Item 5A.
BCWMC 4-19-18

Feasibility Report for Westwood Lake Water Quality Improvement Project

St. Louis Park, MN

April 2018

Prepared for
Bassett Creek Watershed Management Commission

4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435
952.832.2600
www.barr.com

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Feasibility Report for Westwood Hills Nature Center

April 2018

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Certifications

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.

	date
Michelle Kimble	Date
PE #: 42012	

1.0 Background

The BCWMC's 2015-2025 Watershed Management Plan (Plan, Reference (1)) addresses the need to improve the quality of stormwater runoff reaching the Mississippi River by reducing nonpoint source pollution, protecting and enhancing fish and wildlife habitat, reducing stormwater runoff volume to improve water quality, and taking into account aesthetics and recreational opportunities within the watershed. This project is consistent with the goals (Section 4.1) and policies (Sections 4.2.1 and 4.2.10) in the Plan. The Plan's 10-year Capital Improvement Program (CIP, Table 5-3 in the Plan) includes project WST-2 Westwood Lake Water Quality Improvement Project. The BCWMC approved the 5-year (working) CIP at their March 17, 2016 meeting, which included implementation of the Westwood Lake Water Quality Improvement Project in 2019.

The Westwood Lake Water Quality Improvement Project is part of a larger project at the Westwood Hills Nature Center (WHNC). WHNC is in the planning phase of a complete reconstruction of its facilities in 2019. A master plan for the reconstruction project was completed in May 2016 for the City of St. Louis Park. The proposed improvements in the master plan include trail circulation and wayfinding, additional parking, expanded outdoor classroom area and water garden, expanded natural play and outdoor education area, improved canoe and kayak launch, interpretive features, and a new interpretive center building. This study examines the feasibility of constructing additional water quality improvements to treat stormwater runoff that would otherwise flow untreated to Westwood Lake.

1.1 Project Area Description

The WHNC is a 160-acre park located in St. Louis Park in the southern portion of the Bassett Creek watershed, southeast of the intersection of Interstate 394 and Highway 169 (Figure 1-1). The park is bordered by Westwood Hills Drive, Virginia Avenue South, and Westwood Hills Road on the east; and Westmoreland Lane and Flag Avenue South on the south and west. Wayzata Boulevard is north of the park. The park contains trails, marsh, woods, and restored prairie, and is surrounded by medium density residential and commercial areas (Figure 1-2). The existing interpretive center at the WHNC is located in the southeast portion of the park, approximately 360 feet north of the existing parking lot, and is accessed via a paved trail from the parking lot. The existing interpretive center will be demolished as part of the larger WHNC reconstruction project and the new interpretive center will be built near the north edge of the existing parking lot. The existing parking lot will be demolished and reconstructed farther to the south. The new facility will be nearly five times as large as the existing building. The existing parking lot has 33 parking spaces and the proposed parking lot will provide nearly double the number of parking spaces (Figure 1-3).

1.1.1 Westwood Lake

Westwood Lake is a 38-acre lake in St. Louis Park in the southern portion of the Bassett Creek watershed. The BCWMC classified Westwood Lake as a Priority 1 shallow lake, making this water quality improvement project eligible for inclusion in the BCWMC's CIP. Westwood Lake has a maximum depth of 5 feet, a normal water elevation of 887.6 feet (NAVD88 datum), and a 100-year elevation of 890.0 feet (NAVD88 datum). Runoff draining into the lake enters through five storm sewers located around the perimeter. On

the north side of the lake, the outlet is a 400-foot long open channel which discharges to a 27-inch reinforced concrete pipe (RCP) storm sewer at an elevation of 886.2 feet (NAVD88 datum). From there runoff drains through several ponds and pipes over 1500 feet in length, and outlets into the main stem of Bassett Creek, downstream of General Mills Boulevard.

1.1.2 Westwood Lake Subwatershed

Westwood Lake's 463-acre watershed includes portions of St. Louis Park, Golden Valley, and Minnetonka. The watershed primarily comprises low-density residential land use, park and recreational areas, and a golf course (Figure 1-2). The lake is adjacent to parkland and within the WHNC, both of which provide access to trails surrounding the lake and opportunities for canoeing or kayaking, scenic viewing, birding, and hiking. The project area is generally flat or moderately undulating, with the exception of a steep hilly area near the existing WHNC interpretive center. Adjacent upland areas east of the parking lot have steep topography. A detailed topographic map can be found in Appendix A.

1.1.3 Turtle Pond

Turtle Pond is a small wetland located northwest of the proposed WHNC interpretive center building. The Turtle Pond outlet is a 12-inch polyvinyl chloride (PVC) culvert with an invert elevation of 889.4. Turtle Pond drains into a small unnamed wetland which then drains into Westwood Lake via an 8-inch PVC culvert with an invert elevation of 888.6 (Figure 1-3).

1.1.4 Wetland Delineation

The City of St. Louis Park, in coordination with HGA Architects and Engineers (HGA), completed a site topographic and tree survey, wetland delineation, and Phase 1 environmental site assessment in 2017 as part of the larger WHNC reconstruction project. The site topographic and tree survey, which shows the wetland locations, was provided by HGA is included in Appendix A.

1.1.5 Soil Borings

The City of St. Louis Park, in coordination with HGA, completed soil borings in 2017 for the proposed WHNC reconstruction project. Soils are generally characterized as fill, swamp deposits, peat, or clay with groundwater seven to ten feet below grade. The Soil boring logs were provided by HGA and are included in Appendix B.

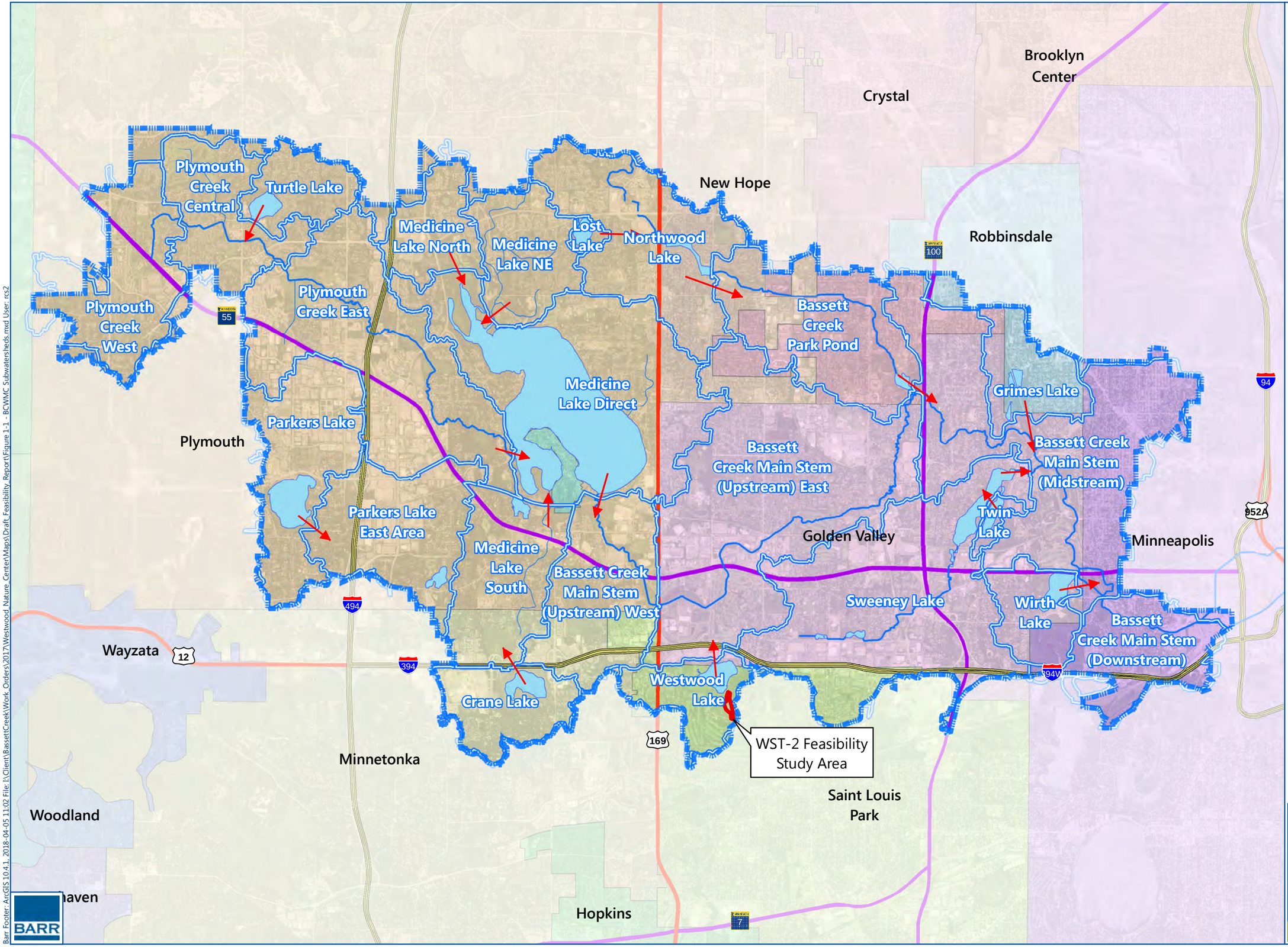
1.2 Hydrologic and Hydraulic Models

The BCWMC completed the Phase II XP-SWMM model for Bassett Creek and its contributing watersheds in 2016. Hydrologic and hydraulic information was not reviewed or analyzed as part of this feasibility study because no changes are proposed that would impact the information included in the XP-SWMM model.

1.3 Water Quality Models

The BCWMC developed the P8 model for Bassett Creek and its contributing watersheds in 2012. The P8 water quality model was not reviewed or analyzed as part of this feasibility study, however this study

included a preliminary MIDS and water balance analysis to estimate the water quality improvement expected from each proposed alternative. Final design efforts should include both additional refinements to the water quality modeling as the design components are finalized and incorporation of the constructed improvements into the BCWMC's P8 model after completion of the project.



Flow Directions
BCWMC Priority Streams
WST-2 Feasibility Study Area
Major Subwatersheds
Lakes and Ponds
BCWMC Jurisdictional Boundary

N

0 2,000 4,000
Feet

BCWMC
MAJOR SUBWATERSHEDS
AND DRAINAGE PATTERNS
Westwood Hills
Nature Center

FIGURE 1-1

BARR

Barr Footer: ArcGIS 10.4.1, 2018-04-05 11:02 File: I:\Client\BassettCreek\Work_Orders\2017\Westwood_Nature_Center\Maps\Draft_Feasibility_Report\Figure1-1_BCWMC_Subwaters heds.mxd User: rcs2

Westwood Lake

Turtle Pond

Westwood Hills Nature Center (WHNC)

WST-2 Feasibility Study Area

N Frontage Rd
General Mills Blvd
394
Laurel Ave
Hanley Rd
Utah Ave S
Winnetka Ave S
Sumter Ave S
Rhode Island Ave S
Wayzata Blvd S Frontage Rd
Wayzata Blvd
Wisconsin Ave S
Wayzata Frontage Rd
W 13th La
W 13 1/2 St
Westwood Hills Dr
W 14th St
Lancaster Ave
Kilmer Ave
Jordan Ave
Hillsboro Ave S
W 16th St
169
Melrose Ave
Independence Ave S
Hillsboro Ave
Parker Rd
W Franklin Ave
Westmoreland La
Flag Ave S
E Service Rd
W 22nd St
Virginia Ave
Utah Dr
Utah Ave S
Texas Ave S
Utah Ave
Franklin Ave
Westwood Hills Dr
Virginia Ave S
Westwood Hills Cv
W 22nd St
W Quebec Ave
Quebec Dr
Pennsylvania Ave S

Creeks

WST-2 Feasibility Study Area

Westwood Hills Nature Center

2016 Generalized Land Use (Met Council)

- Open Water
- Retail and Other Commercial
- Office
- Institutional
- Residential
- Park, Recreational, or Preserve
- Golf Course

N

0 500

Feet

LOCATION AND LAND USE
Westwood Hills
Nature Center
Bassett Creek Watershed
Management Commision

FIGURE 1-2

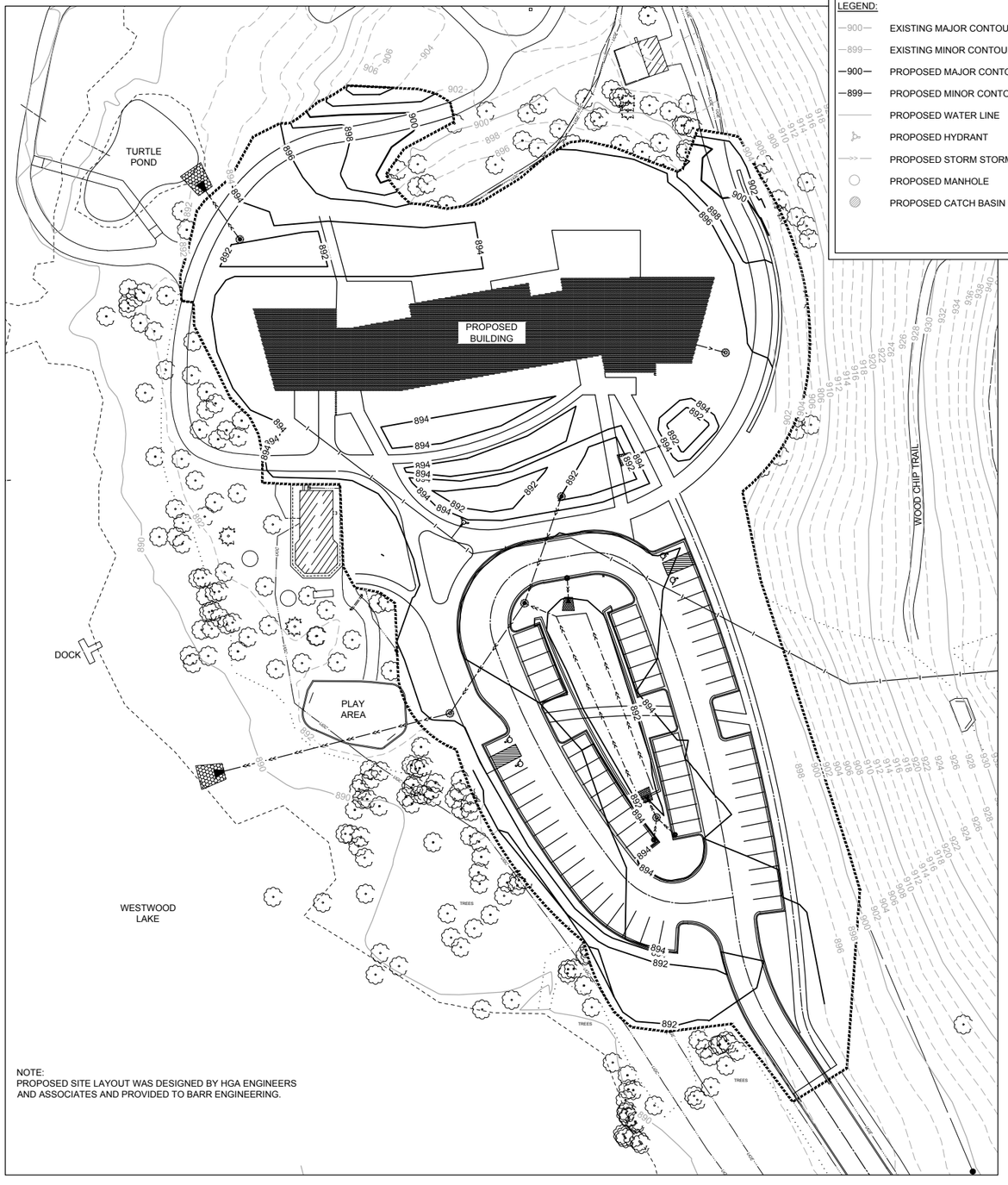
Barr Footer: ArcGIS 10.4.1, 2018-03-29 13:56 File: \\barr.com\gis\Client\BassettCreek\Work_Orders\2017\Westwood_Nature_Center\Maps\Draft_Feasibility_Report\Figure 1-1 - Location and Land Use.mxd User: rcs2

BARR

NOTE:
EXISTING CONDITIONS SURVEY SURVEY COMPLETED BY SUNDE LAND SURVEYING AND PROVIDED TO BARR ENGINEERING BY HGA ARCHITECTS AND ENGINEERS.

1 PLAN: EXISTING CONDITIONS
SCALE AS SHOWN

0 40 80
SCALE IN FEET



NOTE:
PROPOSED SITE LAYOUT WAS DESIGNED BY HGA ENGINEERS AND ASSOCIATES AND PROVIDED TO BARR ENGINEERING.

2 PLAN: PROPOSED CONDITIONS
SCALE AS SHOWN

0 40 80
SCALE IN FEET

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION
A	JPP	MAK	KLC	04/11/2018	BCWMC AND CITY REVIEW

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.

PRINTED NAME _____

SIGNATURE _____

DATE _____ LICENSE # _____

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CLIENT							
BID							
CONSTRUCTION							
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	DATE RELEASED						

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Scale	AS SHOWN
Date	04/11/2018
Drawn	JPP
Checked	MAK
Designed	
Approved	KLC

BCWMC

WESTWOOD LAKE WATER QUALITY IMPROVEMENT PROJECT (WST-2)

EXISTING CONDITIONS AND PROPOSED CONDITIONS

BARR PROJECT No. 23/27-0051.40
CLIENT PROJECT No.
DWG. No. FIGURE 1-3
REV. No. A

2.0 Goals and Objectives

The goals and objectives of the feasibility study are to:

1. Review the feasibility of improving quality of stormwater runoff reaching Westwood Lake.
2. Develop conceptual designs.
3. Provide an opinion of cost for design and construction of concepts.
4. Identify potential impacts and permitting requirements.

The goals and objectives of the water quality project is to:

1. Reduce nonpoint source pollution
2. Protect and enhance fish and wildlife habitat at WHNC
3. Reduce stormwater runoff volume
4. Prevent erosion of soil into Westwood Lake and surrounding wetlands
5. Consider aesthetics and recreational opportunities at WHNC
6. Increase the quality of wetlands

2.1 Scope

As part of the larger WHNC reconstruction project, the City of St. Louis Park is proposing to construct additional water quality improvements to treat stormwater runoff that would otherwise flow untreated to Westwood Lake. The BCWMC's WST-2 CIP project funding would be applied towards the portions of the water quality improvements that provide treatment "above and beyond" the BCWMC requirements for the WHNC reconstruction project.

This project is consistent with the goals (Section 4.1) and policies (Sections 4.2.1, 4.2.2, and 4.2.10) in the 2015 – 2025 BCWMC Watershed Management Plan. The BCWMC has included the Westwood Hills Nature Center Water Quality Project in its CIP, based on gatekeeper policy 110 from the BCWMC Plan:

The BCWMC will consider including projects in the CIP that meet one or more of the following "gatekeeper" criteria.

- *Project is part of the BCWMC trunk system (see Section 2.8.1, Figure 2-14 and Figure 2-15)*
- *Project improves or protects water quality in a priority waterbody*
- *Project addresses an approved TMDL or watershed restoration and protection strategy (WRAPS)*
- *Project addresses flooding concern*

The BCWMC will use the following criteria, in addition to those listed above, to aid in the prioritization of projects:

- *Project protects or restores previous Commission investments in infrastructure*
- *Project addresses intercommunity drainage issues*
- *Project addresses erosion and sedimentation issues*

- *Project will address multiple Commission goals (e.g., water quality, runoff volume, aesthetics, wildlife habitat, recreation, etc.)*
- *Subwatershed draining to project includes more than one community*
- *Addresses significant infrastructure or property damage concerns*

The BCWMC will place a higher priority on projects that incorporate multiple benefits, and will seek opportunities to incorporate multiple benefits into BCWMC projects, as opportunities allow.

The Westwood Hills Nature Center Water Quality Project meets multiple of the gatekeeper criteria—the project is part of the BCWMC trunk system, the project would improve water quality, and would address multiple commission goals.

2.2 Considerations

The following considerations played a key role in determining recommendations for the Westwood Hills Nature Center Water Quality Project and should continue to be evaluated through final design:

1. Maximizing the water quality benefit.
2. Minimizing permitting required to construct the project.
3. Minimizing wetland impacts.
4. Minimizing tree loss.
5. Adding educational opportunities.

3.0 Stakeholder Input

3.1 Public Stakeholder Meeting

Two public stakeholder open house meetings were held on February 22 and 28, 2018. The City of St. Louis Park and their consultant organized these meetings. The BCWMC administrator did not attend either meeting, however Chair de Lambert did attend one of the meetings. While the presentations and discussions focused on the proposed interpretive center, the BCWMC had a display at the meetings with a watershed map, a brief project description, educational materials, and information about the BCWMC. An opportunity was provided for residents to offer thoughts or concerns about the project on index cards; however, no comments were passed along to Barr or BCWMC concerning the water quality portion of the project.

3.2 Technical Stakeholder Meeting

Two technical stakeholder meetings were held for the project. The first was held onsite on November 21, 2017. The meeting included representatives from the City of St. Louis Park, HGA (the city's architect and engineer), and the Commission Engineer. The attendees discussed project scope, field work schedule, design and meeting schedules, and site layout.

The second meeting was held at City of St. Louis Park offices on March 1, 2018. Attendees included representatives from the City of St. Louis Park, the city's consultant, the BCMWC administrator, and the BCWMC Engineer. Attendees discussed possible design concepts, permitting needs, project schedule and funding were also reviewed.

3.3 BCWMC Stakeholder Comments

A draft version of the April 2018 draft report was provided to the BCWMC administrator and City of St. Louis Park staff. The draft feasibility study was revised in response to the comments received. Additional review of the technical comments is recommended during final design.

4.0 Water Quality Improvement Concepts

This section provides a summary of the alternatives analyzed for water quality and other improvements at WHNC. Multiple alternatives were evaluated for removing sediment, improving water quality, protecting and enhancing fish and wildlife habitat, and adding aesthetic and educational opportunities within the project area. The measures considered for potential implementation include the following:

- Adding additional permeable paver parking bays in the proposed parking lot for water quality treatment and a possible reduction of salt application in the parking bay (Concept 1)
- Increasing the size of proposed filtration basins, or supplementing the site with additional filtration basins (Concept 2)
- Installing a linear water quality feature on the north side of the interpretive center with signage and interactive features for education (Concept 3)
- Directing additional site runoff to Turtle Pond to increase the water quality treatment provided by the pond (Concept 3)

Three water quality treatment concepts were developed. The proposed concepts will reduce sediment and phosphorus loading to Westwood Lake and all downstream water bodies, including Bassett Creek and the Mississippi River.

4.1 Concept 1 – Additional Permeable Pavers

Concept 1 includes installing additional permeable pavers in the proposed parking lot. The proposed parking lot is designed with an outer and inner ring of parking stalls and includes permeable pavers at the inner ring location. Concept 1 would increase the amount of pervious concrete pavers by constructing the outer ring of parking stalls with the same permeable paver design proposed for the inner ring of parking stalls. All pervious pavers would include granular filters with draintile beneath them. An overflow structure would be installed in each paver bay to minimize flooding if the pavers become plugged. Concept 1 is shown in detail on Figure 4-1.

The soil borings show soils near the proposed parking lot that would not be conducive to infiltration. As a result, the permeable pavers are designed as a filtration system. Pervious pavers improve water quality by trapping sediments and nutrients at the surface or in the sand filter below. There is also evidence that pervious pavers require less salt application during winter months than traditional bituminous or concrete paving. Installing additional permeable pavers would reduce sediment and nutrient loading, and may reduce chloride loading to Westwood Lake, Bassett Creek, and the Mississippi River. Signage could be used to educate the visitors on how the pavers are improving water quality in the watershed.

To maintain effectiveness, permeable pavers must be maintained. Regular maintenance includes removing accumulated sediment or organic matter with sweeping and cleaning out the draintile. Even with regular maintenance, eventually the pavers may need to be removed and reinstalled to replace the filter media. The life of the pavers depends on how well they are maintained.

4.2 Concept 2 – Expand Filtration Basins

Concept 2 includes increasing size and filtration capacity of the proposed filtration basins on the south side of the proposed interpretive center. Two areas have been identified for expansion of the filtration basins, which could provide an additional 3,300 cubic feet (0.08 acre-feet) of storage. Concept 2 is shown in detail on Figure 4-2. At the time of this report, the site design for the WHNC reconstruction project had not yet been completed. It is possible additional locations could be identified for expansion of the filtration basins. This should be evaluated during final design.

The soil borings show soils near the proposed parking lot that would not be conducive to infiltration. As a result, the basins are designed as filtration systems. The expanded filtration basins would match the design of the proposed filtration basins. These designs have not yet been finalized but will generally include a sand trench with draintile, planting soil, surface mulch, plantings, and an overflow outlet. Filtration basins improve water quality by trapping sediments and nutrients, or removing nutrients through plant uptake. Expanding the proposed filtration basins would increase the filtration capacity of the basins, and further reduce the sediment and nutrient loading to Westwood Lake, Bassett Creek, and the Mississippi River. Signage could be used to educate the visitors on how the basins are improving water quality in the watershed.

To maintain effectiveness, filtration basins must be maintained. Regular maintenance includes removal of trash and debris, weeding, cleaning out the draintile, loosening the surface of the basin, removing accumulated sediment or organic material, replacing plants, and replacing surface mulch. Even with regular maintenance, eventually the filtration basins may require removal and replacement of the planting soil, plants, and sand trench to restore effectiveness.

Adding iron filings to the sand trenches for iron enhanced sand filtration to remove soluble phosphorus was discussed. Soil borings near the basins show groundwater elevations to be as high as 888.0 feet (NAVD88 datum), and could be higher when groundwater is seasonally high. The basin sand trenches could be close to this elevation. We do not recommend using iron in continuously wet areas as the system can go anoxic, the iron can clump together, the system may discharge iron into the downstream waterbodies, and may not function as intended.

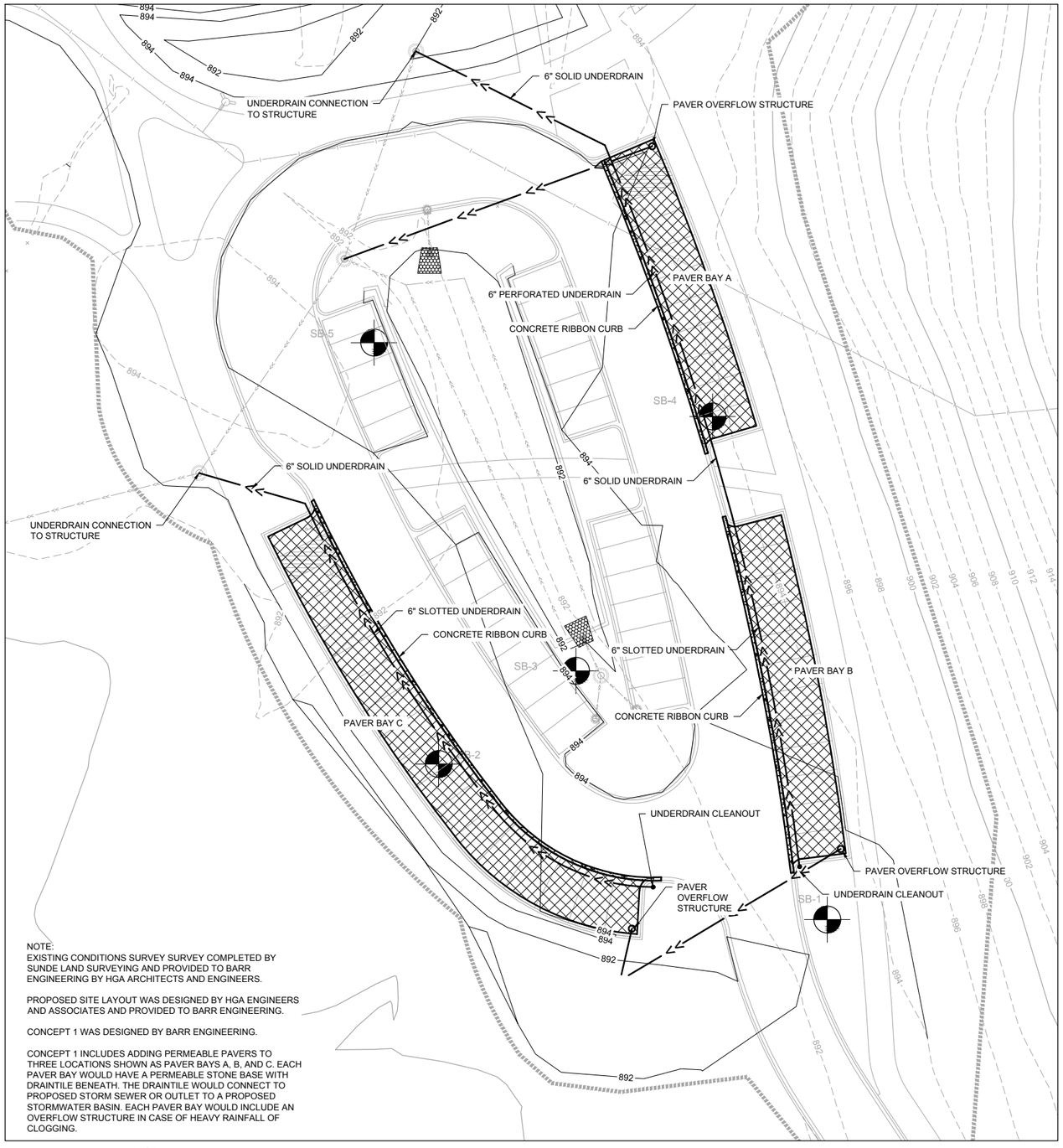
4.3 Concept 3 – Linear Water Feature

Concept 3 includes collecting stormwater runoff from the roof of the proposed interpretive center and the north patio areas. Runoff would be routed through a series of meandering channels and basins on the north side of the proposed interpretive center. Pumps would recirculate the runoff through the channels and basins until it leaves the system through infiltration, evaporation, or evapotranspiration. The recirculation pumps could be solar-powered or manual. An overflow would be provided from the downstream basin to Turtle Pond for storm events larger than the design event. Turtle Pond is currently stagnant and receives minimal runoff. This concept would increase flows to Turtle Pond, which may improve its water quality.

All of the basins and channels would be constructed to promote infiltration. Soils may not be highly conducive to infiltration, however an appropriate infiltration rate for the soil type would be used in design calculations. Infiltration basins improve water quality by trapping sediments and nutrients, or removing nutrients through plant uptake, and reducing runoff volume. Routing stormwater runoff to this series of channels and basins would reduce the sediment and nutrient loading to Westwood Lake, Bassett Creek, and the Mississippi River.

To maintain effectiveness, infiltration basins must be maintained. Regular maintenance includes removal of trash and debris, weeding, cleaning out the draintile, loosening the material at the surface of the basin, removing accumulated sediment or organic material, replacing plants, and replacing surface mulch. Even with regular maintenance, eventually the basins may require removal and replacement of surface mulch and plants.

In addition to water quality benefits, this system could be designed as an educational experience with signage, pedestrian bridges, and interactive features. A recirculation pump could be powered with a stationary bike, a wheel, or a hand crank. When initiated, the manual pumping could discharge at a highly visible, elevated, and accessible location. These, or similar educational features, would allow WHNC visitors see the connection between their effort and the recirculation flow. A separate solar-powered recirculation pump could provide a lower “base-flow” for the system to ensure that the system is providing consistent water quality treatment. A manual switch could be provided for the pumps to turn them off during winter months or when visitors are not at the site. This concept would also provide added aesthetics to the north side of the building.



NOTE:
EXISTING CONDITIONS SURVEY SURVEY COMPLETED BY SUNDE LAND SURVEYING AND PROVIDED TO BARR ENGINEERING BY HGA ARCHITECTS AND ENGINEERS.

PROPOSED SITE LAYOUT WAS DESIGNED BY HGA ENGINEERS AND ASSOCIATES AND PROVIDED TO BARR ENGINEERING.

CONCEPT 1 WAS DESIGNED BY BARR ENGINEERING.

CONCEPT 1 INCLUDES ADDING PERMEABLE PAVERS TO THREE LOCATIONS SHOWN AS PAVER BAYS A, B, AND C. EACH PAVER BAY WOULD HAVE A PERMEABLE STONE BASE WITH DRAINTILE BENEATH. THE DRAINTILE WOULD CONNECT TO PROPOSED STORM SEWER OR OUTLET TO A PROPOSED STORMWATER BASIN. EACH PAVER BAY WOULD INCLUDE AN OVERFLOW STRUCTURE IN CASE OF HEAVY RAINFALL OF CLOGGING.

1 - PLAN: WST-2 FEASIBILITY STUDY - CONCEPT 1: ADDITIONAL PERMEABLE PAVERS
AS SHOWN

0 20 40
SCALE IN FEET

N

LEGEND:

- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- BCWMC CIP MAJOR CONTOUR
- BCWMC CIP MINOR CONTOUR
- PROPOSED WATER LINE
- PROPOSED HYDRANT
- PROPOSED STORM STORM
- BCWMC CIP STORM SEWER
- PROPOSED MANHOLE
- PROPOSED CATCH BASIN
- SOIL BORING
- WST-2 STORMWATER TREATMENT (BY BARR ENGINEERING)

CONCEPT LEVEL DRAFT COST ESTIMATES

- PAVER BAY A: $37,000 TO $60,000
- PAVER BAY B: $38,000 TO $62,000
- PAVER BAY C: $52,000 TO $84,000
- TOTAL ESTIMATE: $127,000 TO $206,000

ASSUMPTIONS:

- SUBCUT AND COMMON EXCAVATION PROVIDED BY PROPOSED PROJECT AND NOT REQUIRED AS PART OF BCWMC CIP WORK.
- PROPOSED STORM SEWER STRUCTURES ARE FABRICATED WITH KNOCKOUTS FOR BCWMC CIP STORM SEWER.
- ESTIMATE INCLUDES DESIGN AND CONSTRUCTION COSTS

ISSUED FOR REVEIW
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION
B	JPP	MAK	KLC	04/11/2018	BCWMC AND CITY REVIEW
A	JPP	MAK	KLC	03/09/2018	BCWMC AND CITY REVIEW

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.

PRINTED NAME _____

SIGNATURE _____

DATE _____ LICENSE # _____

	03/09/18	04/11/18					
CLIENT							
BID							
CONSTRUCTION							
RELEASED TO/FOR	A	B	C	0	1	2	3
	DATE RELEASED						

BARR
Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277

Project Office:
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
Suite 200
MINNEAPOLIS, MN 55435
Ph: 1-800-632-2277
Fax: (952) 832-2601
www.barr.com

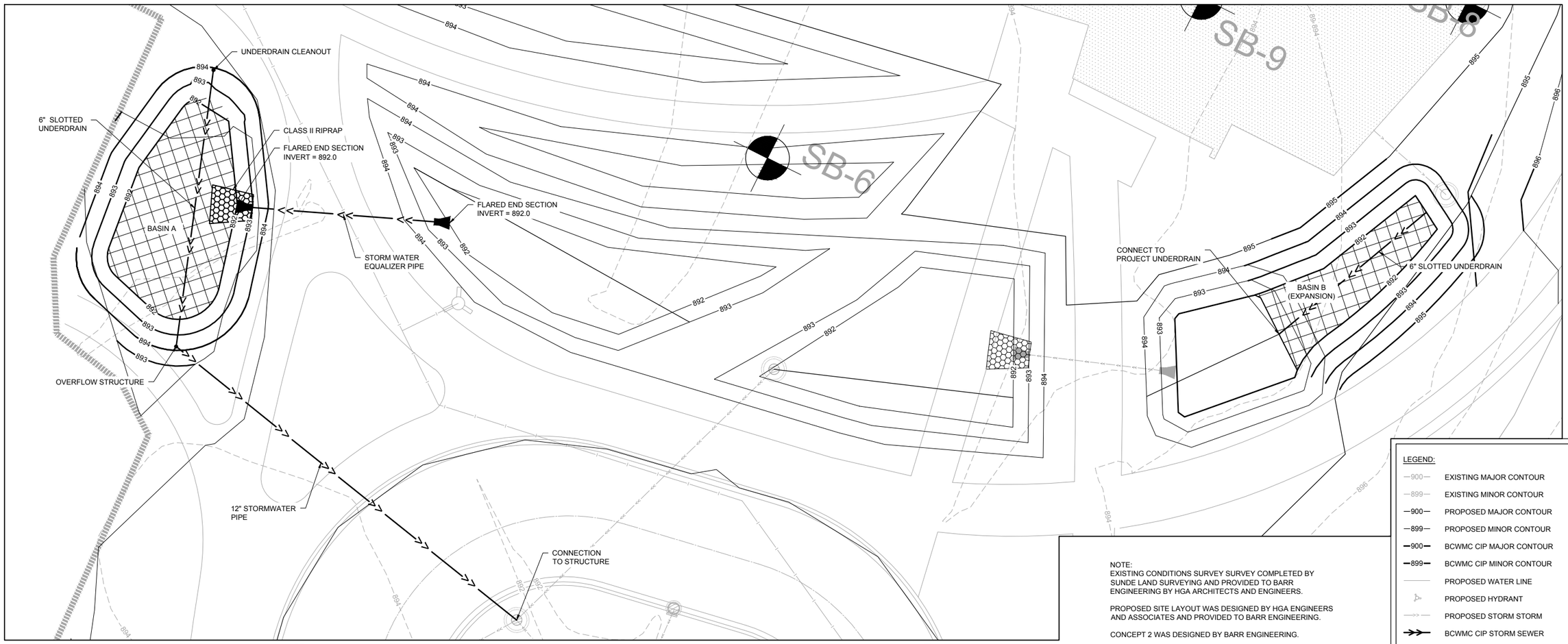
Scale	AS SHOWN
Date	04/11/2018
Drawn	JPP
Checked	MAK
Designed	MAK
Approved	KLC

BCWMC

WESTWOOD LAKE WATER QUALITY IMPROVEMENT PROJECT (WST-2)

FEASIBILITY STUDY - CONCEPT 1
ADDITIONAL PERMEABLE PAVERS

BARR PROJECT No. 23/27-0051.40
CLIENT PROJECT No.
DWG. No. FIGURE 4-1
REV. No. B



1 - PLAN: WST-2 FEASIBILITY STUDY - CONCEPT 2: EXPANDED FILTRATION BASINS
AS SHOWN

0 10 20
SCALE IN FEET

NOTE:
EXISTING CONDITIONS SURVEY SURVEY COMPLETED BY SUNDE LAND SURVEYING AND PROVIDED TO BARR ENGINEERING BY HGA ARCHITECTS AND ENGINEERS.

PROPOSED SITE LAYOUT WAS DESIGNED BY HGA ENGINEERS AND ASSOCIATES AND PROVIDED TO BARR ENGINEERING.

CONCEPT 2 WAS DESIGNED BY BARR ENGINEERING.

CONCEPT 2 INCLUDES EXPANDING HGA'S PROPOSED STORMWATER BASIN IN TWO LOCATIONS. BASIN A EXPANDS THE BASIN TO A NEW AREA OF THE SITE, AND BASIN B EXPANDS EXISTING GRADING ON THE WEST SIDE OF THE BASIN. THE EXPANDED BASIN AREAS WOULD MATCH HGA'S PROPOSED STORMWATER BASINS TO INCLUDE A GRANULAR TRENCH WITH DRAINTILE. THE DRAINTILE WOULD TIE INTO HGA'S DESIGN OR THE PROPOSED STORM SEWER. THE EXPANDED BASIN AREAS WOULD MATCH THE ELEVATIONS HGA'S PROPOSED STORMWATER BASIN AND BASIN A WOULD BE CONNECTED WITH AN EQUALIZED PIPE. THE EXPANDED BASIN AREAS WOULD BE PLANTED TO MATCH THE PLANTINGS OF HGA'S PROPOSED STORMWATER BASIN.

LEGEND:

—900—	EXISTING MAJOR CONTOUR
—899—	EXISTING MINOR CONTOUR
—900—	PROPOSED MAJOR CONTOUR
—899—	PROPOSED MINOR CONTOUR
—900—	BCWMC CIP MAJOR CONTOUR
—899—	BCWMC CIP MINOR CONTOUR
	PROPOSED WATER LINE
	PROPOSED HYDRANT
	PROPOSED STORM STORM
	BCWMC CIP STORM SEWER
	PROPOSED MANHOLE
	PROPOSED CATCH BASIN
	SOIL BORING
	WST-2 STORMWATER TREATMENT (BY BARR ENGINEERING)

CONCEPT LEVEL DRAFT COST ESTIMATE:
- TOTAL ESTIMATE RANGE = $47,000 TO $76,000

ASSUMPTIONS:
- PROPOSED STORM SEWER STRUCTURES ARE FABRICATED WITH KNOCKOUTS FOR BCWMC CIP STORM SEWER.
- PLANTINGS SPACED 18" O.C. IN BASINS, INCLUDING BOTTOM AND SIDE SLOPES
- ESTIMATE INCLUDES DESIGN AND CONSTRUCTION COSTS

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

NO.	BY	CHK	APP.	DATE	REVISION DESCRIPTION
B	JPP	MAK	KAL	04/11/2018	BCWMC AND CITY REVIEW
A	JPP	MAK	KAL	03/09/2018	BCWMC AND CITY REVIEW

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.
PRINTED NAME
SIGNATURE
DATE LICENSE #

CLIENT	03/09/18	04/11/18						
BID								
CONSTRUCTION								
RELEASED TO/FOR	A	B	C	0	1	2	3	
	DATE RELEASED							

BARR
Corporate Headquarters:
Minneapolis, Minnesota
Ph: 1-800-632-2277

Project Office:
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
Suite 200
MINNEAPOLIS, MN 55435
Ph: 1-800-632-2277
Fax: (952) 832-2601
www.barr.com

Scale	AS SHOWN
Date	04/11/2018
Drawn	JPP
Checked	MAK
Designed	MAK
Approved	KLC

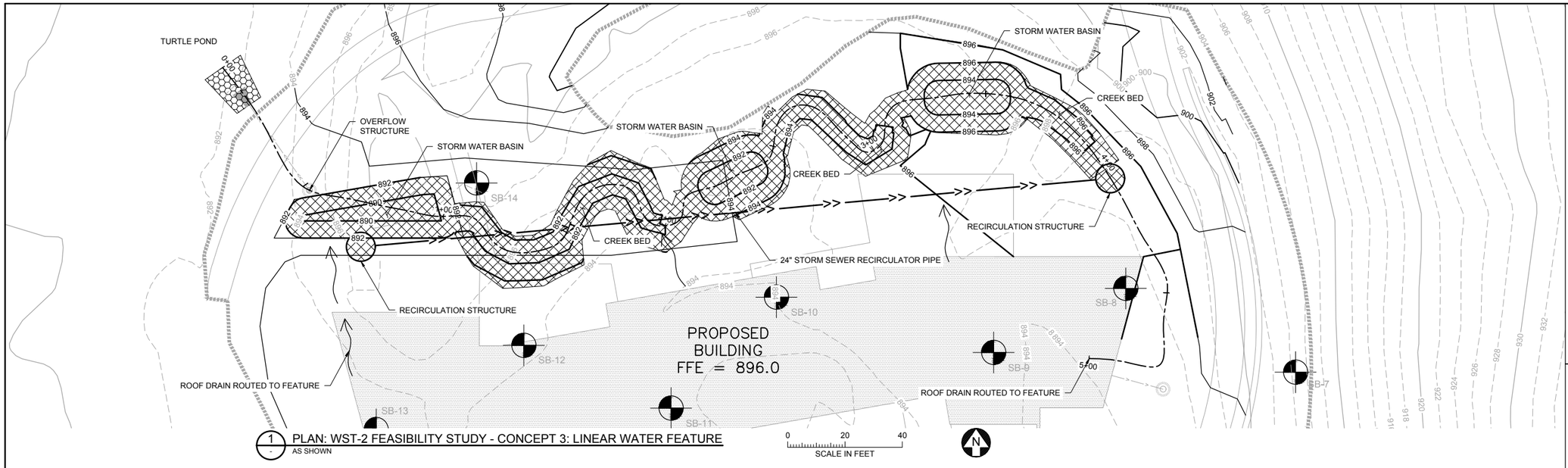
BCWMC

WESTWOOD LAKE WATER QUALITY IMPROVEMENT PROJECT (WST-2)

FEASIBILITY STUDY - CONCEPT 2 EXPANDED FILTRATION BASINS

BARR PROJECT No. 23/27-0051.40
CLIENT PROJECT No.
DWG. No. FIGURE 4-2
REV. No. B

CADD USER: Josh Phillips FILE: M:\DESIGN\23270051.40\23270051.40_CONCEPT_2.DWG PLOT SCALE: 1:2 PLOT DATE: 4/11/2018 3:33 PM
BARR M:\AutoCAD 2011\AutoCAD 2011 Support\enu\Template\Barr_2011_Template.dwt Plot at 1 10/05/2010 14:03:50



1 PLAN: WST-2 FEASIBILITY STUDY - CONCEPT 3: LINEAR WATER FEATURE
AS SHOWN

LEGEND:

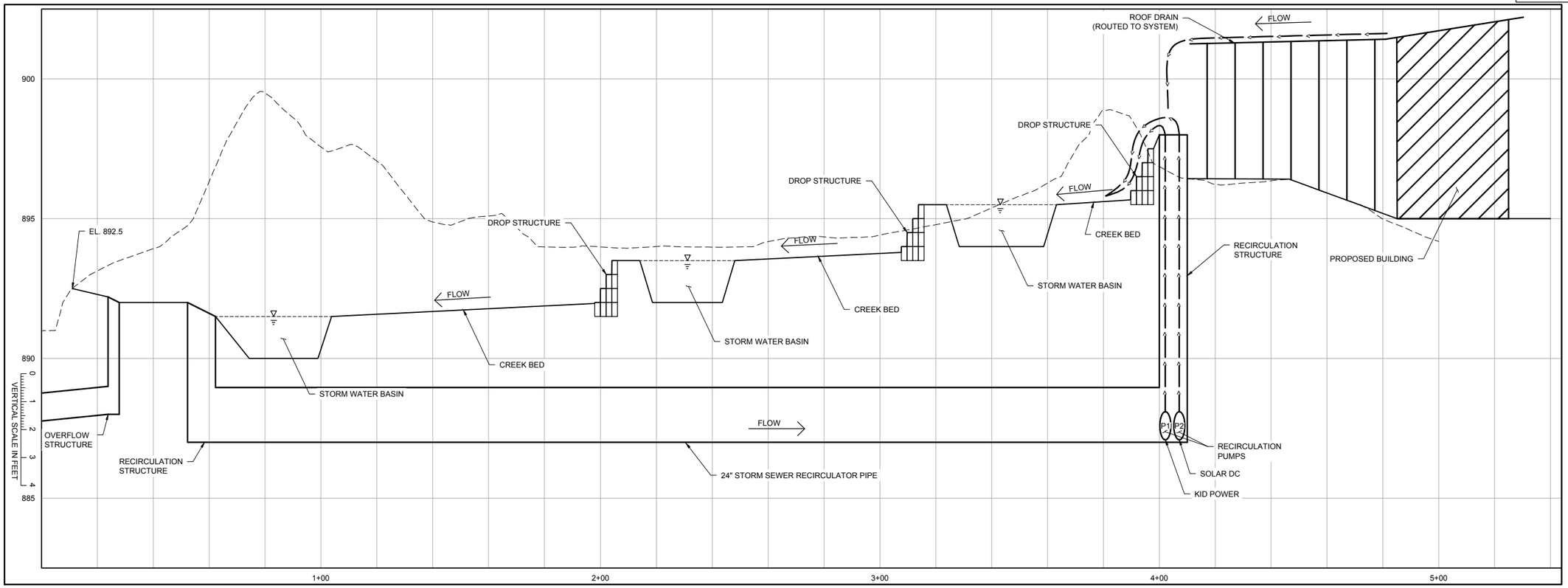
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- BCWMC CIP MAJOR CONTOUR
- BCWMC CIP MINOR CONTOUR
- PROPOSED WATER LINE
- PROPOSED HYDRANT
- PROPOSED STORM STORM
- BCWMC CIP STORM SEWER
- PROPOSED MANHOLE
- PROPOSED CATCH BASIN
- SOIL BORING
- ROOF AND PATIO RUNOFF ROUTED TO LINEAR STORMWATER FEATURE
- WST-2 STORMWATER TREATMENT (BY BARR ENGINEERING)

CONCEPT LEVEL DRAFT COST ESTIMATE:

- TOTAL ESTIMATE RANGE = $255,000 TO $414,000

ASSUMPTIONS:

- ESTIMATE DOES NOT INCLUDE STRUCTURES TO GET THE WATER FROM THE ROOF INTO THE RECIRCULATION STRUCTURE.
- ESTIMATE INCLUDES DESIGN AND CONSTRUCTION COSTS



0 20 40
HORIZONTAL SCALE IN FEET

2 PROFILE: WST-2 FEASIBILITY STUDY - CONCEPT 3: LINEAR WATER FEATURE
AS SHOWN

NOTE:
EXISTING CONDITIONS SURVEY SURVEY COMPLETED BY SUNDE LAND SURVEYING AND PROVIDED TO BARR ENGINEERING BY HGA ARCHITECTS AND ENGINEERS.

PROPOSED SITE LAYOUT WAS DESIGNED BY HGA ENGINEERS AND ASSOCIATES AND PROVIDED TO BARR ENGINEERING.

CONCEPT 2 WAS DESIGNED BY BARR ENGINEERING.

CONCEPT 2 INCLUDES CREATING A LINEAR WATER FEATURE ALONG THE NORTH SIDE OF THE BUILDING. ROOF AND PATIO RUNOFF WILL BE DIRECTED INTO A SERIES OF BASINS CONNECTED BY A MEANDERING CREEK.

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION
B	JPP	MAK	KAL	04/11/2018	BCWMC AND CITY REVIEW
A	JPP	MAK	KAL	03/09/2018	BCWMC AND CITY REVIEW

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.

PRINTED NAME _____

SIGNATURE _____

DATE _____ LICENSE # _____

	03/09/18	04/11/18					
CLIENT							
BID							
CONSTRUCTION							
RELEASED TO/FOR	A	B	C	0	1	2	3
	DATE RELEASED						

BARR
Corporate Headquarters:
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MINNEAPOLIS, MN 55435
Ph: 1-800-632-2277
Fax: (952) 832-2601
www.barr.com

Scale	AS SHOWN
Date	04/11/2018
Drawn	JPP
Checked	MAK
Designed	KAL
Approved	KLC

BCWMC

WESTWOOD LAKE WATER QUALITY IMPROVEMENT PROJECT (WST-2)

FEASIBILITY STUDY - CONCEPT 3
LINEAR WATER FEATURE

BARR PROJECT No. 23/27-0051.40
CLIENT PROJECT No.
DWG. No. FIGURE 4-3
REV. No. B

5.0 Water Quality Impacts

This section discusses impacts of the Westwood Lake Water Quality Improvement Project, including estimated pollutant reductions resulting from each alternative. The MIDS Calculator was used to evaluate anticipated pollutant removals for Concept 1 and Concept 2. A water balance spreadsheet was used to evaluate anticipated pollutant removals for Concept 3. The same concentrations of TSS and TP loading was applied to both the MIDS Calculator evaluation and the water balance spreadsheet calculations. Table 5-1 summarizes the results from each alternative.

Table 5-1 Estimated Annual TSS and TP Removals for Concepts 1, 2, and 3

Alternative	Estimated TSS Removal (pounds/year)	Estimated TP Removal (pounds/year)
Concept 1 – Additional Permeable Pavers	39.5	0.171
Concept 2 – Expand Filtration Basins	0.7	0.004
Concept 3 – Linear Water Feature	59.9	0.330

6.0 Project Cost Considerations

This section presents a feasibility level opinion of cost of the evaluated concepts, discusses potential funding sources, and provides an approximate project schedule.

6.1 Opinion of cost

The opinion of cost is a Class 4 feasibility-level cost estimate as defined by the American Association of Cost Engineers International (AACI International) and uses the assumptions listed below and detailed in the following sections.

1. The cost estimate assumes a 30% construction contingency.
2. Costs associated with design, permitting, and construction observation (collectively "engineering") is assumed to be 30% of the estimated construction costs (excluding contingency).
3. Additional work may be required to determine if cultural and/or historical resources are present at any project site.

The Class 4 level cost estimates have an acceptable range of between -15% to -30% on the low range and +20% to +50% on the high range. Based on the development of concepts and initial vetting of the concepts by the City of St. Louis Park, it is not necessary to utilize the full range of the acceptable range for the cost estimate; and we assume the final costs of construction may be between -20% and +30% of the estimated construction budget. The assumed contingency for the project (30%) incorporates the potential high end of the cost estimate range.

The estimated capital and a range of 20-year to 35-year annualized costs for each alternative are summarized in Table 6-1. Detailed cost-estimate tables for all concepts considered are provided in Appendix C.

Table 6-1 Estimated Capital and Annualized Costs for Concepts 1, 2, and 3

Alternative	Construction Cost	Construction Contingency[1]	Planning, Engineering, Design, and Construction Observation[2]	Total Cost	Estimated TSS Removal (lbs/year)	Estimated Annualized Cost per Pound of TSS Removal ($/lb TSS/year)[3]	Estimated TP Removal (lbs/year)	Estimated Annualized Cost per Pound of TP Removal ($/lb TP/year)[3]
Concept 1 – Additional Permeable Pavers	$101,000	$30,000	$39,000	$170,000	39.5	$260 - $340	0.171	$59,060 - $78,950
Concept 2 – Expand Filtration Basins	$37,000	$11,000	$14,000	$62,000	0.7	$5,290 - $7,140	0.004	$925,000 - $1,250,000
Concepts 1 plus Concept 2	$138,000	$41,000	$53,000	$232,000	40.2	$440 - $580	0.175	$100,570 - $133,710
Concept 3 – Linear Water Feature	$208,000	$62,000	$81,000	$351,000	59.9	$350 - $470	0.330	$63,380 - $84,610

(1) Assumed 30% contingency based on feasibility-level design (Class 4, 10-15% design completion per ASTM E 2516-06).
(2) Assumed 30% of construction cost for Engineering, Design, and Construction Observation.
(3) Assumed 4% interest rate and 20-year to 35-year lifespan.

6.2 Funding Sources

The City of St. Louis Park proposes to use BCWMC CIP funds to pay for the WHNC Water Quality Improvement project. The source of these funds is an ad valorem tax levied by Hennepin County over the entire Bassett Creek watershed.

6.3 Project Schedule

For project construction to occur in 2019, project design would be completed 2018. The BCWMC must hold a public hearing and order the project in time to submit its ad valorem tax levy request to Hennepin County. The City of St. Louis Park is currently preparing the final design.

7.0 Permitting, Site Impacts, and Coordination

This section discusses permitting and coordination required for each alternative.

7.1 Permitting

No disturbance or fill of any wetlands, nor any work in public waters is anticipated as part of the WHNC reconstruction project. The City of St. Louis Park and its contractors will be responsible for any permits required by the WHNC reconstruction project. No additional permits are anticipated as part of the Westwood Lake Water Quality Improvement Project.

7.2 Site Impacts

Some tree removals are anticipated as part of the WHNC reconstruction project. Minimal additional tree removals and no additional site impacts are anticipated for the Westwood Lake Water Quality Improvement Project.

7.3 Coordination

Trail usage and pedestrian safety during construction is a significant consideration for the WHNC reconstruction project. The interpretive center and some nearby paths and trails will be closed during construction, but most WHNC paths and trails will remain open. Trail closure signs and barricades will be installed and a pedestrian detour route will be determined during final construction. The parking lot will also be closed during construction and the existing park entrance drive will be used for construction access. Minimal additional path and trail closures are anticipated as part of the Westwood Lake Water Quality Improvement Project. Continued coordination with the City of St. Louis Park's Parks and Recreation Department will be required during final design.

8.0 Recommendations

The Commission Engineer recommends Concept 3 – Linear Water Feature due to water quality improvement, education, cost effectiveness, and aesthetic possibilities. We recommend that the opinions of cost identified in this study be used to develop a levy request for the selected concept(s) and that the concept(s) proceeds to the design and construction phase.

9.0 References

1. **Bassett Creek Watershed Management Commission.** 2015 Watershed Management Plan. September 2015.

Appendix A

Westwood Hills Nature Center Site Topographic and Tree Survey

DESCRIPTION OF PROPERTY SURVEYED

Part of Outlot 1, Westwood Estates 2nd Addition, and part of Lot 1, Block 1, Westwood Estates, according to the recorded plats thereof, and part of the Southeast Quarter of Section 6, Township 117, Range 21, Hennepin County, Minnesota.

TITLE COMMITMENT

This survey was prepared without the benefit of current title work. Easements, appurtenances, and encumbrances may exist in addition to those shown hereon. This survey is subject to revision upon receipt of a current title insurance commitment or attorney's title opinion.

GENERAL NOTES

1.) Survey coordinate and bearing basis: Hennepin County Coordinates

2.) Wetlands shown hereon are per delineation markers observed in the process of conducting the fieldwork.

3.) Property is subject to Resolution Granting Conditional Use Permit per Document No. A10408790.

UTILITY NOTES

1.) Utility information from plans and markings was combined with observed evidence of utilities to develop a view of the underground utilities shown hereon. However, lacking excavation, the exact location of underground features cannot be accurately, completely and reliably depicted. Where additional or more detailed information is required, excavation and/or a private utility locate request may be necessary.

2.) Other underground utilities of which we are unaware may exist. Verify all utilities critical to construction or design.

3.) Contact GOPHER STATE ONE CALL at 651-454-0002 (800-252-1166) for precise onsite location of utilities prior to any excavation.

LEGEND

AIS	Denotes advertising/information sign
BE	Denotes building entrance
BR	Denotes bike rack
BRIG	Denotes bridge
BTL	Denotes beavertail curb
CB	Denotes catch basin
CBOX	Denotes control box
CBX	Denotes communication box
CC	Denotes curb cut
CDS	Denotes civil defense siren
CIP	Denotes cast iron pipe
COL	Denotes building column
CONC	Denotes concrete
CS	Denotes curb stop
DIP	Denotes ductile iron pipe
EB	Denotes electric box
EM	Denotes electric meter
EO	Denotes electric outlet
G	Denotes gutter
GDCR	Denotes gate card reader
GM	Denotes gas meter
GRDL	Denotes ground light
GW	Denotes guy wire
HCR	Denotes disabled ramp
HCS	Denotes disabled sign
HH	Denotes hand hole
HHC	Denotes communication hand hole
HHF	Denotes fiber optic hand hole
HYD	Denotes fire hydrant
INV	Denotes structure invert
KWB	Denotes keystone wall base
LP	Denotes light pole
MB	Denotes mail box
MG	Denotes metal grate
MOWELL	Denotes monitoring well
OD	Denotes overhead door
OHE	Denotes overhead electric line
(P)	Denotes per plan
PEP	Denotes polyethylene pipe
PKS	Denotes parking sign
PP	Denotes power pole
PPLP	Denotes power and light pole
PPT	Denotes power pole with transformer
PPU	Denotes power pole with underground utility
PTBL	Denotes picnic table
PVC	Denotes polyvinylchloride pipe
RCP	Denotes reinforced concrete pipe
RD	Denotes roof drain
SAN	Denotes sanitary manhole
SAN S	Denotes sanitary sewer
SANC	Denotes sanitary cleanout
SMH	Denotes storm manhole
SPG	Denotes spigot
ST S	Denotes storm sewer
STA	Denotes survey control station
SWB	Denotes stone wall base
TC	Denotes top of concrete curb
TCS	Denotes traffic control sign
TRANS	Denotes transformer
UGC	Denotes underground communication line
UGE	Denotes underground electric line
VSP	Denotes vitrified sewer pipe
W	Denotes water line
WAF	Denotes drinking fountain
WET	Denotes wetland stake
WST	Denotes wood step
WV	Denotes water valve
WWB	Denotes wood wall base
BAS	Denotes Basswood tree
BIR	Denotes Birch tree
BOX	Denotes Boxelder tree
CED	Denotes Cedar tree
COT	Denotes Cottonwood tree
CRAB	Denotes Crabapple tree
HACK	Denotes Hackberry tree
LOC	Denotes Locust tree
MPL	Denotes Maple tree
PIN	Denotes Pine tree
PINW	Denotes White Pine tree
POP	Denotes Poplar tree
SPCG	Denotes Colorado Green Spruce tree
SPR	Denotes Spruce tree
TR	Denotes deciduous tree

BENCH MARKS (BM)

(NGVD 29)

1.) Top of top nut of fire hydrant southeast of school building.
Elevation = 912.77 feet

2.) Top of concrete base on south side of light pole in center island of parking lot.
Elevation = 895.21 feet

3.) Top of top nut of fire hydrant on west side of Westwood Hills Drive opposite #1649
Elevation = 944.21 feet

I hereby certify that this survey, plan, or report was prepared by me or under my direct supervision and that I am a duly Licensed Land Surveyor under the laws of the State of Minnesota.

Dated this 6th day of December, 2017

SUNDE LAND SURVEYING, LLC.

By: Arlee J. Carlson
Arlee J. Carlson P.L.S. Minn. Lic. No. 44900

Revision	By	Date
	SJT	

Drawing Title:
PARTIAL BOUNDARY, LOCATION, TOPOGRAPHIC and UTILITY SURVEY FOR:
City of St. Louis Park
Westwood Hills Nature Center

SUNDE LAND SURVEYING
Main Office:
9001 East Bloomington Freeway (35W) • Suite 118
Bloomington, Minnesota 55420-3435
952-881-2455 (Fax: 952-888-9526)
www.sunde.com

Project: 2017-204	By/Pg: 1095/7
Township: 117 Range: 21 Section: 6	Date: 12/06/2017
File: 20172040l.dwg	Sheet: 1 of 2

30 0 30 60
SCALE IN FEET

LEGEND

AIS	Denotes advertising/information sign
BE	Denotes building entrance
BR	Denotes bike rack
BRIG	Denotes bridge
BTL	Denotes beavertail curb
CB	Denotes catch basin
CBOX	Denotes control box
CBX	Denotes communication box
CC	Denotes curb cut
CDS	Denotes civil defense siren
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G	Denotes gutter
GDCR	Denotes gate card reader
GM	Denotes gas meter
GRDL	Denotes ground light
GW	Denotes guy wire
HCR	Denotes disabled ramp
HCS	Denotes disabled sign
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HHC	Denotes communication hand hole
HHF	Denotes fiber optic hand hole
HYD	Denotes fire hydrant
INV	Denotes structure invert
KWB	Denotes keystone wall base
LP	Denotes light pole
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MG	Denotes metal grate
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OHE	Denotes overhead electric line
(P)	Denotes per plan
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CED	Denotes Cedar tree
COT	Denotes Cottonwood tree
CRAB	Denotes Crabapple tree
HACK	Denotes Hackberry tree
LOC	Denotes Locust tree
MPL	Denotes Maple tree
PIN	Denotes Pine tree
PINW	Denotes White Pine tree
POP	Denotes Poplar tree
SPCG	Denotes Colorado Green Spruce tree
SPR	Denotes Spruce tree
TR	Denotes deciduous tree

POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
3000	163529.824	499078.518	892.77	Station
3001	163555.536	498866.582	892.27	Station
3002	163744.161	499050.540	894.77	Station
3003	163914.572	499020.703	904.69	Station
3004	163796.481	498890.185	898.46	Station
3005	163767.445	498807.299	892.00	Station
3006	164078.060	499045.915	913.80	Station
3007	164143.534	499166.098	931.64	Station
3008	164271.359	499087.362	916.35	Station
3009	163317.503	499203.883	894.61	Station

Dated this 6th day of December, 2017

Certified by: Arlee J. Carlson

Arlee J. Carlson, P.L.S. Minn. Lic. No. 44900

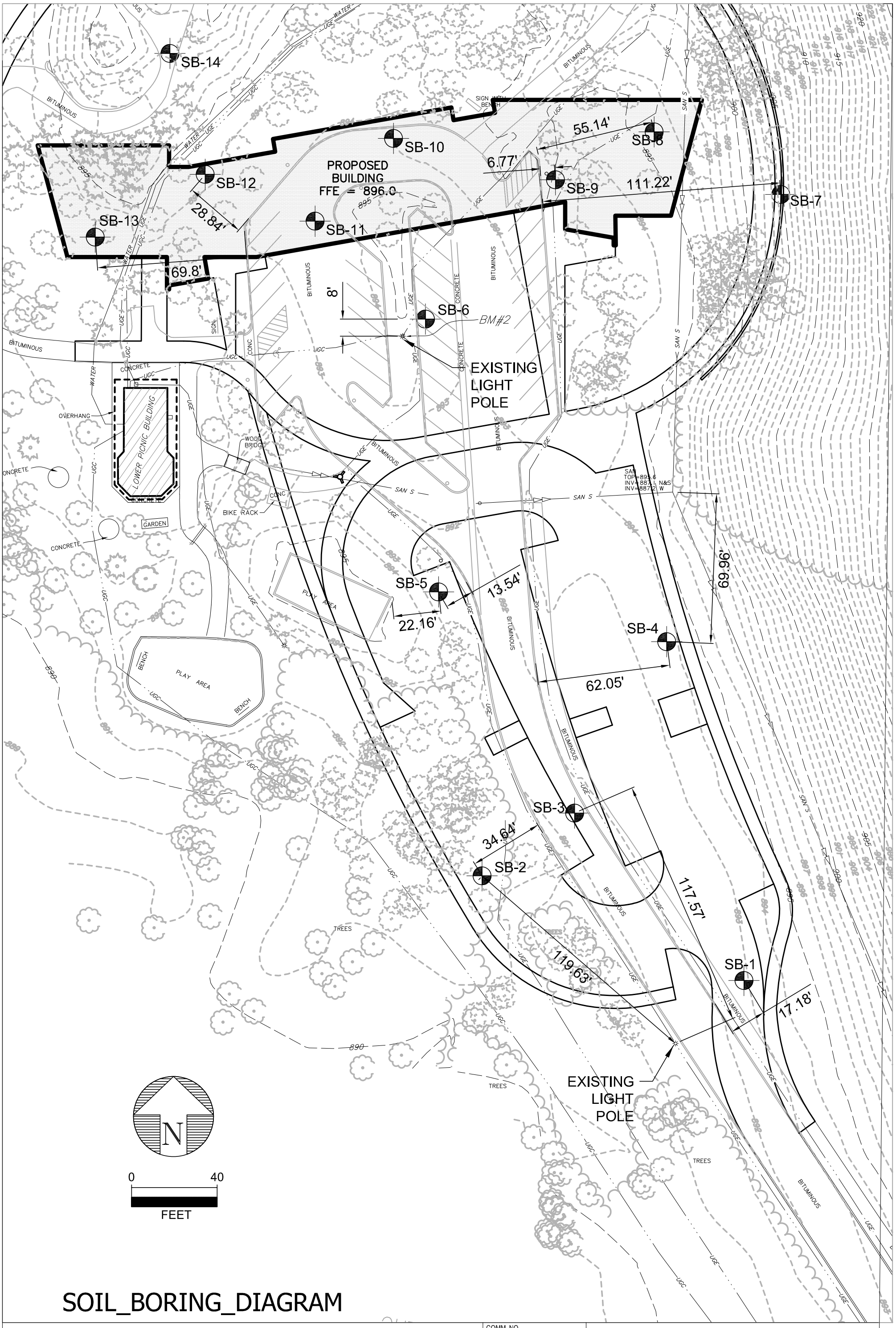
30 0 30 60
SCALE IN FEET

SUNDE LAND SURVEYING
9001 East Bloomington Freeway (35W) • Suite 118
Bloomington, Minnesota 55420-3435
952-881-2455 (Fax: 952-888-9526)
www.sunde.com

File: 201720401.dwg

Appendix B

Soil Borings



SOIL_BORING_DIAGRAM

Architecture | Engineering | Planning
HAMMEL, GREEN AND ABRAHAMSON, INC.
420 5th Street North - Suite 100
Minneapolis, Minnesota 55401
Telephone 612.758.4000 Facsimile 612.758.4199

COMM. NO.	1575-005-00
SCALE	1"=40'
DATE	12/18/2017
DRAWN	EH/DKS

WESTWOOD HILLS NATURE CENTER

8300 W FRANKLIN AVENUE

ST. LOUIS PARK, MN 55426

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-1 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

DEPTH IN FEET	Surface Elevation **893.4** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand, a little gravel, trace roots, dark brown, frozen to 2'	FILL		F	SU						
2											
3			8	M	SS	16					
4											
5	SAPRIC PEAT, black, laminations of sand (PT)	SWAMP DEPOSIT	5	M	SS	18					
6											
7											
8	CLAYEY SAND, trace rootsdark gray, moist, soft, laminations of sand (SC)	MIXED ALLUVIUM	4	M	SS	22					
9				▼							
10			4	W	SS	18					
11											
12											
13	SILT, trace roots, gray, wet, loose, laminations of sand (ML)	FINE ALLUVIUM	5	W	SS	20	30				
14											
15	SILTY SAND, fine to medium grained, gray, wet, loose (SM)		5	W	SS	16					
16											
	END OF BORING										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-14½' 3.25" HSA	**1/26/18**	**10:30**	**11.5**	**9.5**	**9.6**		**9.5**	
	1/26/18	**10:35**	**11.5**	**9.5**	**9.6**		**9.3**	
BORING COMPLETED: **1/26/18**								
DR: **TA** LG: **SB** Rig: **69C**								

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-2A (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

DEPTH IN FEET	Surface Elevation **891.4** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand, a little gravel, dark brown, frozen to 2'	FILL		F	SU						
3	FILL, mixture of silty sand and sandy lean clay, a little gravel, trace roots, brown and black		8	M	SS	20					
5	HEMIC PEAT, dark brown (PT)	SWAMP DEPOSIT	7	M	SS	16					
8	SAPRIC PEAT, with shells, dark brown to light brown (PT)		2	M	SS	24					
11	BOGLIME, trace shells and roots, white (OH-OL)		1	M ▼	SS	24					
13	SILTY SAND WITH GRAVEL, fine to medium grained, gray, wet, loose (SM)	COARSE ALLUVIUM	7	W	SS	16					
14	**END OF BORING**										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-12½' 3.25" HSA	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
	1/26/18	**9:20**	**14.5**	**12.5**	**12.5**		**12.0**	
	1/26/18	**9:25**	**14.5**	**12.5**	**12.5**		**11.6**	
BORING COMPLETED: **1/26/18**								
DR: **TA** LG: **SB** Rig: **69C**								

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-3A (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

Surface Elevation **890.7**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand with organic fines, a little graavel, trace roots, dark brown, frozen to 2'	FILL		F	SU						
3	FILL, mixture of clayey sand and silty sand, a little gravel, light brown and dark brown		9	M	SS	18					
5	HEMIC PEAT, black (PT)	SWAMP DEPOSIT	7	▼	SS	24					
8	HEMIC PEAT, with shells, black (PT)		WH	W	SS	20					
10	BOGLIME WITH SILT, trace shells, white and gray, wet (OH)		WH	W	SS	24					
13			WH	W	SS	24					
15											
16	SILT, a little gravel, trace roots, gray, wet, very loose, laminations of silty sand (ML)	MIXED ALLUVIUM	2	W	SS	20	35				
17	LEAN CLAY, gray, soft (CL)	FINE ALLUVIUM					34				
18	CLAYEY SAND, a little gravel, gray, soft (SC)	MIXED ALLUVIUM	3	W	SS	20	17				
20	SAND, fine to medium grained, gray, waterbearing, very loose to loose (SP)	COARSE ALLUVIUM	WH	W	SS	2					
23			7	W	SS	20					
24	**END OF BORING**										

DEPTH: DRILLING METHOD

0-22½' 3.25" HSA

BORING COMPLETED: **1/26/18**

DR: **TA** LG: **SB** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/26/18	**9:50**	**9.0**	**7.0**	**7.0**		**6.5**
1/26/18	**9;55**	**9.0**	**7.0**	**7.0**		**6.0**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-4 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

Surface Elevation **893.7**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand, trace roots, black and brown, frozen	FILL		F	SU						
3	FILL, mostly silty sand, a little gravel, black, frozen to 3.5'		25	F/M	SS	20					
5	SAPRIC PEAT, black (PT)	SWAMP DEPOSIT	5	M	SS	20					
8	ORGANIC CLAY, trace roots, black and gray, soft (CL)		4	M	SS	24	30				
10	LEAN CLAY, gray, very soft (CL)		1	W	SS	18	28				
12	SANDY LEAN CLAY, a little gravel, trace roots, gray, firm, lenses of sand (CL)	TILL	6	W	SS	12	18				
14	**END OF BORING**										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-12½' 3.25" HSA	**1/26/18**	**11:40**	**14.5**	**12.5**	**14.5**		**None**
BORING COMPLETED: **1/26/18**							
DR: **TA** LG: **SB** Rig: **69C**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-5 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

DEPTH IN FEET	Surface Elevation **892.7** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand, a little gravel, trace roots, dark brown, frozen	FILL		F	SU						
2											
3	FILL, mostly silty sand, a little gravel, dark brown, frozen to 2.5'		21	F/M	SS	22					
4											
5	SAPRIC PEAT, black, a lens of fibric peat at 7' (PT)	SWAMP DEPOSIT	7	M	SS	12					
6											
7											
8			5	M	SS	20					
9											
10	HEMIC PEAT, with shells, black (PT)		3	M	SS	24					
11											
12	BOGLIME WITH SILT, gray (OL-OH)			▼							
13			WH	W	SS	24					
14	CLAYEY SAND, fine grained, gray,w et, very loose, laminations and lenses of sandy lean clay (SC)	COARSE ALLUVIUM/ SWAMP DEPOSIT	3	W	SS	22					
15											
16							16				
17											
18	CLAYEY SAND, a little gravel, gray, firm to stiff, laminations of silty sand (SC)	MIXED ALLUVIUM	8	W/M	SS	18					
19							13				
20											
21			12	M	SS	16	15				
	END OF BORING	*SWAMP DEPOSIT									

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-19½' 3.25" HSA	**1/26/18**	**8:00**	**14.5**	**12.5**	**12.8**		**12.6**
BORING COMPLETED: **1/26/18**							
DR: **TA** LG: **SB** Rig: **69C**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-6A (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

Surface Elevation **893.8**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
0	5" Bituminous pavement	FILL		F	SU						
1	FILL, mostly silty sand, a little gravel, dark brown, frozen			F	SU						
2											
3	FILL, mostly silty sand with organic fines, a little gravel, trace roots, light brown and black, frozen to 2.5'		15	F/M	SS	16					
4											
5	CLAYEY SAND, a little gravel, trace roots, gray and light brown mottled, firm (SC)	TILL									
6			6	M ▼	SS	16	15				
7											
8	SAND, a little gravel, fine to medium grained, light brown and gray, waterbearing, loose (SP)	COARSE ALLUVIUM	7	W	SS	15					
9											
10			10	W	SS	10					
11											
12											
13			6	W	SS	18					
14											
	END OF BORING										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-12½' 3.25" HSA	**1/24/18**	**1:30**	**9.0**	**7.0**	**7.7**		**6.8**	
	1/24/18	**1:35**	**9.0**	**7.0**	**7.7**		**6.5**	
BORING COMPLETED: **1/24/18**								
DR: **TA** LG: **SB** Rig: **69C**								

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-7 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

DEPTH IN FEET	Surface Elevation **896.6** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly sandy lean clay and clayey sand, a little gravel, trace roots, black, frozen to 2'	FILL		F	SU						
2											
3	FILL, mostly clayey sand, dark brown		5	M	SS	18					
4											
5											
6			5	M	SS	24					
7											
8	SILTY SAND, a little gravel, fine to medium grained, dark brown, wet, loose (SM)	COARSE ALLUVIUM	5	W	SS	14					
9				▼							
10											
11			5	W	SS	20					
12											
13	SAND, a little gravel, fine to medium grained, light brown, waterbearing, very loose (SP)										
14			6	W	SS	16					
	END OF BORING										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-12½' 3.25" HSA	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
	1/25/18	**1:35**	**11.5**	**9.5**	**9.7**		**9.4**	
	1/25/18	**1:40**	**11.5**	**9.5**	**9.7**		**9.1**	
BORING COMPLETED: **1/25/18**								
DR: **TA** LG: **SB** Rig: **69C**								

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-8 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

Surface Elevation **895.1**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand and sandy lean clay, a little gravel, trace roots, black, frozen to 2'	FILL		F	SU						
3	FILL, mostly clayey sand and sandy lean clay, black and brown		7	M	SS	18					
5	CLAYEY SAND, a little gravel, brown to light brown, stiff to firm (SC)	TILL	12	M	SS	15	20				
8				M	TW	16					
10			8	M	SS	18					
13	SILTY GRAVEL WITH SAND, medium to coarse grained, light brown, wet, medium dense (GM)	COARSE ALLUVIUM	15	W	SS	16					
20	SAND, a little gravel, fine to medium grained, light brown, waterbearing, medium dense (SP)		13	W	SS	18					
21	**END OF BORING**										

DEPTH: DRILLING METHOD

0-19½' 3.25" HSA

BORING COMPLETED: **1/25/18**

DR: **TA** LG: **SB** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/25/18	**12:30**	**14.5**	**12.5**	**12.2**		**8.8**
1/25/18	**12:35**	**14.5**	**12.5**	**12.2**		**7.9**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-9 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

Surface Elevation **895.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly sand with silt, a little gravel, trace roots, dark brown, frozen to 2.5'	FILL		F	SU						
3			13	F/M	SS	12					
5	ORGANIC CLAY, trace roots, black to gray, firm (OH)	SWAMP DEPOSIT	6	M	SS	12					
8			6	M	SS	20					
9	▼ –										
10	BOGLIME WITH SILT, gray, trace roots (OL-OH)		5	M	SS	13					
13				M	TW	20					
20	SAND, a little gravel, fine to medium grained, gray, waterbearing, loose (SP)	COARSE ALLUVIUM	15	W	SS	12					
21	**END OF BORING**										

DEPTH: DRILLING METHOD

0-19½' 3.25" HSA

BORING COMPLETED: **1/25/18**

DR: **TA** LG: **SB** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/25/18	**10:55**	**21.0**	**19.5**	**19.0**		**10.8**
1/25/18	**11:00**	**21.0**	**19.5**	**19.0**		**9.0**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-10 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

Surface Elevation **893.9**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	6" Bituminous pavement	FILL		F	SU						
1	FILL, mostly silty sand, a little gravel, dark brown to light brown, frozen			F	SU						
2											
3	HEMIC PEAT, laminations of sand, black, frozen to 3.5' (PT)	SWAMP DEPOSIT	66	F	SS	18					
4											
5											
6			8	M	SS	5					
7				▼							
8	SILTY SAND, a little gravel, fine to medium grained, gray, moist, loose (SM)	COARSE ALLUVIUM	9	W/M	SS	6					
9											
10	SAND, fine to medium grained, light brown, waterbearing, very loose to loose (SP)		2	W	SS	10					
11											
12											
13			5	W	SS	15					
14											
15											
16											
17											
18											
19											
20	SAND WITH GRAVEL, fine to medium grained, light gray, waterbearing, loose (SP)		10	W	SS	16					
21	**END OF BORING**										

DEPTH: DRILLING METHOD **0-19½' 3.25" HSA**

BORING COMPLETED: **1/24/18**

DR: **TA** LG: **SB** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/24/18	**10:15**	**11.5**	**9.5**	**9.1**		**7.6**
1/24/18	**10:25**	**11.5**	**9.5**	**8.7**		**6.8**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-11 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

Surface Elevation **893.2**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	6" Bituminous pavement	FILL		F	SU						
1	FILL, mostly silty sand, a little gravel, dark brown, frozen			F	SU						
2	FILL, mostly silty sand, a little gravel, black, frozen										
3	FILL, mostly clayey sand, a little gravel, trace roots, black, frozen to 3.5'		68	F/M	SS	24					
4											
5	SAPRIC PEAT, a little gravel, black, laminations of sand (PT)	SWAMP DEPOSIT	57	M	SS	8					
6											
7				▼							
8	ORGANIC SANDY LEAN TO FAT, a little gravel, black to gray, soft (OL-OH)		4	W/M	SS	20					
9											
10	CLAYEY SAND, a little gravel, gray, soft to firm (SC)	MIXED ALLUVIUM	4	W/M	SS	20	21				
11											
12											
13			5	W/M	SS	16	21				
14											
15											
16											
17											
18											
19											
20	SILTY SAND, a little gravel, fine to medium grained, gray, wet, loose (SM)		9	W/M	SS	10					
21	**END OF BORING**										

DEPTH: DRILLING METHOD **0-19½' 3.25" HSA**

BORING COMPLETED: **1/24/18**

DR: **TA** LG: **SB** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/24/18	**12:20**	**11.5**	**9.5**	**9.3**		**7.7**
1/24/18	**12:30**	**11.5**	**9.5**	**9.3**		**7.0**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-12 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

Surface Elevation **893.6**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand and silty sand, a little gravel, trace roots, brown to black, frozen to 2'	FILL		F	SU						
3			8	M	SS	16					
5	SAPRIC PEAT, black (PT)	SWAMP DEPOSIT	10	M	SS	14					
8	SILTY SAND, a little gravel, fine to medium grained, gray, moist, loose, a lens of clayey sand (SM)	COARSE ALLUVIUM	7	W/M	SS	13					
10	SAND, fine to medium grained, gray, waterbearing, loose (SP)		6	W	SS	18					
13	SAND, a little gravel, fine to coarse grained, gray, waterbearing, very dense (SP)		54	W	SS	10					
20	SAND, fine to medium grained, gray, waterbearing, loose (SP)		7	W	SS	13					
21	**END OF BORING**										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-19½' 3.25" HSA	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
	1/24/18	**2:00**	**11.5**	**9.5**	**8.7**		**6.9**	
	1/25/18	**8:15**	**11.5**	**9.5**	**8.3**		**5.5**	
BORING COMPLETED: **1/24/18**								
DR: **TA** LG: **SB** Rig: **69C**								

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-13 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

Surface Elevation **893.8**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand, a little gravel, trace roots, dark brown, frozen to 2'	FILL		F	SU						
3	SAPRIC PEAT, black, laminations of sand (PT)	SWAMP DEPOSIT	6	M	SS	8					
5	CLAYEY SAND, a little gravel, trace roots, firm, a lens of silty sand (SC)	MIXED ALLUVIUM	8	M	SS	22	16				
7	SAND, fine to medium grained, light brown and gray, waterbearing, loose to very loose to medium dense (SP)	COARSE ALLUVIUM	6	W	SS	20					
11			6	W	SS	24					
13			2	W	SS	13					
20			22	W	SS	15					
21	**END OF BORING**										

DEPTH: DRILLING METHOD

0-19½' 3.25" HSA

BORING COMPLETED: **1/25/18**

DR: **TA** LG: **SB** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/25/18	**9:20**	**9.0**	**7.0**	**7.4**		**6.7**
1/25/18	**9:25**	**9.0**	**7.0**	**7.4**		**6.5**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-07434** Log of Boring No. **B-14 (p. 1 of 1)**

Project: **Westwood Hills Nature Center; St. Louis Park, MN**

Surface Elevation **897.4**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly silty sand, a little gravel, piece of bituminous pavement, dark brown, frozen	FILL		F	SU						
3	SAND WITH SILT, a little gravel, fine to medium grained, light brown, frozen to 3.5' (SP-SM)	COARSE ALLUVIUM	64	F/M	SS	24					
5	SAND WITH SILT, a little gravel, fine to medium grained, tan to light brown, moist, medium dense, a lens of clayey sand (SP-SM)		12	M	SS	18					
8	CLAYEY SAND WITH GRAVEL, fine to medium grained, light brown, moist, medium dense (SP)		15	M	SS	6					
10	SILTY SAND, a little gravel, fine to medium grained, light brown, wet, loose (SM)		5	W	SS	10					
13	SAND, fine to medium grained, light brown, wet, loose (SP)		6	W	SS	22					
	END OF BORING										

DEPTH: DRILLING METHOD

0-12½' 3.25" HSA

BORING COMPLETED: **1/25/18**

DR: **TA** LG: **SB** Rig: **69C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
1/25/18	**10:05**	**11.5**	**9.5**	**10.0**		**9.8**
1/25/18	**10:10**	**11.5**	**9.5**	**9.9**		**9.5**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 01-07434.GPJ AET+CPT+WELL.GDT 2/9/18

Appendix C

Cost Estimates

PREPARED BY: BARR ENGINEERING COMPANY

SHEET:	1	OF		
BY:	JPP		DATE:	4/6/2018
CHECKED BY:	MAK		DATE:	4/6/2018
APPROVED BY:	KAL		DATE:	4/6/2018
ISSUED:	For BCWMC/St. Louis Park Review		DATE:	4/6/2018
ISSUED:			DATE:	
ISSUED:			DATE:	
ISSUED:			DATE:	

ENGINEER'S OPINION OF PROBABLE PROJECT COST
PROJECT: Westwood Lake Water Quality Improvement Project
LOCATION: St. Louis Park, MN
PROJECT #: 23/27-0051.40
OPINION OF COST - SUMMARY

Engineer's Opinion of Probable Project Cost
Concept 1 - ADDITIONAL PERMEABLE PAVERS

Item. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	MOBILIZATION/DEMOBILIZATION (5%)	LS	1	$2,500.00	$2,500.00	1,2,3,4,5,6,7,8
B	EROSION AND SEDIMENT CONTROL	LS	1	$500.00	$500.00	1,2,3,4,5,6,7,8
C	TRAFFIC CONTROL	LS	1	$500.00	$500.00	1,2,3,4,5,6,7,8
D	GEOTEXTILE FABRIC	SY	1,000	$2.50	$2,500.00	1,2,3,4,5,6,7,8
E	6" CPEP SLOTTED UNDERDRAIN (SMOOTH INTERIOR) & FITTINGS	LF	400	$18.00	$7,200.00	1,2,3,4,5,6,7,8
F	6" SCHEDULE 40 SOLID POLYVINYL CHLORIDE (PVC) PIPE & FITTINGS	LF	120	$18.00	$2,160.00	1,2,3,4,5,6,7,8
G	UNDERDRAIN CLEANOUT & COVER UNIT	EA	3	$300.00	$900.00	1,2,3,4,5,6,7,8
H	CLEAN WASHED SAND (IN PLACE)	CY	30	$60.00	$1,800.00	1,2,3,4,5,6,7,8
I	2"-4" ASTM #3 CRUSHED GRANITE (STRUCTURAL COURSE)	TON	250	$40.00	$10,000.00	1,2,3,4,5,6,7,8
J	1" ASTM #57 CRUSHED GRANITE (BASE COURSE)	TON	230	$40.00	$9,200.00	1,2,3,4,5,6,7,8
K	PERMEABLE PAVERS WITH BEDDING COURSE (3/8" ASTM #8 CRUSHED GRANITE) AND JOINT FILLER (1/4" ASTM #9 CRUSHED GRANITE)	SF	6,300	$6.00	$37,800.00	1,2,3,4,5,6,7,8
L	CONCRETE RIBBON CURB AT PERMEABLE PAVERS	LF	380	$20.00	$7,600.00	1,2,3,4,5,6,7,8
M	SITE RESTORATION	AC	0.1	$4,500.00	$415.57	1,2,3,4,5,6,7,8
N	OVERFLOW STRUCTURE - 48" CB	EA	3	$2,500.00	$7,500.00	1,2,3,4,5,6,7,8
O	12" STORM SEWER	LF	200	$35.00	$7,000.00	1,2,3,4,5,6,7,8
P	SIGNAGE - 1 SIGN	LS	1	$3,000.00	$3,000.00	1,2,3,4,5,6,7,8
	CONSTRUCTION SUBTOTAL				$101,000.00	1,2,3,4,5,6,7,8
	CONSTRUCTION CONTINGENCY (30%)				$30,000.00	1,5,8
	ESTIMATED CONSTRUCTION COST				$131,000.00	1,2,3,4,5,6,7,8
	PLANNING, ENGINEERING & DESIGN (30%)				$39,000.00	1,2,3,4,5,8
	ESTIMATED TOTAL PROJECT COST				$170,000.00	1,2,3,4,5,7,8
	ESTIMATED ACCURACY RANGE	**-20%**			**$136,000.00**	5,7,8
		30%			**$221,000.00**	5,7,8

Notes

[1] Limited Design Work Completed (10 - 15%).

[2] Quantities Based on Design Work Completed.

[3] Unit Prices Based on Information Available at This Time.

[4] Limited Field Investigation Completed.

[5] This feasibility-level (Class 4, 10-15% design completion per ASTM E 2516-06) cost estimate is based on feasibility-level designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of the completion of design, but are not included at this level of project definition. The estimated accuracy range for the Total Project Cost as the project is defined is -20% to +30%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency. Operation and Maintenance costs are not included.

[6] Estimate assumes that projects will not be located on contaminated soil. No costs included for soil correction or overexcavation.

[7] Estimate costs are to design, construct, and permit each alternative. The estimated costs do not include maintenance, monitoring or

[8] Estimate costs are reported to nearest thousand dollars.

PREPARED BY: BARR ENGINEERING COMPANY

SHEET:	1	OF	1	
BY:	JPP		DATE:	4/6/2018
CHECKED BY:	MAK		DATE:	4/6/2018
APPROVED BY:	KAL		DATE:	4/6/2018
ISSUED:	For BCWMC/St. Louis Park Review		DATE:	4/6/2018
ISSUED:			DATE:	
ISSUED:			DATE:	
ISSUED:			DATE:	

ENGINEER'S OPINION OF PROBABLE PROJECT COST
PROJECT: Westwood Lake Water Quality Improvement Project
LOCATION: St. Louis Park, MN
PROJECT #: 23/27-0051.40
OPINION OF COST - SUMMARY

Engineer's Opinion of Probable Project Cost
Concept 2 - EXPAND FILTRATION BASINS

Item. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	MOBILIZATION/DEMOBILIZATION (5%)	LS	1	$2,200.00	$2,200.00	1,2,3,4,5,6,7,8
B	EROSION AND SEDIMENT CONTROL	LS	1	$1,000.00	$1,000.00	1,2,3,4,5,6,7,8
C	TRAFFIC CONTROL	LS	1	$500.00	$500.00	1,2,3,4,5,6,7,8
D	COMMON EXCAVATION (IN-PLACE)	CY	168	$7.50	$1,262.50	1,2,3,4,5,6,7,8
E	DISPOSE OF EXCAVATED MATERIALS OFF-SITE (IN-PLACE)	CY	168	$12.00	$2,020.00	1,2,3,4,5,6,7,8
F	12" CPEP STORM SEWER	LF	125	$25.00	$3,125.00	1,2,3,4,5,6,7,8
H	6" CPEP SLOTTED UNDERDRAIN (SMOOTH INTERIOR) & FITTINGS	LF	95	$18.00	$1,710.00	1,2,3,4,5,6,7,8
I	UNDERDRAIN CLEANOUT & COVER UNIT	EA	2	$300.00	$600.00	1,2,3,4,5,6,7,8
J	CLEAN WASHED SAND	CY	95	$60.00	$5,700.00	1,2,3,4,5,6,7,8
K	GEOTEXTILE FILTER - MnDOT TYPE V	SY	17	$20.00	$340.00	1,2,3,4,5,6,7,8
L	GRANULAR FILTER MATERIAL	TON	0.4	$200.00	$80.00	1,2,3,4,5,6,7,8
M	RIPRAP - MnDOT CLASS II	TON	12	$60.00	$720.00	1,2,3,4,5,6,7,8
N	PERFORM SOIL LOOSENING	SY	116	$4.00	$465.33	1,2,3,4,5,6,7,8
O	PLANTING SOIL (IN-PLACE)	CY	109	$50.00	$5,451.85	1,2,3,4,5,6,7,8
P	PLANTINGS	EACH	1,060	$3.50	$3,710.00	1,2,3,4,5,6,7,8
Q	DOUBLE SHREDDED HARDWOOD MULCH	CY	27	$65.00	$1,771.85	1,2,3,4,5,6,7,8
R	4" BLACK STEEL LANDSCAPE EDGING	LF	273	$10.00	$2,730.00	1,2,3,4,5,6,7,8
S	SITE RESTORATION	AC	0.07	$4,500.00	$334.30	1,2,3,4,5,6,7,8
T	SIGNAGE - 1 SIGN	LS	1	$3,000.00	$3,000.00	1,2,3,4,5,6,7,8
	CONSTRUCTION SUBTOTAL				$37,000.00	1,2,3,4,5,6,7,8
	CONSTRUCTION CONTINGENCY (30%)				$11,000.00	1,5,8
	ESTIMATED CONSTRUCTION COST				$48,000.00	1,2,3,4,5,6,7,8
	PLANNING, ENGINEERING & DESIGN (30%)				$14,000.00	1,2,3,4,5,8
	ESTIMATED TOTAL PROJECT COST				$62,000.00	1,2,3,4,5,7,8
	ESTIMATED ACCURACY RANGE	**-20%**			**$50,000.00**	5,7,8
		30%			**$81,000.00**	5,7,8

Notes
[1] Limited Design Work Completed (10 - 15%).
[2] Quantities Based on Design Work Completed.
[3] Unit Prices Based on Information Available at This Time.
[4] Limited Field Investigation Completed.
[5] This feasibility-level (Class 4, 10-15% design completion per ASTM E 2516-06) cost estimate is based on feasibility-level designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of the completion of design, but are not included at this level of project definition. The estimated accuracy range for the Total Project Cost as the project is defined is -20% to +30%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency. Operation and Maintenance costs are not included.
[6] Estimate assumes that projects will not be located on contaminated soil.
[7] Estimate costs are to design, construct, and permit each alternative. The estimated costs do not include maintenance, monitoring or
[8] Estimate costs are reported to nearest thousand dollars.

PREPARED BY: BARR ENGINEERING COMPANY

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ENGINEER'S OPINION OF PROBABLE PROJECT COST

PROJECT: Westwood Lake Water Quality Improvement Project

LOCATION: St. Louis Park, MN

PROJECT #: 23/27-0051.40

OPINION OF COST - SUMMARY

Engineer's Opinion of Probable Project Cost
Concept 3 - LINEAR WATER FEATURE

Item. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	MOBILIZATION/DEMOBILIZATION (5%)	LS	1	$13,000.00	$13,000.00	1,2,3,4,5,6,7,8
B	EROSION AND SEDIMENT CONTROL	LS	1	$1,000.00	$1,000.00	1,2,3,4,5,6,7,8
C	TRAFFIC CONTROL	LS	1	$500.00	$500.00	1,2,3,4,5,6,7,8
D	BASIN AND CREEK BED EXCAVATION, FILL, DROP STRUCTURES, OVERFLOWS, MULCH, PLANTS, AND RESTORATION	SF	6,000	$15.00	$90,000.00	1,2,3,4,5,6,7,8
E	24" CPEP STORM SEWER	LF	268	$45.00	$12,060.00	1,2,3,4,5,6,7,8
F	SOLAR POWER SUBMERSIBLE PUMP & CONNECTIONS	LS	1	$10,000.00	$10,000.00	1,2,3,4,5,6,7,8
G	KID POWER SUBMERSIBLE PUMP & CONNECTIONS	LS	1	$10,000.00	$10,000.00	1,2,3,4,5,6,7,8
H	KID POWER SITE FEATURES	LS	1	$25,000.00	$25,000.00	1,2,3,4,5,6,7,8
I	10' DIAMETER MANHOLE STRUCTURE, 10' DEPTH	EA	1	$25,000.00	$25,000.00	1,2,3,4,5,6,7,8
J	10' DIAMETER MANHOLE STRUCTURE, 5' DEPTH	EA	1	$15,000.00	$15,000.00	1,2,3,4,5,6,7,8
K	SIGNAGE - 2 SIGNS	LS	1	$6,000.00	$6,000.00	1,2,3,4,5,6,7,8
	CONSTRUCTION SUBTOTAL				$208,000.00	1,2,3,4,5,6,7,8
	CONSTRUCTION CONTINGENCY (30%)				$62,000.00	1,5,8
	ESTIMATED CONSTRUCTION COST				$270,000.00	1,2,3,4,5,6,7,8
	PLANNING, ENGINEERING & DESIGN (30%)				$81,000.00	1,2,3,4,5,8
	ESTIMATED TOTAL PROJECT COST				$351,000.00	1,2,3,4,5,7,8
	ESTIMATED ACCURACY RANGE	**-20%**			**$281,000.00**	5,7,8
		30%			**$457,000.00**	5,7,8

Notes

[1] Limited Design Work Completed (10 - 15%).

[2] Quantities Based on Design Work Completed.

[3] Unit Prices Based on Information Available at This Time.

[4] Limited Field Investigation Completed.

[5] This feasibility-level (Class 4, 10-15% design completion per ASTM E 2516-06) cost estimate is based on feasibility-level designs, alignments, quantities and unit prices. Costs will change with further design. Time value-of-money escalation costs are not included. A construction schedule is not available at this time. Contingency is an allowance for the net sum of costs that will be in the Final Total Project Cost at the time of the completion of design, but are not included at this level of project definition. The estimated accuracy range for the Total Project Cost as the project is defined is -20% to +30%. The accuracy range is based on professional judgement considering the level of design completed, the complexity of the project and the uncertainties in the project as scoped. The contingency and the accuracy range are not intended to include costs for future scope changes that are not part of the project as currently scoped or costs for risk contingency. Operation and Maintenance costs are not included.

[6] Estimate assumes projects will not be located on contaminated soil.

[7] Estimate costs are to design, construct, and permit each alternative. The estimated costs do not include maintenance, monitoring or additional tasks following constuction.

[8] Estimate costs are reported to nearest thousand dollars.

Annualized Cost Summary 1% CONSTRUCTION COSTS

Alternative	Construction Cost	Construction Contingency	Planning, Engineering, Design, and Construction Observation	Total Cost	Estimated Annual Maintenance Cost	Estimated Annualized Cost (20-year lifespan)	Estimated Annualized Cost (35-year lifespan)	Annualized Cost per pound of TSS Removal 20 Year Life Span ($/lb TSS/yr)	Annualized Cost per pound of TP Removal 20 Year Life Span ($/lb TP/yr)	Annualized Cost per pound of TSS Removal 35 Year Life Span ($/lb TSS/yr)	Annualized Cost per pound of TP Removal 35 Year Life Span ($/lb TP/yr)
Concept 1	$ 101,000	$ 30,000	$ 39,000	$ 170,000	$ 1,000	$ 13,500	$ 10,100	$ 340	$ 78,950	$ 260	$ 59,060
Concept 2	$ 37,000	$ 11,000	$ 14,000	$ 62,000	$ 400	$ 5,000	$ 3,700	$ 7,140	$ 1,250,000	$ 5,290	$ 925,000
Concept 1 and Concept 2	$ 138,000	$ 41,000	$ 53,000	$ 232,000	$ 1,400	$ 23,400	$ 17,600	$ 580	$ 133,710	$ 440	$ 100,570
Concept 3	$ 208,000	$ 62,000	$ 81,000	$ 351,000	$ 2,100	$ 27,900	$ 20,900	$ 470	$ 84,610	$ 350	$ 63,380