeling results are expected to be one of the foundations of phosphorus wasteload allocations in the Zumbro River watershed.

Table 2-3. Proposed Nonpoint Source Implementation Rates for South Fork Zumbro Allocation Scenarios

Practice	S. Fk. Zumbro R. Implementation Rate[1]	Source
Cover crops	30% of cropland	Combined HSPF scenario
Retention basins	30% of cropland	Combined HSPF scenario
Target P205 rate	80% or 90,420 acres	WRAPS report
Reduced tillage	10% or 4,190 acres	WRAPS report
Riparian buffers	100% or 6,770 acres	WRAPS report
Perennial crop % of marginal corn/soybean	50% or 3,170 acres	WRAPS report
Rye cover crop on corn/soybean	6% or 6,460 acres	WRAPS report
Short season crops planted to rye cover crop	80% or 4,310 acres	WRAPS report
Alternative tile intakes	3% or 580 acres	WRAPS report
Inject/incorporate manure	50% or 5,050 acres	WRAPS report

[1]*Table 19 of the 2017 Zumbro River WRAPS report specifies implementation rates for other subwatersheds as well.*

2.1.3 Limit Development

The ongoing modeling described in section 2.1.2is expected to provide part of the technical basis for phosphorus wasteload allocations in the Zumbro River watershed. With nonpoint source reductions fixed based upon realistic BMP implementation rates (Table 2-3), the aggregate point source allocations could be determined. The manner in which the aggregate point source wasteload allocations are distributed between facilities will require additional discussions between MPCA, the City, and other stakeholders. In some settings, larger wastewater treatment plants are required to achieve greater proportional reductions or lower concentrations than smaller facilities due to economies of scale or greater pollutant reduction ability. However, the high purity oxygen technology employed at the Rochester WRP cannot reliably achieve a phosphorus limit below a 0.8 mg/L. The City has demonstrated that wasteload allocations based on lower concentrations would entail high upgrade costs on both a per pound and a per ratepayer basis for Rochester, relative to smaller facilities (City of Rochester, 2019). Hence, the City has recommended that the wasteload allocation basis should be similar for point sources within the watershed.

Other factors to be determined for the limit development include averaging period, operational variability, seasonal application, and expression as mass vs. concentration. The City's current preference is that the limit be expressed as a 5-year rolling average based on summer average mass limit, which would protect Lake Zumbro with the maximum amount of operational flexibility especially considering the WRP's use of biological phosphorous removal which has known operational variability.

2.2 Nitrogen

The Rochester WRP's NPDES permit does not currently include a permit limit for nitrogen species as a contributor to eutrophication, and such limits are not expected in the next permit iteration. However, nitrogen-related limits are a possibility for future NPDES permits. Potential drivers of such limits

include nitrate criteria and Minnesota's programmatic goals for reducing nitrogen loading to downstream waters. The existing nitrate criterion for the protection of human health in Minnesota is set at 10 mg/L, which applies to surface waters designated for drinking water uses (Class 2A and Class 2Bd). Nitrate standards to protect aquatic life in Minnesota surface waters might also be developed in the next few years.

The Minnesota Nutrient Reduction Strategy developed (MPCA, 2014) established a planning level nitrogen reduction goal of 45 percent by the provisional target date of 2040, from the average 1980-1996 conditions for major basins, including the Mississippi River/Gulf of Mexico, to which the Zumbro Lake ultimately discharges. The nitrogen milestone for the Mississippi River is set at a 20 percent (18,200 metric tons) reduction by 2025. The Zumbro River watershed is a priority watershed to attain the nitrogen reduction goal. Several steps used in the Minnesota Phosphorus Strategy (MPCA, 2000) are also proposed for nitrogen, including influent and effluent nitrogen monitoring at wastewater treatment facilities, nitrogen management plans for wastewater treatment facilities, nitrogen effluent limits, adding nitrogen removal capacity with facility upgrade and point source to nonpoint source trading.

At this time, MPCA has not established a schedule to include nitrogen limits in NPDES permits. If and when a nitrogen limit is included in the Rochester WRP permit, the City's preference would be that it be developed for nitrite plus nitrate rather than total nitrogen or TKN. This is because the plant influent contains a relatively high proportion of soluble non-degradable organic nitrogen that cannot be removed using conventional wastewater treatment process and does not contribute to downstream eutrophication to the same degree as inorganic nitrogen species.

2.3 Trading

Nutrient trading could be a supplementary compliance strategy for Rochester WRP. Although credits obtained by trading are likely to be small relative to the City's reduction requirements, trading could potentially be useful to bridge a small gaps between discharged loads and wasteload allocations, or provide a margin of safety. Minnesota does not currently have a statewide nutrient trading framework, but has allowed trading as a compliance option in individual permits. From the City's perspective, it is desired that a trading framework provide a clear trading mechanism while not placing undue burdens that would diminish the incentive for trading.

In 2018, the City proposed draft language (City of Rochester, elec. comm., 11 Feb 2019) for a permit-specific trading framework to MPCA, with much of the language drawn from other Minnesota NPDES permits (Princeton, South Minnesota Beet Sugar). The proposed language identifies various nonpoint source BMPs (e.g., soil erosion controls, cover cropping, stormwater retrofits) as eligible for generating credits and states that MPCA would evaluate the eligibility of other BMPs on a case-by-case basis. It also describes the process for MPCA approval of credits and for annual reporting.

One trading issue to be resolved is the degree of conservativeness of the trading framework, as reflected into factors such as the nonpoint-to-point trading ratio and BMP-specific crediting factors. In combination with conservative factors for crediting individual BMPs (e.g., conservatively low BMP efficiencies of delivery factors), a high trading ratio reduces the incentive for trading. MPCA has recently required a nonpoint-to-point source trading ratio of 2.6, meaning that the permittee would have to obtain 2.6 lb/yr of nonpoint source reduction for every 1 lb/yr discharged at the WRP. The 2.6 factor reflects the basic offset requirement (1.0) plus an engineering safety factor (0.6), and an uncertainty factor (1.0).

The trading ratio of 2.6 is relatively high compared to what many other states and regions have used. For example, USEPA (2014) recommended a trading ratio of at least 2.0, but also acknowledged that

lower ratios could be used in situations where nonpoint source load reductions can be more reliably determined. Similarly, USEPA (2019) states that "The use of appropriate models and verification practices may reduce or eliminate the need for trade ratios which ultimately reduce the value of a water quality credit and increase the cost of participation." The City's proposed framework recommends a trading ratio of 1.6 with the understanding that the design and maintenance nonpoint source practices would be subject to review and verification.

Another trading issue to be resolved is assurance that projects could be brought forth to the MPCA and approved without reissuing or public notice of the permit. Similarly, it would be desired that upon substantial completion of the project, credits could be applied without reissuing or public notice of the permit. Without this aspect of the framework, the implementation of non-point source reduction projects would be extremely challenging.

Section 3: Salt-Related Parameters

Salt-related parameters include chloride, total dissolved salts (salinity), and specific conductance. These parameters are challenging for wastewater treatment plants because standard treatment technologies do not remove them, and the technologies that are effective (e.g., reverse osmosis) are generally cost prohibitive. Widespread use of water softeners in the community contributes to high concentrations in wastewater influent/effluent. Recent monitoring data suggests that the Rochester WRP has reasonable potential to cause exceedances of water quality criteria for these parameters and could meet a potential chloride limit, but could not meet limits for specific conductance, and may not be able to reliably meet limits for total dissolved salts.

3.1 Water Quality Drivers

The relevant water quality standards for salt-related parameters pertain to Class 2 (aquatic life), Class 3 (industrial consumption) and Class 4 (agriculture and wildlife) (Table 3-1). Of these classes, the South Fork of the Zumbro River carries classifications of 2 (aquatic life and recreation), 3C (industrial cooling and materials transport), 4A (irrigation), and 4B (wildlife and livestock watering). The South Fork Zumbro River is not listed as impaired for salt-related parameters, nor have these parameters been cited as a likely cause of biological impairments of the stream (MPCA, 2016).

Table 3-1. Salt-Related Standards Applicable to the South Fork of the Zumbro River

Parameter	Value	Use Classification
Chloride (mg/L)	230 (chronic)	2—Aquatic life and recreation
Hardness, mg/L as CaCO3	500	3C—Industrial cooling and materials transport
Total dissolved solids, mg/L	700	4A—Irrigation
Bicarbonates, mg/L as CaCO3	250	4A—Irrigation
Specific conductance, µmho/cm	1,000	4A—Irrigation
Total salinity, mg/L	1,000	4B—Wildlife and livestock watering

In 2019, MPCA requested comments on possible amendments to rules governing water quality standards for industrial (Class 3) and agricultural and wildlife (Class 4) usage. As outlined in the associated technical support document (MPCA, 2019a), the major potential changes were as follows:

- Replacing numeric standards for existing subclasses 3A–3D with a single narrative standard;
- Limiting the Class 3 designation to only surface waters subject to the Minnesota Department of Natural Resources (MDNR) water appropriations permitting program for specific industrial uses;

- Updating numeric standards for Class 4A (irrigation) and Class 4B (wildlife and livestock watering) to reflect current science, including the replacement of the 1,000 mg/L salinity standard with a 3,000 mg/L total dissolved solids standard.
- Limiting the Class 4A standards with application only on a seasonal basis (during the growing season) and only to waters with active MDNR water appropriation permits.
- There must be an active MNDNR surface water irrigator downstream of the WWTP to consider a WQBEL based on Class 4A (irrigation).

The technical support document also described a narrative translator process that could be used to determine if a water quality-based effluent limit (WQBEL) should be placed in a NPDES permit. This process would include WQBELs if, among other factors, the water quality at the first downstream irrigators is unsuitable for irrigation and the soils have a salinization risk. A preliminary evaluation indicates that the application of this process to the Rochester WRP would result in a determination that no WQBEL for salt-related parameters is necessary. The timeline for adoption of the Class 3 and Class 4 rule changes has not been precisely determined, but it could occur as early as 2020.

3.2 Variance

If the Rochester WRP did receive a WQBEL for a parameter such as total dissolved solids or specific conductance, the facility would likely to obtain a water quality variance, which are available to municipalities under Minn. R. 7050.0190 and Title 40 Code of Federal Regulations (CFR) part 131.14. A variance is a temporary change in a state's water quality standard for a specific pollutant and its relevant criteria, allowing deviation from meeting a water quality-based effluent limit (WQBEL) for a particular discharger. MPCA has developed a variance screening calculator to determine economic feasibility of reducing chloride in a number of manners. This calculator commonly shows that municipalities are eligible for variances to the short-term economic impracticality of installing membrane treatment, replacing water softeners, or otherwise achieving the necessary level of salty parameter reduction over a small number of permit terms.

Proposed variances are subject to public comments and USEPA review and approval. Under Minnesota's requirements of water quality variances, municipalities must provide a, "quantifiable expression of the highest attainable condition" and "must commit to optimization of current treatment and a pollutant minimization program if additional controls are not feasible" (MPCA, 2017). If a variance is granted, the NPDES permit would contain an interim limit for the relevant parameters and the requirement to develop and implement a management plan for those parameters. MPCA is also exploring a streamlined variance process that would use predetermined eligibility criteria and standardized compliance activities (MPCA, 2019b).

Section 4: Metals

Based on recent monitoring data and discussions with the MPCA, the City expects to receive a copper limit in the next NPDES permit. The finding of reasonable potential for copper is driven by a single high value that was observed in the effluent. Because this value represents an outlier, the City expects to be able to comply with the copper limit. As of writing, the City does not anticipate triggering reasonable potential for other metals.

Section 5: Alternative Outfall

If future effluent limits for the South Fork of the Zumbro River were to become excessively stringent, significant capital expenditures would be required for the necessary facility upgrades. A cursory analysis has been performed to understand the financial impacts of excessively low limits in terms of both capital expenditures and annual operating costs, focusing on reduced limits for chlorides and phosphorus. The Liquids Treatment Alternatives technical memorandum provides recommendations for plant improvements based on an ultimate limit of 0.1 mg/L for Phosphorus and 405 mg/L for Chlorides. If these limits were to be further reduced, the required increase in capital and operating costs for additional microfiltration and reverse osmosis facilities would increase significantly. For purposes of this assessment, limits of .075 mg/L and 252 mg/L for Phosphorus and Chlorides respectively were selected. The corresponding cost for required capital improvements is estimated to be $215,300,000 and the annual operating costs are estimated to be $23,555,000.

With these costs becoming prohibitively expensive, consideration was given to an alternate outfall at the Mississippi River near Kellogg, MN. This is predicated on the assumption that final effluent limits for the Mississippi River may be less stringent than those required at the South Fork of the Zumbro river.

An outfall to the Mississippi River would require an effluent pump station and approximately 36 miles of combined forcemain and gravity sewer. The hydraulic basis of design used for a new pump station is the projected 2045 peak wet weather flow of 50 MGD. The pump station would be expected to have up to 6 pumps, providing five 10 MGD pumps for firm capacity. The discharge forecmain would be approximately 23 miles in length, traversing primarily agricultural land with a rolling topography that would require multiple air/vacuum relief valves.

There would be an approximately 350 FT vertical drop from the farmland at the top of the bluffs to the river flood plain below with an additional 13 miles of gravity sewer to a new Mississippi River outfall. A general alignment in both plan and profile is shown in Figure 5.1.

From this comparison it is apparent that effluent limits that may be technically feasible can become economically impractical, even when considering solutions such as an alternative outfall.

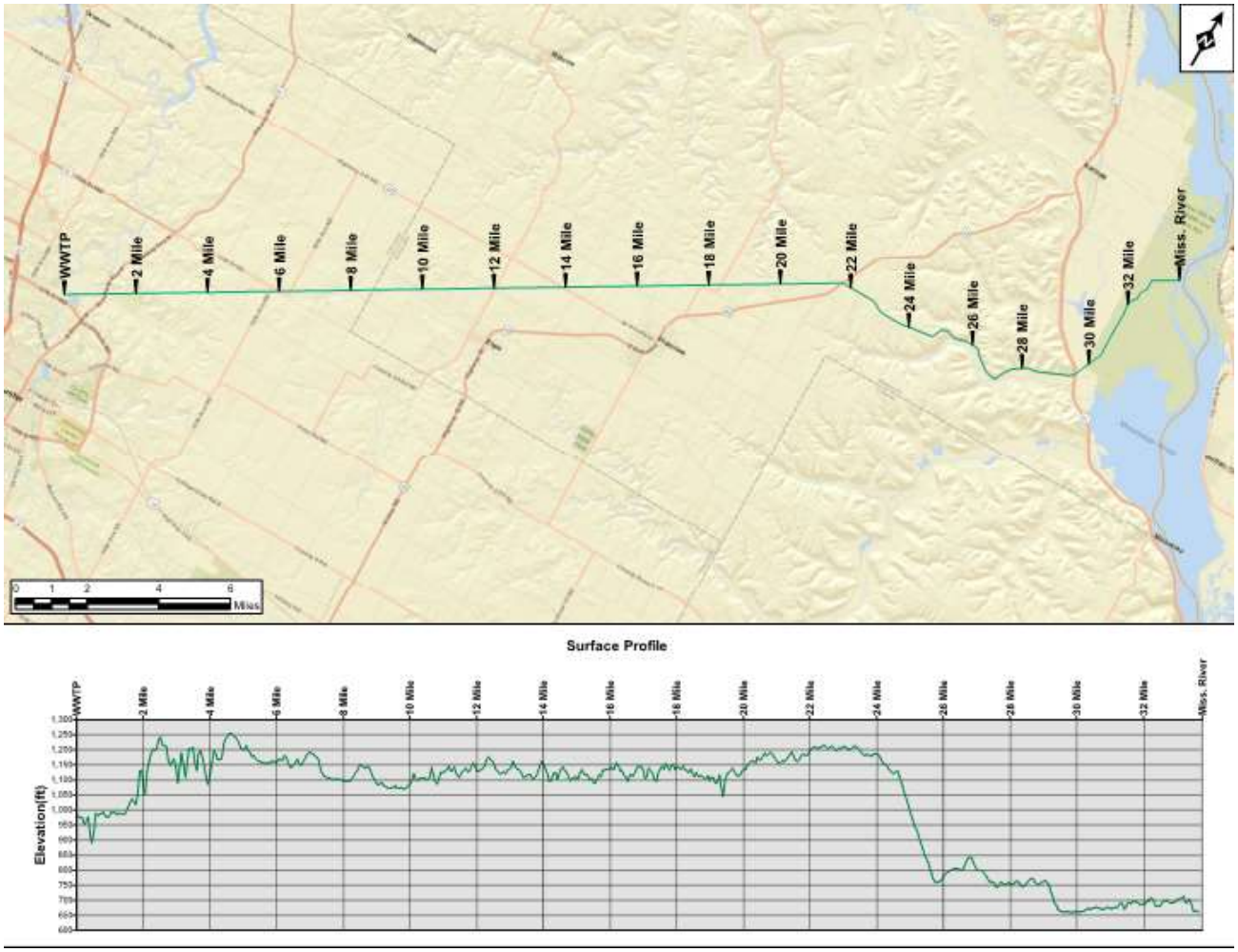

Figure 5.1 – Potential Alternative Outfall Plan and Profile

Basic design parameters for the alternative outfall are presented in Table 5.1

Table 5.1 Alternative Outfall Design Parameters

Design Flow	50 MGD
Forcemain Length	23 Miles
Forcemain Size	60 Inches
Gravity Sewer Length	13 Miles
Gravity Sewer Size	60 Inches
Type of Pump	Vertical Turbine
Total Dynamic Head	390 Feet
Pump Capacity	7,000 GPM (10 MGD)
Number of Pumps	6

A Class V (-50% to + 100%) opinion of probable construction cost for the pump station and outfall pipe is presented in Table 5.2.

Table 5.2 Alternative Outfall Opinion of Probable Construction Cost

	Quantity	Unit	Unit Cost	Extended Amount
Pump Station	1	LS	$30,000	$30,000,000
Forcemain	121,440	LF	$543	$65,942,000
Gravity Sewer	68,640	LF	$450	$30,888,000
Restoration	3%	LS	$2,905,000	$2,905,000
Undeveloped Design Details	50%	LS	$68,868,000	$64,868,603
Construction Subtotal				$194,603,000
Land Acquisition	3%			$4,865,000
Engineering/Administration	15%			$29,190,000
Total Project Cost				$223,658,000

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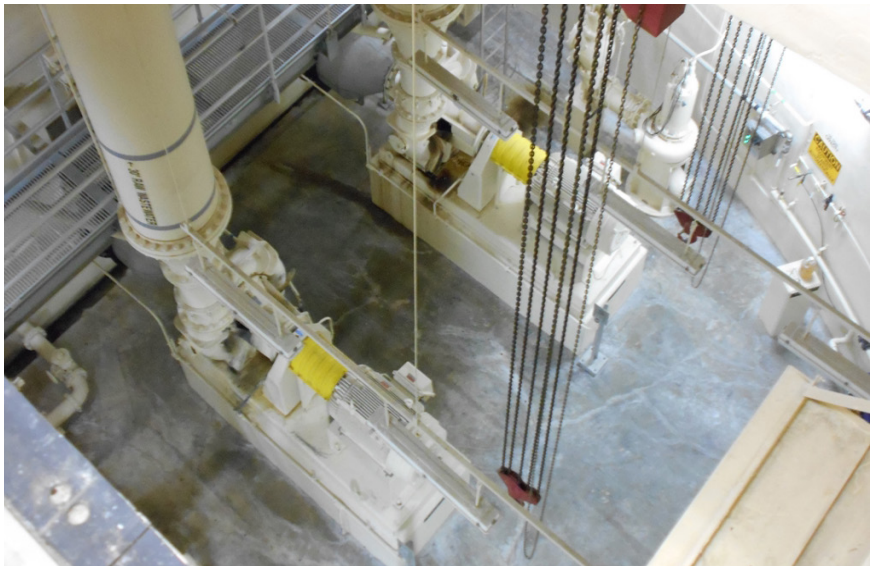

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