Ramsey County Stormwater Reuse Assessment

Prepared for
Ramsey County - Parks & Recreation, Soil and Water Conservation Division

RAMSEY COUNTY

December 17, 2021

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

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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 Registered Professional Engineer under the laws of the State of Minnesota.

Jennifer Koehler
PE #: MN 47500

12/17/2021
Date

1 Introduction

Ramsey County – Parks & Recreation, Soil and Water Conservation Division (County) is leading the Ramsey County Stormwater Reuse Assessment. The objective of this project was to perform a County-wide assessment to identify potential opportunities for stormwater reuse for irrigation in order to conserve groundwater and benefit surface water quality. This study is being funded by a Board of Water and Soils Resources (BWSR) Clean Water Fund Watershed Based Funding Grant and Ramsey County.

The project was completed in four broad phases:

- Phase 1 – Reviewing the *Stormwater Reuse for Irrigation Assessment Methodology* (original methodology) prepared by Houston Engineering Inc. in 2016 under a separate scope, identifying potential data issues, and collecting inputs to complete the assessment methodology within Ramsey County; running the assessment, then reviewing and revising the methodology and/or inputs based on lessons learned throughout the process. Running the assessment methodology generated a list of the most promising sites for reuse projects.
- Phase 2 – Field-verifying the top ten sites and obtaining landowner support for Phase 3.
- Phase 3 – Develop reuse project concepts and planning-level cost estimates for sites verified by the assessment and supported by landowners.
- Phase 4 - Completing a final report and submitting all files to the County.

The intent of this assessment is for the results to be utilized by organizations, such as the watershed management organizations (WMOs) and municipalities, to identify partnerships in the implementation of new stormwater reuse for irrigation projects within Ramsey County.

2 Assessment Methodology

The following outlines the assessment methodology for identifying areas that are potentially suitable for reuse projects in Ramsey County. The assessment methodology for reuse projects began as a desktop analysis which utilized available geospatial data to identify potential reuse project locations. Utilizing geospatial data, the assessment was applied in two steps to determine:

1. parcels that were technically feasible for reuse irrigation projects, and
2. prioritization of those technically feasible parcels based on which parcels potentially have the highest impact of reducing groundwater usage for irrigation, as well as the greatest benefit for improving surface water quality.

For the highest priority sites, we also performed an equity evaluation, and evaluate parcels on their social vulnerability, and target parcels that have a higher vulnerability.

Table 1 summarizes the geospatial data used to identify project locations following the assessment methodology.

Future stormwater reuse analyses would benefit from incorporating private storm sewer data into the digital elevation model. In addition, utilizing storm sewer invert elevations, rather than relying on surface topography, would improve digital elevation model accuracy. Lastly, having access to current and precise turf data would allow greater accuracy in determining both site feasibility and projected annual irrigation demand.

Table 1 Assessment Geospatial Data

Planning Criterion	Criterion Purpose	Criterion Type	Layer for 2021 Analysis	Use Rules
Step 1: Technical Feasibility Data				
Parcel Data	Define parcel boundaries, landowner, and potential for aggregation.	Technical	Parcel Data (Ramsey County, 2021)	Aggregate adjacent parcels by landowner.
Turf Area of Parcels	Determine the turf area of parcels.	Technical	U of MN Landcover Dataset (2015) Ramsey County Impervious Dataset (2015)	Parcels are feasible if they have a turf area equal to or greater than one (1) acre. Calculate annual adjusted irrigation demand from turf area.
Calculate Annual Runoff Loading	Determine if a parcel's watershed generates sufficient runoff volume to meet irrigation demands.	Technical	1-meter Digital Elevation Model (DNR, 2011) Storm sewer data (Municipalities) Generalized Land Use (Metropolitan Council, 2016) Ramsey County Impervious Dataset (2015)	Parcels are feasible if the adjusted annual runoff volume satisfies the irrigation need of the parcel.
Step 2: Qualitative Data for Ranking				
Nearby Ditch or Storm Sewer	Parcels can route surface water from abutting ditches and/or storm sewers into a storage feature for reuse irrigation.	Qualitative	Ditch data (WMOs) Storm sewer data (Municipalities)	Parcels abutting ditches and storm sewer receive a higher score.
Potable Groundwater Source	Determine if parcel is served by potable groundwater source. A reuse project would put less strain on groundwater sources.	Qualitative	Drinking Water Supply Management Areas (DNR, 2019) Source Water Assessment Area (MDH, 2019) Wellhead Protection Areas (MDH, 2019)	Parcels intersecting these features receive a higher score.
Groundwater Contamination Potential	Depth to water table is sufficient to provide zone of treatment, avoiding contamination of groundwater from stored stormwater runoff.	Qualitative	Water-Table Elevation and Depth to Water Table, Minnesota Hydrogeology Atlas series HG-03 (DNR, 2016) Karst Features	Parcels intersecting these features receive a lower score.
Proximity to Sensitive Landscape Features	Sensitive landscape features reliant on stormwater runoff as a source of water, or, within sensitive landscape features which would be disrupted by water reuse projects.	Qualitative	State Wildlife Management Areas (DNR, 2021) Scientific and Natural Area Units (DNR, 2021) MCBS sites of biodiversity significance (DNR, 2020)	Parcels intersecting these features receive a lower score.
Structures on Parcel	Parcels with structures have a higher likelihood that the turf is irrigated.	Qualitative	Building Footprints, Ramsey County Impervious Dataset (2015)	Parcels with structures receive a higher score.
Water Quality Benefit	Parcel watersheds with high pollutant loading have the potential to reduce stormwater discharge and pollutant load.	Qualitative	Total suspended solids/total phosphorus (TSS/TP) loading raster derived from Ramsey County Impervious Dataset (2015)	Parcels with watersheds having high pollutant loading receive a higher score.
Impaired Water Quality Benefit	Parcels located in an impaired waters watershed have the potential to reduce stormwater discharge and pollutant load.	Qualitative	Impaired Streams (MDH, 2020) DRAFT Impaired Waterbodies (MDH, 2020) DRAFT	Parcels intersecting an impaired stream or waterbody watershed receive a higher score.
MPARS Irrigation Permit	Determine if parcel has an active irrigation permit.	Qualitative	MPARS Irrigation Users	Parcels with an MPARS permit for irrigation receive a higher score.
Desirable Land Use	Determine if parcel has a land use type that would make irrigation more likely.	Qualitative	Generalized Land Use (Metropolitan Council, 2016)	Parcels with a desirable land use type (i.e., ag, golf course, institutional, etc.) receive a higher score.
Desirable Landowner Type	Determine if parcel is privately or publicly owned.	Qualitative	Parcel Data (Ramsey County, 2021)	Parcels that are publicly owned receive a higher score.
Hydrologic Soil Groups	Determine the dominant hydrologic soil group.	Qualitative	NRCS Soils data, 2021	Parcels with a majority of A,B soils receive a higher score than C,D soils.
Social Justice	As a final assessment, evaluate parcels on their social vulnerability, and target parcels that have a higher vulnerability.	Qualitative	Social Base Vulnerability (2016 Ramsey Co. CCVA)	Calculate the average social vulnerability of each parcel. Those that are more vulnerable would receive a more moderate rank for implementation.

2.1 Technical Feasibility Assessment

Technical criteria were used to identify parcels within the County expected to be technically feasible for a reuse project. Parcels are preliminarily identified as technically feasible by estimating their "feasibility ratio," defined as the ratio of each parcel's potential irrigation supply to potential irrigation demand.

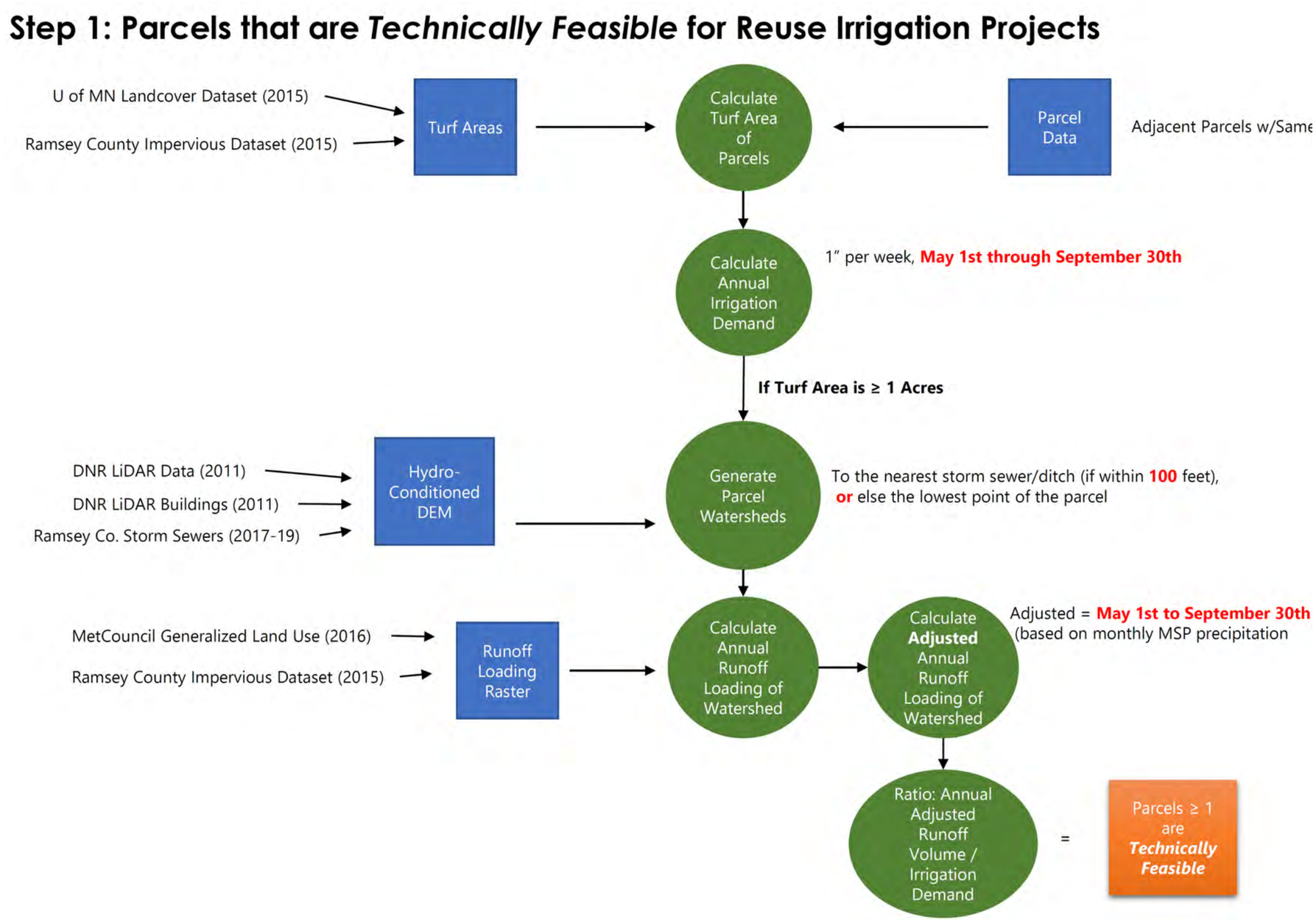
Irrigation demand is the estimated amount of volume needed to irrigate the turf area of a parcel during an irrigation season. First, parcel data were aggregated by landowner, which merged adjacent parcels with the same landowner into larger parcels. Next, using the University of Minnesota landcover dataset and the Ramsey County imperviousness dataset, turf acreage was calculated for each parcel. Adjusted annual irrigation demand was calculated by multiplying the turf acres by 22 weeks (the typical irrigation season from May 1st to September 30th) and then by a conversion factor to convert the inches to feet. The resulting value, in acre-feet, was the adjusted annual irrigation demand.

Irrigation supply is the annual adjusted volume from surface water runoff for each parcel's watershed. A watershed was generated to the nearest storm sewer or ditch (if within 100 feet of the parcel), or to the lowest point of each parcel that had at least one acre of turf. For this study, watersheds were generated using a custom GIS tool (proprietary to Barr) and County-wide LiDAR data with storm sewer data incorporated. However, there are GIS-based tools that are publicly available that can replicate the delineation of watersheds.

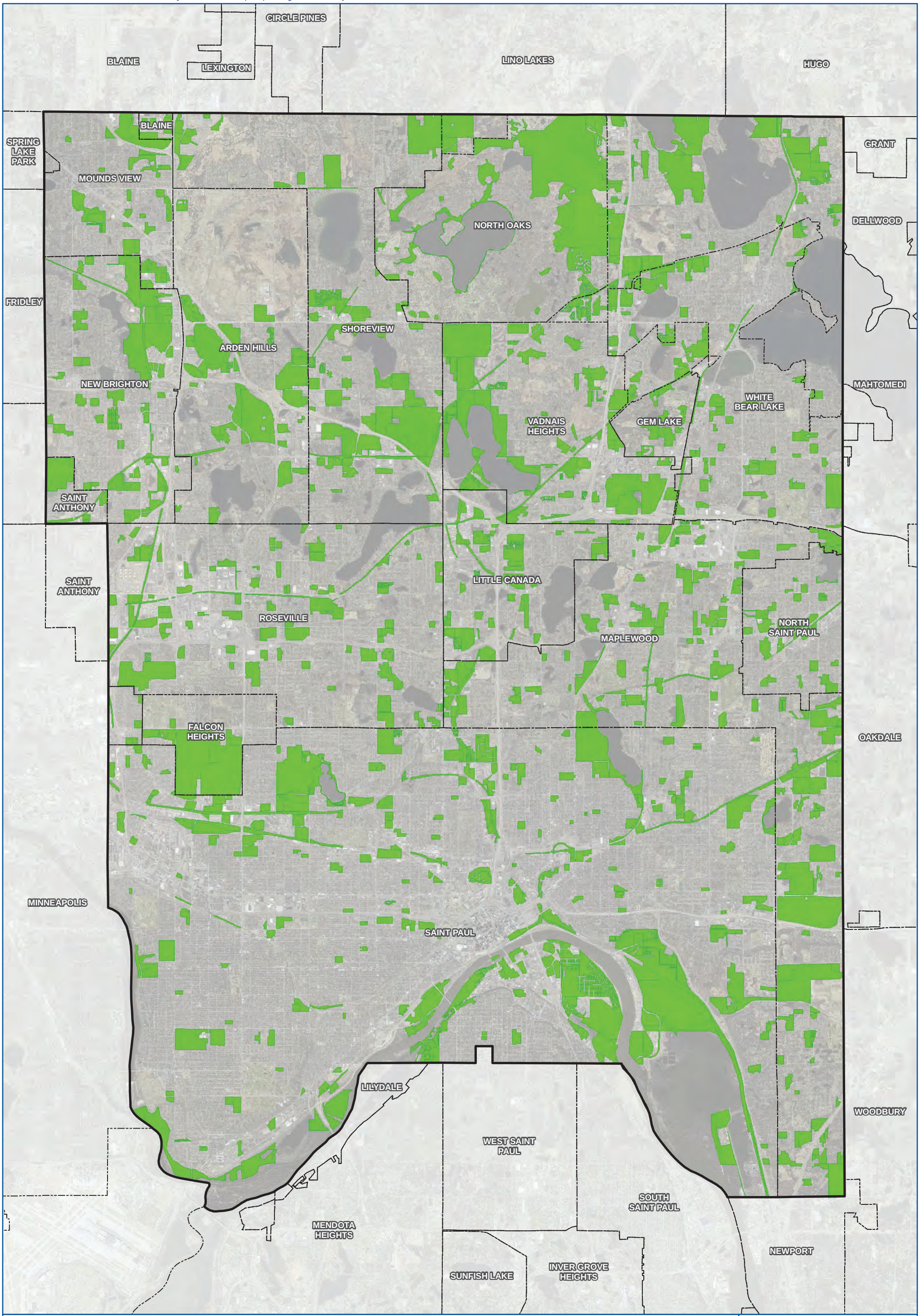
The size of the watershed, along with a runoff loading raster, were used to determine the amount of runoff available for each parcel. The runoff loading raster was created using generalized land use data from the Metropolitan Council and Ramsey County's imperviousness dataset. The resulting raster had values for the total runoff, expressed in inches per year. The average annual runoff loading value per watershed was determined, and then an adjusted value was calculated based on monthly precipitation recorded at the Minneapolis–Saint Paul International Airport. This annual adjusted runoff volume was divided by the parcel irrigation demand, which resulted in a ratio. Parcels with a ratio value of one or greater were determined to be "technically feasible," meaning the runoff volume available to a parcel was enough to satisfy the irrigation requirements of the parcel.

Technically feasible parcels moved to Step 2 analysis, while parcels failing to meet this threshold were removed from additional consideration. 1,032 parcels were identified to be technically feasible for stormwater reuse in Ramsey County. Figure 1 summarizes the geospatial data evaluation flow chart that was used to identify technically feasible parcels. A map of these technically feasible parcels can be seen in Figure 2.

Figure 1 **Flow Chart to Identify Technically Feasible Parcels**



Barr Footer: ArcGIS 10.8.1, 2021-11-17 13:32 File: I:\Projects\23\62\1380\Maps\Reports\Figure 2-Technically Feasible Parcels.mxd User: EMA



Technically Feasible Parcels

Ramsey County

Municipal Boundary

N

0 1 2

Miles

BARR

TECHNICALLY FEASIBLE PARCELS
Ramsey County Stormwater Reuse Assessment

FIGURE 2

2.2 Parcel Refinement and Ranking

In Step 2, qualitative criteria were then used within the assessment to prioritize and rank the 1,032 technically feasible parcels, based on the County's project goal of reducing groundwater use for irrigation and benefiting surface water quality. The goal of ranking and prioritization was to identify the ten most promising sites for stormwater reuse. These qualitative criteria were based on input from County staff along with input gathered during a stakeholder engagement meeting with watershed organizations within the County. The engagement meeting included reviewing the assessment methodology, determining which qualitative criteria should be applied as part of the site ranking, and finalizing the scoring system used to rank the sites.

Qualitative criteria were based on data outlined in Table 1, and include the following:

- Parcel abuts ditch or large storm sewer
- Parcel is served by potable groundwater source
- Parcel has groundwater contamination potential
- Parcel intersects sensitive landscape features
- Structures present on parcel
- Potential water quality benefit
- Potential impaired water quality benefit
- Parcel has existing irrigation permit
- Parcel has desirable land use
- Parcel has desirable landowner type
- Parcels had high irrigation demand
- Parcel has desirable hydrologic soil group

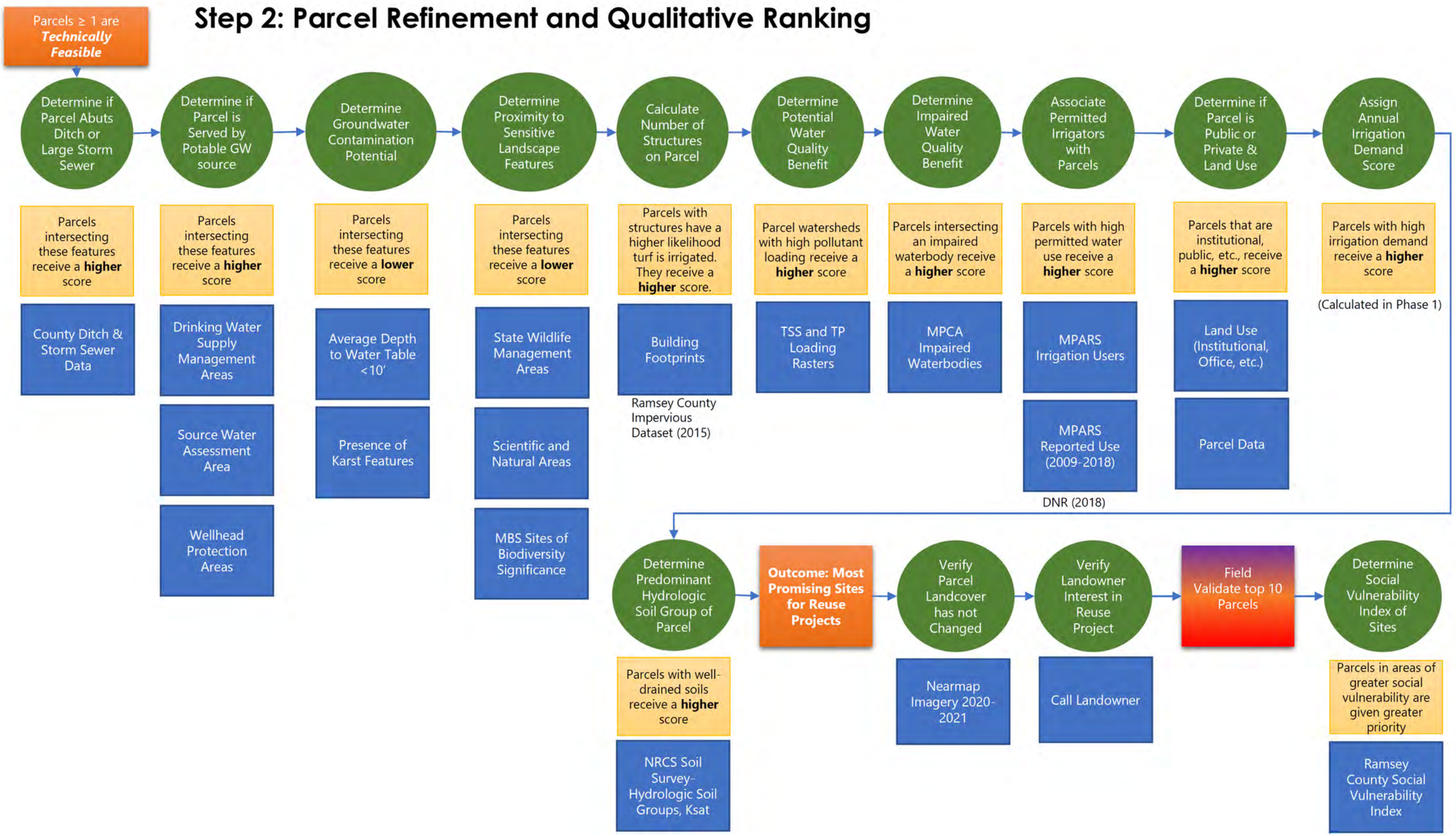
Parcels were intersected with the above geospatial data and assigned points based on whether or not they intersected qualitative criteria. Table 2 outlines the scoring system used in Step 2. Figure 3 summarizes the parcel refinement and ranking flowchart that was used to prioritize and rank technically feasible parcels. All intersections were considered positive/beneficial, with the exceptions of groundwater contamination potential and proximity to sensitive landscape features. For those two criteria, points were awarded to parcels that did not intersect these features.

In order to give greater weight to the criteria directly supporting the project goals, points were assigned based on the amount of irrigation demand and the amount of potential water quality benefit. For irrigation demand, parcels were ranked into quintiles by irrigation demand volumes. Volumes of the smallest quintile were assigned one point, while volumes of the highest quintile were assigned five points. Quintiles in between were assigned two to four points. Similarly, parcels were ranked into quintiles by the amount of total suspended solids (TSS) pollutant loading of the watershed, which was used to represent water quality benefit. The quintile with the lowest TSS values was assigned one point, the highest quintile five points, and quintiles in between were given two to four points.

Table 2 Qualitative Scoring System

Criterion	Possible Points	Lowest Possible Score	Highest Possible Score
Abuts Ditch or Storm Sewer	0,1	0	1
Potable Groundwater Source	0,1	0	1
Groundwater Contamination Potential	0,1	0	1
Sensitive Landscape Features	0,1	0	1
Structures Present	0,1	0	1
Potential Water Quality Benefit	1,2,3,4,5	1	5
Impaired Waters Watershed	0,1	0	1
MPARS Irrigation Permit	0,1	0	1
Land Use Type	0,1	0	1
Landowner Type	0,1	0	1
Hydrologic Soil Type	0,1	0	1
Irrigation Demand	1,2,3,4,5	1	5
	TOTALS	2	20

Figure 3 **Flow Chart to Rank Technically Feasible Parcels**



Following the assignment of criteria points to each parcel, the points were summed, and the parcels were ranked. Out of a total of twenty possible points, the highest-ranked parcel in the analysis received a score of eighteen. Table 3 summarizes these highest-ranked parcels, including the individual criterion scores that each parcel received. Figure 4 shows the locations of the thirteen highest-ranked parcels.

Table 3 Highest-ranked Parcels for Stormwater Reuse Potential

Property/Parcel Name	County PIN	Owner Name	Watershed District	Parcel Acreage	Watershed Acres	Turf Acres	Irrigation Demand (Acre-Feet)	Feasibility Ratio	Watershed Adjusted Runoff Loading (Acre Feet)	Percent of Adjusted Runoff Used	Watershed Adjusted TSS Loading	Watershed Adjusted TP Loading	Potential TSS Pounds Removed by Reuse	Potential TP Pounds Removed by Reuse	Points											
															Irrigation Demand	Water Quality Benefit	Abutting Ditch and/or Storm Sewer	Potable Groundwater	Potential Groundwater Contamination	Landscape Sensitivity	Structure(s) Present	Impaired Waters Watershed	MPARS Permit	Desirable Land Use	Public Ownership	Soil Type	Points Total
Como Regional Park Golf Course	222923440003	CITY OF ST PAUL	Capitol Region WSD	344.1	727.3	147.4	270.2	1.2	315.7	0.86	83,783	278.5	71,709	238.4	5	5	1	0	0	1	1	1	1	1	1	18
Midland Hills Country Club	172923130066	MIDLAND HILLS COUNTRY CLUB	Rice Creek WSD	156.9	515.8	99.4	182.3	1.0	182.3	1	46,790	157.1	46,788	157.1	5	4	1	0	0	1	1	1	1	0	1	16
3M Campus	362922240005	3M COMPANY	Ramsey-Washington-Metro WSD	374.6	793.9	76.5	140.3	3.1	437.7	0.32	119,705	394.3	38,362	126.4	4	4	1	0	0	1	1	0	1	1	0	14
Bethel University	273023240002	BETHEL UNIVERSITY	Rice Creek WSD	193.6	908.6	33.3	61.0	6.5	395.6	0.15	105,012	349	16,196	53.8	3	3	1	1	0	1	1	1	1	0	1	14
Phalen Park Golf Course	212922230003	CITY OF ST PAUL	Ramsey-Washington-Metro WSD	173.9	490.1	92.3	169.3	1.1	187.1	0.9	48,664	162.8	44,032	147.3	4	4	1	0	0	1	1	0	0	1	1	1	14
St. Paul Downtown Airport	42822330001	MPLS ST PAUL MET AIRPORTS COMM	Lower Mississippi WMO	383.3	629.6	202.1	370.6	1.0	372.2	1	102,545	337	102,083	335.5	5	5	1	0	0	1	1	0	0	1	0	0	14
Pioneer Park	52922230020	CITY OF LITTLE CANADA	Ramsey-Washington-Metro WSD	33.2	110.9	20.1	36.9	1.1	40.8	0.9	10,534	35.3	9,527	31.9	3	3	1	1	0	1	1	0	1	1	1	1	14
Harvest Park	102922240079	CITY OF MAPLEWOOD	Ramsey-Washington-Metro WSD	28.7	724.9	20.2	36.9	8.3	307.6	0.12	81,348	270.7	9,771	32.5	3	3	1	1	1	1	1	0	0	1	1	1	14
Pig's Eye Regional Park	112822230006	CITY OF ST PAUL	Ramsey-Washington-Metro WSD	266.2	1658.8	140.5	257.6	2.7	704.2	0.37	186,248	619.7	68,143	226.7	5	5	1	0	0	0	1	0	0	1	1	0	14
North Oaks Farms, Inc.	93022320002	NORTH OAKS FARMS INC	Vadnais Lake Area WMO	910.7	1459.8	57.7	105.7	4.4	467.5	0.23	117,729	397.8	26,623	89.9	4	4	1	1	0	0	1	1	0	1	0	1	14
Island Golf Course and County Park	263023430007	RAMSEY COUNTY PARKS AND REC	Rice Creek WSD	91.6	232.9	28.0	51.4	2.7	140.8	0.36	38,874	127.7	14,178	46.6	3	3	1	1	0	1	1	1	1	1	0	1	14
Hill-Murray School	132922440003	THE HILL MURRAY FOUNDATION	Ramsey-Washington-Metro WSD	45.2	285.7	20.6	37.7	2.5	92.7	0.41	23,405	79	9,519	32.1	3	3	1	1	0	1	1	1	1	1	0	0	13
University of MN (St Paul Campus)	282923220001	UNIVERSITY OF MINNESOTA	Capitol Region WSD	298.0	588.4	53.8	98.7	3.6	358.6	0.28	99,095	325.4	27,265	89.5	4	4	1	0	0	1	1	0	0	1	0	1	13

Barr Footer: ArcGIS 10.8.1, 2021-12-03 16:27 File: I:\Projects\23\62\1380\Maps\Reports\Figure 4 - Highest Ranked Parcels.mxd User: EMA

BLAINE
CIRCLE PINES
LEXINGTON
LINO LAKES
HUGO
GRANT
MOUNDS VIEW
North Oaks Farms, Inc. 14 Points
DELLWOOD
RICE CREEK WD
NORTH OAKS
VADNAIS LAKE AREA WMO
ARDEN HILLS
SHOREVIEW
Bethel University 14 Points
MAHTOMEDI
NEW BRIGHTON
WHITE BEAR LAKE
Island Lake Golf Course & County Park 14 Points
VADNAIS HEIGHTS
GEM LAKE
SAINT ANTHONY
Pioneer Park 14 Points
VALLEY BRANCH WD
SAINT ANTHONY
LITTLE CANADA
Harvest Park 14 Points
Midland Hills Country Club 16 Points
ROSEVILLE
NORTH SAINT PAUL
MAPLEWOOD
Hill-Murray School 13 Points
Phalen Park Golf Course 14 Points
FALCON HEIGHTS
Como Regional Park 18 Points
OAKDALE
MISSISSIPPI WMO
RAMSEY-WASHINGTON METRO WD
University of MN (St Paul Campus) 13 Points
3M Corporate Campus 14 Points
CAPITOL REGION WD
SAINT PAUL
MINNEAPOLIS
Pig's Eye Regional Park 14 Points
St Paul Downtown Airport 14 Points
WOODBURY
WEST SAINT PAUL
LOWER MISSISSIPPI RIVER WMO
SOUTH SAINT PAUL
MENDOTA HEIGHTS
NEWPORT
SUNFISH LAKE
INVER GROVE HEIGHTS

Parcels with Highest Rank
Ramsey County
Municipal Boundary
Watershed Management Districts and Organizations Boundary

N

0 1 2
Miles

BARR

HIGHEST-RANKED PARCELS

Ramsey County Stormwater Reuse Assessment

FIGURE 4

3 Field Verification of Priority Sites

Using the highest-ranked sites identified by the technical feasibility and qualitative ranking assessment, Ramsey County staff contacted applicable landowners and coordinated site visits with interested parties.

Table 4 summarizes the top ranked sites, including the status of the landowner coordination and interest, contact information, and summary of sites visited in the field or discussed virtually with the landowner.

Further discussion of the assessment of the priority sites, the existing site conditions and irrigation systems (if applicable), and the conceptual plan of a new or improvements to an existing stormwater reuse system are discussed in Section 4 of this report.

Table 4 **Priority Sites for Field Verification and Landowner Interest in Stormwater Reuse**

Property/Parcel Name	County PIN	Status	Address, Zip Code	Contact	Notes	Visit Summary
Como Regional Park Golf Course	222923440003	Interested	1250 Kaufman Drive, 55103	Tyler McKean Tyler.McKean@stpaul.gov; Tim Kuebelbeck tim@phalengolf.com	Tyler is the Planner, and Tim is the Golf Course Manager for Como and Phalen.	Visited on 11/10/2021
Midland Hills Country Club	172923130066	Interested	2001 Fulham Street, 55113	Mike Manthey mmanthey@midlandhillscc.org	Mike is the Golf Course Superintendent.	Visited on 10/18/2021
3M Campus	362922240005	Interested	2510 Conway Avenue, 55109	Kari Samuel kjsamuel@mmm.com; Ryan Steinberg rsteinberg@mmm.com	Kari is the grounds manager, and Ryan is the facilities supervisor.	Virtual call was held on 9/27/2021
Bethel University	273023240002	Not Interested	3900 Bethel Drive, 55112	glenn-hofer@bethel.edu	Glenn is the grounds manager.	No Action
Phalen Park Golf Course	212922230003	Interested	1000 Wheelock Parkway, 55106	Tyler McKean Tyler.McKean@stpaul.gov; Tim Kuebelbeck tim@phalengolf.com	Tyler is the Planner, and Tim is the Golf Course Manager for Como and Phalen.	Visited on 11/10/2021
St. Paul Downtown Airport	42822330001	In another study	711 Eaton Street, 55107	None	This is part of a subwatershed analysis with Lower Mississippi River Watershed District.	No Action
Pioneer Park	52922230020	Interested	2950 Centerville Road, 55117	Bill Dircks bill.dircks@littlecanadamn.org; Bryce Shearen bryce.shearen@littlecanadamn.org; Eric Seaburg Eric.Seaburg@bolton-menk.com	Bill is the Public Works Director, Bryce is the Parks and Rec Director, and Eric is the City Engineer.	Visited on 11/8/2021
Harvest Park	102922240079	Interested	2561 Barclay Street, 55109	Audra Robbins Audra.Robbins@maplewoodmn.gov	Audra is the Parks Director.	Visited on 9/30/2021
Pigs Eye Regional Park	112822230006	No irrigation	Pigseye Lake Road, 55106	No irrigation	None	No Action
North Oaks Farms, Inc	93022320002	Being redeveloped	Black Lake Road, 55127	None	Site being redeveloped into housing.	No Action
Island Golf Course and County Park	263023430007	Existing reuse system	1000 Red Fox Rd, 55126	Lisa Hanson-Lamey Lisa.HansonLamey@CO.RAMSEY.MN.US	Lisa is the Golf and Arena Director.	No Action
Hill-Murray School	132922440003	Interested	2625 Larpenteur Ave, 55109	Melissa Dan mdan@hill-murray.org; Frank Scundi fscundi@hill-murray.org	Brent is the grounds manager, Frank and Melissa are supervisors.	Visited on 9/29/2021
University of MN (St. Paul Campus)	282923220001	Not interested	1170 Gibbs Avenue, 55108	Tom Ritze ritze001@umn.edu; Cathy Abene abene@umn.edu	Tom is the landscape architect, and Cathy is the campus engineer.	No Action

4 Priority Site Assessment and Reuse Concepts

Section 4 outlines detailed information for each of the top priority sites that were assessed either in the field or virtually with the landowners. This includes:

- Discussion of the existing site conditions and irrigation systems (if applicable);
- More thorough evaluation of watersheds based on field visits and site-specific conditions;
- Development of a conceptual plan of a new or improvements to an existing stormwater reuse system;
- Evaluation of the estimated stormwater reuse system performance as it relates to irrigation demand and pollutant load reduction (utilizing the Mississippi Watershed Management Organization (MWMO) reuse calculator and the Minnesota Pollution Control Agency (MPCA) Minimal Impact Design Standards (MIDS) calculator); and
- Development of planning-level costs for each system, including capital and operations and maintenance. The planning-level costs are considered to be AACE Class 4 (-30%/+50%) due to the uncertainty at this limited level of evaluation and design.

Table 5 summarizes the results of the priority site evaluation including a summary of the concepts, estimated performance (% of irrigation demand met by reuse concept, estimated annual pollutant load reduction achieved (total phosphorus and total suspended solids), and planning-level costs.

Also included in the table is the 2018 Ramsey County social vulnerability index for each site, including the index for the parcel itself as well as the index for area within ¼ mile of the site which the County and other stakeholders can consider when prioritizing projects to pursue. The social vulnerability index was developed considering factors such as the percent of the population living below the poverty level, living with a disability, receiving medical assistance, etc. Higher scores indicate greater social vulnerability.

Appendix A includes the stormwater reuse system storage optimization curves for the various sites and concepts (as applicable), generated using the MWMO reuse calculator results. Appendix B includes the MIDS calculator output for the various sites to estimate the TSS and TP load reductions. Appendix C includes the planning-level engineer's opinions of probable cost.

Table 5 **Priority Site Assessment Summary**

Site	Hill-Murray School						Harvest Park			Midland Hills Country Club				Pioneer Park	Como Golf Course			Phalen Park Golf Course
Storage/Pond Location	Athletic Field		Larpenteur Avenue Ditch				West of Athletic Fields		MnDNR PWI: 62-0152 (Gerten Pond)	Walsh Lake				Onsite Ponds	Onsite Pond			Lake Phalen
Scenario	*Alt 1A*	*Alt 1B*	*Alt 2A (i)*	*Alt 2A (ii)*	*Alt 2B (i)*	*Alt 2B (ii)*	*Alt 1A*	*Alt 1B*	*Alt 2*	*Existing Conditions 1-ft Drawdown with Groundwater Augmentation*	*Proposed 1-ft Drawdown*	*Proposed 2-ft Drawdown*	*Proposed 5-ft Drawdown*	*Proposed 1-ft drawdown*	*Existing Reuse System with Existing Pond Bathymetry with Groundwater Augmentation*	*Existing Reuse System with Proposed Pond Expansion with Groundwater Augmentation*	*Existing Reuse System with Proposed Pond Expansion*	*Proposed 0.03-ft Drawdown*
Watershed Area Tributary to Storage/Pond (acres)	8.9	8.9	122.7	122.7	122.7	122.7	42.4	42.4	762.8	358.0	358.0	358.0	358.0	39.1	210.8	210.8	210.8	14906.6
Watershed Average Imperviousness (%)	52.5%	52.5%	32.0%	32.0%	32.0%	32.0%	17.7%	17.7%	34.9%	26.6%	26.6%	26.6%	26.6%	18.1%	37.4%	37.4%	37.4%	39.5%
Watershed Hydrologic Soil Group	C	C	C	C	C	C	A	A	C	C	C	C	C	C	C	C	C	C
Existing Site Irrigation Area (acres)	9.4	9.4	9.4	9.4	9.4	9.4	0	0	0	120	120	120	120	11.2	40	40	40	55
Future Site Irrigation Area (acres)	9.4	10.6	9.4	9.4	10.6	10.6	14.8	14.8	14.8	120	120	120	120	11.2	40	40	40	55
Irrigation Rate (inches/week)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.5	0.5	0.5	0.5	0.4	0.45	0.45	0.45	0.45
Peak Irrigation Rate / Reuse System Size (gpm)	75	75	75	75	75	75	100	100	100	1,900	1,900	1,900	1,900	120	1,000	1,000	1,000	1,000
Reuse Storage Volume (gallons)	200,000	200,000	100,000	350,000	100,000	350,000	250,000	450,000	1,000,000	1,824,800	1,824,800	3,421,440	8,081,116	470,000	1,912,117	2,225,565	2,225,565	2,000,000
Type of Storage (surface/ subsurface)	subsurface	subsurface	surface	subsurface	surface	subsurface	surface	subsurface	surface pond (existing)	surface lake (existing)	surface lake (existing)	surface lake (existing)	surface lake (existing)	surface pond (existing)	surface pond (existing)	surface pond (existing expanded)	surface pond (existing expanded)	surface lake
% of Annual Stormwater Runoff Managed by Stormwater Reuse System	52.4%	53.4%	6.3%	10.4%	6.5%	11.4%	49.6%	57.6%	2.9%	19.4%	26.9%	32.4%	39.1%	32.7%	6.3%	6.8%	17.4%	0.3%
% of Annual Irrigation Demand Met by Stormwater Reuse System	50.1%	45.2%	57.0%	90.5%	52.3%	88.2%	47.2%	54.7%	96.7%	49.4%	67.0%	79.9%	89.7%	87.6%	40.3%	43.3%	95.7%	96.6%

Site	Hill-Murray School						Harvest Park			Midland Hills Country Club				Pioneer Park	Como Golf Course			Phalen Park Golf Course
Storage/Pond Location	Athletic Field		Larpenteur Avenue Ditch				West of Athletic Fields		MnDNR PWI: 62-0152 (Gerten Pond)	Walsh Lake				Onsite Ponds	Onsite Pond			Lake Phalen
Scenario	*Alt 1A*	*Alt 1B*	*Alt 2A (i)*	*Alt 2A (ii)*	*Alt 2B (i)*	*Alt 2B (ii)*	*Alt 1A*	*Alt 1B*	*Alt 2*	*Existing Conditions 1-ft Drawdown with Groundwater Augmentation*	*Proposed 1-ft Drawdown*	*Proposed 2-ft Drawdown*	*Proposed 5-ft Drawdown*	*Proposed 1-ft drawdown*	*Existing Reuse System with Existing Pond Bathymetry with Groundwater Augmentation*	*Existing Reuse System with Proposed Pond Expansion with Groundwater Augmentation*	*Existing Reuse System with Proposed Pond Expansion*	*Proposed 0.03-ft Drawdown*
Irrigation Demand Met by Stormwater Reuse System (gallons/yr)	1,734,736	1,768,449	1,970,091	3,136,157	2,045,262	3,615,136	2,579,234	2,989,831	6,028,653	15,591,242	21,616,872	26,063,323	31,422,758	2,225,767	3,815,333	4,098,234	9,061,678	13,943,158
Annual TSS Load Reduction (lbs. removed)[1]	974	1000	1097	1702	1145	1876	2169	2658	2752	9437	12928	15368	17251	1393	2005	2154	4761	6668
Annual TP Load Reduction (lbs. removed)[1]	5.4	5.5	6.0	9.4	6.3	10.3	11.9	14.6	15.1	51.9	71.2	84.6	95.0	7.7	11.0	11.9	26.2	36.7
Project Capital Cost - Point Estimate	$1,275,000		$679,000	$1,729,000	$679,000	$172,9000	$705,000	$2,020,000	$718,000	Planning-level costs not developed for this site				$674,000	N/A	$261,000		$358,000
Project Capital Cost Range (-30%/+50%)	$893,000 - $1,913,000		$475,000 - $1,019,000	$1,210,000 - $2,594,000	$475,000 - $1,019,000	$1,210,000 - $2,594,000	$494,000 - $1,058,000	$1,414,000 - $3,030000	$503,000 - $1,077,000	Planning-level costs not developed for this site				$472,000 - $1,011,000	N/A	$183,000 - $392,000		$251,000 - $537,000
Annual O&M Cost	$4,200		$3,200	$4,200	$3,200	$4,200	$3,200	$4,200	$3,200	Annual O&M costs not developed for this site				$3,200	Annual O&M costs not developed for this site			$8,500
Social Vulnerability Index (parcel)	0.71						0.29			0.48				0.66	0.28			0.55
Social Vulnerability Index (1/4 mile of parcel)	0.70						0.41			0.45				0.66	0.47			0.59

1 – The MWMO reuse calculator was used to estimate system performance for stormwater reuse and irrigation demand volumes while the MIDS calculator was used for estimate of pollutant removals. For existing reuse systems that include augmentation by groundwater (e.g., Midland Hills Country Club and Como Golf Course) into the existing storage (ponds), the stormwater reuse BMP in the MIDS calculator does not capture the impact of augmentation directly into the system storage. The MIDS calculator was used to evaluate the proposed scenarios where the ponds are not augmented by groundwater (allowing for more fluctuation in pond water levels) to estimate TSS and TP pollutant removals. Pollutant removals for the augmentation scenarios was back calculated based on the pollutant removals estimated for the non-augmentation scenarios and the ratio of the volume of stormwater being used to meet irrigation demand for the augmentation vs non-augmentation scenarios.

4.1 Hill-Murray School

Hill-Murray School is located at 2625 Larpenteur Ave. E, Saint Paul, MN 55109. The site is located in the Ramsey-Washington-Metro Watershed District and the northern portion of the site drains to Wakefield Lake (impaired for nutrients with an approved Total Maximum Daily Load (TMDL)) and the southern portion of the site drains to Beaver Lake.

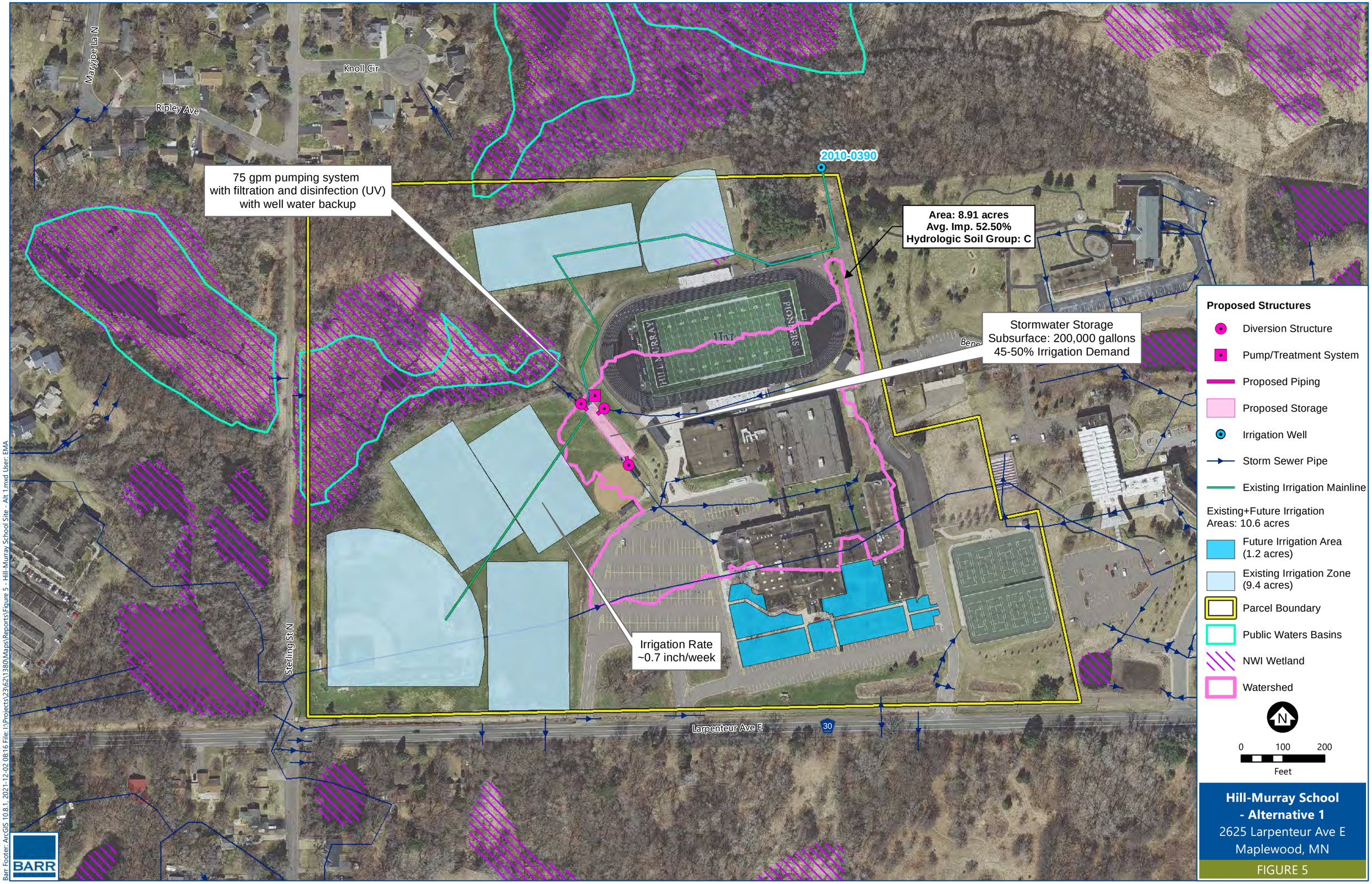
This is a private site owned by the Hill Murray Foundation. The site was visited on September 29, 2021. The site currently irrigates 9.4 acres from an irrigation well, using approximately 3.0 – 4.0 million gallons per year (approximately 0.7 inches per week during the irrigation season). The school has future plans to irrigate an additional 1.2 acres in the next few years. The peak irrigation rate is approximately 75 gallons per minute (gpm).

After review of the site, it was determined that stormwater reuse for irrigation was feasible at the site.

Although there is an existing wetland on the north side of the property, conversation with school representatives indicated there is not consistent water in the wetland to draw from for stormwater reuse. As a result, stormwater reuse concepts will need to include the construction of stormwater storage. Additionally, conversations with school staff indicated interest in providing stormwater treatment, including filtration and ultraviolet (UV) disinfection, and both alternatives would still utilize the existing well for irrigation back-up supply.

Two locations were identified as potential stormwater reuse collection and storage locations, as outlined below and on Figure 5 and Figure 6:

1. **Hill Murray Alternative 1A/1B** – This location would intercept runoff along an existing storm sewer, collecting 8.9 acres of watershed area runoff near the athletic field in a 200,000-gallon subsurface storage system. Alternative 1A assumes the current irrigation area while Alternative 1B assumes the expanded, future irrigation area. It is estimated that 45-50% of the annual irrigation demand could be met by this system, depending on the total irrigation area. It is estimated that this alternative could reduce annual TSS by 974 – 1,000 pounds per year and annual TP loads by 5.4 – 5.5 pounds per year.
2. **Hill Murray Alterative 2A/2B** – This location would divert runoff from a surface ditch along Larpenteur Avenue, collecting more than 122.7 acres of watershed area runoff in an open space between Larpenteur Avenue and the baseball fields. In this area, is it estimated that approximately 100,000 gallons of surface storage could be developed or 350,000 gallons of subsurface storage. Alternative 2A assumes the current irrigation area while Alternative 2B assumes the expanded, future irrigation area. It is estimated that the surface system could meet 52-57% of the annual irrigation demand while the subsurface system could meet 88-90% of the annual irrigation demand, depending on the irrigation areas. It is estimated that this alternative could reduce annual TSS by 1,097 – 1,702 pounds per year and annual TP loads by 6.0 – 9.4 pounds per year.


Manjoe la N
Knoll Cir
Ripley Ave
2010-0390
75 gpm pumping system
with filtration and disinfection (UV)
with well water backup
Area: 8.91 acres
Avg. Imp. 52.50%
Hydrologic Soil Group: C
Stormwater Storage
Subsurface: 200,000 gallons
45-50% Irrigation Demand
Irrigation Rate
~0.7 inch/week
Sterling St N
Larpenteur Ave E
30
Proposed Structures
Diversion Structure
Pump/Treatment System
Proposed Piping
Proposed Storage
Irrigation Well
Storm Sewer Pipe
Existing Irrigation Mainline
Existing+Future Irrigation
Areas: 10.6 acres
Future Irrigation Area
(1.2 acres)
Existing Irrigation Zone
(9.4 acres)
Parcel Boundary
Public Waters Basins
NWI Wetland
Watershed
N
0
100
200
Feet
Hill-Murray School
- Alternative 1
2625 Larpenteur Ave E
Maplewood, MN
FIGURE 5
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Barr Footer: ArcGIS 10.8.1, 2021-12-02 08:16 File: I:\Projects\23\62\13880\Maps\Reports\Figure 5 - Hill-Murray School Site - Alt 1.mxd User: EMA

Barr Footer: ArcGIS 10.8.1, 2021-12-02 08:19 File: I:\Projects\23\62\1380\Maps\Reports\Figure 6 - Hill-Murray School Site - Alt 2.mxd User: EMA

BARR

Hill-Murray School
- Alternative 2
2625 Larpenteur Ave E
Maplewood, MN

FIGURE 6

4.2 Harvest Park

Harvest Park is located at 2561 Barclay St., Maplewood, MN 55109. The site is located in the Ramsey-Washington-Metro Watershed District and drains to Keller Lake.

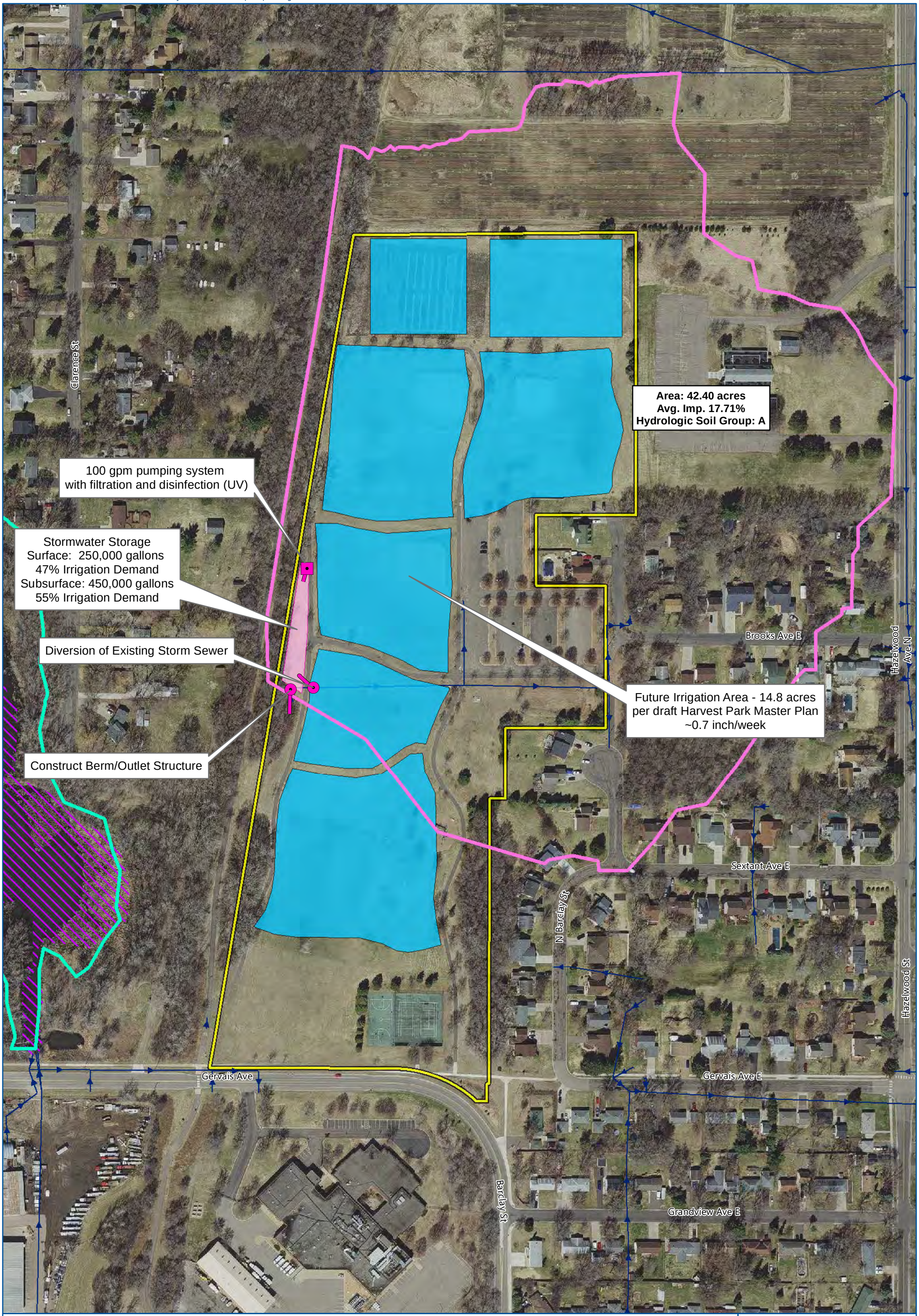
The public site is owned by the City of Maplewood. The site was visited on September 30, 2021. There is currently no irrigation of any portion of the site, although it is a heavily utilized athletic complex. The city completed a master plan for Harvest Park that does identify the addition of irrigation, with future plans to irrigate approximately 14.8 acres, and plans to implement the master plan over the next few years.

Additionally, conversations with city parks staff indicated interest in providing treatment including filtration and disinfection (UV), and both alternatives would utilize potable water for irrigation back-up supply. Estimated costs for this site do not include the cost of a new irrigation system. The peak irrigation rate is estimated to be 100 gpm.

Two locations were identified as potential stormwater collection and storage locations, as outlined below and on Figure 7 and Figure 8. Although there is an existing wetland west of the park property and the Bruce Vento Trail, one alternative assumes the stormwater reuse concept will need to include the construction of stormwater storage while the other option assumes stormwater can be drawn from the wetland west of the Bruce Vento Trail.

1. **Harvest Park Alternative 1A/1B** – This location would intercept runoff along existing storm sewer, collecting 42.4 acres of watershed area runoff. This option would require the development of storage in the western portion of the park. Alternative 1A estimates that approximately 250,000 gallons of surface storage could be developed, while Alternative 1B estimates that approximately 450,000 gallons of subsurface storage could be developed in the western portion of the park. It is estimated that the surface system could meet 47% of the annual irrigation demand, while the subsurface system could meet 55% of the annual irrigation demand. It is estimated that this alternative could reduce annual TSS by 2,169 – 2,658 pounds per year and annual TP loads by 11.9 – 14.6 pounds per year.
2. **Harvest Park Alternative 2** – This location would draw water from the wetland west of the Bruce Vento Trail (MnDNR PWI: 62-0152 along Larpenteur Avenue), collecting more than 761.3 acres of watershed area runoff. This option would utilize the top 0.1 ft (approximately 1,000,000 gallons) in the wetland and meet an estimated 97% of the annual irrigation demand. It is estimated that this alternative could reduce annual TSS by 2,752 pounds per year and annual TP loads by 15.1 pounds per year.

Barr Footer: ArcGIS 10.8.1, 2021-12-02 08:21 File: I:\Projects\23\62\1380\Maps\Reports\Figure 7 - Harvest Park - Alt 1.mxd User: EMA



Harvest Park - Alternative 1
2561 Barclay St N
Maplewood, MN

FIGURE 7

Stormwater Storage
Surface (Gerten Pond/PWI): 1.0 million gallons
Drawdown ~0.1 ft from NWL
97% Irrigation Demand

Future Irrigation Area - 14.8 acres
per draft Harvest Park Master Plan
~0.7 inch/week

100 gpm pumping system
with filtration and disinfection (UV)
with potable water backup

Area: 762.81 acres
Avg. Imp. 34.90%
Hydrologic Soil Group: A

Kohlman Lake
Markham Pond
Casey Lake
Wakefield Lake

19 20 61 23 65 36 25 150 29

Proposed Piping
Proposed Storage
Proposed Structures
Pump/Treatment System
Future Irrigation Area (14.8 acres)
Parcel Boundary
Watershed
Storm Sewer Pipe
Public Waters Basins
NWI Wetland

N
0 500 1,000
Feet

BARR

Harvest Park
- Alternative 2
2561 Barclay St N
Maplewood, MN

FIGURE 8

4.3 Midland Hills Country Club

Midland Hills Country Club is located at 2001 Fulham St., Roseville, MN 55113. The western portion of the site is located within the MWMO boundaries and drains west to the Mississippi River. The remainder of the site is located in the Rice Creek Watershed District and is pumped north to Pike Lake (impaired for nutrients with an approved Total Maximum Daily Load (TMDL).

This is a private site owned by Midland Hills Country Club. The site was visited on October 18, 2021. The golf course currently irrigates the 120 acres of golf course from Walsh Lake and utilizes wells to augment lake water levels as needed, using an average of approximately 30 million gallons of stormwater and groundwater for irrigation per year (approximately 0.5 inches per week during the irrigation season). The peak irrigation rate is approximately 1,900 gpm, although the system can pump up to 2,400 gpm.

Under current operations, the golf course uses groundwater wells to augment Walsh Lake water levels, so water levels only fluctuate approximately 1 foot from a constant elevation for aesthetic reasons. Walsh Lake collects runoff from 358.3 acres. The golf course uses approximately 15 million gallons per year of groundwater from their existing wells to augment Walsh Lake water levels and golf course irrigation. Under current operations, the existing reuse for irrigation system uses stormwater to meet approximately 50% of the estimated irrigation demand. It is estimated that the existing system removes 9,437 pounds of TSS and 51.9 pounds of TP annually.

Figure 9 shows the existing stormwater reuse system and also outlines potential improvements to the system.

To reduce the system demand on groundwater and increase pollutant removals, the operation of the existing reuse system could be modified. If water levels in Walsh Lake were not augmented by groundwater to maintain constant lake levels, the assessment of the site indicates that stormwater could provide a larger portion of the irrigation demand if water levels are able to fluctuate without augmentation, as summarized below:

- 67% of the estimated irrigation demand is met and increases TSS removals to 12,928 pounds per year and TP removals to 71.2 pounds per year, if water levels in Walsh Lake are allowed to fluctuate by approximately 1 foot with no groundwater augmentation.
- 80% of the estimated irrigation demand is met and increases TSS removals to 15,368 pounds per year and TP removals to 84.6 pounds per year, if water levels in Walsh Lake are allowed to fluctuate by approximately 2 feet.
- 90% of the estimated irrigation demand is met and increases TSS removals to 17,251 pounds per year and TP removals to 95.0 pounds per year, if water levels in Walsh Lake are allowed to fluctuate by approximately 5 feet.

Based on conversations with golf course staff, sedimentation around the irrigation system pump intake is a concern in Walsh Lake and improvements to the system could include:

- Dredging of accumulated sediment in the wetland south of Walsh Lake (to prevent scour and movement of sediment into Walsh Lake and around the pump intakes). This is a stormwater pond in the City of Lauderdale and maintained by the City of Roseville.
- Modification of the irrigation pump intake in Walsh Lake (currently at the lake bottom at a depth of 6-8 feet) to be a floating intake that extends over the deeper portion of the lake, drawing water from 1-2 feet below the water surface.

Based on review of the available data and the reuse assessment, it appears that system operations could be improved to reduce reliance on groundwater for irrigation by 15-30% and increasing pollutant removals by 35 - 80% by allowing Walsh Lake water levels to fluctuate without augmentation.

Modifying operation of the existing reuse system performance could be performed at minimal capital cost.

No costs were summarized for the management of the sedimentation concerns for the existing system, including the removal of sediment from the stormwater pond in the City of Lauderdale or for the floating intake modification to address sedimentation concerns for the existing system intake, as these items do not impact the system's demand on groundwater or water quality improvement (in relation to the stormwater reuse system).

Existing irrigation area: 120.0 acres
Irrigation rate: ~0.5 in/week

Extend intake into deeper portion of Walsh Lake and modify to floating intake.

Allow Walsh Lake levels to fluctuate more (less augmentation by groundwater).

Dredge accumulated sediment from existing pond south of Walsh Lake.

1988-6105

1985-6178

Area: 358.02 acres
Avg. Imp. 26.60%
Hydrologic Soil Group: C

MISSISSIPPI WMO

RICE CREEK WD

CAPITOL REGION WD

ROSEVILLE

LAUDERDALE

FALCON HEIGHTS

MINNEAPOLIS

Fulham St
Fairways Ln
Sharondale Ave
Wilder St
Eldridge Ave W
Prior Ave N
Skillman Ave W
Evergreen Ct N
North Rosewood La W
South Rosewood La W
Midland Hills Rd
Draper Ave W
Cleveland Ave N
Loren Rd
Aurum Pl
Rosedale Rd
Westwood Cir
Hythe St N
Broadway St
Ryan Ave
Pleasant St
Lake St
Roselawn Ave W
Sumner St
Summer St
Walnut St
Malvern St N
Eustis St
Carl St
Spring St
Pleasant St N
Lake St N
Fulham Ave
Ione St
Larpenteur Ave W
N Cleveland Ave
Moore St
Prior Ave
Autu
Gord

35W
280
26
128
127
46
30

Parcel Boundary
Existing Irrigation Pump Intake (~6 ft deep)
Proposed Floating Intake/Extension
Existing Irrigation Area (120.0 acres)
Existing Irrigation Pump House
Existing Well House
Sedimentation Management
Watershed
Irrigation Well
Public Waters Basins
NWI Wetland
Municipal Boundary
Watershed Management Organization Boundary

Note:
Existing Irrigation Area: 120 acres

N

0 250 500
Feet

Midland Hills Country Club Alternative
2001 Fulham St
Roseville, MN

FIGURE 9

BARR

4.4 Pioneer Park

Pioneer Park is located at 2950 Centerville Rd., Little Canada, MN. The site is located in the Ramsey-Washington-Metro Watershed District and drains to Gervais Creek and ultimately Gervais Lake.

The public site is owned by the City of Little Canada. The site was visited on November 8, 2021. The site currently irrigates 11.2 acres, including several athletic fields from an irrigation well, using an average of approximately 2.2 million gallons per year (approximately 0.4 inches per week during the irrigation season). The city completed a master plan for Pioneer Park that suggests continuing irrigation at the park, with no plans for expansion of the irrigation system. The existing irrigation rate ranges from approximately 80-120 gpm.

There are ponds located on the east side of the park that could be used for stormwater storage for reuse for irrigation. The north pond has a depth of approximately 6 feet. The south pond has as depth of approximately 3 feet and these ponds have a surface connection below a small footbridge. The ponds collect runoff from 39.1 acres.

After review of the site, it was determined that stormwater reuse for irrigation was feasible at the site. Figure 10 shows the potential stormwater reuse system at Pioneer Park.

The proposed stormwater reuse system could utilize the top 1 foot of water in the existing two ponds (approximately 470,000 gallons of storage). Assuming this volume, it is estimated that stormwater runoff could meet 88% of the annual irrigation demand for Pioneer Park. It is estimated that this alternative could reduce annual TSS loads by 1,393 pounds per year and annual TP loads by 7.7 pounds per year.

Additionally, conversations with city staff indicated interest in providing treatment including filtration and disinfection (UV) and that the system would utilize the existing well water for irrigation back-up supply.

Also, City staff indicated the master plan for Pioneer Park will be implemented over the next few years and has identified a water feature in the park. As implementation of the master plan progresses, further evaluation on if discharges from this water feature can be directed to the existing ponds and used as a source of water for reuse as well, should reuse for irrigation be implemented at the park.

Irrigation Rate
~0.4 inch/week

Stormwater Storage
Surface Pond
470,000 gallons: Drawdown ~1 ft from NWL
88% Irrigation Demand

Future Discharge from Proposed
Water Feature identified in
Pioneer Park Master Plan
Potential Volume: TBD

120 gpm pumping system
with filtration and disinfection (UV)
with well back-up

1992-6065

Area: 39.10 acres
Avg. Imp. 18.07%
Hydrologic Soil Group: C

South Owasso Blvd
Allan Ave
Caroline Ct
Sherry Ct
Fratellone La
David Cir
Costa La N
Centerville Rd
Desoto St
Costa La
Costa La S
Nadeau Rd
Labore Rd
Noel Dr
County Dr
35E
19

Proposed Structures

- Pump/Treatment System
- Proposed Piping
- Proposed Storage
- Irrigation Well
- Storm Sewer Pipe
- Existing Irrigation Zone (11.25 acres)
- Parcel Boundary
- Public Waters Basins
- NWI Wetland
- Watershed

N

0 100 200
Feet

Pioneer Park Alternative
2950 Centerville Rd
Little Canada, MN

FIGURE 10

BARR

Barr Footer: ArcGIS 10.8.1, 2021-12-02 08:24 File: I:\Projects\23\62\138\Maps\Reports\Figure 10 - Pioneer Park.mxd User: EMA

4.5 Como Golf Course

Como Golf Course is located at 1431 Lexington Pkwy. N., Saint Paul, MN 55103. The site is located in the Capital Region Watershed District and drains to Como Lake.

The public site is owned by the City of Saint Paul. The site was visited on November 10, 2021. The site is a 110-acre golf course and currently irrigates approximately 40 acres. The irrigation system draws water from approximately 3 feet above the bottom of two adjacent/connected existing stormwater ponds (that are each approximately 6 feet deep) west of the intersection of Lexington Parkway and Como Lake Drive. Water levels in the ponds are augmented with groundwater pumped from an irrigation well, as needed, into the stormwater pond for irrigation purposes. The peak irrigation rate is approximately 1,000 gpm.

Although the potential watershed to the existing stormwater ponds used for the golf course reuse system is fairly large (approximately 1,066.7 acres), there are four diversion structures that allow higher flows to bypass the stormwater ponds in the golf course and flow directly to Como Lake. Based on a high-level assumption, using the pipes sizes in the diversion structures, we have estimated that approximately 20% of the watershed (approximately 210.8 acres) contributes runoff consistently to the stormwater ponds for reuse, and this area was used in our assessment.

Conversations with city parks staff indicated that the existing reuse system does not provide treatment (filtration or UV disinfection) before the water is used for irrigation, and they do not see a need to add treatment into the existing system.

Because Como Golf Course has already implemented stormwater reuse for irrigation, we do not have an exact number for annual irrigation usage. Assuming a weekly irrigation rate of 0.45 inches/week based on the average weekly irrigation rate at Phalen Park Golf Course. Based on the MnDNR appropriations permit data, the Como Golf Course is using an average of approximately 9.45 million gallons of groundwater for irrigation per year, which is approximately 85-90% of the average annual irrigation demand. This is on average 60,000 gallons of groundwater augmentation per day during the irrigation period. We estimate that stormwater reuse for irrigation makes up approximately 10-15% of the annual irrigation demand. The estimated pollutant removals for the existing reuse system is 2,005 pounds TSS and 11.0 pounds TP per year.

Figure 11 shows the existing stormwater reuse system at Como Golf Course along with the potential improvements to the system.

Based on conversation with parks staff, sedimentation is a concern in the existing stormwater ponds used for irrigation and their suggested improvements to the system could include:

- Dredging of accumulated sediment in the current stormwater ponds being used for irrigation to increase storage capacity/water available for irrigation.
- Expanding the pond into the low area northwest of the main basin to increase storage capacity for irrigation purposes.

Bathymetric data provided by Ramsey County indicates that the maximum pond depth in both ponds is still 6 feet, similar to the original design, although approximately one (1) foot of sediment has accumulated over the pond bottom in some areas of the pond. Given that the irrigation intake is elevated approximately 3 feet above the pond bottom, dredging accumulated material from the bottom of the pond will have minimal impact on the performance of the stormwater reuse system or the amount of water available for irrigation. As the system currently functions, water below the elevated irrigation intake is not able to be used for irrigation. As a result, we have not included dredging the existing ponds as part of this assessment or included this in the estimated project costs.

Expanding the pond to the low area to the northwest to a depth of 6 feet could increase the available amount of stormwater available in the pond for reuse by approximately 1.0 acre-ft when considering of storage within the top 3 feet of the two ponds where water is being used for irrigation. However, if the expanded ponds water levels continue to be augmented by groundwater at an average rate of 60,000 gallons per day during the irrigation season, this increase in storage would only slightly increase the amount of stormwater used to meet the annual irrigation demand and pollutant removals by the system and would only increase the annual pollutant reductions for TSS to 2154 pounds per year and for TP to 11.9 pounds per year.

However, to reduce the system demand on groundwater and increase pollutant removals, the operation of the existing reuse system could be modified. If the pond storage capacity were increased as outlined above and water levels in the stormwater ponds were not augmented by groundwater to maintain more constant water levels, the assessment of the site indicates that stormwater could provide a much larger portion of the irrigation demand (approximately 95%) and increase annual TSS and TP removals to 4,761 and 26.2 pounds per year, respectively.

Potential Watershed Area: 1066.7 acres
Effective Watershed Area
(due to diversions): 210.8 acres
Avg. Imp. 37.40%
Hydrologic Soil Group: C

Existing irrigation area: 40.0 acres
Irrigation rate: ~0.45 in/week

Expand pond storage to northwest providing an additional 1.0 acre-ft of water for reuse.

Allow pond levels to fluctuate more (less augmentation by groundwater).

1986-6221

1986-6221

1986-6221

McCarrons Lake

Lake Como

Proposed Storage
Irrigation Well
Storm Sewer Pipe
Parcel Boundary
Public Waters Basins
NWI Wetland
Watershed
Existing Irrigation Area (60.0 acres)

N

0 500 1,000
Feet

Como Golf Course Alternative
1250 Kaufman Dr
St. Paul, MN

FIGURE 11

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Barr Footer: ArcGIS 10.8.1, 2021-12-02 08:27 File:I:\Projects\23\62\1380\Maps\Reports\Figure 11 - Como Golf Course.mxd User: EMA

4.6 Phalen Park Golf Course

Phalen Park Golf Course is located at 1615 Phalen Dr. E., Saint Paul, MN 55106. The site is located in the Ramsey-Washington-Metro Watershed District and drains to Lake Phalen.

The public site is owned by the City of Saint Paul. The site was visited on November 10, 2021. The site is a 110-acre golf course and currently irrigates approximately 55 acres. The irrigation system draws from an irrigation well, using an average of approximately 14.85 million gallons of groundwater per year (which is equivalent to 0.45 inches per week during the irrigation season). The peak irrigation rate is approximately 1,000 gpm.

After review of the site, it was determined that there are opportunities to reduce groundwater usage for irrigation at the site. Figure 12 shows the potential stormwater reuse system at Phalen Park Golf Course.

Given the site's proximity to Lake Phalen, which has a large surface area and very large watershed (approximately 14,906.6 acres), the reuse system could utilize the top 0.03 feet of water from the existing lake surface (approximately 2,000,000 gallons of storage) and meet 97% of the annual irrigation demand. It is estimated that this alternative could reduce annual TSS by 6,668 pounds per year and annual TP loads by 36.7 pounds per year.

Conversations with city parks staff indicated that the system would not need to provide treatment (filtration or UV disinfection), only potentially screening at the intake. Additionally, the system would utilize the existing well water for irrigation back-up supply.

Barr Footer: ArcGIS 10.8.1, 2021-12-16 10:30 File: I:\Projects\23\62\1380\Maps\Reports\Figure 12 - Phalen Park Golf Course.mxd User: EMA

Round Lake

Lake Phalen

1959-0525

1000 gpm lift station with screened intake connecting to existing irrigation system mainline with well backup. 97% of irrigation demand

Existing irrigation area: 55.0 acres
Irrigation rate = ~0.45 in/week

Area: 14906.55 acres
Avg. Imp. 39.46%
Hydrologic Soil Group: C

Maple Hill Dr
Arcade St
Frost Ave
Sophia Ave
Phalen Pl
East Shore Dr
Parkway Dr
27
E Larpenteur Ave
61
E Idaho Ave
Phalen Dr
E Iowa Ave
E Hoyt Ave
N Weide St
E Montana Ave
E Nebraska Ave
N Arcade St
E Nevada Ave
E Wheelock Ave
E Wheelock Pkwy
E Sherwood Ave
E Cottage Ave
E Clear Ave
N Mendota St
N Forest St
E Ivy Ave
E Hyacinth Ave
N Earl St
N Frank St
E Orange Ave
N Cypress St

Proposed Piping
Proposed Storage
Proposed Structures
Pump/Treatment System
Parcel Boundary
Watershed
Storm Sewer Pipe
Irrigation Well
Public Waters Basins
NWI Wetland
Existing Irrigation Area (60.0 acres)

N
0 200 400
Feet

BARR

Phalen Park Golf Course Alternative
1000 Wheelock Pkwy E
St Paul, MN

FIGURE 12

4.7 3M Corporate Campus

The 3M Corporate Campus is located at 2510 Conway Ave. E., Maplewood, MN. The site is located in the Ramsey-Washington-Metro Watershed District and drains to 3M Lake and ultimately Battle Creek.

The site is owned by the 3M Corporation. A virtual call was held with 3M staff on September 27, 2021. The corporate campus is approximately 400 acres, with approximately 80 acres that are irrigated/ manicured. There are three wells used primarily for irrigation (although the water can be used for other purposes as needed, such as construction dust control, etc.). The average annual usage for these three wells is 34.5 million gallons per year (which is an irrigation rate of approximately 0.61 inches/week, assuming all pumped water is used for irrigation). 3M staff also noted that some buildings on campus utilize potable water for irrigation as well. Figure 13 shows the 3M Corporate campus, existing irrigation well locations, 3M Lake and its approximate watershed.

3M is committed to reducing water usage as part of their corporate sustainability goals. They are transitioning some turf areas of the campus to prairie habitat. Additionally, they transitioned to a smarter irrigation system two years ago that includes soil moisture sensors.

3M Lake is located on the north end of the corporate campus with an estimated watershed of 695 acres and could serve as a potential source for irrigation water for the campus.

Initial conversations were started with 3M staff, and they indicated that stormwater reuse for irrigation is an approach that would support the corporate sustainability goals. However, during this study, no further information was provided by 3M staff. Due to the complex nature of the site and corporate campus, next steps could include reengaging with 3M staff and pursue a corporate campus specific feasibility study for stormwater reuse, in partnership with other potential stakeholders such as 3M and the Ramsey-Washington-Metro Watershed District.

Beaver Lake
Three M Lake
MAPLEWOOD
SAINT PAUL
Case Ave
Lakewood Dr
Harvester Ave E
Sterling St N
Glendon St N
Midvale Pl
Harvester Ave
15th St N
Evar St
Edith St
Michael La
E Stillwater Ave
Stillwater Rd
Brand St E
14th St N
Bartelmy La N
7th St E
E 7th St
Lake St
N Howard St
E Ross Ave
Olivia Ct
Mary St N
12th St N
Meyer St
E Bush St
Bush Ave
Mayhill Rd N
E Reaney Ave
Reaney Ave E
Crestview Dr
Minnehaha Ave E
E Minnehaha Ave
E Beech St
E Margaret St
Margaret St E
9th St N
E 6th St
Ferndale St N
Century Ave N
E 5th St
5th St E
Carlton St
Farrell St N
7th St N
E 4th St
E Fremont St
Fremont Ave E
E 3rd St
E Conway St
Conway Ave E
Howard Ct
Tower St
E Wilson Ave
N Mcknight Rd
4th St N
Old Hudson Rd
E Suburban Ave
E Burns Ave
Hudson Rd
Hudson Pl
O Day Ave
Mcclelland St

Area: 694.11 acres
Avg. Imp. 44.57%
Hydrologic Soil Group: C

Irrigation area: ~80 acres
Irrigation rate: ~0.61 in/week

1975-6084
1986-6251
2012-0280

Parcel Boundary
Watershed
Storm Pipe
Public Waters Basins
NWI Wetland
Irrigation Well
Municipal Boundary

N
0 300 600
Feet

BARR

3M Corporate Campus Alternative
2510 Conway Ave E
Maplewood, MN

FIGURE 13

5 Summary

This study demonstrated that there are many potential stormwater reuse opportunities throughout Ramsey County.

Of the 13 priority sites considered, more than half (7) were interested in further evaluating stormwater reuse to either improve existing reuse system performance or install a new stormwater reuse system. One (1) site had an existing stormwater reuse for irrigation system but was not interested in participating in the study. One (1) site is currently performing a study of reuse for irrigation. Two (2) sites irrigate but were not interested in participating in this study, one (1) site is in the process of being redeveloped into a housing development, and one site (1) did not have irrigation (and does not plan to have irrigation in the future).

In the concepts evaluated at the different sites, the alternatives demonstrated that stormwater can be used to meet from approximately 50% to greater than 90% of the annual irrigation demand and also increase both TSS and TP pollutant removals.

For some sites with existing reuse systems that augment water levels with groundwater (Midland Hills Country Club and Como Golf Course), there may be opportunities to reduce demand on groundwater and increase pollutant removals by modifying system operations and allowing pond water levels to fluctuate more significantly without augmenting with groundwater.

Additionally, the costs of stormwater reuse systems are significantly impacted by the need to construct stormwater storage. Systems able to utilize water from existing ponds are much more cost effective than those having to construct stormwater storage for reuse. And for those concepts requiring the construction of storage, surface storage is more cost effective than subsurface storage; however, more storage can be achieved in the same footprint if subsurface storage is used.

Treatment (including filtration and disinfection) can also add cost to a system. However, most landowners indicated a preference to include treatment of water prior to irrigation, especially those in park or school settings. Currently there are no treatment requirements for stormwater reuse for irrigation at the state or local levels, although it is recommended to reduce public health risk and reduce wear on irrigation system components.

Most of the sites evaluated have existing irrigation systems. However, Hill-Murray School has plans to expand their irrigation area in the front of the school and Harvest Park has plans to construct a new irrigation system as part of its master plan implementation. Costs included in this study do not include the cost of the installation of a new irrigation system.

5.1 Prioritization and Next Steps

Considering the results of the high-level concept analysis, we have recommended alternatives considering impact on reductions on groundwater usage for irrigation and pollutant loads, overall capital costs, and location as it relates to the county social vulnerability index, as summarized in Table 6. The ranking of

each site by each of the factors listed above is included for County consideration in terms of moving each of the projects forward.

In general, next steps by the county should include the following:

- Reengaging with the property owners and sharing the results of this high-level concept evaluation, including review of project components, discussion of project costs, and outlining potential partnership/grant opportunities. Some of these efforts could align with upcoming projects including implementation of park master plans over the next few years at locations such as Harvest Park and Pioneer Park.
- Reaching out to potential project partners such as the watershed management organizations as it relates to project funding and implementation.
- Identifying potential grants to help support implementation of stormwater reuse projects such as grants through the Metropolitan Council, the Minnesota Pollution Control Agency, or the Board of Water and Soil Resources
- The evaluations performed for this study were based on high-level concepts. Based on owner interest to continue pursuing stormwater reuse at each site, we would recommend further evaluation of feasibility, request and review of any additional construction plans/as-built data from cities, and coordination with state agencies (specifically Minnesota Department of Natural Resources (MnDNR) as it relates to appropriations permits), and collection of detailed survey and other field investigations such as wetland delineations, and final design and permitting.

Table 6 Summary of Recommended Alternatives and Site Prioritization

Property/ Parcel Name	Recommended Alternative	Increase in Stormwater Reuse for Irrigation Demand Rank	Increase in Pollutant Removal Rank	Capital Cost Rank[1]	Social Vulnerability Index Rank
Como Regional Park Golf Course	Alternative: Modify system operation (less groundwater augmentation) and expand pond storage to northwest	**4** 5,246,345 gal/yr	**4** 2756 lbs TSS/yr 0.8 – 15.2 lbs TP/yr	**1** $261,000	**7** 0.28/0.47
Midland Hills Country Club	Alternative: Modify system operation (less groundwater augmentation)	**3** 6,025,630 - 15,831,516 gal/yr	**2** 3490 - 7814 lbs TSS/yr 19.2 – 43.0 lbs TP/yr	N/A	**5** 0.48/0.41
3M Campus[1]	Feasibility study for use of 3M Lake for reuse	N/A	N/A	N/A	**2** 0.71/0.67
Phalen Park Golf Course	Alternative: Use of Lake Phalen	**1** 13,943,158 gal/yr	**1** 6,668 lbs TSS/yr 36.7 lbs TP/yr	**2** $358,000	**4** 0.55/0.59
Pioneer Park	Alternative: Use of onsite ponds	**5** 2,225,767 gal/yr	**5** 1,393 lbs TSS/yr 7.7 lbs TP/yr	**3** $674,000	**3** 0.66/0.66
Harvest Park	Alternative: Use of water from MnDNR PWI: 62-0152	**2** 6,028,653 gal/yr	**3** 2,752 lbs TSS/yr 15.1 bs TP/yr	**4** $718,000	**6** 0.29/0.41
Hill-Murray School	Alternative: Diversion of water from Larpenteur Ave Ditch	**6** 1,734,736 - 1,768,449 gal/yr	**6** 1097 – 1702 lbs TSS/yr 6.0- 9.4 lbs TP/yr	**5** $679,000 - $1,729,000	**1** 0.71/0.70

1 – Based on point estimate of capital cost; based on limited design, actual costs can range from -30% to +50%, does not include costs for new irrigation systems

6 References

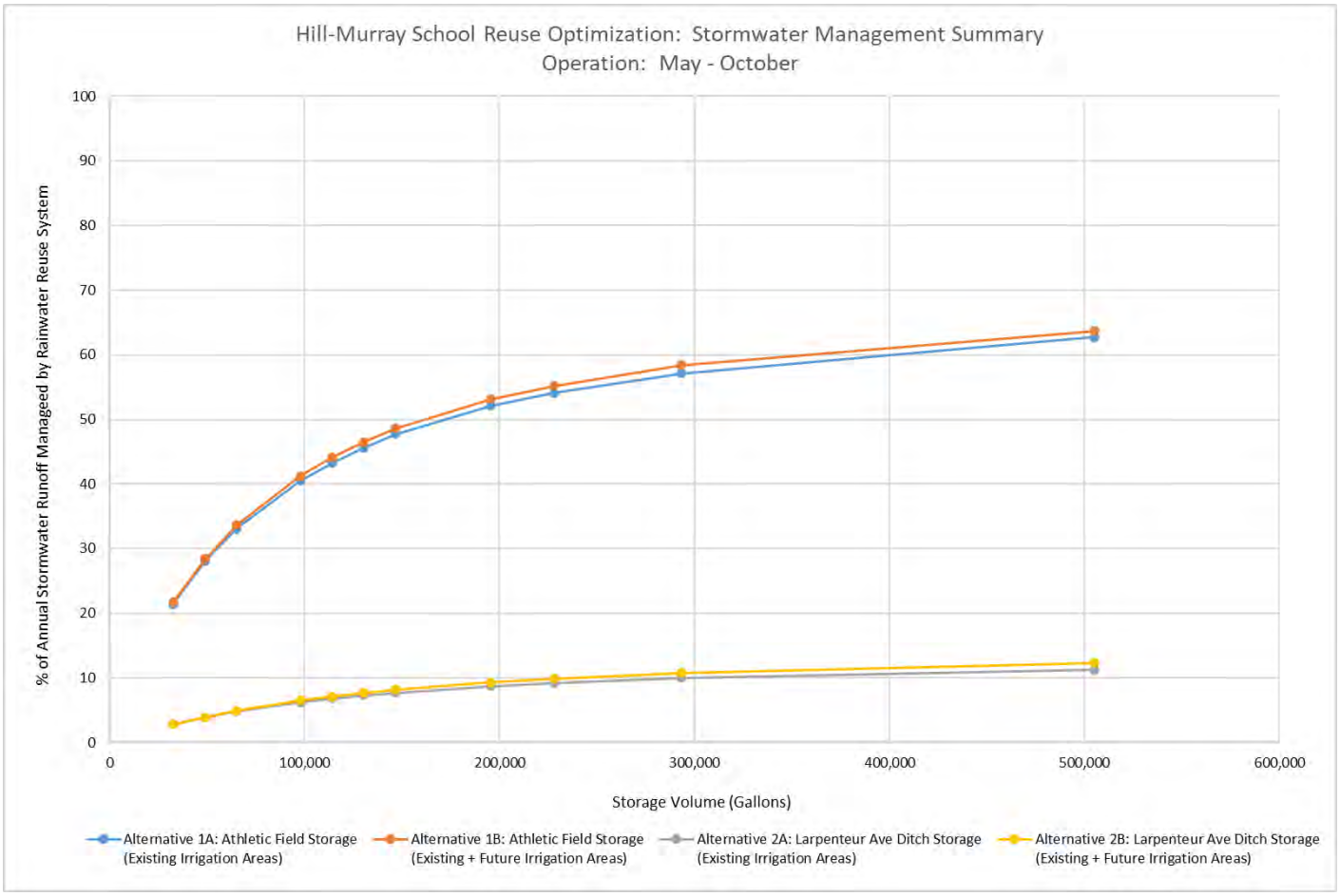
Houston Engineering, Inc. 2016. The Stormwater Reuse for Irrigation Assessment Methodology – Targeting Water Reuse for Irrigation to Reduce Reliance on Groundwater. Prepared for Rice Creek Watershed District.

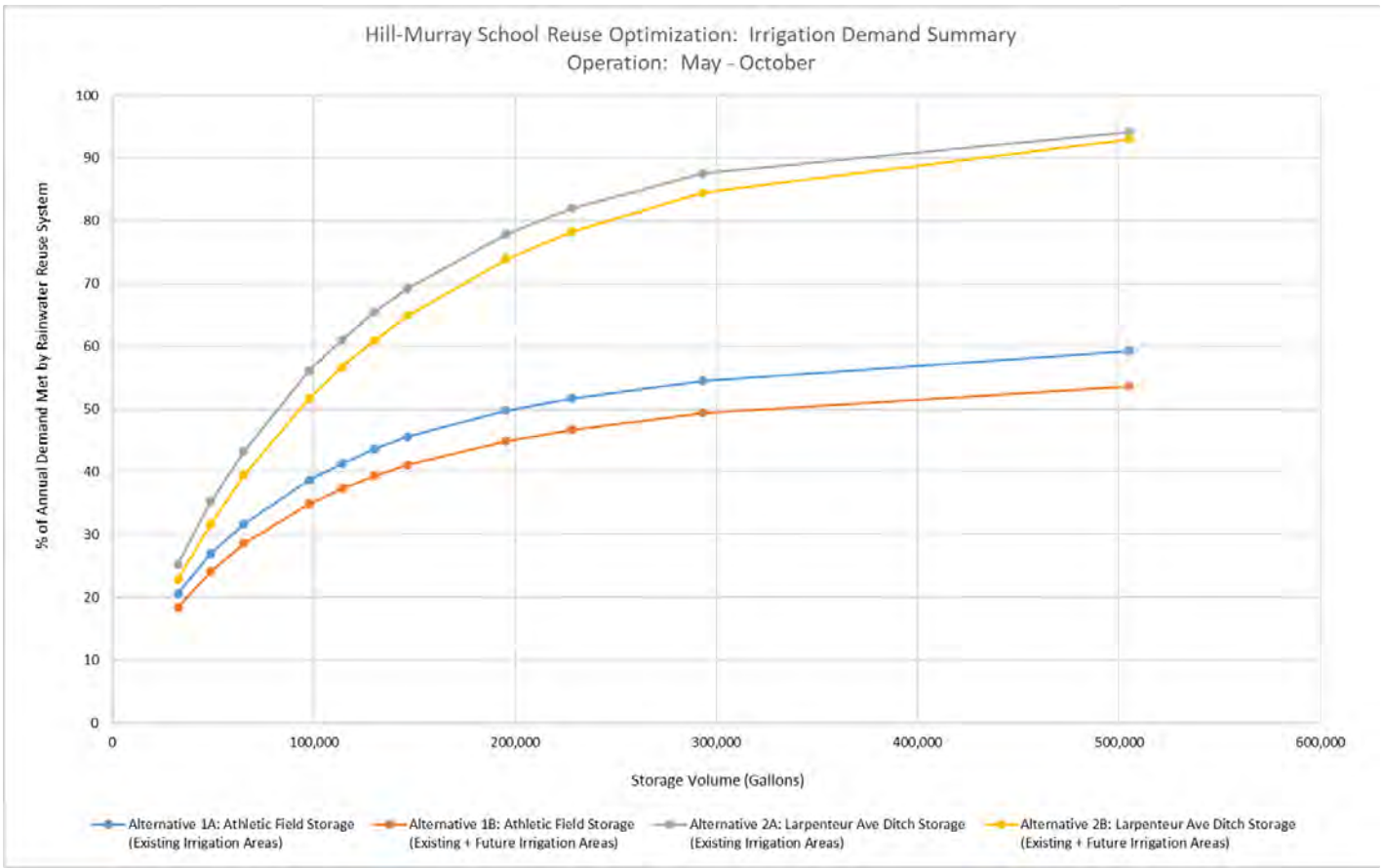
Houston Engineering, Inc. 2020. Targeting Reuse Irrigation in Washington County. Prepared for Washington County.

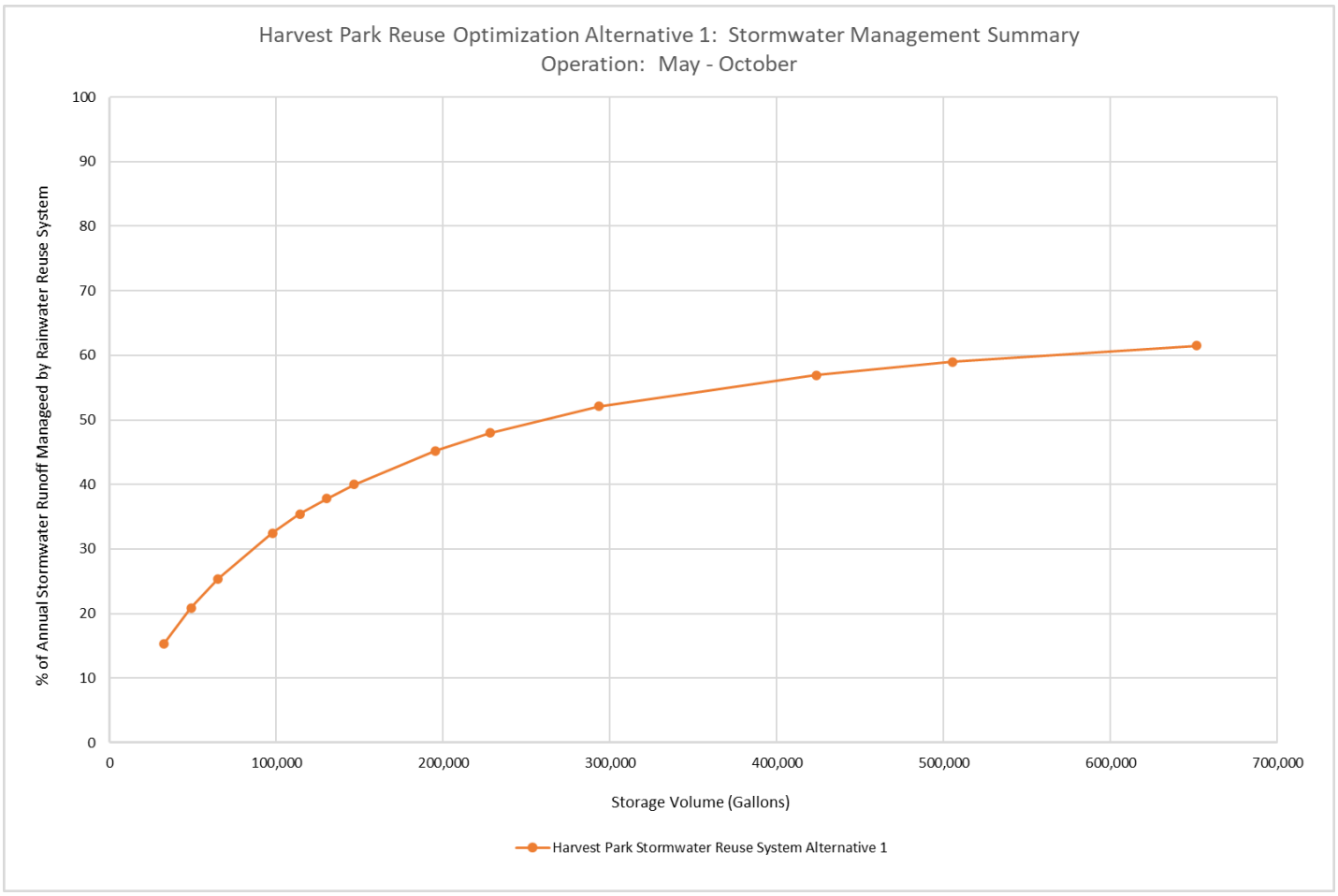
Appendices

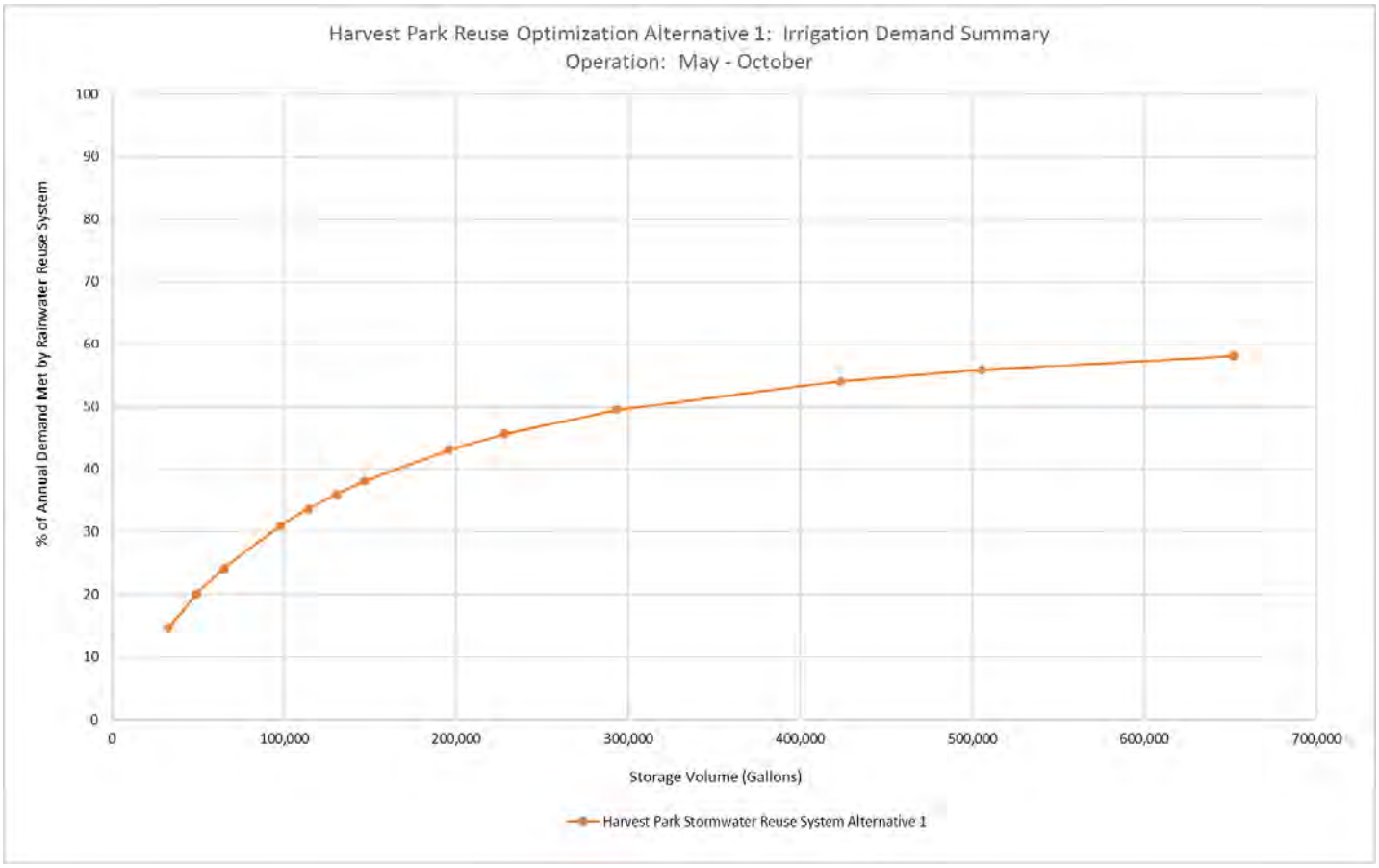
Appendix A

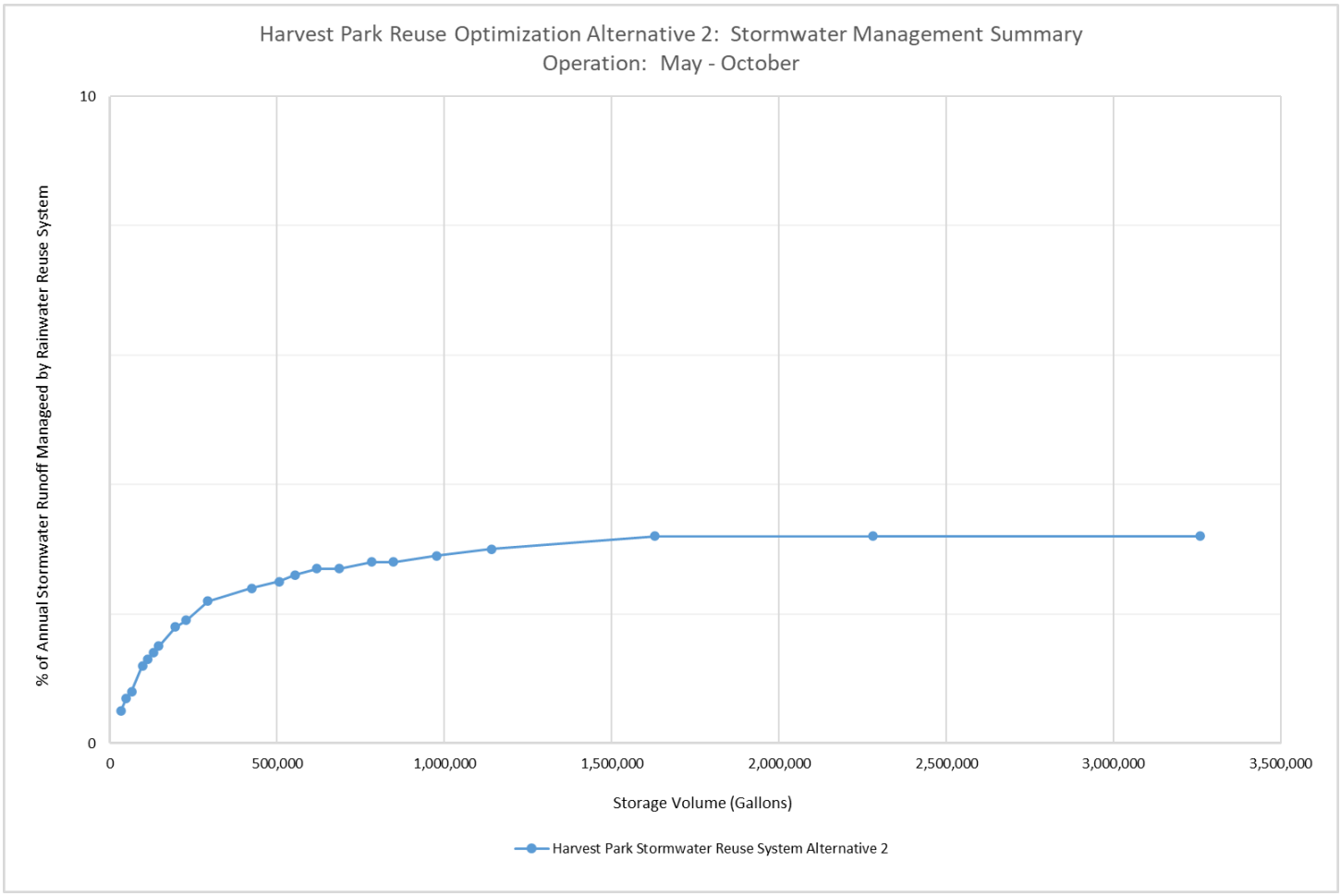
Concept Optimization Curves

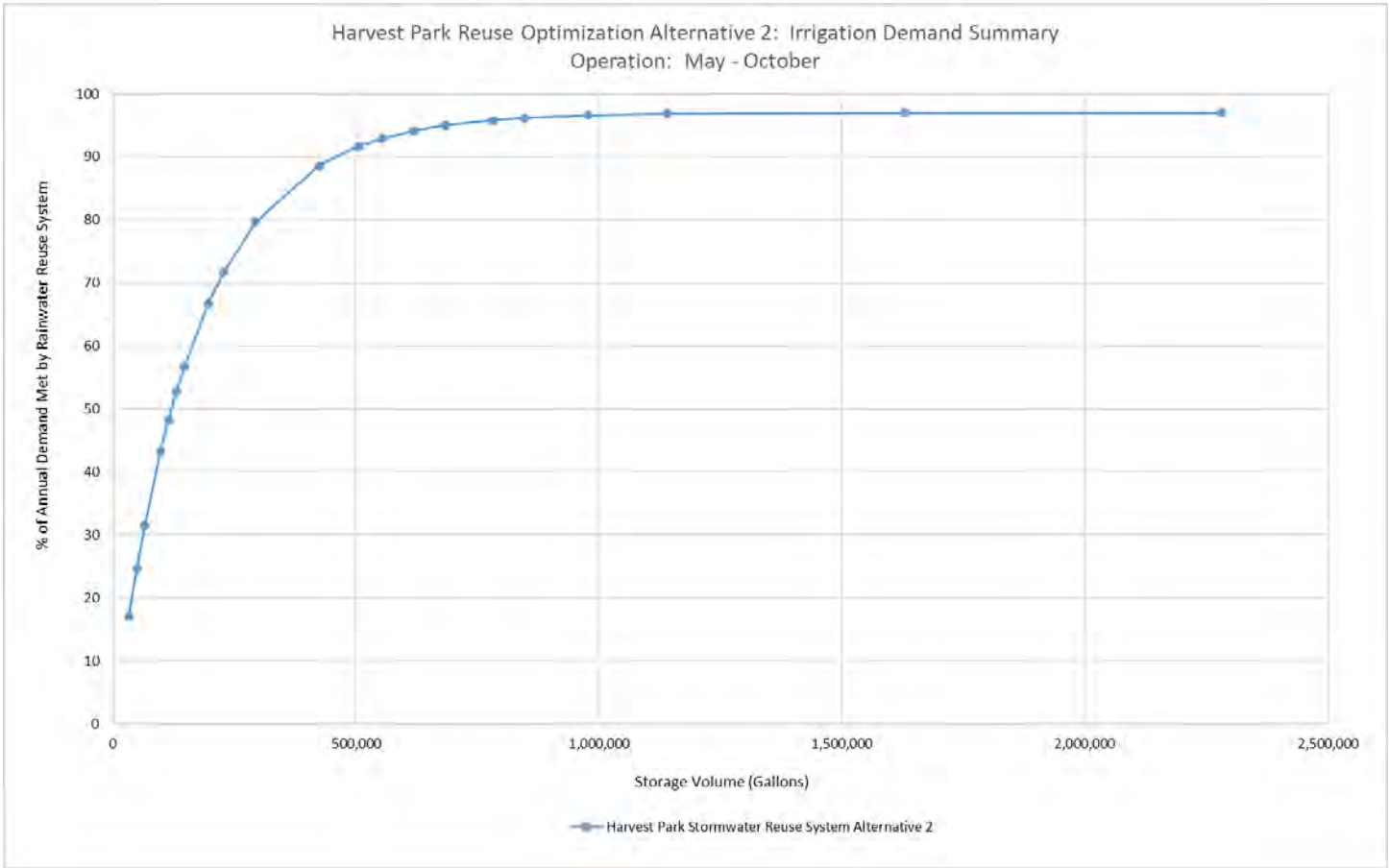

Hill-Murray School Reuse Optimization: Stormwater Management Summary
Operation: May - October
% of Annual Stormwater Runoff Managed by Rainwater Reuse System
100
90
80
70
60
50
40
30
20
10
0
0
100,000
200,000
300,000
400,000
500,000
600,000
Storage Volume (Gallons)
Alternative 1A: Athletic Field Storage (Existing Irrigation Areas)
Alternative 1B: Athletic Field Storage (Existing + Future Irrigation Areas)
Alternative 2A: Larpenteur Ave Ditch Storage (Existing Irrigation Areas)
Alternative 2B: Larpenteur Ave Ditch Storage (Existing + Future Irrigation Areas)

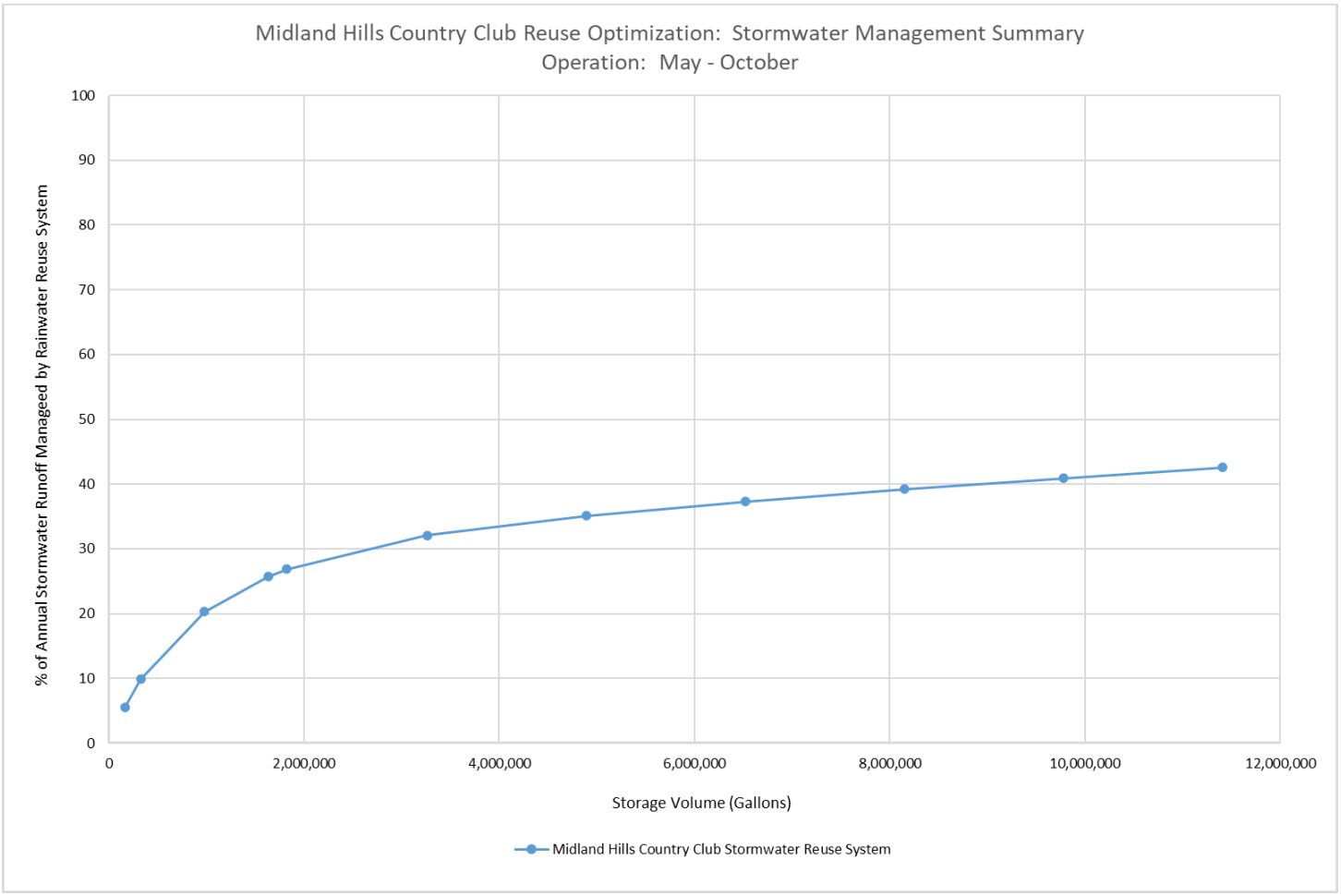

Hill-Murray School Reuse Optimization: Irrigation Demand Summary
Operation: May - October
% of Annual Demand Met by Rainwater Reuse System
100
90
80
70
60
50
40
30
20
10
0
0
100,000
200,000
300,000
400,000
500,000
600,000
Storage Volume (Gallons)
Alternative 1A: Athletic Field Storage (Existing Irrigation Areas)
Alternative 1B: Athletic Field Storage (Existing + Future Irrigation Areas)
Alternative 2A: Larpenteur Ave Ditch Storage (Existing Irrigation Areas)
Alternative 2B: Larpenteur Ave Ditch Storage (Existing + Future Irrigation Areas)

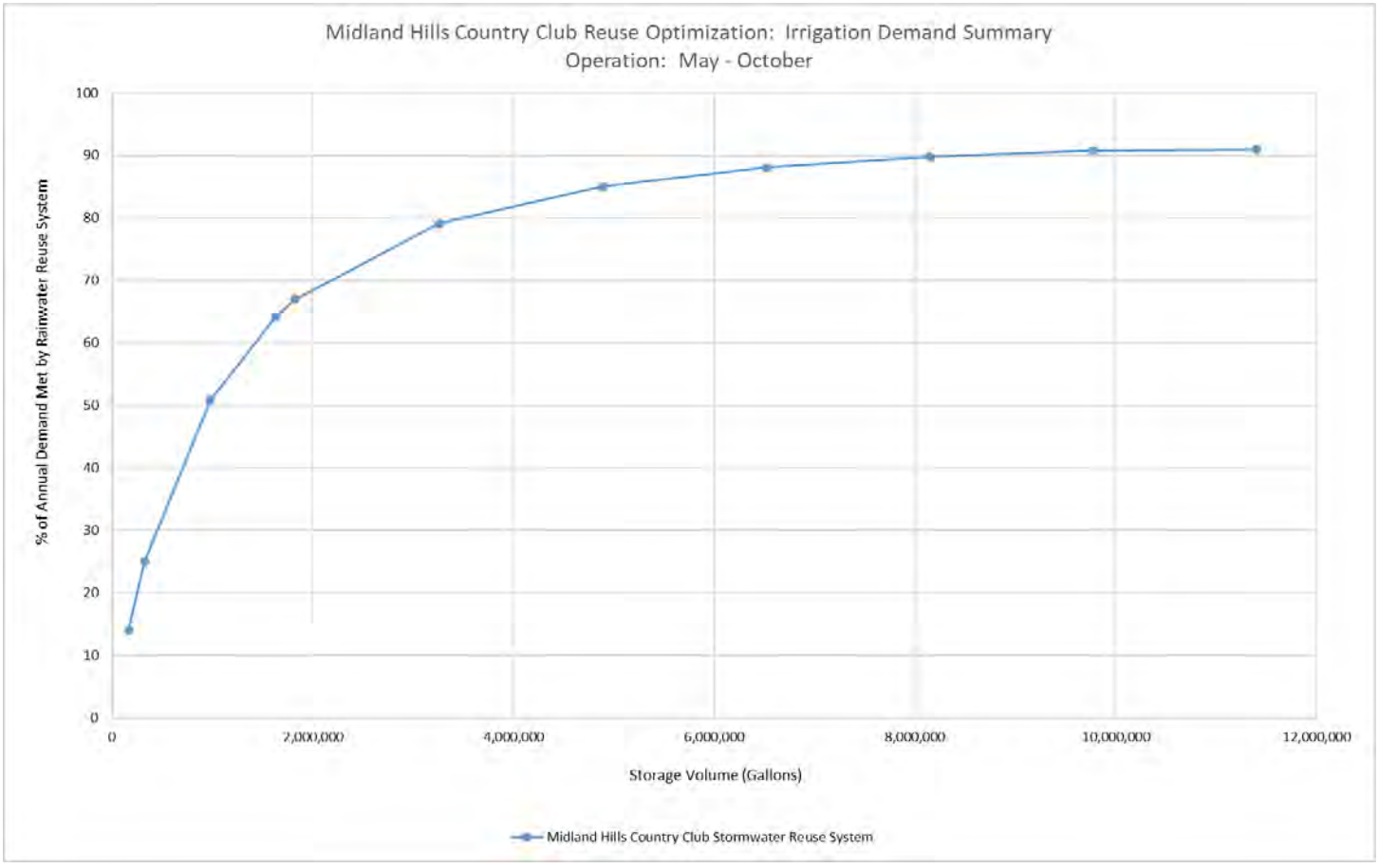

Harvest Park Reuse Optimization Alternative 1: Stormwater Management Summary
Operation: May - October
% of Annual Stormwater Runoff Manageed by Rainwater Reuse System
100
90
80
70
60
50
40
30
20
10
0
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
Storage Volume (Gallons)
Harvest Park Stormwater Reuse System Alternative 1

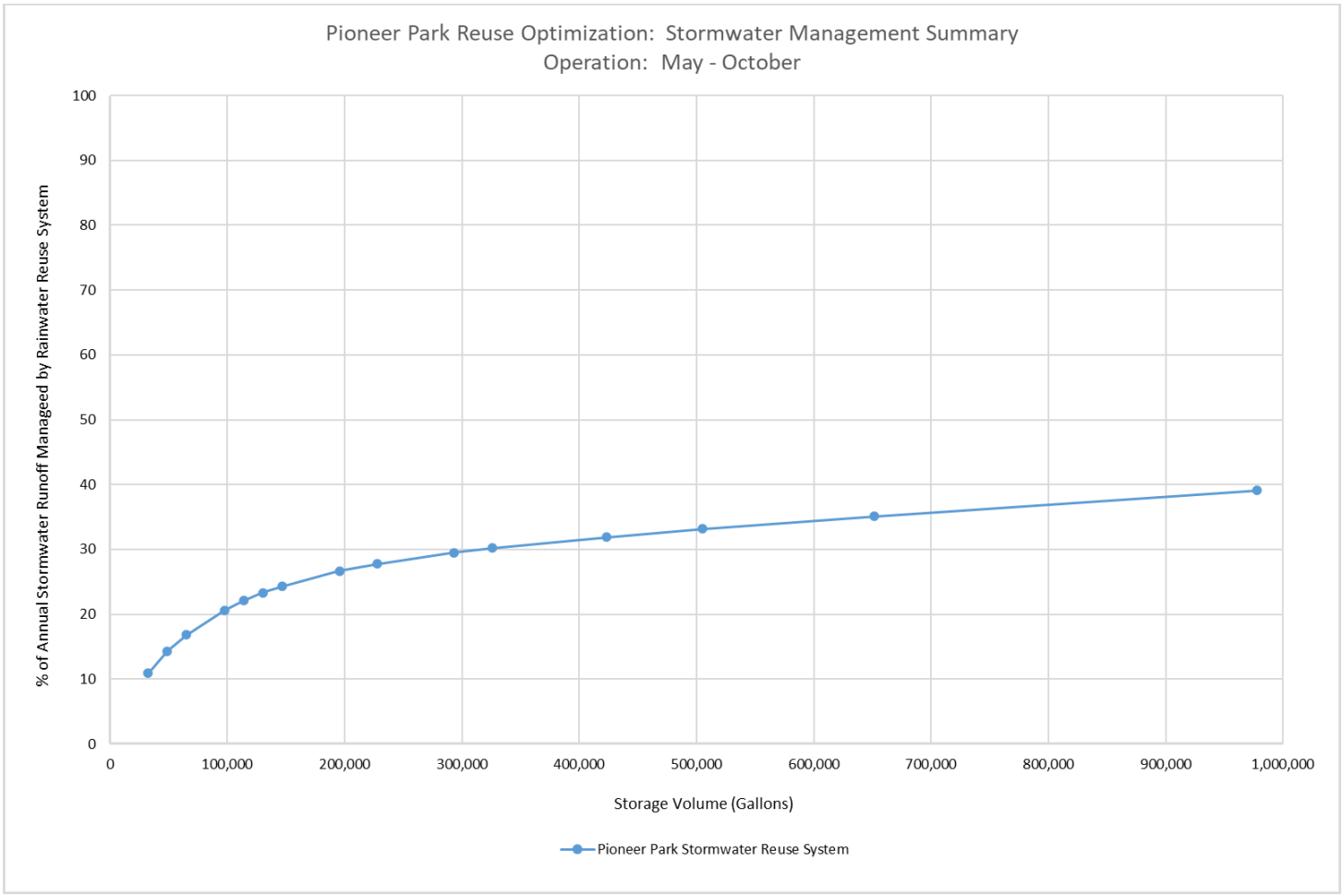

Harvest Park Reuse Optimization Alternative 1: Irrigation Demand Summary
Operation: May - October
% of Annual Demand Met by Rainwater Reuse System
100
90
80
70
60
50
40
30
20
10
0
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
Storage Volume (Gallons)
Harvest Park Stormwater Reuse System Alternative 1

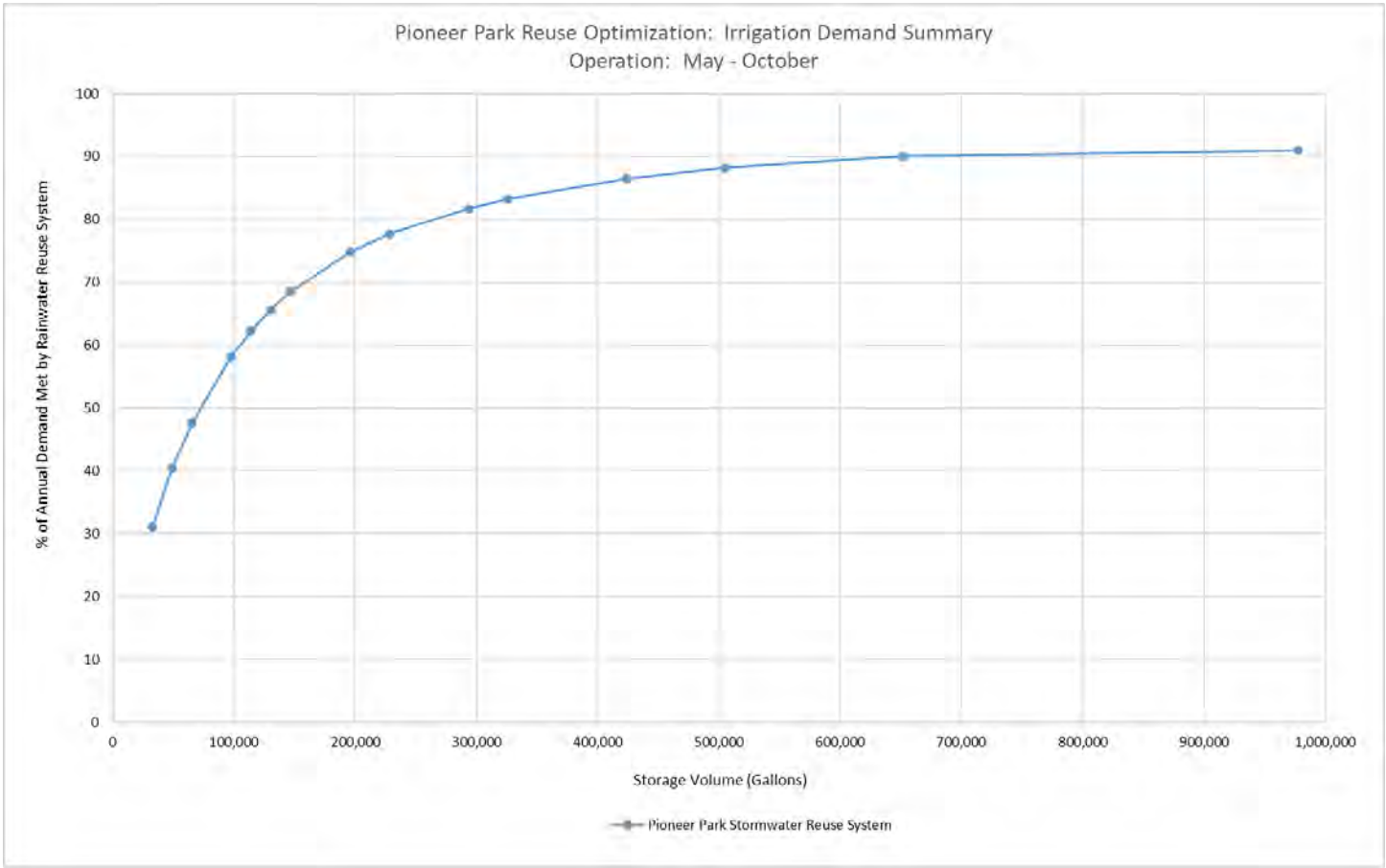

Harvest Park Reuse Optimization Alternative 2: Stormwater Management Summary
Operation: May - October
% of Annual Stormwater Runoff Manageed by Rainwater Reuse System
10
0
0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
3,000,000
3,500,000
Storage Volume (Gallons)
Harvest Park Stormwater Reuse System Alternative 2

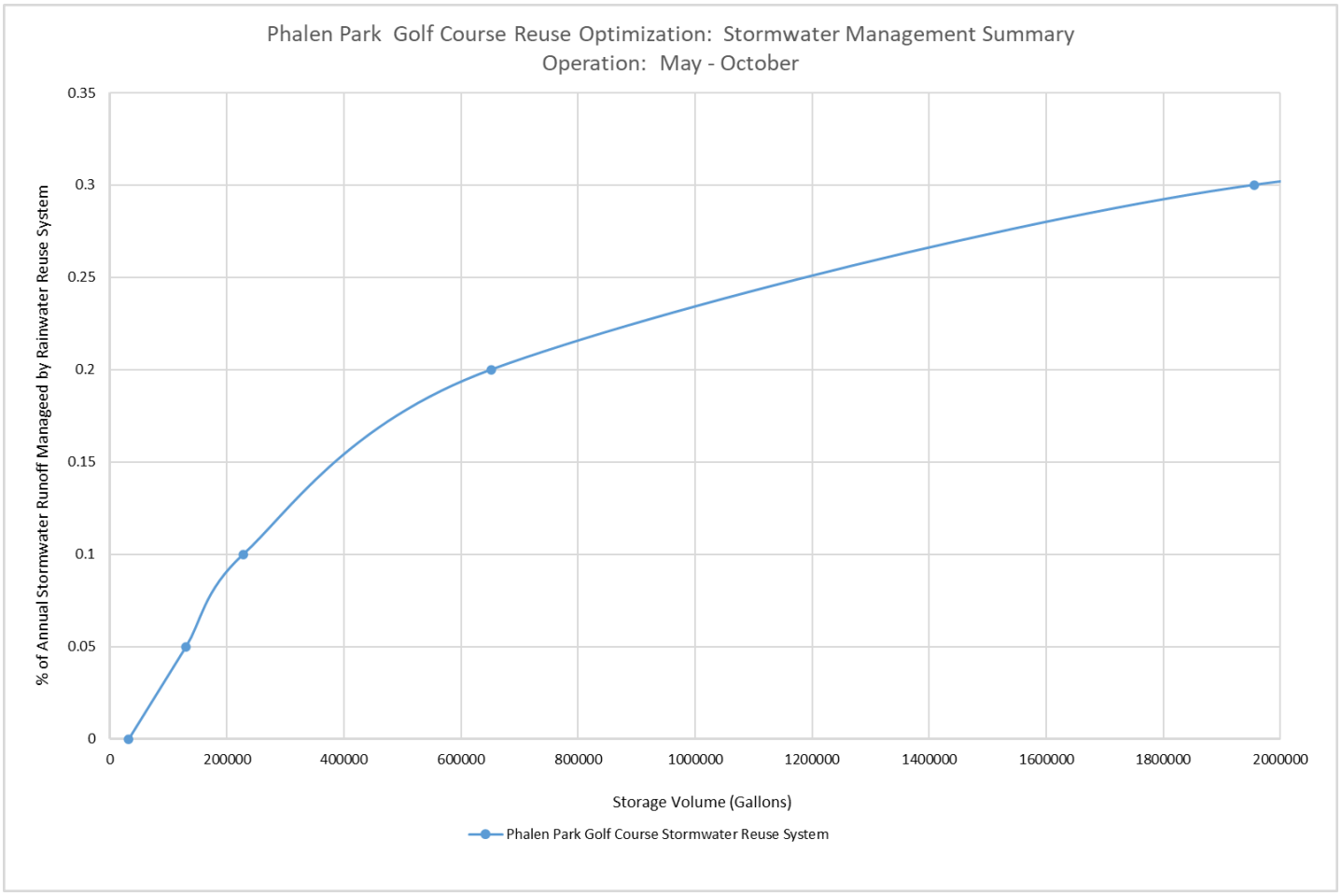

Harvest Park Reuse Optimization Alternative 2: Irrigation Demand Summary
Operation: May - October
% of Annual Demand Met by Rainwater Reuse System
100
90
80
70
60
50
40
30
20
10
0
0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
Storage Volume (Gallons)
Harvest Park Stormwater Reuse System Alternative 2

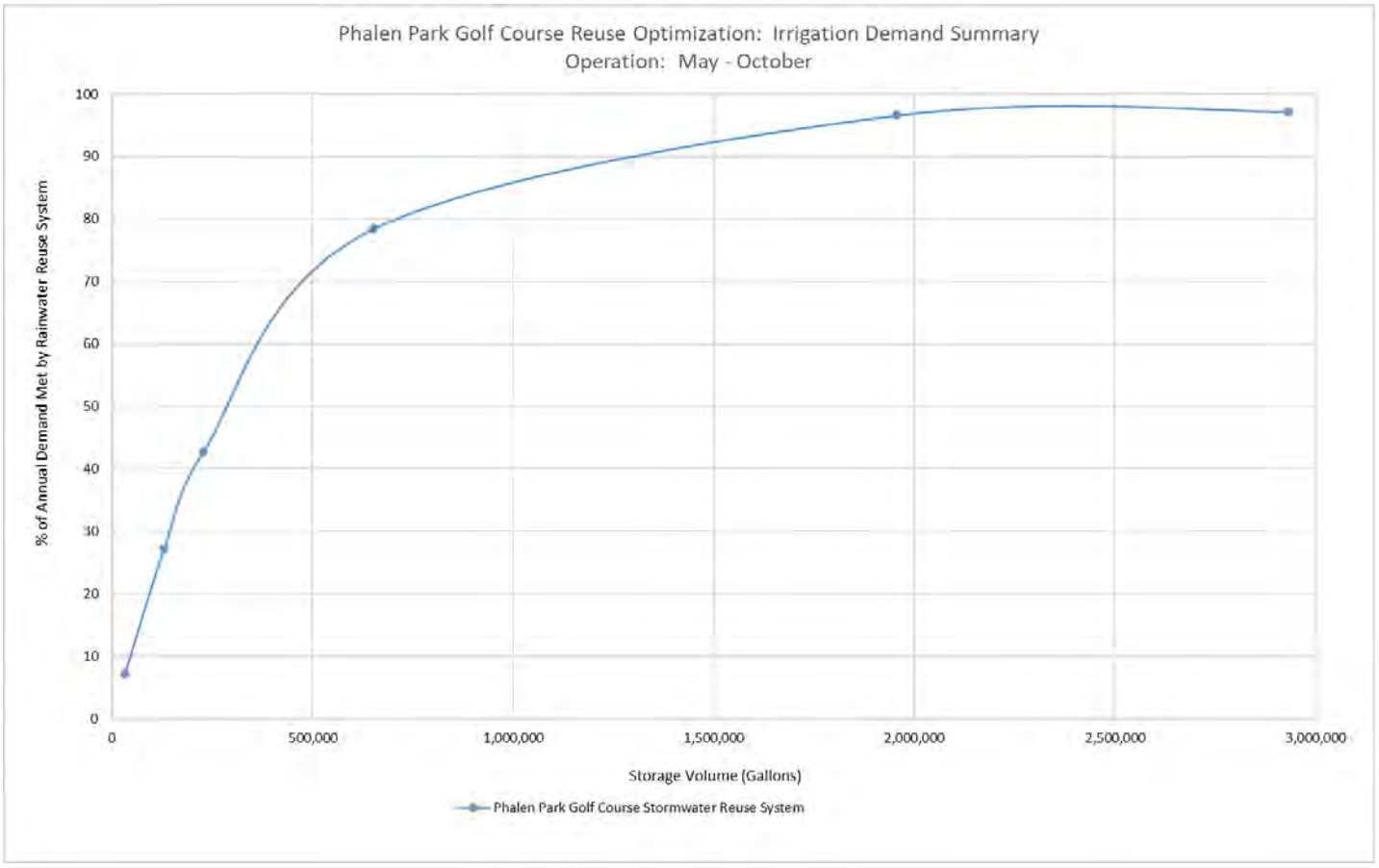

Midland Hills Country Club Reuse Optimization: Stormwater Management Summary
Operation: May - October
% of Annual Stormwater Runoff Managed by Rainwater Reuse System
100
90
80
70
60
50
40
30
20
10
0
0
2,000,000
4,000,000
6,000,000
8,000,000
10,000,000
12,000,000
Storage Volume (Gallons)
Midland Hills Country Club Stormwater Reuse System


Midland Hills Country Club Reuse Optimization: Irrigation Demand Summary
Operation: May - October
% of Annual Demand Met by Rainwater Reuse System
100
90
80
70
60
50
40
30
20
10
0
0
2,000,000
4,000,000
6,000,000
8,000,000
10,000,000
12,000,000
Storage Volume (Gallons)
Midland Hills Country Club Stormwater Reuse System


Pioneer Park Reuse Optimization: Stormwater Management Summary
Operation: May - October
% of Annual Stormwater Runoff Manageed by Rainwater Reuse System
100
90
80
70
60
50
40
30
20
10
0
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
800,000
900,000
1,000,000
Storage Volume (Gallons)
Pioneer Park Stormwater Reuse System


Pioneer Park Reuse Optimization: Irrigation Demand Summary
Operation: May - October
% of Annual Demand Met by Rainwater Reuse System
100
90
80
70
60
50
40
30
20
10
0
0
100,000
200,000
300,000
400,000
500,000
600,000
700,000
800,000
900,000
1,000,000
Storage Volume (Gallons)
Pioneer Park Stormwater Reuse System


Phalen Park Golf Course Reuse Optimization: Stormwater Management Summary
Operation: May - October
% of Annual Stormwater Runoff Manageed by Rainwater Reuse System
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
200000
400000
600000
800000
1000000
1200000
1400000
1600000
1800000
2000000
Storage Volume (Gallons)
Phalen Park Golf Course Stormwater Reuse System


Phalen Park Golf Course Reuse Optimization: Irrigation Demand Summary
Operation: May - October
% of Annual Demand Met by Rainwater Reuse System
100
90
80
70
60
50
40
30
20
10
0
0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
3,000,000
Storage Volume (Gallons)
Phalen Park Golf Course Stormwater Reuse System

Appendix B

Concept MIDS Calculator Evaluation

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Hill Murray School Stormwater Reuse
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Hill Murray School Stormwater Reuse Run. Alternate 1A. Athletic field subsurface storage with existing irrigation areas.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55109
Annual Rainfall (inches):	32
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			4.227		4.227
				Impervious Area (acres)	4.672
				Total Area (acres)	8.899

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			4.227		4.227
				Impervious Area (acres)	4.672
				Total Area (acres)	8.899

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	18655	ft3
Volume removed by BMPs towards performance goal:	10050	ft^3
Percent volume removed towards performance goal	**54**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	12.884	acre-ft
Annual runoff volume removed by BMPs:	6.5689	acre-ft
Percent annual runoff volume removed:	**51**	**%**
Post development annual particulate P load:	5.7823	lbs
Annual particulate P removed by BMPs:	2.948	lbs
Post development annual dissolved P load:	4.731	lbs
Annual dissolved P removed by BMPs:	2.412	lbs
Total P removed by BMPs	5.36	lbs
Percent annual total phosphorus removed:	**51**	**%**
Post development annual TSS load:	1909.9	lbs
Annual TSS removed by BMPs:	973.8	lbs
Percent annual TSS removed:	**51**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	10050	18655	10050	8605	54

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	12.884	0	6.5689	6.3151	51

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	5.7823	0	2.9481	2.8342	51

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	4.731	0	2.4121	2.3189	51

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	10.5133	0	5.3602	5.1531	51

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	1909.93	0	973.78	936.15	51

BMP Schematic

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Hill Murray School Stormwater Reuse Run
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Hill Murray School Stormwater Reuse Run. Alternate 1B. Athletic field subsurface storage with future irrigation areas.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55109
Annual Rainfall (inches):	32
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			4.227		4.227
				Impervious Area (acres)	4.672
				Total Area (acres)	8.899

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			4.227		4.227
				Impervious Area (acres)	4.672
				Total Area (acres)	8.899

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	18655	ft3
Volume removed by BMPs towards performance goal:	11333	ft^3
Percent volume removed towards performance goal	**61**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	12.884	acre-ft
Annual runoff volume removed by BMPs:	6.7469	acre-ft
Percent annual runoff volume removed:	**52**	**%**
Post development annual particulate P load:	5.7823	lbs
Annual particulate P removed by BMPs:	3.028	lbs
Post development annual dissolved P load:	4.731	lbs
Annual dissolved P removed by BMPs:	2.478	lbs
Total P removed by BMPs	5.506	lbs
Percent annual total phosphorus removed:	**52**	**%**
Post development annual TSS load:	1909.9	lbs
Annual TSS removed by BMPs:	1000.2	lbs
Percent annual TSS removed:	**52**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	11333	18655	11333	7322	61

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	12.884	0	6.7469	6.1371	52

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	5.7823	0	3.028	2.7543	52

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	4.731	0	2.4775	2.2535	52

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	10.5133	0	5.5055	5.0078	52

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	1909.93	0	1000.16	909.77	52

BMP Schematic

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Hill Murray School Stormwater Reuse Run
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Hill Murray School Stormwater Reuse Run. Alternate 2A (i). Larpenteur Ave surface ditch storage with existing irrigation areas.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55109
Annual Rainfall (inches):	32
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			83.436		83.436
				Impervious Area (acres)	39.264
				Total Area (acres)	122.7

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			83.436		83.436
				Impervious Area (acres)	39.264
				Total Area (acres)	122.7

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	156781	ft3
Volume removed by BMPs towards performance goal:	10050	ft^3
Percent volume removed towards performance goal	**6**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	133.5761	acre-ft
Annual runoff volume removed by BMPs:	7.397	acre-ft
Percent annual runoff volume removed:	**6**	**%**
Post development annual particulate P load:	59.949	lbs
Annual particulate P removed by BMPs:	3.32	lbs
Post development annual dissolved P load:	49.049	lbs
Annual dissolved P removed by BMPs:	2.716	lbs
Total P removed by BMPs	6.036	lbs
Percent annual total phosphorus removed:	**6**	**%**
Post development annual TSS load:	19801.3	lbs
Annual TSS removed by BMPs:	1096.5	lbs
Percent annual TSS removed:	**6**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	10050	156781	10050	146730	6

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	133.5761	0	7.397	126.1791	6

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	59.949	0	3.3198	56.6292	6

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	49.0492	0	2.7162	46.333	6

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	108.9982	0	6.036	102.9622	6

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	19801.33	0	1096.53	18704.8	6

BMP Schematic

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Hill Murray School Stormwater Reuse
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Hill Murray School Stormwater Reuse Run. Alternate 2A (ii). Larpenteur Ave subsurface ditch storage with existing irrigation areas.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55109
Annual Rainfall (inches):	32
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			83.436		83.436
				Impervious Area (acres)	39.264
				Total Area (acres)	122.7

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			83.436		83.436
				Impervious Area (acres)	39.264
				Total Area (acres)	122.7

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	156781	ft3
Volume removed by BMPs towards performance goal:	10050	ft^3
Percent volume removed towards performance goal	**6**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	133.5761	acre-ft
Annual runoff volume removed by BMPs:	11.4825	acre-ft
Percent annual runoff volume removed:	**9**	**%**
Post development annual particulate P load:	59.949	lbs
Annual particulate P removed by BMPs:	5.153	lbs
Post development annual dissolved P load:	49.049	lbs
Annual dissolved P removed by BMPs:	4.216	lbs
Total P removed by BMPs	9.369	lbs
Percent annual total phosphorus removed:	**9**	**%**
Post development annual TSS load:	19801.3	lbs
Annual TSS removed by BMPs:	1702.2	lbs
Percent annual TSS removed:	**9**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	10050	156781	10050	146730	6

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	133.5761	0	11.4825	122.0936	9

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	59.949	0	5.1533	54.7957	9

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	49.0492	0	4.2164	44.8328	9

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	108.9982	0	9.3697	99.6285	9

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	19801.33	0	1702.16	18099.17	9

BMP Schematic

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Hill Murray School Stormwater Reuse
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Hill Murray School Stormwater Reuse Run. Alternate 2B (i). Larpenteur Ave surface ditch storage with existing and future irrigation areas.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55109
Annual Rainfall (inches):	32
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			83.436		83.436
				Impervious Area (acres)	39.264
				Total Area (acres)	122.7

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			83.436		83.436
				Impervious Area (acres)	39.264
				Total Area (acres)	122.7

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	156781	ft3
Volume removed by BMPs towards performance goal:	11333	ft^3
Percent volume removed towards performance goal	**7**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	133.5761	acre-ft
Annual runoff volume removed by BMPs:	7.727	acre-ft
Percent annual runoff volume removed:	**6**	**%**
Post development annual particulate P load:	59.949	lbs
Annual particulate P removed by BMPs:	3.468	lbs
Post development annual dissolved P load:	49.049	lbs
Annual dissolved P removed by BMPs:	2.837	lbs
Total P removed by BMPs	6.305	lbs
Percent annual total phosphorus removed:	**6**	**%**
Post development annual TSS load:	19801.3	lbs
Annual TSS removed by BMPs:	1145.4	lbs
Percent annual TSS removed:	**6**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	11333	156781	11333	145447	7

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	133.5761	0	7.727	125.8491	6

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	59.949	0	3.4679	56.4811	6

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	49.0492	0	2.8373	46.2119	6

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	108.9982	0	6.3052	102.693	6

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	19801.33	0	1145.44	18655.89	6

BMP Schematic

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Hill Murray School Stormwater Reuse
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Hill Murray School Stormwater Reuse Run. Alternate 2B (II). Larpenteur Ave subsurface ditch storage with existing and future irrigation areas.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55109
Annual Rainfall (inches):	32
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			83.436		83.436
				Impervious Area (acres)	39.264
				Total Area (acres)	122.7

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			83.436		83.436
				Impervious Area (acres)	39.264
				Total Area (acres)	122.7

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	156781	ft3
Volume removed by BMPs towards performance goal:	11333	ft^3
Percent volume removed towards performance goal	**7**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	133.5761	acre-ft
Annual runoff volume removed by BMPs:	12.6535	acre-ft
Percent annual runoff volume removed:	**9**	**%**
Post development annual particulate P load:	59.949	lbs
Annual particulate P removed by BMPs:	5.679	lbs
Post development annual dissolved P load:	49.049	lbs
Annual dissolved P removed by BMPs:	4.646	lbs
Total P removed by BMPs	10.325	lbs
Percent annual total phosphorus removed:	**9**	**%**
Post development annual TSS load:	19801.3	lbs
Annual TSS removed by BMPs:	1875.8	lbs
Percent annual TSS removed:	**9**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	11333	156781	11333	145447	7

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	133.5761	0	12.6535	120.9226	9

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	59.949	0	5.6789	54.2701	9

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	49.0492	0	4.6464	44.4028	9

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	108.9982	0	10.3253	98.6729	9

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	19801.33	0	1875.76	17925.57	9

BMP Schematic

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Harvest Park Stormwater Reuse
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Harvest Park Stormwater Reuse Run. Alternate 1A. Surface storage located west of athletic fields.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55109
Annual Rainfall (inches):	32
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed	34.895				34.895
				Impervious Area (acres)	7.505
				Total Area (acres)	42.4

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed	34.895				34.895
				Impervious Area (acres)	7.505
				Total Area (acres)	42.4

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	29967	ft3
Volume removed by BMPs towards performance goal:	15311	ft^3
Percent volume removed towards performance goal	**51**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	29.6736	acre-ft
Annual runoff volume removed by BMPs:	14.6292	acre-ft
Percent annual runoff volume removed:	**49**	**%**
Post development annual particulate P load:	13.3175	lbs
Annual particulate P removed by BMPs:	6.566	lbs
Post development annual dissolved P load:	10.896	lbs
Annual dissolved P removed by BMPs:	5.372	lbs
Total P removed by BMPs	11.938	lbs
Percent annual total phosphorus removed:	**49**	**%**
Post development annual TSS load:	4398.8	lbs
Annual TSS removed by BMPs:	2168.6	lbs
Percent annual TSS removed:	**49**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	15311	29967	15311	14656	51

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	29.6736	0	14.6292	15.0444	49

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	13.3175	0	6.5656	6.7519	49

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	10.8961	0	5.3718	5.5243	49

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	24.2136	0	11.9374	12.2762	49

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	4398.81	0	2168.63	2230.18	49

BMP Schematic

1 - Harvest and re-use/
Cistern

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Harvest Park Stormwater Reuse
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Harvest Park Stormwater Reuse Run. Alternate 1B. Subsurface storage located west of athletic fields.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55109
Annual Rainfall (inches):	32
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed	34.895				34.895
				Impervious Area (acres)	7.505
				Total Area (acres)	42.4

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed	34.895				34.895
				Impervious Area (acres)	7.505
				Total Area (acres)	42.4

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	29967	ft3
Volume removed by BMPs towards performance goal:	15311	ft^3
Percent volume removed towards performance goal	**51**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	29.6736	acre-ft
Annual runoff volume removed by BMPs:	17.9274	acre-ft
Percent annual runoff volume removed:	**60**	**%**
Post development annual particulate P load:	13.3175	lbs
Annual particulate P removed by BMPs:	8.046	lbs
Post development annual dissolved P load:	10.896	lbs
Annual dissolved P removed by BMPs:	6.583	lbs
Total P removed by BMPs	14.629	lbs
Percent annual total phosphorus removed:	**60**	**%**
Post development annual TSS load:	4398.8	lbs
Annual TSS removed by BMPs:	2657.6	lbs
Percent annual TSS removed:	**60**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	15311	29967	15311	14656	51

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	29.6736	0	17.9274	11.7462	60

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	13.3175	0	8.0458	5.2717	60

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	10.8961	0	6.5829	4.3132	60

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	24.2136	0	14.6287	9.5849	60

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	4398.81	0	2657.55	1741.26	60

BMP Schematic

1 - Harvest and re-use/
Cistern

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Harvest Park Stormwater Reuse
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Harvest Park Stormwater Reuse Run. Alternate 2. Draw from offsite Gerten Pond (surface storage)
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55109
Annual Rainfall (inches):	32
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			495.61		495.61
				Impervious Area (acres)	265.69
				Total Area (acres)	761.3

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			495.61		495.61
				Impervious Area (acres)	265.69
				Total Area (acres)	761.3

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	1060896	ft3
Volume removed by BMPs towards performance goal:	15824	ft^3
Percent volume removed towards performance goal	**1**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	867.4553	acre-ft
Annual runoff volume removed by BMPs:	18.5627	acre-ft
Percent annual runoff volume removed:	**2**	**%**
Post development annual particulate P load:	389.3139	lbs
Annual particulate P removed by BMPs:	8.331	lbs
Post development annual dissolved P load:	318.53	lbs
Annual dissolved P removed by BMPs:	6.816	lbs
Total P removed by BMPs	15.147	lbs
Percent annual total phosphorus removed:	**2**	**%**
Post development annual TSS load:	128591.6	lbs
Annual TSS removed by BMPs:	2751.7	lbs
Percent annual TSS removed:	**2**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	15824	1060896	15824	1045072	1

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	867.4553	0	18.5627	848.8926	2

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	389.3139	0	8.3309	380.983	2

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	318.5296	0	6.8162	311.7134	2

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	707.8435	0	15.1471	692.6964	2

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	128591.57	0	2751.73	125839.84	2

BMP Schematic

1 - Harvest and re-use/
Cistern

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Midland Hills Country Club Proposed Conditions 1 ft drawdown
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Midland Hills Country Club run with proposed conditions at Walsh Lake. 1-ft drawdown of Walsh Lake.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55113
Annual Rainfall (inches):	31.7
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			262.99		262.99
				Impervious Area (acres)	95.31
				Total Area (acres)	358.3

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			262.99		262.99
				Impervious Area (acres)	95.31
				Total Area (acres)	358.3

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	380571	ft3
Volume removed by BMPs towards performance goal:	93306	ft^3
Percent volume removed towards performance goal	**25**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	352.8265	acre-ft
Annual runoff volume removed by BMPs:	87.2073	acre-ft
Percent annual runoff volume removed:	**25**	**%**
Post development annual particulate P load:	158.3485	lbs
Annual particulate P removed by BMPs:	39.139	lbs
Post development annual dissolved P load:	129.558	lbs
Annual dissolved P removed by BMPs:	32.022	lbs
Total P removed by BMPs	71.161	lbs
Percent annual total phosphorus removed:	**25**	**%**
Post development annual TSS load:	52303	lbs
Annual TSS removed by BMPs:	12927.6	lbs
Percent annual TSS removed:	**25**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	93306	380571	93306	287265	25

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	352.8265	0	87.2073	265.6192	25

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	158.3485	0	39.1386	119.2099	25

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	129.5579	0	32.0225	97.5354	25

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	287.9064	0	71.1611	216.7453	25

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	52303	0	12927.61	39375.39	25

BMP Schematic

1 - Harvest and re-use/
Cistern

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Midland Hills Country Club Proposed Walsh Lake 2-ft Drawdown
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Midland Hills Country Club run with proposed conditions at Walsh Lake. 2-ft drawdown of Walsh Lake.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55113
Annual Rainfall (inches):	31.7
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			262.99		262.99
				Impervious Area (acres)	95.31
				Total Area (acres)	358.3

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			262.99		262.99
				Impervious Area (acres)	95.31
				Total Area (acres)	358.3

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	380571	ft3
Volume removed by BMPs towards performance goal:	93306	ft^3
Percent volume removed towards performance goal	**25**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	352.8265	acre-ft
Annual runoff volume removed by BMPs:	103.6699	acre-ft
Percent annual runoff volume removed:	**29**	**%**
Post development annual particulate P load:	158.3485	lbs
Annual particulate P removed by BMPs:	46.527	lbs
Post development annual dissolved P load:	129.558	lbs
Annual dissolved P removed by BMPs:	38.068	lbs
Total P removed by BMPs	84.595	lbs
Percent annual total phosphorus removed:	**29**	**%**
Post development annual TSS load:	52303	lbs
Annual TSS removed by BMPs:	15368	lbs
Percent annual TSS removed:	**29**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	93306	380571	93306	287265	25

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	352.8265	0	103.6699	249.1566	29

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	158.3485	0	46.527	111.8215	29

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	129.5579	0	38.0676	91.4903	29

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	287.9064	0	84.5946	203.3118	29

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	52303	0	15368.02	36934.98	29

BMP Schematic

1 - Harvest and re-use/
Cistern

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Midland Hills Country Club Proposed Walsh Lake 5-ft Drawdown
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Midland Hills Country Club run with proposed conditions at Walsh Lake. 5-ft drawdown of Walsh Lake.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55113
Annual Rainfall (inches):	31.7
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			262.99		262.99
				Impervious Area (acres)	95.31
				Total Area (acres)	358.3

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			262.99		262.99
				Impervious Area (acres)	95.31
				Total Area (acres)	358.3

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	380571	ft3
Volume removed by BMPs towards performance goal:	93306	ft^3
Percent volume removed towards performance goal	**25**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	352.8265	acre-ft
Annual runoff volume removed by BMPs:	116.3712	acre-ft
Percent annual runoff volume removed:	**33**	**%**
Post development annual particulate P load:	158.3485	lbs
Annual particulate P removed by BMPs:	52.227	lbs
Post development annual dissolved P load:	129.558	lbs
Annual dissolved P removed by BMPs:	42.732	lbs
Total P removed by BMPs	94.959	lbs
Percent annual total phosphorus removed:	**33**	**%**
Post development annual TSS load:	52303	lbs
Annual TSS removed by BMPs:	17250.9	lbs
Percent annual TSS removed:	**33**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	93306	380571	93306	287265	25

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	352.8265	0	116.3712	236.4553	33

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	158.3485	0	52.2274	106.1211	33

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	129.5579	0	42.7315	86.8264	33

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	287.9064	0	94.9589	192.9475	33

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	52303	0	17250.87	35052.13	33

BMP Schematic

1 - Harvest and re-use/
Cistern

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Pioneer Park Reuse: Proposed Onsite Ponds 1-ft Drawdown
User Name / Company Name:	Barr Engineering Co.
Date:	November 21, 2021
Project Description:	Pioneer Park proposed reuse system. Drawdown 1-ft storage volume of onsite ponds.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55117
Annual Rainfall (inches):	31.9
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			32.02		32.02
				Impervious Area (acres)	7.08
				Total Area (acres)	39.1

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			32.02		32.02
				Impervious Area (acres)	7.08
				Total Area (acres)	39.1

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	28270	ft3
Volume removed by BMPs towards performance goal:	6970	ft^3
Percent volume removed towards performance goal	**25**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	32.9457	acre-ft
Annual runoff volume removed by BMPs:	9.3949	acre-ft
Percent annual runoff volume removed:	**29**	**%**
Post development annual particulate P load:	14.786	lbs
Annual particulate P removed by BMPs:	4.216	lbs
Post development annual dissolved P load:	12.098	lbs
Annual dissolved P removed by BMPs:	3.45	lbs
Total P removed by BMPs	7.666	lbs
Percent annual total phosphorus removed:	**29**	**%**
Post development annual TSS load:	4883.9	lbs
Annual TSS removed by BMPs:	1392.7	lbs
Percent annual TSS removed:	**29**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	6970	28270	6970	21301	25

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	32.9457	0	9.3949	23.5508	29

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	14.786	0	4.2164	10.5696	29

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	12.0977	0	3.4498	8.6479	29

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	26.8837	0	7.6662	19.2175	29

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	4883.87	0	1392.69	3491.18	29

BMP Schematic

1 - Harvest and re-use/
Cistern

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Como Golf Course Reuse: Proposed Conditions (Dredge and Expand Pond)
User Name / Company Name:	Barr Engineering Co.
Date:	December 16, 2021
Project Description:	Como Golf Course reuse system. Proposed conditions. Draw from onsite pond based on proposed bathymetry following dredging and pond expansion.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55103
Annual Rainfall (inches):	32
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			131.96		131.96
				Impervious Area (acres)	400.55
				Total Area (acres)	532.51

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			78.84		78.84
				Impervious Area (acres)	400.55
				Total Area (acres)	479.39

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	1599390	ft3
Volume removed by BMPs towards performance goal:	28003	ft^3
Percent volume removed towards performance goal	**2**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	982.9289	acre-ft
Annual runoff volume removed by BMPs:	32.1191	acre-ft
Percent annual runoff volume removed:	**3**	**%**
Post development annual particulate P load:	441.1385	lbs
Annual particulate P removed by BMPs:	14.415	lbs
Post development annual dissolved P load:	360.932	lbs
Annual dissolved P removed by BMPs:	11.794	lbs
Total P removed by BMPs	26.209	lbs
Percent annual total phosphorus removed:	**3**	**%**
Post development annual TSS load:	145709.4	lbs
Annual TSS removed by BMPs:	4761.3	lbs
Percent annual TSS removed:	**3**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	28003	1599390	28003	1571387	2

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	1177.0217	0	32.1191	1144.9026	3

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	528.2473	0	14.415	513.8323	3

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	432.2024	0	11.7941	420.4083	3

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	960.4497	0	26.2091	934.2406	3

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	174481.69	0	4761.33	169720.36	3

BMP Schematic

1 – Harvest and re-use/
Cistern

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Phalen Lake Golf Course Reuse: Draw from Lake Phalen
User Name / Company Name:	Barr Engineering Co.
Date:	December 16, 2021
Project Description:	Phalen Park Golf Course reuse system. Proposed conditions. Draw from Lake Phalen (0.03 ft) for storage volume.
Construction Permit?:	No

Site Information

Retention Requirement (inches):	1.1
Site's Zip Code:	55106
Annual Rainfall (inches):	32.1
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			9018		9018
				Impervious Area (acres)	5888
				Total Area (acres)	14906

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land					0
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed			9018		9018
				Impervious Area (acres)	5888
				Total Area (acres)	14906

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	23510690	ft3
Volume removed by BMPs towards performance goal:	38504	ft^3
Percent volume removed towards performance goal	**0**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	18242.9757	acre-ft
Annual runoff volume removed by BMPs:	44.9815	acre-ft
Percent annual runoff volume removed:	**0**	**%**
Post development annual particulate P load:	8187.4475	lbs
Annual particulate P removed by BMPs:	20.188	lbs
Post development annual dissolved P load:	6698.821	lbs
Annual dissolved P removed by BMPs:	16.517	lbs
Total P removed by BMPs	36.705	lbs
Percent annual total phosphorus removed:	**0**	**%**
Post development annual TSS load:	2704338.7	lbs
Annual TSS removed by BMPs:	6668.1	lbs
Percent annual TSS removed:	**0**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
1 - Harvest and re-use/Cistern	38504	23510690	38504	23472186	0

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
1 - Harvest and re-use/Cistern	18242.9757	0	44.9815	18197.9942	0

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	8187.4475	0	20.1877	8167.2598	0

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	6698.8207	0	16.5172	6682.3035	0

Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	14886.2682	0	36.7049	14849.5633	0

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
1 - Harvest and re-use/Cistern	2704338.72	0	6668.06	2697670.66	0

BMP Schematic

1 - Harvest and re-use/
Cistern

Appendix C

Concept Cost Estimates

BARR	**PREPARED BY: BARR ENGINEERING COMPANY**	SHEET:	1	OF	1
		BY:	KMB	DATE:	12/2/2021
PRELIMINARY ENGINEERING REPORT		CHECKED BY:	JAK2	DATE:	12/3/2021
ENGINEER'S OPINION OF PROBABLE PROJECT COST		APPROVED BY:	KMB	DATE:	12/3/2021
PROJECT: Ramsey County Stormwater Reuse Assessment		ISSUED: DRAFT		DATE:	12/6/2021
LOCATION: Hill-Murray School (2625 Larpenteur Ave. E, Saint Paul, MN 55109)		ISSUED: FINAL		DATE:	12/17/2021
PROJECT #: 23621380.00		ISSUED:		DATE:	
OPINION OF COST - SUMMARY		ISSUED:		DATE:	

Engineer's Opinion of Probable Project Cost
Hill Murray - Alternative 1A/1B
Underground (200,000 gal) storage

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$99,500	$99,500	1,2,3,4
B	Erosion Control	L.S.	1	$13,300	$13,300	1,2,3,4
C	Clearing and Grubbing/ Site Preparation	L.S.	1	$6,600	$6,600	1,2,3,4
D	Site Restoration	L.S.	1	$33,200	$33,200	1,2,3,4
E	Underground Storage (200,000 gallons)	C.F.	26736	$12	$320,833	1,2,3,4
F	Diversion Structure	Each	3	$15,000	$45,000	1,2,3,4
G	Wet Well	Each	1	$20,000	$20,000	1,2,3,4
H	Intake Pipe	L.F.	25	$100	$2,500	1,2,3,4
I	Diversion Pipe	L.F.	25	$100	$2,500	1,2,3,4
J	Outlet Pipe	L.F.	25	$100	$2,500	1,2,3,4
K	Connection to Existing Irrigation System	L.S.	1	$10,000	$10,000	1,2,3,4
L	Well Water Back-up (Valves/Communications)	L.S.	1	$10,000	$10,000	1,2,3,4
M	Treatment System Package (75 GPM Filtration, UV Disinfection, Pumps, Electrical, Controls, Shelter)	L.S.	1	$250,000	$250,000	1,2,3,4
	CONSTRUCTION SUBTOTAL				$816,000	1,4,5,6
	CONSTRUCTION CONTINGENCY			25%	$204,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$1,020,000	1,4,5,6
	PLANNING, ENGINEERING & DESIGN, LEGAL, PERMITTING & APPROVALS			25%	$255,000	1,4,6
	ESTIMATED TOTAL PROJECT COST				**$1,275,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE			**-30%**	**$893,000**	4,5,6
				50%	**$1,913,000**	4,5,6

Notes

[1] Limited design work completed (1%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

[4] This feasibility-level (Class 4, 1-15% design completion per ASTM E 2516-06) cost estimate is based on 1% 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 -30% to +50%. 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.

[5] Estimate costs are to design, construct, and permit each alternative. The estimated costs do not include installation of irrigation systems. The estimated costs also do not include maintenance, monitoring or additional tasks following construction.

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

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LOCATION: Hill-Murray School (2625 Larpenteur Ave. E, Saint Paul, MN 55109)		ISSUED: FINAL		DATE:	12/17/2021
PROJECT #: 23621380.00		ISSUED:		DATE:	
OPINION OF COST - SUMMARY		ISSUED:		DATE:	

Engineer's Opinion of Probable Project Cost
Hill Murray - Alternative 2A (i)/2B (i)
Surface (100,000 gal) storage

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$52,900	$52,900	1,2,3,4
B	Erosion Control	L.S.	1	$7,100	$7,100	1,2,3,4
C	Clearing and Grubbing/ Site Preparation	L.S.	1	$3,500	$3,500	1,2,3,4
D	Site Restoration	L.S.	1	$17,600	$17,600	1,2,3,4
E	Surface Storage (100,000 gallons)	C.Y.	495	$30	$14,853	1,2,3,4
F	Diversion Structure	Each	1	$15,000	$15,000	1,2,3,4
G	Wet Well	Each	1	$20,000	$20,000	1,2,3,4
H	Intake Pipe	L.F.	50	$100	$5,000	1,2,3,4
I	Diversion Pipe	L.F.	80	$100	$8,000	1,2,3,4
J	Outlet Pipe	L.F.	200	$100	$20,000	1,2,3,4
K	Connection to Existing Irrigation System	L.S.	1	$10,000	$10,000	1,2,3,4
L	Well Water Back-up (Valves/Communications)	L.S.	1	$10,000	$10,000	1,2,3,4
M	Treatment System Package (75 GPM Filtration, UV Disinfection, Pumps, Electrical, Controls, Shelter)	L.S.	1	$250,000	$250,000	1,2,3,4
	CONSTRUCTION SUBTOTAL				$434,000	1,4,5,6
	CONSTRUCTION CONTINGENCY			25%	$109,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$543,000	1,4,5,6
	PLANNING, ENGINEERING & DESIGN, LEGAL, PERMITTING & APPROVALS			25%	$136,000	1,4,6
	ESTIMATED TOTAL PROJECT COST				**$679,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE			**-30%**	**$475,000**	4,5,6
				50%	**$1,019,000**	4,5,6

Notes

[1] Limited design work completed (1%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

[4] This feasibility-level (Class 4, 1-15% design completion per ASTM E 2516-06) cost estimate is based on 1% 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 -30% to +50%. 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.

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

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LOCATION: Hill-Murray School (2625 Larpenteur Ave. E, Saint Paul, MN 55109)		ISSUED: FINAL		DATE:	12/17/2021
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Engineer's Opinion of Probable Project Cost
Hill Murray - Alternative 2A (ii)/2B (ii)
Underground (350,000 gal) storage

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$134,900	$134,900	1,2,3,4
B	Erosion Control	L.S.	1	$18,000	$18,000	1,2,3,4
C	Clearing and Grubbing/ Site Preparation	L.S.	1	$9,000	$9,000	1,2,3,4
D	Site Restoration	L.S.	1	$45,000	$45,000	1,2,3,4
E	Underground Storage (350,000 gallons)	C.F.	46788	$12	$561,458	1,2,3,4
F	Diversion Structure	Each	1	$15,000	$15,000	1,2,3,4
G	Wet Well	Each	1	$20,000	$20,000	1,2,3,4
H	Intake Pipe	L.F.	50	$100	$5,000	1,2,3,4
I	Diversion Pipe	L.F.	80	$100	$8,000	1,2,3,4
J	Outlet Pipe	L.F.	200	$100	$20,000	1,2,3,4
K	Connection to Existing Irrigation System	L.S.	1	$10,000	$10,000	1,2,3,4
L	Well Water Back-up (Valves/Communications)	L.S.	1	$10,000	$10,000	1,2,3,4
M	Treatment System Package (75 GPM Filtration, UV Disinfection, Pumps, Electrical, Controls, Shelter)	L.S.	1	$250,000	$250,000	1,2,3,4
	CONSTRUCTION SUBTOTAL				$1,106,000	1,4,5,6
	CONSTRUCTION CONTINGENCY			25%	$277,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$1,383,000	1,4,5,6
	PLANNING, ENGINEERING & DESIGN, LEGAL, PERMITTING & APPROVALS			25%	$346,000	1,4,6
	ESTIMATED TOTAL PROJECT COST				**$1,729,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE			**-30%**	**$1,210,000**	4,5,6
				50%	**$2,594,000**	4,5,6

Notes

[1] Limited design work completed (1%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

[4] This feasibility-level (Class 4, 1-15% design completion per ASTM E 2516-06) cost estimate is based on 1% 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 -30% to +50%. 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.

[5] Estimate costs are to design, construct, and permit each alternative. The estimated costs do not include installation of irrigation systems. The estimated costs also do not include maintenance, monitoring or additional tasks following construction.

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

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PROJECT: Ramsey County Stormwater Reuse Assessment		ISSUED: DRAFT		DATE:	12/6/2021
LOCATION: Harvest Park (2561 Barclay St., Maplewood, MN 55109)		ISSUED: FINAL		DATE:	12/17/2021
PROJECT #: 23621380.00		ISSUED:		DATE:	
OPINION OF COST - SUMMARY		ISSUED:		DATE:	

Engineer's Opinion of Probable Project Cost
Harvest Park - Alternative 1A
Surface (250,000 gal) storage

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$55,000	$55,000	1,2,3,4
B	Erosion Control	L.S.	1	$7,300	$7,300	1,2,3,4
C	Clearing and Grubbing/ Site Preparation	L.S.	1	$3,700	$3,700	1,2,3,4
D	Site Restoration	L.S.	1	$18,300	$18,300	1,2,3,4
E	Surface Storage (250,000 gallons)	C.Y.	1238	$30	$37,133	1,2,3,4
F	Diversion Structure	Each	1	$15,000	$15,000	1,2,3,4
G	Standard Manhole	Each	1	$10,000	$10,000	1,2,3,4
H	Wet Well	Each	1	$20,000	$20,000	1,2,3,4
I	Intake Pipe	L.F.	35	$100	$3,500	1,2,3,4
J	Diversion Pipe	L.F.	50	$100	$5,000	1,2,3,4
K	Outlet Pipe	L.F.	60	$100	$6,000	1,2,3,4
L	Connection to Existing Irrigation System	L.S.	1	$10,000	$10,000	1,2,3,4
M	Potable Water Back-up (Valves/Communications)	L.S.	1	$10,000	$10,000	1,2,3,4
N	Treatment System Package (100 GPM Filtration, UV Disinfection, Pumps, Electrical, Controls, Shelter)	L.S.	1	$250,000	$250,000	1,2,3,4
	CONSTRUCTION SUBTOTAL				$451,000	1,4,5,6
	CONSTRUCTION CONTINGENCY			25%	$113,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$564,000	1,4,5,6
	PLANNING, ENGINEERING & DESIGN, LEGAL, PERMITTING & APPROVALS			25%	$141,000	1,4,6
	ESTIMATED TOTAL PROJECT COST				**$705,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE			**-30%**	**$494,000**	4,5,6
				50%	**$1,058,000**	4,5,6

Notes

[1] Limited design work completed (1%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

[4] This feasibility-level (Class 4, 1-15% design completion per ASTM E 2516-06) cost estimate is based on 1% 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 -30% to +50%. 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.

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LOCATION: Harvest Park (2561 Barclay St., Maplewood, MN 55109)		ISSUED: FINAL		DATE:	12/17/2021
PROJECT #: 23621380.00		ISSUED:		DATE:	
OPINION OF COST - SUMMARY		ISSUED:		DATE:	

Engineer's Opinion of Probable Project Cost
Harvest Park - Alternative 1B
Underground (450,000 gal) storage

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$157,700	$157,700	1,2,3,4
B	Erosion Control	L.S.	1	$21,000	$21,000	1,2,3,4
C	Clearing and Grubbing/ Site Preparation	L.S.	1	$10,500	$10,500	1,2,3,4
D	Site Restoration	L.S.	1	$52,600	$52,600	1,2,3,4
E	Underground Storage (450,000 gallons)	C.F.	60156	$12	$721,875	1,2,3,4
F	Diversion Structure	Each	1	$15,000	$15,000	1,2,3,4
G	Standard Manhole	Each	1	$10,000	$10,000	1,2,3,4
H	Wet Well	Each	1	$20,000	$20,000	1,2,3,4
I	Intake Pipe	L.F.	35	$100	$3,500	1,2,3,4
J	Diversion Pipe	L.F.	50	$100	$5,000	1,2,3,4
K	Outlet Pipe	L.F.	60	$100	$6,000	1,2,3,4
L	Connection to Existing Irrigation System	L.S.	1	$10,000	$10,000	1,2,3,4
M	Potable Water Back-up (Valves/Communications)	L.S.	1	$10,000	$10,000	1,2,3,4
N	Treatment System Package (100 GPM Filtration, UV Disinfection, Pumps, Electrical, Controls, Shelter)	L.S.	1	$250,000	$250,000	1,2,3,4
	CONSTRUCTION SUBTOTAL				$1,293,000	1,4,5,6
	CONSTRUCTION CONTINGENCY			25%	$323,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$1,616,000	1,4,5,6
	PLANNING, ENGINEERING & DESIGN, LEGAL, PERMITTING & APPROVALS			25%	$404,000	1,4,6
	ESTIMATED TOTAL PROJECT COST				**$2,020,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE			**-30%**	**$1,414,000**	4,5,6
				50%	**$3,030,000**	4,5,6

Notes

[1] Limited design work completed (1%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

[4] This feasibility-level (Class 4, 1-15% design completion per ASTM E 2516-06) cost estimate is based on 1% 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 -30% to +50%. 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.

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PROJECT: Ramsey County Stormwater Reuse Assessment	ISSUED:	DRAFT		DATE:	12/6/2021
LOCATION: Harvest Park (2561 Barclay St., Maplewood, MN 55109)	ISSUED:	FINAL		DATE:	12/17/2021
PROJECT #: 23621380.00	ISSUED:			DATE:	
OPINION OF COST - SUMMARY	ISSUED:			DATE:	

Engineer's Opinion of Probable Project Cost
Harvest Park - Alternative 2
Use existing pond for storage

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$56,000	$56,000	1,2,3,4
B	Erosion Control	L.S.	1	$7,500	$7,500	1,2,3,4
C	Clearing and Grubbing/ Site Preparation	L.S.	1	$3,700	$3,700	1,2,3,4
D	Site Restoration	L.S.	1	$18,700	$18,700	1,2,3,4
E	Diversion Structure	Each	1	$15,000	$15,000	1,2,3,4
F	Standard Manhole	Each	1	$10,000	$10,000	1,2,3,4
G	Wet Well	Each	1	$20,000	$20,000	1,2,3,4
H	Intake Pipe	L.F.	330	$100	$33,000	1,2,3,4
I	Outlet Pipe	L.F.	254	$100	$25,400	1,2,3,4
J	Connection to Existing Irrigation System	L.S.	1	$10,000	$10,000	1,2,3,4
K	Potable Water Back-up (Valves/Communications)	L.S.	1	$10,000	$10,000	1,2,3,4
L	Treatment System Package (100 GPM Filtration, UV Disinfection, Pumps, Electrical, Controls, Shelter)	L.S.	1	$250,000	$250,000	1,2,3,4
	CONSTRUCTION SUBTOTAL				$459,000	1,4,5,6
	CONSTRUCTION CONTINGENCY			25%	$115,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$574,000	1,4,5,6
	PLANNING, ENGINEERING & DESIGN, LEGAL, PERMITTING & APPROVALS			25%	$144,000	1,4,6
	ESTIMATED TOTAL PROJECT COST				**$718,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE			**-30%**	**$503,000**	4,5,6
				50%	**$1,077,000**	4,5,6

Notes

[1] Limited design work completed (1%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

[4] This feasibility-level (Class 4, 1-15% design completion per ASTM E 2516-06) cost estimate is based on 1% 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 -30% to +50%. 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.

[5] Estimate costs are to design, construct, and permit each alternative. The estimated costs do not include installation of irrigation systems. The estimated costs also do not include maintenance, monitoring or additional tasks following construction.

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

BARR	**PREPARED BY: BARR ENGINEERING COMPANY**	SHEET:	1	OF	1
		BY:	KMB	DATE:	12/2/2021
PRELIMINARY ENGINEERING REPORT		CHECKED BY:	JAK2	DATE:	12/3/2021
ENGINEER'S OPINION OF PROBABLE PROJECT COST		APPROVED BY:	KMB	DATE:	12/3/2021
PROJECT: Ramsey County Stormwater Reuse Assessment		ISSUED: DRAFT		DATE:	12/6/2021
LOCATION: Pioneer Park (2950 Centerville Rd., Little Canada, MN)		ISSUED: FINAL		DATE:	12/17/2021
PROJECT #: 23621380.00		ISSUED:		DATE:	
OPINION OF COST - SUMMARY		ISSUED:		DATE:	

Engineer's Opinion of Probable Project Cost
Pioneer Park
Use existing pond for storage

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$52,600	$52,600	1,2,3,4
B	Erosion Control	L.S.	1	$7,000	$7,000	1,2,3,4
C	Clearing and Grubbing/ Site Preparation	L.S.	1	$3,500	$3,500	1,2,3,4
D	Site Restoration	L.S.	1	$17,500	$17,500	1,2,3,4
E	Wet Well	Each	1	$20,000	$20,000	1,2,3,4
F	Intake Pipe	L.F.	90	$100	$9,000	1,2,3,4
G	Proposed Water Features Discharge Pipe	L.F.	410	$100	$41,000	1,2,3,4
H	Irrigation Mainline Pipe Connection to Park	L.F.	105	$100	$10,500	1,2,3,4
I	Connection to Existing Irrigation System	L.S.	1	$10,000	$10,000	1,2,3,4
J	Well Water Back-up (Valves/Communications)	L.S.	1	$10,000	$10,000	1,2,3,4
K	Treatment System Package (120 GPM Filtration, UV Disinfection, Pumps, Electrical, Controls, Shelter)	L.S.	1	$250,000	$250,000	1,2,3,4
	CONSTRUCTION SUBTOTAL				$431,000	1,4,5,6
	CONSTRUCTION CONTINGENCY			25%	$108,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$539,000	1,4,5,6
	PLANNING, ENGINEERING & DESIGN, LEGAL, PERMITTING & APPROVALS			25%	$135,000	1,4,6
	ESTIMATED TOTAL PROJECT COST				**$674,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE			**-30%**	**$472,000**	4,5,6
				50%	**$1,011,000**	4,5,6

Notes

[1] Limited design work completed (1%).

[2] Quantities based on design work completed.

[3] Unit prices based on information available at this time.

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

BARR

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	BY:	KMB	DATE:	12/2/2021	
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ENGINEER'S OPINION OF PROBABLE PROJECT COST	APPROVED BY:	KMB	DATE:	12/3/2021	
PROJECT: Ramsey County Stormwater Reuse Assessment	ISSUED:	DRAFT	DATE:	12/6/2021	
LOCATION: Phalen Park Golf Course (1615 Phalen Dr. E., Saint Paul, MN 55106)	ISSUED:	FINAL	DATE:	12/17/2021	
PROJECT #: 23621380.00	ISSUED:		DATE:		
OPINION OF COST - SUMMARY	ISSUED:		DATE:		

Engineer's Opinion of Probable Project Cost
Phalen Park Golf Course
Use existing lake for storage

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$28,000	$28,000	1,2,3,4
B	Erosion Control	L.S.	1	$3,700	$3,700	1,2,3,4
C	Clearing and Grubbing/ Site Preparation	L.S.	1	$1,900	$1,900	1,2,3,4
D	Site Restoration	L.S.	1	$9,300	$9,300	1,2,3,4
E	Wet Well	Each	1	$20,000	$20,000	1,2,3,4
F	Intake Pipe	L.F.	375	$100	$37,500	1,2,3,4
G	Irrigation Mainline Pipe Connection to Park	L.F.	90	$100	$9,000	1,2,3,4
H	Connection to Existing Irrigation System	L.S.	1	$10,000	$10,000	1,2,3,4
I	Well Water Back-up (Valves/Communications)	L.S.	1	$10,000	$10,000	1,2,3,4
J	Pumps, Electrical, Controls, Shelter - No Treatment	L.S.	1	$100,000	$100,000	1,2,3,4
	CONSTRUCTION SUBTOTAL				$229,000	1,4,5,6
	CONSTRUCTION CONTINGENCY			25%	$57,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$286,000	1,4,5,6
	PLANNING, ENGINEERING & DESIGN, LEGAL, PERMITTING & APPROVALS			25%	$72,000	1,4,6
	ESTIMATED TOTAL PROJECT COST				**$358,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE			**-30%**	**$251,000**	4,5,6
				50%	**$537,000**	4,5,6

Notes

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		BY:	KMB	DATE:	12/2/2021
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ENGINEER'S OPINION OF PROBABLE PROJECT COST		APPROVED BY:	KMB	DATE:	12/3/2021
PROJECT: Ramsey County Stormwater Reuse Assessment	ISSUED:	DRAFT		DATE:	12/6/2021
LOCATION: Como Golf Course (1431 Lexington Pkwy. N., Saint Paul, MN 55103)	ISSUED:	FINAL		DATE:	12/17/2021
PROJECT #: 23621380.00	ISSUED:			DATE:	
OPINION OF COST - SUMMARY	ISSUED:			DATE:	

Engineer's Opinion of Probable Project Cost
Como Golf Course
Existing pond expansion for additional storage

Cat. No.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ITEM COST	NOTES
A	Mobilization/Demobilization	L.S.	1	$20,300	$20,300	1,2,3,4
B	Erosion Control	L.S.	1	$2,700	$2,700	1,2,3,4
C	Clearing and Grubbing/ Site Preparation	L.S.	1	$1,400	$1,400	1,2,3,4
D	Site Restoration	L.S.	1	$6,800	$6,800	1,2,3,4
E	Surface Storage (~980,000 gallons)	C.Y.	2420	$56	$135,511	1,2,3,4
	CONSTRUCTION SUBTOTAL				$167,000	1,4,5,6
	CONSTRUCTION CONTINGENCY			25%	$42,000	1,4,6
	ESTIMATED CONSTRUCTION COST				$209,000	1,4,5,6
	PLANNING, ENGINEERING & DESIGN, LEGAL, PERMITTING & APPROVALS			25%	$52,000	1,4,6
	ESTIMATED TOTAL PROJECT COST				**$261,000**	1,2,3,4,5,6
	ESTIMATED ACCURACY RANGE			**-30%**	**$183,000**	4,5,6
				50%	**$392,000**	4,5,6

Notes

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Appendix D

GIS Databases (see separate *.Zip file with Geodatabases)