Minnehaha Creek Watershed District ***REQUEST FOR BOARD ACTION***

MEETING DATE: September 27, 2018

TITLE: Authorization to solicit quotes for Wassermann West Alum Treatment

RES.NUMBER: 18-104

PREPARED BY: Anna Brown

E-MAIL: Abrown@minnehahacreek.org **TELEPHONE:** (952) 641-4522

REVIEWED BY: ☐Administrator ☐ Counsel ☒ Program Mgr.: Michael Hayman
☐ Board Committee ☐ Engineer ☐ Other

WORKSHOP ACTION:

☐ Advance to Board mtg. Consent Agenda. ☐ Advance to Board meeting for discussion prior to action.

☐ Refer to a future workshop (date):________ ☐ Refer to taskforce or committee (date):_______________

☐ Return to staff for additional work. ☐ No further action requested.

☒ Other (specify): Approval at the September 27, 2018 Board Meeting

PURPOSE or ACTION REQUESTED:
Authorization to solicit quotes for alum treatment of Wassermann West Pond.

PROJECT/PROGRAM LOCATION:
Wassermann West Property, Victoria, MN

PROJECT TIMELINE:

April 2018	Development of alum treatment schedule and specifications for Wassermann West
July 2018	BWSR approval of preliminary project list and work plan for Carver County Clean Water Pilot
Oct. 2018	Award contract for alum treatment
Nov. 2018	Alum treatment occurs

PROJECT/PROGRAM COST:
Fund name and number: 300-3153
Current Budget: $124,000
Expenditures to date: $55,000
Requested amount of funding: $0

PAST BOARD ACTION:

February 23, 2017	Authorization for the District to acquire the Wassermann West property (17-014)
May 11, 2017	Authorization to enter cooperative agreement with the City of Victoria (17-035)
Nov 17, 2017	Approval of design contract for park design and alum feasibility (17-071)
June 28, 2018	Authorization to apply to the Watershed-Based Funding Pilot (18-064)

SUMMARY:

In February 2017, the MCWD Board of Managers approved a purchase agreement for two parcels – PID 650230600 and 650230700 – in Victoria, MN, also known as Wassermann West. A condition of that purchase agreement was the development of a Cooperative Agreement with the City of Victoria memorializing the agencies' mutual interest in developing a plan for recreational amenities and natural resource improvements on the property. In May 2017 a Cooperative Agreement was approved and the District proceeded to close. In November 2017 a contract was awarded for preliminary design of Wassermann West park and natural resources improvements.

The Wassermann West property is 32 acres and includes a 22 acre wetland with six acres of open marsh, approximately 500 feet of stream channel, and a wooded shoreline. In 2016, the District identified approximately 75 pounds per year of phosphorus being exported from the pond on site to Lake Wassermann, an impaired waterbody, and recommended investigation of alum treatment.

In April 2018, as part of the park design scope, Wenck Associates prepared a technical memo and specifications for alum treatment. The project would reduce phosphorus export to Lake Wassermann by 39 pounds per year. The proposed treatments would occur over three years, with years one and three being active treatment years. The estimated cost for the first two treatments are $34,100 per treatment. The memo recommends the District plan for a third maintenance dose sometime in the following two to five year window.

The Board of Water and Soil Resources has preliminarily awarded $93,879 of funding through the Clean Water Pilot Program to the Wassermann West project for alum treatment and stream stabilization, pending approval of the final work plan and execution of the grant agreement. Funding is anticipated to begin in late October of this year. The stream stabilization component of the approved work plan is anticipated to be designed in coordination with the future Wassermann West park project.

Following authorization, the quote package will be finalized and released in early October to a list of known alum contractors. Quotes are being solicited for the first treatment, and any future treatments will follow similar procurement processes. The contract will be awarded at the end of October and treatment will occur in early November.

Staff recommends the Board authorize staff to solicit quotes for alum treatment.

Attachments:

- Wassermann West Alum Treatment Feasibility Study

RESOLUTION

RESOLUTION NUMBER: **18-104**

TITLE: **Authorization to Solicit Quotes for Wassermann West Alum Treatment**

WHEREAS, the legislature appropriated $9,750,000 from the Clean Water Fund to the Board of Water and Soil Resources (BWSR) for the FY2018-19 biennium for a pilot program to provide performance-based grants to local government units (LGUs) to implement projects identified in comprehensive watershed plans; and

WHEREAS, to determine the allocation approach for the FY 2018 Watershed-Based Funding Pilot Program, The Minnehaha Creek Watershed District (MCWD) staff participated in a discussions with Hennepin and Carver Counties, and both Counties agreed on a collaborative approach;

WHEREAS, under the allocation approach within Carver County, The Minnehaha Creek Watershed District (MCWD) will receive $93,879 for project funding for the Wassermann West Project;

WHEREAS, in November 2017, the MCWD Board approved a contract with Wenck Associates for Wassermann West Park and Natural Resource Improvements, including the development of feasibility and specifications for alum treatment;

WHEREAS, in April 2018, Wenck Associates, Inc. completed a feasibility study of the Wassermann West Pond to evaluate sediment cores and develop specifications and cost estimates for alum treatment of the site; and

WHEREAS, in June 2018, the MCWD Board of Managers approved resolution 18-064 authorizing staff to submit the Wassermann West Restoration Project for funding through the Carver County Pilot Program;

WHEREAS, in July 2018 MCWD submitted a preliminary work plan to BWSR specifying the use of these funds for alum treatment of the Wassermann West Pond, as well as stream stabilization in the creek that flows on the southern border of the Wassermann West property;

NOW, THEREFORE, BE IT RESOLVED that the Minnehaha Creek Watershed District Board of Managers authorizes staff to solicit quotes for alum treatment of the Wassermann West Pond.

Resolution Number 18-104 was moved by Manager _____________, seconded by Manager ____________. Motion to adopt the resolution ___ ayes, ___ nays, ___abstentions. Date: _______________.

____ Date:____________________________
Secretary

MEMORANDUM

To: Anna Brown, Minnehaha Creek Watershed District

From: Brian Beck, Minnehaha Creek Watershed District

Date: September 17, 2018

Re: Wasserman West Alum Treatment Feasibility Study

Introduction and Background

In 2016, the Minnehaha Creek Watershed District (MCWD) formed the Six Mile – Halsted Bay Planning Partnership, which brings together a variety of organizations located in the subwatershed to engage in proactive communication about plans, priorities, and opportunities for collaboration in the region. During routine coordination with the City of Victoria, staff from the City and MCWD identified 33.5 acres of undeveloped land for sale along the Lake Wassermann shoreline. The parcel includes Wassermann West Pond and adjacent wetlands, and restoring these areas could result in significant reduction in phosphorus entering Wasserman Lake, while also providing the public access to the lake, which was a goal identified in the City of Victoria's 2008 Comprehensive Plan.

The Wassermann West Waterfront Park is the first major project in the Six Mile Creek – Halsted Bay Subwatershed that exemplifies the District's balanced urban ecology framework (Figure 1). This can be seen in the commitment to partnership between MCWD and the City of Victoria to realize natural resource benefits while meeting community goals. Wassermann West Waterfront Park would provide water quality improvements, while providing public access and recreation opportunities on Lake Wassermann.

The District purchased the 33.5 acres from the landowner in June 2017. In May 2017, the District and the City of Victoria signed an agreement stating that the City of Victoria and District would coordinate to develop a park design that provides public access to and enjoyment of the site while restoring its wetland and woodland areas and implementing water quality improvements. The park will be a City Park and the District will retain easements that allow for ongoing management and maintenance of the site's natural resources.

Monitoring efforts from 2014 to 2016 indicated that phosphorus release from Wasserman West Pond may be a potential source of phosphorus to Wasserman Lake. The purpose of this technical memorandum is to assess the feasibility of reducing phosphorus loading to Wasserman Lake by inactivating sediment phosphorus remobilization in Wasserman West Pond.

Figure 1. Wasserman West Waterfront Park restoration concept plan

Surface Water Quality of Wasserman Lake and Wasserman West Pond

Wasserman Lake is a deep eutrophic lake located in Victoria, MN. In 2012 the Minnesota Pollution Control Agency (MPCA) listed Wasserman Lake as impaired for excess nutrients. Water quality in Wasserman Lake has not met State of Minnesota water quality standards since monitoring efforts began in 2002 (Figure 2). Total phosphorus (TP) and chlorophyll-a (chl-a) appear to be closely related, which is expected since phosphorus is the primary driver for algae growth. Interestingly, water clarity, as measured by secchi depth, is consistently low and does not appear to be related to TP or chl-a. Overall, these data indicate that excess phosphorus loading is causing excess algae growth. However, low clarity is likely driven by a combination of common carp in the spring and algae growth in the summer and fall.

In 2013, MCWD completed a diagnostic study to assess nutrient loading concerns and provide strategies to reduce phosphorus loading to impaired lakes (Wenck, 2013). The Six Mile Creek Diagnostic Study identified watershed loading as the primary driver of poor water quality in Wasserman Lake. Since the completion of the Six Mile Creek Diagnostic study, monitoring efforts by MCWD identified a small watershed just west of Wasserman Lake (Figure 1) as a large source of phosphorus. This watershed flows through a large pond (Wasserman West Pond) prior to discharging to Wasserman Lake. Table 1 outlines physical characteristics of the Wasserman Lake and Wasserman West Pond.

From 2014-2016, MCWD collected surface water quality samples in Wasserman West Pond to quantify phosphorus loading from Wasserman West Pond to Wasserman Lake (Figure 3). The total phosphorus concentrations in Wasserman West Pond were relatively high (368-384 µg/L; Figure 3). In addition, ortho-phosphorus (Ortho-P) accounts for approximately 75% of the total phosphorus pool, which suggests that sediment phosphorus release is an important factor in Wasserman West Pond since watershed runoff is typically dominated by particulate phosphorus, not ortho-P.

Table 1. Physical characteristics of Wasserman Lake and Wasserman West Pond

Parameter	Wasserman West Pond	Wasserman Lake
Surface Area (acres)	7.1	164
Maximum Depth (ft)	23	41
Volume (ac-ft)	86	1,698
Residence Time (years)	1.2	0.94
Littoral Area (%)	75	68
Watershed Size (ac)	148	876

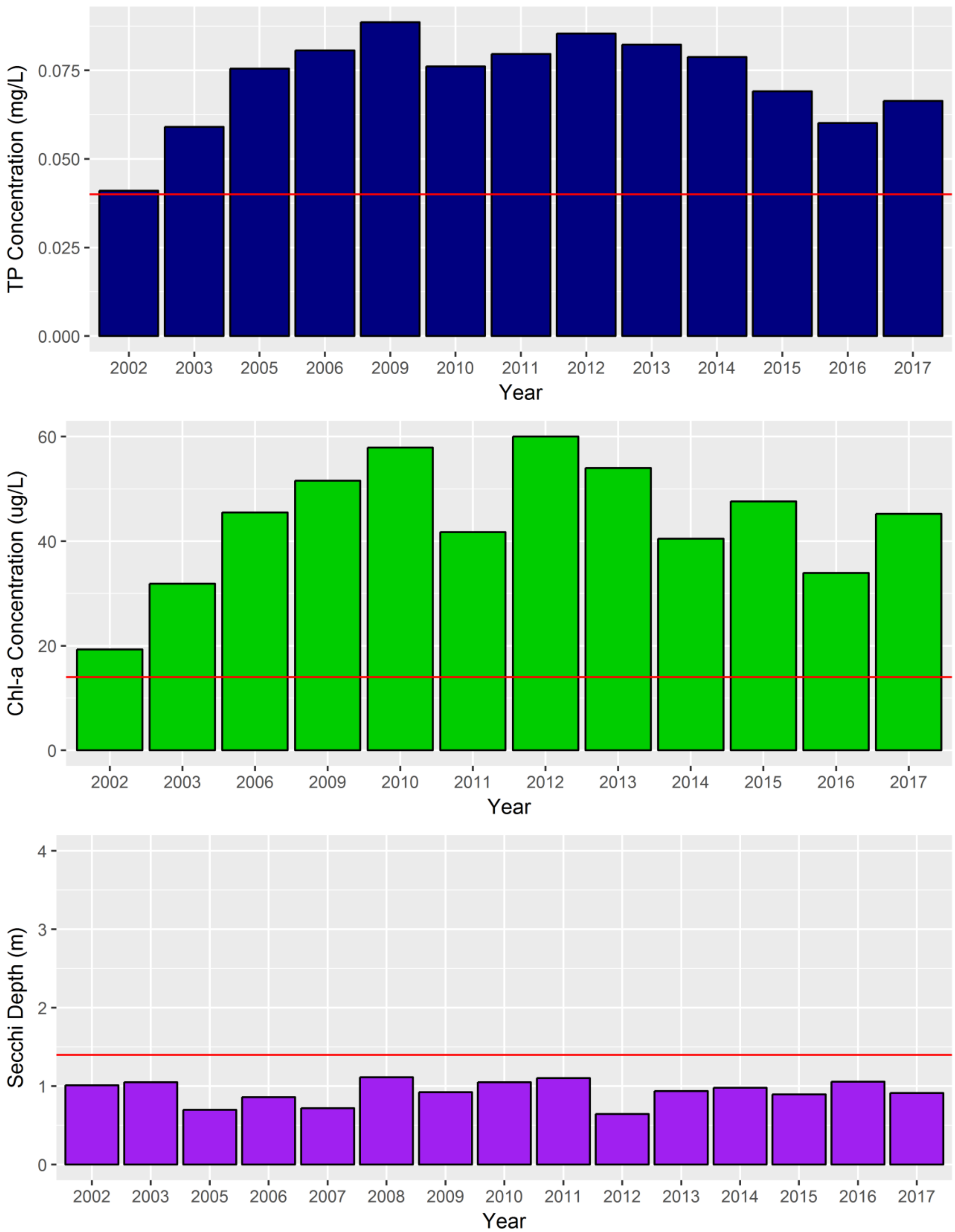

Figure 2. Wasserman Lake water quality data. Red line on each figure marks the state nutrient standard.

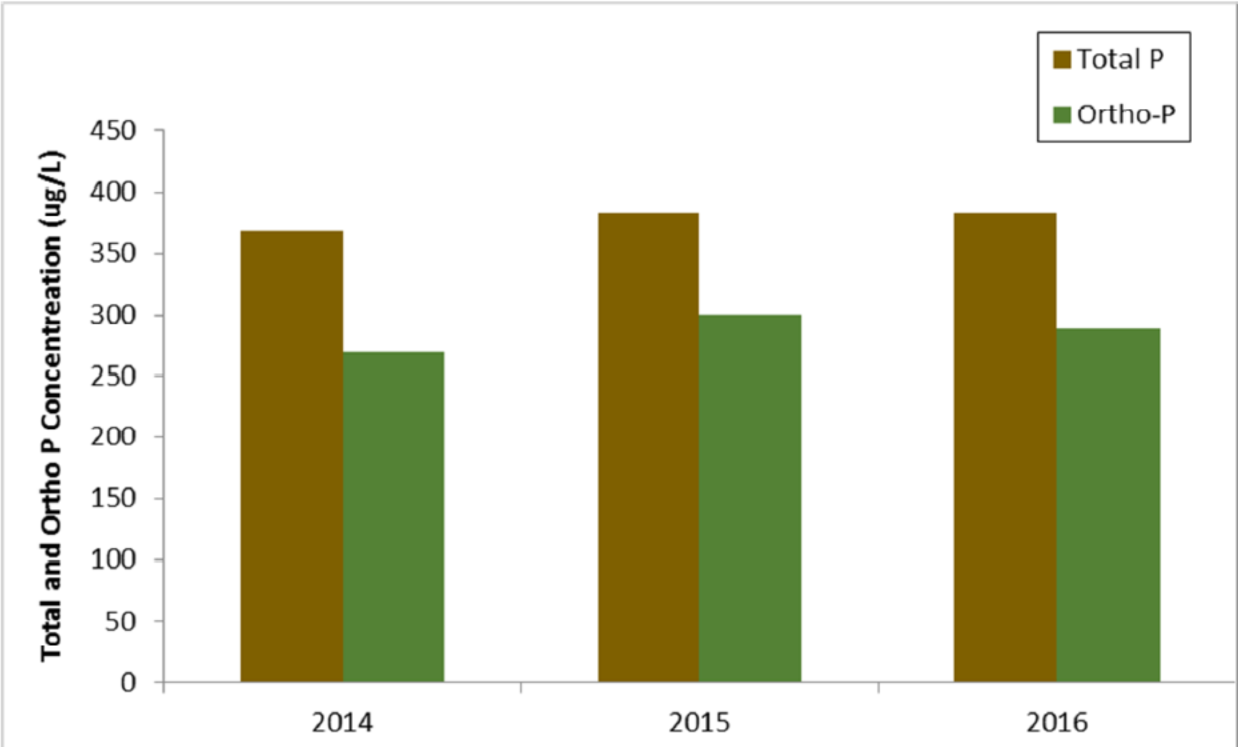

Figure 3. Wasserman West Pond surface water total and ortho-P concentrations from 2014 to 2016.

Wasserman Lake and Wasserman West Pond Nutrient Loading Analysis

Wasserman Lake Nutrient Budget

The Six Mile Creek Diagnostic Study developed phosphorus budgets for impaired lakes within the Six Mile Creek subwatershed, which included a detailed phosphorus budget for Wasserman Lake (Wenck, 2013). Watershed loading was estimated with a P8 watershed model calibrated with stream water quality data. Internal phosphorus loading in Wasserman Lake was estimated using sediment phosphorus release rates combined with dissolved oxygen data (Wenck, 2013). Watershed and lake modeling indicate that over half the phosphorus budget is from watershed loading (61%; Figure 4) and that the total watershed phosphorus reduction needed for Wasserman Lake to meet water quality standards is 457 lbs/year.

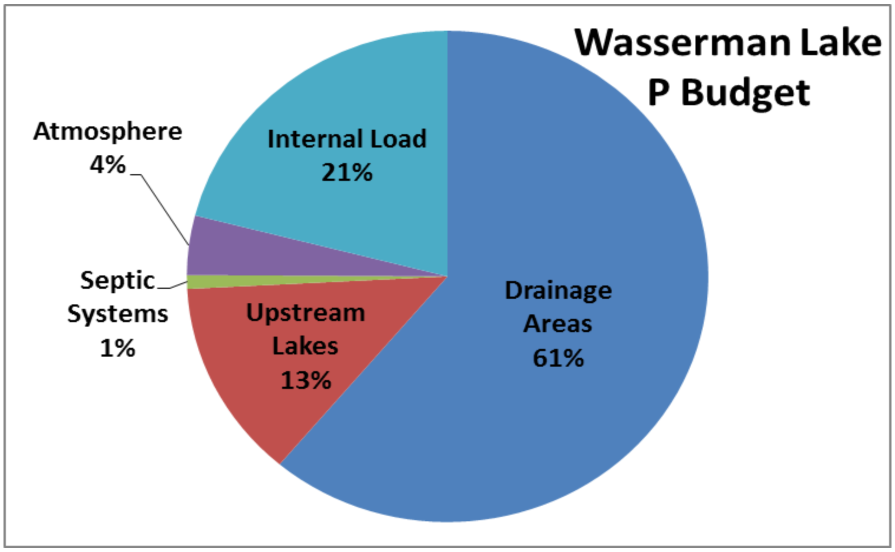

Figure 4. Wasserman Lake Annual Phosphorus Budget

Wasserman West Pond Sediment Chemistry and Phosphorus Release

One potential source of phosphorus to Wasserman Lake is from the Wasserman West Pond subwatershed. Wenck Associates conducted an analysis of the ecological and water quality conditions within the Wasserman West Pond subwatershed (Attachment 1). Water quality monitoring and an existing P8 model for the Wasserman West Pond subwatershed indicated that watershed loading, which includes phosphorus sediment release in Wasserman West Pond, contributes 75 pounds of phosphorus per year to Wasserman Lake (Attachment 1). For perspective, the total watershed phosphorus budget for Wasserman Lake is 613 pounds per year, which means that the Wasserman West subwatershed represents 12% of Wasserman Lake's annual watershed phosphorus budget.

In 2018, MCWD conducted a feasibility study to develop cost estimates and load reductions associated with an alum treatment on Wasserman West Pond (Attachment 2). Wenck Associates collected sediment cores from one location on Wassermann West on 1/16/2018 to assess the magnitude of internal loading in Wassermann West pond (Figure 5). The sediment core was sectioned vertically at 2-cm intervals over the upper 10-cm layer and at 5-cm intervals below 10 cm to evaluate variations in sediment physical-textural and chemical characteristics. A gravity sediment coring device (Aquatic Research Instruments, Hope ID) equipped with an acrylic core liner (6.5-cm ID and 50-cm length) was used to collect sediment in 1/16/2018.

Sediment phosphorus release in Wasserman West Pond is 11.6 mg/m^2/day, which is relatively high compared to most water bodies in Minnesota. We can combine this data with bathymetry and dissolved oxygen profiles to estimate the phosphorus load from sediments is 39 pounds of phosphorus per year. These data indicate that over half of the phosphorus from the Wasserman West Pond subwatershed is from sediments in Wasserman West Pond.

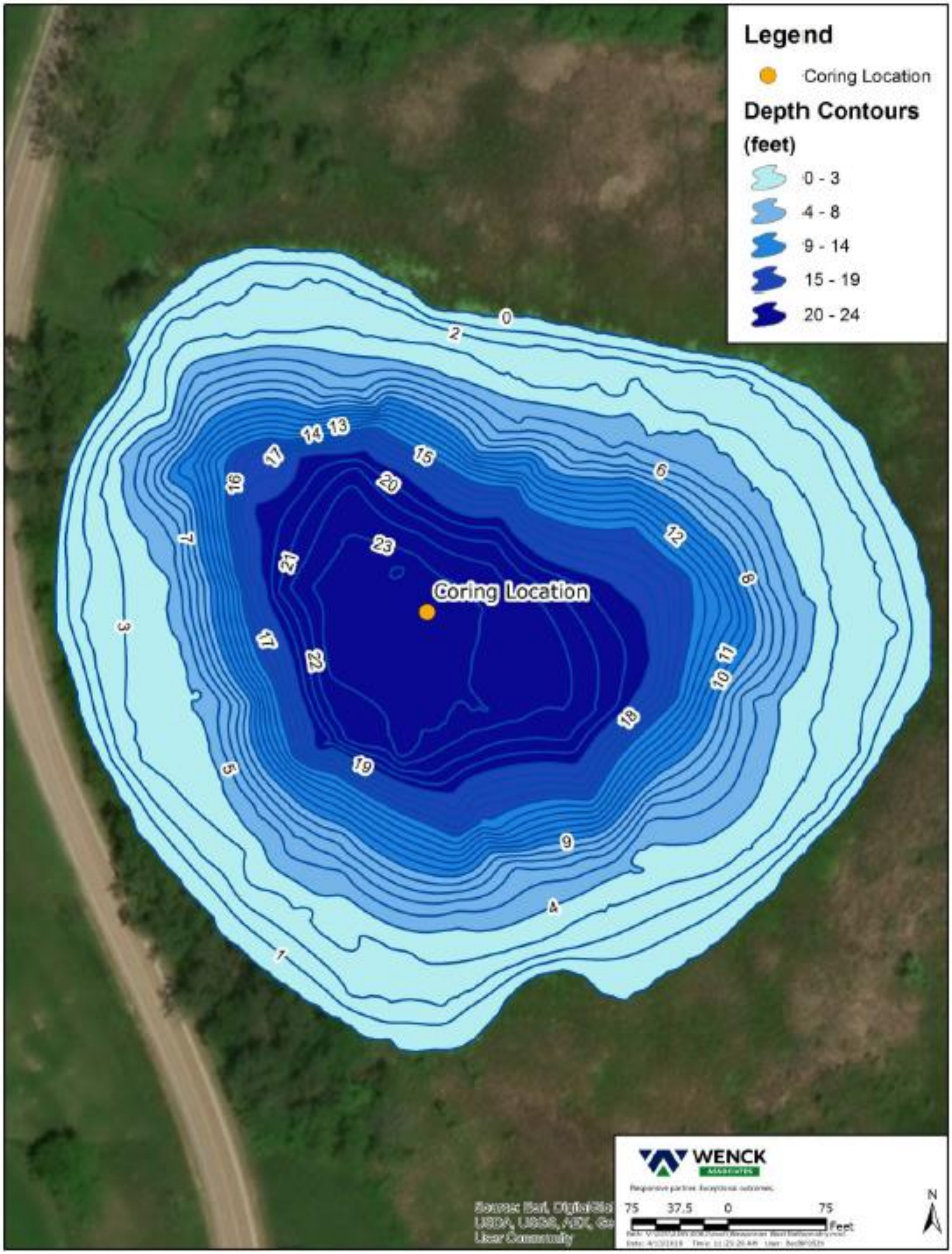

Figure 5. Wasserman West sediment coring location

Alum Dosing Recommendations

Alum Treatments for Anoxic Area

The goal of a sediment inactivation treatment is to drive 90% of mobile phosphorus (redox-P) to an inactive form of phosphorus (aluminum bound-P) to reduce phosphorus release rates by 90%. The mass of alum needed to reduce phosphorus loading from anoxic sediments is based on the sediment chemical characteristics in the uppermost 8 cm in Wasserman West Pond and the sediment area that is typically exposed to anoxia (dissolved oxygen < 2 mg/L). An application rate of 517 g Al/m^2 is needed to inactivate 90% of the phosphorus available for release in the uppermost 8 cm. The minimum anoxic depth in Wasserman West Pond is six feet (Figure 6). Therefore, alum will be applied to Wasserman West Pond in areas deeper than 6 feet at an application rate of 517 g Al/m^2. This is an unusually large amount of alum to apply during one application, which would drive pH below 6 and cause aquatic toxicity issues.

MCWD will avoid causing low pH during alum applications on Wasserman West Pond by splitting the dose into two buffered aluminum (sodium aluminate and aluminum sulfate) applications. This option would also be beneficial because two applications of a buffered alum solution would allow more time for the aluminum to react with sediments in Wasserman West Pond. MCWD will conduct monitoring after the initial application and final alum application to assess the effectiveness of the treatments. Follow up sediment monitoring is an effective method for tracking the conversion of redox-P to aluminum-bound P. More importantly, the amount of releasable phosphorus within Wasserman West sediments is unusually high. Therefore, follow up monitoring will also inform MCWD if more alum is needed due to the elevated redox-P concentrations. The final sediment monitoring event will inform MWCD whether a contingency/maintenance dose is necessary to fully inactivate releasable phosphorus within Wasserman West Pond sediment.

Table 2. Wasserman West Pond alum application cost estimate for 8 cm treatment depth

Item	Unit	Quantity	Unit Cost	Total Cost
Initial Aluminum Sulfate Application	Gal $Al_2(SO_4)_3$	7,418	$1.85	$13,700
Initial Sodium Aluminate Application	$NaAlO_2$	3,709	$5.50	$20,400
Second Aluminum Sulfate Application	Gal $Al_2(SO_4)_3$	7,418	$1.85	$13,700
Second Sodium Aluminate Application	$NaAlO_2$	3,709	$5.50	$20,400
Contingency/Maintenance Aluminum Sulfate Dose	Gal $Al_2(SO_4)_3$	8,533	$1.85	$15,800
Total Chemical Cost Estimate				**$84,000**
Follow up Monitoring				$15,000
Application Oversight[1]				$2,500
Total Cost Estimate				**$101,500**

[1]This includes 10 hours of application/construction oversight during each application

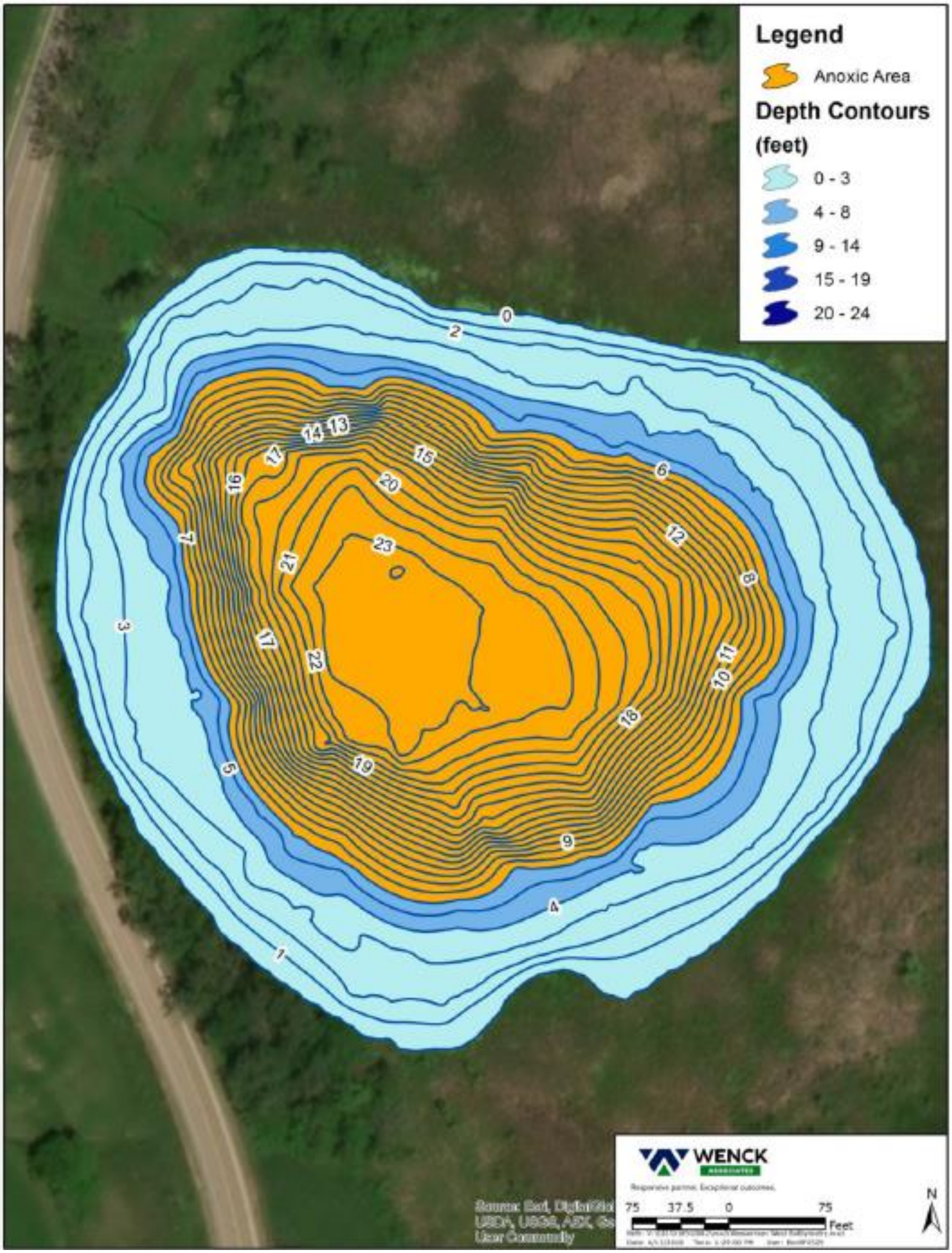

Figure 6. Sediment area typically exposed to anoxic conditions is West Wasserman Pond (orange).

Estimated Reduction and Longevity

As mentioned earlier, 90% of redox-P in sediment should be inactivated by the two buffered alum applications, which should result in a reduction in sediment phosphorus release of 90%. Therefore, MCWD expects an estimated annual phosphorus reduction to Wasserman Lake of 35 pounds per year, which would achieve 8% of the required watershed load reduction for Wasserman Lake.

The longevity of the treatment is another important factor; however, it is important to note that this alum application is for Wasserman West Pond, not for Wasserman Lake. The question about alum treatment longevity is typically reserved for evaluating lake alum treatments. With that said, it is still important to discuss the life-cycle costs for watershed reduction projects even though MCWD considers the alum treatment on Wasserman West Pond a watershed project, not an in-lake project.

Generally, the purpose of an alum treatment is to inactivate historic phosphorus loading to a water body. Wasserman West Pond's watershed has historically been dominated by feedlot and agricultural land use, which explains why it has such high phosphorus release rates. However, in recent years residential development has resulted in watershed improvements since development must follow MCWD rules to improve water quality. For example, land use transition from agriculture to residential in the northwest watershed resulted in the construction of a treatment basin that removes phosphorus prior to draining to Wasserman West Pond (Figure 7). The construction of a storm basin upstream of the largest subwatershed draining to Wasserman West Pond has drastically reduced the amount of phosphorus that would have otherwise been delivered directly to Wasserman West Pond. The only remaining agricultural land use within the West Wasserman Pond watershed comprises a relatively small portion of the total watershed. In addition, this feedlot/agricultural area will likely transition to residential development within the next decade, which will lead to improved water quality conditions in the West Wasserman Pond watershed.

Overall, treating the West Wasserman Pond with alum is the final step in reducing phosphorus loading from the Wasserman West Pond watershed to Wasserman Lake. The Wasserman West Pond alum longevity is difficult to assess since this body of water falls somewhere between a pond and a deep lake. It is reasonable to assume that there will be a minimum 15 year life cycle of the alum treatment on Wasserman West Pond since watershed treatment devices have recently been constructed upstream of Wasserman West Pond. The conservative cost per pound estimate using a 15 year life cycle for the Wasserman West Pond is $193/lb P/yr, which makes this project extremely cost effective. Furthermore, a watershed project that achieves 8% of the total watershed phosphorus reduction for Wasserman Lake makes this a high impact water quality improvement project.

Figure 7. Wasserman West Pond subwatershed and drainage path

In Lake Response to an Alum Treatment

Aquatic Plant Community

The aquatic plant community was assessed on Wassermann West Pond on June 21, 2018 and again on September 7, 2018 using the point-intercept survey method. A total of 66 sample points were spaced evenly and sampled across the pond. Despite the pond's small size (7.1 acres), it is relatively deep with a maximum depth of 23 feet. Of the 7.1 acres, 75% is littoral (≤ 15 ft.). Maximum depth of vegetation growth was observed as 7 feet during the June survey, and 7.4 feet during the September survey. Vegetation was observed growing at 51.5% (June) and 0% (September) of sample points, and 72% (June) and 67.4% (September) of the littoral points vegetated. The plant community was composed of 4 to 5 species between the two surveys. The invasive plant Curlyleaf Pondweed (*Potamogeton crispus*) is present, and dies off mid-summer. Coontail (*Ceratophyllum demersum*) is the most dominant plant year-round, occurring at 50% of littoral sample points in June, and 58.7% of littoral points in September.

Mid-summer die-off of Curlyleaf Pondweed (CLP) can contribute nutrients to the pond during warmer periods of the year. CLP was present at 21.2% of sample sites in June, with a low to moderate abundance (Figure 8). The application of alum will result in increased water clarity, which could increase the growth of aquatic vegetation, including CLP. Annual spring surveys will occur annually on Wassermann West Pond to track CLP growth. If CLP abundance increases above 25% frequency of occurrence, and becomes denser, treatment may be considered to manage growth and reduce its impact on water quality.

No residents live on Wasserman West Pond since the shoreline is owned by MCWD. Furthermore, there is no public access to Wasserman West Pond. Therefore, social receptiveness to greater submerged aquatic vegetation use is not a concern for the Wasserman West Pond alum treatment.

Fish Community

Wassermann West is a small pond and does not have an actively managed fishery. There is very little fish community data in the Wasserman West Pond, however, a fish survey was completed in 2015 and 2016 using trap-nets by the University of Minnesota as part of a study funded by MCWD to assess common carp in the Six Mile Creek – Halsted Bay Subwatershed. In 2015, one – one-year old carp was sampled. Common carp are present, but in very low numbers and do not seem to be affecting habitat in the pond. Dominant species observed include bullheads, green sunfish, pumpkinseed sunfish and golden shiners.

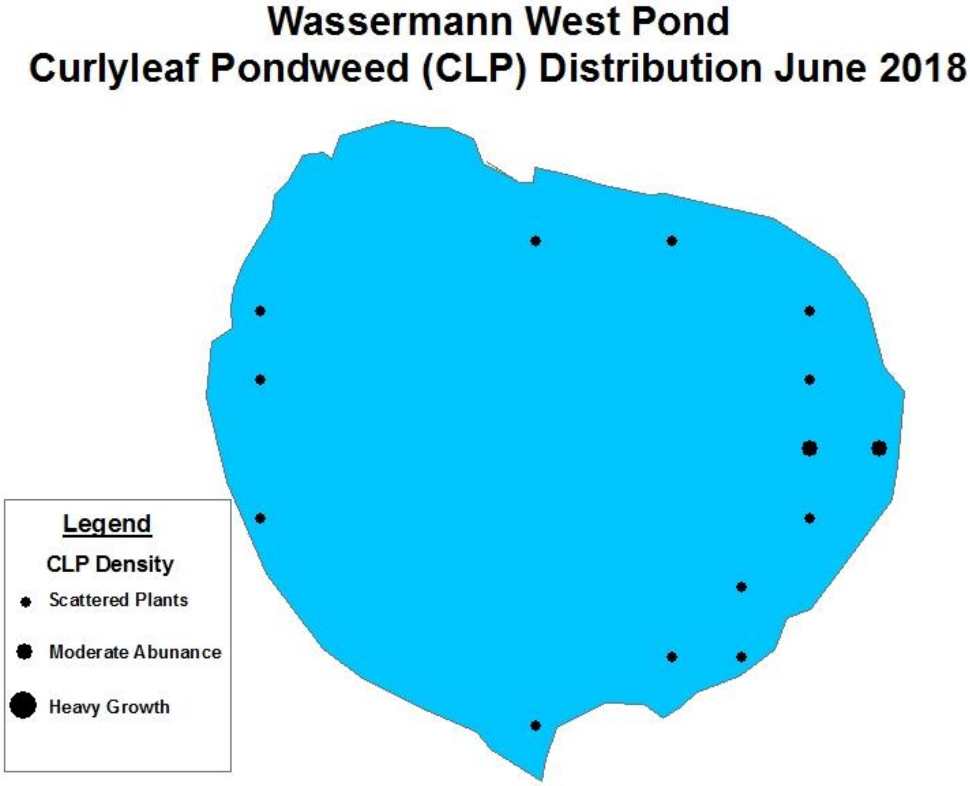

Figure 8. Curlyleaf Pondweed Distribution, June 2018

Alum Treatment Feasibility

Residential development has reduced phosphorus loading to Wasserman West Pond through BMPs and by land use conversion with stormwater treatment and volume control. It is likely that the Wasserman West Pond alum treatment will have a 15 year life cycle, however, monitoring by MCWD will help track the effectiveness of the project and help assess if maintenance alum applications are necessary. Based on this information, an alum treatment on Wasserman is feasible and will be cost-effective if dosed properly. Assuming an internal load reduction of 90%, the annual load reduction that could be achieved by alum is estimated as 35 pounds on Wasserman West Pond, which would account for 8% of the watershed phosphorus reduction needed for Wasserman Lake to meet water quality standards.

References

Wenck, 2013. Six Mile Creek Diagnostic Study. Technical Report. https://www.minnehahacreek.org/sites/minnehahacreek.org/files/Six%20Mile%20Creek%20Diagnostic%20and%20Feasibility%20Study%20FINAL%20DRAFT.pdf

Attachment 1

Technical Memo

WENCK ASSOCIATES

Responsive partner.
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To: Anna Brown, Planner
Minnehaha Creek Watershed District

From: Joe Bischoff, Wenck Associates, Inc.
Brian Beck, Wenck Associates, Inc.

Copy: Chris Meehan, Wenck Associates, Inc.

Date: August 9, 2016

Subject: DRAFT Evaluation of Wetland and Associated Property, Fronting on County Road 43 and with Shoreline on Lake Wasserman, East of Hesse Farm

Purpose

This memorandum describes the water quality aspects and other opportunities to enhance or protect ecological qualities of the property that Wenck evaluated as part of a Scope of Work approved by MCWD staff.

The overall purpose of the evaluation was to assess the value to MCWD of acquiring the property and estimating potential for significant benefit to Lake Wasserman and the general public. In accomplishing that purpose, Wenck reviewed the following aspects of the property and its association with the lake:

- Land use in the area and drainage patterns of the subwatershed where the property is located. In particular, Wenck looked at existing information to estimate subwatershed loading of nutrients and whether some or all of that loading could be managed, reduced and/or treated. The overall loading to Lake Wasserman was also reviewed. We took into account notes from a MCWD staff field visit looking at specific drainage features like tiles and culverts.
- Existing regulations governing land use and development were reviewed to determine what type of wetland buffers, structure setbacks and potential wetland impact requirements are in-place that provides a level of protection without acquiring the property.
- Opportunities to enhance natural, ecological, water quality and access.

Property and Watershed Overview

Lot Descriptions and Wetlands

The property being evaluated includes 30.5 acres split between two tax lots (North Lot and South Lot; Figures 1 through 3) on the west side of Wassermann Lake that includes a large pond that receives drainage from a predominantly agricultural watershed including a feed lot prior to discharging to Wassermann Lake (Figures 4 and 5). The tax lots are predominantly wetlands (90 percent) and include mostly seasonally flooded cattail marsh although there appears to be some remnants of hardwood swamp, grassland, and wet meadow (Figure 6). The lots include some altered/non-native vegetation, mostly on the west side where County Road 43 boarders the property. The wetland is designated by the

MCWD Function and Value Assessment as a Preserve wetland which would require a 75 foot buffer for development (Figure 7). Some wetland buffer width averaging may be allowed but existing buffer requirements coupled with existing wetland impact avoidance will severely restrict development of Lot 1, containing most of the wetland area. This lot may be a reasonable target for acquisition because it contains the bulk of the open water wetland and the bulk of the Lake Wasserman shoreline.

Shoreline

The parcels cover about 1,700 feet of shoreline, most of which is wetland. Lots 2 and 3, the most likely buildable lots, have about 600 feet of shoreline that could be impacted. Based on the Score the Shore Assessment, Wassermann Lake has excellent shoreline conditions which should be protected. Development of the lots could impact approximately one third of the shoreline on these lots.

Watershed

The drainage area to the property and pond includes 148.3 acres of mostly upland agriculture. A recent development did occur in the watershed (Lennar at Rhapsody) converting a large area from agriculture to residential development. This development occurred under District rules and includes a large pond for water quality treatment. Runoff volume was estimated for current (2010) and future (2020) conditions. Runoff volumes were estimated to be:

- 2010 Land use, Annual runoff depth (5.9 inches), Approximately 72.9 AF of annual runoff.
- 2020 land use, Annual runoff depth (10.7 inches), Approximately 132.23 AF of annual runoff.

A dominant feature of the watershed is the feed lot to the west that drains to the pond on the North Lot. Based on discussions with Mike Wanous of the Carver County Soil and Water Conservation District, there are approximately 200 Animal units in the feedlot, with 140 mature dairy cows, 40 dairy heifers, and 20 calves. Assuming that these cows produce approximately 0.03 kg/day of phosphorus per animal unit (ASAE 2005), the manure produced contains about 2,190 kg/year or 4,818 pounds/year of phosphorus that gets applied to the watershed. Solid manure from the pen pack is likely spread on the soil surface. Most of the manure is likely liquid which gets injected into the soils or incorporated by tillage within 24 hours. While a good portion will remain in the soils after spreading, this represents a significant source of P to the pond. It is important to note that the farm should have a manure management plan that they are following.

Manure spreading likely occurs on the 46 acres cropland directly adjacent to the feedlot (Figure 8). The majority of this cropland is outside of the drainage area to the pond and flows to the south and enters Wassermann Lake through wetlands on the South side. Because the manure is spread on fields that flow to the south and not through the ponds, there is little water quality treatment of the manure applied field runoff.

Pond

The majority of the watershed area drains to the large pond located on the North Lot. The pond is 6.6 acres in size with an average depth of 13 feet and a maximum depth of about

22 feet and stores about 86 acre-feet of water. The residence time of the pond is currently over a year (429 days) and expected to be about 237 days under 2020 land use. This is a fairly large pond that has a high solids settling potential.

Another unique consideration was whether or not the wetland area is actually isolated from the lake or whether it is hydraulically connected and the wetland area is actually a floating mass. This would have a profound impact on the effectiveness of some potential treatment alternatives and fisheries considerations. Based on a review of historical aerial photos, the pond has been in existence since at least 1937 and appears to have never had a defined outlet. Even today, no outlet is obvious on aerial photos and it likely discharges as sheet flow to Wassermann Lake through the wetland (Figure 9).

Water Quality

Water quality data were collected for the pond from2014 through 2016. Water quality in the pond is generally poor with average TP concentrations ranging from 368 to 384 µg/L (Figure 9). On Average, 75% of the phosphorus is in a dissolved form (ortho-phosphorus) which is not treated by a settling pond (Figure 10). This problem is further exacerbated by significant anoxia in the pond that can lead to sediment P release (Figure 11). It is difficult to say which process is leading to the high TP and dissolved fractions in the pond, but it is likely that both runoff from fields applied with manure and sediment P release are factors.

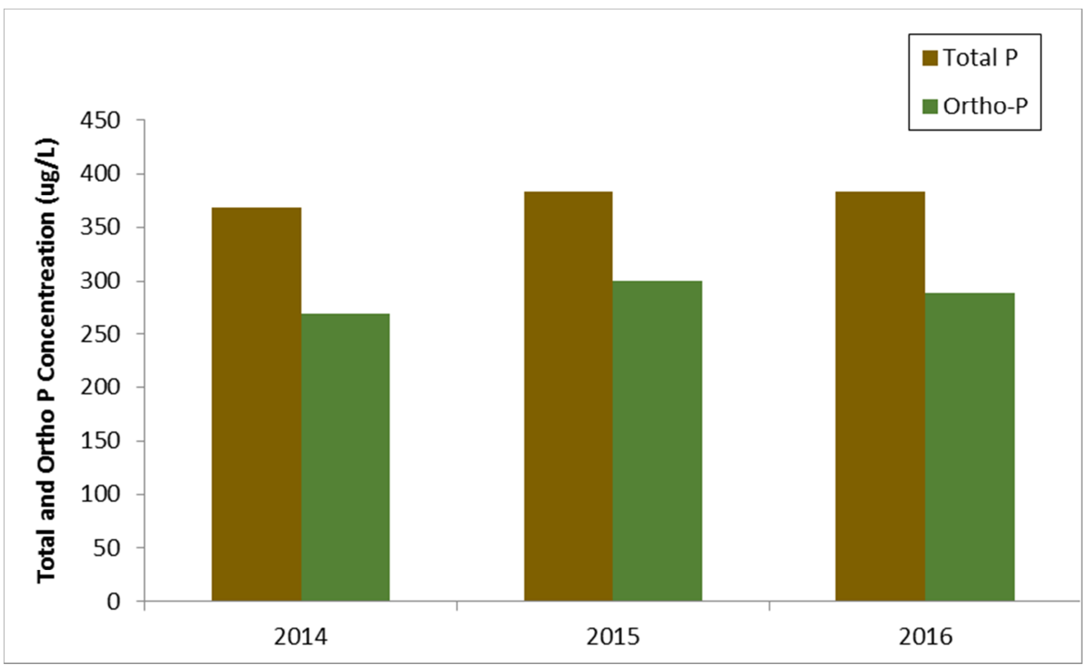

Figure 10. Annual average total and ortho-phosphorus concentrations in the primary pond on the evaluation property.

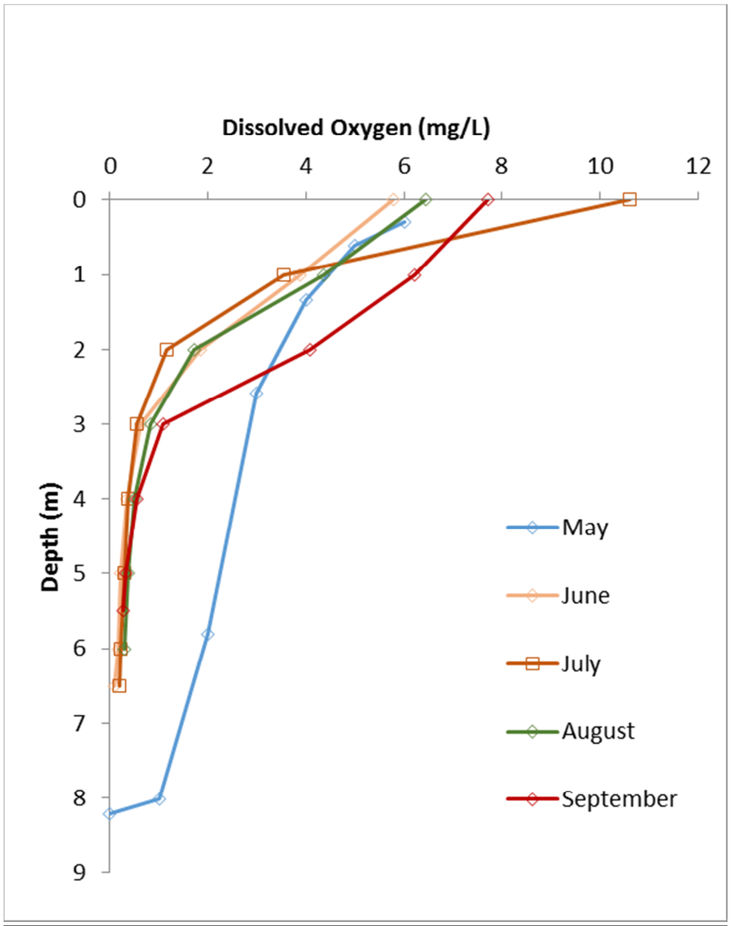

Figure 11. Dissolved oxygen profiles in the primary pond in 2014.

Using the 2010 runoff volume of 73 acre-feet and an average pond TP concentration of 379 µg/L, the average annual load from this watershed is approximately 75 pounds per year. This does not include the significant amount of P in manure applied to fields that drain to the south and then to Wassermann Lake. The total P budget for Wassermann Lake was 1,118 pounds per year so this watershed represents about 7% of the P loading to Wassermann Lake. Reducing this load by 85% (64 pounds) would achieve 15% of the required watershed load reduction for Wassermann Lake. This makes this pond and watershed an attractive water quality project.

Water Quality Treatment Options

The location of the pond and the high proportion of dissolved P results in few options for improving water quality treatment in the pond. The high dissolved fraction suggests that filtration or chemical addition is necessary to improve pond performance. Because there is little elevation difference between the pond surface and Wassermann surface, an iron enhanced sand filter was deemed impractical. Since filters are not an option, chemical injection is the only reasonable alternative.

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There are two possible approaches for chemical treatment including periodic addition to the pond to strip water column P or alum injection. Alum injection would be difficult and expensive compared to periodic alum injection so this process was not further investigated at this time.

Periodic treatment with alum may be feasible because of the long residence time of the pond (429 days). Stripping dissolved P and sediment P release inactivation could significantly reduce P loading to Wassermann Lake. Assuming an initial application rate of 100 g Al/m^2, he initial sediment inactivation is approximately $22,000 and annual treatment of around 40 g Al/m^2 are around $10,000 per year and should be conducted annually.

One other consideration that is outside of the property area is the land that receives manure but drains to the south. This land flows through a large wetland then through the Lakeside-Pinnacle Series and Lake Wassermann Ridge developments and then through a small ravine south of Lot 3 down to Wassermann Lake (Figures 12 and 13). The Lot 3 property line appears to abut to the ravine which may allow for some water quality treatment options. Further evaluation of this option may be warranted.

Summary

The property under evaluation contains a large pond and receives drainage from the Hesse Farm, a small feedlot with about 200 animal units on site. The property was reviewed and found:

1. The site is approximately 90% wetlands categorized as Preserve, with a mix of degraded cattail marsh and a few remnants of high quality hardwood swamp, grassland, and wet meadow.
2. The shoreline area of the site is mostly wetland and contributes to the high quality shoreline of Wassermann Lake.
3. The large pond on site demonstrates poor water quality with a large proportion of dissolved P and receives drainage form around 148 acres of land. However, most of the fields that likely receive manure application drain to the wetland to the south before entering Wassermann Lake.
4. Even though much of the manure applied fields drain to the south, the pond drainage still accounts for 75 pounds P per year or about 7% of the P loading to Wassermann Lake. Reducing this load by 85% (64 pounds) would achieve 15% of the required watershed load reduction for Wassermann Lake.
5. Because of the elevation of the pond, filtration to address the dissolved P would be very difficult. Rather, the pond could be treated periodically with alum to strip water column dissolved phosphorus and reduce P loading to Wassermann Lake.
6. The fields to the south that receive manure drain past the southern portion of the property through a small ravine that might provide some options for treatment, but elevations may require pumping or ponding and require further investigations.

Recommendations

Any water quality project pursued must address the significant dissolved fraction of P in the pond and likely in the runoff from the feedlot to the west. The property appears to present two options for improved water quality treatment including periodic alum treatment (annually) and a potential water quality project in the ravine to the south of the property.

Attachment 2

Technical Memo

To: Anna Brown, Minnehaha Creek Watershed District

From: Tom Langer, Wenck Associates, Inc.
Brian Beck, Wenck Associates, Inc.
Chris Meehan, Wenck Associates, Inc.
Joe Bischoff, Wenck Associates, Inc.

Date: 18 April 2018

Subject: Wassermann West Pond Sediment Investigation

INTRODUCTION

Wassermann West is a seven acre pond located upstream of Wassermann Lake in the City of Victoria. Wasserman West pond's drainage area is approximately 148 acres and contains a mix of residential, agricultural, and feedlot land use. In 2017, Wenck collected sediment cores to estimate the internal phosphorus loading in Wasserman West and calculate potential load reductions from sediment phosphorus inactivation. At that time, it was difficult to create an accurate internal load and cost estimate since no bathymetric data for Wasserman West existed. The goal of this analysis is to use recently collected Wasserman West bathymetry data and sediment data to estimate the load reduction and cost of inactivating sediment phosphorus release.

METHODS

Wenck Associates collected sediment cores from one location on Wassermann West on 1/16/2018 to assess the magnitude of internal loading in Wassermann West pond. A single intact sediment core was collected from the deepest area of the basin (Figure 1). The sediment core was sectioned vertically at 2-cm intervals over the upper 10-cm layer and at 5-cm intervals below 10 cm to evaluate variations in sediment physical-textural and chemical characteristics. A gravity sediment coring device (Aquatic Research Instruments, Hope ID) equipped with an acrylic core liner (6.5-cm ID and 50-cm length) was used to collect sediment in 1/16/2018.

PHOSPHORUS LOAD ANALYSIS

The 2017 memo indicated that internal loading in Wasserman West pond ranged from 26 to 78 pounds. The wide range estimate was due to the lack of bathymetry data within Wasserman West. We reviewed dissolved oxygen data from 2014 and 2015 to assess the average depth of anoxia in Wasserman West pond. These data were combined with the recently collected bathymetry data, which indicated that summer anoxia is present within the basin and establishes at approximately two meters (Figure 2; 6 feet).

Sediment phosphorus release data is the final piece needed to complete the story for Wasserman West Pond. Sediment cores collected in 2017 indicated that phosphorus release in Wasserman West is 11.6 mg/m^2/day, which is relatively high compared to most lakes in Minnesota. We can combine this data with bathymetry and dissolved oxygen profiles to estimate that the phosphorus load from sediments is 39 pounds of phosphorus per year.

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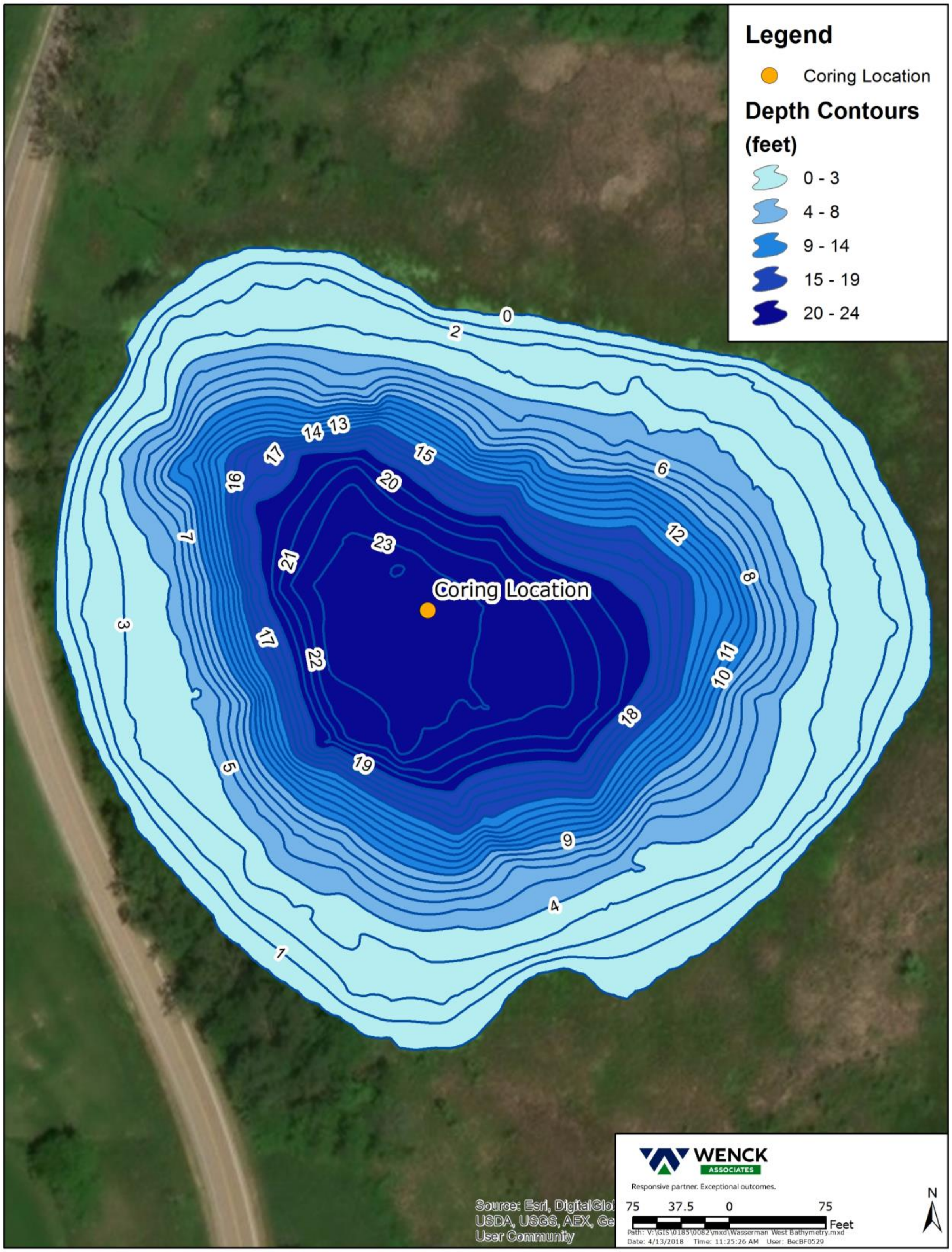

Figure 1. Wassermann West basin contour and sediment coring location

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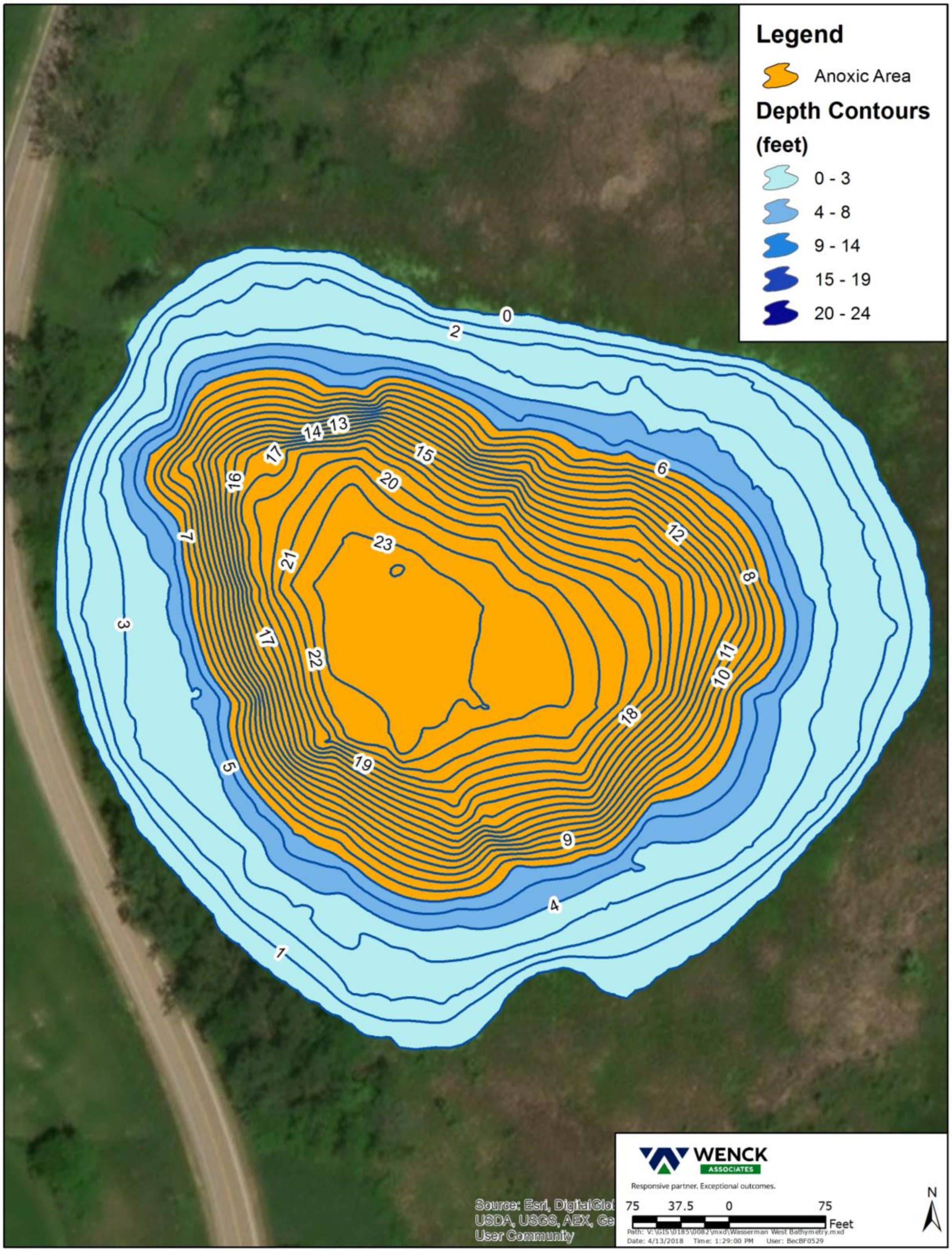

Figure 2. Sediment area typically exposed to anoxic conditions is West Wasserman Pond (orange).

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SEDIMENT CHEMISTRY FACTORS INFLUENCING INTERNAL LOADING

The sediment data collected in 2017 only depicted the uppermost 10 cm of sediment, which indicated that phosphorus concentrations were uniformly high from 0-10 cm. This was surprising since the mobile forms of phosphorus (iron-bound and loosely-bound P; referred to as redox-P) are typically elevated in the top 0-6 cm. The sediment data collected 2017 suggested that the elevated peak of phosphorus may be deeper than 10 cm, which prompted Wenck to recommend collecting sediment data beyond 10 cm. The purpose of this recommendation was to characterize the depth of elevated redox-P to improve the long-term effectiveness of a prescribed aluminum sulfate dose.

Results from the 2018 coring indicated a relatively high amount of redox-P (2 mg/g) in the upper 8 cm of sediment within Wasserman West Pond. The redox-P concentrations decline from 2 mg/g to 1 mg/g in sediment sections deeper than 8 cm. The very high iron-bound P peak at Wassermann West suggests that the anoxic release of P is driven by iron bound phosphorus susceptible to release under anaerobic conditions. Reducing phosphorus release from sediments will require the inactivation of redox-P in the uppermost 8 cm. With that being said, redox P concentrations below 8 cm are still greater than 1 mg/g, which is still relatively high. It will be critical to conduct follow up sediment monitoring to assess how the sediment reacts to an aluminum sulfate treatment since concentrations below 8 cm are higher than we typically see in most lakes.

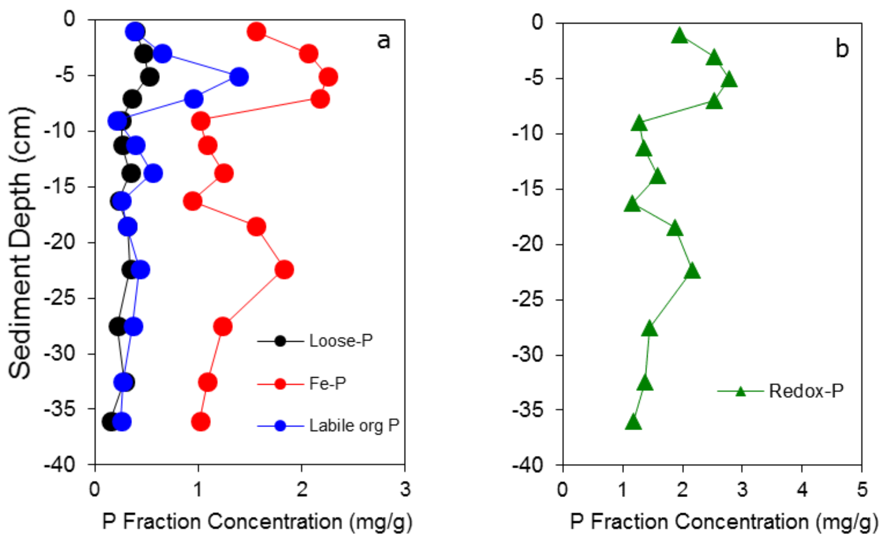

Figure 3. Vertical sediment profiles of loosely-bound P, iron-bound P, and labile organic P (a). The combination of loosely-bound P and iron-bound P is redox-P (b).

RECOMMENDATION FOR INTERNAL LOAD REDUCTION

Sediment data combined with dissolved oxygen profiles and bathymetry data were used to quantify an internal phosphorus load in Wasserman West Pond of 39 pounds per year. For comparison, the total P budget for Wassermann Lake is 1,118 pounds per year, which indicates that internal loading from this pond represents 3% of the P loading to

Wassermann Lake. Wenck expects an estimated annual phosphorus reduction to Wasserman Lake of 35 pounds per year, which would achieve 8% of the required watershed load reduction for Wasserman Lake.

Alum Treatments for Anoxic Area

The goal of a sediment inactivation treatment is to drive 90% of redox-P to aluminum-bound P to reduce phosphorus release rates under anoxic conditions. The mass of alum needed to reduce phosphorus loading from anoxic sediments is based on the sediment chemical characteristics in the uppermost 8 cm. An application rate of 517 g Al/m^2 of alum is needed to inactivate 90% of the phosphorus available for release in the uppermost 8 cm. This is an unusually large amount of alum to apply during one application. Also, adding this much alum would drive pH below 6, which would cause aquatic toxicity issues. Wenck recommends splitting the dose into two applications of a buffered aluminum solution (sodium aluminate and aluminum sulfate) to allow more time for aluminum to react with sediments in Wasserman West.

Wenck recommends applying the initial half dose and waiting approximately two years to apply the second half dose. Wenck recommends sediment monitoring after the initial application and final alum application to assess the effectiveness of the treatments. Follow up sediment monitoring is an effective method for tracking the conversion of redox-P to aluminum-bound P. More importantly, the amount of releasable phosphorus within Wasserman West sediments is unusually high. Therefore, follow up monitoring will also inform MCWD if more aluminum sulfate is needed due to the elevated redox-P concentrations. The final sediment monitoring event will inform MWCD whether a contingency/maintenance dose is necessary to fully inactivate releasable phosphorus within Wasserman West sediment.

Table 2. Wassermann West alum application cost estimate.

Item	Unit	Quantity	Unit Cost	Total Cost
Initial Aluminum Sulfate Application	Gal $Al_2(SO_4)_3$	7,418	$1.85	$13,700
Initial Sodium Aluminate Application	$NaAlO_2$	3,709	$5.50	$20,400
Second Aluminum Sulfate Application	Gal $Al_2(SO_4)_3$	7,418	$1.85	$13,700
Second Sodium Aluminate Application	$NaAlO_2$	3,709	$5.50	$20,400
Contingency/Maintenance Aluminum Sulfate Dose	Gal $Al_2(SO_4)_3$	8,533	$1.85	$15,800
Total Chemical Cost Estimate				**$84,000**
Follow up Monitoring				$15,000
Application Oversight[1]				$2,500
Total Cost Estimate				**$101,500**

[1]This includes 10 hours of application/construction oversight during each application