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TECHNICAL MEMORANDUM

To:	Rex Vaughn, Chairman Cedar Lake Improvement Board	**Date:**	June 18, 2026
From:	Mark Kieser, Senior Scientist John Jacobson, PE, Senior Engineer Josh Kieser, Field Manager Kieser & Associates, LLC	**cc:**	Files
RE:	**Findings for 2025 Cedar Lake Groundwater/Surface Water Level Monitoring**		

This memorandum presents 2025 results compiled by Kieser & Associates, LLC (K&A) related to the ongoing water level monitoring program at Cedar Lake, Alcona and Iosco Counties, MI. K&A staff were authorized to continue management and oversight of ongoing data collection efforts in 2025 on behalf of the Cedar Lake Improvement Board (CLIB). The purpose of this long-term monitoring program is to best understand critical needs and relevant influences on water levels in Cedar Lake. Findings are used to identify new opportunities for enhanced lake level management and monitor benefits of previous improvement projects towards maintaining recreationally suitable lake levels.

Desirable summer month water levels in Cedar Lake are a function of both rainfall and management strategies designed to support water level maintenance in dry summer months. These management strategies, as defined in the approved Cedar Lake Watershed Management Plan (WMP), relate to ongoing efforts to bolster water retention in the northwest cedar swamp throughout the year. Data collection started in 2004. Based on robust data collection, the CLIB has implemented and expanded successful water level control efforts in the Cedar Lake watershed since 2017 as summarized in this report. They have also avoided alternatives with high costs and uncertain benefits. Implemented efforts have included:

1) A wetland berm to the south of Sherman Creek paralleling this water course was constructed in 2017 to retain water in immediately adjacent areas of the northwest cedar swamp on CLIB property. This reduced out-of-watershed losses to the south through the King's Corner Culvert.

2) Sherman Creek instream grade structure controls, designed and permitted in 2018 and constructed in Fall 2019, serve to further retain water levels in the cedar swamp. This promotes extended surface water inflows and enhanced groundwater volume inputs to Cedar Lake. These bolster lake level management during open-water recreational periods and enhance northern pike spawning wetland habitat under spring-time flow conditions.

   K&A and CLIB representatives continue to monitor and observe flow conditions around these structures to ensure they are operating as designed and to verify benefits under a range of spring snowpack and summer-time precipitation conditions.

3) The Cedar Lake outlet structure, designed by the Drain Commission to maintain the lake at the legal lake level of 608.20 feet, was reconstructed in September of 2020. Concerns regarding a suspected loss of water from the outlet structure were voiced by Cedar Lake stakeholders, however, periodically collected streamflow data by K&A suggest that low-flow groundwater is likely the culprit of the continual trickle visually exiting through the lake outlet structure. Future monitoring efforts will continue to closely inspect the outlet structure and will guide any action needed to correct potential losses of water through the structure.

This technical memorandum presents findings of the 2025 water level conditions as observed in Cedar Lake and its watershed, with discussions of implemented, ongoing, and potential future water level management strategies. Readers can find all tables and figures referenced in the body of this memorandum published at the end of the memo narrative.

Program Background

A volunteer water level monitoring program was initially developed at select groundwater and surface water monitoring sites around Cedar Lake in 2004. Since then, water level monitoring efforts have expanded to include additional critical areas using automated water level logger equipment in lieu of intermittent volunteer measurements. The 2025 water level monitoring totaled 32 level loggers in operation around the Cedar Lake from March to November. The location and addresses of the sites of the level loggers are provided on the map in Figure 1.

The combination of surface water stations, shallow piezometers, and deep piezometers allow and facilitate observations of the interactions between surface water, groundwater, and Cedar Lake water levels. Monitoring continued at Sherman Creek and Jones Ditch as well as within their contributing wetlands in 2025, to calculate estimated surface water flows into Cedar Lake.

Monitoring also continued at the wetland berm on CLIB property, constructed as part of the ongoing efforts to retain water levels in the cedar swamp. The berm's stone-laden spillway design allows overflows above an elevation of 611.50 feet so as not to permanently alter historic high-water levels in the swamp or alter any historic flooding or outflow southward out of this area and out of the Cedar Lake watershed. This station provides critical information regarding water retention improvements in the northwest cedar swamp including those related to the Sherman Creek instream grade structures and stream flows into Cedar Lake.

Monitoring in 2025 also included instream level loggers deployed at newer sites in Jones Ditch since 2022 within the contributing wetland complex. The Jones Ditch data loggers will help further define the Jones Ditch wetland contribution of surface and groundwater to the lake following several structural changes within the last decade monitoring. In 2018 the Alcona County Road Commission replaced the creek culvert during reconstruction on West Cedar Lake Road affecting flow estimates through Jones Ditch during the 2018-2020 reporting period. K&A modified the flow equation in 2021 to more accurately quantify flow data and continue to refine wetland and streamflow relationships using additional logger locations data since 2022. These recent data suggest that Jones Ditch, under certain conditions, may contribute more surface water to Cedar Lake than Sherman Creek; a discovery with implications for potential future engineering designs and management efforts in and along the northwest corner of Cedar Lake.

The estimated lifespan of the level loggers is ten years. Replacement of aged-out level loggers around Cedar Lake began in 2018, with all thirty-two level loggers since updated to ensure a high degree of confidence in the dataset. This includes three loggers replaced in 2017, eleven in 2019, eight in 2020, seven in 2021, and three new loggers deployed in 2022 at Jones Ditch and the Timberlakes property on the northwest and northeast sides, respectively of Cedar Lake. K&A rigorously evaluates logger data each year to ensure accuracy in the dataset. Table 1 illustrates the current age and predicted lifespan of the Cedar Lake level logger regime. Three loggers are predicted to age out in 2027 and should be considered for replacement at that time.

2025 Precipitation and Water Level Data

Precipitation Analysis:

Historic summer precipitation totals for the Cedar Lake area presented in Figure 2, show 2025 summer precipitation information from the Cedar Lake volunteer rain gauge. Data from this monitoring station, updated with a new rain gauge in 2020, were analyzed for quality against other regional weather stations and found to be the most representative localized data available. From 2016 to 2020, reported rainfall data present triangulated data from the Harrisville 2 NNE (USC00203628) and Oscoda Wurtsmith Airport (Station #14808) weather stations, and the Cedar Lake rain gauge. Available data from 1998 to 2025 (minus 2006 with no local functioning rain gauges) reflect a 28-year summer average (June-September) of 12.40 inches of rainfall.

The 2011 Cedar Lake Augmentation Feasibility Study revealed that 2.75 inches of precipitation during each summer month is needed to avoid a lake level drop of $\geq$3-inches per month (June-September). As such, during any summer month that does not exceed the 2.75 inches of precipitation threshold, Cedar Lake can expect a drop in lake level of 3 inches or more. Since 2011, this summer precipitation threshold of 11 inches (i.e., 2.75 inches multiplied by 4 months) has guided lake-wide assessments of summer conditions and their effect on desirable lake levels. Ongoing management efforts aim to lower this threshold or augment the water budget of the Cedar Lake watershed to limit the impact of low summer precipitation on lake level.

Figure 2 graphs the 28-year summer precipitation dataset against the critical precipitation threshold. In 2025, Cedar Lake precipitation exceeded the critical threshold of 2.75 inches (to avoid lake-elevation drop) in June (4.84 inches), July (5.05 inches), and August (3.63 inches). Each of these months experienced above-average rainfall relative to past years. Monthly total precipitation in September (1.37 inches) fell below the threshold and the respective 28-year average for that month. The resulting summer (June – September) precipitation total was 14.89 inches, an above-average value indicative of a relatively wet summer season.

Cedar Lake Water Elevation:

Figure 3 plots the 2025 Cedar Lake outlet water elevation from March to November, with daily precipitation data recorded from the Cedar Lake volunteer rain gauge to visualize the correlation of precipitation and lake elevation. Flow over the Cedar Lake outlet weir occurs when the lake elevation exceeds 608.2 ft. The new outlet structure controls the lake level elevation closer to the legal level throughout the year compared to the historic outlet structure. Elevations above 607.2 ft (within one foot below the legal lake limit) generally provide recreationally acceptable conditions for summer month recreation.

Lake levels in March were just below the lake outlet elevation until heavy rain events in late-March and early-April induced lake outlet flows with elevations well-above the legal lake level. Lake outlet flows continued through the summer months, producing a record amount of outflow volume (approximately 1,089 Mgal) from April until early September. No lake outlet flows occurred after September. Lake elevations remained above the desired lake level threshold (607.2 ft) throughout the monitoring period until early November.

Cedar Lake mid to late-summer water levels followed the predicted pattern for a year with above-average summer rainfall. Periodic rises in summer lake elevation responded directly to rainfall and corresponding inflows from the Sherman and Jones wetlands throughout the summer months. Both Sherman Creek and Jones Ditch flowed continuously until the end of August, underscoring the importance of water retention efforts implemented in the watershed.

Since construction of the Cedar Lake outlet structure in fall of 2020, Cedar Lake stakeholders have voiced concerns of an apparent constant "leak" of water coming from the outlet structure even when the lake elevation sits below the outlet weir of 608.20 ft. Site visits since 2021 confirm a very low flow of groundwater exiting through the north side of the outlet structure. K&A field staff have periodically collected measurements of the velocity and channel area of the outlet structure, as well as downstream channel to understand the discharge of water flowing through the outlet structure during non-wet weather/weir overflow conditions. Based on low flow rates from the outlet structure box culvert, impacts on lake level associated with groundwater leakage into the box culvert can reasonably be described as negligible.

Figure 4 presents Cedar Lake outlet discharge data and calculated equivalent fluctuations in Cedar Lake water elevations. Evaporation and discharge (leakage) to groundwater across the entirety of the lake's 1,050-acre surface area remain the leading causes of water losses from Cedar Lake during critical summer months. The average lake outflow in 2025 of 5.1 million gallons per day (Mgpd) was several orders of magnitude higher than the average daily outflow over the past four years (since March of 2021) of approximately 0.07 Mgpd or 0.0002 ft/day in equivalent lake level. This reflects a year with plentiful spring snowmelt along with spring and summer rainfall amounts.

Figure 4 also illustrates the relationship between summer precipitation and water elevation fluctuations with respect to the critical summer precipitation threshold, water level goals designed in the Cedar Lake WMP, and the legal lake level. The average summer-month water elevation of Cedar Lake for June – September 2025 was 608.12 ft, or just 0.08 ft below the legal lake level. The 2025 season saw the highest average water level since 2019, the highest maximum water level since 2015, and the highest average and maximum levels since construction of the new lake outlet spillway since 2020. Comparing the average summer-month lake level with the average summer-month rainfall shows some interesting trends, discussed in the next paragraph.

Following wetland flow enhancements in Sherman Creek (2017-2020), average lake elevations increased despite a decline in average rainfall as compared to a decade earlier (2007-2010), showing the importance of such water retention efforts to improving lake levels. The important influence of winter snowfall and spring snowmelt amounts must also be considered. For example, summer-month lake level in 2021 was much lower than average due to far-below average snowmelt in early-spring 2021, causing severely reduced lake levels despite higher-than-average summer rainfall.

The new lake outlet structure controls the winter and spring lake levels at an elevation closer to the legal lake elevation. Nonetheless, higher than average rainfall during the 2025 monitoring period produced higher than average early-spring flows from the contributing wetlands of Sherman and Jones Ditches. These are reflected in the above-average summer month lake levels and relatively high lake outflow volumes.

Groundwater Levels and Gradients

Figures 5-18 present the 2025 groundwater elevation data from the groundwater monitoring Sites 1-12, as well as TL-2 and TL-Road, referenced with the estimated Cedar Lake water levels. Level loggers on the east side of Cedar Lake typically show groundwater elevations below the lake level, while those on the lake's west side show groundwater elevations above the lake level, showing in fine detail the surface and groundwater gradient movements in the watershed.

East Side of Cedar Lake

On the east-central section of Cedar Lake, at Sites 1 and 4 (Figures 5 and 8), level loggers continued to record groundwater elevations below Cedar Lake level with no exceptions in 2025. With this gradient present throughout the summer, northeastward groundwater movement serves as a continual loss vector for Cedar Lake, well-documented since monitoring began.

Level loggers on the southeast section of Cedar Lake at Sites 8, 9, 10, and 11 (Figures 12 – 15), report even steeper groundwater gradients consistently moving groundwater away from Cedar Lake, towards the southeast. This exemplifies the surface grades away from the lake and the groundwater-losing condition intensified by a neighborhood subdrainage system designed to help keep house foundations and crawl spaces dry and residential septic systems functioning properly in the Lakewood Shores neighborhood.

K&A also installed three new loggers in 2023 near the Timberlakes development on the lake's northeastern-most section. "TL Lake" is a level loggers in a stilling tube along the seawall at the Timberlakes Clubhouse. "TL Lake 2" (Figure 17) and "TL Road" (Figure 18) are groundwater piezometers installed adjacent to the lake and at distance from the shoreline, respectively. The goal for groundwater monitoring at these latter two stations is to better understand northeasterly groundwater losses occurring near the Timberlakes residential development. Comparing these elevations and gradients to stations in the southeast allows for a comparison of the Timberlakes area to the Lakewood Shores residential district where subsurface drains already exist. Like the other eastern groundwater loggers (1, 4, and 8-10), TL Road showed a four to five foot drop in groundwater elevation compared to TL-Lake and TL-2, which were well above the lake outlet elevation throughout the year. This shows that a natural northeasterly groundwater gradient flow away from the lake and the nearshore already exists towards the Timberlakes district.

West Side of the Lake

On the southwest section of Cedar Lake, Site 3 (Figure 7) tracks the more-nuanced movement of shallow groundwater toward or away from Cedar Lake throughout the summer months. From late-March to early-May, shallow groundwater at Site 3 moved mostly toward Cedar Lake. Conversely, from mid-May to November, shallow groundwater moved mostly away from Cedar Lake, except in response to occasional rain events which tilted gradients back toward the lake. The seasonal periods of groundwater gradient tilting towards Phelan Creek (Van Etten Lake) represent water loss from Cedar Lake during the dryest summer months. Since construction of the wetland berm (2017) and instream Sherman Creek grade structures (2019), groundwater gradients at Site 3 have periodically shown greater contributions to Cedar Lake than were observed historically.

Similarly, and prior to 2021, shallow groundwater at Site 6 (Figure 10) experienced intermittent gradient flow patterns under dry or wet conditions much like Site 3. Since 2021, groundwater has more-consistently moved towards Cedar Lake at this location, suggesting increased groundwater elevations resulting from the 2017 and 2020 Sherman wetland improvements. In 2025, shallow groundwater flowed strongly toward Cedar Lake from March until the driest period, September to November when gradients began tilting slightly away from the lake.

Site 12 (Figure 16), installed in 2018 approximately 1,750 ft south of Sherman Creek and 85 ft southeast from the intersection of West Cedar Lake Road and King's Corner Road, further illustrates effects on groundwater gradients from the Sherman wetland improvements. As in years past, the groundwater at Site 12 was consistently 1 to 2-feet above lake level during spring and the gradient remained flowing toward the lake all year, flattening out a bit by late-summer.

Site 7 (Figure 11), along the western lakeshore just north of Sherman Creek, also continues to reflect an increase in groundwater recharge in the spring months as compared to years prior to 2021, resulting from the wetland water-retention improvements. Like Site 12, groundwater at upgradient PZ-7s2 was consistently 1 to 2 feet above the near-lake PZ-7s groundwater as well as the lake level throughout the 2025 monitoring period. This year-long trend was not evident at this location prior to the 2017 wetland berm installation.

The cedar swamp complex northwest of Cedar Lake continues to contribute a critical supply of groundwater throughout the recreational season, from both the Sherman and Jones Ditch. Site 2 (Figure 6), on the northwest side of the lake nearest to Jones Ditch, shows groundwater levels above the lake elevation in both the shallow and deep wells with a natural gradient of shallow groundwater toward the lake throughout the monitoring period. Groundwater levels at Site 2 continue to consistently and closely mirror the surface water fluctuations at the Lake Outlet.

2025 Estimated Surface Flows

Water level loggers located in or near the Cedar Lake outlet, Sherman Creek, Jones Ditch, and the King's Corner culverts were used to monitor incoming and outgoing surface water discharges. Sherman Creek and Jones Ditch are critical vectors by which surface water flows from the northwest wetland complex into Cedar Lake. The King's Corner Road culvert historically diverted water from the southernmost portion of the wetland complex away from the Cedar Lake watershed to the south towards Phelan Creek and Van Etten Lake. The wetland enhancement berm constructed in 2017 serves to retain surface water in the Cedar Lake swamp and limit surface water losses through the King's Corner culvert. The new Cedar Lake outlet structure constructed in September 2020 functions to maintain the legal lake level of 608.2 feet. If the lake elevation exceeds this limit, water spills over the outlet and eventually drains to Lake Huron.

Additional efforts regarding water retention improvements in Sherman Creek were conducted in September 2019 with the implementation of three instream grade structures. Large stone instream grade structures were installed at approximately 50 ft, 100 ft and 150 ft upstream of the Sherman Creek culvert. These instream barriers serve to retain water in the northwestern wetland complex by slowing discharge rates into Cedar Lake during snowmelt and rain events in the spring. By lengthening the time needed for surface water in the wetland complex to reach Cedar Lake, the high flows present in spring can be extended into the summer when lake inputs become critically important for lake level.

Surface water discharge rates and total volumes associated with the full 2025 monitoring period at Jones Ditch, Sherman Creek, Cedar Lake outlet, and the King's Corner culvert are presented in Figures 20, 21, 22, 23, and 24, respectively, in addition to the wetland berm in Figure 25. All flow data are derived from water level stage-discharge relationships specific to each monitoring station that have been calibrated and validated using previous data collected on Cedar Lake. The discharge data and estimated total volumes are graphically displayed together in Figure 26.

The water level stage-discharge relationship for Jones Ditch was re-calibrated following the installation of the new culvert in 2018 that allows increased flows under Cedar Lake Road. The stage-discharge equation was updated in 2021 to quantify the increased flow more accurately through the larger diameter culvert. New logger stations installed upstream and downstream of the culvert in 2022 have helped to further refine this flow equation over time.

Surface Water Inflows and Outflows:

The following discussion of estimated surface water flows and volumes focuses on the late-spring to late-summer period of May 1 to September 30 to assess the impact of inflows and outflows on lake levels during the summer recreational months. Table 2 summarizes estimated inflow or outflow volumes for surface water stations from May-September of each year 2014-2025 for more than a decade of comparison. Jones Ditch and Sherman Creek provide inflows of surface water into Cedar Lake from the northwest cedar swamp contributing area, while King's Corner culvert and the Lake Outlet represent surface water leaving the watershed and flowing toward Phelan Creek and Lake Huron, respectively.

From May 1 to September 30, 2025, inflows from Jones Ditch and Sherman Creek totaled 260.4 million gallons (Mgal) and 262.6 Mgal, respectively. Summer month inflow volumes from these two sources were slightly less than the previous year in Jones Ditch but slightly higher in Sherman Creek. Notably though, inflows from these two creeks were much higher than average in spring (late March-April). Total inflows for the whole monitoring period in Jones Ditch and Sherman Creek were estimated at 809.9 and 488.2 Mgal, respectively. These inflow volumes reflect heavy precipitation events during the early spring months, prior to the summer month recreation period. This led to higher-than-average inflows from both creeks during early spring. Flows from both creeks slowed to a trickle with only some periodic flows by September 2025.

Comparing 2025 summer month inflow volumes to 2014, a year with similar summer month rainfall prior to the Sherman Creek wetland enhancements and Jones Ditch culvert replacement, shows a marked increase in inflow volumes from both Sherman and Jones Ditch. This comparison confirms how inflow volumes have improved because of these wetland water retention and infrastructure improvement efforts. Connectivity in the Jones Ditch wetland generally allows precipitation to runoff rather than being infiltrated as groundwater. This geomorphic feature and the larger surface area of the Jones Ditch wetland complex represent the difference in outflows between the Sherman Creek and Jones Ditch cumulative discharges.

During the May 1 – September 30 timeframe in 2025, a higher than average 990 MGal discharged through the outlet from Cedar Lake. This cumulative discharge exited Cedar Lake for a longer than average period, with continuous flows occurring between April 4 and August 26, 2025. From August 26 to the end of the monitoring period, no surface water flowed over the outlet weir and the lake elevation remained below the legal lake limit of 608.2 ft. Lake levels in 2025 also marked the largest fluctuation in maximum and minimum water level, relative to the legal lake level as recorded since the installation of the new outlet structure.

The implementation of the wetland berm continues to retain water within the Sherman Creek wetland and limits losses through the King's corner culvert. The outflow volume that exited the Cedar Lake watershed through the King's Corner culvert during the May-September period totaled 5.21 MGal. This volume is higher than the previous year which was historically low, but still in line with historic higher-precipitation years since retention improvements began in the wetland. The most volume of runoff occurred during April of 2025, in line with other high early season flow observations from the wetlands to Cedar Lake.

Surface Water Retention Design Implications:

The wetland berm continues to prove highly effective in limiting losses through the King's Corner culvert and out of the Cedar Lake watershed. Prior to implementation of the berm, approximately 13.6% of the total water volume leaving the Sherman Creek wetland area was lost out of the watershed through King's Corner culvert (on average between May-September). After implementing the berm, only about 1.8% of the total volume, on average, is lost from this area through Kings Corner culvert (between May-Sep). In 2025, this percentage of water lost through Kings Corner culvert was near average, at 1.9% (between May-September). Water elevations and flows through the wetland enhancement berm on the Lake Board parcel should continue to be closely monitored to definitively demonstrate additional long-term improvements to water retention in the wetlands via reductions to water volume lost through King's Corner culvert.

Sherman Creek cumulative discharge in 2025 for the May 1 – September 30 period (262.6 Mgal) was just below the historic 10-year average of 279 MGal. Snowpack and spring precipitation are the biggest factors in Sherman Creek contributions. As such, Sherman Creek produced higher than average spring flows in April following snowmelt and spring rain, with the cumulative volume of the entire 2025 monitoring period calculated at 500.2 Mgal, nearly twice the total May-September volume. Improvements to water retention bolstered by the wetland berm and instream grade structures helped to extend the Sherman Creek discharge period in 2025 to the end of August.

Figure 27 presents the surface/groundwater elevations at the Sherman Creek culvert and upstream wetland (Sherman 2) stations. These data are consistent with observations from previous years of improved water retention and storage in the wetland complex. Figure 28 illustrates the 2025 water elevations at the wetland berm monitoring station, positioned at the upstream side of the berm spillway, compared to lake levels. Figure 29 compares water elevations at the wetland berm spillway, King's Corner culvert, and Sherman 2 located in the cedar swamp upstream of the Sherman Creek culvert. Figure 30 compares surface water flows and volumes for the 2025 monitoring season at the wetland berm spillway to outflows at King's Corner Culvert and inflows to Cedar Lake via Sherman Creek.

Surface water flowed through the wetland berm spillway from early spring to early summer, after which no flows occurred. Surface outflows through the spillway totaled 19.4 MGal from May 1 to September 30, 2025. About 5.21 MGal, or 27% of the berm's outflowing volume, flowed out of the watershed through King's Corner culvert. Since the berm was constructed, an average of 24.5% of runoff outflowing through the berm spillway flows out through King's Corner culvert. This varies from year to year, depending on annual wetland soil saturation conditions that either allow or do not allow berm spillway runoff to absorb into the ground before reaching the King's Corner culvert. The approximately 75% of berm spillway runoff not flowing out of King's Corner indicates gains in groundwater contributed toward Cedar Lake.

These observations once again underscore the importance of precipitation as the ultimate factor in limiting substantial decline in lake level throughout the monitoring period. Continued monitoring is necessary to determine additional viable lake level augmentation strategies and improve on previously implemented projects and their effectiveness in maintaining Cedar Lake's water elevation within the desirable range.

Conclusions and Recommendations

Improvements in water retention continue to prove effective in limiting outflow losses from the watershed as reported by previous years' findings. Water retention improvements have limited outflows through King's Corner culvert as a percentage of the total Sherman Creek outflow (Sherman Creek and King's Corner culvert).

Jones Ditch continues to supply an increased amount of discharge following the culvert replacement in 2018. The purchasing of the parcel through which Jones Ditch originates will allow the CLIB to continue to protect Jones Ditch and further improve connectivity between the northwest wetland complex and Cedar Lake. The extra piezometers placed in Jones Ditch will continue to help K&A improve the current discharge-stage relationship and work to quantify incoming flows more accurately from Jones Ditch. These data monitoring efforts should help guide any future action in augmenting Jones Ditch to improve Cedar Lake water levels throughout the summer recreation months.

Precipitation, spring snow melt, and evaporation remain as the three dominant factors that influence the Cedar Lake elevation throughout the summer. Twenty-seven years of rainfall data show how precipitation in the Cedar Lake area oscillates between multi-year periods of dryer and wetter years. While lake level has improved despite declining or stagnant precipitation totals in past years, drier conditions in the future could require new or novel management implementation efforts. Planning and coordination by the CLIB and K&A should always consider emerging trends within the watershed and implement engineering design as needed. As such, K&A recommends the continuation of the hydrology monitoring program in 2026.

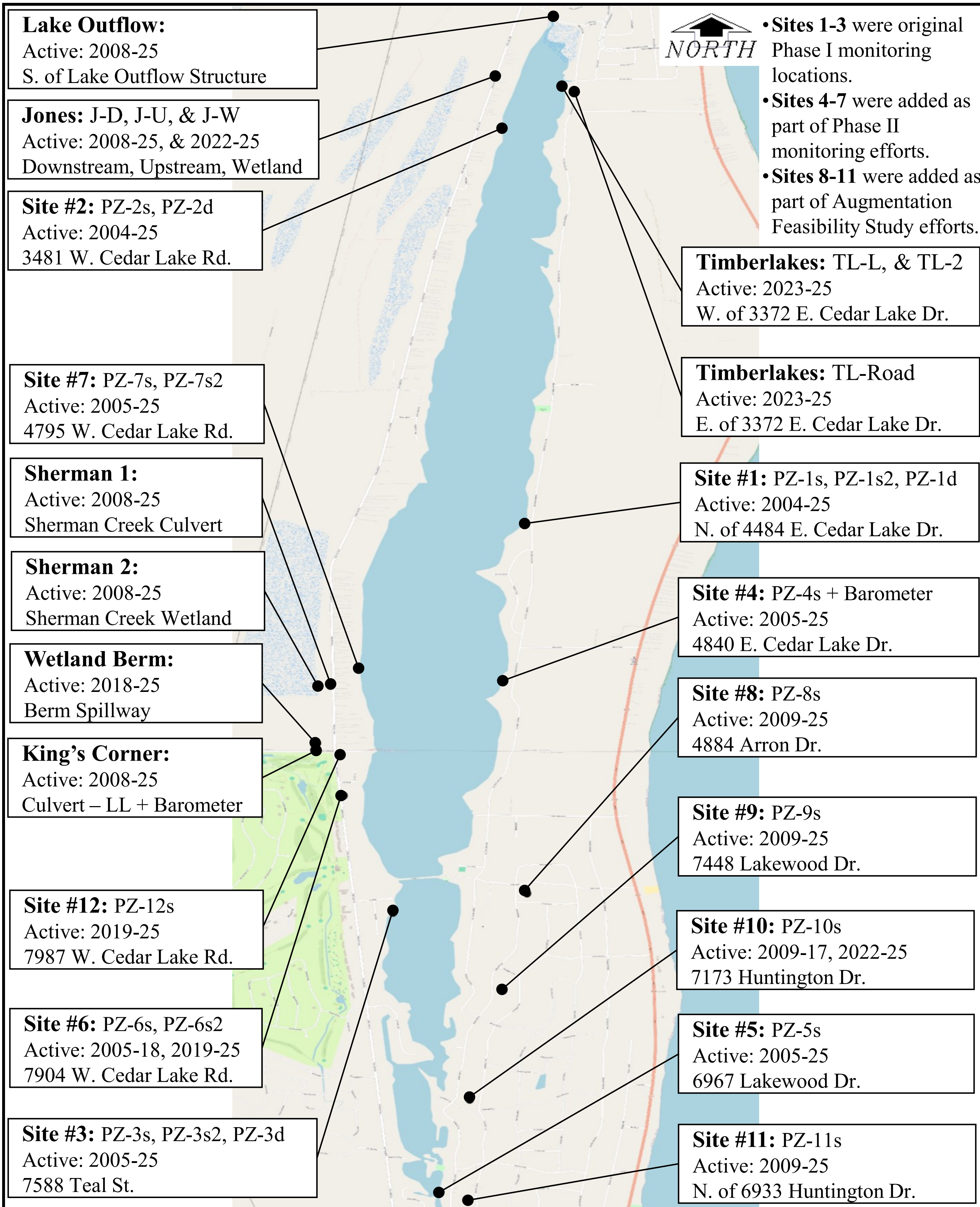
Recommendations for the 2026 Monitoring Program:

1. Identify additional hydraulic improvements in Jones Ditch areas including the maintenance of railroad culverts for watershed flows, and identify improvements to Jones Ditch contributing wetlands to provide ecological enhancements such as fish passage and flow management. Such additional monitoring is planned in these regards with the pending Midwest Glacial Lakes Partnership award to the CLIB for lower Jones Ditch improvements.

2. Redeployment of groundwater piezometers in Sherman Creek, especially with potential Jones Ditch grant funding for fish passage improvements to better assess flows, particularly for fish passage movement in the Creek in conjunction with those for Jones Ditch. Upstream level loggers above and below the railroad culvert should be considered.

3. Consider additional groundwater level evaluations for the southeastern portions of the Cedar Lake shoreline where County Drain Commission drainage improvements are being contemplated. Preliminary evaluation of possible implementation efforts would provide a backdrop for future approaches to protect and/or improve already impactful drain conditions on Cedar Lake levels.

2025 Cedar Lake Hydrology Report: List of Tables and Figures.



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Map of 2025 groundwater and surface water elevation monitoring sites with piezometers & level loggers, located around the perimeter of Cedar Lake.

FIGURE 1

Table 1. Cedar Lake level loggers 2025 status.

Piezometer ID #	LL Manu-factured Year	LL Age (years)	Predicted LL Lifespan (years)	Predicted Year of LL "Age-Out"	Status
Wetland Berm	2017	8	10	2027	Functioning (Added site in 2017)
PZ-02s	2017	8	10	2027	Functioning
TL Lake 2	2017	8	10	2027	Functioning (Added site in 2023)
Sherman 1(Culvert)	2019	6	10	2029	Functioning
Sherman 2 (Wetland)	2019	6	10	2029	Functioning
Kings Corner	2019	6	10	2029	Functioning
Kings Corner Barlog	2019	6	10	2029	Functioning
Lake Out	2019	6	10	2029	Functioning
PZ-12s	2019	6	10	2029	Functioning (Added site in 2019)
TL Road	2019	6	10	2029	Functioning (Added site in 2023)
PZ-06s	2019	6	10	2029	Functioning (Added site in 2019)
PZ-06s2	2019	6	10	2029	Functioning (Added site in 2019)
PZ-07s2	2019	6	10	2029	Functioning
Jones (Upstream)	2019	6	10	2029	Functioning
PZ-01s	2020	5	10	2030	Functioning
PZ02d	2020	5	10	2030	Functioning
PZ-03s	2020	5	10	2030	Functioning
PZ-03s2	2020	5	10	2030	Functioning
PZ-03d	2020	5	10	2030	Functioning
PZ-07s	2020	5	10	2030	Functioning
PZ-10s	2020	5	10	2030	Functioning
PZ-09s	2020	5	10	2030	Functioning
PZ-01s2	2021	4	10	2031	Functioning
PZ-01d	2021	4	10	2031	Functioning
PZ-04s	2021	4	10	2031	Functioning
PZ-04s Barlog	2021	4	10	2031	Functioning
PZ-05s	2021	4	10	2031	Functioning
PZ-08s	2021	4	10	2031	Functioning
PZ-11s	2021	4	10	2031	Functioning
TL-Lake	2022	3	10	2032	Functioning (Added site in 2023)
Jones (Downstream)	2022	3	10	2032	Functioning (Added site in 2023)
Jones (Wetland)	2022	3	10	2032	Functioning (Added site in 2023)

Table 2. Comparison of Surface Water Volumes from May 1 to Sep 30, 2014 to 2025.

Site	Volume (Mgal)											
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Sherman Creek (inflow to CL)	136.040	190.929	198.126	449.441	328.134	446.753	359.857	195.171	147.428	[4] 296.374	252.977	262.600
Jones Ditch (inflow to CL)	64.817	21.587	17.964	[1] 59.784	75.712	654.691	[3] 177.250	[3] 799.967	287.755	[4] 555.566	260.380	260.406
Cedar Lake Outlet (outflow from CL)	13.003	109.500	[2] 0.162	[2] 26.123	51.975	143.156	21.560	0.000	0.145	[4] 40.991	1.110	990.020
Kings Corner (outflow away from CL)	32.208	46.862	17.049	38.053	4.384	10.161	21.819	0.158	0.156	10.373	0.050	5.200

[1] Jones Ditch 2017 flows from 5/1/17 to 9/1/17 only.

[2] Lake elevations affected by presence of beaver dam upstream of Cedar Lake outlet, mechanically removed in fall 2017.

[3] Jones Ditch volume calculations affected by sediment accumulation resultant of beaver activity within Jones Ditch culvert after its replacement in 2018.

[4] The 2023 table incorrectly showed 2023 flow volumes for a period of Mar 30 - Sep 30 (Table 2 corrects this to compare volumes for May 1 - Sep 30 only).

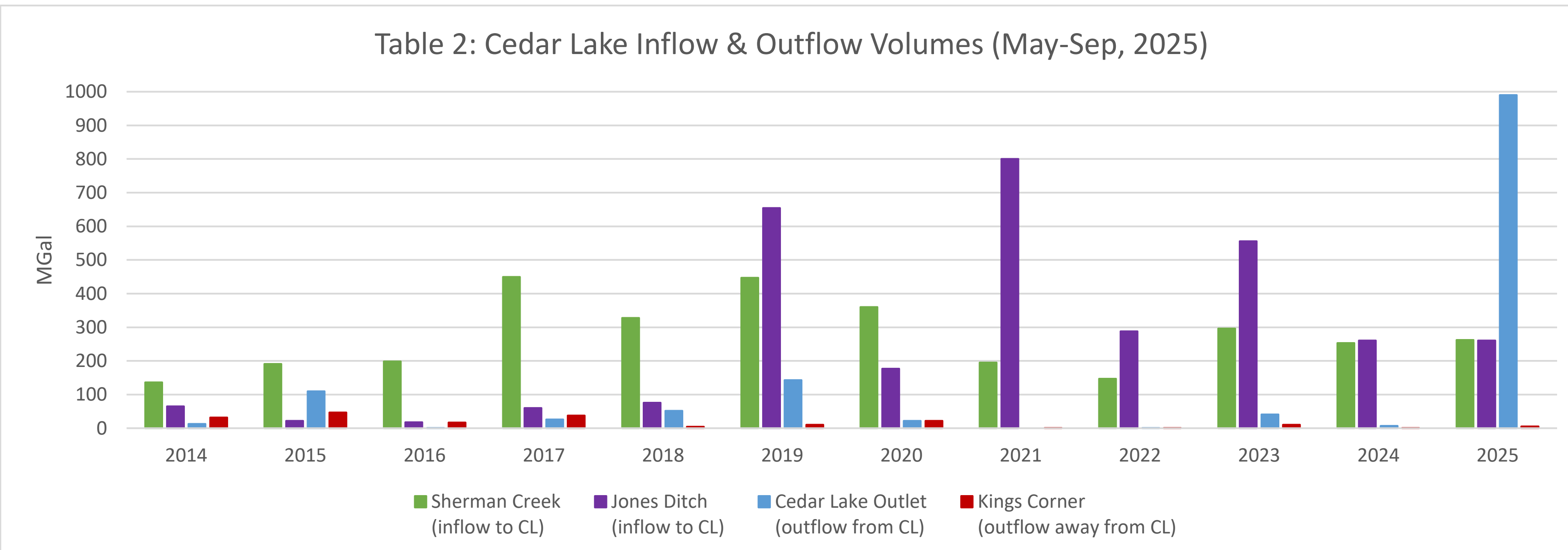
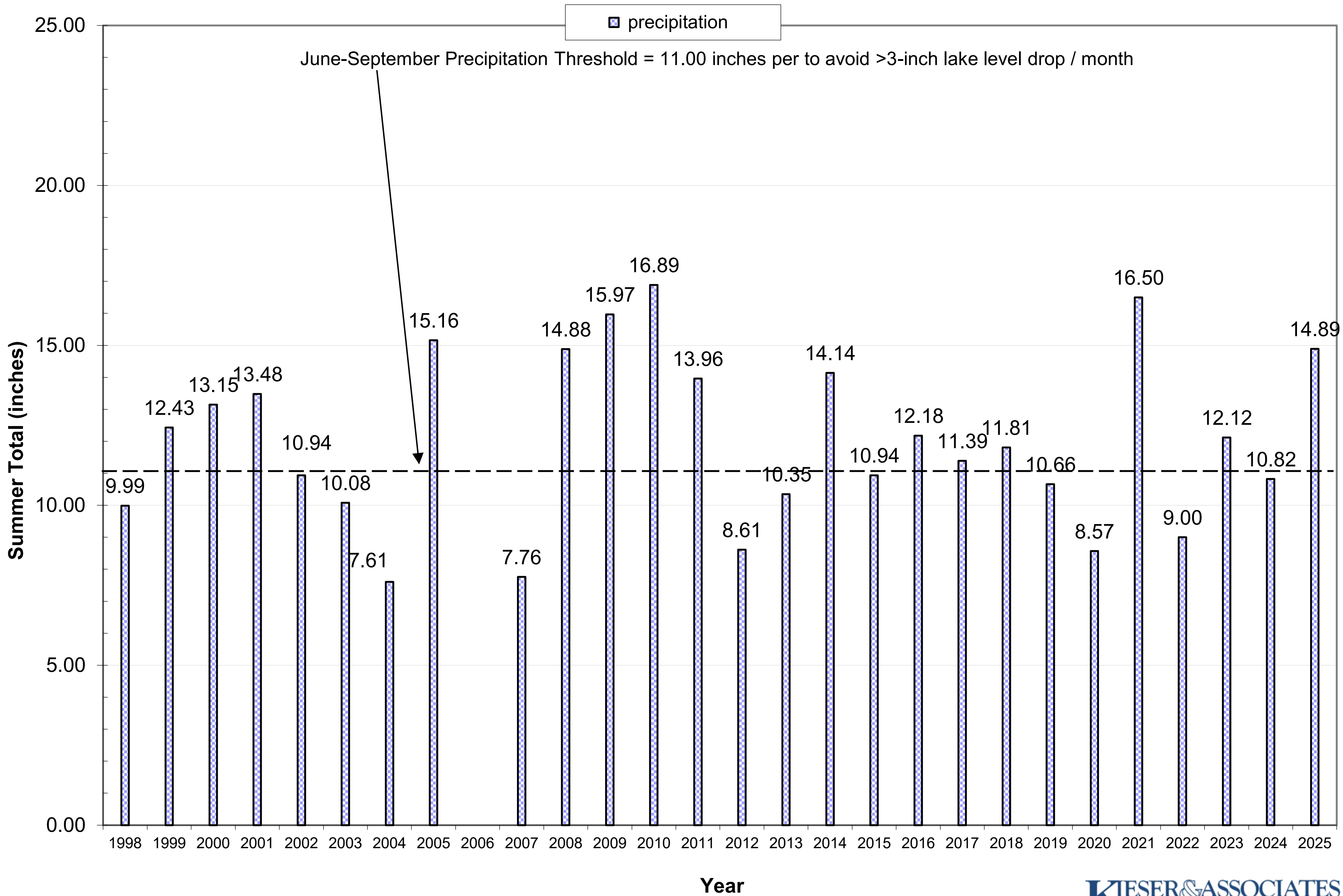


Figure 2. Historic Summer (Jun - Sep) Precipitation Totals for Cedar Lake

(*Precipitation Sources:* Cedar Lake Rain Gauge, Alcona County, MI,
Harrisville 2 NNE (USC00203628), Alcona County, MI
Oscoda Wurtsmith Airport (Station #14808), Iosco County, MI



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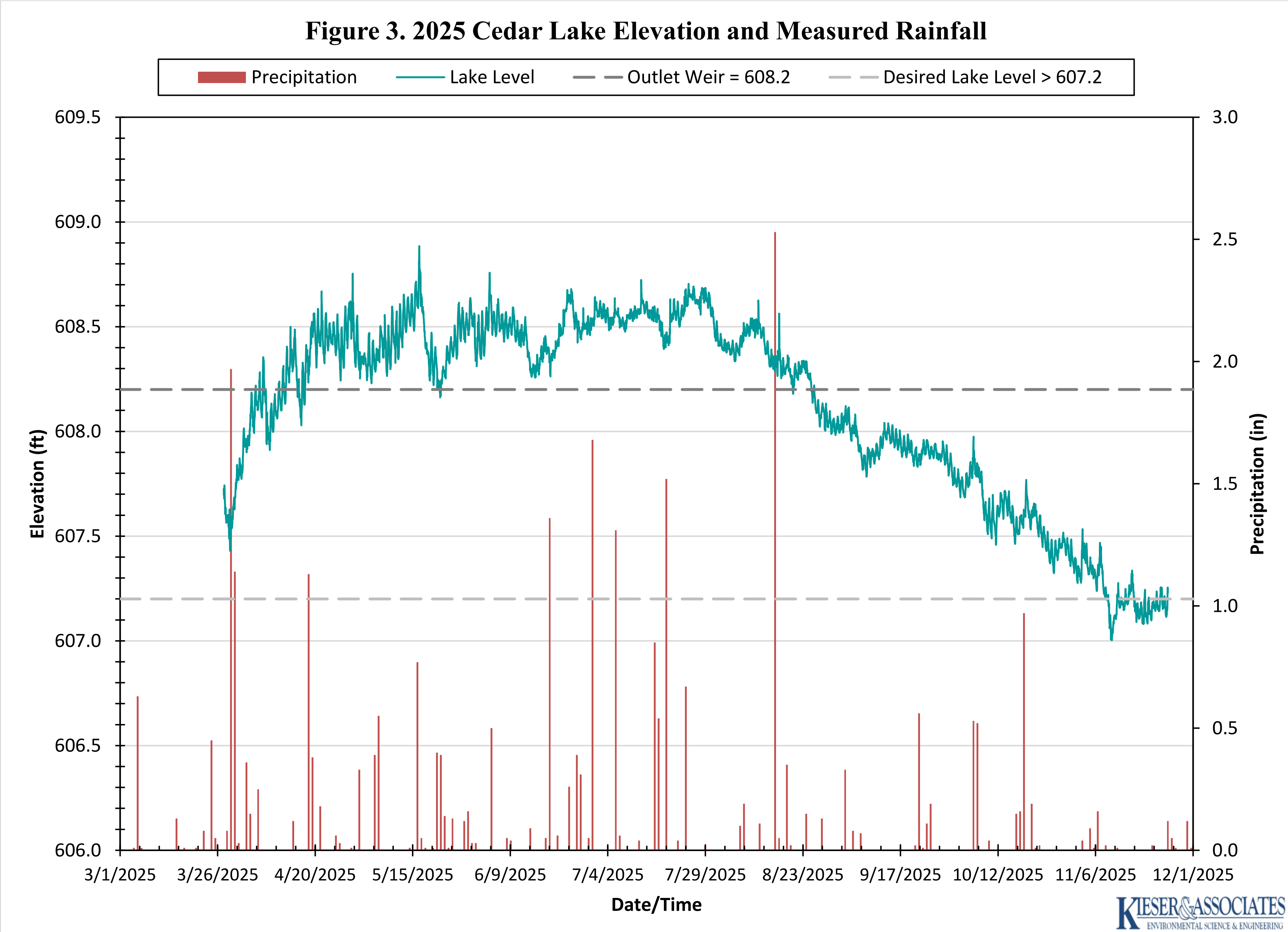
Figure 3. 2025 Cedar Lake Elevation and Measured Rainfall
Precipitation
Lake Level
Outlet Weir = 608.2
Desired Lake Level > 607.2
Elevation (ft)
Precipitation (in)
Date/Time
609.5
609.0
608.5
608.0
607.5
607.0
606.5
606.0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
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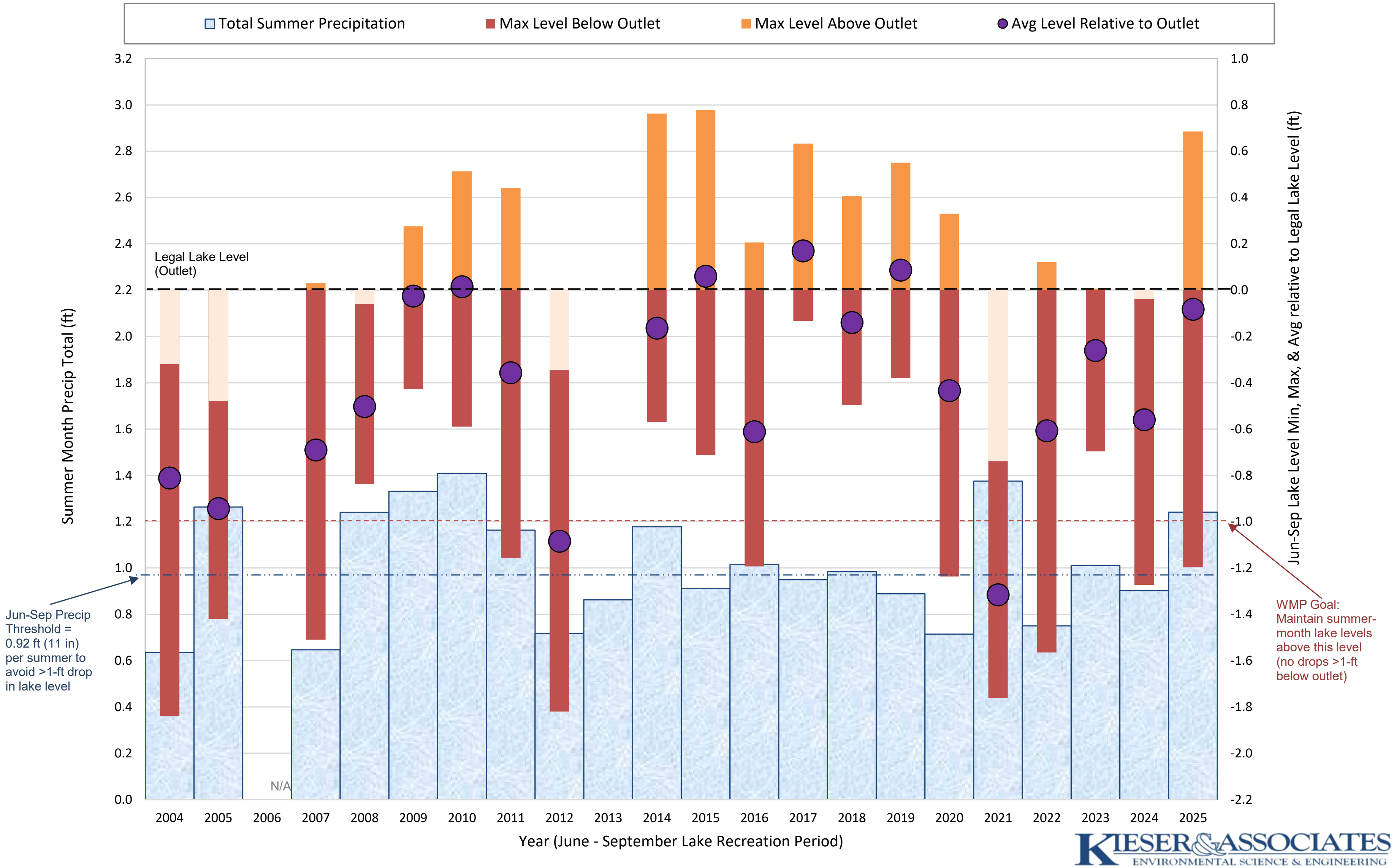
Figure 4. Cedar Lake Summer (Jun-Sep) Lake Level Fluctuations and Precipitation
Lake Level Minimum, Maximum, and Average Relative to Legal Lake Level (Outlet)



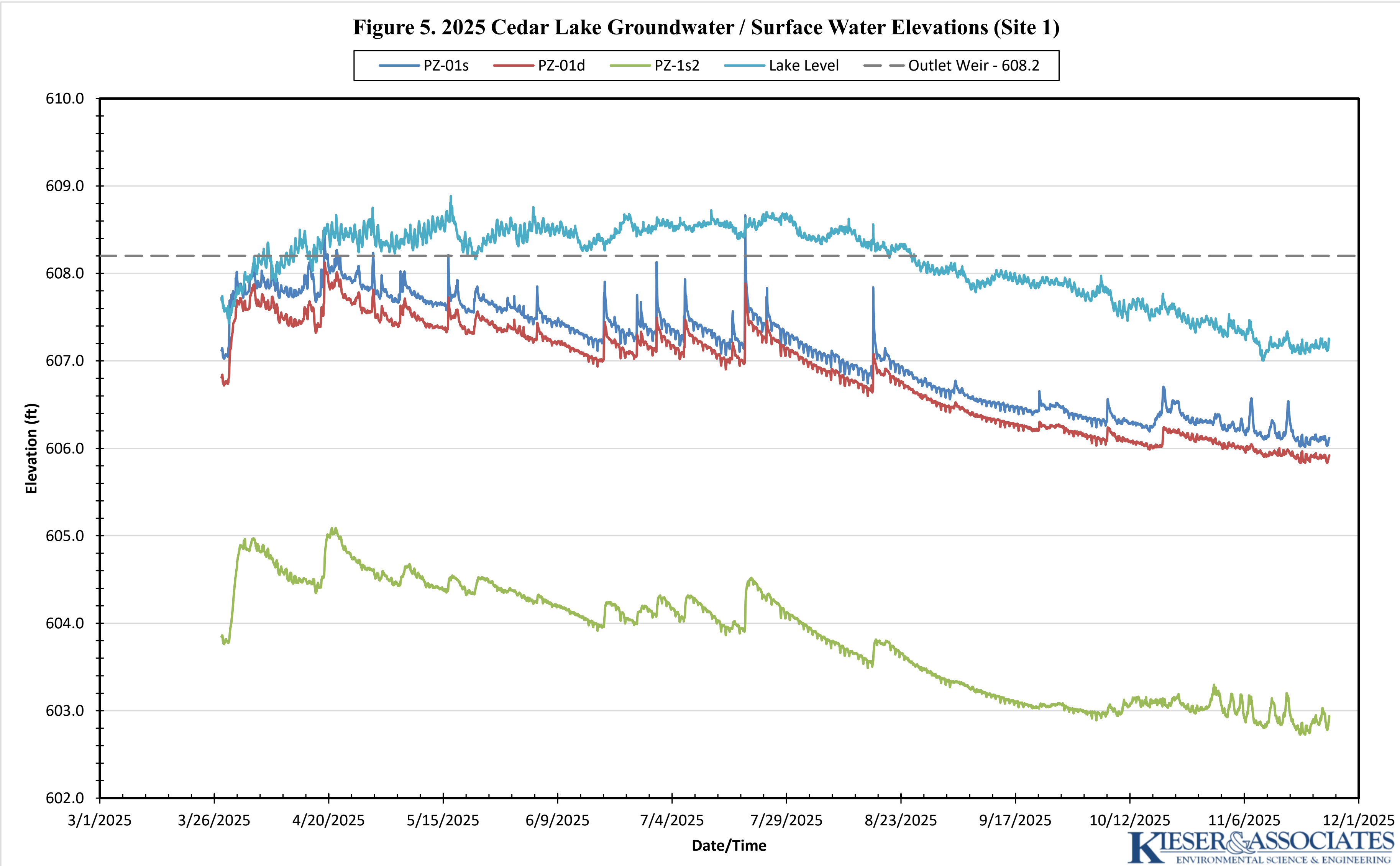


Figure 5. 2025 Cedar Lake Groundwater / Surface Water Elevations (Site 1)
PZ-01s
PZ-01d
PZ-1s2
Lake Level
Outlet Weir - 608.2
610.0
609.0
608.0
607.0
606.0
605.0
604.0
603.0
602.0
Elevation (ft)
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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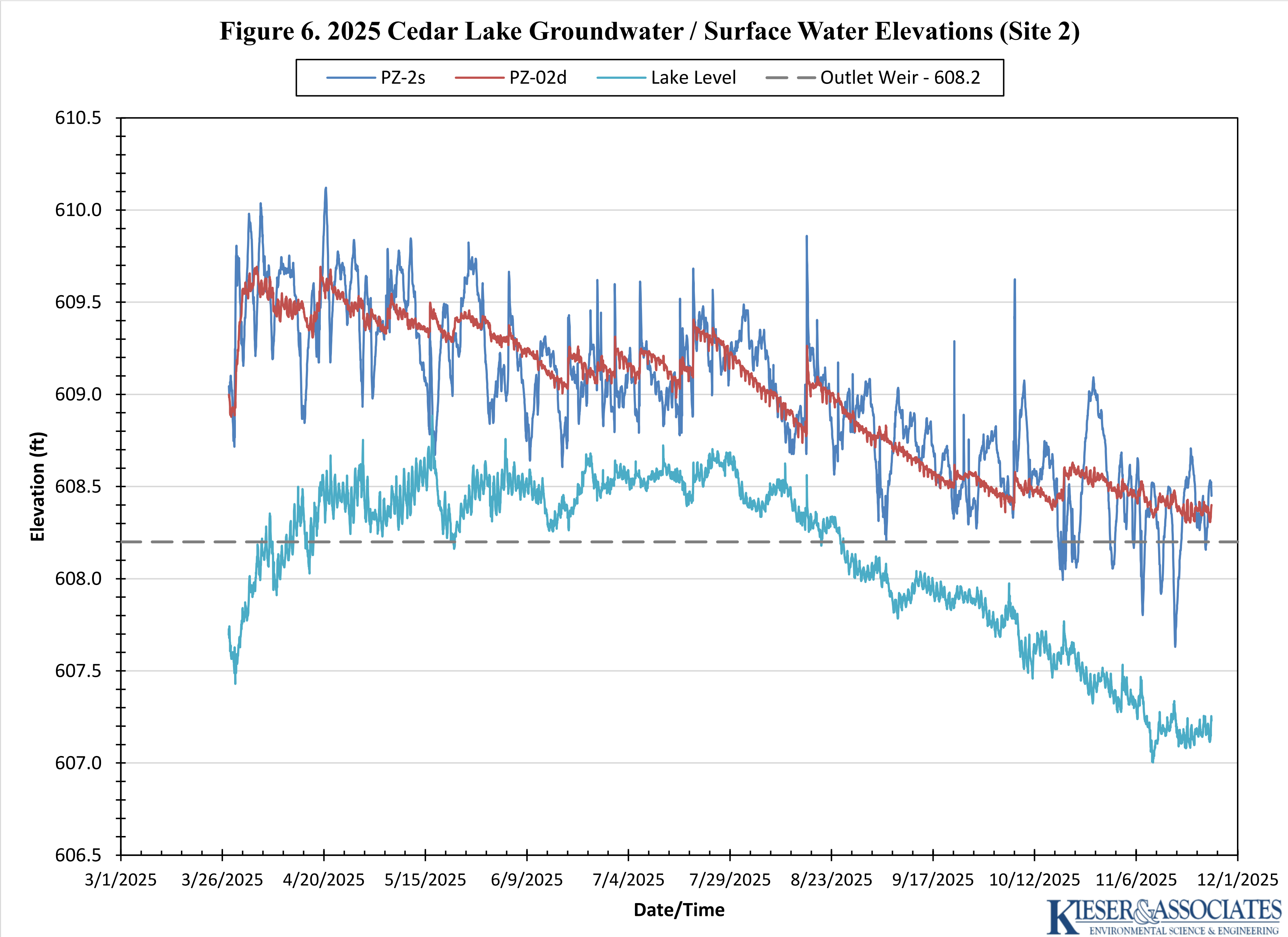

Figure 6. 2025 Cedar Lake Groundwater / Surface Water Elevations (Site 2)
PZ-2s
PZ-02d
Lake Level
Outlet Weir - 608.2
Elevation (ft)
610.5
610.0
609.5
609.0
608.5
608.0
607.5
607.0
606.5
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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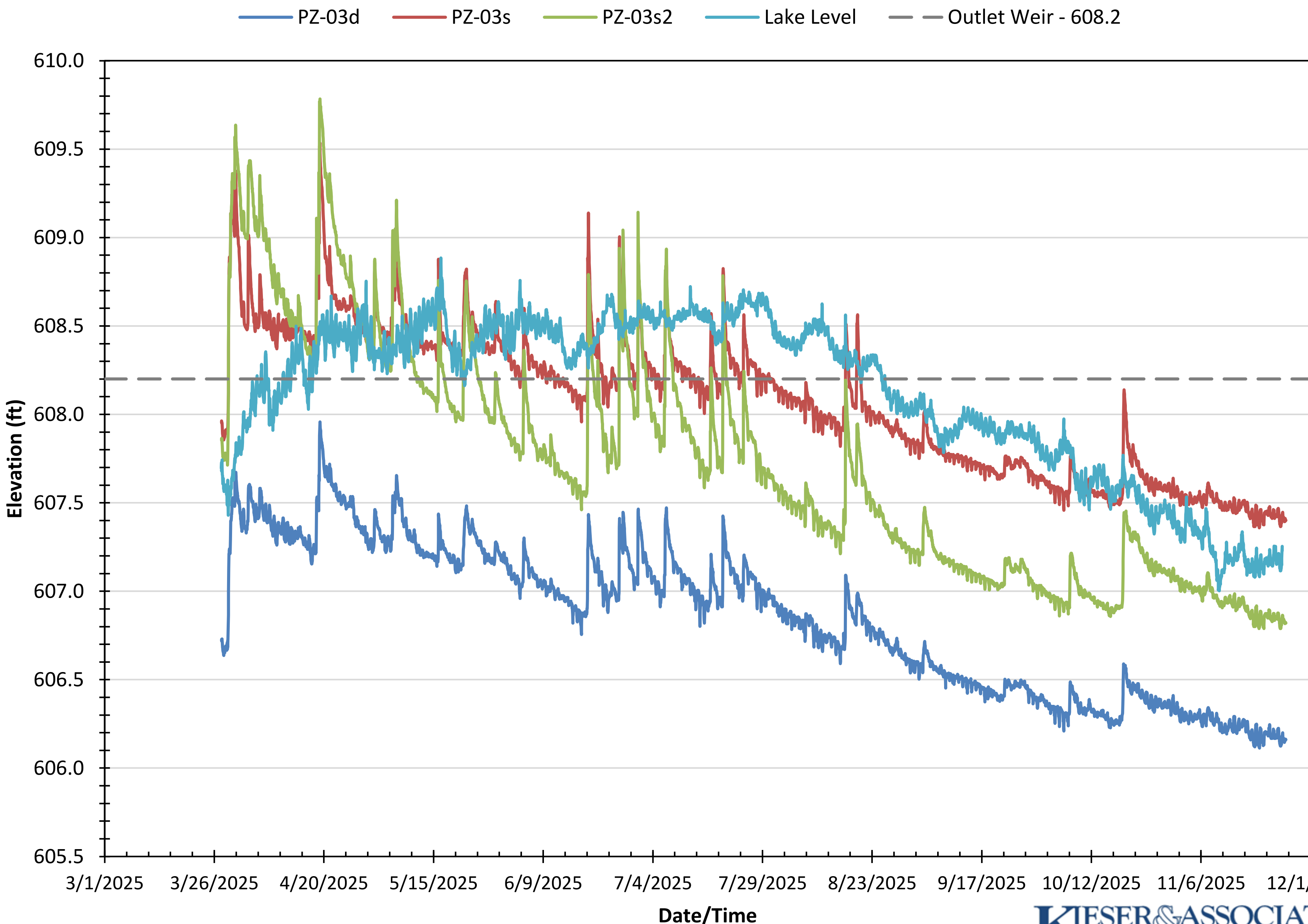
Figure 7. 2025 Cedar Lake Groundwater / Surface Water Elevations (Site 3)



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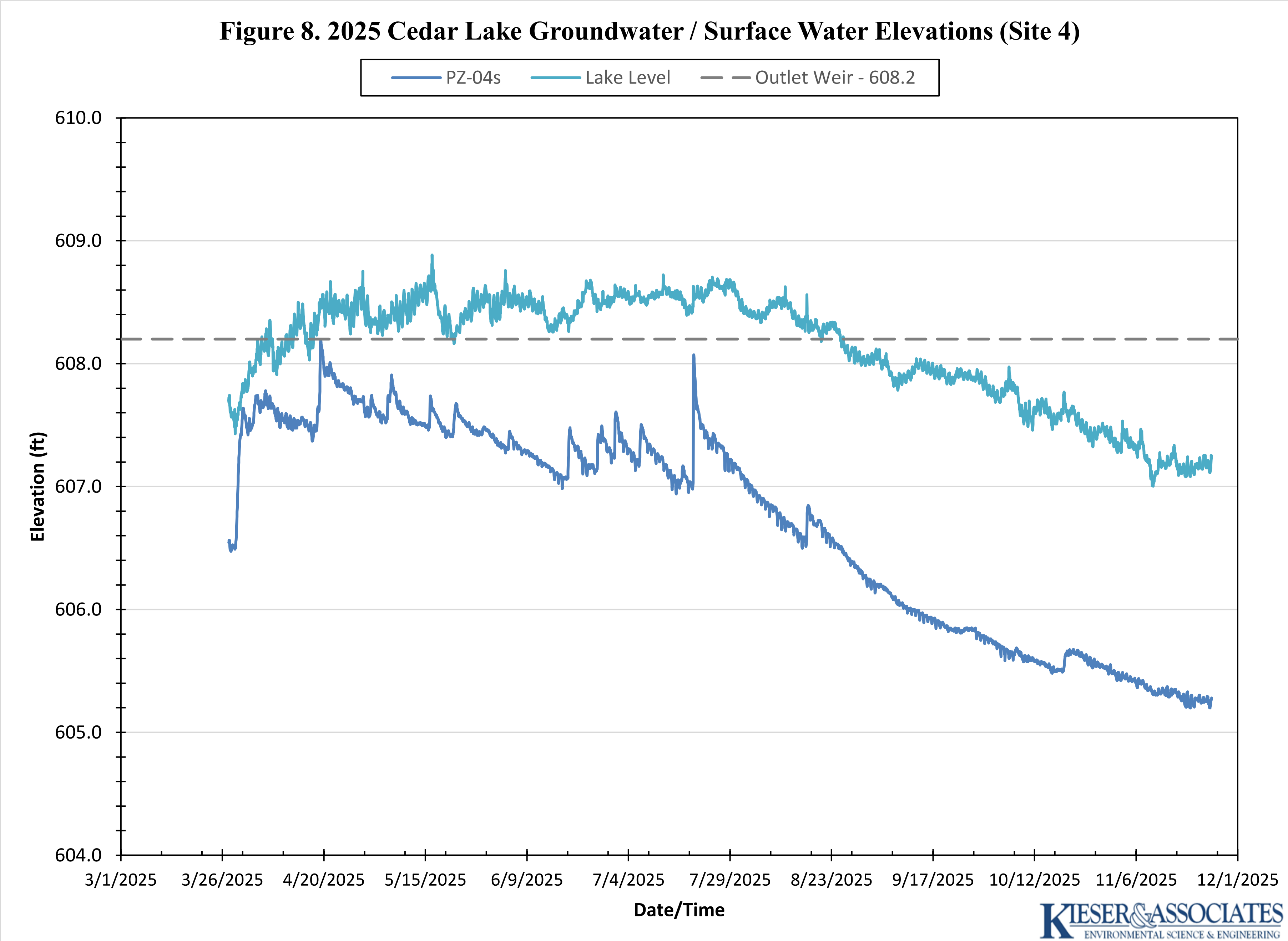

Figure 8. 2025 Cedar Lake Groundwater / Surface Water Elevations (Site 4)
PZ-04s
Lake Level
Outlet Weir - 608.2
610.0
609.0
608.0
607.0
606.0
605.0
604.0
Elevation (ft)
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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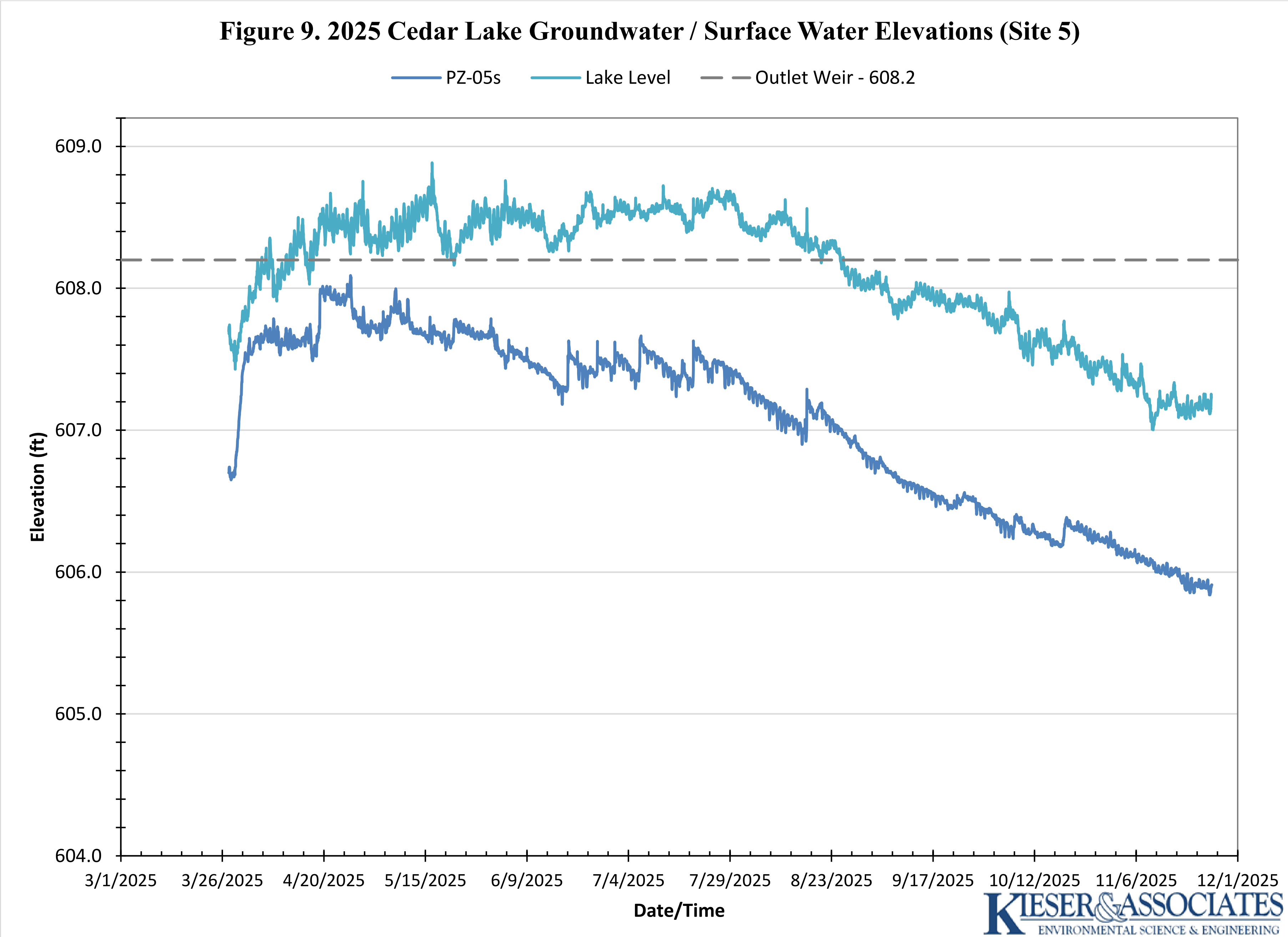
Figure 9. 2025 Cedar Lake Groundwater / Surface Water Elevations (Site 5)
PZ-05s
Lake Level
Outlet Weir - 608.2
609.0
608.0
607.0
606.0
605.0
604.0
Elevation (ft)
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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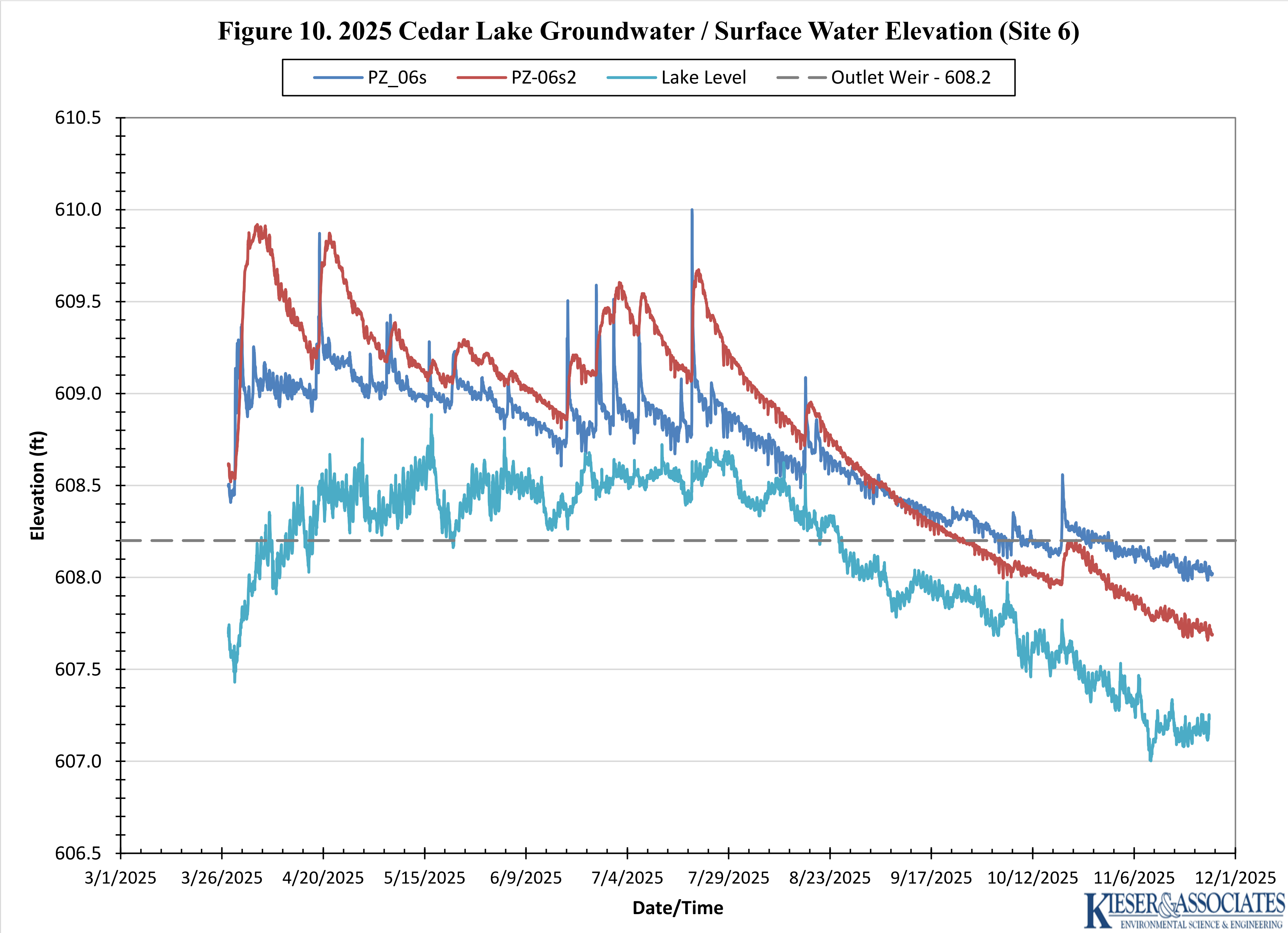

Figure 10. 2025 Cedar Lake Groundwater / Surface Water Elevation (Site 6)
PZ_06s
PZ-06s2
Lake Level
Outlet Weir - 608.2
Elevation (ft)
610.5
610.0
609.5
609.0
608.5
608.0
607.5
607.0
606.5
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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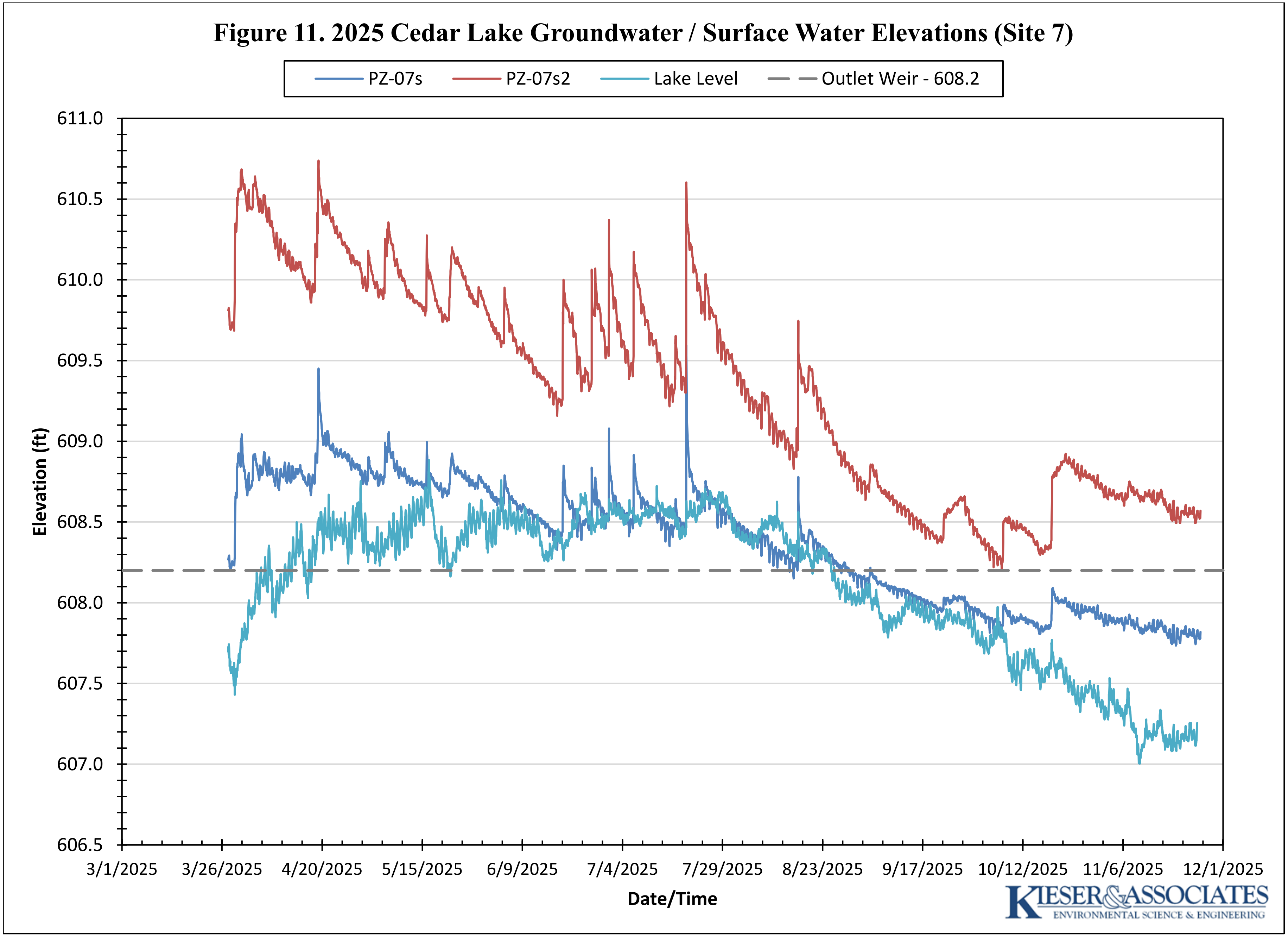

Figure 11. 2025 Cedar Lake Groundwater / Surface Water Elevations (Site 7)
PZ-07s
PZ-07s2
Lake Level
Outlet Weir - 608.2
611.0
610.5
610.0
609.5
609.0
608.5
608.0
607.5
607.0
606.5
Elevation (ft)
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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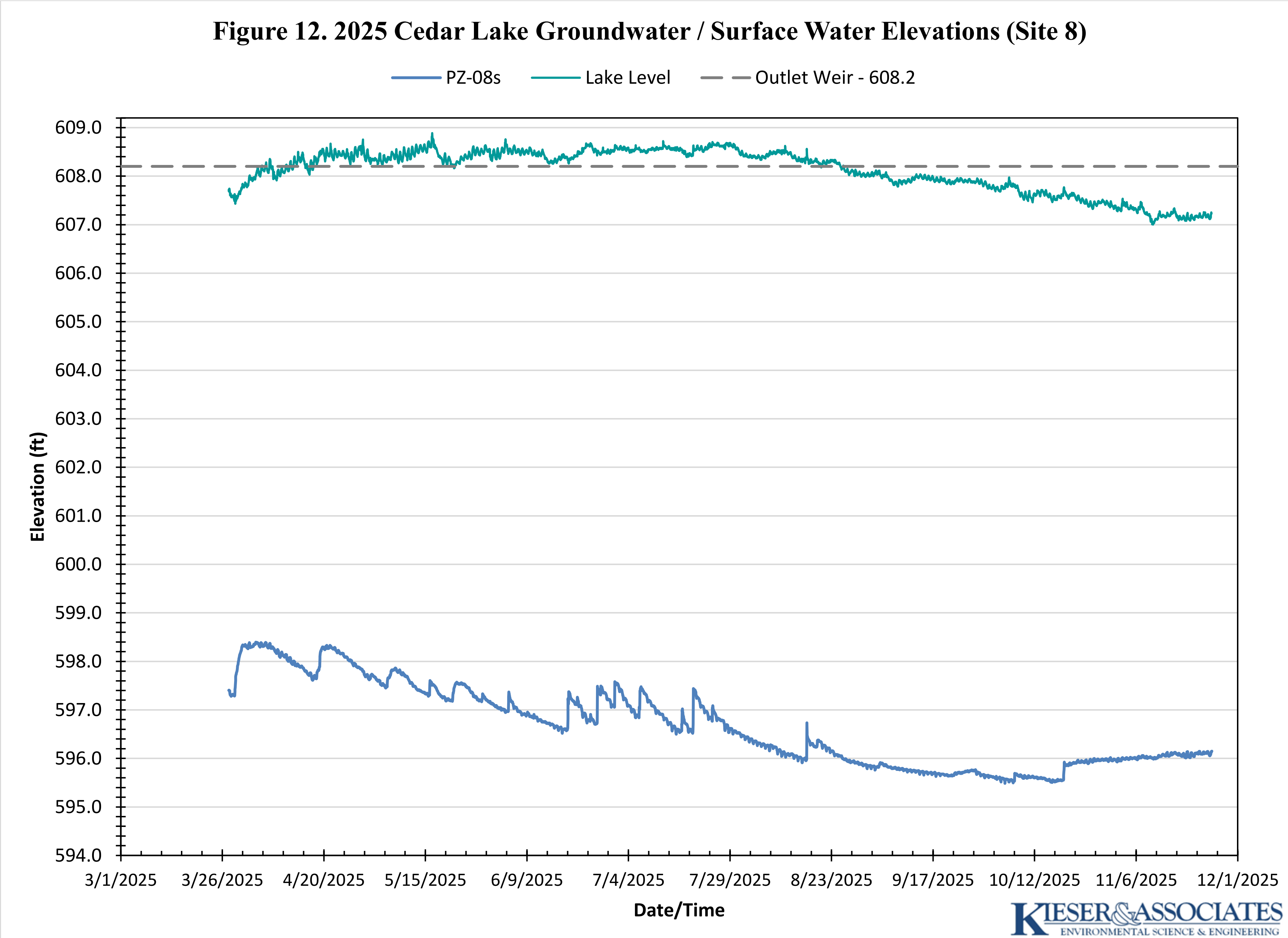
Figure 12. 2025 Cedar Lake Groundwater / Surface Water Elevations (Site 8)
PZ-08s
Lake Level
Outlet Weir - 608.2
609.0
608.0
607.0
606.0
605.0
604.0
603.0
602.0
601.0
600.0
599.0
598.0
597.0
596.0
595.0
594.0
Elevation (ft)
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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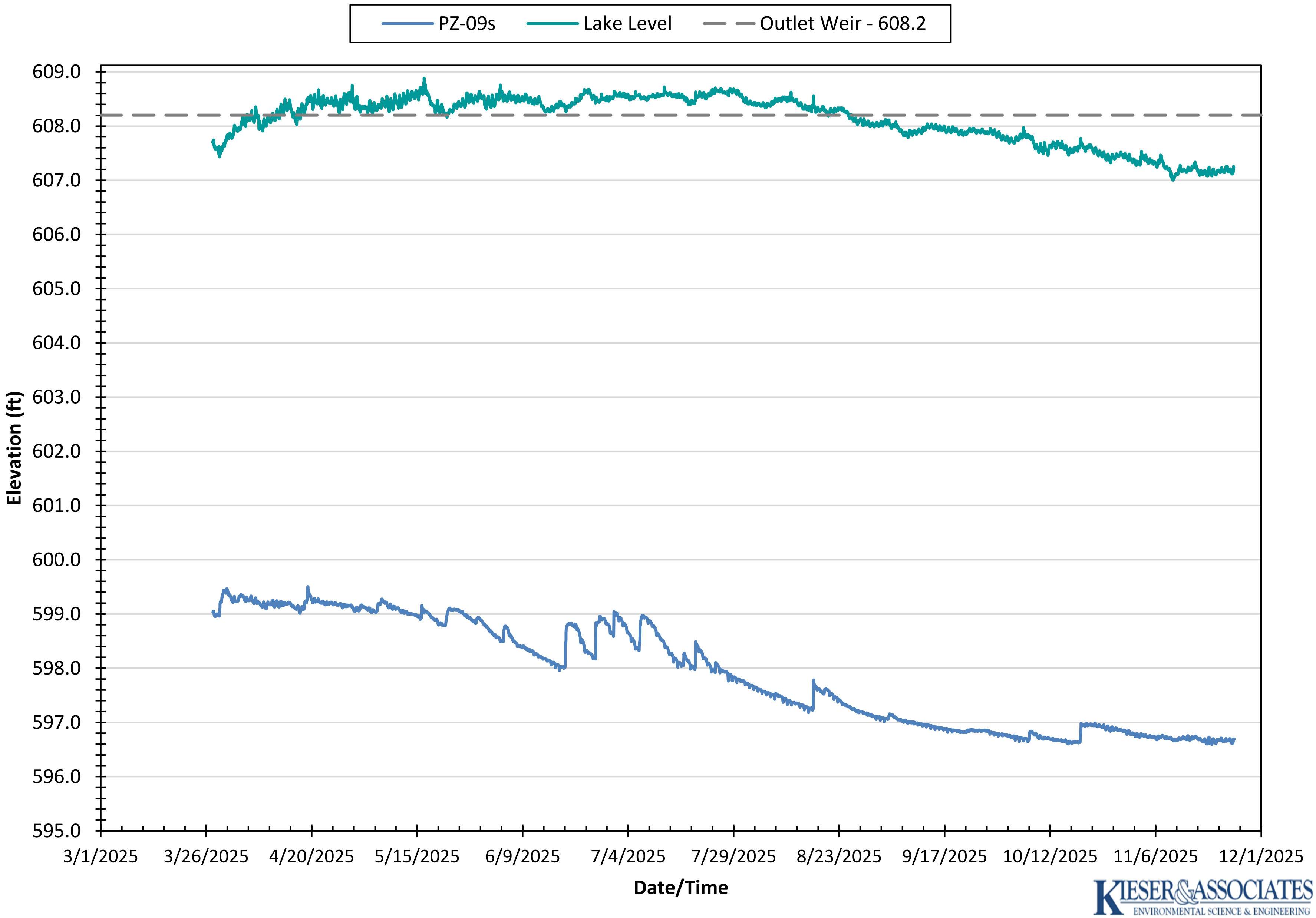
Figure 13. 2025 Cedar Lake Groundwater / Surface Water Elevations (Site 9)



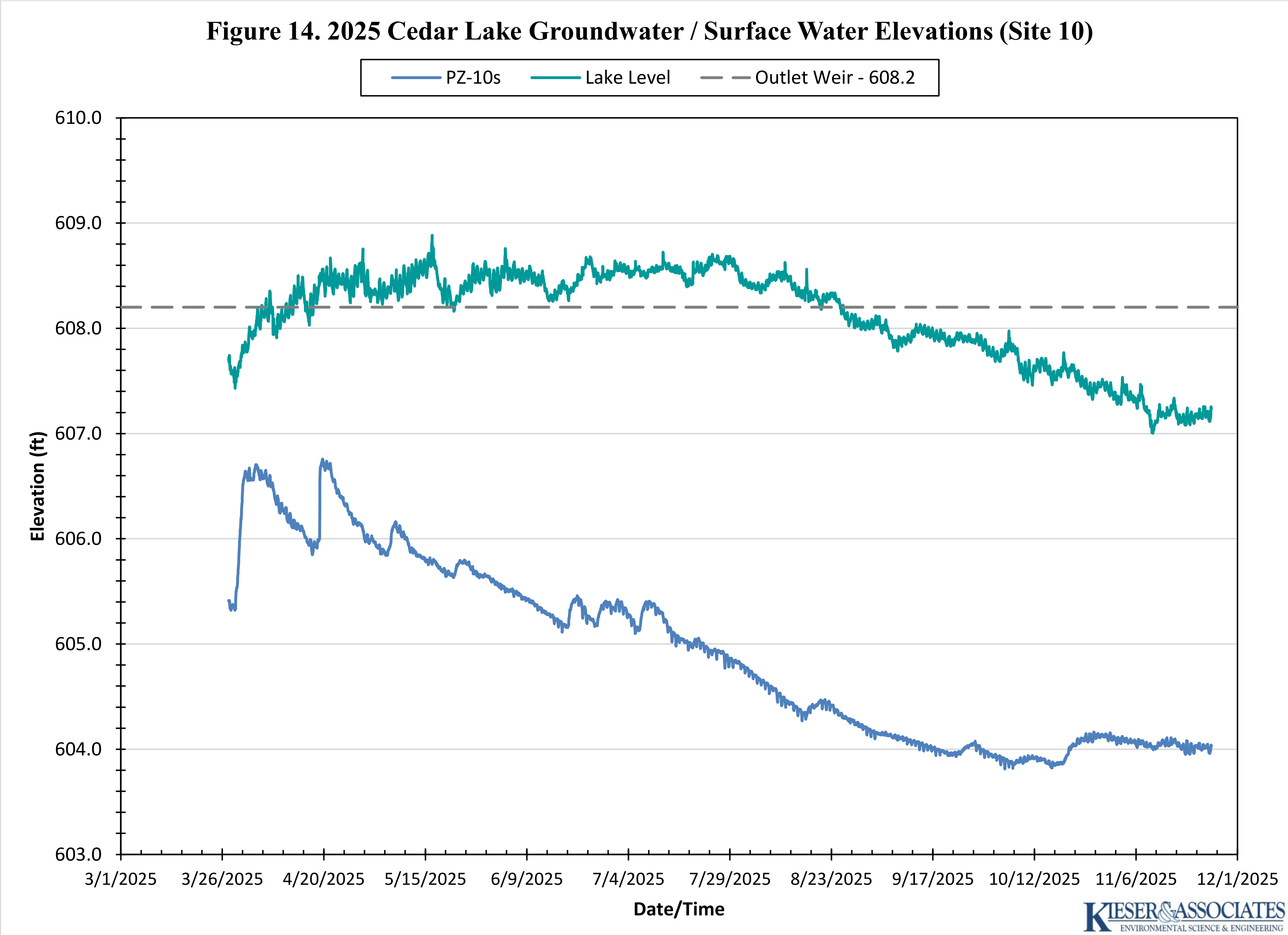


Figure 14. 2025 Cedar Lake Groundwater / Surface Water Elevations (Site 10)
PZ-10s
Lake Level
Outlet Weir - 608.2
610.0
609.0
608.0
607.0
606.0
605.0
604.0
603.0
Elevation (ft)
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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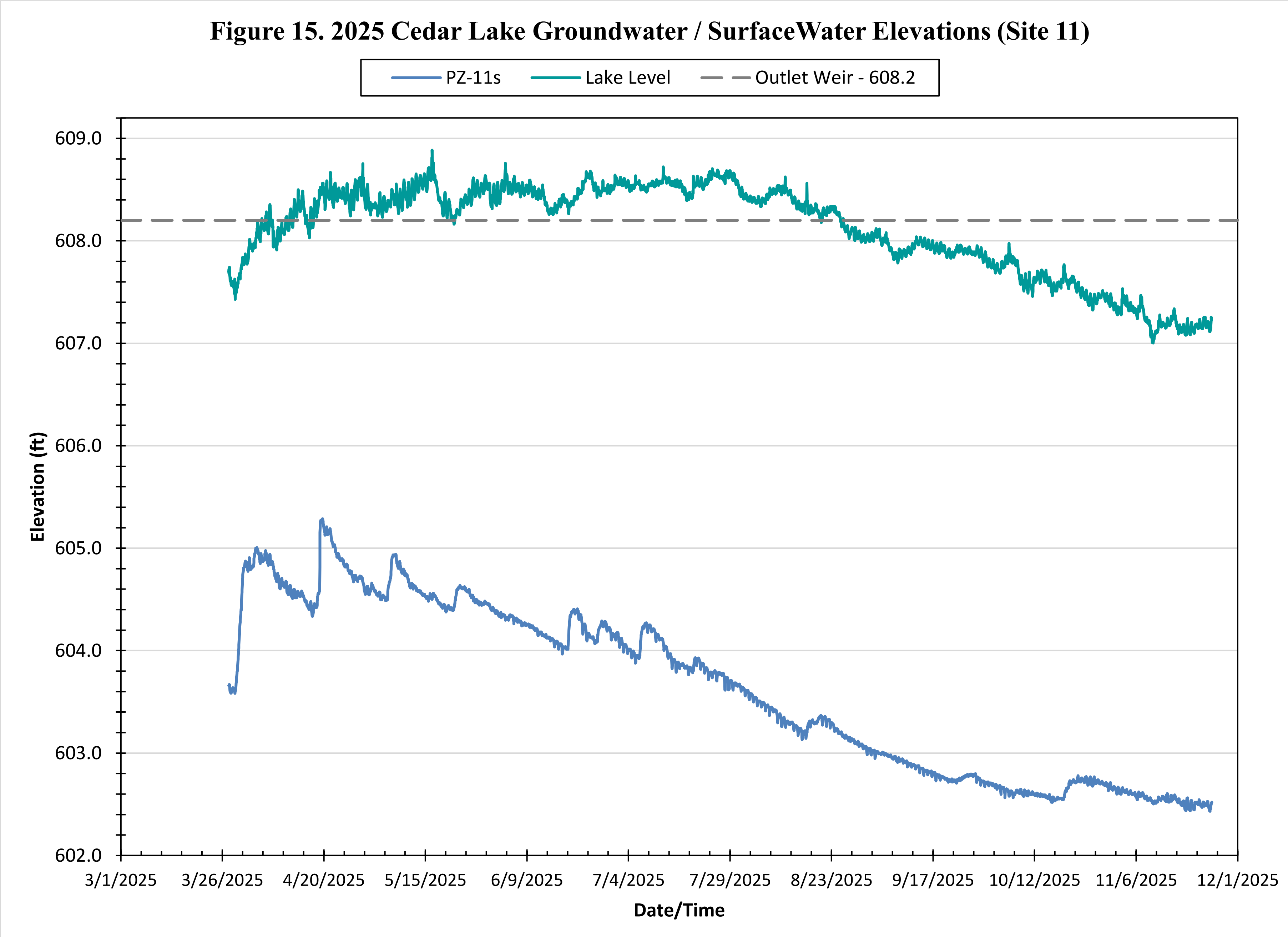

Figure 15. 2025 Cedar Lake Groundwater / SurfaceWater Elevations (Site 11)
PZ-11s
Lake Level
Outlet Weir - 608.2
609.0
608.0
607.0
606.0
605.0
604.0
603.0
602.0
Elevation (ft)
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time

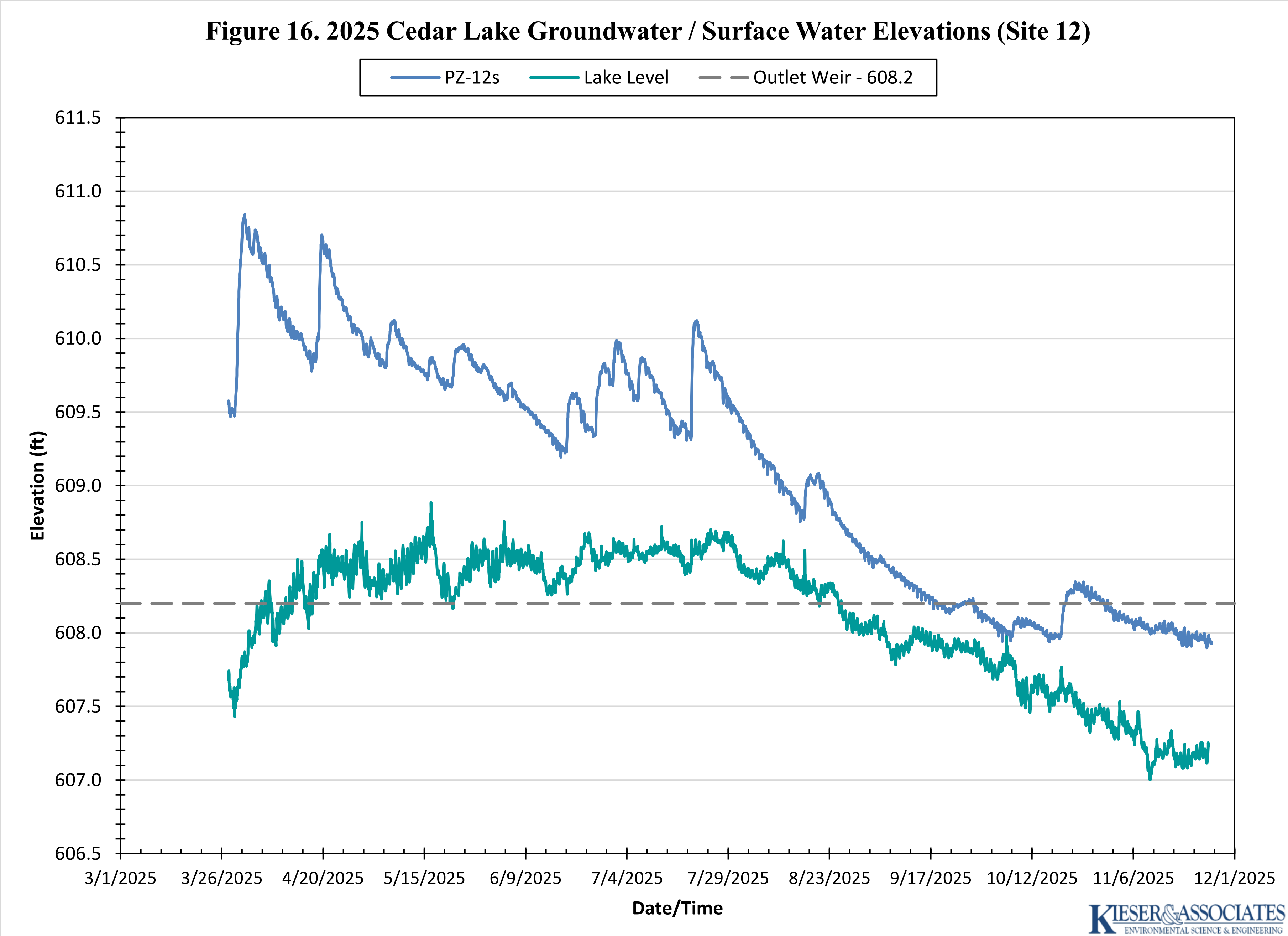
Figure 16. 2025 Cedar Lake Groundwater / Surface Water Elevations (Site 12)
PZ-12s
Lake Level
Outlet Weir - 608.2
611.5
611.0
610.5
610.0
609.5
609.0
608.5
608.0
607.5
607.0
606.5
Elevation (ft)
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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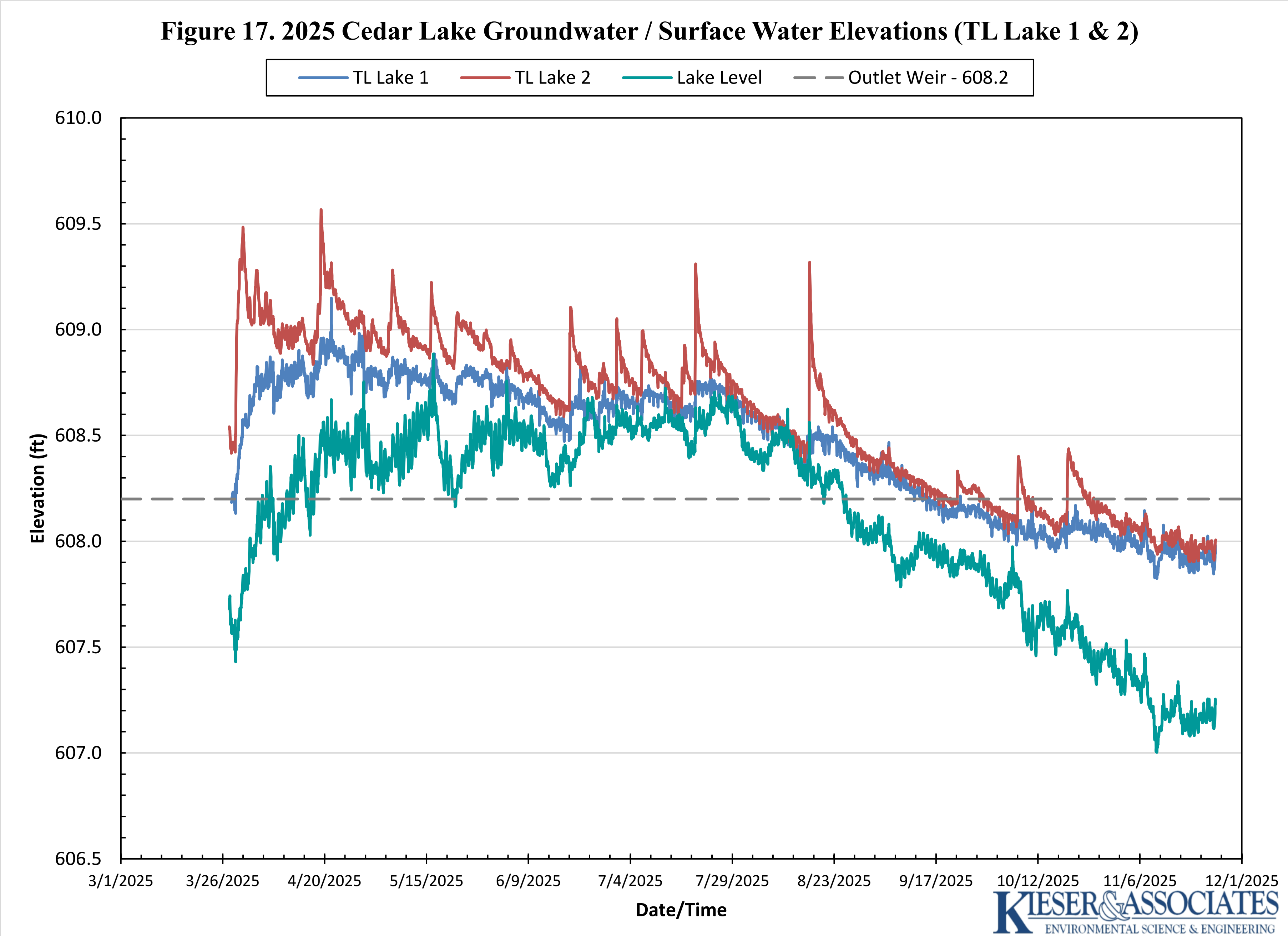

Figure 17. 2025 Cedar Lake Groundwater / Surface Water Elevations (TL Lake 1 & 2)
TL Lake 1
TL Lake 2
Lake Level
Outlet Weir - 608.2
Elevation (ft)
610.0
609.5
609.0
608.5
608.0
607.5
607.0
606.5
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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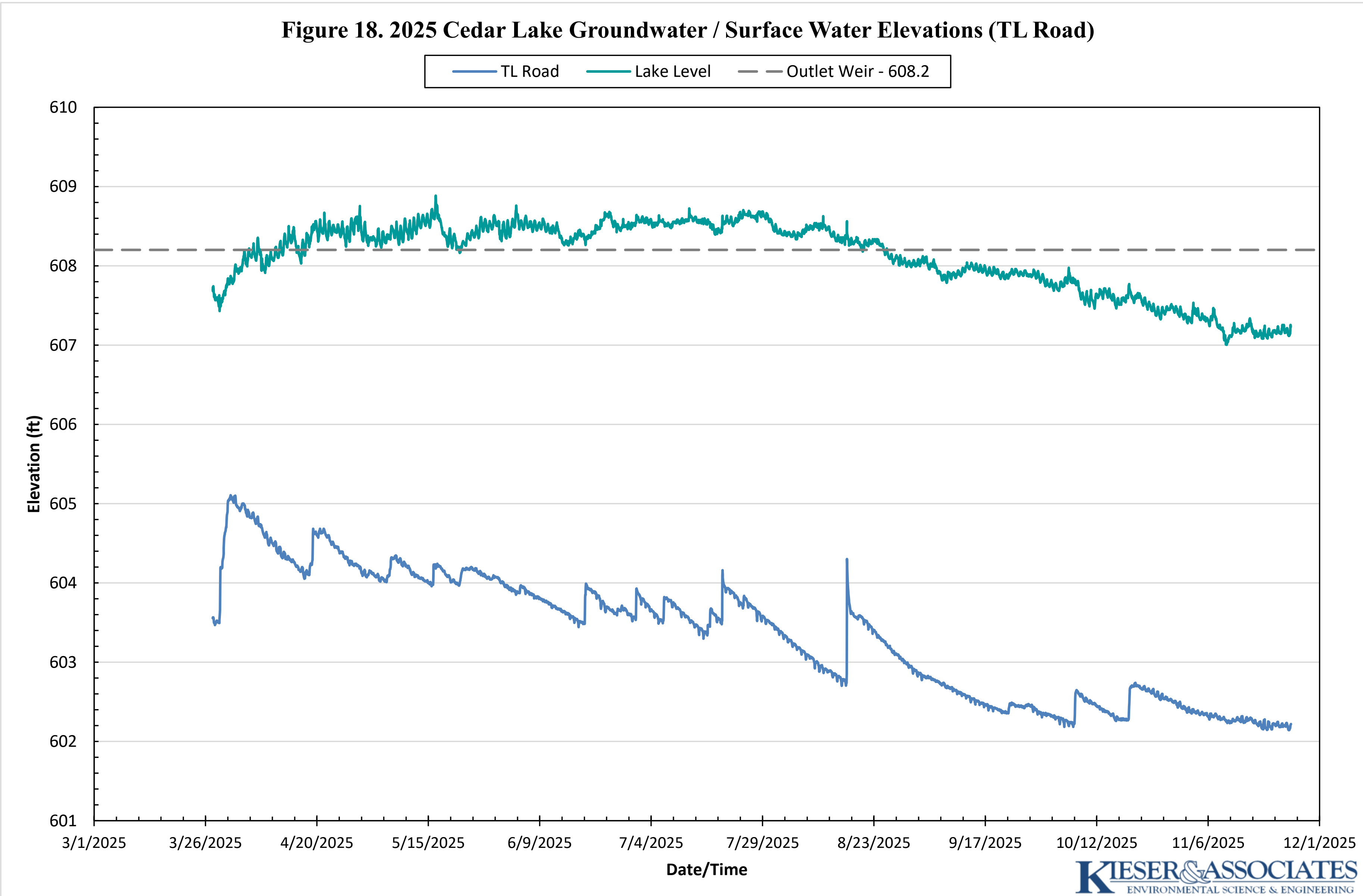
Figure 18. 2025 Cedar Lake Groundwater / Surface Water Elevations (TL Road)
TL Road
Lake Level
Outlet Weir - 608.2
610
609
608
607
606
605
604
603
602
601
Elevation (ft)
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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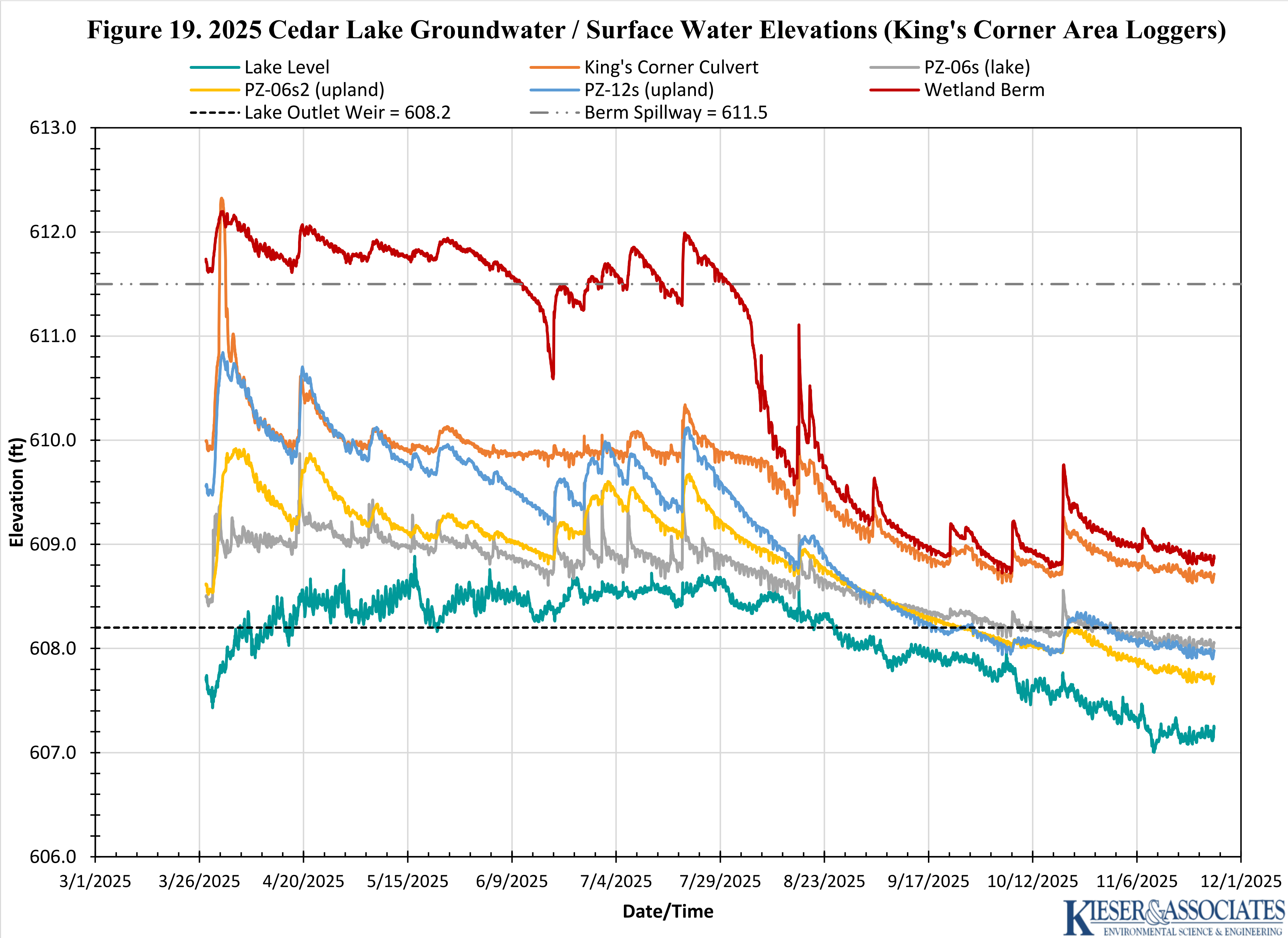

Figure 19. 2025 Cedar Lake Groundwater / Surface Water Elevations (King's Corner Area Loggers)
Lake Level
King's Corner Culvert
PZ-06s (lake)
PZ-06s2 (upland)
PZ-12s (upland)
Wetland Berm
Lake Outlet Weir = 608.2
Berm Spillway = 611.5
Elevation (ft)
613.0
612.0
611.0
610.0
609.0
608.0
607.0
606.0
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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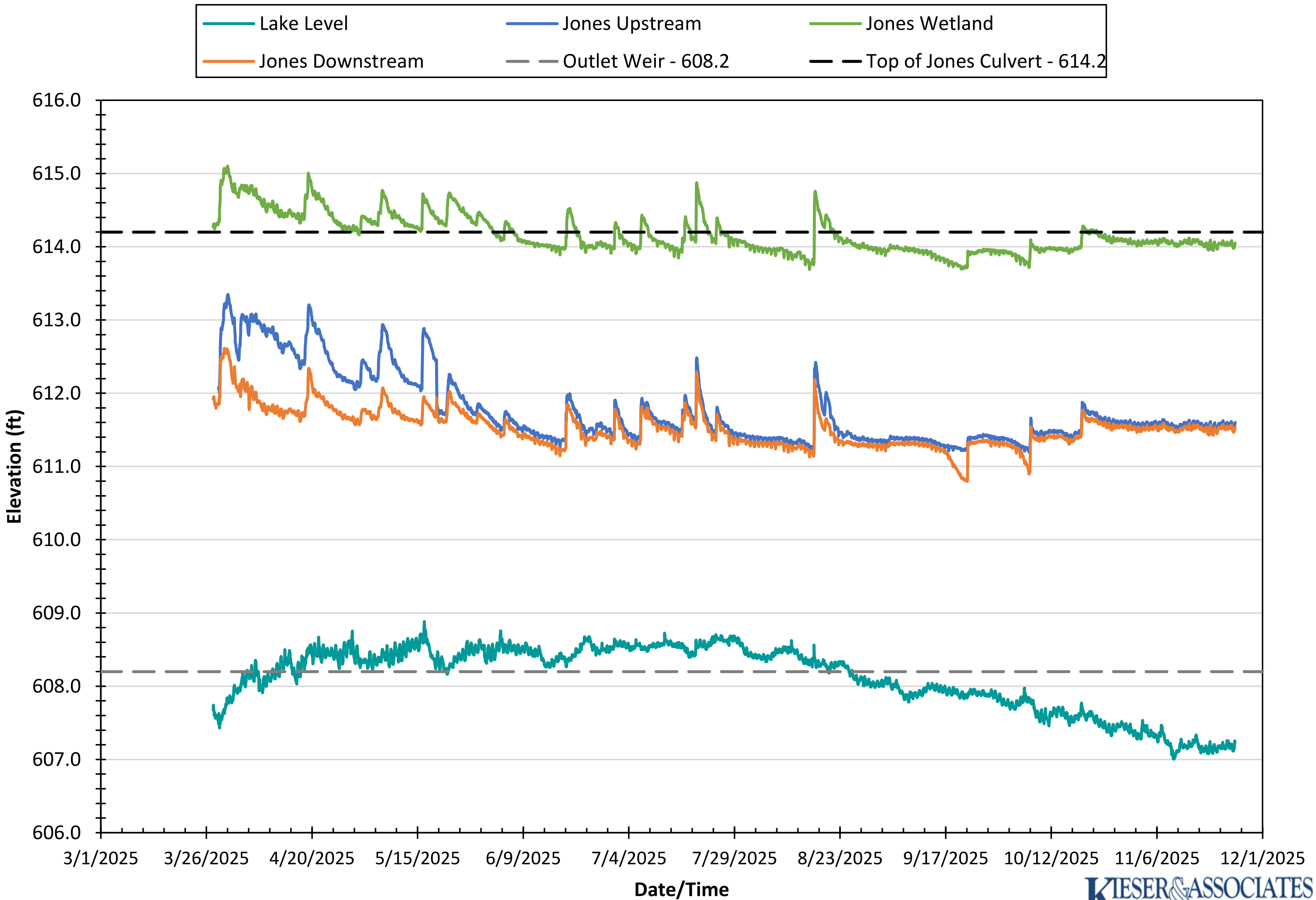
Figure 20. 2025 Jones Ditch Groundwater / Surface Water Elevations



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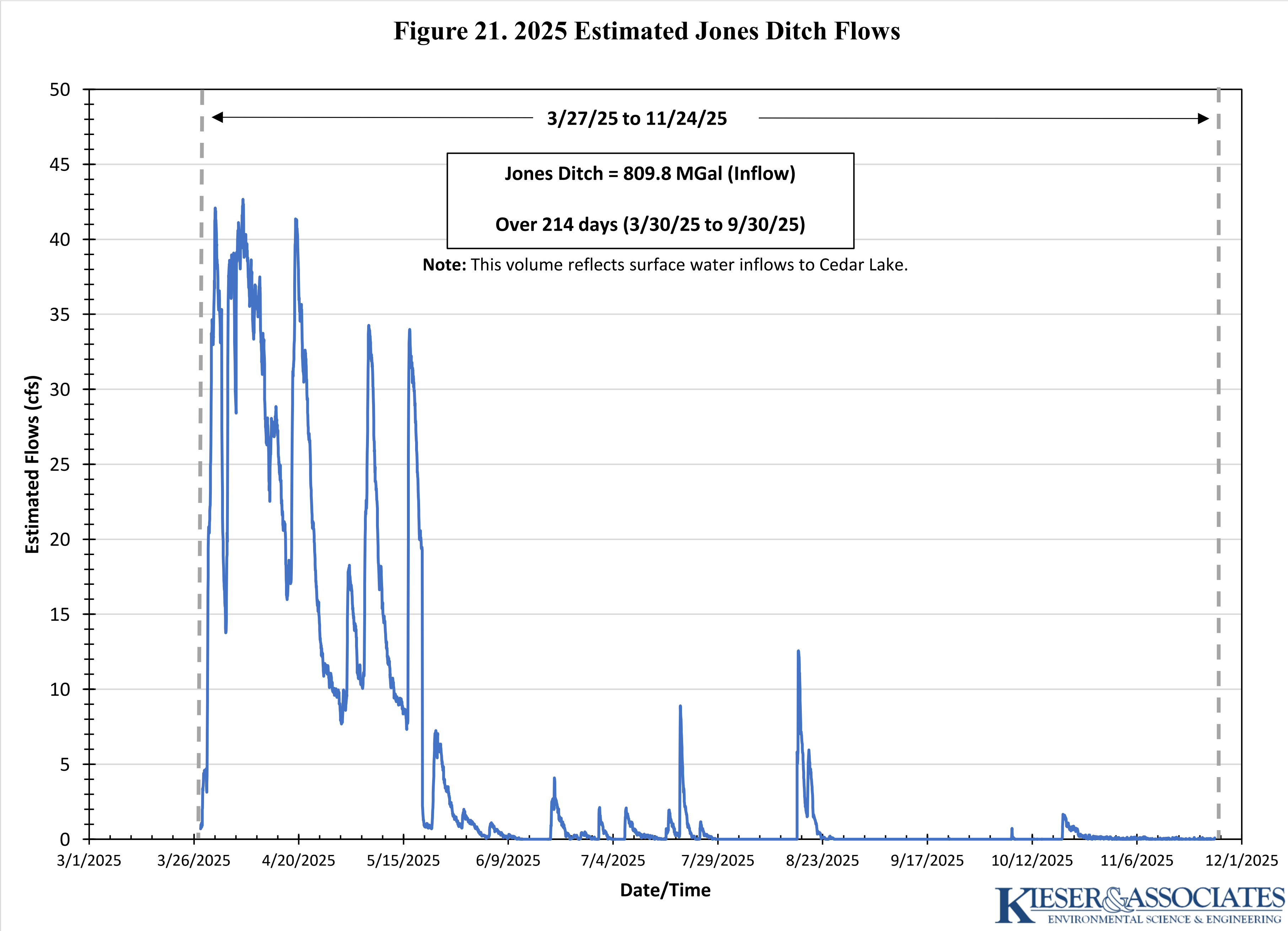

Figure 21. 2025 Estimated Jones Ditch Flows
3/27/25 to 11/24/25
Jones Ditch = 809.8 MGal (Inflow)
Over 214 days (3/30/25 to 9/30/25)
Note: This volume reflects surface water inflows to Cedar Lake.
Estimated Flows (cfs)
50
45
40
35
30
25
20
15
10
5
0
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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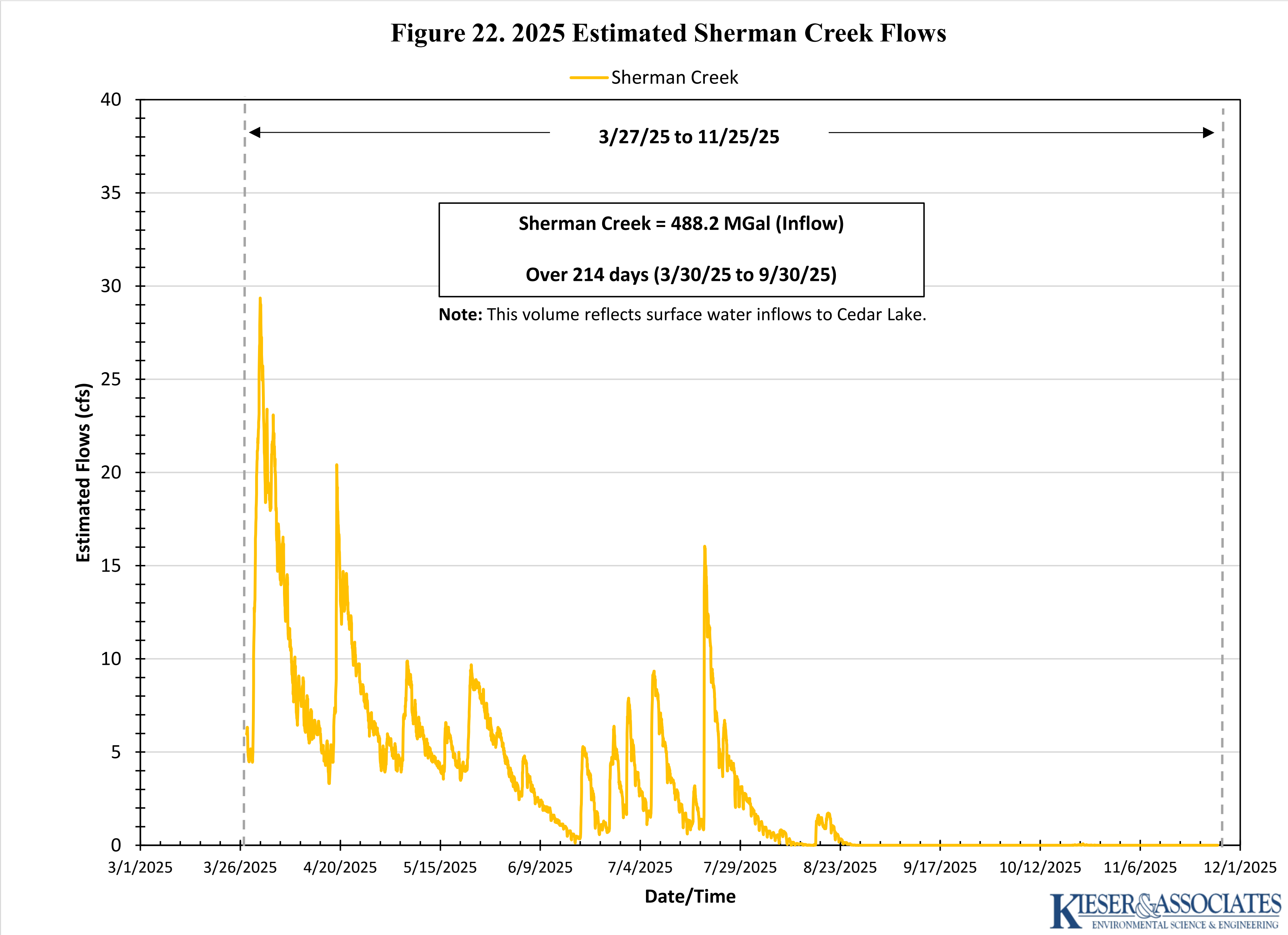
Figure 22. 2025 Estimated Sherman Creek Flows
Sherman Creek
3/27/25 to 11/25/25
Sherman Creek = 488.2 MGal (Inflow)
Over 214 days (3/30/25 to 9/30/25)
Note: This volume reflects surface water inflows to Cedar Lake.
Estimated Flows (cfs)
40
35
30
25
20
15
10
5
0
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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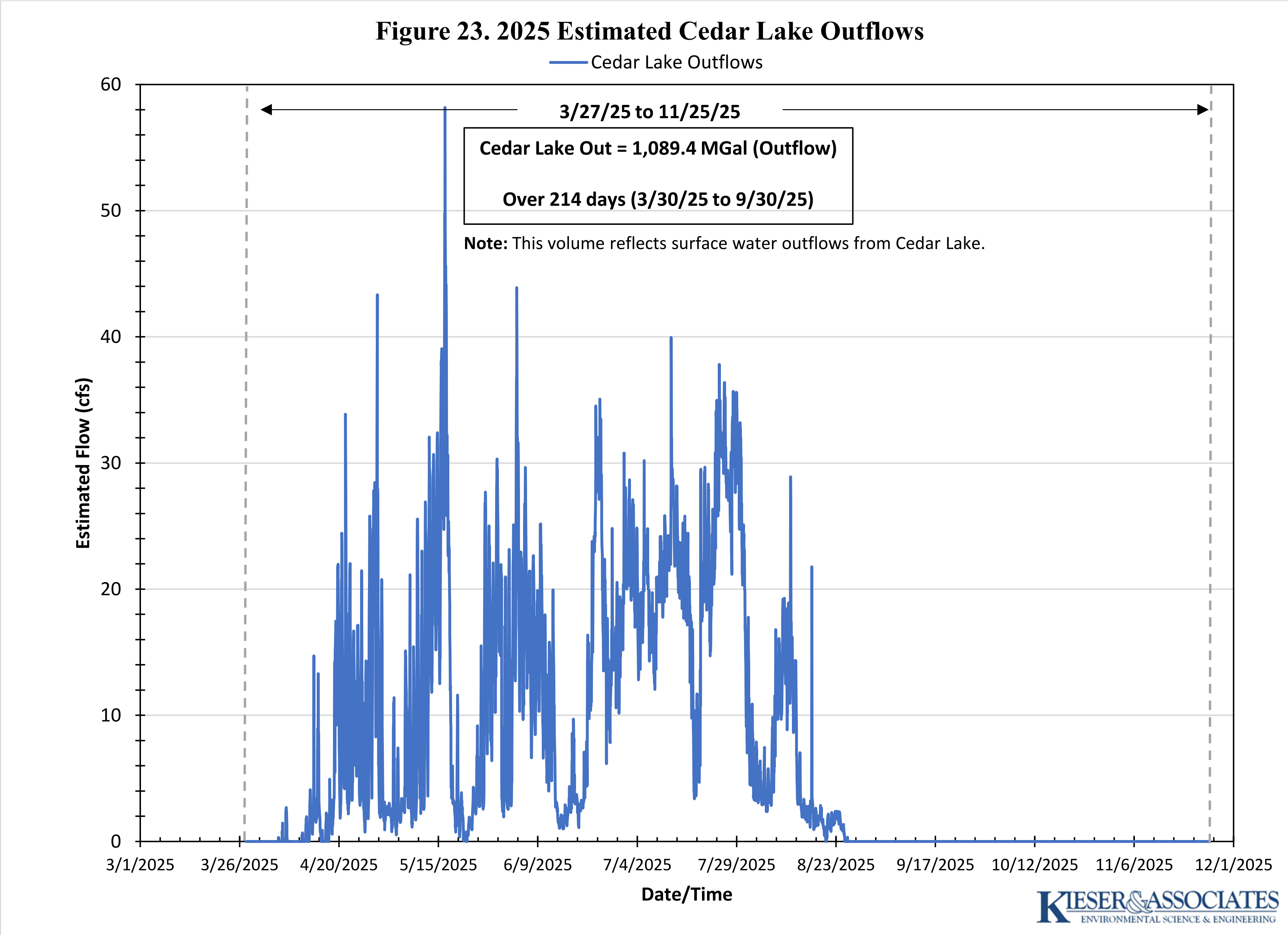
Figure 23. 2025 Estimated Cedar Lake Outflows
Cedar Lake Outflows
3/27/25 to 11/25/25
Cedar Lake Out = 1,089.4 MGal (Outflow)
Over 214 days (3/30/25 to 9/30/25)
Note: This volume reflects surface water outflows from Cedar Lake.
Estimated Flow (cfs)
60
50
40
30
20
10
0
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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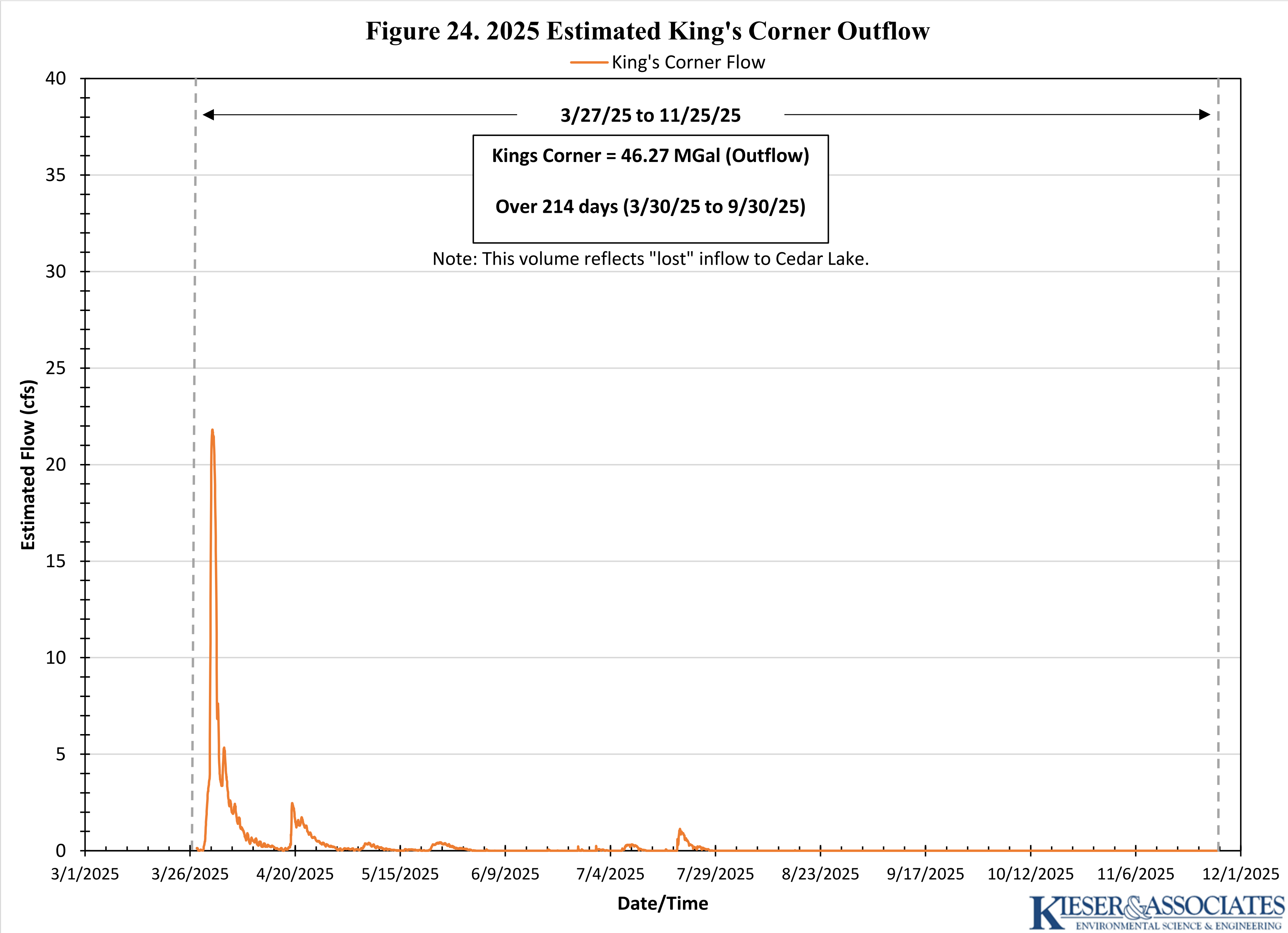

Figure 24. 2025 Estimated King's Corner Outflow
King's Corner Flow
3/27/25 to 11/25/25
Kings Corner = 46.27 MGal (Outflow)
Over 214 days (3/30/25 to 9/30/25)
Note: This volume reflects "lost" inflow to Cedar Lake.
Estimated Flow (cfs)
40
35
30
25
20
15
10
5
0
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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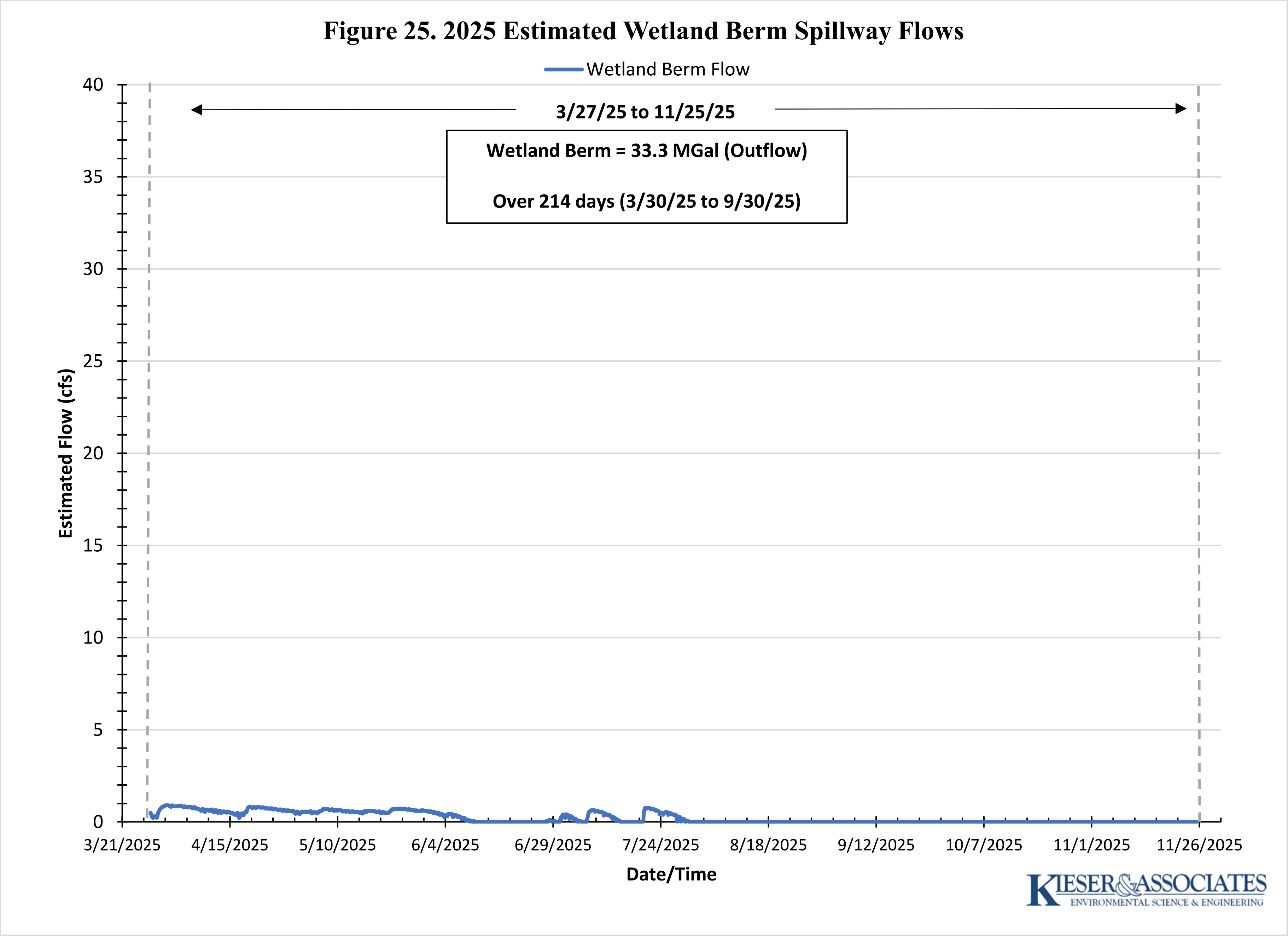

Figure 25. 2025 Estimated Wetland Berm Spillway Flows
Wetland Berm Flow
3/27/25 to 11/25/25
Wetland Berm = 33.3 MGal (Outflow)
Over 214 days (3/30/25 to 9/30/25)
Estimated Flow (cfs)
40
35
30
25
20
15
10
5
0
3/21/2025
4/15/2025
5/10/2025
6/4/2025
6/29/2025
7/24/2025
8/18/2025
9/12/2025
10/7/2025
11/1/2025
11/26/2025
Date/Time
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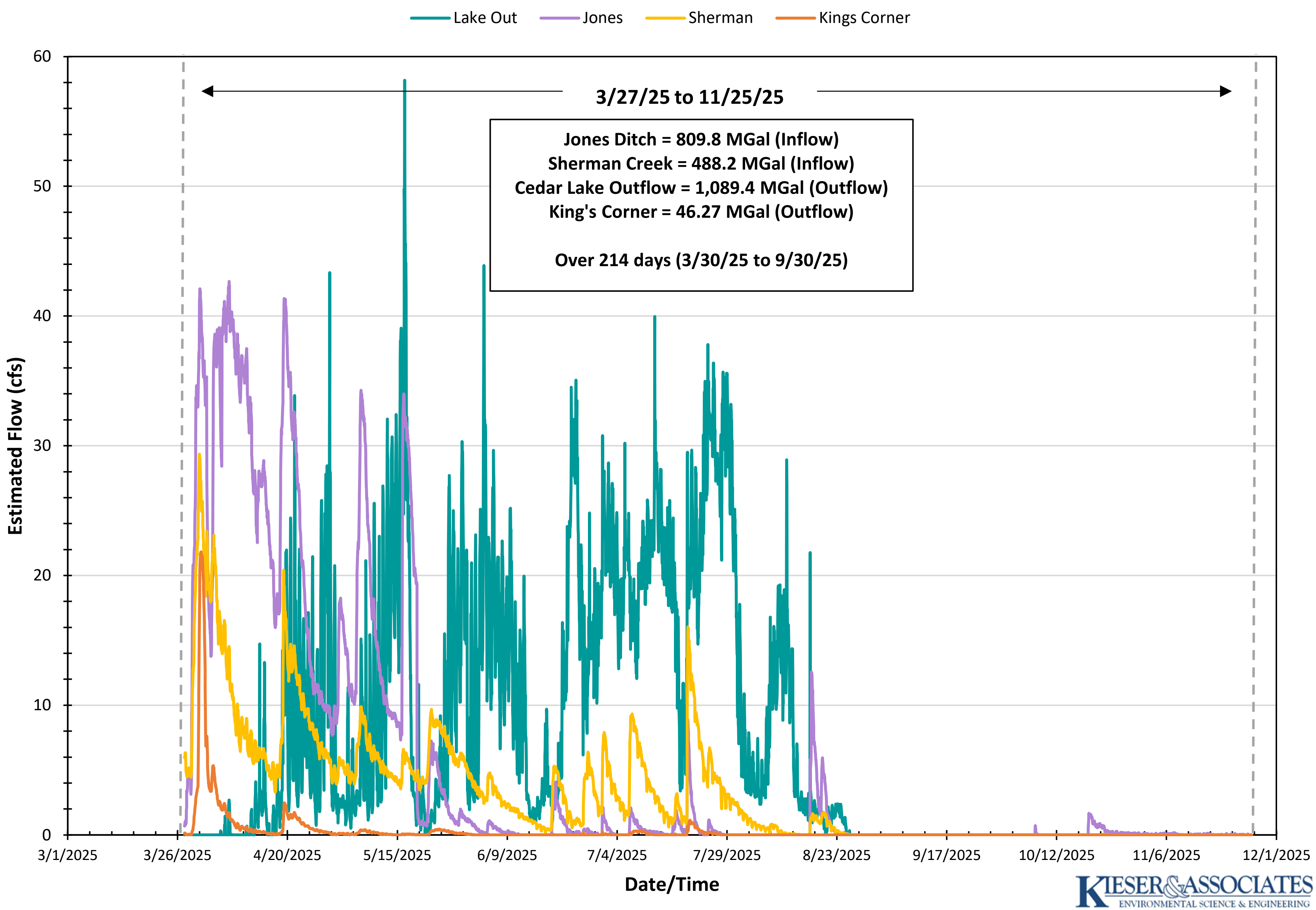
Figure 26. 2025 Estimated Cedar Lake Inflows/Outflows



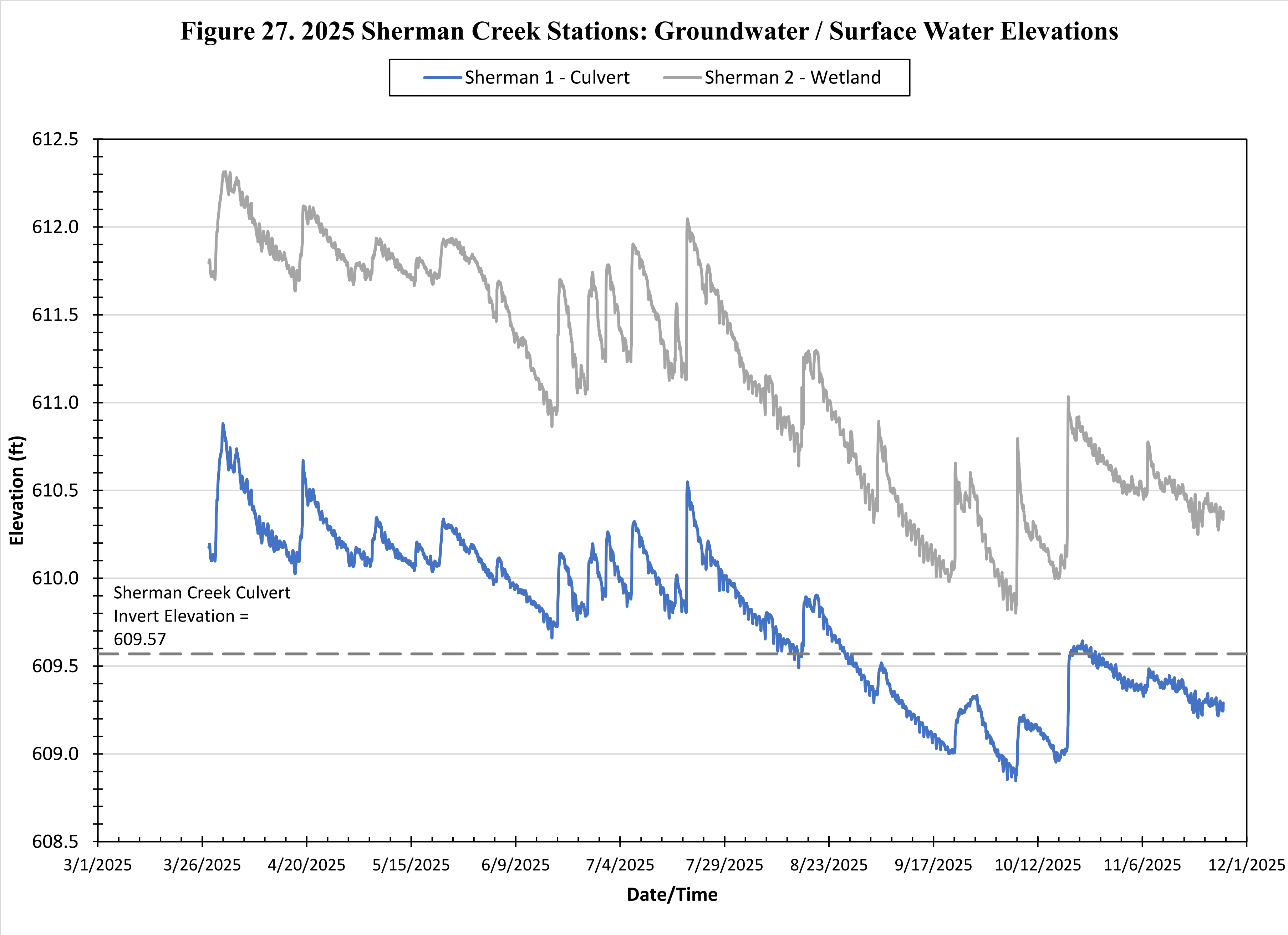
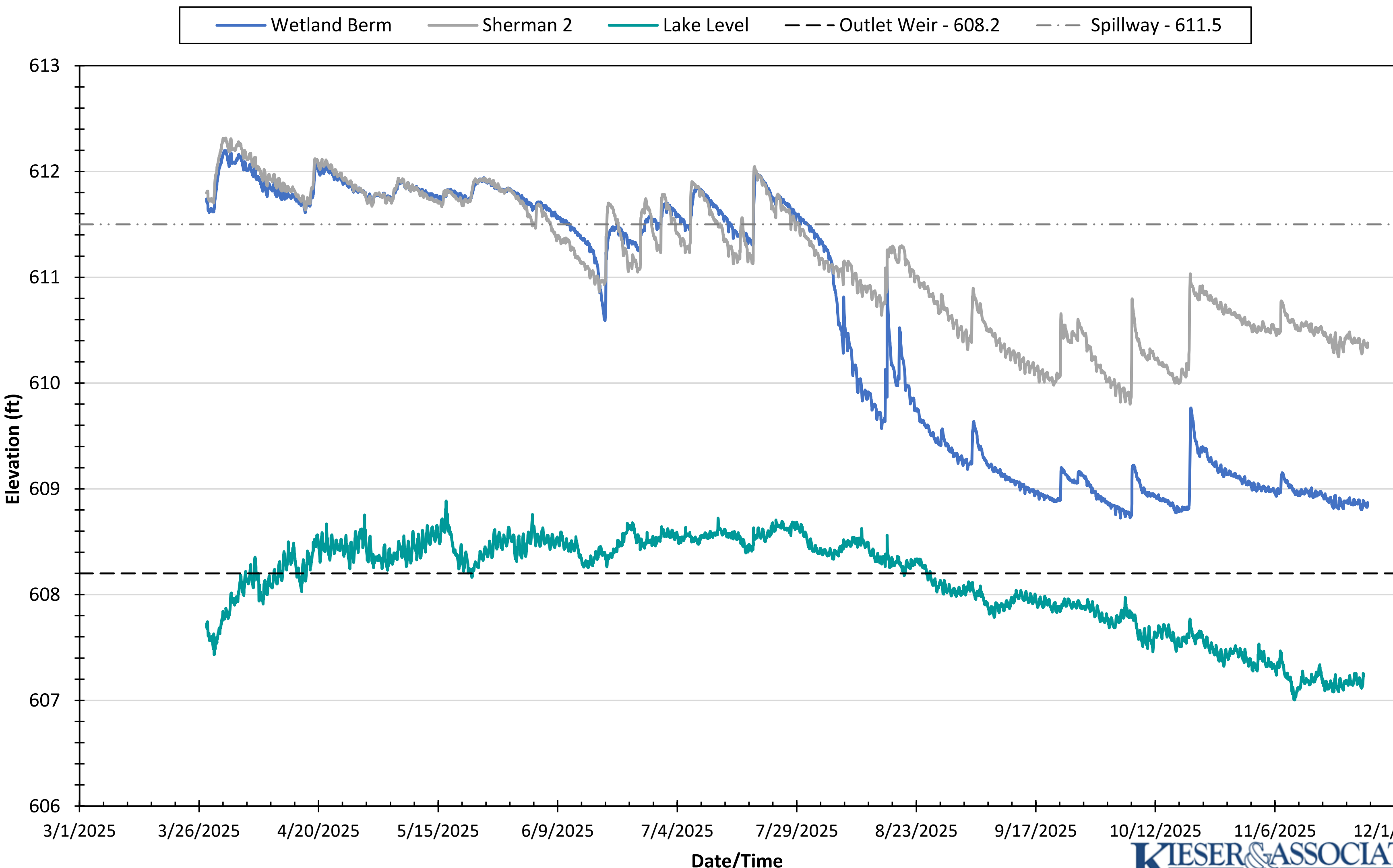


Figure 27. 2025 Sherman Creek Stations: Groundwater / Surface Water Elevations
Sherman 1 - Culvert
Sherman 2 - Wetland
Elevation (ft)
612.5
612.0
611.5
611.0
610.5
610.0
609.5
609.0
608.5
Sherman Creek Culvert
Invert Elevation =
609.57
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time

Figure 28. 2025 Cedar Lake Groundwater / Surface Water Elevations (Wetland Berm)



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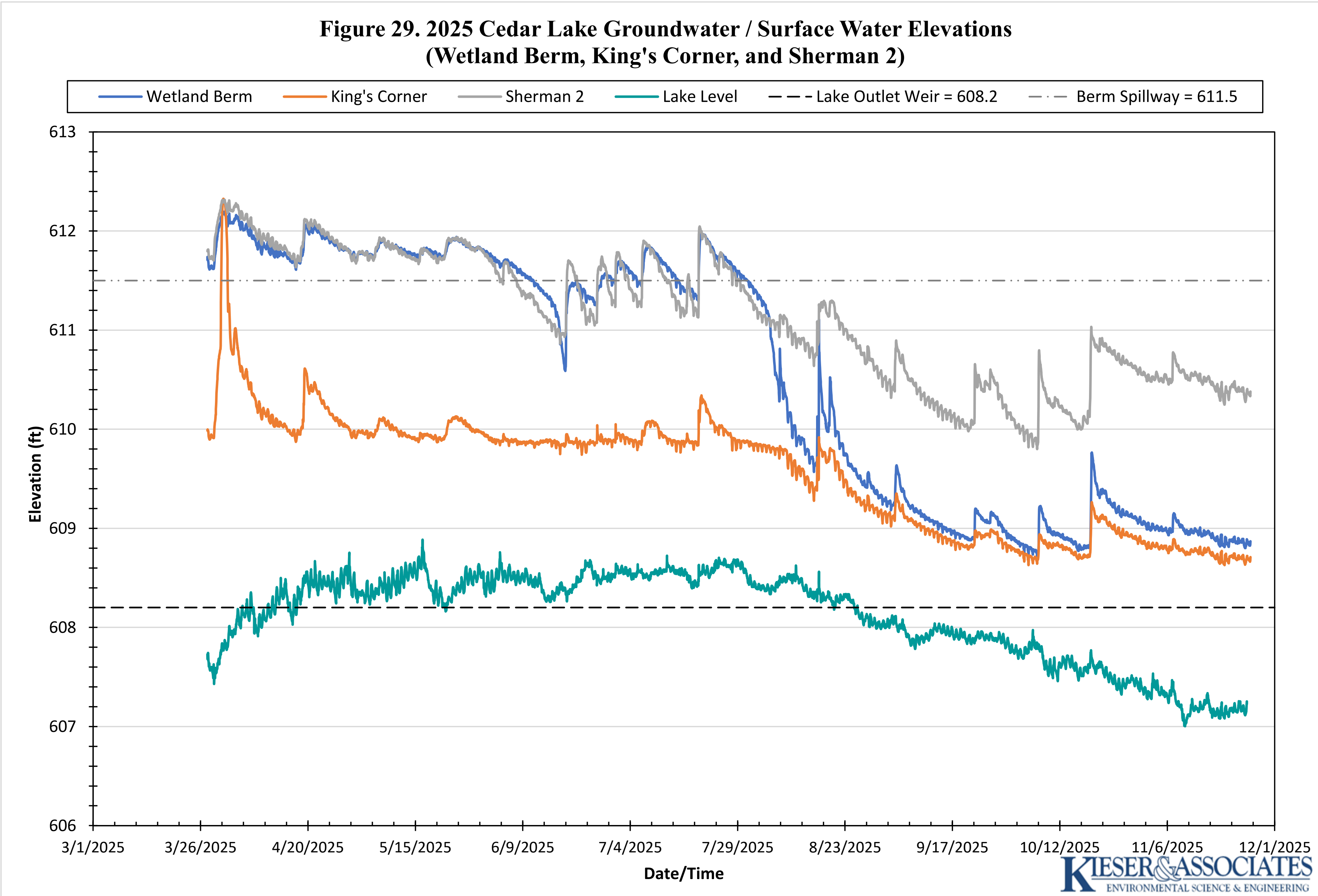

Figure 29. 2025 Cedar Lake Groundwater / Surface Water Elevations
(Wetland Berm, King's Corner, and Sherman 2)
Wetland Berm
King's Corner
Sherman 2
Lake Level
Lake Outlet Weir = 608.2
Berm Spillway = 611.5
Elevation (ft)
613
612
611
610
609
608
607
606
3/1/2025
3/26/2025
4/20/2025
5/15/2025
6/9/2025
7/4/2025
7/29/2025
8/23/2025
9/17/2025
10/12/2025
11/6/2025
12/1/2025
Date/Time
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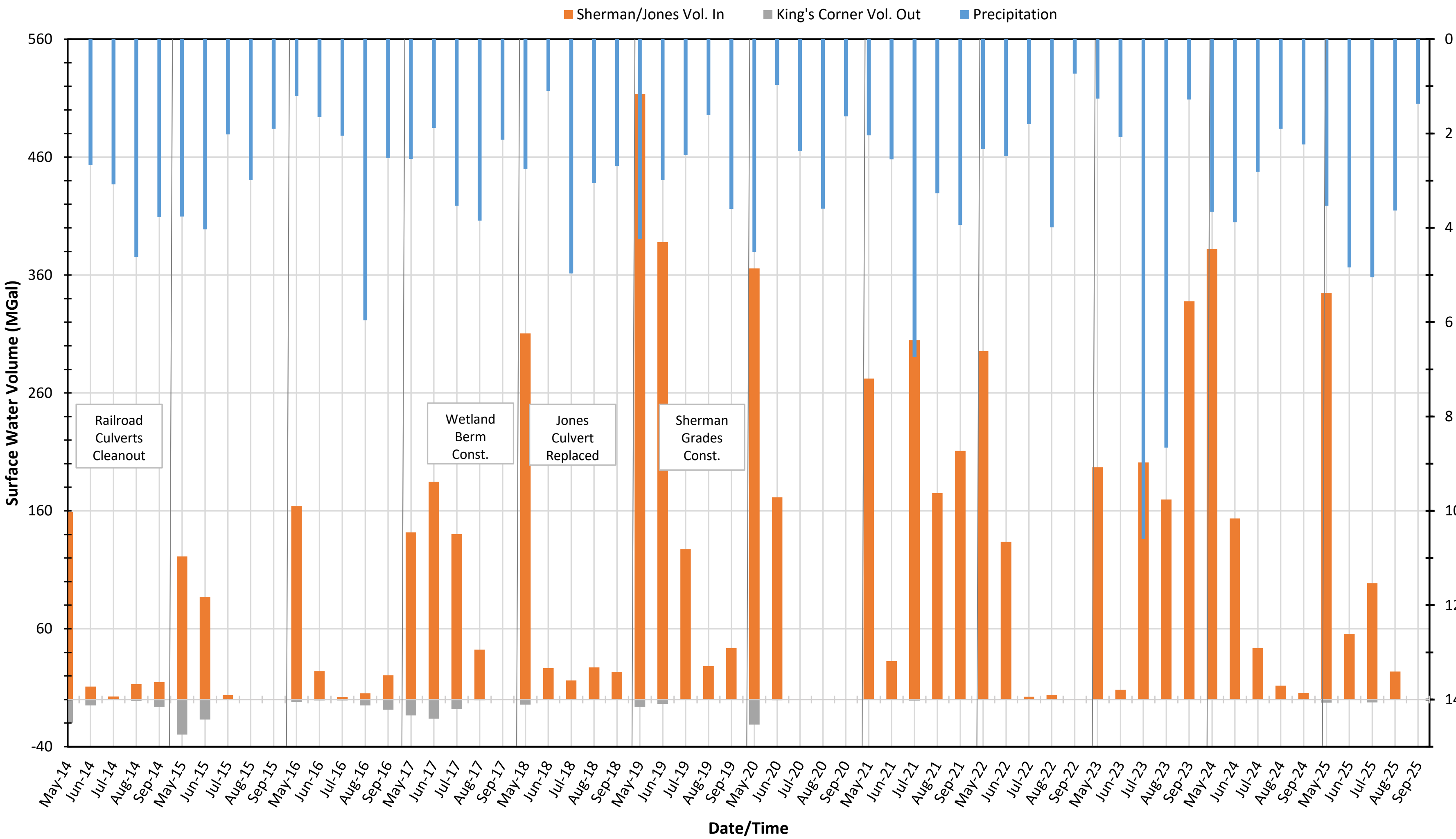
Figure 30. May-Sept, 2014-2025: Precipitation, Sherman/Jones Creek Combined Surface Water Volume into Cedar Lake, and King's Corner Water Volume Away from Cedar Lake



May - September	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Precipitation (in.)	14.14	14.70	13.39	13.93	14.55	14.90	13.08	18.54	11.33	23.88	14.48	18.42
Inflow Volume (Mgal)	200.90	212.50	216.10	509.20	338.30	534.30	383.50	995.10	435.20	1,477.10	1,121.20	523.01
King's Outflow Vol. (Mgal)	32.20	46.90	17.10	38.10	4.30	10.20	21.80	0.16	0.16	10.37	0.05	5.20