

Feasibility Report

May 2010

Updated July 2011

Updated August 2012

Taft Lake/Legion Lake Watershed Water Quality Improvement Project

Prepared for:



City of Richfield
6700 Portland Avenue S.
Richfield, MN 55423

WSB Project No. 1532-47

701 Xenia Avenue South, Suite 300 Minneapolis, MN 55416 763.541.4800



FEASIBILITY REPORT

TAFT LAKE / LEGION LAKE WATERSHED WATER QUALITY IMPROVEMENT PROJECT

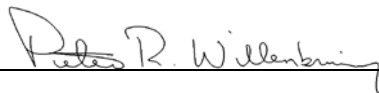
May 2010
Updated July 2011
Updated August 2012

Prepared By:

WSB & Associates, Inc.
701 Xenia Avenue S., Suite 300
Minneapolis, MN 55416
(763) 541-4800
(763) 541-1700 (Fax)

CERTIFICATION

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.



Peter R. Willenbring, PE

Date: July 27, 2011

Lic. No. 15998

TABLE OF CONTENTS

TITLE SHEET
CERTIFICATION
TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	PROPOSED IMPROVEMENT PLAN AND BACKGROUND.....	3
III.	FEATURES AND BENEFITS OF THE PROJECT	8
IV.	OPERATION AND MAINTENANCE.....	15
V.	PROJECT COSTS	17
VI.	PROJECT SCHEDULE.....	19
VII.	SUMMARY AND RECOMMENDATIONS.....	20

List of Figures:

Figure 1	Area Treated by Taft Lake / Legion Lake Watershed Water Quality Improvement Project.....	2
Figure 2	Taft Lake / Legion Lake Watershed Water Quality Improvement Project Detail Map	13
Figure 3	Portable Flocculation / Sedimentation Treatment System Schematic.....	14

List of Tables:

Table 1	Lake Nokomis TMDL Data.....	4
Table 1A	2009 Average Water Quality Results	5
Table 1B	Average Hydraulic Modeling Results.....	6
Table 2	Summary of Infiltration Systems	9
Table 3	Annual Operating Costs for Taft Lake / Legion Lake Watershed Water Quality Improvement Project.....	16
Table 4	Potential Annual Load Reduction for Proposed Improvements	20

List of Appendices:

Appendix A	Hennepin County Property Tax Information for MAC Property Adjacent to Taft Lake
Appendix B	Correspondence Documenting Infiltration Testing and XP-SWMM Results for Taft-Legion Subwatershed
Appendix C	Construction Costs for Proposed Project

I. INTRODUCTION

This Feasibility Report outlines an improvement plan that, when fully implemented, will provide significantly enhanced treatment for stormwater runoff discharged from within the City of Richfield's boundaries to Lake Nokomis and Minnehaha Creek.

In 2008, the Richfield City Council authorized WSB & Associates, Inc. (WSB) to work with City Public Works Staff to develop a water quality management plan for the Taft Lake/ Legion Lake Watershed. The study area (see *Figure 1*) includes the portion of the City that is tributary to Lake Nokomis and the Minnehaha Creek Watershed District (MCWD.)

This report provides the following:

- Background information outlining the need for the project
- Discussion of locations available to provide water quality treatment
- Identification of project goals
- Project elements and their benefits
- Description of itemized costs for construction and operation of the project
- Proposed schedule for development and construction of the project

Since this report was completed in May 2010, there have been additional studies completed to better define the feasibility, benefits, and costs associated with this project. This additional information has been incorporated into this report.

Where the report has been revised, the text is red and a line has been placed in the left margin.

II. PROPOSED IMPROVEMENT PLAN AND BACKGROUND

The City of Richfield has developed a unique water quality improvement plan which can provide significant water quality benefits to Lake Nokomis, as well as improve the in-lake water quality of Taft Lake.

The goal of this project is to develop a system that:

- Utilizes the most cost-effective methods for removing phosphorus from stormwater being conveyed to Lake Nokomis from the City of Richfield,
- Allows for maintenance and operation by City Public Works staff,
- Improves the water quality in Taft Lake,
- Uses a regional approach for stormwater management,
- Operates as a dual-use system, preserving park land for recreational use, and
- Provides water reuse, infiltration, and active treatment opportunities

Background

Through the City or Richfield's active participation in the development of the MCWD's 2007 management plan, the MCWD Lakes' "Total Maximum Daily Load" draft report (TMDL), and the ongoing rule revision process, the City has gained a thorough understanding of the challenges facing the MCWD.

The following background information has been reviewed in preparation for this report. This understanding has helped shape an opportunity for the City and MCWD to partner together and face these challenges head-on.

- *Draft MCWD Lakes Total Maximum Daily Load (TMDL) Study*, prepared by EOR, dated January 2010.
- *Stormwater Capital Improvement Program for Areas of the Minnehaha Creek Watershed District*, prepared by WSB, dated April 22, 2009.
- *City of Richfield Comprehensive Stormwater Management Plan*, prepared by WSB, dated August 2008.
- *A Public Works Perspective on the Cost vs. Benefit of Various Stormwater Management Practices*, prepared by WSB, dated August 2008.
- *Minnehaha Creek Watershed District Comprehensive Water Resources Management Plan*, prepared by Wenck Associates, dated April 2007.

- *Memorandum: Summary of Surface Water Quality & Quantity Monitoring*, prepared by WSB, dated February 16, 2010.
- *Technical Memorandum: Taft-Legion Subwatershed, Richfield Feasibility Study; XP-SWMM Results and Basis for Estimating Project Effectiveness*, prepared by Wenck Associates, Inc., dated June 2, 2011.
- *Technical Memorandum: Veterans and Taft Park Infiltration Test Results*, prepared by Wenck Associates, Inc., dated June 10, 2011.

MCWD Lakes Draft TMDL

The MCWD Lakes TMDL study shows a breakdown, by agency, of land cover and pollutant loading for the Lake Nokomis watershed as summarized in **Table 1**. Over 1,550 acres of land from the City of Richfield and the Metropolitan Airport Commission (MAC) property (tributary to Mother Lake) drains through the Taft Lake outfall into Minnehaha Creek. This represents over 60 percent of the surface area tributary to Lake Nokomis. The study estimates that, on an annual basis, 137 pounds of phosphorus are discharged to the Minnehaha Creek and Lake Nokomis system through the Taft Lake subwatershed.

The study recommends that there be an annual loading reduction of 16 pounds of phosphorus from stormwater runoff generated by the City of Richfield and the MAC property combined.

**Table 1
LAKE NOKOMIS TMDL DATA
Tributary Area: 2578 Acres**

City	Drainage Area (ac)	Existing Annual TP* Loading (lbs)	Proposed Annual TP* Loading (lbs)	Required Annual Reduction (lbs)
Minneapolis	878	509	190	319
Richfield	1,234	118	104	14
Metropolitan Airports Commission	318	19	17	2
Hennepin County	50	16	8	8
Mn/DOT	98	12	11	1

*Total Phosphorus (TP)

Richfield's Comprehensive Stormwater Management Plan

During the development of the City's Comprehensive Stormwater Management Plan, WSB worked with the Richfield Community Services Commission and its staff to evaluate a number of stormwater management practices on the basis of cost-benefit (cost versus pounds of phosphorus removed). Some of the systems evaluated include Nationwide Urban Runoff Program (NURP) basins, rain gardens, water reuse/irrigation, wastewater treatment plants, on-site flocculation, and underground treatment devices. The study determined that water reuse and on-site flocculation were two of the more cost-effective practices.

Furthermore, the Richfield City Council has expressed a significant interest in reusing stormwater for irrigation uses, undertaking a project that could improve the quality of water within Taft Lake, and utilizing regional treatment options that can offer long-term goal solutions upfront rather than waiting for redevelopment to trigger onsite stormwater management systems.

Water Quality Monitoring

In preparation for this project, the City has been conducting water quality monitoring on both Legion and Taft Lakes. Grab samples were taken once a month (a total of six samples in each location) and analyzed for various pollutants. The average concentration of typical storm water pollutants was determined and reported in WSB's memo dated February 16, 2010. *Table 1A* summarizes the 2009 average water quality results.

**Table 1A
2009 AVERAGE WATER QUALITY RESULTS**

Location	Total Phosphorus (ug/l)	Ortho-Phosphorus (ug/l)	Total Suspended Solids (mg/l)	Chloride (mg/l)
Legion Lake - north	450	60	6	27.9
Legion Lake - south	200	50	12	34.5
Taft Lake	100	40	3	116

The concentrations of phosphorus determined as part of this additional testing confirm that the concentrations used to develop the earlier version of this report are reasonable.

Hydraulic Modeling

Additional modeling was undertaken to determine the volume of runoff that is conveyed through Legion and Taft Lakes. Based on Wenck's Technical Memorandum dated June 2, 2011, three years of precipitation data were used to determine an average discharge volume for each lake was. The average of the three years (1997, 2000, and 2008) is summarized in *Table 1B*.

**Table 1B
AVERAGE HYDRAULIC MODELING RESULTS**

Location	Annual Discharge (ac-ft)	Average TP Concentration (ug/l)	Annual TP Loading (lb/yr)
Legion Lake	200	450	245
Taft Lake	700	100	190

The additional testing confirms that the annual discharge volume and the annual TP loading are actually higher than the values used in the development of the earlier version of this report. This results in a potential for more phosphorus being removed than was earlier predicted.

The concentrations of phosphorus determined as part of this additional testing confirm that the concentrations used to develop the earlier version of this report are reasonable.

Infiltration Testing

In preparation for this project, the MCWD completed infiltration testing in both Veteran’s Park and Taft Park. This consisted of ten double-ring infiltrometer tests in various locations in each park.

Based on Wenck’s Technical Memorandum dated June 10, 2011, three areas in Veterans Park and one area in Taft Park were identified as the best locations for potential infiltration trenches. Infiltration rates ranged from 2.87 to 10.20 inches per hour.

For purposes of design, the procedure outlined in Chapter 12-8 of the Minnesota Stormwater Manual can be followed. When using measured rates, the Manual recommends using a Correction Factor. Depending on the uniformity of the soil profile the measured rate should be divided by a Correction Factor ranging from 2.5 to 8.5. Applying Correction Factors of 2.5 and 6.5, yields design infiltration rates ranging from 1.1 to 4.1 inches per hour.

The areas identified as having high (or, in the case of Taft Park, moderate) infiltration potential were selected as the locations for the infiltration trenches. The average infiltration rates for these areas, after applying the Correction Factors are 1.1 to 2.0 inches per hour. For purposes of design, we will use 1 inch per hour to determine the length of infiltration trench needed to meet the goals of the project.

The additional testing confirms that the infiltration rates are actually higher than the values used in the development of the earlier version of this report. This results in a potential for higher infiltration volumes and more phosphorus being removed than was earlier predicted.

Donation of Land

Because Richfield is fully-developed, the parks offer the only available open spaces for the proposed dual-use treatment systems which could operate within existing water bodies and open park space.

This project proposes to remove the frontage road around the north and east sides of Taft Lake. It is the City understanding that the MAC may allow the City of Richfield to construct a perimeter treatment system in place of the existing perimeter road.

III. FEATURES AND BENEFITS OF THE PROJECT

In order to meet the goals of the project, the City developed a project with several elements as shown on *Figure 2*. A description of the selected project elements and benefits of each is outlined below:

- **Water Reuse Irrigation System**

This portion of the system will utilize new irrigation systems in Taft Lake Park and Veterans Park (areas adjacent to Legion Lake.) Stormwater runoff will be withdrawn from the adjacent ponds and used to irrigate park land. This will enhance the quality of the park, reduce downstream runoff volumes, reduce pollutant loadings, and reduce the amount of City water that is used for irrigation purposes. As part of this work, pre-treatment cells will be constructed at the end of each pipe discharging to Legion Lake.

It is anticipated that this system will apply one inch of water per week over a 24-week irrigation period in the summer. Approximately 12 to 40 acres are available for spray irrigation. Operating within this range will reduce the annual runoff volume from the watershed by **25 to 75 acre-feet (AF)** and reduce the total phosphorus loading **12 to 35 pounds** annually.

Based on the additional studies, we have refined the areas available for spray irrigation. We have identified the open area south of Legion Lake as the best area for installing an irrigation system. This area is approximately 7.2 acres. With an anticipated application rate of one to three inches per week over a 24-week irrigation period in the summer, the annual runoff volume from the watershed can be reduced by **14 to 40 acre-feet (AF.)** Using the average concentration of 450 ug/l, the total phosphorus loading can be reduced **17 to 50 pounds** annually.

The pump system that runs the infiltration system will also serve the irrigation system in the north portion of Veteran's Park.

The updated review and analysis confirms that the previously anticipated load and volume reductions can be achieved.

- **Water Reuse Infiltration System**

This system component will be used in tandem with the irrigation system. If additional water is available, the system will direct runoff to underground infiltration systems in both park areas to infiltrate additional stormwater runoff and reduce downstream runoff volumes and pollutant loadings.

It is anticipated the installation and operation of this system will reduce the annual runoff volume from the watershed by **25 to 75 acre-feet (AF)** and reduce the total phosphorus loading from between **12 to 35 pounds** annually.

Based on the infiltration study, we have recomputed the potential volume that can be infiltrated within the park areas. Infiltration will be accomplished by pumping storm water to 3-foot wide infiltration trenches containing pea gravel and 6-inch draintile. The trenches will be installed in the three locations identified as having the highest infiltration potential. The trenches will be at least 3 feet above the highest potential ground water elevation, which will create an effective trench width of 10 feet. For every 1,000 feet of trench, there is 10,000 square feet of infiltration area available.

The general layout of the proposed infiltration system is shown in *Figure 2*. We are proposing three separate infiltration systems, with a total of 5,000 feet of draintile trench, which is equal to 1.4 acres of effective area. *Table 2* summarizes the potential infiltration available from the three proposed systems.

Table 2
Summary of Infiltration Systems (see notes below)

Area	Infiltration Trench Length (feet)	Potential Annual Volume Reduction (AF)	Actual Annual Volume Reduction (AF)	Concentration (ug/l)	Annual TP Reduction (pounds)
North Portion of Veteran's Park	2,000	165	80	450	97
South Portion of Veteran's Park	1,400	116	80	450	97
Taft Park	1,600	132	80	100	22
Total	5,000	413	240	-	216

Notes:

1. *The Potential Annual Volume is based on infiltration rate of 1 inch per hour. Each 1,000 feet of infiltration trench can infiltrate 830 cubic feet (CF) per hour per linear foot, or 83 AF over 180 days.*
2. *The Actual Annual Volume is based on 100 gallons per minute (gpm) for each of the three systems. By pumping each system at 100 gpm for 180 days, we anticipate the annual runoff volume from the watershed can be reduced by 240 acre-feet (AF) and the total phosphorus loading reduced up to 216 lbs annually.*

The proposed system will include a weir control structure at the outlet of Legion Lake. The weir will impound water that can then be pumped into the infiltration systems within Veteran's Park.

The updated review and analysis confirms that the previously anticipated load and volume reductions can be achieved, and exceeded, given the proposed infiltration within Veteran's and Taft Parks.

- **Habitat Enhancement – Native Prairie Restoration and Buffer Strips**
As part of the restoration of the disturbed areas, a native prairie area and wildflower buffer strip will be planted around Legion Lake. The buffer will be planted in select areas, vary in width, and be planted with a wet wildflower mix.

This portion of the project is included primarily for habitat enhancement and aesthetics. The 40 acre tributary to Legion Lake (on the south and west sides of the lake) is currently maintained as low-maintenance turf, with little fertilizer or chemical treatment. With an anticipated removal efficiency of 40%, the buffer will reduce the total phosphorus loading to Legion Lake by **2 to 8 pounds** annually.

The additional analysis done to update this report did not result in any changes to habitat enhancement.

- **Construct Grit Chambers**
At the suggestion of the MCWD Board of Managers, grit chambers will be constructed in three locations. This will result in a reduction of approximately 25% of the coarse suspended solids, which will reduce the frequency of future maintenance of the storm water ponds near Legion Lake.

- **Flocculation Treatment for Stormwater Runoff Discharged Downstream to Lake Nokomis**

To provide regional treatment for stormwater runoff from the 1,552 acre tributary drainage area, a flocculation treatment system will be constructed around the perimeter of Taft Lake near the outfall from the area within Richfield that is tributary to Lake Nokomis.

A schematic drawing of the flocculation treatment system is shown on **Figure 3**. The flocculation treatment system takes pre-treated stormwater runoff and adds a flocculation re-agent that will combine with both particulate and soluble phosphorus in the water to form a floc. As part of the treatment process, the floc is settled out and the treated water is discharged either directly downstream to Lake Nokomis or to Taft Lake for additional in-lake treatment. As needed, operation of the system is shut down and the floc discharged to the sanitary sewer. The process utilizes treatment re-agents identical to those used by the City of Richfield Public Works staff to treat the City's drinking water.

This flocculation process has been utilized effectively since the 1960's in water and wastewater treatment and has been incorporated to address more stringent regulations for stormwater in the past 5 to 15 years.

Based on data collected in test operations of this type of system, the system will be able to remove between 70 and 90 percent of the phosphorus from water treated by the system.

It is further noted this treatment process has the capability to remove soluble phosphorus, which will allow water discharged from the area to have such high quality that it could flush out lower quality water present in downstream lakes and streams as part of the Lake Nokomis improvement project. It is anticipated this system will have the capability to remove **40 to 125 pounds** of phosphorus from water within Taft Lake or water discharged downstream into Lake Nokomis on an annual basis.

Based on the additional information, the proposed operation of the flocculation system has been updated. Treatment of storm water runoff is still accomplished primarily by drawing from Taft Lake and treating it in the flocculation system. The proposed system provides flexibility to discharge the treated water back into the lake, into a proposed pond located on the east side of Taft Lake, or directly to Lake Nokomis.

The proposed pumping rate for the flocculation system will be between 250 gpm and 400 gpm. If the system is run for 180 days each year, **200 to 320 AF** of storm water will be treated. Another variable is the quality of water being treated. Using an initial concentration of phosphorus ranging from 100 parts per billion (ppb) to 200 ppb, and reducing the concentration to 20 ppb, the annual load is reduced **40 to 160 pounds**.

The additional testing and revised operating plan confirms that the reduction in the annual TP loading are within the range of the removals previously calculated in the development of the earlier version of this report.

- **Flocculation Treatment System for In-lake Water**

In addition to the treatment of runoff conveyed through the system, there is potential to reduce the total phosphorus concentration of water in Taft Lake from approximately 100 to 120 ppb (existing) to less than 60 ppb in the future. The normal pool volume for Taft Lake is estimated at 270 AF. Depending on the extent to which this system is operated, another **35 to 70 pounds** of phosphorus can be removed on an annual basis from the internal loading of Taft Lake.

This is a significant reduction in total phosphorus concentration that may improve water quality to the point that the City Council may consider the construction of a swimming beach on this park property. This would be one more amenity for the lake that currently is surrounded by park land, has a fishing pier located on it, and is part of a fish stocking program that is undertaken by the DNR.

The updated analysis indicates the phosphorus removal projections originally outlined can be met or exceeded.

Based on a review of the TMDL for Lake Nokomis, the MCWD Plan, City of Richfield Stormwater Plan, and other considerations, a number of agencies have been identified that could benefit from this project. These include:

- City of Minneapolis
- City of Richfield
- Minnesota Department of Transportation (Mn/DOT)
- Hennepin County
- Metropolitan Airports Commission
- Minnehaha Watershed District

These projects will benefit these agencies by helping to meet the requirements of their MS4 permits and the upcoming Lake Nokomis TMDL.

| The updated analysis does not change the list of potential beneficiaries above.

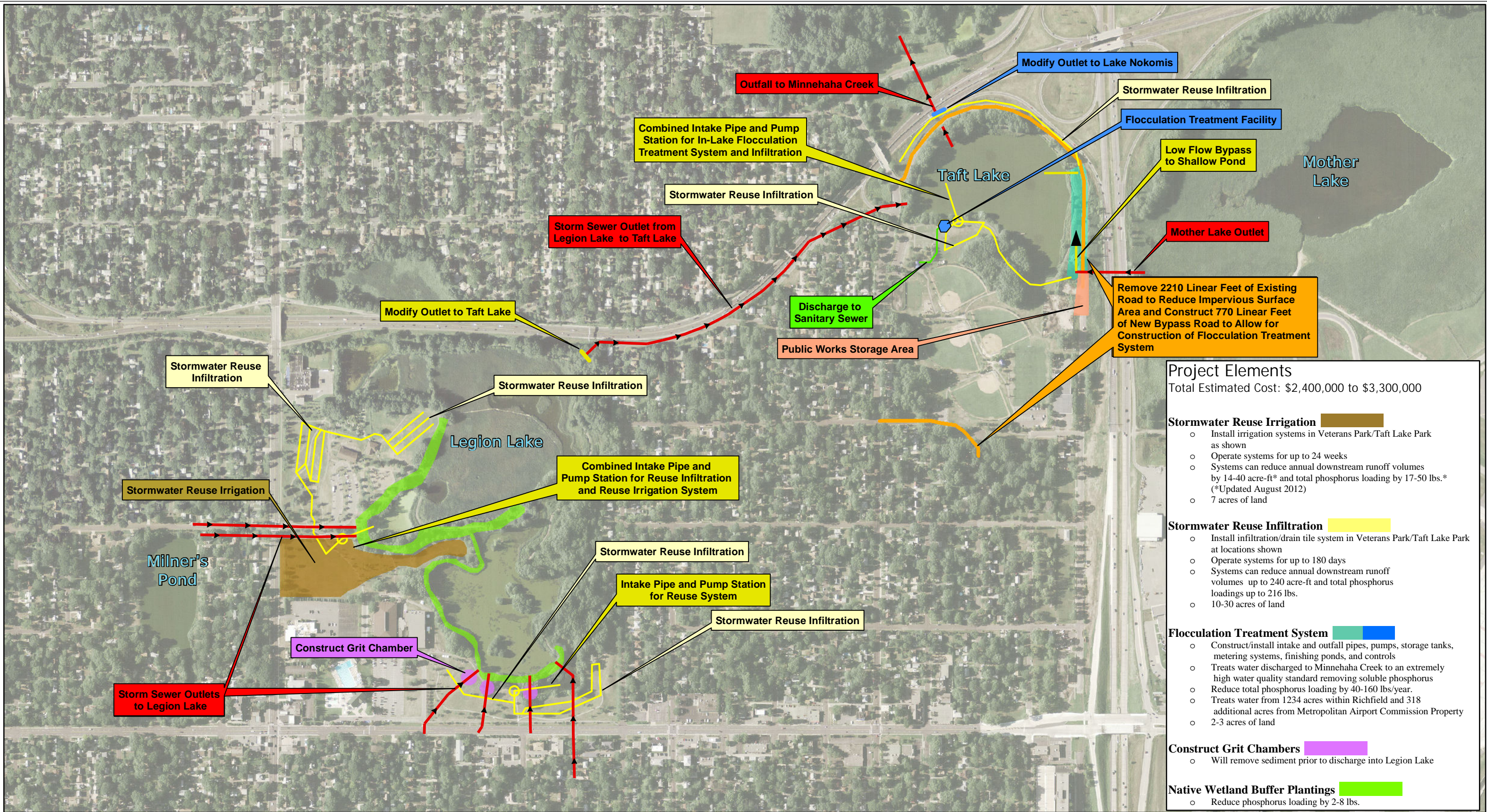
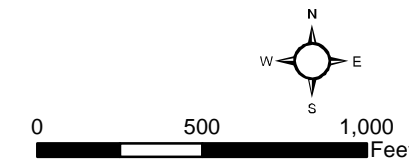
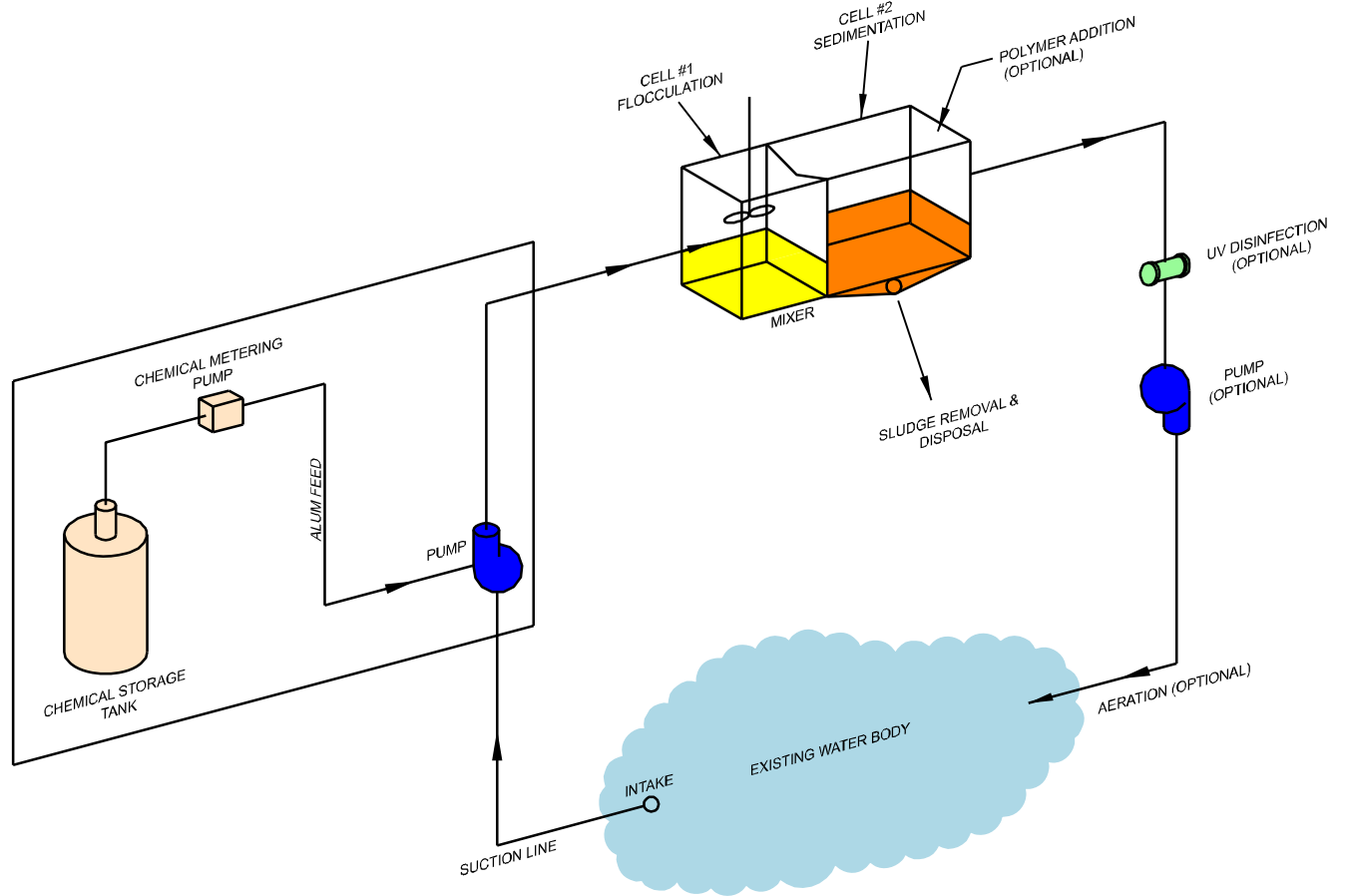


Figure 2

Taft Lake/Legion Lake Watershed
 Water Quality Improvement Project
 Detail Map



PORTABLE FLOCCULATION/SEDIMENTATION TREATMENT SYSTEM SCHEMATIC



701 Xenia Avenue South, Suite 300
 Minneapolis, MN 55416
 www.wsbeng.com

763-541-4800 - Fax 763-541-1700
 INFRASTRUCTURE | ENGINEERING | PLANNING | CONSTRUCTION

Water Quality Improvement Project for
Taft Lake/Legion Lake Watershed
Richfield, Minnesota

WSB Project No. 1532-47

Date: April 12, 2010

Figure 3

IV. OPERATION AND MAINTENANCE

The systems outlined in Section III to improve water quality are “Active Treatment Processes” and, in addition to operation, require regular monitoring and maintenance.

The systems will be operated by the City of Richfield’s Public Works staff. Because the system is publicly operated, the City can provide assurances that the system is properly operated and maintained. Such assurances are more difficult to achieve when improvements are constructed by private entities on private property as part of development or redevelopment.

The MS4 permit that will be re-issued this year is anticipated to include minimum requirements for chemical treatment of stormwater for phosphorus removal. The sampling and testing requirements are similar to those previously anticipated.

The final layout of the various systems will dictate the operating plan for each component. In general, the City will undertake the following monitoring and operational activities:

- Inspect pumps, controls, and other lift station components in a manner similar to that used to operate and maintain other pumps and lift stations within the City. Appropriate components of this system will be tied into the SCADA monitoring system the City currently uses for other lift stations.
- Monitor/measure the amount of water pumped and/or removed during operation of the spray irrigation and infiltration system. As part of this activity, a report will be created annually to document the extent to which runoff volumes and pollutant loadings were reduced through the use of the spray irrigation and infiltration system.
- Collect water quality samples from raw water sources. The samples will be analyzed for total phosphorus, chloride, and other appropriate parameters for the purpose of further quantifying the benefits of this system operation.
- Monitor the flocculation treatment system for the purpose of maximizing the efficiency of the flocculation treatment system operation, as well as quantify the extent to which phosphorus and other pollutants are removed as part of this system operation. Pre-treatment and post-treatment water samples will be routinely collected and analyzed to determine the extent to which total phosphorus and ortho-phosphorus are removed by the treatment process. Pumping records will be maintained to quantify the load reductions of the pollutants of concern, and an annual report will also be completed to document the benefits of the system operation.

- Record the annual costs for system operation, maintenance, and floc disposal. These costs will be tracked so the viability of this type of system operation can be evaluated for other applications.
- Prepare an annual report that summarizes the amount of phosphorus removed and the operational costs.
- Maintenance of the native wildflower buffer including watering, reseeding, and controlled burns, will be done by the City as needed.

Based on the feasibility analysis completed by the City of Richfield, the operating cost for these activities is estimated at \$150,000 annually as outlined in **Table 3**.

Table 3
ANNUAL OPERATING COSTS FOR TAFT LAKE/LEGION LAKE
WATERSHED WATER QUALITY IMPROVEMENT PROJECT

Description	Annual Cost	Notes
Sampling and reporting	\$ 20,000	Includes lab testing fees
Pump maintenance, operation, and inspection	\$ 26,000	Includes pulling the pumps for winterization and routine maintenance
Floc disposal	\$ 15,000	Slurry will be discharged to sanitary sewers during off-peak hours
Electricity	\$ 7,000	Includes power for intake pumps, mixing/dosing pumps, slurry pumps, control panels, and security lighting
Floc re-agents	\$ 77,000	Based on \$5,000/10 pounds TP removed for 164 pounds
Native vegetation buffer maintenance	\$ 5,000	Includes controlled burns for weed control
Total	\$150,000	

Based on the update operating plan developed in response to the updated analysis, the operational costs of the system are within the range of the costs calculated in the development of the earlier version of this report.

V. PROJECT COSTS

As outlined in *Section III*, “Features and Benefits of the Project,” a number of project elements were identified:

1. Spray irrigation systems in Taft Lake and Veterans Park
2. Underground infiltration systems in Taft Lake and Veterans Park
3. Habitat Enhancement – Native Prairie Restoration and Buffer Strips
4. Flocculation treatment system adjacent to Taft Lake for stormwater runoff
5. Flocculation treatment system in Taft Lake for in-lake water quality

The capital cost for the entire treatment system is estimated at \$2,460,000. A breakdown of the cost for each project element follows:

- **Water Reuse Irrigation System**

Construction for this portion of the system consists of constructing a screened intake pipe and pumping station to draw water out of Legion or Taft Lake, the irrigation system to spray irrigate the adjacent parks, excavation of pre-treatment cells at the outlet of each pipe that discharges to Legion Lake, and planting of a native wetland buffer around portions of Legion Lake. The estimated costs for this portion are \$686,000.

- **Water Reuse Infiltration System**

To minimize disruption of the adjacent parks, the City will install the underground infiltration system in each park at the same time the irrigation systems are installed. Controls will be in place at the irrigation pump station that will allow it to be used to distribute stormwater to the underground infiltration system. Costs for the pump controls are included with the irrigation system. The estimated costs for this portion are \$214,000.

- **Habitat Enhancement – Native Prairie Restoration and Buffer Strips**

The cost associated with the establishment of the native prairie vegetation and buffer strip around Legion Lake is estimated at \$60,000.

- **Flocculation Treatment System for Stormwater Runoff**

The City will construct the flocculation treatment system for stormwater runoff around the perimeter of Taft Lake. Construction will include removing the old road surface, excavating linear conveyance channels, installing the flocculation treatment system, building approximately 2,100 linear feet of road, and restoring the disturbed areas. The estimated cost for this work is \$1,439,000.

- **Flocculation Treatment System for In-lake Water Quality Treatment**

The in-lake flocculation treatment system will utilize the treatment system used to treat storm water runoff. Construction for this portion of the system consists of constructing a screened intake pipe to draw water out of Taft Lake so it can be

directed to the flocculation treatment system. The estimated cost for this work is \$61,000.

As outlined in *Section III*, “Features and Benefits of the Project,” the project elements have been slightly modified based on the additional testing completed. Based on this update, the current elements of the project include:

1. Spray irrigation in Veteran Park, west of Legion Lake (area reduced)
2. Underground infiltration systems in Taft and Veteran’s Park (area increased)
3. Native prairie buffers adjacent to Legion Lake (no change)
4. Grit removal on storm sewers discharging to Legion Lake (item added at Board of Manager’s request)
5. Road re-alignment, including road removal, reconstruction, and house removal (instead of one home, 3 homes now need to be removed as part of the project)
6. Flocculation system adjacent to Taft Lake capable of treating in-lake water and storm water runoff

The updated design now includes installation of grit removal structures to treat storm water runoff prior to discharge to Legion Lake (at a cost of \$300,000) and the removal of three houses to facilitate construction of the new access road (an additional cost of \$600,000). Based on these features, the project cost is increased from \$2,460,000 to \$3,300,000. However the City is still only requesting \$2,700,000 from the MCWD to cover construction costs of the treatment facilities. The cost estimate for the project has been revised and is included in *Appendix C*.

VI. PROJECT SCHEDULE

The feasibility report for this project was presented to the Richfield City Council on April 22, 2009. A timeline for the other activities necessary to move this project forward is outlined below:

Complete final design for project	January – December 2011
Go through bid process and award project.	January – April 2012
Construct project.....	May 2012 – April 2013
Begin operating of system including monitoring and reporting	May 2013

Based on the updated project outlined herein, the schedule has been updated as follows:

Complete update to MCWD CIP/Execute Agreement between Richfield and MCWD.....	September 2011
Begin final design	October 2011
Complete final design	June 2012
Advertise, bid, and award project	July – August 2012
Begin construction	September 2012
Finish construction then begin operation and reporting	June 2013

VII. SUMMARY AND RECOMMENDATIONS

The City of Richfield has completed a feasibility study and determined that the most cost-effective way to remove phosphorus from stormwater runoff generated within the City is to construct a flocculation treatment system at the outlet of Taft Lake and to construct water reuse systems adjacent to Taft Lake and Legion Lake. This will provide water quality treatment of stormwater runoff prior to discharging from the City to Lake Nokomis and the Minnehaha Creek Watershed District. The systems (outlined in *Section III*, “Features and Benefits of the Project”) will remove **126 to 273 pounds** of phosphorus annually.

An updated analysis indicates that the potential annual load reduction is within the range previously anticipated, as summarized in *Table 4*.

**Table 4
Potential Annual Load Reduction for Proposed Improvements**

Improvement	Annual Reduction (pounds)
Water Reuse Irrigation System	17* to 50*
Water Reuse Infiltration System	108 to 216
Habitat Enhancement	2 to 8
Construct Grit Chambers	-
Reduction of Impervious Surface	1
Flocculation Treatment	40 to 160*
Total	167* to 413*

* Updated August 2012

Based on the TMDL study currently being developed for Lake Nokomis, the City of Richfield and the MAC will be required to reduce, on an annual basis, total phosphorus loading by **14 pounds and 2 pounds**, respectively.

The above statement did not change based on our updated analysis.

Section IV, “Operation and Maintenance,” outlines the ongoing costs of these systems. Operation and maintenance costs will consist of inspecting pumps and motors, monitoring water quality, purchasing chemical re-agents, power, and waste disposal. These costs are anticipated to be \$150,000 annually.

Our updated analysis indicates that operational costs are within the range previously anticipated.

As outlined in *Section V*, “Project Costs,” we anticipate the capital cost to construct the water re-use systems and the flocculation treatment systems to serve this area at \$2,460,000 dollars. The anticipated annualized cost of this capital outlay can be determined using the following illustration: Amortizing a \$2,460,000 dollar capital cost over a 30-year period at 5 percent interest would result in an annual expenditure of approximately \$150,000 for debt retirement.

Based on the updated project design, the capital costs to the MCWD have increased to \$2,700,000.

Based on the above, the project will cost \$300,000 annually to operate and pay off debt. This equates to an annualized (operational and capital) cost of **\$1,100 to \$2,400 per pound of phosphorus removed.**

Based on our updated analysis, the annual cost to operate the system and pay off debt is \$324,000 with this cost approximately shared equally between the City of Richfield and the MCWD. This equates to an annualized (operational and capital) cost to remove phosphorus of \$1,200 to \$1,400 per pound. Based on Mike Panzer’s June 22, 2011 e-mail, this is consistent with other projects the MCWD has undertaken in the past.

Appendix A
Hennepin County Property Tax Information for MAC Property
Adjacent to Taft Lake



Hennepin County Property Locator

[Update to Birdseye Viewer](#)

Zoom In Zoom Out Pan / Move Identify Clear Map

- Home
- Parcel
- City
- County
- Print
- Overview
- Legend
- Help
- map size
- map size



Search Results Layers Legend Help

- 1) Click For Tax Info.
- 2) Click For Birds Eye
- 3) Click For Community Info.
- 4) Show Other Map Features

ADDRESS:	
PID:	2302824440001
House #:	6100
Street Name:	CEDAR AVE S
Unit:	
City:	MET AIRPORT
Zip:	55450
OWNER/TAXPAYER:	
Owner:	MET AIRPORTS COMM
Taxpayer:	METRO AIRPORT COMMISSION
	6040 28TH AVE S
	MINNEAPOLIS MN
	55450
TAX DISTRICT:	
School #:	000
Sewer #:	
Watershed #:	0
PARCEL:	
Area: (Acres)	26.30
Area: (Sq. Feet)	1145580

About the application

Parcels updated on: 4/5/2010

Welcome to Hennepin County's Property Locator. To begin using the application either search by (PID, Address, Additon or Twp-Rng-Sec) using the "Quick Search" commands or simply navigate to the desired location using the "Map Tools". For more detailed information click on the Help Button!

Although extensive effort has been made to produce error free and complete data, all geographic information has limitations due to the scale, resolution, date and interpretation of the original source materials. You should consult

Done

Done



Hennepin County Property Locator

[Update to Birdseye Viewer](#)

Zoom In Zoom Out Pan / Move Identify Clear Map

Home

Parcel

City

County

Print

Overview

Legend

Help

map size



About the application Parcels updated on: 4/5/2010

Welcome to Hennepin County's Property Locator. To begin using the application either search by (PID, Address, Additon or Twp-Rng-Sec) using the "Quick Search" commands or simply navigate to the desired location using the "Map Tools". For more detailed information click on the Help Button!

Although extensive effort has been made to produce error free and complete data, all geographic information has limitations due to the scale, resolution, date and interpretation of the original source materials. You should consult

Search Results Layers Legend Help

- 1) [Click For Tax Info.](#)
- 2) [Click For Birds Eye](#)
- 3) [Click For Community Info.](#)
- 4) [Show Other Map Features](#)

ADDRESS:

PID: 2302824440004

House #: 6005

Street Name: 16TH AVE S

Unit:

City: MET AIRPORT

Zip: 55450

OWNER/TAXPAYER:

Owner: MET AIRPORT COMM

Taxpayer: METRO AIRPORT COMMISSION

6040 28TH AVE S
MINNEAPOLIS MN 55450

TAX DISTRICT:

School #: 000

Sewer #:

Watershed #: 0

PARCEL:

Area: (Acres) 4.12

Area: (Sq. Feet) 179460

Done

Appendix B
Correspondence Documenting Infiltration Testing and XP-SWMM Results
for Taft-Legion Subwatershed

TECHNICAL MEMORANDUM

TO: James Wisker, Planner
Minnehaha Creek Watershed District

FROM: Mike Panzer

DATE: June 2, 2011

SUBJECT: Taft-Legion Subwatershed, Richfield Feasibility Study
XP-SWMM Results and Basis for Estimating Project Effectiveness

Project Benefits

The benefits of the project envisioned by the City of Richfield and MCWD are multi-faceted, and in some cases, difficult to quantify in a straightforward way. These benefits are qualitatively listed below, some of which were addressed in the feasibility report prepared by WSB and Associates, Inc. for the City of Richfield in May 2010:

1. Nutrient loads to Taft Lake, and concentrations in Taft Lake, will be reduced by interception and treatment of storm water runoff entering the lake. Treatment would be some combination of traditional sedimentation via wet-detention and removal of TSS and nutrients by means of alum injection and flocculation.
2. The average nutrient concentration in Taft Lake will be reduced by withdrawal of enriched hypolimnetic water during dry weather, and subsequent treatment via alum injection and flocculation, followed by discharge of clean water back to the lake. This will lower average surface concentrations and loading downstream.
3. Nutrient loading from the Legion Lake discharge to Taft Lake and the Taft Lake discharge to Lake Nokomis will be reduced by means of 1. and 2. above, and, by withdrawal of water from Legion for reuse in irrigating sandy areas in Veteran's Park and municipal ball fields. One impact of the reuse will be less frequent or lower discharges to Taft Lake. Since concentrations in Legion are over four times higher, this will have a beneficial impact on Taft Lake water quality.
4. The runoff volume to Taft Lake and Lake Nokomis will be reduced by reuse of water from Legion Lake.
5. Runoff volume and loads to Taft Lake will be reduced by removal of pavement associated with the existing frontage road on the east and north side of Taft Lake. Higher quality and additional vegetative buffers will provide a higher quality habitat associated with the aquatic fringe.
6. The load allocation reduction requirements of the Lake Hiawatha TMDL for the City of Richfield will be accomplished and likely exceeded, and will address the loading from MAC property via the Mother Lake drainage. Future lane expansion impacts of the Highway 62 Crosstown will be partially mitigated as well.

Some of the more intangible but valuable benefits brought by the project include:

7. A cooperative project and long term commitment demonstration by two units of government that incorporates innovative financing and leverages funding resources for the benefit of the public over the long term.
8. A local partner that will take responsibility and assure long term maintenance, monitoring, measurement of water quality benefits and protection of the capital investments.
9. Opportunity for cooperative educational functions by and between MCWD education staff and City of Richfield Park staff.
10. Opportunity for coordination with future regional trail systems, extending benefits to the public and increasing educational opportunity.

Quantifying the actual water quality benefits of the project is a challenge for two reasons:

First, water quality and hydrologic monitoring data availability is minimal and spotty for Legion Lake and Taft Lake. Estimates of average discharge from these two bodies of water were acquired by the MCWD XP-SWMM model, utilizing actual precipitation records from 1997 (a wet year with summer flooding from frequent intense thunder storms), 2000 (a near normal year for precipitation) and 2008 (a dry year). Estimates of runoff volumes and nutrients, from XP-SWMM and other available sources, are shown in Table 1.

Secondly, estimates of runoff volume and loads derived from multiple existing sources are not very consistent with each other so some sort of average or median estimate must be chosen for evaluating existing conditions and project benefits.

Table 1 - Available Sources and Estimates of Runoff Volumes and Nutrient Loads

Runoff Volumes (ac-ft)

Location	1998 Nokomis Diagnostic	2003 MCWD PLOAD	2011 XP-SWMM		
			1997 34.4 inches Precip.	2000 30.5 inches Precip.	2008 22.4 inches
Volume into Legion	*	476	962	855	550
Volume out of Legion	*	476	441	231	64
Volume into Taft	*	740	*	*	*
Volume out of Taft	171	740	1,025	728	377
Volume into Nokomis	1303	1170	*	*	*
Volume out of Nokomis	1303	1170	*	*	*

TP Loads (lbs)

Into Legion	*	421	*	*	*
Out of Legion	*	337	*	*	*
Into Taft	*	467	*	*	*
Out of Taft	*	397	279	198	103
Into Nokomis	1243	456	*	*	*
Out of Nokomis	115	207	*	*	*

* not modeled

Water Quality Benefit Estimates from Other Existing Sources

The remainder of this memorandum discusses quantification of water quality benefit. The average 2009 surface water quality in Legion Lake and Taft Lake is known based upon limited but valuable monitoring performed by the City of Richfield in 2009. See Table 2.

Table 2 - 2009 Average Water Quality

Location	Total Phosphorus ug/l	Ortho-phosphorus ug/l	Total Suspended Solids mg/l	Chloride mg/l
Legion Lake North	450	60	6	27.9
Legion Lake South	200	50	12	34.5
Taft Lake	100	40	3	116

Source: WSB & Associates, Inc. memo dated February 16, 2010

The Minnesota standard for Total Phosphorus concentrations in a lake like Taft Lake is 40 ug/l so the lake water quality does not meet the State standard. If the average in-lake concentrations of TP could be reduced, the water quality of Taft Lake would obviously be benefitted. In addition, Taft Lake discharges to Lake Nokomis and increased water quality in Taft Lake (or less frequent discharge, or both) would also reduce the loading to Lake Nokomis and benefit water quality there. Reducing the TP concentrations in Taft Lake and reducing the loads to Lake Nokomis are the two main water resource benefits expected from the project.

Concentration and volume are the two components necessary to compute loads. The volume of water discharged from Taft Lake can only be estimated and varies from year-to-year based upon the extent and timing of precipitation. The City of Richfield is monitoring the outflow from Taft Lake but data is very limited at this point in time. Therefore, a reasonable and cost efficient estimate of the discharge was completed utilizing the existing District-wide XP-SWMM model completed by MCWD as well as previous studies, like the 1998 Lake Nokomis and Lake Hiawatha Diagnostic and Feasibility Studies. See XP-SWMM output hydrographs for Legion and Taft Lakes for 1997, 2000 and 2008 included in Attachment A. Note that Legion Lake does not always discharge to Taft Lake, often when Taft is discharging to receiving waters downstream (Lake Nokomis).

The total watershed area of the Taft Lake discharge is 1,839 acres from the XP-SWMM model. Of that, 1,196 acres first drains to Legion Lake, a Type 3 wetland and public water. Legion Lake in turn discharges to Taft Lake, leaving a direct drainage watershed of 634 acres to Taft Lake.

Based upon the previous studies and the XP-SWMM runoff modeling completed as part of this project, the following baseline conditions are recommended. The baseline conditions would be used to gage project benefits and initial loading reductions as the monitoring data record is built.

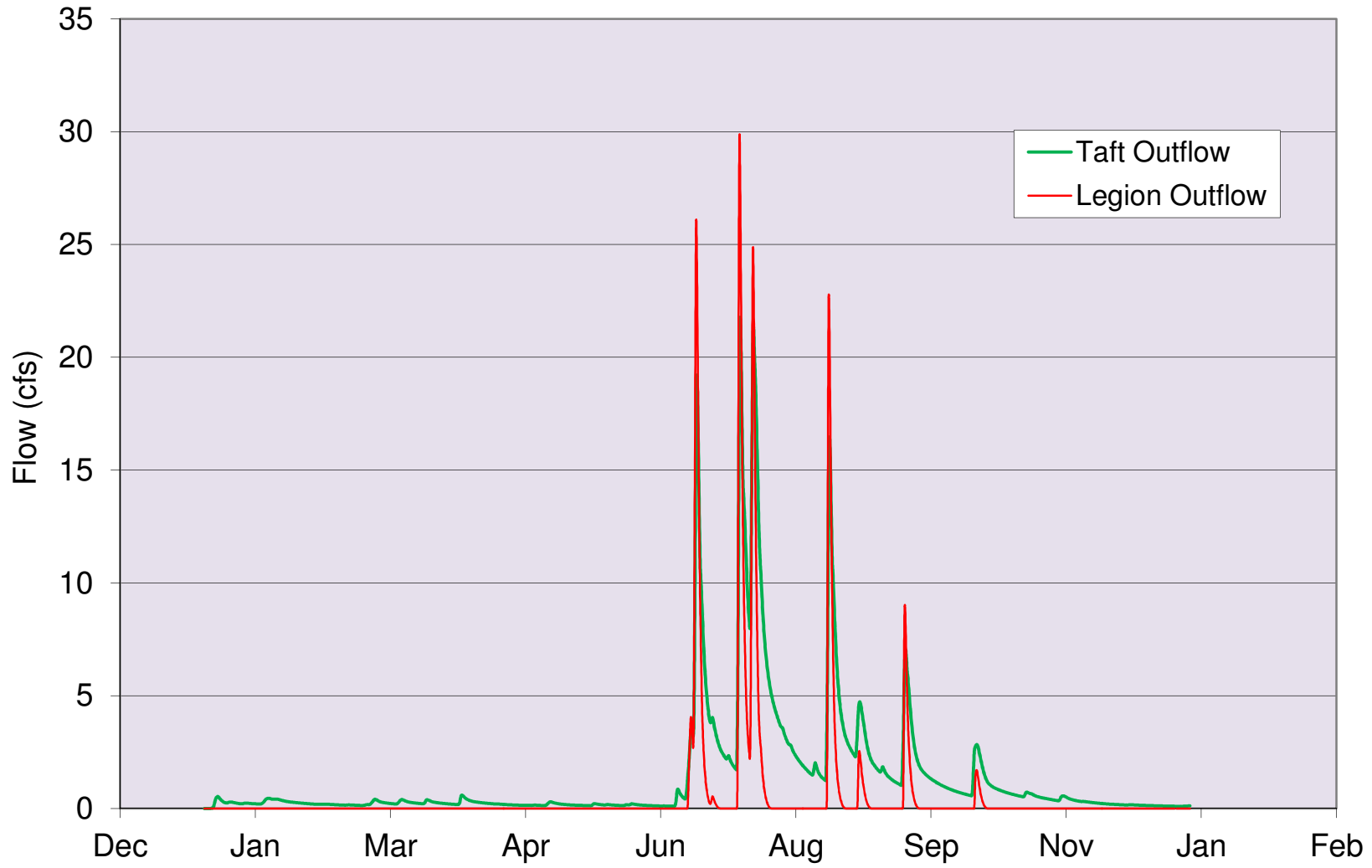
	<u>Annually</u>
Legion Loading to Taft Lake:	245 lb/year
Legion TP Concentration:	450 ug/l
Legion Discharge:	200 ac-ft
Taft Loading to Lake Nokomis:	190 lb/year
Taft TP Concentration:	100 ug/l
Taft Discharge:	700 ac-ft

As an illustration, assume the loading to Nokomis is cut by 50% and the loading to Taft Lake is cut by 70% as well. That would result in a removal of 267 lbs of TP each year over the life of the project. If the project life is 30 years, the total TP removal would be an estimated 8,000 lbs and the approximate cost per lb of TP removed would be \$600 per lb. This unit cost is less than the measured cost of removal of Southwest Calhoun Ponds and less than the estimated removal of the Lake Nokomis Ponds Projects.

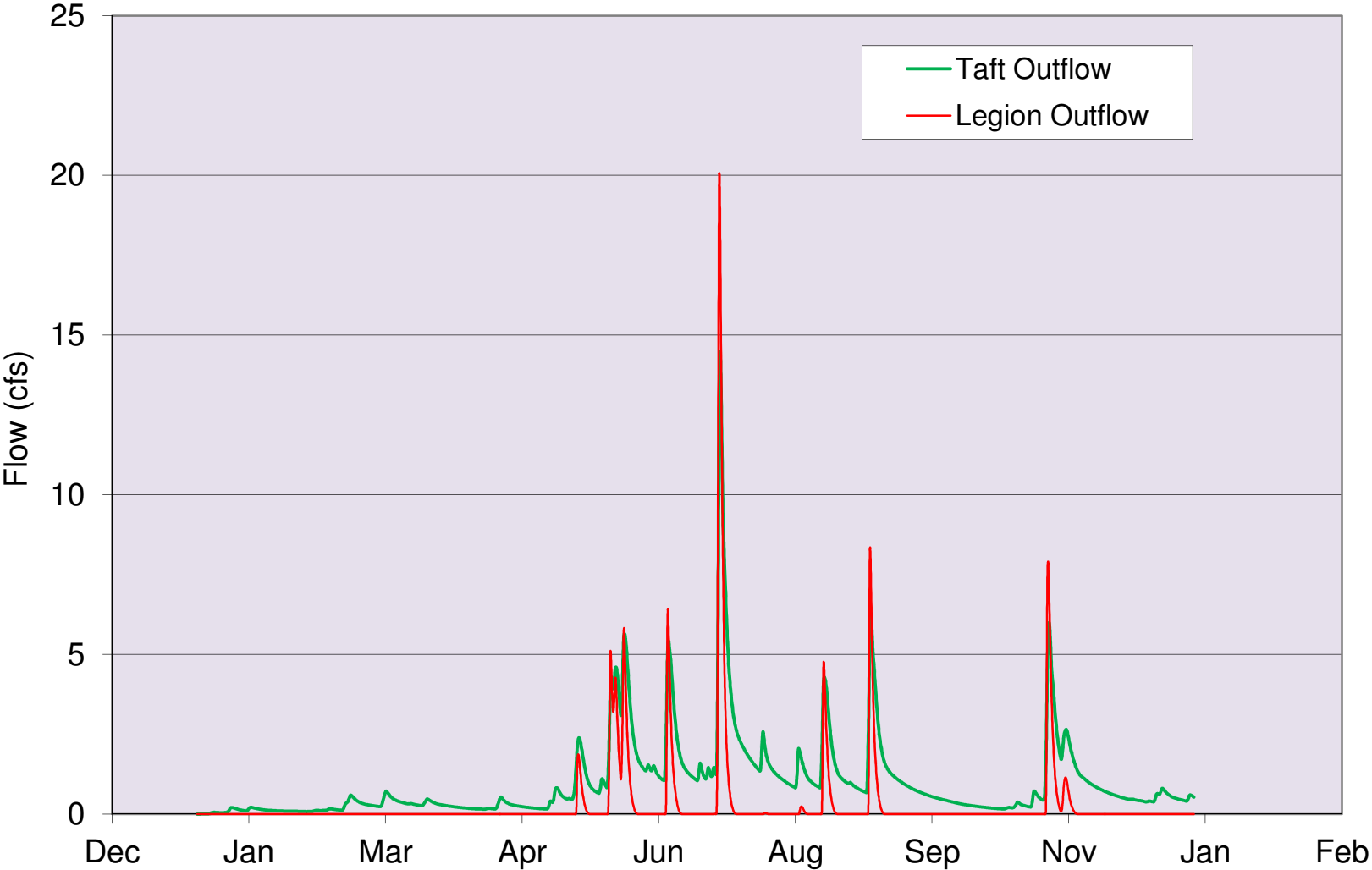
Attachment A

XP-SWMM Outflow Hydrographs from Legion Lake and Taft Lake for 1997, 2000 and 2008 precipitation
Records at MSP Airport

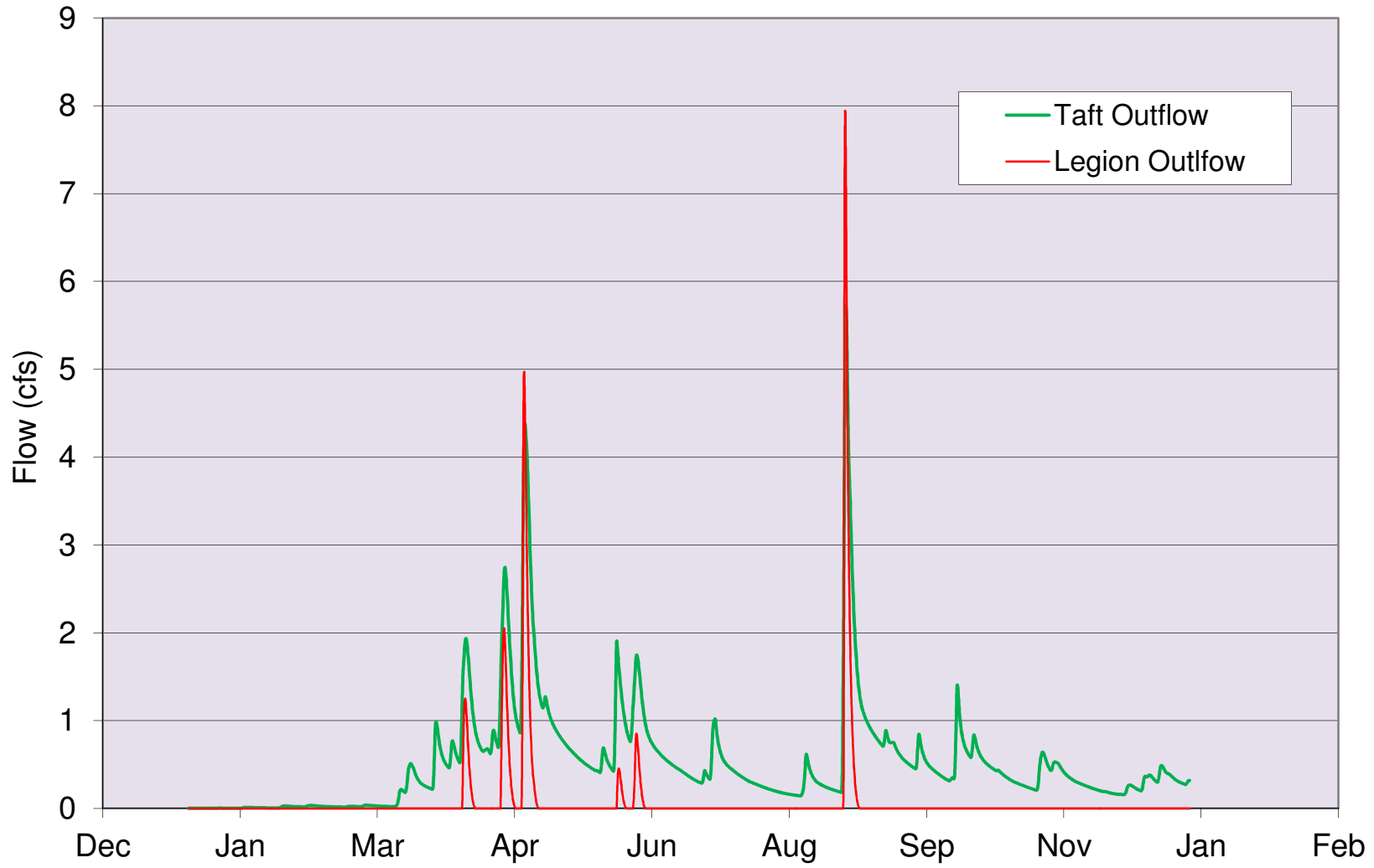
Taft & Legion Lake 1997 Outlet Flow Comparison



Taft & Legion Lake 2000 Outlet Flow Comparison



Taft & Legion Lake 2008 Outlet Flow Comparison



TECHNICAL MEMORANDUM

TO: Mike Panzer, P.E.
FROM: Jeff Madejczyk
DATE: 06/10/2011
SUBJECT: Veteran's and Taft Park Infiltration Test Results
Cc:

Infiltration tests were performed at Veteran's Park and Taft Park in Richfield over the course of two field days including Thursday May 26th and Thursday June 2nd. Weather conditions were very wet leading up to the field work with a large amount of precipitation occurring during the weeks prior to the field tests. A total of ten locations within the two parks were tested including eight locations in Veteran's Park and two locations in Taft Park. Results of the field tests are provided.

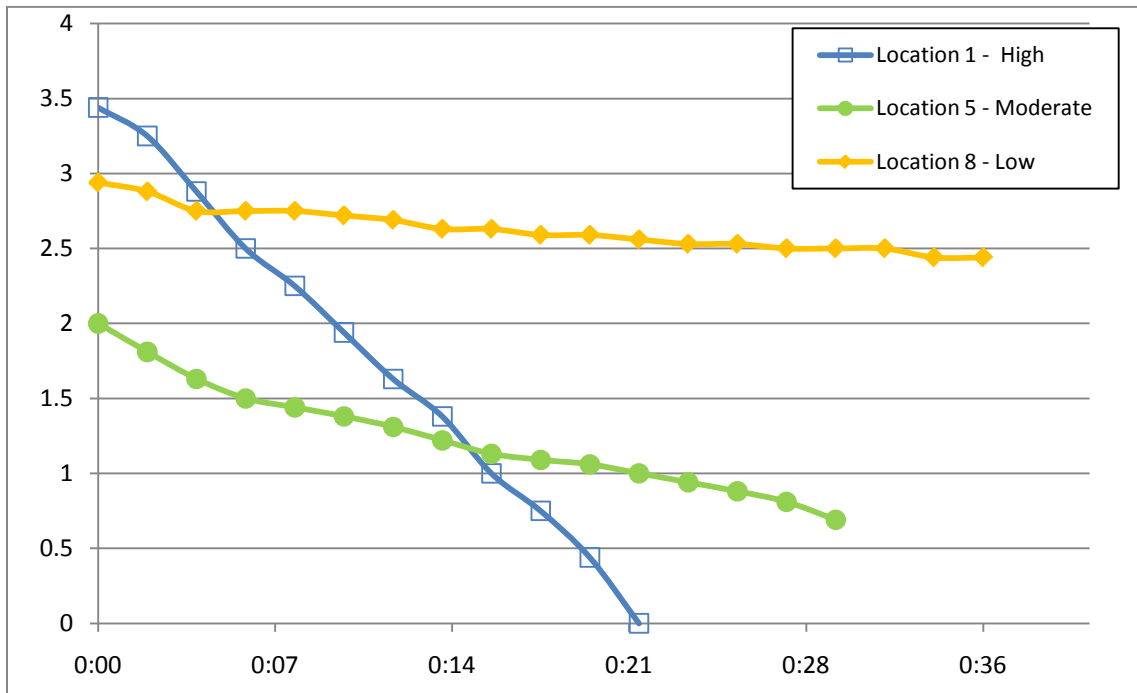
Methods

The infiltration test procedures used a double-ring infiltrometer. At each test location the infiltrometer was pressed into the ground approximately 1 to 1.5 inches to ensure that the water would have to flow down into the ground to leave the rings. Prior to adding water to the rings, the depth from the top of the inner ring to the ground was measured. This was recorded as the total starting depth. Water was then added to both the inner and outer rings and the start time was recorded. Depth of water measurements of the inner ring were recorded every two minutes until no water remained in the ring or until the test had last one hour in time. At most locations the test was run two times, the first time to saturate the ground and the second time to measure the rate of infiltration after saturated conditions were created. At certain locations, soil conditions were saturated prior to the initial test. As a result, only one test was run at these locations. Field photos of the device are provided for review.

Results

A total of 10 locations were tested in Veterans Park and Taft Park (Figure 1). Two infiltration tests were run at eight of the locations while only one test was performed at two of the locations, due to saturated conditions being present prior to testing. The rate of infiltration varied significantly across the ten locations tested, with observed rates less than one inch per hour at some locations and greater than six inches per hour at other locations. All test locations were rated a high (greater than 4inches per hour), moderate (1 to 3 inches per hour) or low rates of infiltration (less than 1 inch per hour). Figure 2 provides a comparison of locations with high, moderate and low rates of infiltration. The results presented are for the second infiltration test at a location.

Figure 2: Comparison of infiltration rates for locations with high, moderate and low rates of infiltration



Classification: High > 3 in/hr; moderate 1 to 3 in/hr; low < 1in/hr.

The results of the infiltration tests showed high rates of infiltration at four locations, moderate rates of infiltration at three locations and low rates of infiltration at three locations (Table 1). Based on the test results and field observations, areas with low rates of infiltration should be avoided for potential irrigation projects as these areas become saturated very easily and remain saturated for long periods of the summer. The results of the field test indicate that the best locations for potential irrigation projects are locations 1, 2 and 7A & 7B in Veteran’s Park and location 9 in Taft Park.

Table 1: Results of infiltrations tests for 10 locations in Veteran’s and Taft Parks.

Location	Rate (in/hr)	Classification
1	9.38	High
2	4.58	High
3	1.36	Moderate
4	0.63	Low
5	2.62	Moderate
6	0.83	Low
7A	7.86	High
7B	10.20	High
8	0.86	Low
9	2.87	Moderate

Classification: High > 3 in/hr; moderate 1 to 3 in/hr; low < 1in/hr.




Photo 1: Double Ring Infiltrometer during the beginning of a field infiltration test.



Photo 2: Example of infiltration progressing during field test.

Legend

 Infiltration Tests



MINNEHAHA CREEK WATERSHED DISTRICT

Veteran's Park - Infiltration Test Locations



Engineers - Scientists
Business Professionals
www.wenck.com

Wenck

1800 Pioneer Creek Center
Maple Plain, MN 55359-0429
1-800-472-2232

JUNE 2011

Figure 1

Appendix C
Construction Costs for Proposed Project

Appendix C

CONSTRUCTION COSTS FOR TAFT / LEGION WATER QUALITY IMPROVEMENTS

Line No.	Item No.	Description	Unit	Unit Price	Estimated Quantity	Estimated Cost
1	2021.501	MOBILIZATION	LUMP SUM	\$120,000.00	1	\$120,000.00
2	2101.501	CLEARING	ACRE	\$3,750.00	2	\$7,500.00
3	2101.506	GRUBBING	ACRE	\$3,750.00	2	\$7,500.00
4	2104.501	REMOVE FENCE	LIN FT	\$5.00	1200	\$6,000.00
5	2104.501	REMOVE STORM SEWER	LIN FT	\$10.00	200	\$2,000.00
6	2104.505	REMOVE BITUMINOUS PAVEMENT	SQ YD	\$3.00	7500	\$22,500.00
7	2104.505	REMOVE SIDEWALK	SQ YD	\$8.00	250	\$2,000.00
8	2104.509	REMOVE PIPE APRON	EACH	\$300.00	4	\$1,200.00
9	2105.501	COMMON EXCAVATION (EV)	CU YD	\$5.00	4800	\$24,000.00
10	2105.525	TOPSOIL BORROW (CV)	CU YD	\$15.00	500	\$7,500.00
11	2105.601	DEWATERING	LUMP SUM	\$20,000.00	1	\$20,000.00
12	2112.501	NEW RICHFIELD PARKWAY CONNECTION	LUMP SUM	\$600,000.00	1	\$600,000.00
13	2501.515	36" RC PIPE APRON	EACH	\$950.00	4	\$3,800.00
14	2501.602	TRASH GUARD FOR 36" PIPE APRON	EACH	\$950.00	4	\$3,800.00
15	2502.521	6" PE PIPE DRAIN	LIN FT	\$9.00	5000	\$45,000.00
16	2503.541	36" RC PIPE SEWER DES 3006 CLIII	LIN FT	\$80.00	1100	\$88,000.00
17	2504.603	8" PVC FORCEMAIN	LIN FT	\$22.00	4500	\$99,000.00
18	2506.501	CONSTRUCT DRAINAGE STRUCTURE-DES 48-4020	LIN FT	\$350.00	20	\$7,000.00
19	2506.502	CONSTRUCT SEDIMENTATION MANHOLE	EACH	\$100,000.00	3	\$300,000.00
20	2506.502	CONSTRUCT WET WELL, PUMPS, AND CONTROLS	EACH	\$65,000.00	3	\$195,000.00
21	2506.516	CASTING ASSEMBLY	EACH	\$350.00	4	\$1,400.00
22	2506.601	IRRIGATION SYSTEM CONTROLS, VALVES & HEADS	LUMP SUM	\$80,000.00	1	\$80,000.00
23	2506.602	FLOCCULATION TREATMENT SYSTEM	LUMP SUM	\$900,000.00	1	\$900,000.00
24	2511.501	RANDOM RIPRAP CL III	CU YD	\$75.00	100	\$7,500.00
25	2511.515	GEOTEXTILE FILTER, TYPE IV	SQ YD	\$3.00	200	\$600.00
26	2563.601	TRAFFIC CONTROL	LUMP SUM	\$5,000.00	1	\$5,000.00
27	2564.602	INSTALL SIGN	EACH	\$250.00	20	\$2,500.00
28	2571.602	TREE PROTECTION TYPE I	EACH	\$50.00	20	\$1,000.00
29	2572.502	CLEAN ROOT CUTTING	LIN FT	\$4.00	175	\$700.00
30	2572.502	CLEAN ROOT CUTTING	LIN FT	\$4.00	75	\$300.00
31	2573.502	SILT FENCE, TYPE HEAVY DUTY	LIN FT	\$3.00	4000	\$12,000.00
32	2573.505	FLOATATION SILT CURTAIN, TYPE STILL WATER	LIN FT	\$15.00	600	\$9,000.00
33	2573.530	STORM DRAIN INLET PROTECTION	EACH	\$150.00	20	\$3,000.00
34	2573.602	TEMPORARY ROCK CONSTRUCTION ENTRANCE	EACH	\$4,400.00	2	\$8,800.00
35	2575.501	SEEDING (INCL. FERT., DISKING, MULCH & WATERING)	ACRE	\$3,500.00	10	\$35,000.00
36	2575.523	EROSION CONTROL BLANKETS CATEGORY 3	SQ YD	\$3.00	3300	\$9,900.00
25% INDIRECT COSTS						\$2,638,500.00
25% INDIRECT COSTS						\$660,000.00
25% INDIRECT COSTS						\$3,298,500.00