PRIOR LAKE - SPRING LAKE
WATERSHED DISTRICT

February 18, 2016

Ms. Jennie Skancke, South Metro Area Hydrologist
Metro Region of Waters
Department of Natural Resources
1200 Warner Road
St. Paul, Minnesota 55106

2015 Prior Lake Outlet System Annual Operations Report

Dear Ms. Skancke:

Enclosed is the Annual Operations Report for the Prior Lake Outlet Channel for the year 2015. If you have any questions or need additional information please contact me at (952) 447-4166 or jrockney@plslwd.org.

Sincerely

Jaime Rockney
Water Resources Specialist

CC:

PLSLWD Board Members
Carl Almer, EOR
Bruce Loney, City of Shakopee
Joe Swentek, City of Shakopee
Linda Loomis, LMRWD
Paul Nelson, Scott County
Scott County Commissioners
Katy Gehler, City of Prior Lake
Pete Young, City of Prior Lake
Stan Ellison, SMSC
Scott Walz, SMSC
Troy Kuphal, Scott SWCD

2015 Prior Lake Outlet System Annual Operations Report

By: Jaime Rockney
PLSLWD Water Resources Specialist
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WATERSHED DISTRICT

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INTRODUCTION

The Prior Lake Outlet Structure and Outlet Channel were constructed in 1983 under DNR permit 79-6016 to address high lake level issues on Prior Lake, which does not have a natural outlet. The Prior Lake Outlet Channel (PLOC) is utilized by the Prior Lake-Spring Lake Watershed District (District or PLSLWD) in managing lake levels on Prior Lake, as well as a trunk stormwater system for the Cities of Prior Lake and Shakopee, and the Shakopee Mdewakanton Sioux Community. The 7 mile long PLOC has been divided into 8 management Segments. Segment 1 is on the southern end beginning at the Prior Lake Outlet Structure, while Segment 8 is on the northern end and flows into the Minnesota River in Shakopee.

To address current needs and plan for future development in the watershed, in 2007 the District finalized a Joint Powers Agreement/Memorandum of Agreement (JPA/MOA) with the Cities of Prior Lake and Shakopee, and the Shakopee Mdewakanton Sioux Community for the operation, maintenance and use of the Prior Lake Outlet Channel. This group of cooperators oversees the operation of the PLOC, while the District administers the day to day operations. In the early 2000's, it was determined by these JPA/MOA Cooperators that while the channel and outlet had worked well since their inception, if modified in several places, they could operate more efficiently, reduce long term maintenance and enhance the environment. With this in mind, the cooperators formed the JPA/MOA and undertook a 5-7 year project to restore and enhance the PLOC. Acknowledging that the PLOC is used as a stormwater conveyance system and is not just a natural conveyance, the JPA/MOA cooperators focus is to manage the easements of the channel and the channel itself to maintain hydrologic capacity, reduce maintenance needs, provide long-term stability and improve water quality. Secondary benefits include increased aesthetics, providing improved habitat and providing consistency with city and county plans for parks and greenways.

Operation of the Prior Lake Outlet Structure is governed by the DNR-approved Prior Lake Outlet Control Structure Management Policy and Operating Procedures dated October 2004, approved February 2005. This plan specifies a review procedure that is to be repeated every 3 years. A review and revision of this document is anticipated to occur in 2015 now that a calibrated rating curve has been established for the new design of the Prior Lake Outlet Structure. Additionally, an Operation, Inspection and Maintenance Manual was drafted and adopted in September 2011 for the Prior Lake Outlet Structure. The purpose of this secondary manual is to establish guidelines and practices to provide existing and future District Staff with the knowledge of how to properly operate, inspect and maintain the structural and operational components of the outlet to maximize the life and effectiveness of the structure. The manual includes a table of recommended inspection items along with the recommend frequency of inspection. These recommendations will be reviewed periodically by District Staff to determine if the frequency is appropriate based on findings in the field and the manual will be updated accordingly.

According to the National Oceanic and Atmospheric Administration records, the 30-year county wide average annual precipitation for Scott County is 30.95 inches. The rainfall in 2015 at the PLSLWD office totaled 35.88 inches (rainfall recorded by volunteer rain gauge monitor, Jonathan Cohen). Figure 1 and Attachment G summarize the precipitation recorded within the District in more detail. Prior Lake reached a maximum of 902.91' on 12/21/15 and a low of 901.09 on 3/20/15.

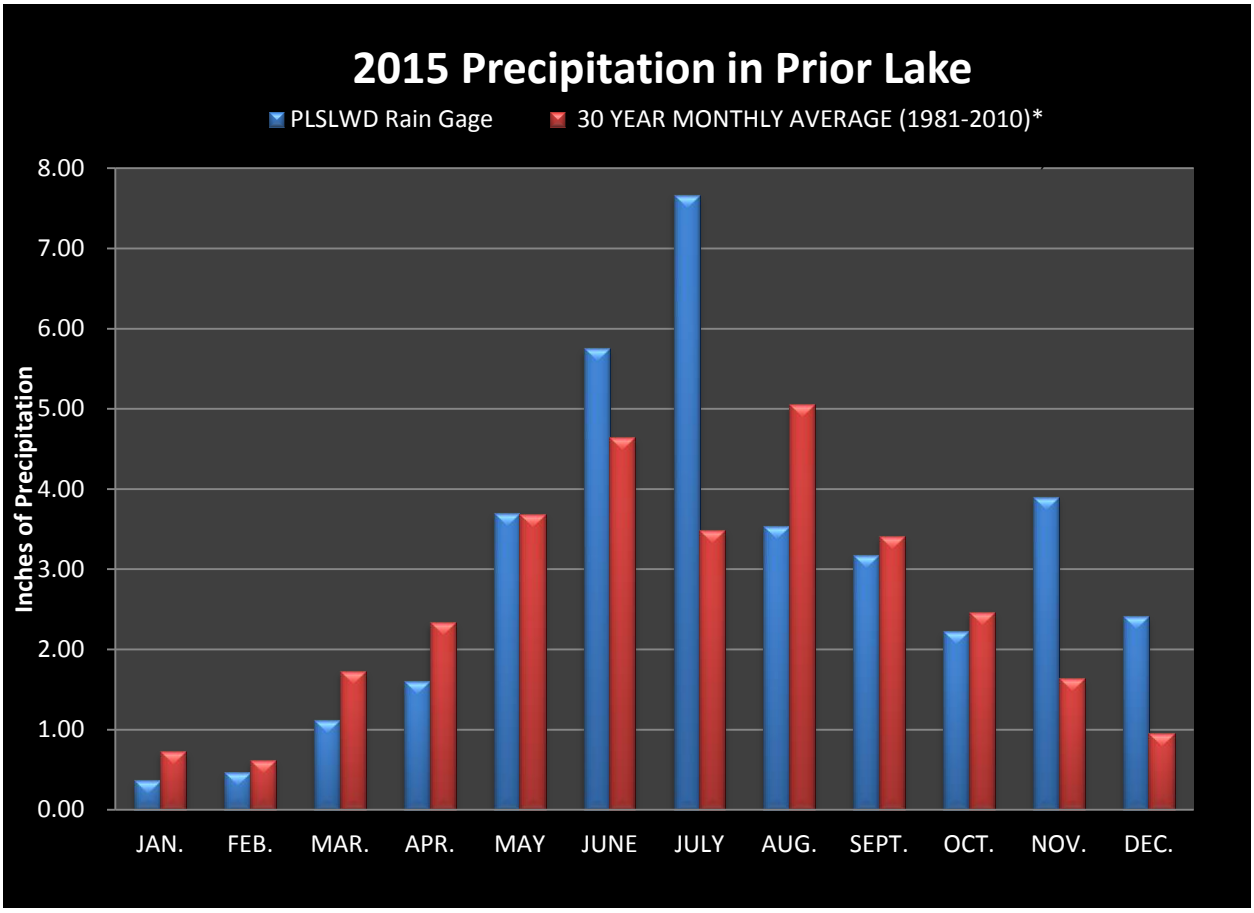


FIGURE 1 PRECIPITATION GRAPH

OUTLET STRUCTURE

HISTORY

The Prior Lake Outlet Structure (Figure 2) was originally constructed in, and has been operated since1983. The original design of the structure required manual operation to open and close gates to regulate the flow. This design posed safety concerns to staff while operating the structure during high water levels. Additionally, there were inefficiencies in the structure's design because the 36 inch pipe connected to the structure did not reach its maximum flow of 65 cfs until lake levels well surpassed the outlet elevation. Over the years the structure had also developed wear and required minor maintenance.

Given these conditions, a replacement structure was pursued by the District and installed in 2010. The new design has increased the efficiency of discharging water by allowing the outlet pipe to reach capacity sooner. It has also proven to provide safer conditions for staff during inspections and maintenance, and is self-operating, which will reduce overall operations and maintenance costs. A schematic of the outlet structure is provided in Attachment A.

MAINTENANCE AND OPERATION

Outlet Structure

FIGURE 2 OUTLET STRUCTURE

The new structure needs minimal maintenance in order to operate. Once Prior Lake reaches 902.5', water starts spilling over the accordion shaped weir located inside the trash rack. Maintenance includes visual inspections, greasing gates, and removing debris from the trash rack. Removing vegetation and other debris from the trash rack is the most time-consuming and labor-intensive task (see Figure 3). When the structure is operating (Prior Lake is greater than 902.5'), the structure will be inspected no less than once a week, and as much as twice per day (depending on the lake level and amount of vegetation getting stuck on the trash rack). Inspections and debris removal is typically conducted by PLSLWD staff. During the 2014 flood, however, the City of Prior Lake staff helped remove vegetation once per day and on the weekends in addition to District staff also removing the vegetation daily in order to ensure Outlet Structure was not blocked.

Excluding 2009, the Prior Lake Outlet Structure had flow, at least partially, every year since 1999. The year 2011 held the greatest volume of water flowing through the system since the structure's establishment in 1983. This was partially due to the more efficient design of the new Outlet Structure; however, the primary factor was the duration of continuous discharge being significantly greater than in previous years.

During 2015 operations, the Prior Lake Outlet Structure performed well throughout the duration that water discharged from the lake. The Prior Lake elevation overtopped the outlet weir from July 15 to August 14, August 17 to September 12, and remained above 902.5 after November 18 through the end of the year. In order to reduce the risk of flooding, the District opened the Low Flow gate on December 21 due to high lake levels, saturated conditions, and minimal storage capacity in the watershed (Figure 4). Opening the Low Flow gate allows more water through the outlet structure, resulting in the lake level lowering more quickly and creating more storage. In its 102 days of discharge during 2015, an estimated 1.60 feet of vertical volume was eliminated from the lake through the Prior Lake Outlet Structure (see Attachment D). It is estimated that the lake level of Prior Lake could have reached approximately 904.51 feet without operating the outlet structure. Attachment D is provided for comparison between years on the overall usage of the Prior Lake Outlet Structure. The numbers shown are calculated based on the most accurate information available. They are not exact and are intended for yearly comparisons only. Attachments E and F show daily Prior Lake elevations throughout 2015.

FIGURE 3 – REMOVING VEGETATION FROM THE OUTLET STRUCTURE GRATE

FIGURE 4 – PLSLWD STAFF OPENING THE LOW FLOW GATE

Outlet Pipe

The JPA/MOA cooperators agreed to televise the Outlet Pipe (the pipe leading from the Outlet Structure to the beginning, or "daylight," of the outlet channel) every 2 years to check the pipe condition. The pipe is approximately 2075 feet long, with 5 manholes and 7 access points. Visu-Sewer televised the pipe on September 15, 2015 to look for potential damage, areas in need of repair, blockages, accumulated debris, and to assess whether the pipe is reaching full hydraulic capacity. Visu-Sewer recorded the entire length of the channel with video equipment. They concluded there were no pipe blockages from broken pipe, no significant root intrusion, and no substantial debris, such as tree branches. They did find some areas with deposits of fine material in the bottom of the pipe which restrict the flow by no more than ten percent. They suspect these deposits would be washed out of the pipe by the force of flow when the outlet structure is in use. They also found that the outfall pipe access manholes are not constructed with nice, smooth benches which they suspect could cause substantial headloss during peak flow periods.

It was originally believed that the pipe material was reinforced concrete throughout the entire length of the pipe. Visu-Sewer identified two segments of what they believe is steel pipe. One segment of steel pipe is located between manhole numbers 2 and 3; the other is located between manhole numbers 3 and 4. The surface of this pipe appears to be rusted and they found loose pieces of rusted pipe when entering manhole number 4. While the steel pipe appears to be maintaining its original round shape, they cannot determine the thickness or structural integrity loss from rusting.

In general, the lake outfall pipe is in good to fair condition. They identified one defect that is coded red for immediate attention. The reinforcement is visible on the edge of the pipe on the downstream end of manhole number 3. Exposed steel is subject to rusting and allows water into the concrete pipe. This defect can be repaired with a cementitious coating; however it is in a difficult location being at the end of the pipe.

FIGURE 5 IMAGE OF OUTLET PIPE DURING TELEVISING

The pipe also has leaking joints with mineral deposits in every pipe segment and some of these joints are likely the source of the fine deposits found downstream of manhole number 4. They identified a number of dripping leaks, but perhaps the most significant dripping water was found at manhole number 6.

While the volume of water leaking through an individual joint may not be substantial, the accumulation of mineral deposits will affect the hydraulic capacity of the pipeline and perhaps more importantly, the movement of fine soils from the area surrounding the pipe can eventually shorten the life of the pipeline as the supporting soils are lost and the pipe can move. Visu-Sewer recommends the JPA/MOA partners consider a project to inject chemical grout in the leaking joints, before lining the existing pipe. Significant leaks must be stopped to facilitate lining work anyway.

In 2016, the spalling joint and manholes gutter bases will be repaired. Originally, the JPA/MOA partners planned to repair the spalling joint in 2015, but determined it would be more cost effective to repair the spalling joint and smooth the manholes at the same time. The chemical grouting is scheduled to be completed in 2017.

FIGURE 6 LOCATIONS OF OUTLET PIPE AND ACCESS POINTS

OUTLET CHANNEL

While the Outlet Structure is in full operation and discharging water, the District is required to perform regular inspections of the Outlet Structure and the Outlet Channel in accordance with the Outlet Operations Manual. An Inspection Frequency Guideline was created and adopted by the JPA/MOA group in 2014 (Figure 7). On the basis of these inspections, the District was able to determine that the Outlet Structure and Outlet Channel were structurally sound and able to handle the lake discharges and surface flows downstream of the Outlet Structure.

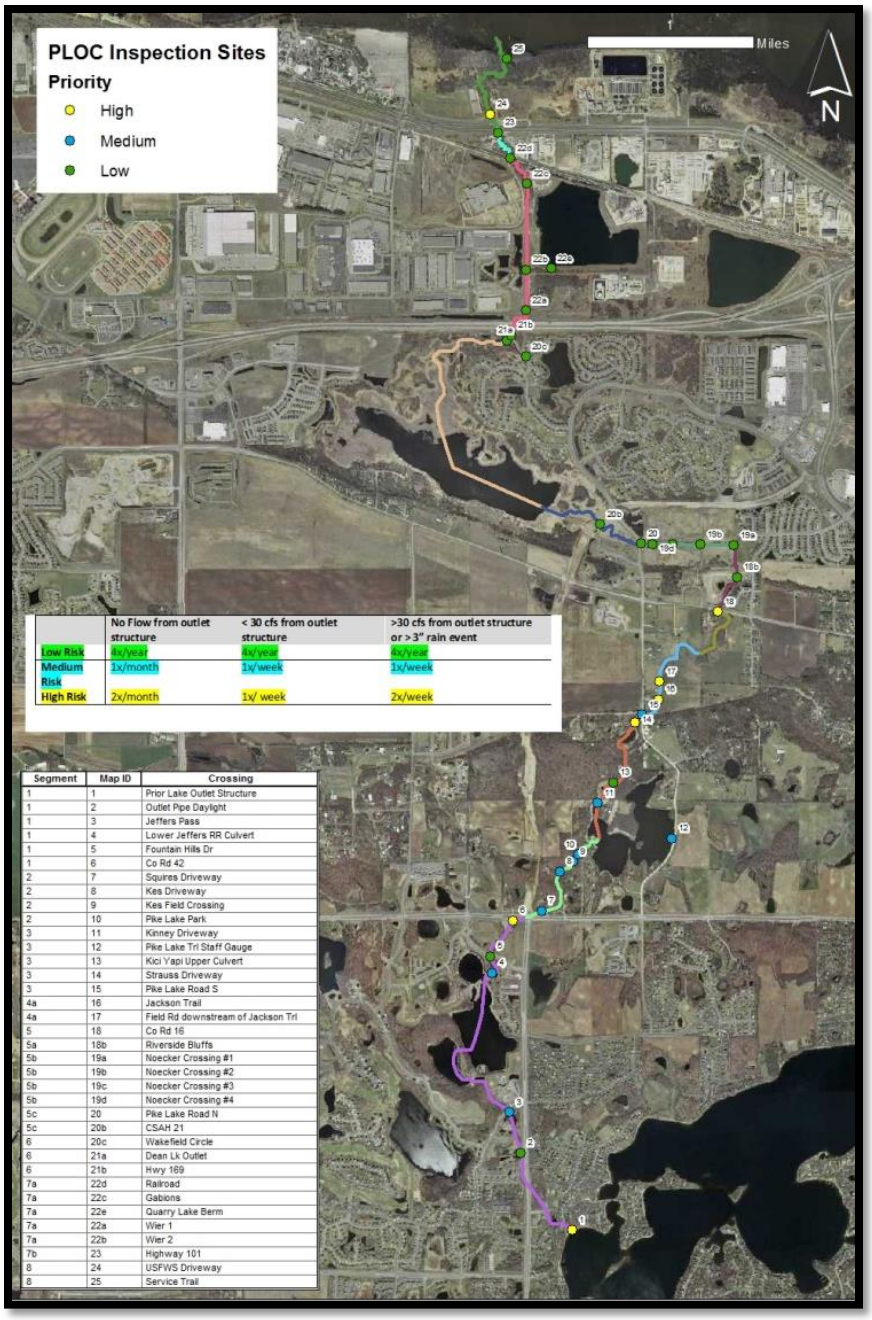


FIGURE 7 INSPECTION SITES

Flood Repair

The Prior Lake Outlet Channel incurred substantial damage during the 2014 flood, including downed trees, accumulated woody debris, sediment accumulation, culvert damage and over 20,000 feet of bank erosion. In 2015, most of the tree removal work was completed and one of the culverts was repaired. The rest of the work will begin in 2016. The Federal Emergency Management Administration (FEMA) has approved federal funding to cover 75% of the costs of the 2014 flood damage to the PLOC. The State of Minnesota will pay the remaining 25%.

As one of the first steps to repair the flood damage, the District Engineer, EOR, surveyed the PLOC and developed tree removal plans, which included removing downed trees and woody debris from the 2014 flood. The plans also included removing downed trees that were posing a maintenance issue in the channel, but were not a direct result of the flood.

The District hired Wetland Habitat Restorations, LLC (WHR) to remove the downed trees and woody debris from all Segments except 6 and part of 8 in the PLOC. Trees were not removed from Segment 6 because there are almost no trees in Segment 6. In Segment 8, USFWS owns some property and their management plan requires woody debris to stay in place for habitat. The majority of the tree removal was completed in 2015, but the project was officially complete on January 27, 2016. Some additional tree removals for maintenance purposes will be removed by the Institution/Community Work Crew Program through the State of Minnesota in 2016.

FIGURE 8 MARKING TREES FOR REMOVAL

FIGURE 9 AFTER TREE REMOVAL (SAME LOCATION AS PREVIOUS PICTURE)

Damage to the KiciYapi, USFWS, Gonyea, and Kes field crossings occurred during the 2014 flood. In partnership with the Shakopee Mdewakanton Sioux Community, the KiciYapi Culvert was replaced in 2015. Bolton and Menk designed the replacement culvert and FEMA and the State of MN helped fund this culvert replacement. The USFWS culvert crossing was completely washed out so the USFWS decided to remove the crossing and with help from the Scott SWCD, restore the crossing in include a wider flood plain and native plant species. In 2016, the Kes Field Crossing culvert will be repaired and the Gonyea Culvert will be repositioned.

FIGURE 10 KICIYAPI CULVERT REPLACEMENT

Channel Repair

Part of the channel was realigned in Segment 4A in 2015. Over time, streams naturally remeander, but this section of the channel remeandered (eroded) to the extent that the driveway and barn of the adjacent property was being compromised and the channel was no longer completely within the original easement. EOR designed and Sunram constructed the project. Trees were removed on one of the adjacent landowner's properties in order to move the channel back into its original location. At the request of the landowner, these trees were replaced Scott Soil and Water Conservation District was hired by the District to coordinate the tree replacement with the landowner. Given the narrow width of the easement, the channel is now lined with riprap, stout stakes and a mix of grasses in order to reduce future erosion potential.

FIGURE 11 REALIGNMENT OF SEGMENT 4A

Annual Maintenance

Removal of vegetation and debris from several culverts and/or grates throughout the year to ensure free flows was the primary extent of the additional maintenance that occurred.

FIGURE 12 REMOVING VEGETATION STUCK ON GRATE

MONITORING

Monitoring along the outlet channel in 2015 consisted of water quantity and quality, and vegetation and erosion monitoring. Some of this monitoring is funded by the JPA/MOA partners, and some is done for other programs or entities. A monitoring map is provided in Figure 13.

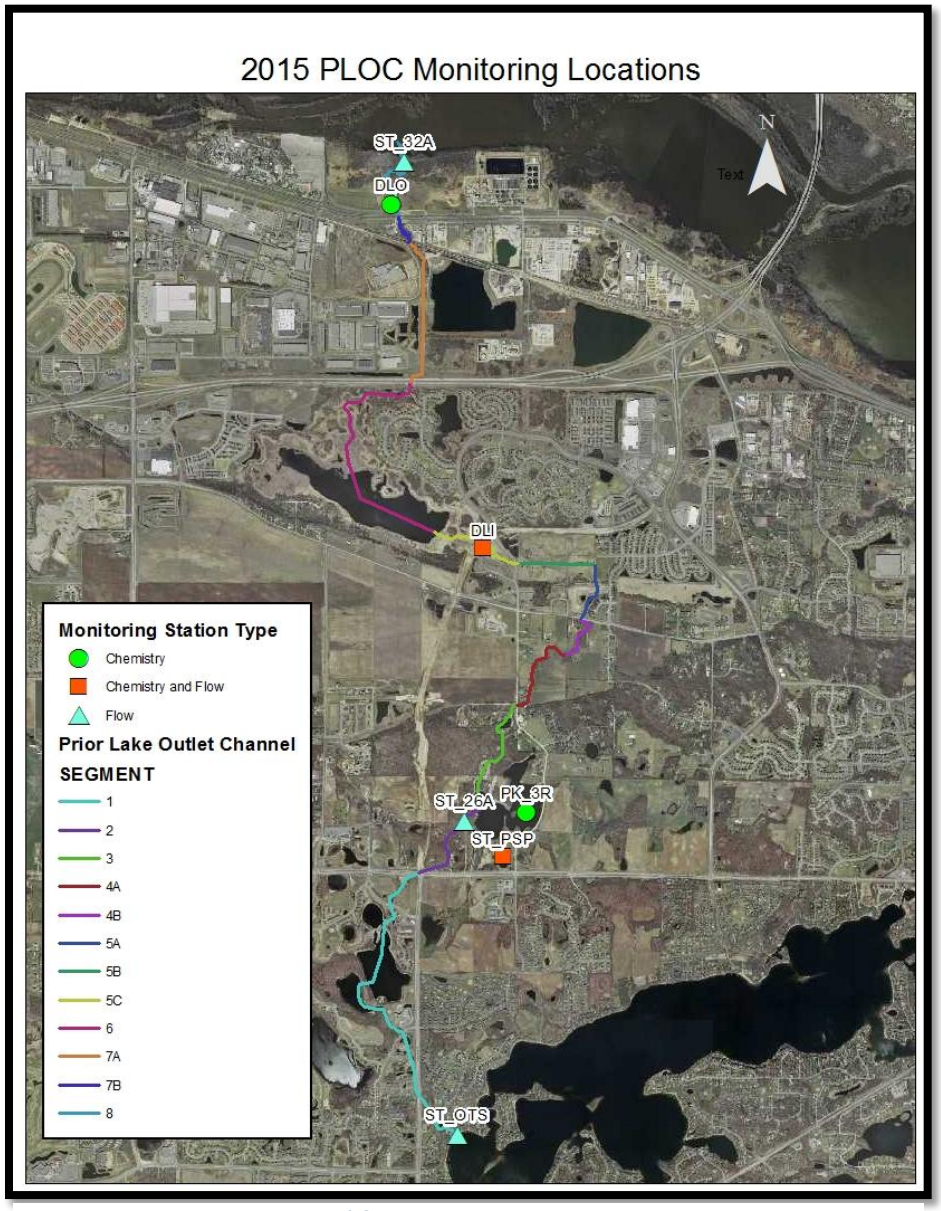


FIGURE 13 MONITORING LOCATIONS

WATER QUANTITY AND QUALITY

Water quantity monitoring consisted of obtaining continuous stage and flow measurements. At each site, a level logger recorded stage in 15 minute increments. Flow measurements were taken at various stages in order to create a stage-discharge relationship (rating curve). Flow data can be used to help estimate pollutant loads, calibrate the XP-SWMM model, and determine the volume of water flowing through the system.

Water quality was monitored at multiple sites along the outlet channel (see Figure 13) and a couple sites in Pike Lake (the east and west bay). Field measurements are collected by using a multi-parameter probe to measure pH, temperature, conductivity, turbidity, and dissolved oxygen. Chemistry samples were sent to RMB Labs (ST_PSP), Metropolitan Council Environmental Services (DLI and DLO), and Three Rivers Park District (Pike Lake) for analysis. PLSLWD staff measured flow and stage at ST_OTS, ST_PSP, ST_26A, and ST_32A. Scott SWCD and EOR helped collect flow samples at ST_OTS on occasion. Scott SWCD collected chemistry samples at DLI and DLO, as well as stage and flow at DLI. Three Rivers Park District sampled Pike Lake chemistry in both the east bay (PK_3RE) and west bay (PK_3RW).

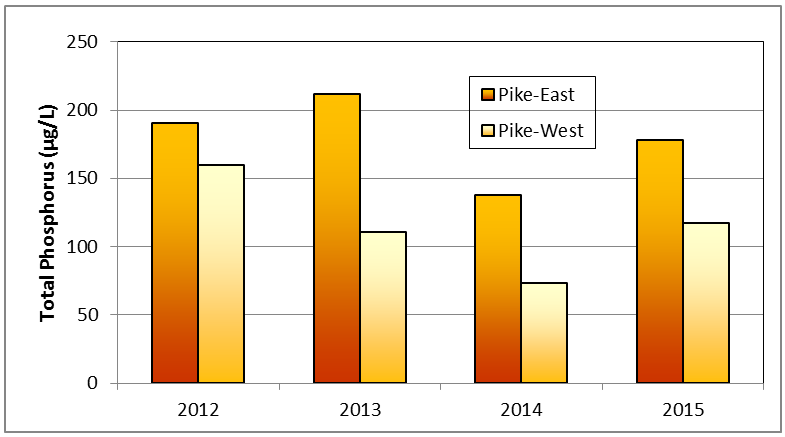
SEDIMENT SAMPLING

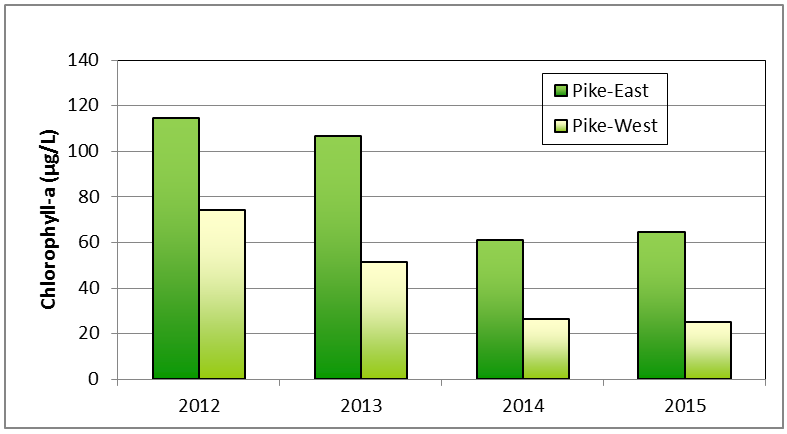
The Lower Minnesota River Watershed District (LMRWD) conducted a Paleolimnology study on Dean Lake in 2014. This study provides information on historic water quality conditions based off of sediment core samples. This information can be obtained by calling the LMRWD for a copy of the report. The results of the study recommended that Dean Lake be reclassified as by the MPCA as a wetland, so it would no longer need to adhere to Lake Water Quality Standards. The District supported LMRWD's request.

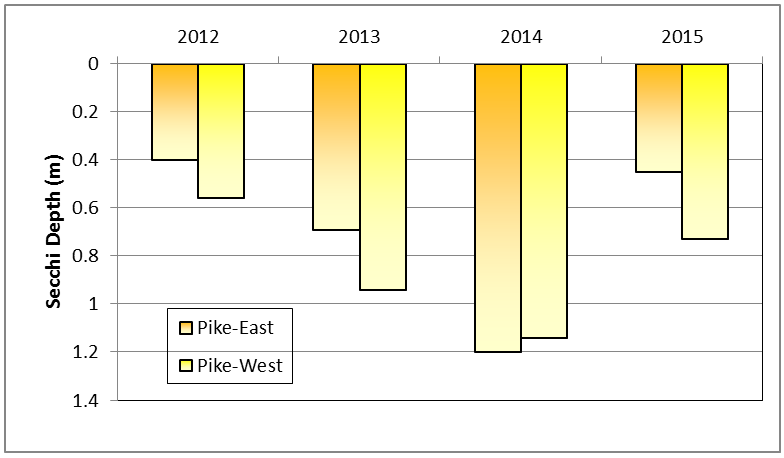
TABLE 1 AVERAGE VALUES OF 2015 STREAM MONITORING SITES

Parameters	ST_PSP	DLI	DLO
Average of TP--ug/L	130	80	60
Average of OP--ug/L	33	42	26
Average of E_coli-- MPN/100mL	1276	214	311
Average of Cl--mg/L	177	52	60
Average of TSS--mg/L	10.0	6.3	10.7
Average of TSVS--mg/L	4.4	5.3	5.0

TABLE 2 PIKE LAKE MONITORING RESULTS (EAST AND WEST BAY)







Vegetation and Erosion Monitoring

Due to the extensive amount of work being done in the channel in 2015, no vegetation or erosion monitoring was conducted along the channel. This work will resume in 2016. However, Blue Water Science did conduct a point-intercept vegetation survey in Pike Lake. This study revealed that 48 of the 74 sampling points had no plants and total of 6 plant species were found. The majority of plants found were Coontail and Eurasion Water Milfoil. See Table 3 for more detail.

Figure 14 Pike Lake Vegetation Sampling Points

TABLE 3 – VEGETATION SAMPLING RESULTS

Site	Depth	Duckweed	Coontail	Curlyleaf	Elodea	Eur. Milfoil	Flatstem	No Plants
1	2	1	3			4		
2	3		4	1		1		
3	4		1					
4	4		3			3		
5	4		4			1		
6	5							1
7	5							1
8	5							1
9	4					1		
10	5							1
11	3				1			
12	4		1			1		
13	5							1
14	5							1
15	5							1
16	3		1		3	2		
17	5							1
18								1
19								1
20	5							1
21	6							1
22	4		1			3		
23	5					1		
24	6							1
25	5							1
26	4		1					
27	3				1	1		
28	land							1
29								1
30								1
31								1
32	3				1	1		
33	2		1				2	
34	5							1
35	5		1					
36	5							1
37								1
38	5							1
39								1
40								1
41								1
42	7							1
43	4		2			2		
44	4		2		2	2		
45	3		4			3		
46	6							1
47								1
48								1
49								1
50	6							1
51	4				1			

Site	Depth	Duckweed	Coontail	Curlyleaf	Elodea	Eur. Milfoil	Flatstem	No Plants
52	4		3			3		
53	5					1		
54								1
55								1
56								1
57	6							1
58	7							1
59								1
60								1
61	6							1
62	2					1		
63	7							1
64	5							1
65	4				2	1		
66	7							1
67	2							1
68	7							1
69	7							1
70	5							1
71	7							1
72	7							1
73	1					1		
74	3					2		
Total	**4.6' (avg depth)**	**1**	**32**	**1**	**11**	**35**	**2**	**48**

More detailed monitoring results will be provided in the 2015 PLSLWD Annual Water Monitoring Report.

PERMITS

In 2015, the District had seven open permits along the PLOC:

- Permit #10.02 *Jeffers Waterfront*: The Certificate of Completion has been sent to the permit holder for signature.
- Permit #11.03 *Jeffers Pointe*: The developer is working with the District to address the degraded raingarden onsite before assigning a Certificate of Completion.
- Permit #12.05 *Pike Lake Road Culvert Replacement*: This permit was closed in 2015.
- Permit #13.01 *Jeffers Pass Outlet*: This permit was closed in 2015.
- Permit #13.04 *Valley Park Business Center*: A few minor issues onsite need to be resolved before a Certificate of Completion is approved.
- Permit #13.05 *East Village 3rd Addition:* Site needs to reach appropriate vegetative cover before a Certificate of Completion is approved. The District anticipates closing out the project this spring.
- Permit #14.01 *KiciYapi Culvert*: This permit was closed in 2015.

The District anticipates closing out the four remaining open permits in 2016.

OUTLET CHANNEL RESTORATION AND ENHANCEMENT PROJECT

Over the last ten years, the JPA/MOA cooperators have undertaken a project to restore and enhance the PLOC. The purpose of the project has been to maintain hydrologic capacity, reduce maintenance needs, provide long-term stability, improve water quality, increase aesthetics, provide improved habitat and provide consistency with city and county plans for parks and greenways. Several portions of this project have been completed.

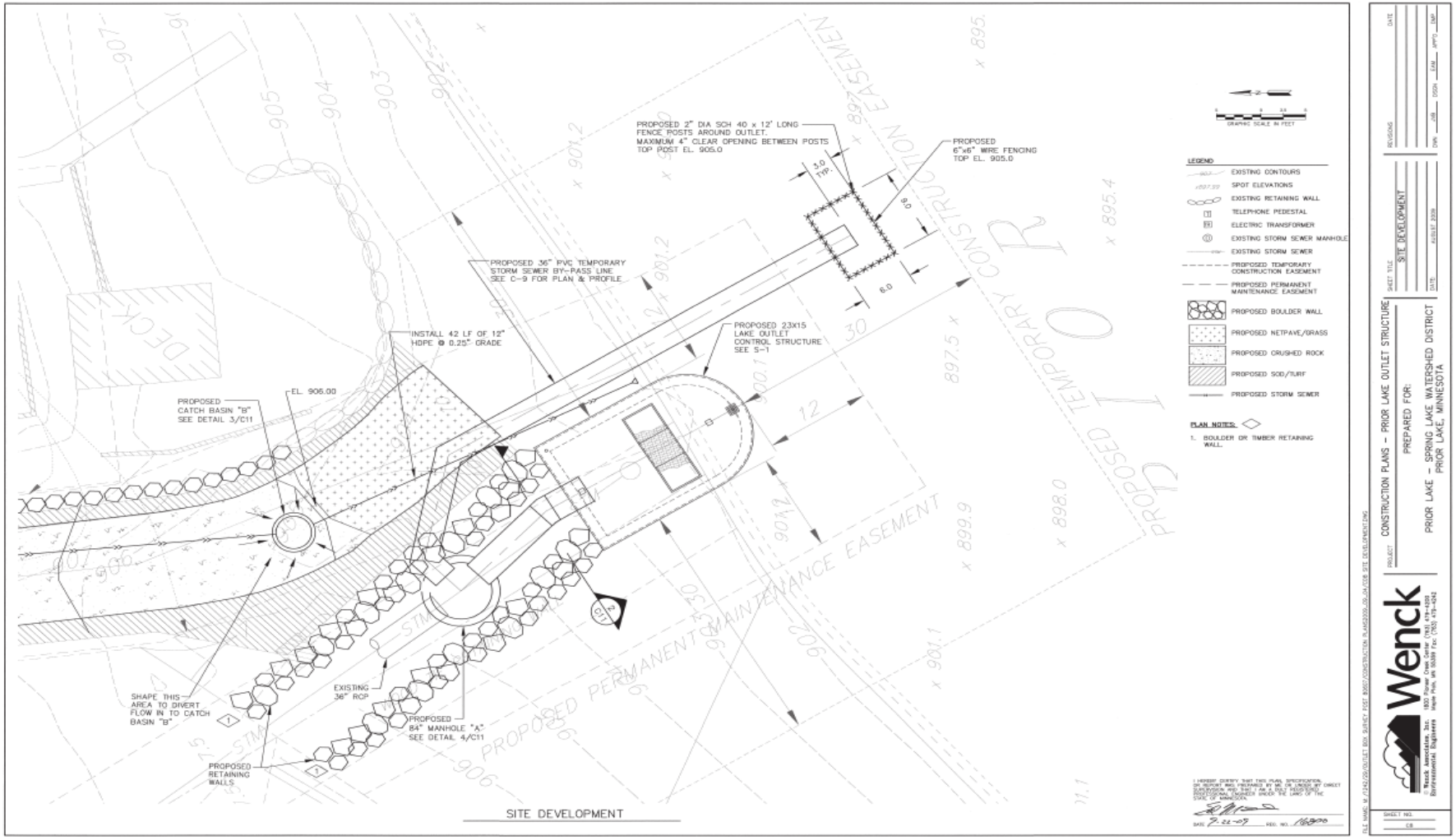
- Work completed on Segment 1 in 2006 consisted of bank stabilizations, increased native plantings and a creation of a spillway between Upper and Lower Jeffers Ponds.
- A basin was excavated and sinuosity was added to the channel in Segment 5c prior to entering Dean Lake during the early portion of 2007.
- Work in 2009 included the replacement of an undersized culvert on the northern end of Segment 8.
- The year 2010 held the finalization of work in several Segments including: banks being reshaped, in addition to toe stabilization and weir reinforcements put in place on Segment 7a; toe stabilization, bank protections and flow realignment in Segment 3; and work to build up the channel bed and reconnect it to the floodplain in Segment 2.
- Additional site checks were made throughout 2012 to ensure stability against erosion and vegetation survival within the areas of previous work in Segments 2, 3, and 7a.
- In 2013, three failing culverts were replaced between Segments 3 and 4B (Pike Lake Road, Jackson Trail, and the Field Road downstream of Jackson Trail). In addition, vegetation along the channel was managed for herbaceous invasives by EOR and woody invasives by Applied Ecological Services. Garlic mustard was hand cut in Segments 3-8. Small populations of Common burdock were cut in Segments 4A, 4B, and 8. Block locust, common buckthorn, and Tatarian honeysuckle suckers and seedlings were treated in segments 1, 3, 4A, 5C, 6, and 7A.
- In 2014, activities include: Garlic mustard was hand cut with a weed cutter in segments 3-7 by EOR. Wild Parsnip was hand cut with a weed cutter in segment 1 by EOR (only location wild parsnip was found). A foliar spray was applied for woody invasives (black locust, common buckthorn, and honeysuckle) in segments 1, 3, 4a, 5c, 6, and 7a (by AES).

- In 2015, Garlic Mustard was hand cut by EOR on May 15 in segments 3 through 8. EOR released flea beetles on June 26 in Segment 7 to treat the leafy spurge in that segment.

Additional areas with planned future reconstruction include Segments 4b and 7b. Segment 4b will include bank stabilizations, grade controls, cattle exclusion fencing and vegetation plantings within the bank and riparian area. Segment 7b is planned to have toe stabilizations and bank protection installed. These additional reconstruction items will be addressed with the JPA/MOA cooperators as they progress.

FIGURE 15 LEAFY SPURGE IN SEGMENT 7

Attachment A. Prior Lake Outlet Structure Diagram



Attachment B. Annual Outlet Channel Operations Summary

Most of the inspection forms were lost from 2015. A computer malfunction deleted many files, including the inspection reports. These are the few that were not deleted.

Date	Elevation	Outlet Activity	Inspections/Channel Activity
7/28/2015	902.75	Inspection	cleared vegetation from outlet structure, debris on Jeffers Pass culvert - alert City. Removed log from Lower Jeffers, Squires driveway, and Kes field crossing.
8/11/2015	902.58	Inspection	cleared vegetation from outlet structure
8/21/2015	902.70	Inspection	cleared vegetation from outlet structure
8/25/2015	902.65	Inspection	cleared vegetation from outlet structure
9/11/2015	902.50	Inspection	Cleaned Pike Lake staff gauge

Attachment C. Stage-Discharge Relationship

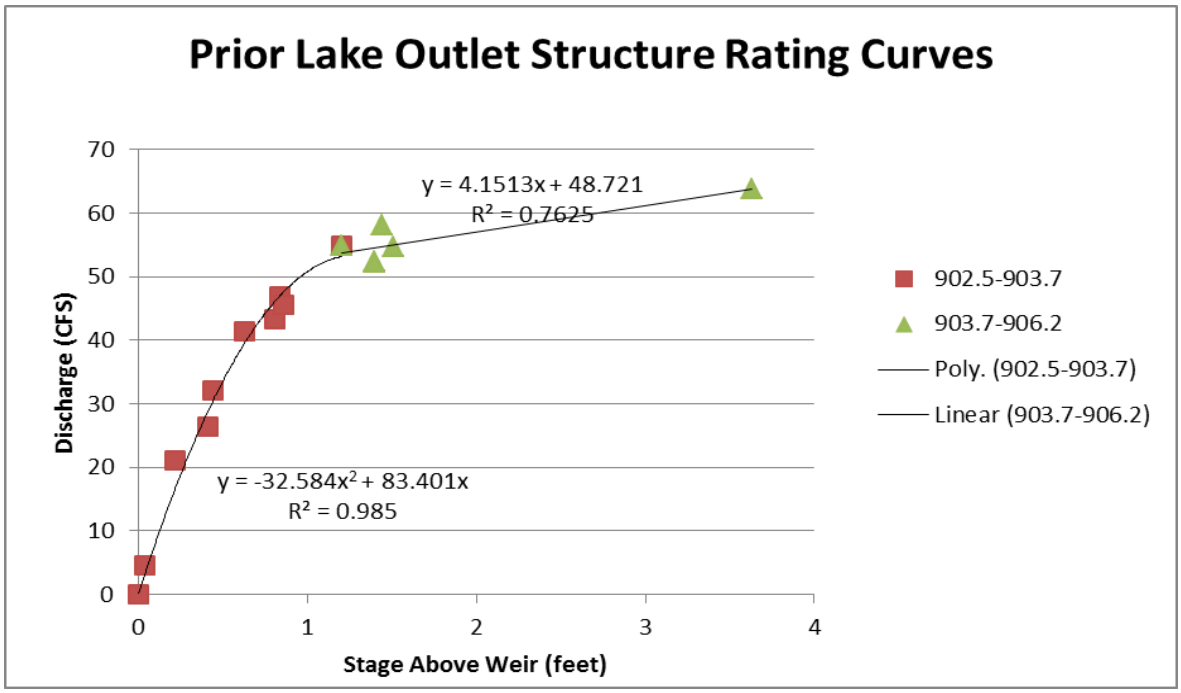
Weir modified in the fall of 2012.
Weir crest cut to 902.36 (NGVD 29) based on EOR survey of the outlet structure on 1/4/2013.
Any previously collected discharge omitted from the rating curve.
Rating curve created by EOR.

Date	Time	Elevation of Prior Lake	Stage above weir	Q [cfs]	
5/22/2013	9:25	902.94	0.44	32.15	
6/13/2013	13:45	903.13	0.63	41.49	
6/18/2013	15:00	903.34	0.84	46.96	
7/15/2013	14:30	903.70	1.20	54.90	
7/22/2013	11:20	903.94	1.44	58.10	
8/22/2013	9:10	902.54	0.04	4.56	
5/21/2013	14:15	902.91	0.41	26.48	
6/17/2013	14:58	903.31	0.81	43.40	
7/2/2013	14:00	903.36	0.86	45.56	
8/16/2013	11:50	902.72	0.22	21.01	
6/12/2014	9:53	904.01	1.51	54.73	
7/2/2014	13:43	906.13	3.63	63.85	
8/5/2014	14:14	903.90	1.40	52.34	
8/5/2014	13:30	903.90	1.40	52.33	
12/21/2015	11:58	902.91	0.41	37.23	
12/21/2015	14:30	902.91	0.41	44.09	*
12/28/2015	13:55	902.78	0.28	34.17	*
12/31/2015	10:05	902.64	0.14	33.95	*
12/31/2015	10:30	902.64	0.14	34.79	*

*These flows were measured when low flow gate was open and are excluded from rating curve

Stage	Discharge
0.04	4.56
0.14	33.95
0.14	34.79
0.22	21.01
0.28	34.17
0.41	26.48
0.41	37.23
0.41	44.09
0.44	32.15
0.63	41.49
0.81	43.40
0.84	46.96
0.86	45.56
1.20	54.90
1.40	52.34
1.40	52.33
1.44	58.10
1.51	54.73
3.63	63.85

2015 Rating Curve (same as 2014 Rating Curve):
For lake levels less than 902.5', flow = 0.0 cfs.
For lake levels between 902.5' (stage above weir = 0) and 903.7' (stage above weir = 1.2'), use rating curve $y = -32.584x^2+83.401x$
For Lake Levels greater than 903.7' (stage above weir = 1.2'), use rating curve $y = 4.1513x + 48.721$



Attachment D. Volumes Discharged from Prior Lake

Volumes Discharged from the Prior Lake Outlet and Associated Elevations								
Year	**Volume Discharged (ac*ft)**	**Depth Eliminated from Lake (ft)**	**Min Elevation for the Year**	**Date of Min Elevation**	**Max Elevation for the Year**	**Date of Max Elevation**	**Max Elevation *without* the Outlet**	**Annual Rainfall**
2015	3043	1.60	901.09	3/20/2015	902.91	12/21/2015	904.51	35.74
2014	12028	6.10	900.1	3/28/2014	906.16	6/30/2014	912.26	36.44
2013	7609	3.93	900.25	3/28/2013	903.95	7/22/2013	907.88	33.25
2012	5751	3.00	900.48	12/6/2012	903.59	6/25/2012	906.59	30.57
2011	20314	9.93	900.87	12/28/2011	903.95	4/5/2011	913.88	26.07
2010	1110	0.59	899.38	1/14/2010	902.78	12/23/2010	903.37	37.23
2009	0	0.00	898.98	9/30/2009	900.44	4/29/2009	900.44	27.41
2008	4993	2.61	900.28	12/29/2008	902.90	5/8/2008	905.51	23.88
2007	1395	0.74	900.55	8/10/2007	902.78	4/23/2007	903.52	28.59
2006	4331	2.27	900.50	12/14/2006	903.27	4/7/2006	905.54	27.77
2005	2299	1.21	900.71	1/18/2005	903.10	10/18/2005	904.31	38.02
2004	13	0.01	900.50	4/15/2004	902.79	7/12/2004	902.80	32.96
2003	5921	3.08	900.62	12/30/2003	903.17	5/23/2003	906.25	23.00
2002	9520	4.88	900.70	3/4/2002	903.60	9/10/2002	908.48	41.96
2001	8692	4.47	901.04	12/28/2001	904.28	5/7/2001	908.75	28.52
2000	80	0.04	901.52	2/20/2000	903.00	7/11/2000	903.04	26.09
1999	6240	3.24	902.00	11/25/1999	904.78	5/27/1999	908.02	33.29
1998			*902.05*	*1/1/1998*	*903.90*	*4/13/1998*		*35.00*
1997	4150	2.18	901.20	2/28/1997	902.90	4/21/1997	905.08	*32.36*
1996		0.00	*900.77*	*11/4/1996*	*902.98*	*4/10/1996*		*26.52*
1995			*902.26*	*9/26/1995*	*903.25*	*3/30/1995*		*30.62*
1994	1760+	0.93	901.90	9/7/1994	903.05	10/24/1994	903.98	*35.28*
1993	10000+	5.12	902.00	3/9/1993	904.49	7/14/1993	909.61	*36.40*
1992	8331	4.29	899.95	2/19/1992	903.16	10/12/1992	907.45	35.86
1991			*898.11*	*4/1/1991*	*900.92*	*6/13/1991*		
1990			*895.46*	*4/24/1990*	*899.38*	*8/10/1990*		
1989			*895.49*	*11/27/1989*	*897.15*	*4/3/1989*		
1988			*896.90*	*11/11/1988*	*899.63*	*1/1/1988*		
1987			*899.63*	*12/31/1987*	*901.54*	*3/6/1987*		
1986			*901.22*	*2/14/1986*	*903.96*	*5/15/1986*		
1985			*902.23*	*9/12/1985*	*903.93*	*4/25/1985*		
1984			*901.75*	*10/9/1984*	*903.60*	*6/24/1984*		
1983	Outlet Installed		*901.76*	*1/17/1983*	*905.68*	*7/20/1983*		
1982			*900.06*	*3/24/1982*	*902.56*	*5/21/1982*		
1981			*898.91*	7/31/1981	*899.88*	*9/17/1981*		
1980			*899.92*	*12/29/1980*	*902.60*	*4/18/1980*		
Averages	**5879 (when operated)**	**2.74 (when operated)**	**900.31**		**902.83**		**906.25**	**31.78**
Unless otherwise noted, data is taken from annual Prior Lake Outlet operations reports								
Italicized rainfall data is from MN Climatology office for 115N, 22W, 15 Prior Lake; all other rainfall as recorded at PLSLWD Office								
Italicized lake level data is from PLSLWD Historic Volunteer Collected Lake Level Data								

Attachment E. Prior Lake Elevations and Precipitation

Elevation	
Average	902.10
Minimum	901.09
Maximum	902.91

Precipitation	
Yearly Total	35.74
Max 1 Day	3.28

Automated Logger is an Ott Ecolog 500 located on the outside of the trash barrier on the Outlet Structure. Values are averaged daily.
Staff Gage is located under Highway 21 Wagon Bridge on pillar. The automated logger is calibrated to the staff gauge readings.
Precipitation Gage was measured by Jonathan Cohen - Rain Gauge Program Volunteer. When no precipitation was recorded, there was no rain.
Cells highlighted in yellow with red text are averaged.

Date Auto Logger	Auto Logger	Date Staff Gage	Staff Gage	Date Precipitation	Precipitation
3/25	901.18	1/28	901.37	1/3	0.05
3/26	901.18	1/28	901.36	1/5	0.05
3/27	901.18	3/9	901.14	1/8	0.09
3/28	901.18	3/11	901.13	1/13	0.02
3/29	901.20	3/12	901.14	1/20	0.05
3/30	901.20	3/17	901.12	1/21	0.06
3/31	901.21	3/20	901.09	1/25	0.04
4/1	901.21	3/23	901.11	2/1	0.04
4/2	901.26	3/25	901.17	2/3	0.15
4/3	901.24	3/30	901.19	2/4	0.02
4/4	901.20	4/7	901.20	2/10	0.14
4/5	901.20	4/10	901.29	2/20	0.05
4/6	901.19	4/15	901.32	2/25	0.06
4/7	901.19	4/22	901.36	3/3	0.10
4/8	901.19	6/24	901.66	3/22	0.70
4/9	901.22	9/1	902.60	3/24	0.16
4/10	901.26	11/30	902.74	3/29	0.16
4/11	901.26	12/2	902.75	4/1	0.46
4/12	901.27	12/8	902.74	4/6	0.04
4/13	901.32	12/9	902.74	4/7	0.04
4/14	901.32	12/11	902.74	4/9	0.02
4/15	901.33	12/14	902.84	4/10	0.09
4/16	901.33	12/15	902.85	4/11	0.67
4/17	901.33	12/17	902.90	4/12	0.06
4/18	901.34	12/18	902.90	4/18	0.07
4/19	901.35	12/21	902.91	4/19	0.05
4/20	901.34	12/22	902.88	4/21	0.01
4/21	901.33	12/23	902.87	4/24	0.09
4/22	901.32	12/28	902.78	5/1	0.02
4/23	901.31	12/31	902.64	5/3	0.19
4/24	901.31			5/5	0.05
4/25	901.32			5/6	0.04
4/26	901.31			5/7	0.04
4/27	901.31			5/9	0.02
4/28	901.31			5/10	0.26
4/29	901.30			5/11	0.05
4/30	901.30			5/12	0.04
5/1	901.29			5/14	0.42
5/2	901.29			5/16	0.08
5/3	901.29			5/17	0.27
5/4	901.30			5/24	0.20
5/5	901.29			5/25	0.10
5/6	901.29			5/26	0.76
5/7	901.30			5/29	0.55
5/8	901.35			6/4	1.10
5/9	901.35			6/7	0.68
5/10	901.34			6/8	0.02
5/11	901.35			6/11	0.46
5/12	901.34			6/13	0.08
5/13	901.33			6/16	0.01
5/14	901.34			6/17	0.46
5/15	901.37			6/20	0.38
5/16	901.37			6/22	1.46
5/17	901.39			6/26	0.02
5/18	901.38			6/28	1.13

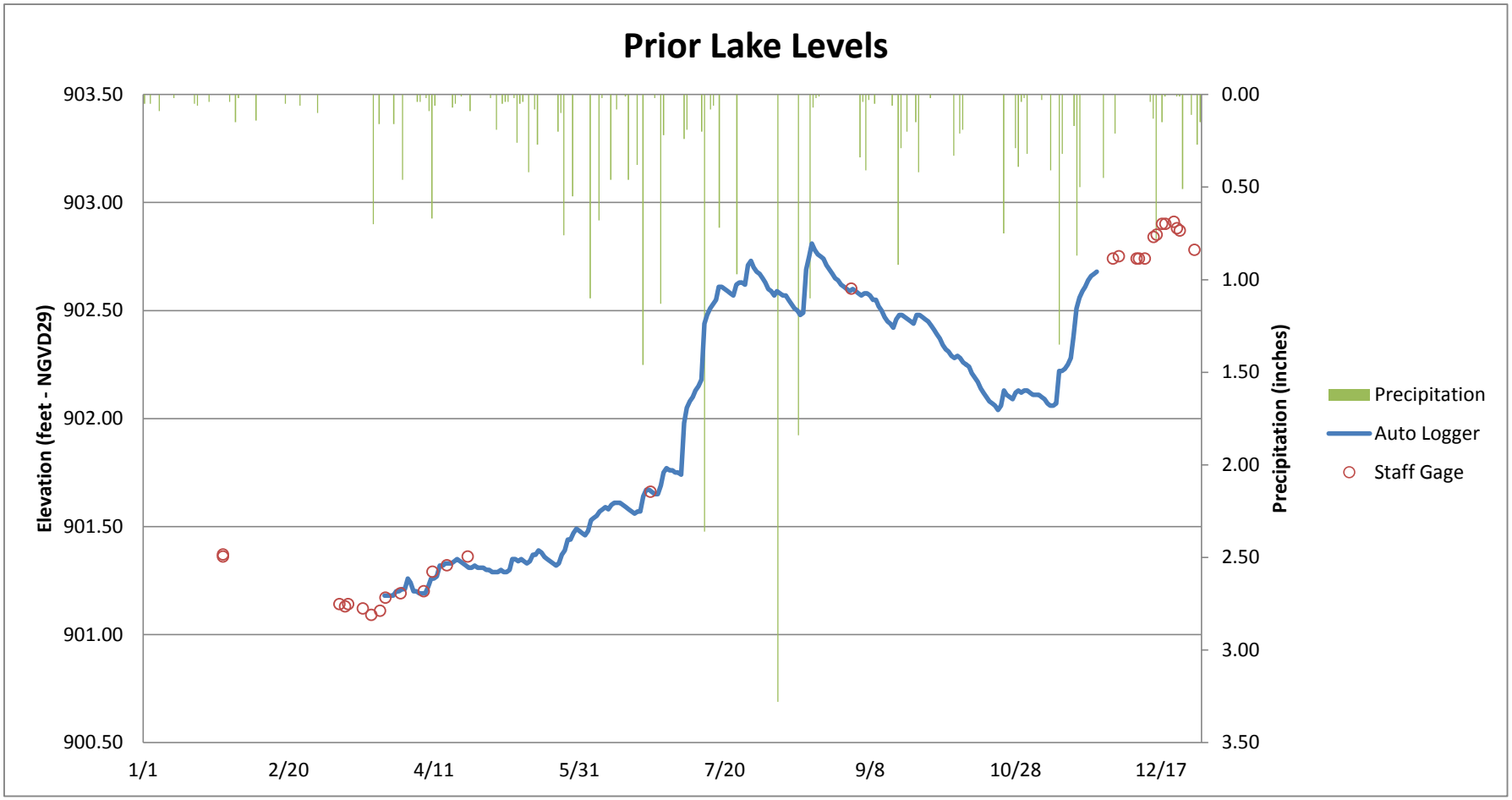
Date Auto Logger	Auto Logger	Date Staff Gage	Staff Gage	Date Precipitation	Precipitation
5/19	901.36			6/29	0.22
5/20	901.35			7/6	0.24
5/21	901.34			7/7	0.19
5/22	901.33			7/12	0.20
5/23	901.32			7/13	2.36
5/24	901.33			7/15	0.08
5/25	901.37			7/16	0.06
5/26	901.39			7/18	0.72
5/27	901.44			7/24	0.97
5/28	901.44			8/7	3.28
5/29	901.47			8/14	1.84
5/30	901.49			8/18	1.10
5/31	901.48			8/19	0.07
6/1	901.47			8/20	0.02
6/2	901.46			8/21	0.01
6/3	901.48			9/4	0.34
6/4	901.53			9/5	0.04
6/5	901.54			9/6	0.41
6/6	901.55			9/7	0.03
6/7	901.57			9/9	0.05
6/8	901.58			9/15	0.06
6/9	901.59			9/17	0.92
6/10	901.58			9/18	0.29
6/11	901.60			9/20	0.20
6/12	901.61			9/23	0.15
6/13	901.61			9/24	0.42
6/14	901.61			9/28	0.02
6/15	901.60			10/6	0.33
6/16	901.59			10/8	0.21
6/17	901.58			10/9	0.19
6/18	901.57			10/23	0.75
6/19	901.56			10/27	0.29
6/20	901.57			10/28	0.39
6/21	901.57			10/29	0.04
6/22	901.64			10/30	0.02
6/23	901.67			10/31	0.32
6/24	901.67			11/5	0.03
6/25	901.66			11/8	0.41
6/26	901.65			11/11	1.35
6/27	901.65			11/12	0.32
6/28	901.69			11/16	0.17
6/29	901.75			11/17	0.87
6/30	901.77			11/18	0.50
7/1	901.76			11/26	0.45
7/2	901.76			11/30	0.21
7/3	901.75			12/12	0.04
7/4	901.75			12/13	0.13
7/5	901.74			12/14	0.78
7/6	901.98			12/16	0.15
7/7	902.05			12/17	0.01
7/8	902.08			12/21	0.01
7/9	902.10			12/22	0.01
7/10	902.13			12/23	0.51
7/11	902.15			12/26	0.11
7/12	902.18			12/28	0.27
7/13	902.44			12/29	0.15
7/14	902.48				
7/15	902.51				
7/16	902.53				
7/17	902.55				
7/18	902.61				
7/19	902.61				
7/20	902.60				
7/21	902.59				
7/22	902.58				
7/23	902.57				
7/24	902.62				
7/25	902.63				

Date Auto Logger	Auto Logger	Date Staff Gage	Staff Gage	Date Precipitation	Precipitation
7/26	902.63				
7/27	902.62				
7/28	902.71				
7/29	902.73				
7/30	902.70				
7/31	902.68				
8/1	902.67				
8/2	902.65				
8/3	902.63				
8/4	902.60				
8/5	902.59				
8/6	902.57				
8/7	902.59				
8/8	902.58				
8/9	902.57				
8/10	902.57				
8/11	902.55				
8/12	902.53				
8/13	902.51				
8/14	902.50				
8/15	902.48				
8/16	902.49				
8/17	902.69				
8/18	902.75				
8/19	902.81				
8/20	902.78				
8/21	902.76				
8/22	902.75				
8/23	902.74				
8/24	902.71				
8/25	902.69				
8/26	902.67				
8/27	902.65				
8/28	902.64				
8/29	902.62				
8/30	902.61				
8/31	902.60				
9/1	902.59				
9/2	902.60				
9/3	902.59				
9/4	902.58				
9/5	902.57				
9/6	902.58				
9/7	902.58				
9/8	902.57				
9/9	902.55				
9/10	902.55				
9/11	902.52				
9/12	902.50				
9/13	902.47				
9/14	902.45				
9/15	902.44				
9/16	902.42				
9/17	902.46				
9/18	902.48				
9/19	902.48				
9/20	902.47				
9/21	902.46				
9/22	902.45				
9/23	902.44				
9/24	902.48				
9/25	902.48				
9/26	902.47				
9/27	902.46				
9/28	902.45				
9/29	902.43				
9/30	902.41				
10/1	902.39				

Date Auto Logger	Auto Logger	Date Staff Gage	Staff Gage	Date Precipitation	Precipitation
10/2	902.37				
10/3	902.34				
10/4	902.32				
10/5	902.31				
10/6	902.29				
10/7	902.28				
10/8	902.29				
10/9	902.28				
10/10	902.26				
10/11	902.25				
10/12	902.24				
10/13	902.21				
10/14	902.19				
10/15	902.17				
10/16	902.14				
10/17	902.12				
10/18	902.10				
10/19	902.08				
10/20	902.07				
10/21	902.06				
10/22	902.04				
10/23	902.06				
10/24	902.13				
10/25	902.11				
10/26	902.10				
10/27	902.09				
10/28	902.12				
10/29	902.13				
10/30	902.12				
10/31	902.13				
11/1	902.13				
11/2	902.12				
11/3	902.11				
11/4	902.11				
11/5	902.11				
11/6	902.10				
11/7	902.09				
11/8	902.07				
11/9	902.06				
11/10	902.06				
11/11	902.07				
11/12	902.22				
11/13	902.22				
11/14	902.23				
11/15	902.25				
11/16	902.28				
11/17	902.38				
11/18	902.51				
11/19	902.56				
11/20	902.59				
11/21	902.61				
11/22	902.64				
11/23	902.66				
11/24	902.67				
11/25	902.68				
11/26	902.69				
11/27	902.70				
11/28	902.71				
11/29	902.72				
11/30	902.74				
12/1	902.74				
12/2	902.75				
12/3	902.74				
12/4	902.74				
12/5	902.74				
12/6	902.74				
12/7	902.74				
12/8	902.74				

Date Auto Logger	Auto Logger	Date Staff Gage	Staff Gage	Date Precipitation	Precipitation
12/9	902.74				
12/10	902.74				
12/11	902.74				
12/12	902.78				
12/13	902.81				
12/14	902.84				
12/15	902.85				
12/16	902.87				
12/17	902.90				
12/18	902.90				
12/19	902.90				
12/20	902.90				
12/21	902.91				
12/22	902.88				
12/23	902.87				
12/24	902.85				
12/25	902.83				
12/26	902.81				
12/27	902.80				
12/28	902.78				
12/29	902.73				
12/30	902.68				
12/31	902.64				

Attachment F. Prior Lake Elevations Graph



*Automated Logger is an Ott Ecolog 500 located on the outside of the trash barrier on the Outlet Structure
**Staff Gage is located under Highway 21 Wagon Bridge on pillar
***Precipitation Gage is located at 2581 Willow Beach Trail in Prior Lake

Attachment G. Summary of Precipitation within PLSLWD

Month	*2015 Rain Gauge Readings (inches)	PLSLWD 2015 YTD (in.)	NOAA Scott Co 30yr mo ave**	NOAA Scott Co 30yr YTD ave	Monthly % Deviation***	Monthly Numeric Deviation	YTD % Deviation	YTD Numeric Deviation
Jan	0.36	0.36	0.73	0.73	-50.7%	-0.37	-50.7%	-0.37
Feb	0.46	0.82	0.62	1.35	-25.8%	-0.16	-39.3%	-0.53
Mar	1.12	1.94	1.73	3.08	-35.3%	-0.61	-37.0%	-1.14
Apr	1.60	3.54	2.53	5.61	-36.8%	-0.93	-36.9%	-2.07
May	3.69	7.23	3.69	9.30	0.0%	0.00	-22.3%	-2.07
Jun	5.75	12.98	4.64	13.94	23.9%	1.11	-6.9%	-0.96
Jul	7.67	20.65	3.49	17.43	119.8%	4.18	18.5%	3.22
Aug	3.53	24.18	5.05	22.48	-30.1%	-1.52	7.6%	1.70
Sep	3.17	27.35	3.41	25.89	-7.0%	-0.24	5.6%	1.46
Oct	2.22	29.57	2.47	28.36	-10.1%	-0.25	4.3%	1.21
Nov	3.90	33.47	1.64	30.00	137.8%	2.26	11.6%	3.47
Dec	2.41	35.88	0.95	30.95	153.7%	1.46	15.9%	4.93
Year Total	35.88	inches	30.95	inches			15.9%	4.93

*measurements recorded by volunteer rain gauge monitor Jonathan Cohen

** NOAA 30 year average is per the NWS site in Jordan for the years 1981-2010

***Deviation is calculated by the difference between the current year PLSLWD average and the 30 year Scott County average