

2022 PRIOR LAKE OUTLET SYSTEM ANNUAL OPERATIONS REPORT



PRIOR LAKE-SPRING LAKE
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 eight 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, the District finalized a Memorandum of Agreement (MOA) in 2007 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. The MOA is updated regularly and was last updated in 2019. This group of cooperators oversees the overall operation of the PLOC, while the District administers the day-to-day operations. In the early 2000's, the cooperators determined that the channel and outlet had worked well since their inception, but they could operate more efficiently if modified in several places, reducing long term maintenance and enhancing the environment. Acknowledging that the PLOC is used as a stormwater conveyance system and is not solely a natural conveyance, the cooperators' focus is to manage the easements of the channel itself to maintain capacity, reduce maintenance needs, provide long-term stability, and improve water quality. Secondary benefits include increased aesthetics, improved habitat, and consistency with city and county plans for parks and greenways.

OUTLET STRUCTURE

HISTORY

The Prior Lake Outlet Structure was originally constructed in 1982 and has been operated since 1983. The original design of the structure required manual operation to open and close gates to regulate the flow. This design posed safety concerns for staff operating the structure during high water levels. Additionally, inefficiencies in the structure's design meant that the 36-inch outlet pipe connected to the structure did not reach its maximum flow of 65 cfs until lake levels had well surpassed the outlet elevation. Over the years, the structure had also developed wear and required minor maintenance.

Given conditions, a replacement structure was pursued by the District and installed in 2010 (Figure 1). The new design has increased the efficiency of discharging water by allowing the outlet pipe to reach capacity sooner. It also provides safer conditions for staff during inspections and maintenance and is self-operating which reduces overall operations and maintenance costs. A schematic of the outlet structure is provided in Attachment A.



FIGURE 1 - OUTLET STRUCTURE

MAINTENANCE AND OPERATION

Operation of the Prior Lake Outlet Structure is governed by the DNR-approved Prior Lake Outlet Control Structure Management Policy and Operating Procedures (Operating Procedures) dated October 2004 and approved February 2005. This plan specifies a review procedure that is to be repeated every 3 years and last occurred in 2017. Changes primarily addressed guidance for opening the low-flow gate and removed old language that referred to the old 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.

The new structure requires minimal maintenance 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 (Figure 2). When the structure is operating (Prior Lake is greater than 902.45'), 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 caught on the trash rack. Inspections and debris removal are typically conducted by PLSLWD staff. During times when water is high and large amounts of vegetation are getting caught on the track rack, the City of Prior Lake staff have helped remove vegetation to ensure the Outlet Structure was not blocked.



FIGURE 2 - REMOVING VEGETATION FROM OUTLET STRUCTURE

Excluding 2009 and 2022, the Prior Lake Outlet Structure had flow, at least partially, every year since 1999. The year 2019 had 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 which was significantly greater than in previous years.

During 2022 operations, the highest water elevation for Prior Lake was 900.95, which was not high enough to reach the outlet weir. No water from Prior Lake was discharged to the Prior Lake Outlet Structure in 2022.

Regardless of whether water was discharging to the Outlet Channel, inspections were completed from March 22 to September 19 (Attachment B). The average lake levels recorded in 2022 were similar to 2009 (13 years ago) and 1991 (31 years ago). According to the U.S. Drought Monitor, Scott County was categorized as experiencing severe to extreme drought during much of 2022 leading to lack of flow and dry channel conditions.

At certain lake levels, the low-flow gate allows more water through the outlet structure, resulting in the lake level lowering more quickly and creating more storage (see Attachment C). The low-flow gate was not operated in 2022 due to low water levels and shortage of precipitation (Figure 3). The stage-discharge relationship curve is used to calculate flows and water quantities leaving Prior Lake.

There were 0 days of discharge during 2022. Total vertical volume of 0.00 feet was eliminated through the Prior Lake Outlet Structure seen in Attachment D. Attachment D also provides 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. Attachment F also includes Pike Lake daily average water levels, which are highly correlated to Prior Lake water levels.



FIGURE 3 - OPENING THE LOW-FLOW GATE

OUTLET PIPE

The Outlet Pipe leads from the Outlet Structure to the beginning, or “daylight,” of the outlet channel (Figure 4). It is buried underground for approximately 2075 feet, with 5 manholes and 7 access points (Figure 5).

MAINTENANCE

The entire length of the pipe is televised every two years to look for potential damage, areas in need of repair, blockages and accumulated debris, and to assess whether the pipe is reaching full hydraulic capacity.

Chemical grouting was completed in 2018. 120 leaks were sealed, but it was originally estimated to only have 50. As the original leaks were sealed, it forced other leaks to start due to increased pressure. Visu-sewer documented all the seals with video.

In 2020, American Environmental televised the pipe revealing the lake outfall pipe is in good to fair condition, but multiple cracks and fractures were found in some segments. Several options will be weighed to decide the best course of action. Some of these options include sealing the joints that fail pressure tests, lining the pipe, a combination of those two, or pipe bursting.

In 2022, American Environmental televised the pipe and found that the pipe is still in good to fair condition. However, many small longitudinal cracks, light to medium leaks, and light to medium mineral deposits around joints (sign of



FIGURE 4 - THE “DAYLIGHT”: BEGINNING OF THE OUTLET CHANNEL

infiltration) were observed throughout entire length of the pipe. The contractor suggested cured-in-place-pipe (CIPP) lining as a suggested fix for the current observed issues. The pipe review summary is shown in Attachment H.



FIGURE 5 - MAP OF OUTLET PIPE

OUTLET CHANNEL

The MOA cooperators' goals of the outlet channel include maintaining 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 of these goals have been met, but the channel will always require maintenance. Between 2020 and 2022 the channel has completed several projects to meet long-term goals including the FEMA funded restorations, removing driveway crossings, and cooperator led bank stabilization projects (Figures 6 & 7).



FIGURE 6 - SEGMENT 4 RESTORATION IN 2022

MAINTENANCE

While the Outlet Structure is in full operation and discharging water, the District is required to perform regular inspections (at least once per week) of the Outlet Structure and the Outlet Channel in accordance with the Operating Procedures. Inspections look for debris or any other issues along the channel or at the structure. Debris, downed trees, and other material are removed when they pose a risk, such as flooding or erosion. When debris is too difficult for PLSLWD staff to remove, the party in charge of that culvert, or land, will be contacted to address the issue.



FIGURE 7 - STRAUSS DRIVEWAY AND CULVERT REMOVAL IN 2021

A detailed report of this year's outlet channel inspections can be found in Attachment B, and a summary of maintenance projects that have been completed in previous years can be found in Attachment I.

Below is a summary of maintenance projects that have been completed in 2022:

- Security cameras were maintained at the outlet structure.
- Bank stabilization near Fountain Hills Road inspection site in segment 1.
- The Whispering Waters development has added several new culverts into the channel, including a new inspection site on Marsh Drive in segment 2.
- Illicit discharge reported in association with development at Pike Landing. City of Prior Lake took lead on resolution.
- Two wooden foot bridges removed from Kici Yapi in segment 3.
- Bank stabilization and floodplain bench excavation occurred in segment 4a. Stream channel was aligned to stay within the existing easement. Additional plantings were installed at the request of the adjacent landowner due to loss of privacy during construction activities.

- Boulder weirs installed in downstream end of segment 5a including a clay core to retain in upstream wetland.



FIGURE 8 SEGMENT 5A STABILIZATION

- Construction of a new outlet channel was completed, and new culverts were installed in segment 5b.
- In February, the Pike Lake Pond sediment project in segment 5c included wetland excavation, dewatering, erosion and sediment control, and vegetation restoration. Approximately 1,673 cubic yards of sediment were removed from this desiltation basin.



FIGURE 9 PIKE LAKE ROAD POND SEDIMENT REMOVAL

- In late May, garlic mustard, wild parsnip, purple loosestrife and other broadleaf weeds within the channel easements were treated by NST in segments 1, 2, 3, 4, 6, and 7. Wild parsnip populations were managed by EOR and PLSLWD staff (at Jeffers Pass, Jeffers Pond Elementary School, and Fountain Hills Road).
- Throughout June and July, follow-up herbaceous invasive treatments were conducted by NST at segments 1, 4, 5, 6 and 7. Another follow-up herbaceous treatment by NST was completed along segments 4a, 4b, 5a, 6, and 7a in August.
- Woody invasive foliar treatments were completed by RES in early to mid-October in segments 1, 2, 3, 4, and 7.

INSPECTIONS

The Outlet Channel was routinely inspected based outlet operation per the Prior Lake Outlet Channel Inspection Frequency Guidelines (Attachment K). The 2022 PLOC Inspection Checklist and map are in Attachment J. Inspections were completed to identify and monitor erosion, blockages, construction activity or flooding problems and may result in adjustment of the low-flow gate or closure of the Outlet Structure main gate if maintenance is needed in the channel. A summary of annual inspections and channel activities are available in Attachment B.

MONITORING

Monitoring along the outlet channel in 2022 consisted of water quantity (flow), water quality (chemistry), vegetation surveys, and erosion monitoring (Figure 8). Some of this monitoring is funded by the MOA cooperators, and some is done for other programs or entities. Figure 8 below shows the location and types of monitoring sites location along the channel.

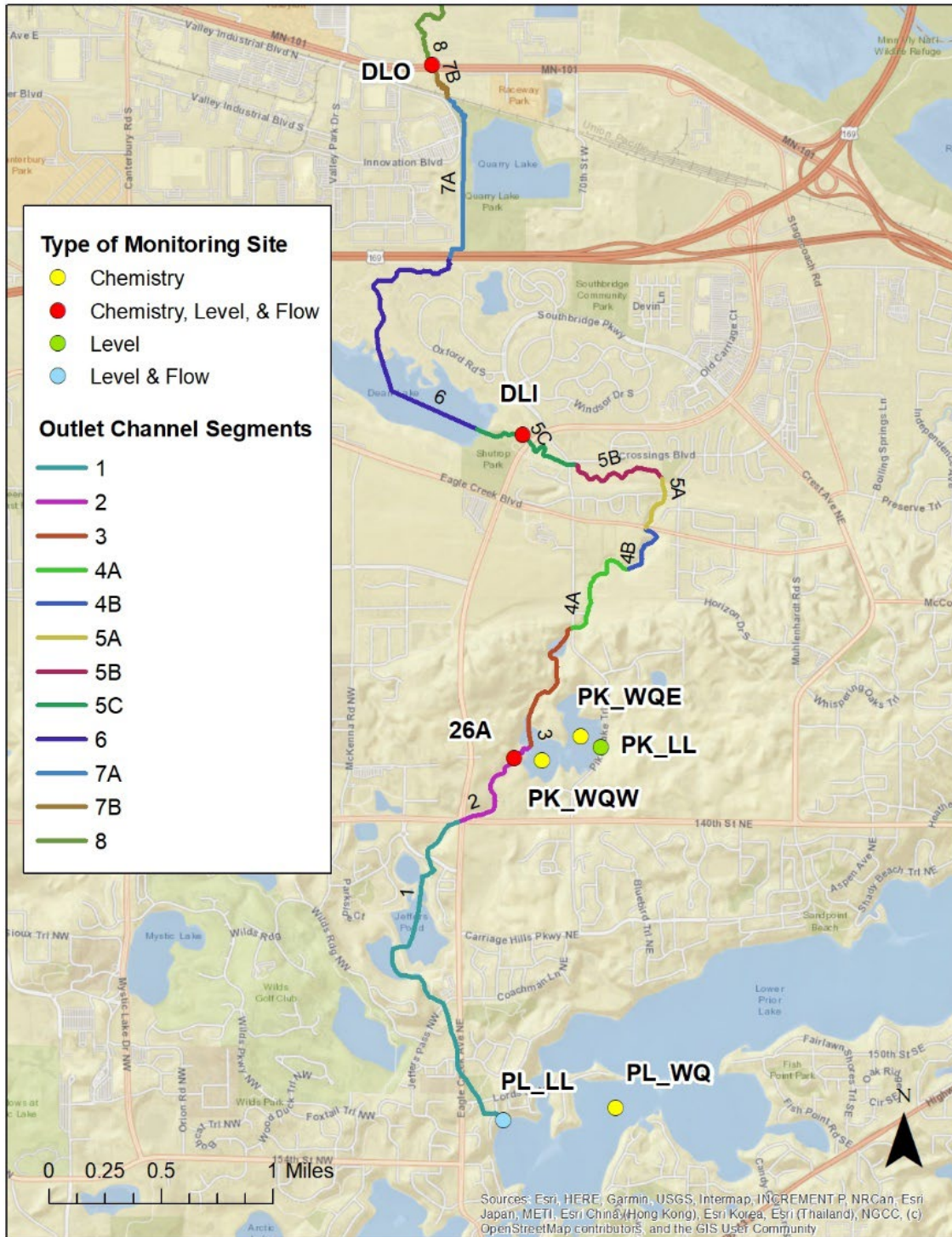


FIGURE 10 – PLOC MONITORING LOCATIONS

MONITORING SITES

From the beginning of the channel to the end, water quality, water level, and flow are collected by a collaboration of several organizations (Table 1).

LP_WQ: Water quality samples at this site are taken every two weeks by a Citizen-Assisted Monitoring Program volunteer. This water quality data represents the water quality at the very beginning of the channel. Samples are taken every 2 weeks for chlorophyll-A, total Kjeldahl nitrogen, total phosphorus, Secchi depth and some physical observations.

PL_LL: This site is located at the Prior Lake Outlet Structure. An automated level logger is connected to the structure and records water levels every 15 minutes. The data is then sent remotely to the PLSLWD website every hour to update the hydrograph and discharge graph. Flow measurements are taken at the end of the outlet pipe, so by comparing flows to lake levels, we can calculate a relationship of lake level and flow. See Attachment F for the annual hydrograph and discharge graph.

26A, DLI, and DLO: These three sites are spaced evenly along the outlet channel. Scott SWCD collected biweekly water quality samples at 26A, DLI, and DLO. Samples include temperature, dissolved oxygen, pH, conductivity, turbidity, Secchi tube, total phosphorus, orthophosphorus, nitrite + nitrate, total Kjeldahl nitrogen, total suspended solids, total volatile suspended solids, and chloride data (Table 2).

PK_WQW and PK_WQE: Three Rivers Park District monitored lake water quality at two sites on Pike Lake, PK_WQW (west bay of Pike Lake) and PK_WQE (east bay of Pike Lake). Samples are collected bimonthly and analyzed at Three Rivers Park District’s laboratory. Parameters that are sampled include temperature, dissolved oxygen, pH, conductivity, Secchi, Chlorophyll-a, total phosphorus, soluble reactive phosphorus, total nitrogen, and chlorides. Results for these sites can be found on the PLSLWD website.

PK_LL: This site is located on the very east side of Pike Lake. An automated level logger was connected to a DNR-surveyed staff gauge. The level logger records water levels every 15 minutes and sends the data remotely to the PLSLWD website every hour to update the hydrograph. Flow measurements are not taken at this site. See Attachment F for the annual hydrograph.

TABLE 1 DESCRIPTION OF MONITORING SITES

New Site Name	Old Site Name	Waterbody Type	Location	Monitored By	Type of Monitoring
LP_WQ	LP_CMP2	Lake	SW end of Lower Prior Lake in deep spot	Citizen Assisted Monitoring Program (CAMP) Volunteer	Lake Water Quality
PL_LL	PL_OUT	Lake	Prior Lake Outlet Structure	PLSLWD Staff	Lake level and flow
26A	26A	Stream	Prior Lake Outlet Channel in Pike Lake Park	PLSLWD and SWCD Staff	Stream chemistry, water level, and flow
PK_WQW	PK_3RW	Lake	West bay of Pike Lake	Three Rivers Park District	Lake Water Quality
PK_WQE	PK_3RE	Lake	East bay of Pike Lake	Three Rivers Park District	Lake Water Quality
PK_LL	PK_SG	Lake	Pike Lake Staff Gauge on east side of lake	PLSLWD	Lake Level
DLI	DLI	Stream	Prior Lake Outlet Channel at Hwy 21 before entering Dean Lake	Scott SWCD	Stream chemistry, water level, and flow

New Site Name	Old Site Name	Waterbody Type	Location	Monitored By	Type of Monitoring
DLO	DLO	Stream	Prior Lake Outlet Channel at Hwy 101 near end of channel	PLSLWD and Scott SWCD	Stream chemistry, water level, and flow

MONITORING DATA

Water level is recorded every 15 minutes at four points along the channel. Flow is shown to increase as water travels downstream from the Outlet Structure to the end of the PLOC. This increase is due in part to runoff in the PLOC watershed, but it is also influenced by groundwater seeps mostly starting downstream of County Road 16.

Water chemistry samples are taken every two weeks at each of the stream monitoring sites when water is flowing in the channel. The following table shows the averages in 2022. The water quality is quite good along the channel, but it is clearest and best at the end. Chemistry data in 2021 and 2022 was higher across many parameters compared to previous years; this could possibly be due to the lower volume of water, which can lead to higher concentrations in some parameters. Samples were not collected at 26A in 2022.

TABLE 2 – 2022 WATER QUALITY OF STREAM SITES (ANNUAL AVERAGE)

Site	CL mg/L	COND uS/cm	DO mg/L	PH units	Nitrates mg/L	Temp C	TP mg/L	Turbidity FNU	TSS mg/L	SECCHI TUBE cm	TSVS mg/L
DLO	100.2	642.17	9.71	8.00	0.11	14.03	0.04	.85	1.97	>100	1.3
DLI	66.463	693.31	8.59	7.58	0.322	15.24	0.061	5.158	9.474	76.59*	4.579
26A	-	-	-	-	-	-	-	-	-	-	-

*average includes some readings that were >100. The >100 was changed to 100 for purposes of finding an average.

Due to extreme drought conditions and no water coming over the weir from Prior Lake in 2022, flow in the outlet channel was minimal, and occurred as snowmelt and stormwater runoff. Flow measurements at 26A, DLI, and DLO were taken in March and May, but the channel was almost entirely dry by the beginning of July.

PRECIPITATION

Precipitation can highly affect water quality and water levels. Precipitation was consistently recorded at the Prior Lake public works weather station, with 18.68" of recorded rainfall. Precipitation in 2022 was 55% below the 1991-2020 average of 33.8" provided by the National Climatic Data Center. The precipitation data is summarized in Attachment G.

VEGETATION AND EROSION MONITORING

The Prior Lake Outlet Channel has been routinely inspected twice annually to document the channel condition, survey debris and log jams, and inspect culverts and road crossings for obstructions of flow. Starting in the fall of 2017, a vegetation assessment was conducted concurrently with the channel condition inspection to assess previously managed areas for invasive plant species and document any satellite populations of invasive species growing within the PLOC easements. Following the assessment, recommendations have been provided to address certain populations of invasive species growing along the channel.

EOR assessed the PLOC on foot from Segment 1 to Segment 7 on May 18 and October 24, with target invasive species surveys conducted on August 11. Segment 8, which is under management by the United States Fish & Wildlife Service, was not assessed. For the spring and fall assessments, a series of photographs were taken in each segment to characterize the condition of the outlet channel, assess any new areas of bank erosion, and document any obstructions to flow such as fallen trees, debris piles, or culvert blockages.

These reports can be found on the PLSLWD website with a summary of recommendations for continued channel and vegetation management in 2022.



FIGURE 11 - BOULDER TOE BANK STABILIZATION IN SEGMENT 7A

PERMITS

In 2022, the District had two open permits along the PLOC:

- Permit #20.02 *Pike Lake Culvert*: Culvert replaced; status closed.
- Permit #20.04 *Strauss Driveway*: Culvert and driveway have been removed creating an open channel. The permit is still open awaiting final vegetation establishment.

The following projects were reviewed or organized by the District but were not permitted by the District.

- PLOC Channel Sediment Removal – Pike Lake Road Pond; status complete.
- PLOC 2022 Bank Stabilization; status complete, vegetation warranty period still open
- Parkhaven at Pike Lake – presumably, there are still some homes under construction.
- Whispering Waters – presumably, there are still homes under construction for the 1st Addition. The 2nd Addition is still under review / development approval by Shakopee.
- Quarry Lake Trail & Pedestrian Bridge – reviewed, uncertain of status but doubtful it has been bid.
- Ridge Creek Park & PLOC Improvements – status complete, as-built plans provided to District in 2022.

EASEMENTS

The District holds drainage easements along most of the Outlet Channel. An easement allows the District to access and maintain the channel and the land within the easement area. For example, because of damage in the channel by the 2014 flood, bank repair was needed along much of the channel. During the preparatory review process for this work, it had come to light that some of the easements are inaccurate and need to be amended. This could be because the channel has shifted over time, or due to errors in the legal description when it was originally established. Although the existing easements may be erroneous, the District retains prescriptive rights along the channel.

No easements were amended in 2022. In the 2022 upper segment 4 restoration site, the channel had drifted to the edge of the easement. Bank stabilization work was carefully completed with the use of temporary easements allowing contractors to align the channel back into current easement boundaries. There are still many locations along the channel that need easements or alignment amendments, but the Cooperators have generally accepted that we won't pursue easement purchases or amendments until the landowner changes hands or development occurs. A spreadsheet exists in the PLSLWD files that describes each potential easement purchase or amendment.