CITY OF OREGON CITY
URBAN RENEWAL COMMISSION
AGENDA

Hanlon Commission Chambers, Libke Public Safety Facility, 1234 Linn Ave, Oregon City
Wednesday, May 6, 2026 at 6:00 PM

Ways to participate in this public meeting:
- *Attend in person, location listed above. Please see the public comment guidelines below.*
- *Attend the livestream of the meeting on the City's YouTube Channel: https://www.youtube.com/user/CityofOregonCity*
- *Register to provide electronic testimony (email recorderteam@orcity.org or call 503-496-1509 by 3:00 PM on the day of the meeting to register)*
- *Email recorderteam@orcity.org (deadline to submit written testimony via email is 3:00 PM on the day of the meeting)*
- *Mail to City of Oregon City, Attn: City Recorder, P.O. Box 3040, Oregon City, OR 97045*

1. CALL TO ORDER AND ROLL CALL

2. PUBLIC COMMENTS

3. DISCUSSION ITEMS

a. Clackamette Cove Water Quality & Alternatives Evaluation Phase 2

b. Personal Services Agreement with Aquatic Insights for the Clackamette Cove Vegetation Management (PS 26-012)

4. COMMUNICATIONS

5. ADJOURNMENT

EXECUTIVE SESSION

The Executive Session will begin after the adjournment of the Urban Renewal Commission meeting pursuant to ORS 192.660(2)(f) To consider information or records that are exempt by law from public inspection.

PUBLIC COMMENT GUIDELINES

Complete a Comment Card prior to the meeting and submit it to the clerk. When the Chair calls your name, proceed to the speaker table, and state your name and city of residence. Each speaker is given 3 minutes to speak. As a general practice, the committee does not engage in discussion with those making comments. Complaints shall be addressed at the department level prior to addressing the committee.

ADA NOTICE

The location is ADA accessible. Hearing devices may be requested from the City Recorder prior to the meeting. Individuals requiring other assistance must make their request known 48 hours preceding the meeting by contacting the City Recorder's Office at 503-657-0891.

Agenda Posted at City Hall, Pioneer Community Center, Library, City Website.

Video Streaming & Broadcasts: The meeting is streamed live on the Oregon City's website and available on demand following the meeting. The meeting can be viewed on Willamette Falls Television channel 28 for

Oregon City area residents as a rebroadcast. Please contact WFMC at 503-650-0275 for a programming schedule.

625 Center Street
Oregon City, OR 97045
503-657-0891

CITY OF OREGON CITY

Staff Report

To:	Urban Renewal Commission	**Agenda Date:**	May 6, 2026
From:	Dayna Webb, Public Works Director		

SUBJECT:
Item 3.a. - Clackamette Cove Water Quality & Alternatives Evaluation Phase 2

STAFF RECOMMENDATION:
Review information presented on the alternatives for Clackamette Cove (Cove) water quality and provide feedback and direction for monitoring.

EXECUTIVE SUMMARY:

The Clackamette Cove (Cove) has experienced harmful algal blooms (HAB) in the past, but little water-quality data was available to determine the cause. Two years of data collection have determined the source is from bottom sediments and thermal stratification of the water column. The goal of this program has been to evaluate conditions in the Cove, develop alternatives for HAB and provide recommendations for improving water quality conditions to support recreational use, aesthetic qualities and future development of the Cove property.

The Cove's vicinity to the Clackamas River means it can either be treated as a lake or an extension of the Clackamas River. Aquatic Insight, LLC has collected data for two years to evaluate conditions and to address concerns in relation to seasonal HAB that could impact recreational uses of the Cove. Data was fed into a numerical Model (CE-QUAL-W2 model) to measure the effectiveness of six hydrologic scenarios that treat the cove as an extension of the river. The six scenarios considered multiple strategies with one basic question in mind, "how much flushing would be necessary to lower the risk of HAB in the Cove if it was treated as a river?". Staff from Public Works and Economic Development, in discussions with the consultant team, have determined all six scenarios to treat the Cove as a river are not practical or feasible given the work that would be needed to accomplish and maintain sufficient flow.

In this presentation, Mark Rosenkranz from Aquatic Insights and Zoe Rodrigez Del Rey from Annear Water Services (Consultants) will discuss similarities and differences between the two years of data, results of the model, and recommended alternatives for mitigating HAB in the future. Aquatic Insights recommend continuing to treat the Cove as a lake and ask a more attainable question, "does removal of invasive aquatic plants minimize the risk of HAB if it was a lake?". The consultant team believes this to be an affordable first step to improving water quality that may be enough to effectively minimize the risk of HAB.

BACKGROUND:

On July 28, 2023, Commissioner Frank O'Donnell met with the Urban Renewal Commission to engage in a discussion on what should be considered to mitigate water quality concerns in the Clackamette Cove (Cove) and how to address concerns in relation to seasonal blue-green algae blooms that could impact recreational and habitat uses of the Cove.

At a work session on September 12, 2023, as directed by the Urban Renewal Commission, Commissioner O'Donnell led a discussion which included the Oswego Lake site tour and the Lake Oswego Corporation's efforts to improve water quality and manage and address the lake's water quality issues including how they address blue-green algae blooms. Staff also provided updates on meetings with representatives from the Portland Permits Section of the US Army Corps of Engineers.

At the conclusion of the September meeting, staff pursued an initial scope of work to study and better understand existing conditions which were used to evaluate opportunities for water quality improvement and identify a plan to understand what may be impacting late-season water quality in the Cove.

On January 17, 2024, the drafted scope of work was submitted to the Urban Renewal Commission for consideration. On January 30, 2024, a small stakeholder group met to provide final feedback that was needed for a Request for Proposals.

A public advertisement requesting proposals was published in the Daily Journal of Commerce on March 8 and 11, 2024. Two proposals were received on March 26, 2024. A five-person evaluation team met on April 3, 2024, and reached unanimous consensus to recommend Aquatic Insight, LLC for the project.

From April 23, 2024, to March 12, 2025 (Phase 1), and July 2025, to October 2025 (Phase 2), data was collected on the Cove and Clackamas River. The following data was collected:

- Multi-parameter sonde data was collected from the cove and from the river.
- Water samples were collected from the cove at depths of two meters and five meters, and analyzed for total phosphorus, soluble reactive phosphorus, total nitrogen, nitrate and nitrite, ammonia, total Mn, total Fe, and alkalinity.
- Phytoplankton samples were collected from the Cove and the Clackamas River.
- Sediment cores were collected from three locations in the cove and analyzed for phosphorus content.
- Water surface elevation data was collected from the cove and river for model calibration.

Aquatic Insight, LLC has developed the baseline CE-QUAL-W2 model (Model), which collects data for water quality and is a hydrodynamic model in 2D (longitudinal-vertical), for rivers, estuaries, lakes, reservoirs and river basin systems. W2 models basic eutrophication processes such as temperature-nutrient-algae-dissolved oxygen-organic matter and sediment relationships.

The two years of monitoring data, combined with CE-QUAL-WA modeling, have supported the final development of the alternative's evaluation to improve water quality and reduce the risk of HAB that could impact recreation. Aquatic Insight finalized the list of six identified management alternatives and conducted a comparative analysis.

This report represents the results of the comparative analysis and what they recommend moving forward.

OPTIONS:

1. Approve Clackamette Cove Water Quality & Alternatives Evaluation Phase 2.
2. Approve Clackamette Cove Water Quality & Alternatives Evaluation Phase 2 with Amendments.
3. Deny Clackamette Cove Water Quality & Alternatives Evaluation Phase 2 and provide further direction.

BUDGET IMPACT:

Amount	N/A
Fiscal Year(s):	N/A
Funding Source(s):	N/A

CE-QUAL-W2 Model Development, Calibration, and Scenario Results

Technical Report Documenting Modeling of Clackamette Cove and the Clackamas River

April 15, 2026

PREPARED FOR:
Mark Rosenkranz | Owner and Principle
Aquatic Insights, LLC
4207 SE Woodstock Blvd #535, Portland, OR

PREPARED BY:
Annear Water Resources, LLC

ANNEAR WATER RESOURCES

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List of Abbreviations

AWR	Annear Water Resources
cfs	cubic feet per second
City	City of Oregon City Urban Renewal Agency
Cove	Clackamette Cove
ft./s	feet per second
GIS	Geographic Information System
Geosyntec	Geosyntec Consultants, Inc.
GRASS	GRAphics Symbiosis System programming language
m/s	meters per second
MAE	mean average error
ME	mean error
Project	Clackamette Cove Water Quality and Alternative Evaluation Program
QGIS	Quantum Geographic Information Systems GIS program
River	Clackamas River
RM	river mile
RMSE	root-mean square error
USACE	U.S. Army Core of Engineers
USGS	U.S. Geological Survey
W2	CE-QUAL-W2

Introduction

The City of Oregon City Urban Renewal Agency (City) manages Clackamette Cove, an approximately 38-acre waterbody located in Oregon City, Oregon. The Cove was previously used for sand and gravel mining and the area now holds substantial recreational and development potential. Despite being hydraulically connected to the Clackamas River, the limited nature of this connection results in heightened residence times supporting elevated nutrient levels and subsequent cyanobacteria algal blooms.

The City is interested in improving water quality conditions in the Cove to support potential recreational and development opportunities. As part of the Clackamette Cove Water Quality and Alternatives Evaluation Program Project (Project), Annear Water Resources, LLC, conducted a modeling effort using CE-QUAL-W2 (W2), a 2-dimensional hydrodynamic and water quality model, to evaluate alternatives for increasing the hydraulic connection of the Cove and Clackamas River to improve water quality.

This technical report documents the development of the model and presents the results of six alternative scenarios developed in coordination with the City to evaluate the potential to improve Cove water quality.

Project Overview

The W2 model extent includes Clackamette Cove and the approximately 1.67-mile reach of the Clackamas River extending from the U.S. Geological Survey (USGS) gage at Oregon City (ID: 142011010) to the Willamette River confluence (Figure 1).

CE-QUAL-W2 Modeling in the Clackamas River

CE-QUAL-W2 Version 4.5 (Wells, 2023) is a two-dimensional (longitudinal-vertical), laterally averaged, hydrodynamic and water quality model originally developed by the U.S. Army Corps of Engineers (USACE) Waterways Experiments Station. The Clackamas River was first modeled with W2 in 2003 by Portland State University to support the development of the Willamette River Temperature Total Daily Maximum Load (Annear et al., 2004). The model extent included the Clackamas River from the River Mill Reservoir at river mile (RM) 26.0 to the Willamette River confluence at RM 0.0. The 2004 model was later updated in 2016 to support a water rights litigation case (Geosyntec, 2016). Neither the 2004 nor 2016 models included Clackamette Cove as a distinct branch in the model.

The 2016 Geosyntec model of the Clackamas River was used as the basis for developing the 2025 Clackamette Cove and Lower Clackamas River model used to simulate the hydrodynamics and temperature of the seasonally connected Cove and River system. The next section presents the modifications made to the 2016 model and additional development supporting the evaluation of alternative scenarios for improving Cove water quality.

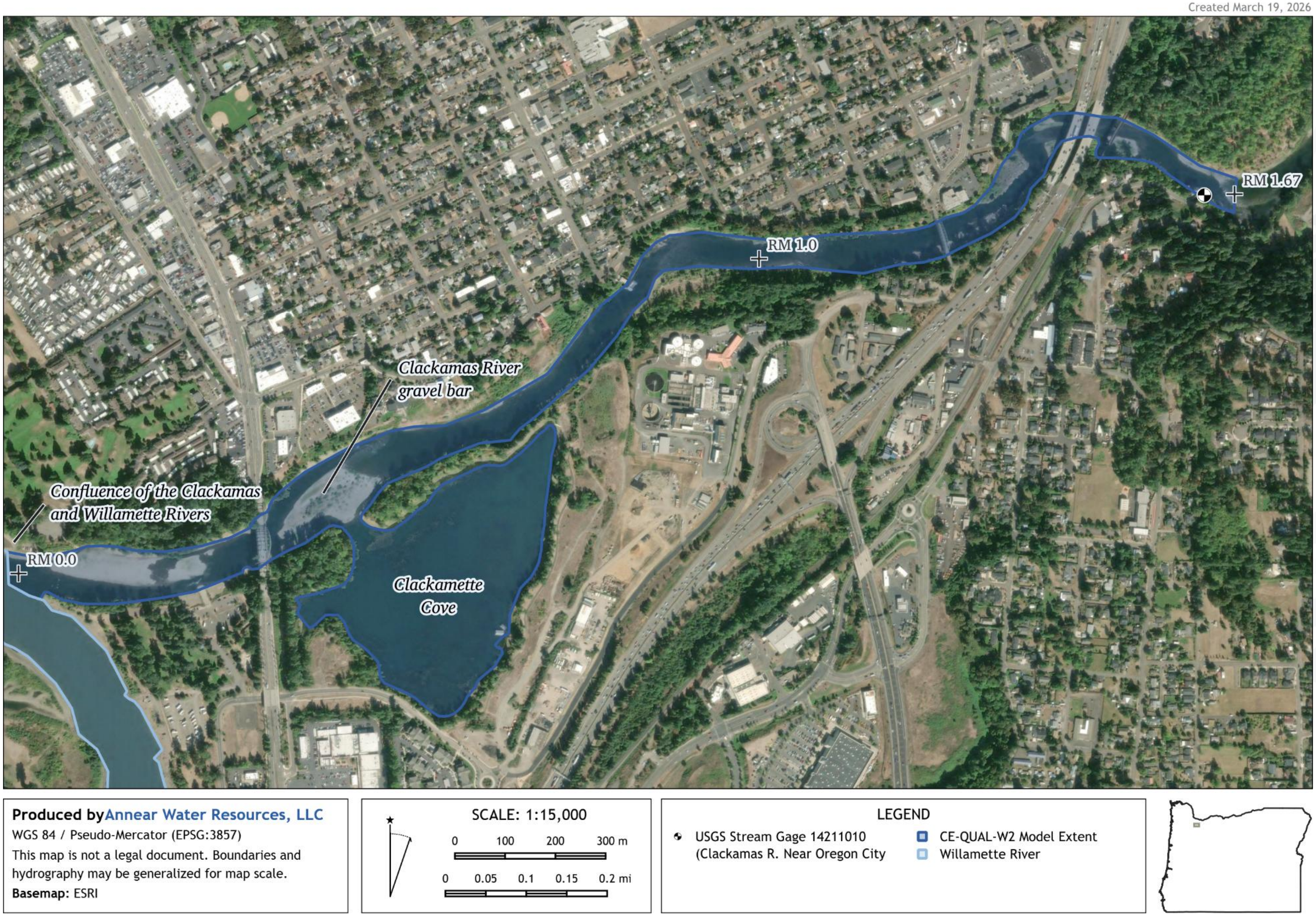

Figure 1. Extent of the 2025 Clackamas River and Clackamette Cove CE-QUAL-W2 model.

Model Development

The Clackamette Cove and Lower Clackamas River model was developed and calibrated to simulate hydrodynamics and water temperature from May 1 to October 28, 2025, using a combination of data collected as part of the Project and time series data obtained from local meteorological and streamflow monitoring stations. The location of the monitoring stations used in the summer 2025 model simulation period and to support model input development are presented in Figure 2. The use of these stations if consistent with previous work in the lower river (Annear et al., 2004; and Geosyntec, 2016).

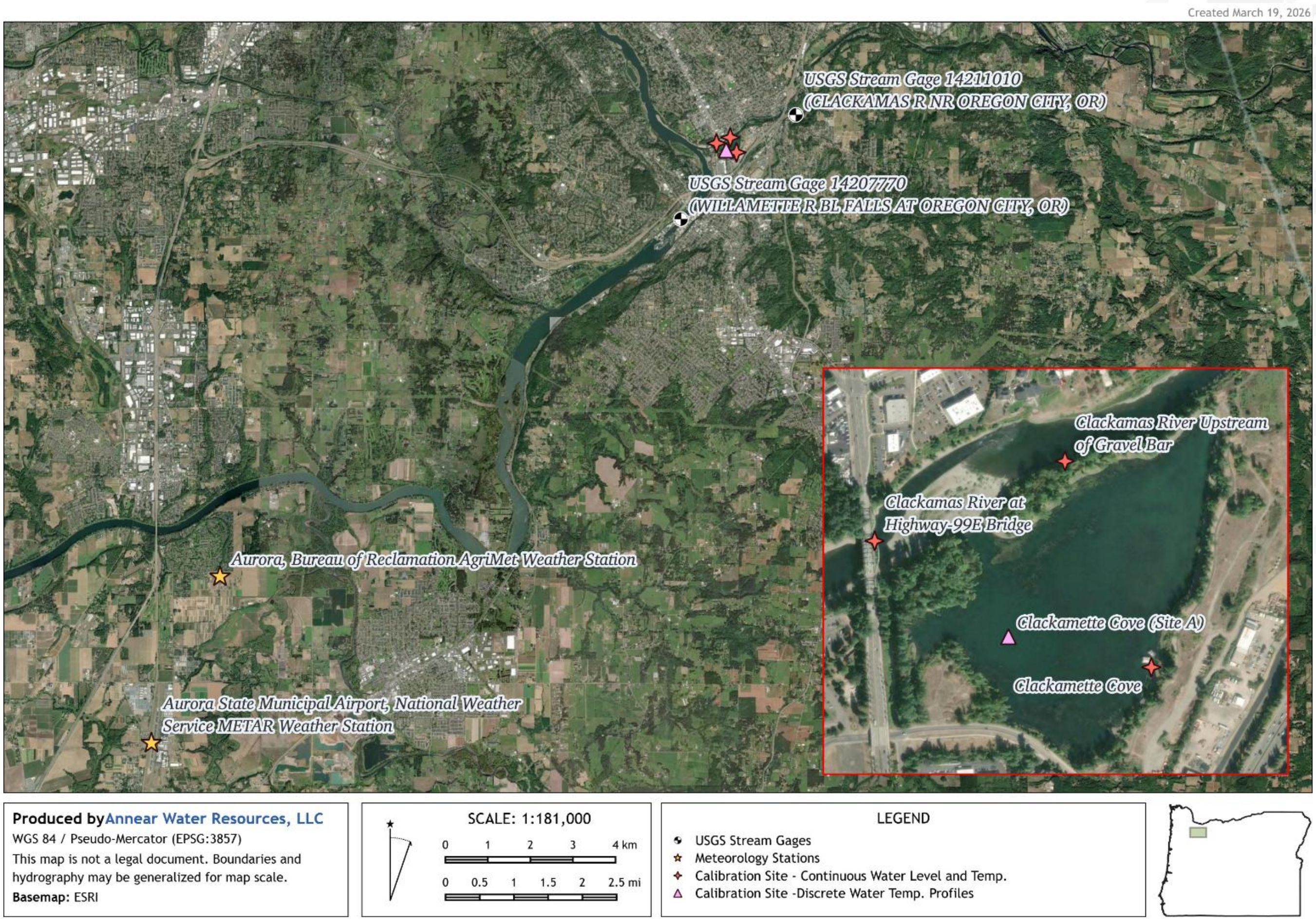

Figure 2. Location of meteorology and monitoring stations used in model development and calibration.

Model Simulation Period

The connection between the Cove and the Clackamas River is driven by the volume of River flows and the structure of the highly dynamic gravel bar located adjacent to the Cove inlet. During summer low flows, the gravel bar acts as a physical barrier between the River and the Cove. The early drawdown of River flows in dry years results in a longer duration of Cove-River separation and a greater potential for Cove water quality to be detrimentally impacted by the lack of water exchange between the two water bodies. The summer of 2025 was therefore selected for the model simulation period to coincide with Project water quality monitoring and to capture the early separation of the Cove and River during a representative low-flow year.

Table 1 provides a comparison of 2025 Clackamas River estimated daily average streamflow in cubic feet per second (cfs) at USGS gage 14211010 to the 20-year historical record preceding the model year (2004 to 2024). From May to October, the monthly average and maximums of daily average flows in 2025 were lower than the same statistics from 2004 to 2024. A comparison of Clackamas River monthly average daily flow rate in 2025 to flows from 2004-2024 reveals 2025 had some of the lowest summer flows over the 20-year historical record (

Figure 3). The driest year in the historical record (2015) and the first year of Project monitoring (2024) are also highlighted for reference.

Table 1. Monthly daily average streamflow statistics at USGS gage 14211010 over the 20-year historical record (2004 to 2024) preceding the model simulation year and 2025. Months included in the model simulation highlighted for reference.

Month	Monthly Daily Flow Rate Statistics, cfs					
	2004-2024 Statistics			2025		
	Minimum	Average	Maximum	Minimum	Average	Maximum
January	1,322	5,973	50,081	1,724	4,336	10,465
February	1,272	4,466	19,773	1,727	5,104	23,727
March	1,067	4,741	22,769	2,889	6,050	11,941
April	1,845	4,790	30,418	2,496	4,203	7,833
May	1,269	3,950	18,445	1,491	2,042	2,631
June	856	2,425	17,849	985	1,164	1,488
July	726	1,113	2,264	741	820	953
August	625	861	2,022	687	739	827
September	639	975	10,792	749	801	890
October	673	1,544	21,799	821	1,122	2,164
November	894	3,521	27,835	1,131	2,203	4,792
December	1,051	5,311	40,677	1,693	9,076	53,294

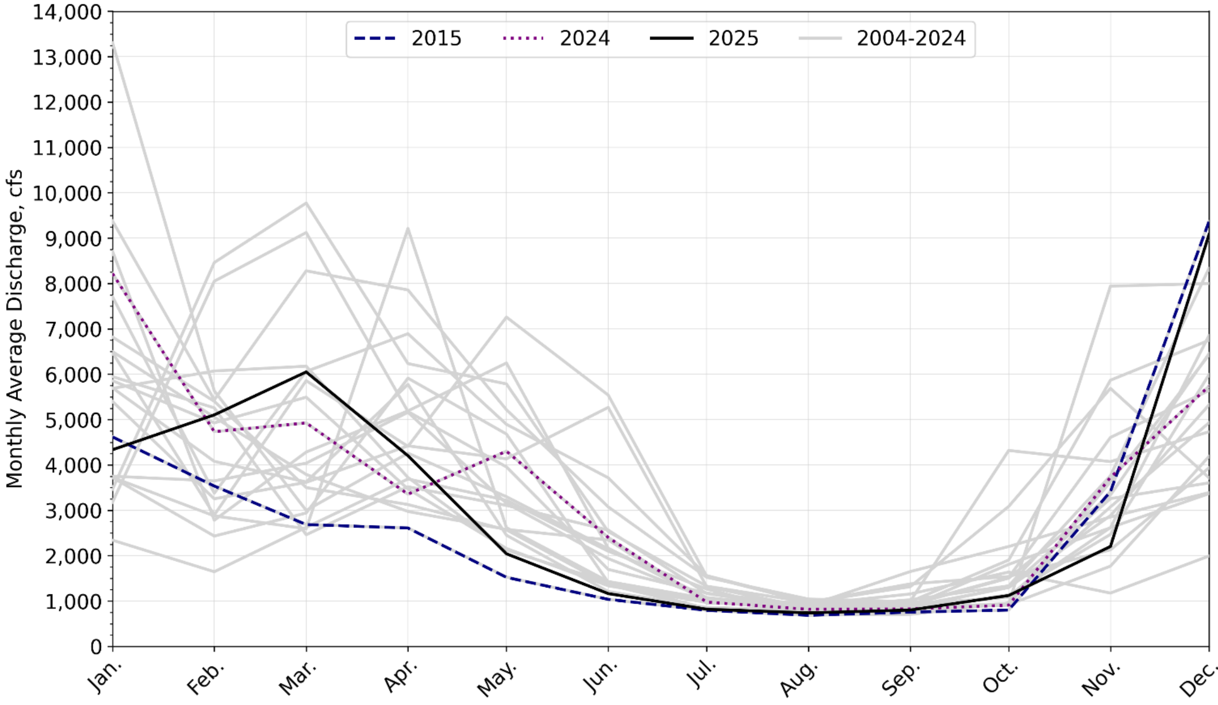

Figure 3. Comparison of monthly average daily flow rate estimated at USGS gage 14211010 over the 20-year historical record (2004 to 2024) preceding the model simulation year and 2025.

Adaptation of the 2016 Clackamas River CE-QUAL-W2 Model

Modifications to the 2016 Clackamas River W2 model as part of the 2025 modeling effort include:

- Limiting the model extent to the reach of the Lower Clackamas River from USGS gage 14211010 (Clackamas River at Oregon City, OR) located at RM 1.67 to the confluence with the Willamette River at RM 0.0. Estimated Clackamas River flow rate and observed water temperatures at the USGS gage were set as the upper boundary conditions for the model.
- Adding Clackamette Cove as a separate branch to the model. The Cove model grid was derived from bathymetric surveys of the Cove and Cove inlet collected in 2005, 2024, and 2025.
- Increasing the complexity of the model grid representing the Clackamas River at the Cove inlet to include the presence of the gravel bar and capture the seasonal separation of the River and Cove.
- Adding a branch at the mouth of the Clackamas River to capture the influence of Willamette River diurnal tidally influenced variations on Clackamas River and Clackamette Cove water levels.
- Conducting an analysis of the observed water level elevations at USGS gage station 14207770 (Willamette Falls at Oregon City, OR) and the Clackamas River confluence using the 2016 Lower Willamette River W2 model to correct observed water level elevations (Geosyntec, 2016).
- Updating model inputs to reflect the May 1 to October 28, 2025, simulation period, including meteorology, City of Lake Oswego raw water withdrawal, and other boundary conditions.

Additional details regarding the adaptation of the 2016 Clackamas River W2 model (Geosyntec, 2016) to support the development of the Clackamette Cove and Clackamas River model are presented in the following sections.

Meteorology

Following Annear et al. (2004) and Geosyntec (2016), the Aurora State Municipal Airport METAR (45.24714, -122.77006) and Aurora AgriMet (45.28194, -122.75028) meteorological sites were used to develop the six-month continuous meteorological timeseries inputs to the model. Figure 2 shows the locations of the meteorological sites used in developing the meteorological inputs. Table 2 lists the sites and the organizations responsible for data collection, with those parameters used as inputs to the model bolded.

Table 2. Availability and source of model input meteorological data (bolded).

Site	Agency (Project)	Available Meteorological Parameters
Aurora State Municipal Airport	National Weather Service (METAR)	**Air Temperature**, **Dew Point Temperature**, Relative Humidity, Wind Speed, Wind Direction, **Cloud Cover**
Aurora	Bureau of Reclamation (AgriMet)	Temperature, Relative Humidity, **Wind Speed, Wind Direction**, **Solar Radiation**

Hourly air temperature measured at the Aurora airport METAR station was used. Air temperature data does not correct well with data from the Aurora AgriMet meteorological site, so small gaps (less than 12 hours) were filled using linear interpolation. Figure 4 shows the air temperature measured at the Aurora site over the model simulation period.

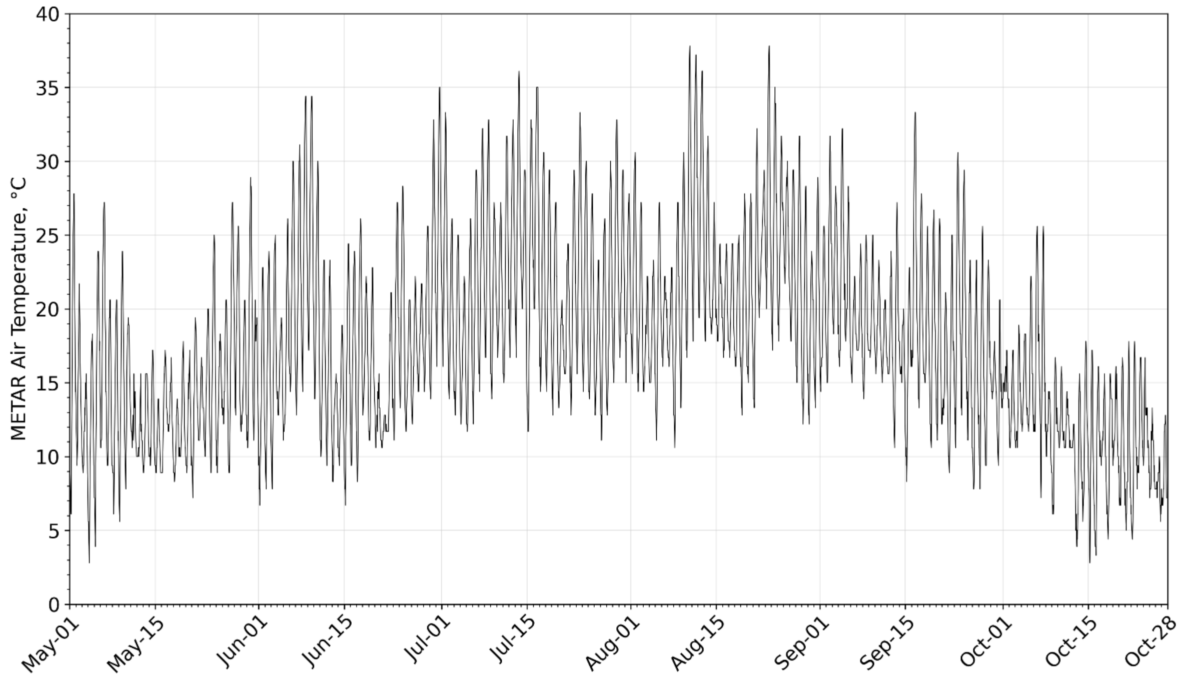

Figure 4. Hourly air temperature observed at the Aurora Agrimet site from May 1 to October 28, 2025.

Hourly dew point temperature measured at the Aurora airport was used. Similar to air temperature, dew point temperature does not correct well with measurements at the Aurora AgriMet site. Gaps less than twelve (12) hours were filled using linear interpolation. Figure 5 shows the dew point measured at the Aurora site.

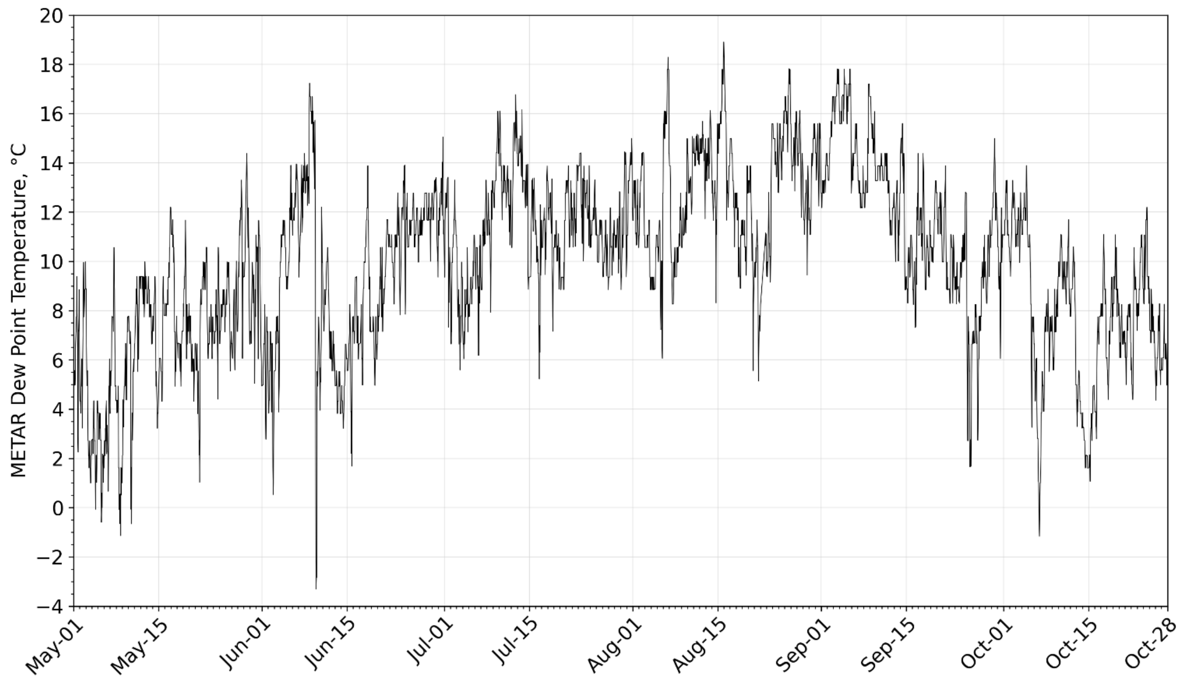

Figure 5. Hourly dew point temperature observed at the Aurora airport from May 1 to October 28, 2025.

Wind speed and direction were retrieved from the Aurora AgriMet and the Aurora Municipal Airport. AgriMet measurements (lower detection limit of 0.30 m/s) were selected over the Aurora airport station (1.54 m/s detection limit) given the former's lower detection limit. 15-minute AgriMet timeseries of wind speed and direction were averaged to match the hourly temperature and cloud cover observations of the Aurora station. Hourly wind data is displayed in Figure 6 and Figure 7.

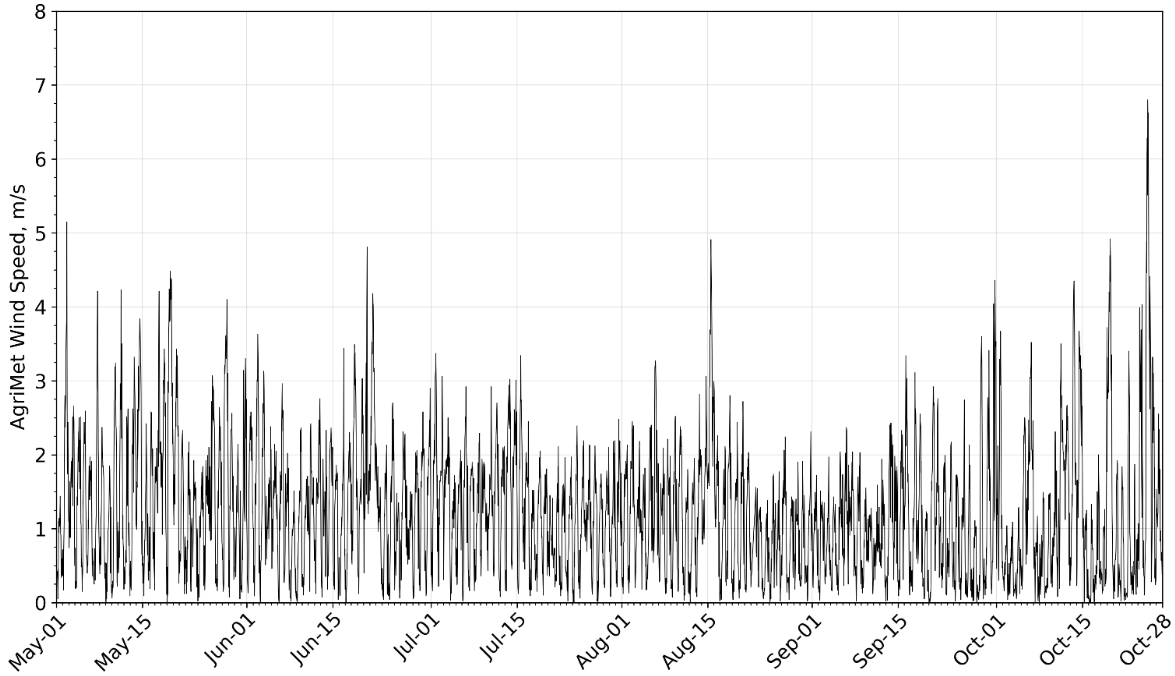

Figure 6. Hourly wind speed observed at the Aurora AgriMet site from May 1 to October 28, 2025.

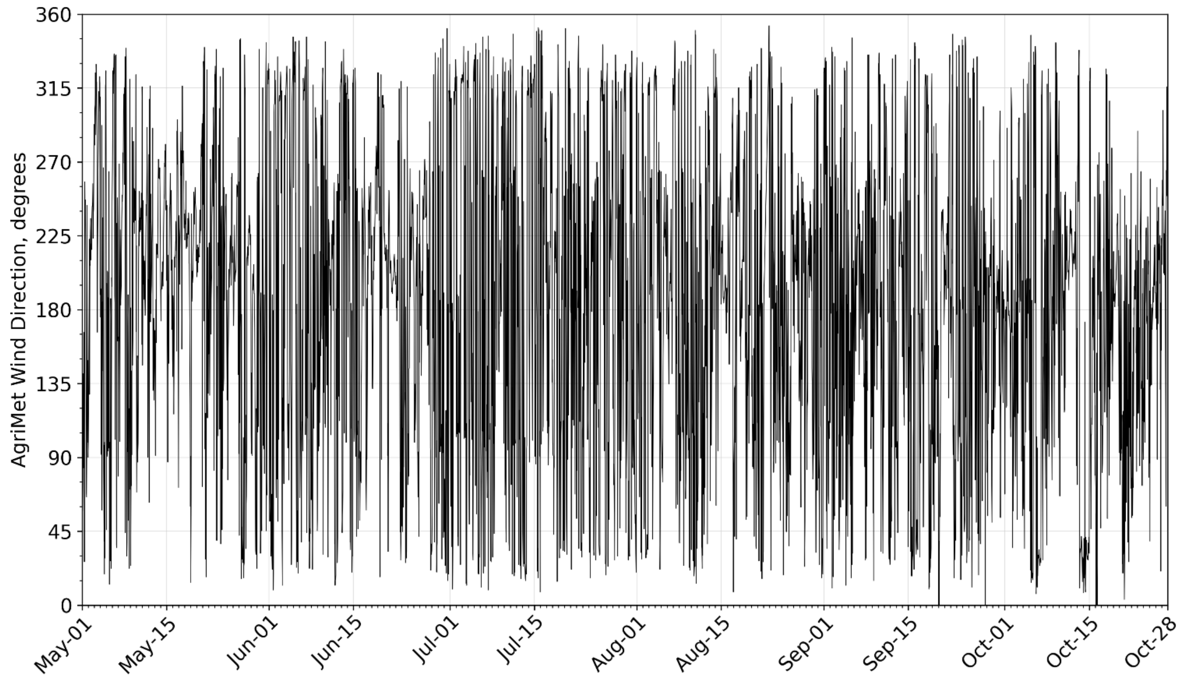

Figure 7. Hourly wind direction observed at the Aurora AgriMet site from May 1 to October 28, 2025.

Cloud cover observations were retrieved from the Aurora airport data access page and converted from the METAR cloud cover designations into scaled (0-10) values (Table 3). Figure 8 shows the coarseness of the METAR designations even after scaling.

Table 3. Conversion of METAR cloud cover observations to scaled (0-10) values.

METAR Observation	Scaled Cloud Cover (0-10)
Vertical Visibility (VV)	10
Overcast (OVC)	10
Broken Clouds (BKN)	7.5
Scattered Clouds (SCT)	4.375
Few Clouds (FEW)	1.875
No clouds below 12,000 ft. (CLR)	0

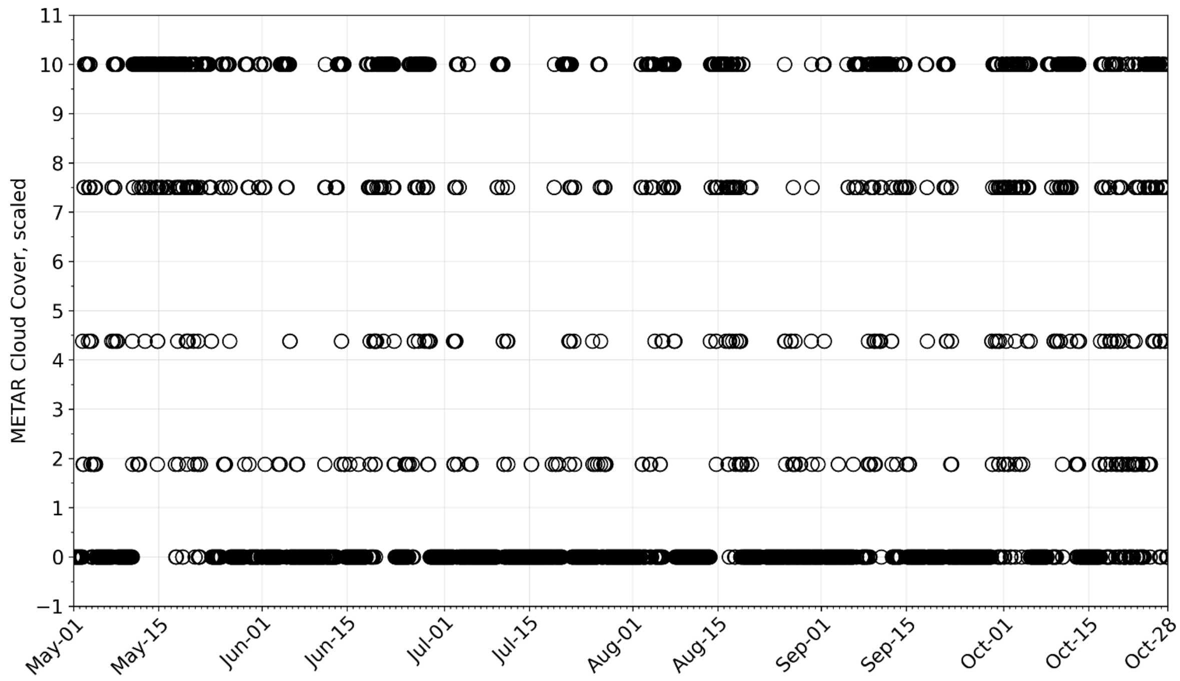

Figure 8. Hourly cloud cover observations at the Aurora AgriMet site from May 1 to October 28, 2025.

Hourly solar radiation as measured at the Aurora AgriMet site was used. Figure 9 depicts the resulting timeseries used as the model input.

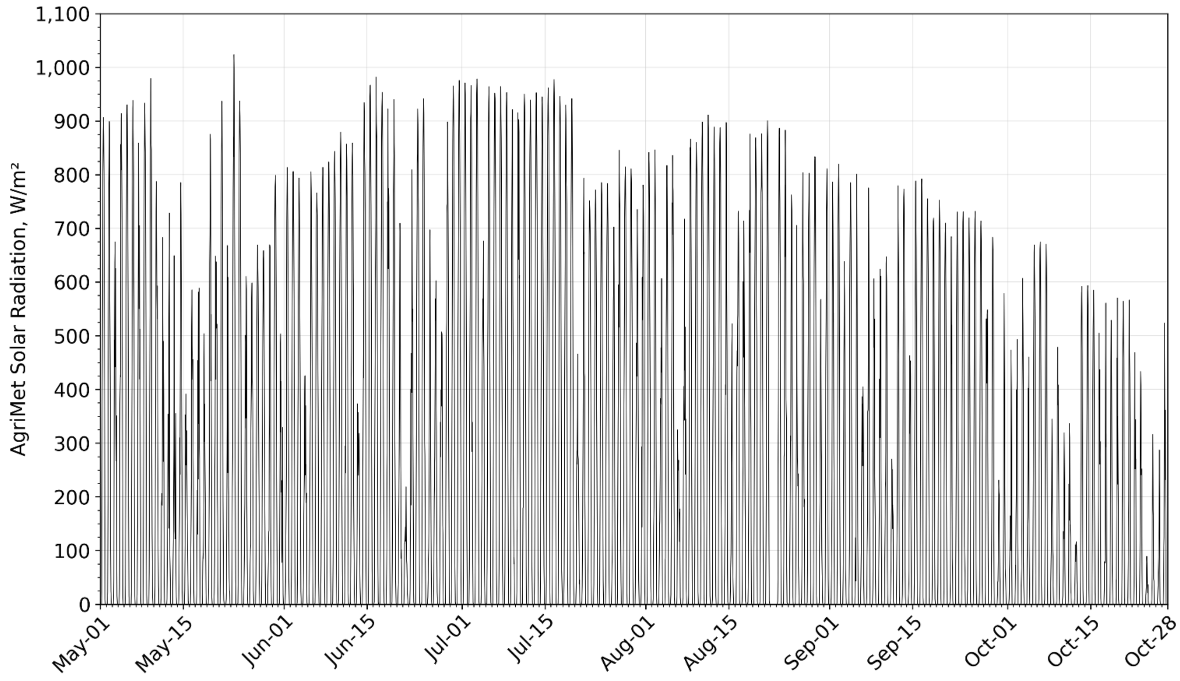

Figure 9. Hourly solar radiation observed at the Aurora AgriMet site from May 1 to October 28, 2025.

Boundary Conditions

The upstream boundary conditions for the W2 model are based on 15-minute river discharge and water temperature data from the USGS gage station located on the Clackamas River at Oregon City, OR (USGS 14211010). The downstream boundary condition is based on 15-minute water level data from the USGS gage station located on the Willamette River below Willamette Falls at Oregon City (USGS 14207770). Observed water level elevations at USGS 14207770 were corrected to account for the change in elevations between Willamette Falls and the Clackamas River confluence using the output of the 2016 Willamette River W2 model (Geosyntec, 2016).

Upstream Boundary Condition

The upstream boundary condition for the W2 model includes estimated 15-minute flow rate and observed 15-minute water temperature at USGS 14211010. Figure 10 shows the estimated flow rate timeseries, and Figure 11 depicts the observed water temperature used.

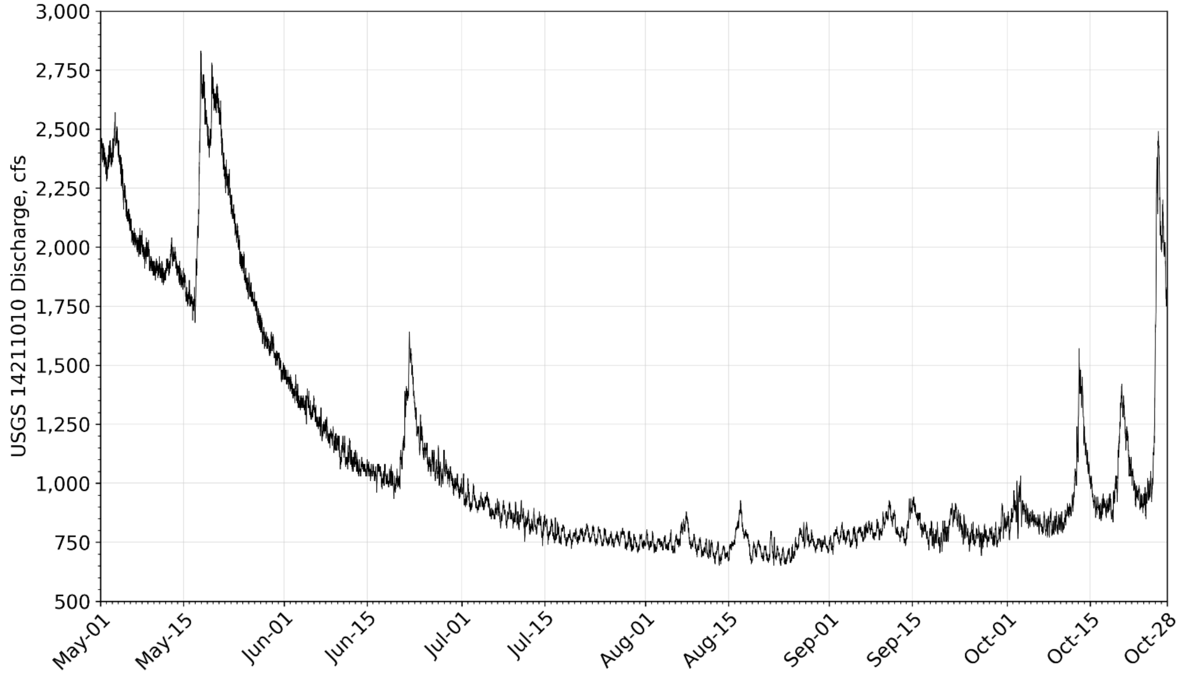

Figure 10. Estimated Clackamas River 15-minute flow rate at USGS gage 14211010 from May 1 to October 28, 2025.

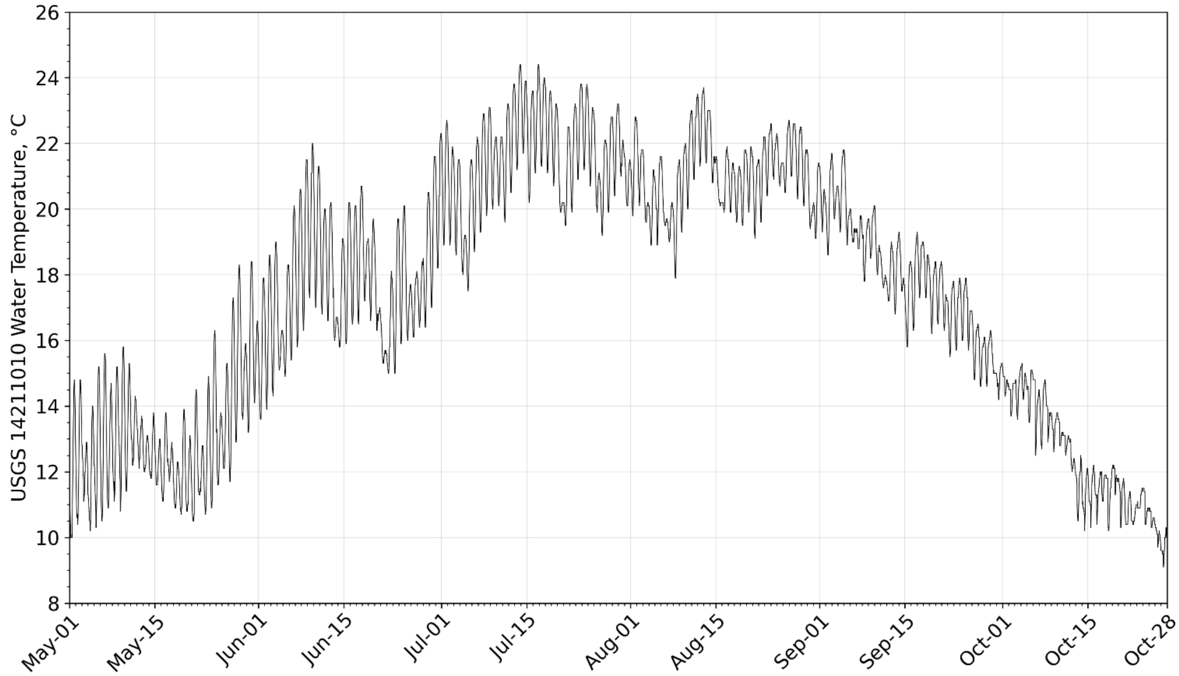

Figure 11. Observed Clackamas River 15-minute water temperatures at USGS gage 14211010 from May 1 to October 28, 2025.

Downstream Boundary Condition

The downstream boundary condition for the W2 model includes observed 15-minute water temperature and model-corrected 15-minute water level elevations observed at USGS 1420770.

The USGS gage, situated on the Willamette River below the Willamette River Falls, is approximately 1.16 miles upstream of the confluence of the Clackamas and Willamette Rivers. The hourly output of the 2016 Lower Willamette River W2 model (Geosyntec, 2016) at the confluence (segment 8) was compared to hourly observations of water level at USGS gage 1420770 to correct for the change in water level elevations between the USGS gage and the confluence. The regression of observed water level elevations at USGS 14207770 and the W2 model output over the model simulation period, March 23 to October 31, 2015, is presented in Figure 12.

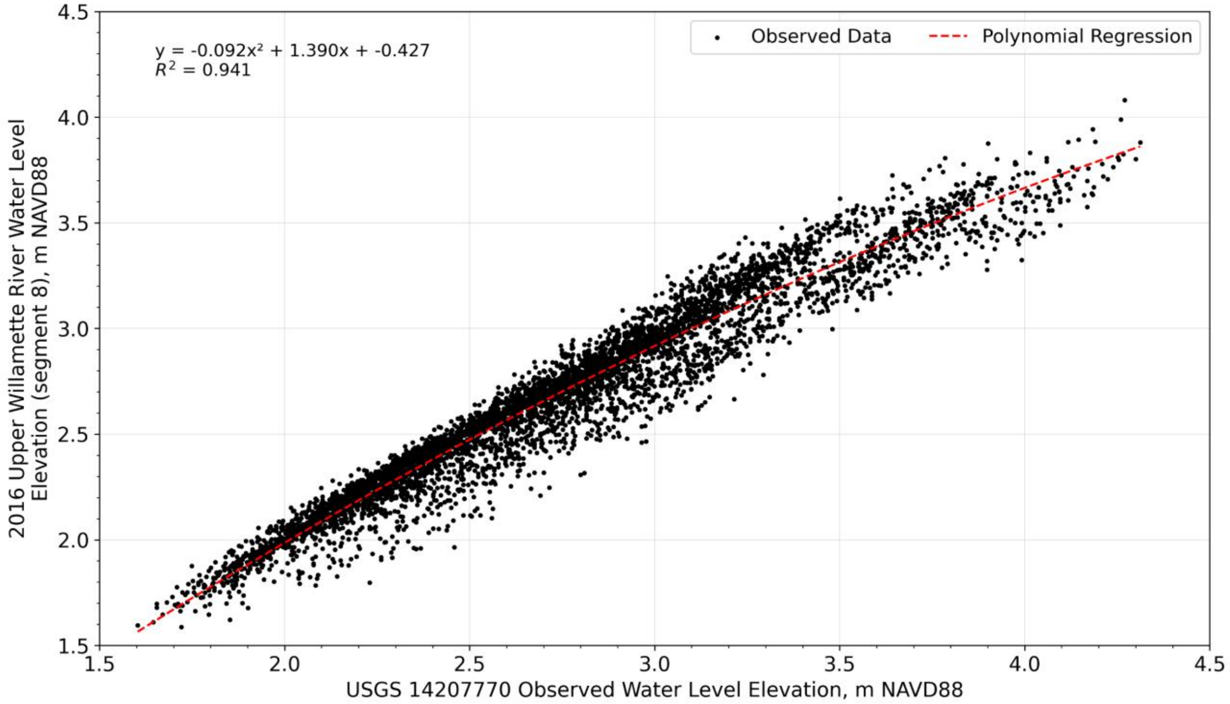

Figure 12. Comparison of observed water level elevations at USGS gage 14207770 to the 2016 CE-QUAL-W2 Willamette River model output at the confluence of the Willamette and Clackamas Rivers (segment 8) over the model simulation period (March 23 to October 31, 2015). Derived polynomial regression shown.

Figure 13 shows the observed and adjusted timeseries of water level elevations at USGS 14207770 used as the downstream boundary condition for the W2 model. Figure 14 presents the 15-minute observed water temperature timeseries used as the downstream boundary condition.

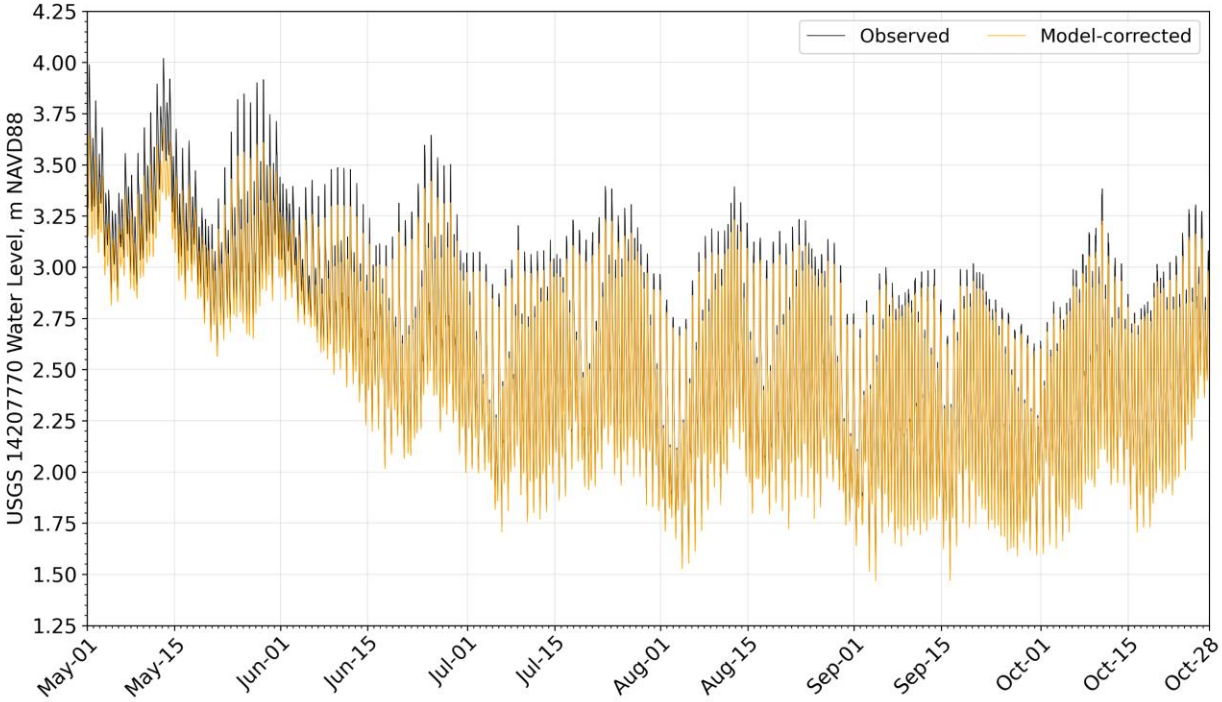

Figure 13. Observed Willamette River 15-minute water level elevations at USGS gage 14207770 and adjusted model input, May 1 to October 28, 2025.

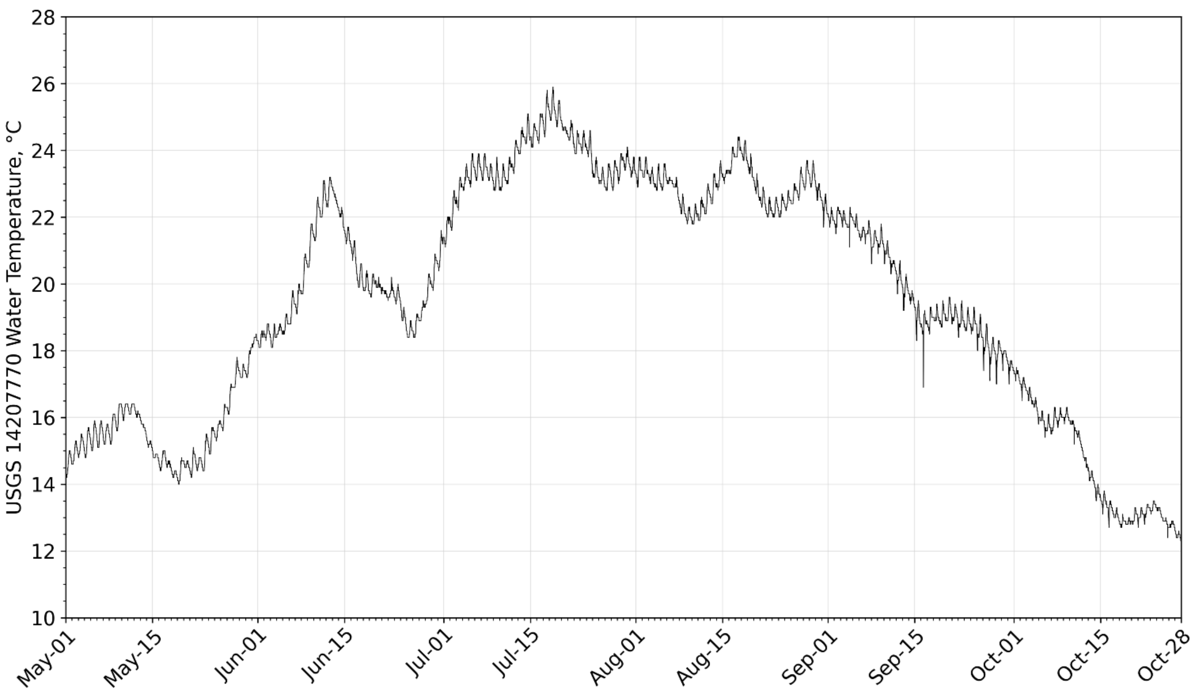

Figure 14. Observed Willamette River 15-minute water temperatures at USGS gage 14207770 from May 1 to October 28, 2025.

Tributaries

The W2 model includes 1.67 miles of the Lower Clackamas River and the entirety of Clackamette Cove. Neither water body over the modeled reach receives substantial surface tributary or groundwater inflows. Therefore, no tributaries were included in the model.

Withdrawals

The City of Lake Oswego's withdrawal from the Clackamas River at RM 0.9 was included in the model as a withdrawal from segment 12 distributed over depth and set at an elevation of 1.5 meters NAVD88. Modeled withdrawals over the simulation period were based on timeseries of daily withdrawals between January 1, 2017, and November 30, 2024, provided by the City of Lake Oswego (Figure 15). Daily withdrawals were averaged for each calendar day over the provided record to derived the model input timeseries, approximating withdrawals in the summer of 2025 (Figure 16).

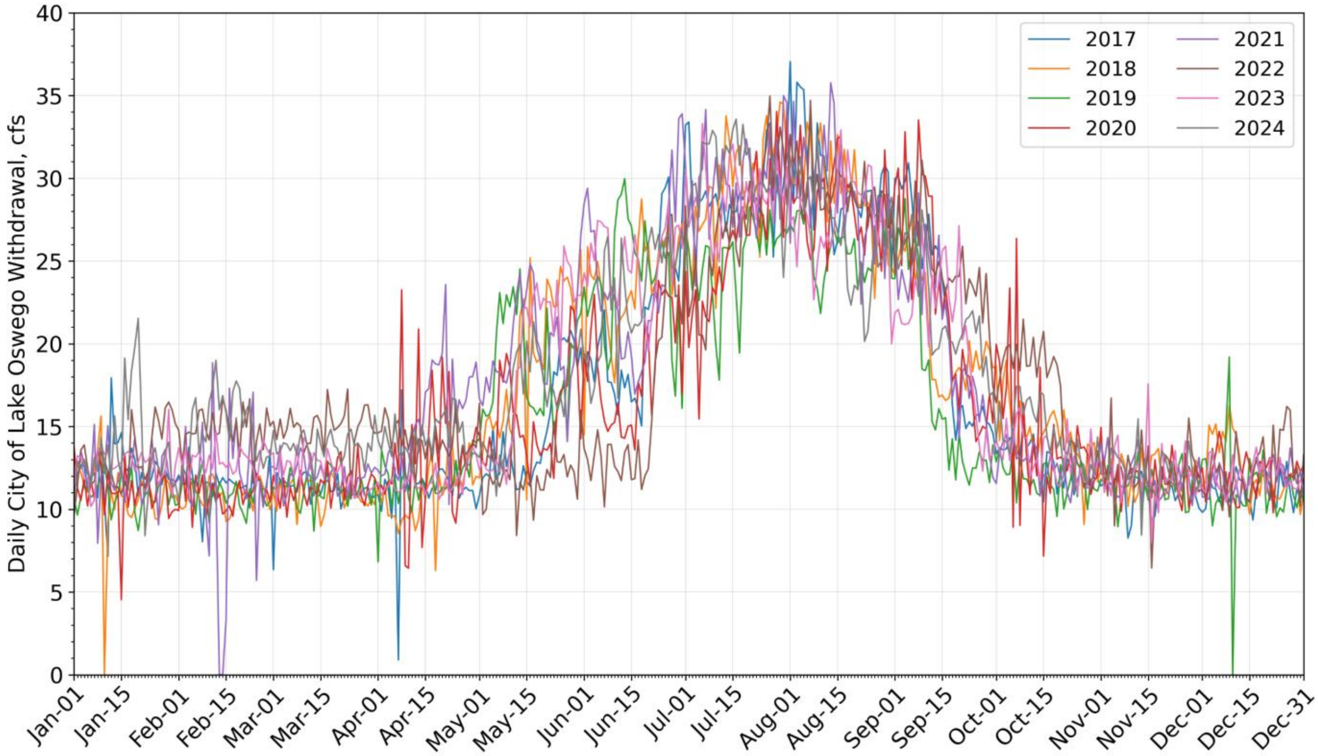

Figure 15. City of Lake Oswego daily withdrawals from January 1, 2017, to November 30, 2024.

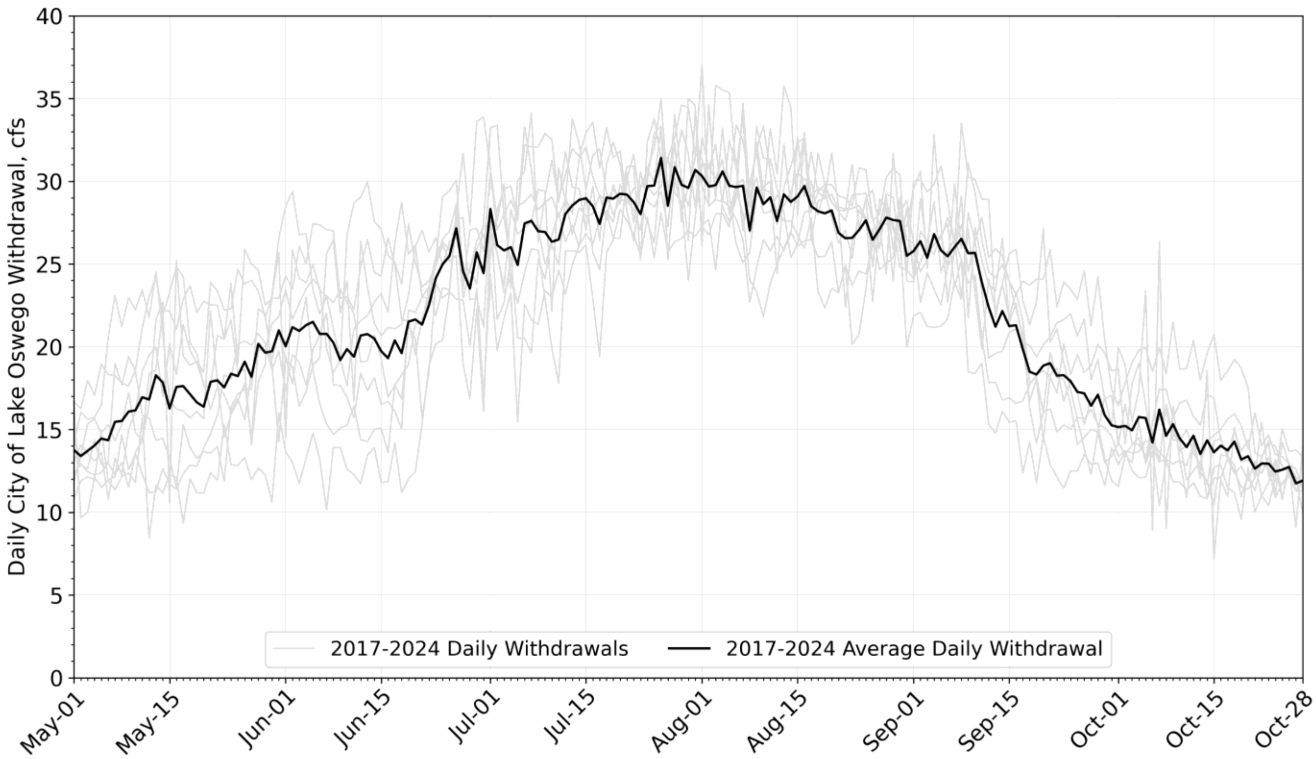

Figure 16. Approximated City of Lake Oswego withdrawals from May 1 to October 28, 2025.

Model Bathymetry

The existing model grid for the Clackamas River upstream and downstream of the gravel bar was retained from the model grid of the 2016 Lower Clackamas W2 model (Geosyntec, 2016). The Clackamas River gravel bar and Clackamette Cove model grid were developed from bathymetric data collected in 2005, 2024, and 2025. Additional details regarding the existing 2005 bathymetry data and 2024 and 2025 surveys conducted to support the Project are presented in the *Clackamette Cove and Clackamas River Bathymetric Data – Survey and Results* technical memorandum (AWR, 2026).

Bathymetric data used to update the Clackamas River gravel bar and Clackamette Cove was post-processed using Quantum Geographic Information Systems (QGIS) version 2.16 “Essen”, a free GIS program based on the GRAphics Symbiosis System (GRASS) programming language, to develop the model grid shapefile representing the bathymetry. The bathymetry shapefile was then joined to a U.S. Geological Survey (USGS) 10-meter digital elevation model (DEM) for the region to capture the surrounding topography and to ensure the transition at the water line was captured accurately.

Figure 17 depicts the bathymetric surface of Clackamette Cove and the Clackamas River gravel bar used to develop select branches of the model grid (detailed in Table 4).

Table 4. Bathymetry surveys used to derive the Clackamette Cove W2 model bathymetry and update the 2016 Clackamas River W2 model bathymetry representing the Clackamas River gravel bar.

Survey Date	Surveyed Reach	Branch	Segments
November 3, 2005	Clackamette Cove	Branch 5	35 - 48
August 12, 2024	Clackamas River gravel bar	Branch 2	19 - 21
		Branch 3	24 - 26
		Branch 5	51
August 12, 2025	Clackamette Cove inlet	Branch 5	48 - 50

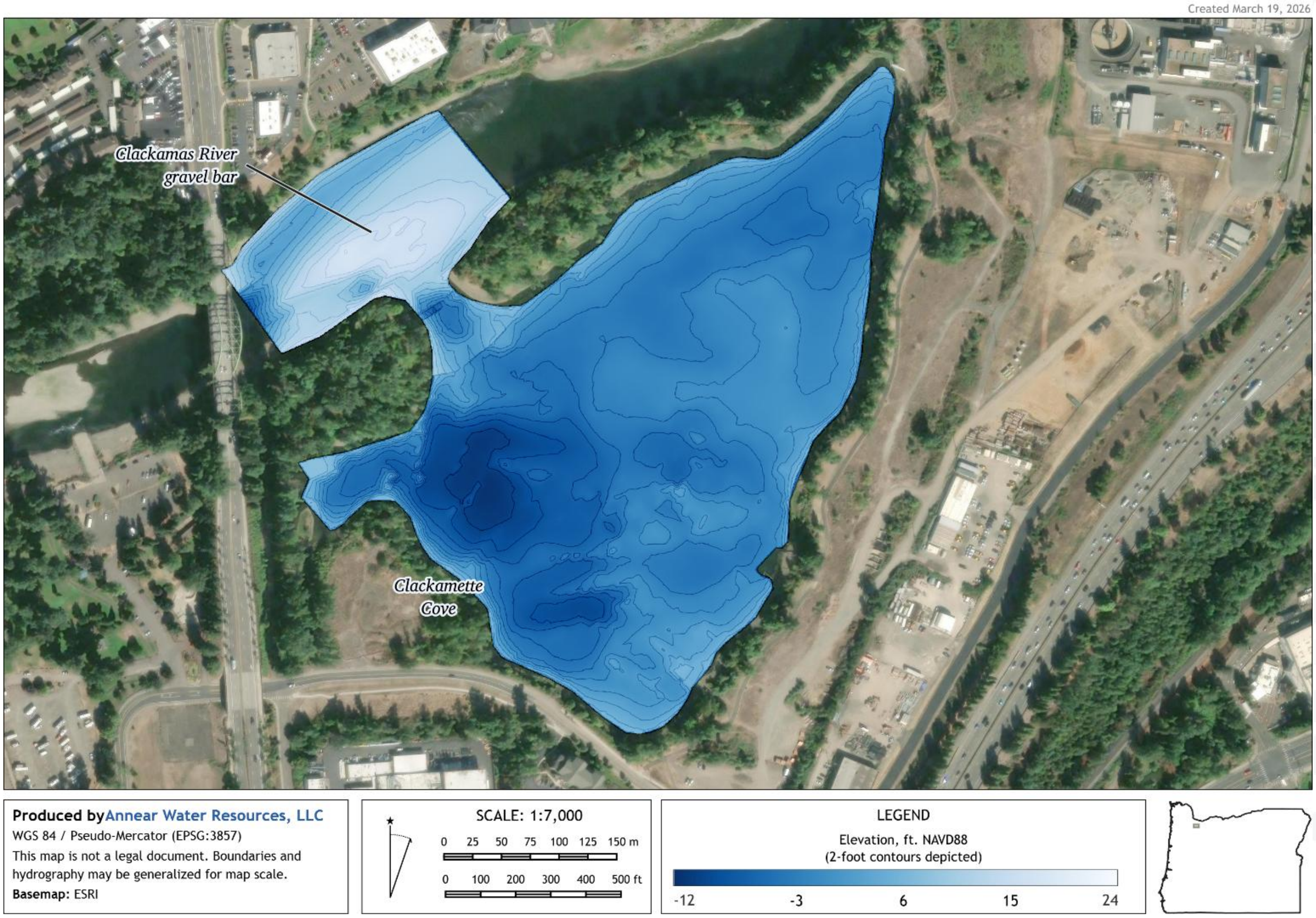

Figure 17. Bathymetric surface of the Clackamas River gravel bar and Clackamette Cove.

Model Grid

The model grid for the Clackamas River upstream and downstream of the gravel bar was copied from the model grid from the 2016 Lower Clackamas W2 model (Geosyntec, 2016). The model grid for the Clackamas River gravel bar and Clackamette Cove, was derived using the bathymetric surface derived from the 2005, 2024, and 2025 surveys. Table 5 lists the W2 model grid characteristics and boundary conditions for each branch. Table 6 outlines the model spillways connecting the branches and the associated spillway parameters. An aerial view of the model grid, highlighting the model branches and spillways, and is presented in Figure 18.

Table 5. Model gid layout and boundary conditions.

Branch/ Waterbody	Segment		Length, km	Slope, %	Boundary Conditions	
	Start	End			Upstream	Downstream
1	2	16	1.75	0. 015	External flow and temperature	Internal
2	19	21	0.23	0. 618	Flow	Internal
3	24	26	0.23	0.0	Flow	Internal
4	29	32	0.47	0.0	Flow	Internal
5	35	51	0.43	0.0	Flow	Internal
6	54	55	0.05	0.0	Flow	External head and temperature

Table 6. Model spillways and parameters.

Spillway	Description	Segment		Elevation, m NAVD88	Withdrawal	
		Upstream	Downstream		Location	Type
1	Clackamas River to north channel of gravel bar	16	19	3.55	Downstream	Distributed
2	Clackamas River to south channel of gravel bar	16	24	3.71	Downstream	Distributed
3	South channel of gravel bar to Cove	25	51	1.91	Lateral	Density
4	North to south channel of gravel bar	19	24	4.63	Lateral	Distributed
5	North to south channel of gravel bar	20	25	5.42	Lateral	Distributed
6	North to south channel of gravel bar	21	26	4.20	Lateral	Distributed
7	North channel of gravel bar to Clackamas River	21	29	0.20	Downstream	Distributed
8	South channel of gravel bar to Willamette River	26	29	3.00	Downstream	Distributed
9	Clackamas River to Willamette River	32	54	2.30	Downstream	Distributed

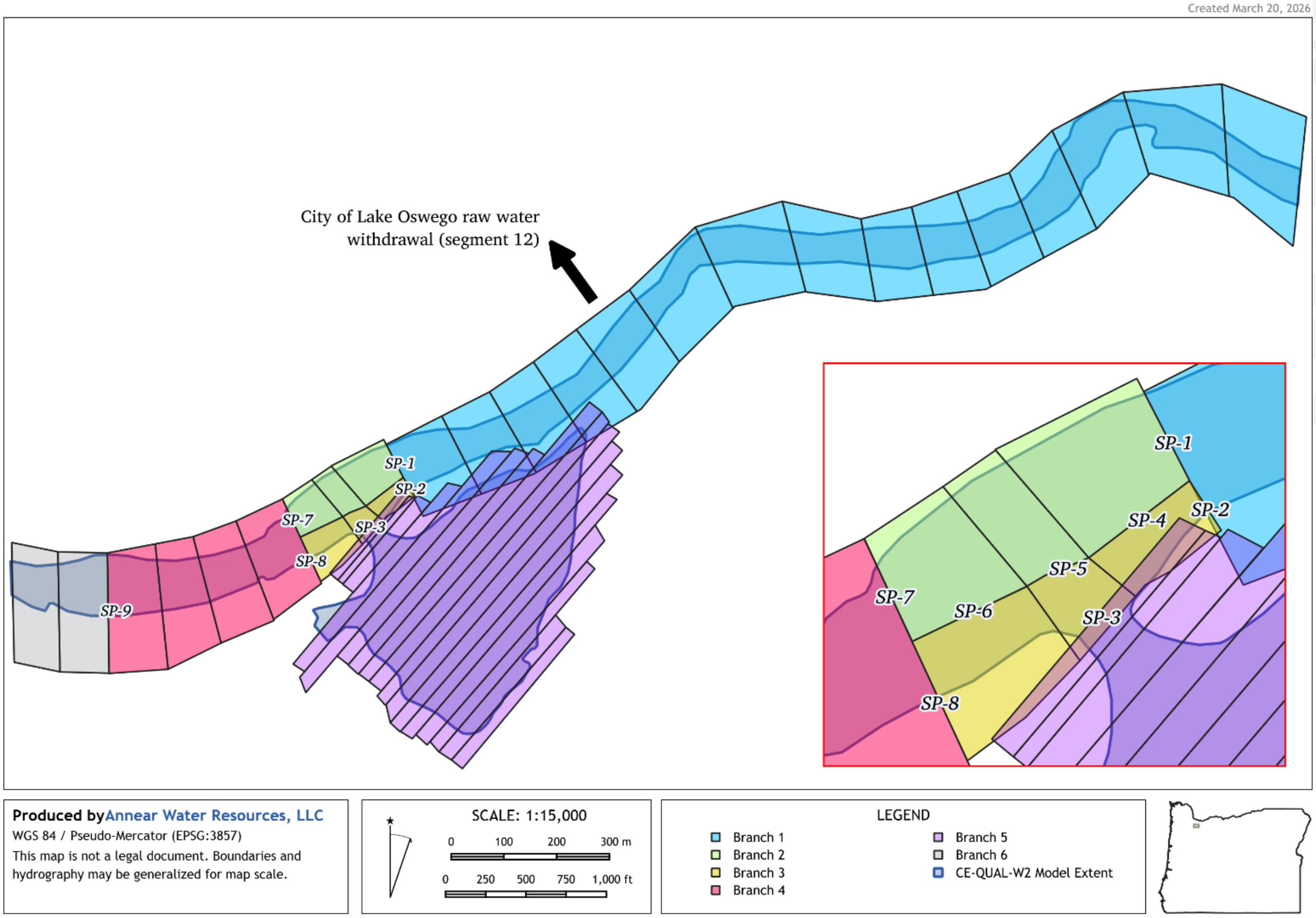

Figure 18. Layout of the model grid.

The vertical resolution of the model grid was set to 1 foot (0.3048 meters). Figure 19 through Figure 24 show the model grid vertical resolution for each branch.

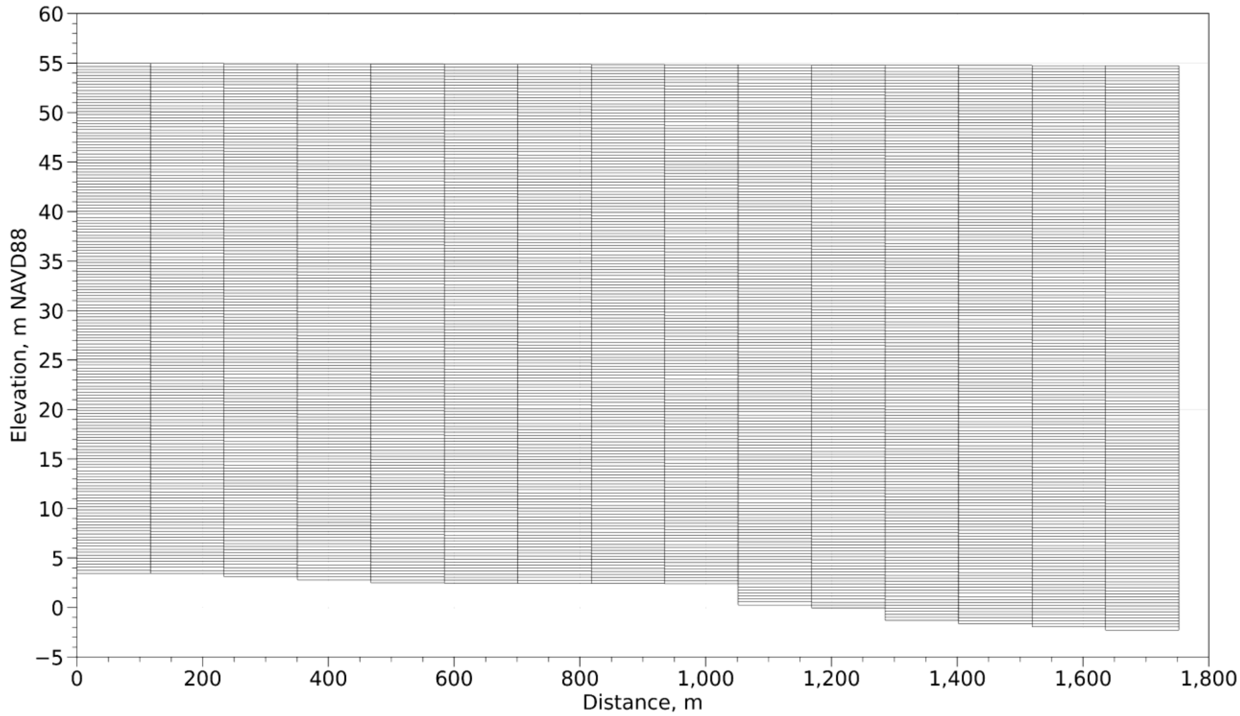

Figure 19. Clackamas River (above gravel bar), Branch 1 vertical grid resolution (segment 2 to 12). Plotted distance measured from the furthest upstream segment (2).

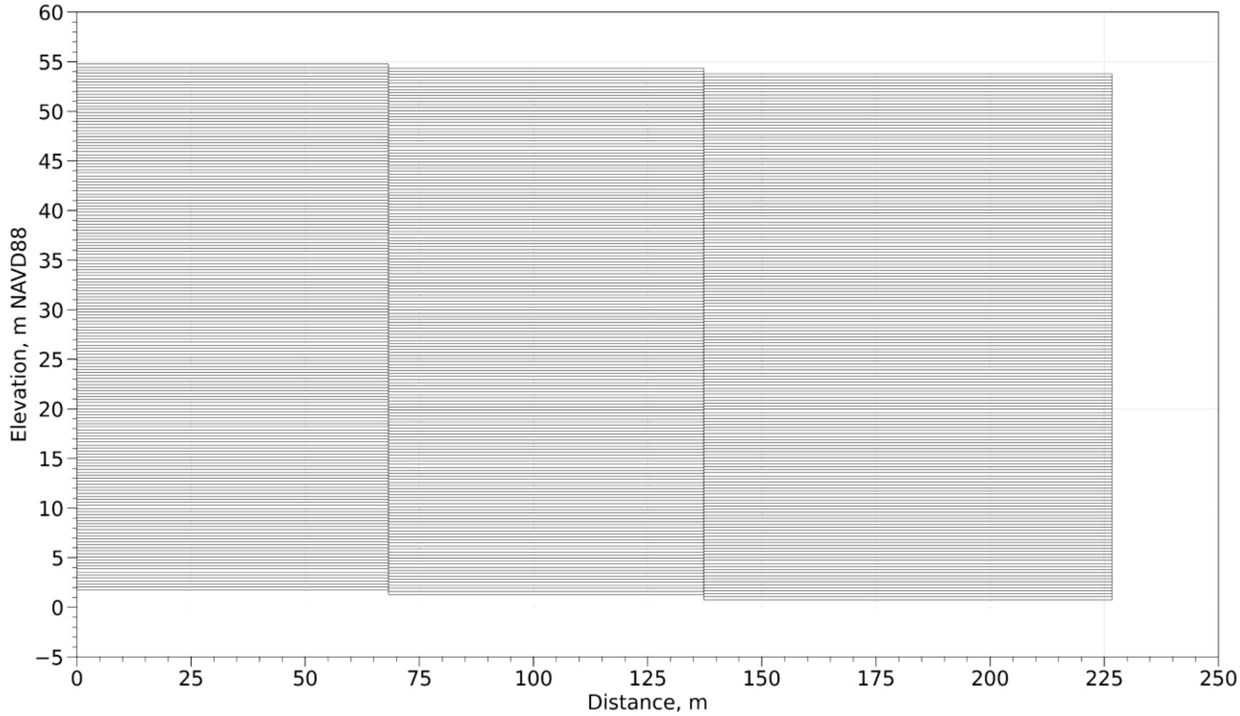

Figure 20. Clackamas River (north channel of gravel bar), Branch 2 vertical grid resolution (segment 19 to 21). Plotted distance measured from the furthest upstream segment (19).

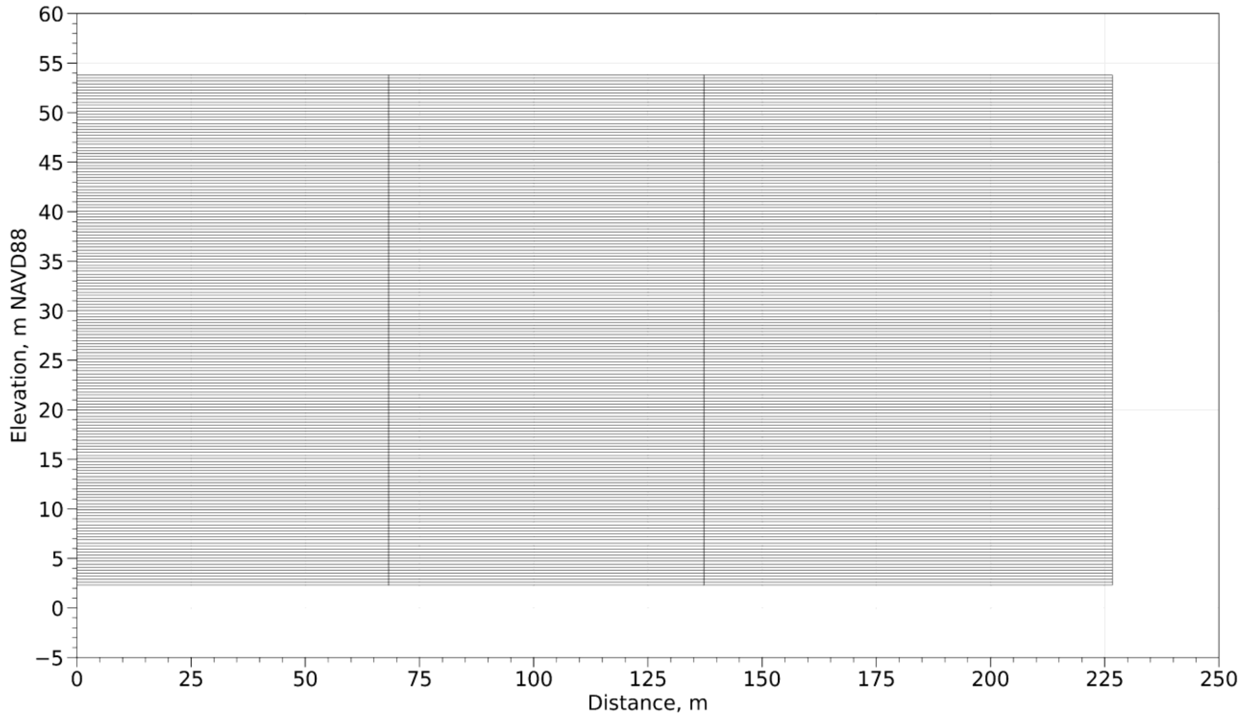

Figure 21. Clackamas River (south channel of gravel bar), Branch 3 vertical grid resolution (segment 24 to 26). Plotted distance measured from the furthest upstream segment (24).

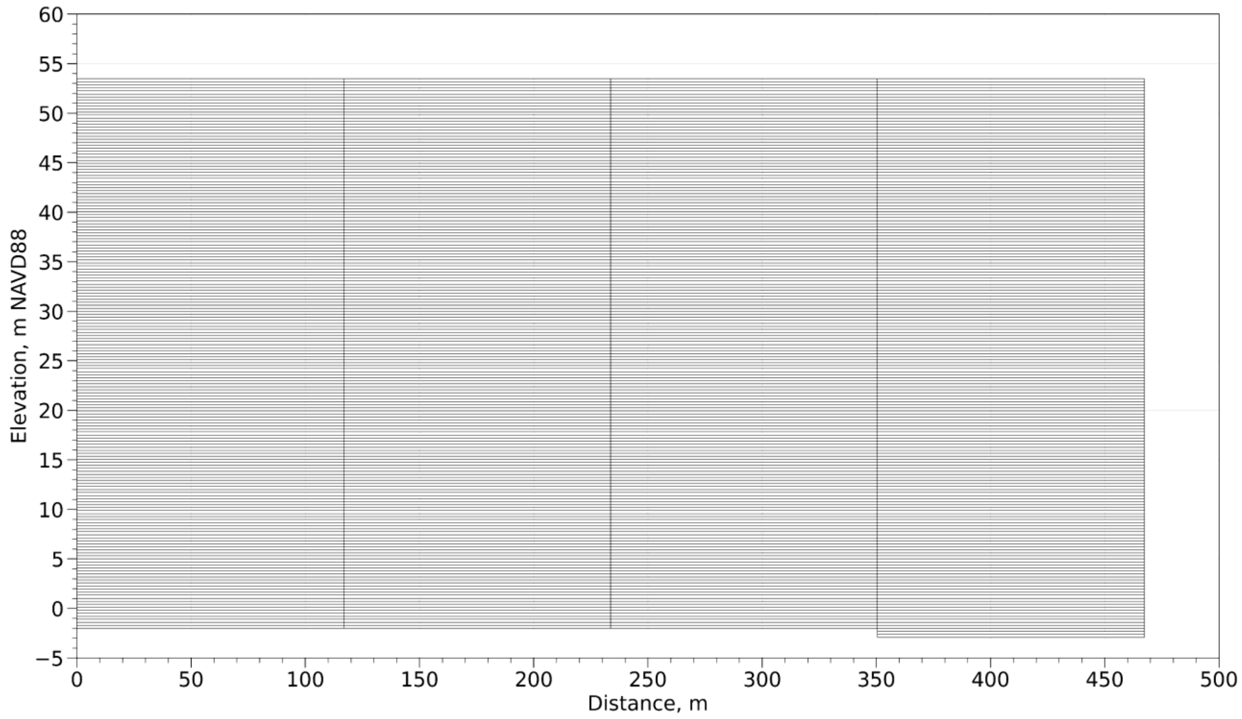

Figure 22. Clackamas River (beneath gravel bar), Branch 4 vertical grid resolution (segment 29 to 32). Plotted distance measured from the furthest upstream segment (2).

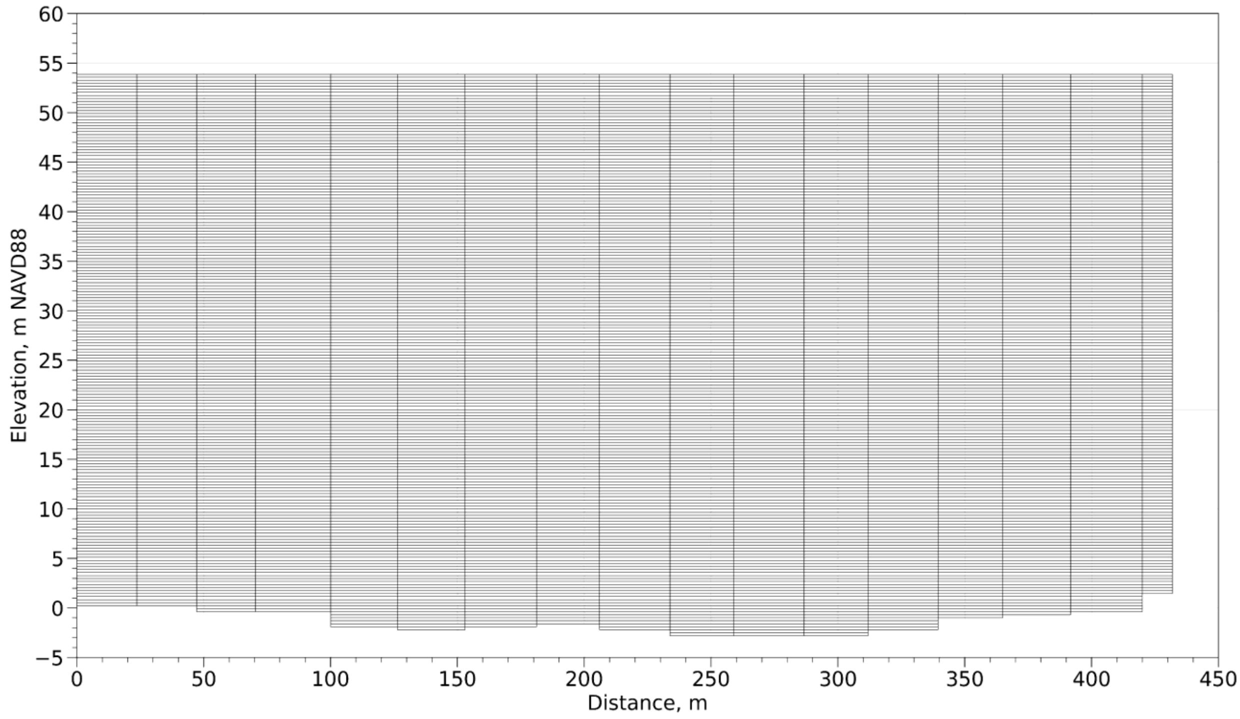

Figure 23. Clackamette Cove, Branch 5 vertical grid resolution (segment 35 to 52). Plotted distance measured from the southeast edge of the Cove interior (segment 35) through the Cove inlet (ending at segment 52).

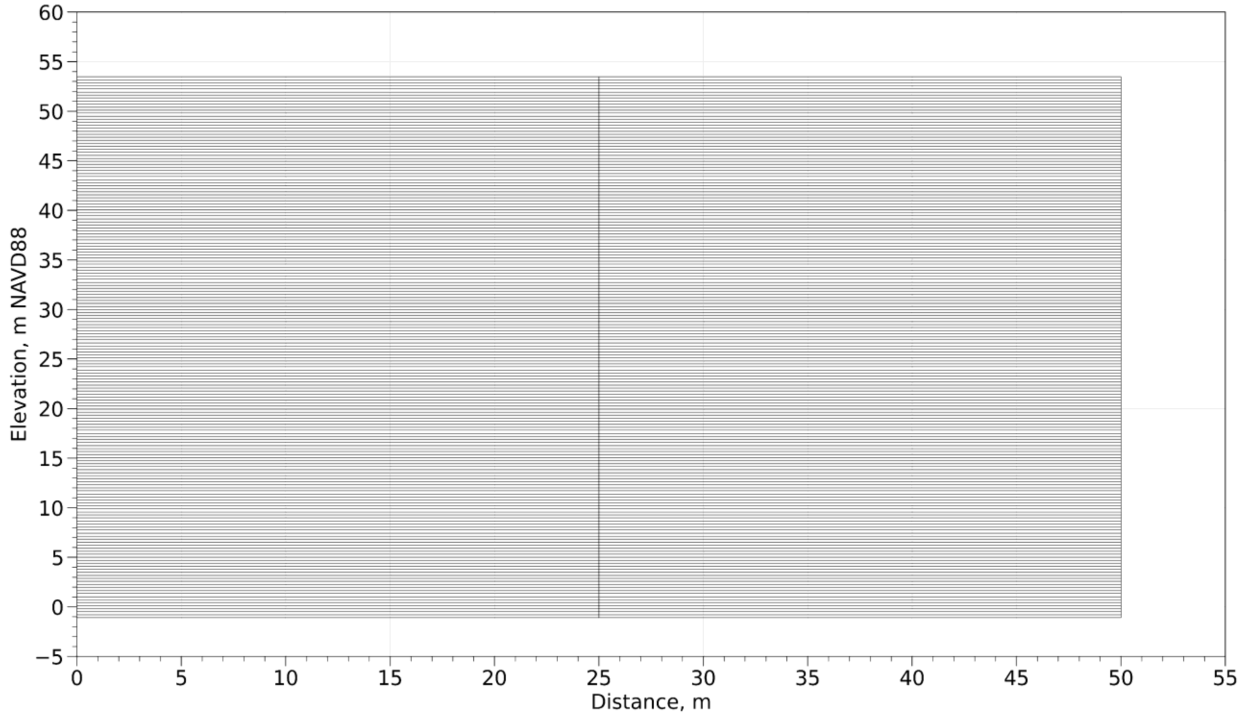

Figure 24. Clackamas River (to Willamette River), Branch 6 vertical grid resolution (segment 54 and 55). Plotted distance measured from the furthest upstream segment (54).

Shading

The Clackamas River is surrounded by moderate slopes that result in limited topographic shading of the water surface supplemented by shading provided by tree cover. The dynamic shading of the Lower Clackamas River used in the 2016 W2 model (Geosyntec, 2016) was retained for the branches representing the Clackamas River in the 2025 model.

Tree cover is considerable around the Cove and results in some shading of the water surface. However, dynamic tree shading was not included in the model due to the lack of data defining tree height, density, and attenuation of incoming solar radiation along the banks of the Cove. Given the focus on matching observed water-level data for the model calibration, capturing dynamic bank shading to improve model-data predictions of water temperature was not deemed critical for the Project.

Model Calibration

Introduction

The W2 model was calibrated using water level timeseries data collected between May 1 and October 28, 2025. A limited calibration of surface water temperature and Cove water temperature vertical profiles collected over the same time period was also conducted, though this was not the main focus of the modeling effort.

The model calibration optimized the simulation of water levels and water temperatures in the late spring through early fall, the critical time period for algal growth and the implementation of any management alternatives. As a result, model-data performance in the winter was neither evaluated nor is expected to represent the hydrodynamic and water quality of interest in this Project.

Calibration Data

Modeled Clackamas River and Clackamette Cove water levels were compared to water level time series data collected between May 1 and October 28, 2025. A limited temperature calibration effort was also conducted using timeseries of water temperature collected in the Clackamas River and vertical water temperature profiles collected in the Cove. The calibration sites used in the hydrodynamic and water temperature calibration are shown in Figure 2 and listed in Table 7.

Table 7. Hydrodynamic and temperature calibration sites.

Location	Site ID	Segment	River Mile	Calibration Parameter(s)
Clackamas River upstream of gravel bar	n/a	16	0.5	Continuous water level and temperature
Clackamas River at Highway 99-E bridge	n/a	29	0.3	Continuous water level and temperature
Clackamette Cove	n/a	45	n/a	Continuous water level and temperature
Clackamette Cove	A	36	n/a	Discrete water temperature profiles

Hydrodynamics

The hydrodynamic calibration of the Clackamette Cove and Clackamas River model was conducted by comparing continuous (15-minute) surface water level elevations to the model output. Model calibration was initially conducted at the furthest upstream location of the Clackamas River, the monitoring location situated in the river upstream of the gravel bar. Calibration proceeded with a comparison of model-data water levels in the Cove and finished with the calibration of the Clackamas River at the HWY-99E bridge (downstream of the Cove). Model adjustments included, but are not limited to:

- Minor adjustments to the channel bathymetry at key locations,
- Adjusting the Manning's friction factor, *n*, and
- Adjusting spillway coefficients, including the spillway elevations and rate of flow exchange.

Timeseries of observed and simulated water levels in the Clackamas River upstream of the gravel bar, the Cove, and the Clackamas River at the HWY-99E bridge are presented in Figure 25 through Figure 27. The model-data error statistics of the hydrodynamic calibration are presented in Table 8. Predicted water levels demonstrate good model-data agreement, with a low mean error (ME), mean average error (MAE), and root-mean-squared error (RMSE), and capture variations in hydrodynamics, with marginally better agreement (a ~0.05-meter improvement in MAE) in the Clackamas River than the Cove.

Table 8. Hydrodynamic model-data error statistics.

Location	Model Segment	River Mile	Water Level Elevation Statistics, meters		
			ME	MAE	RMSE
Clackamas River, upstream of gravel bar	16	0.5	-0.04	0.06	0.07
Clackamas River, Highway 99-E bridge	29	0.3	-0.01	0.05	0.06
Clackamette Cove	36	n/a	-0.00	0.09	0.11
		Average	*-0.02*	*0.07*	*0.08*

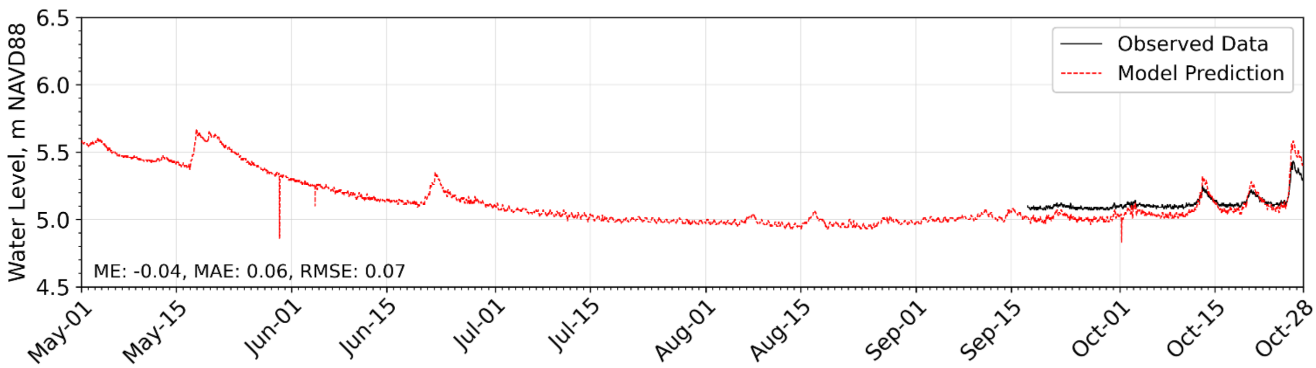

Figure 25. Comparison of observed (black line) and modeled (red dashed line) Clackamas River continuous water elevation timeseries upstream of the gravel bar located at the Cove inlet.

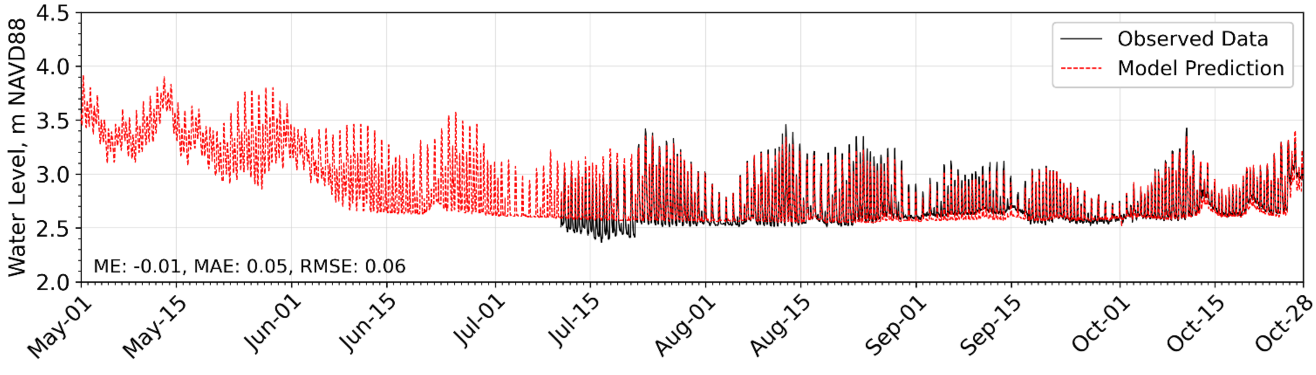

Figure 26. Comparison of observed (black line) and modeled (red dashed line) Clackamas River continuous water elevation timeseries at the Highway 99-E bridge.

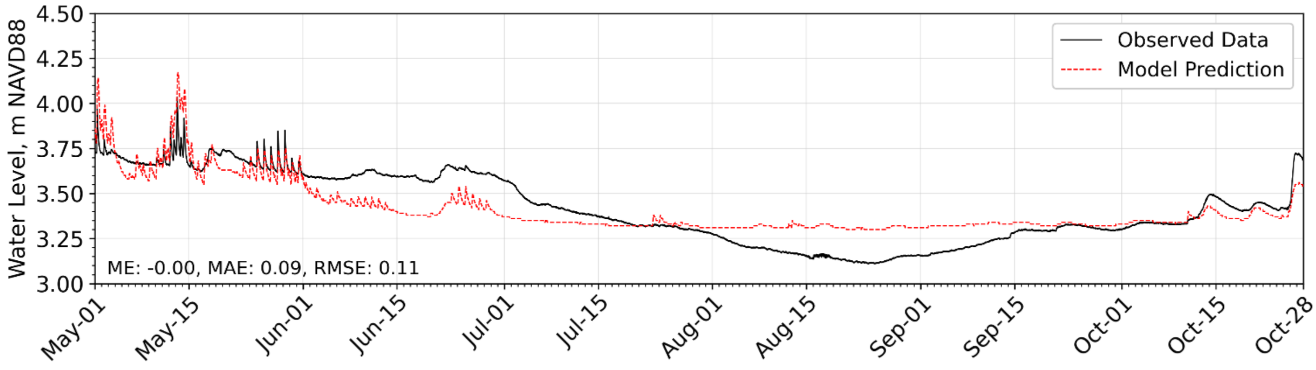

Figure 27. Comparison of observed (black line) and modeled (red dashed line) Clackamette Cove continuous water elevation timeseries.

Water Temperature

A limited water temperature calibration was conducted by comparing continuous (15-minute) water temperature data to the model output as well as discrete monthly Cove water temperature vertical profiles. The temperature calibration proceeded from upstream to downstream and across the Cove (following the hydrodynamic calibration) by adjusting model input coefficients until rough model-data agreement was achieved. Model adjustments included, but are not limited to:

- Adjusting the model initial water temperature,
- Adjusting the temperature of the sediment bed,
- Adjusting the vertical eddy viscosity to decrease vertical mixing in the water column,
- Decreasing the light extinction coefficient to account for the substantial Cove aquatic vegetation, and
- Adjusting the wind sheltering coefficient, which changes the effective wind on the water surface.

Simulated and observed water temperature timeseries as well as discrete observed and simulated water temperature vertical profiles were compared during calibration to evaluate and improve model performance.

Continuous Water Temperatures

The model-data error statistics of the limited continuous (15-minute) water temperature calibration are presented in Table 9. Water temperature timeseries model-data comparisons are presented in Figure 28 through Figure 30. The table and plots show the ME is very low at each site, with an overall MAE of 0.58°C. The model performs slightly better in simulating

Clackamas River water temperatures than in the Cove. However, this difference is marginal (approximately 0.5°C). Overall, the model is well calibrated for surface water temperatures.

Table 9. Continuous water temperature model-data error statistics.

Location	Model Segment	River Mile	Water Temperature Error Statistics, °C		
			ME	MAE	RMSE
Clackamas River, upstream of gravel bar	16	0.5	0.41	0.46	0.64
Clackamas River, Highway 99-E bridge	29	0.3	0.16	0.36	0.46
Clackamette Cove	45	n/a	-0.68	0.91	1.12
		Average	*-0.04*	*0.58*	*0.74*

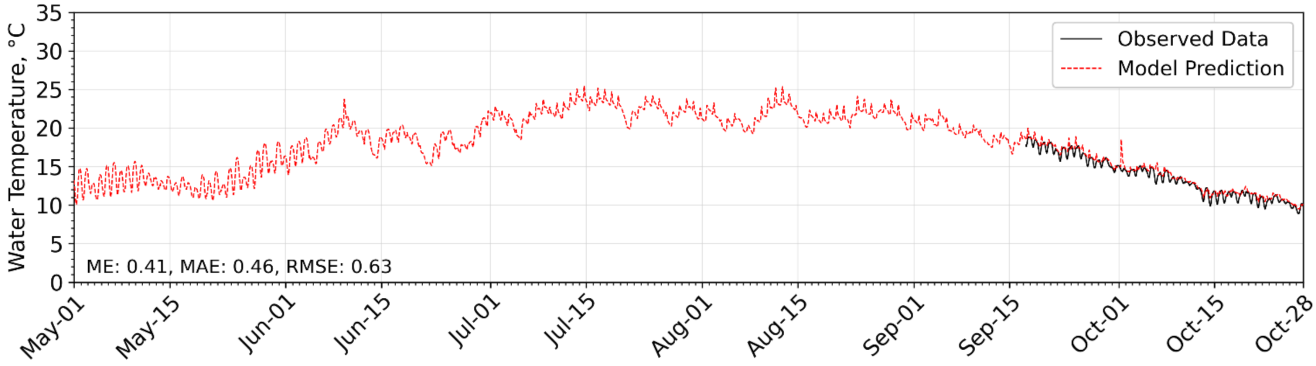

Figure 28. Comparison of observed (black line) and modeled (red dashed line) Clackamas River continuous water temperature timeseries upstream of the gravel bar located at the Cove inlet.

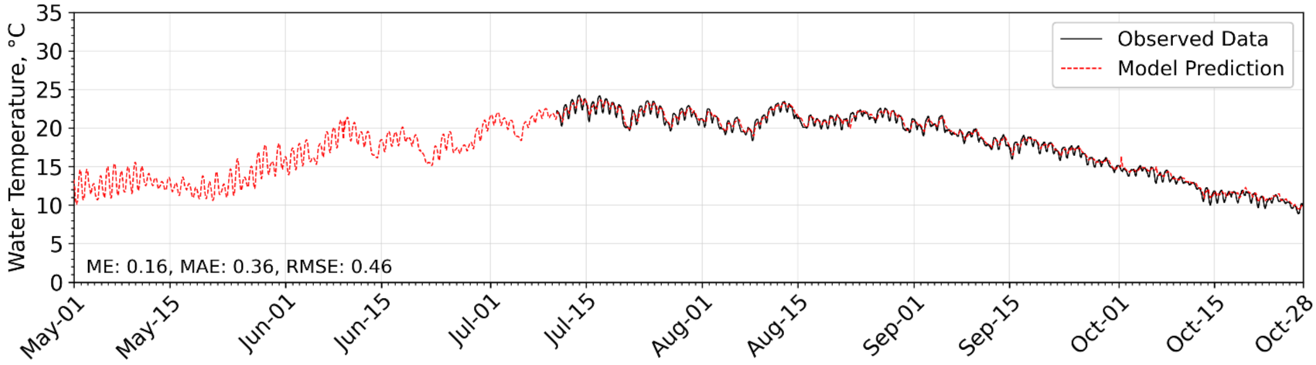

Figure 29. Comparison of observed (black line) and modeled (red dashed line) Clackamas River continuous water temperature timeseries at the Highway 99-E bridge.

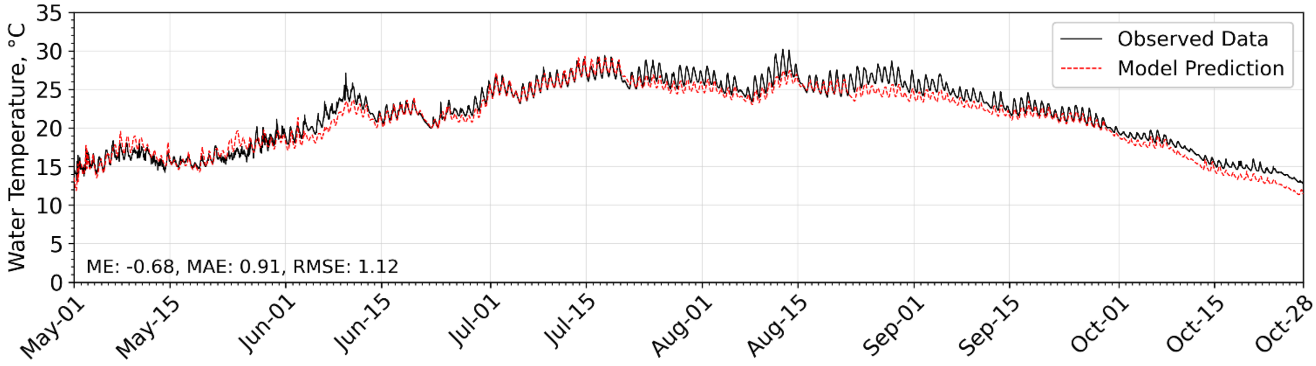

Figure 30. Comparison of observed (black line) and modeled (red dashed line) Clackamette Cove continuous water temperature timeseries.

Discrete Water Temperature Vertical Profiles

Discrete observations of water temperature vertical profiles in the Cove were collected on nine (9) discrete dates between May 1 and October 28, 2025. Table 10 presents the model-data error statistics following the limited calibration effort. Figure 31 provides a visual comparison of model-data water temperature agreement.

The model captures the initial stratification of the Cove through late July. Starting in early August 4, model-data agreement diminishes as the modeled Cove water column becomes decreasingly stratified while the observed profile remains strongly stratified. By September 15, the modeled water column is near isothermal while the observed data indicates a slight diminishment in the stratification observed in the early summer. By September 29, both the model and data demonstrate isothermal conditions in the Cove. However, modeled water temperatures are approximately 2°C colder than observed water temperatures across the water column.

Despite the relatively rapid onset of isothermal conditions in the model compared to observed conditions, the overall model-data mean average error is still less than 2°C. Additional calibration of the model could be conducted to improve the model-data error statistics. However, the presented model-data agreement was deemed sufficient for generally capturing Cove dynamics to supplement evaluations of Cove-River water exchange. The focus of the Project was not to dial in the water temperature calibration, which would have required a lot more information about the distribution and density of the aquatic plants to be included in the model.

Table 10. Discrete Clackamette Cove water temperature profile model-data error statistics.

Sample Collection Time			Water Temperature Error Statistics, °C		
Date	Time*	Model Julian Date	ME	MAE	RMSE
07/10/2025	15:15	557.64	-0.40	0.82	0.90
07/21/2025	15:00	568.63	0.46	1.04	1.25
08/04/2025	13:00	582.54	-0.25	1.86	1.94
08/18/2025	14:30	596.60	0.86	1.58	2.12
09/02/2025	13:15	611.55	0.21	2.47	2.70
09/15/2025	13:00	624.54	-0.51	2.38	2.55
09/29/2025	13:00	638.54	-2.38	2.38	2.38
10/14/2025	12:00	653.50	-2.38	2.38	2.44
10/28/2025	12:00	667.50	-2.16	2.16	2.25
		Average	*-0.73*	*1.90*	*2.06*

** Profiles took between 15-minutes and an hour to collect. The median time of measurement is denoted; instantaneous model profiles were extracted for the corresponding dates and times.*

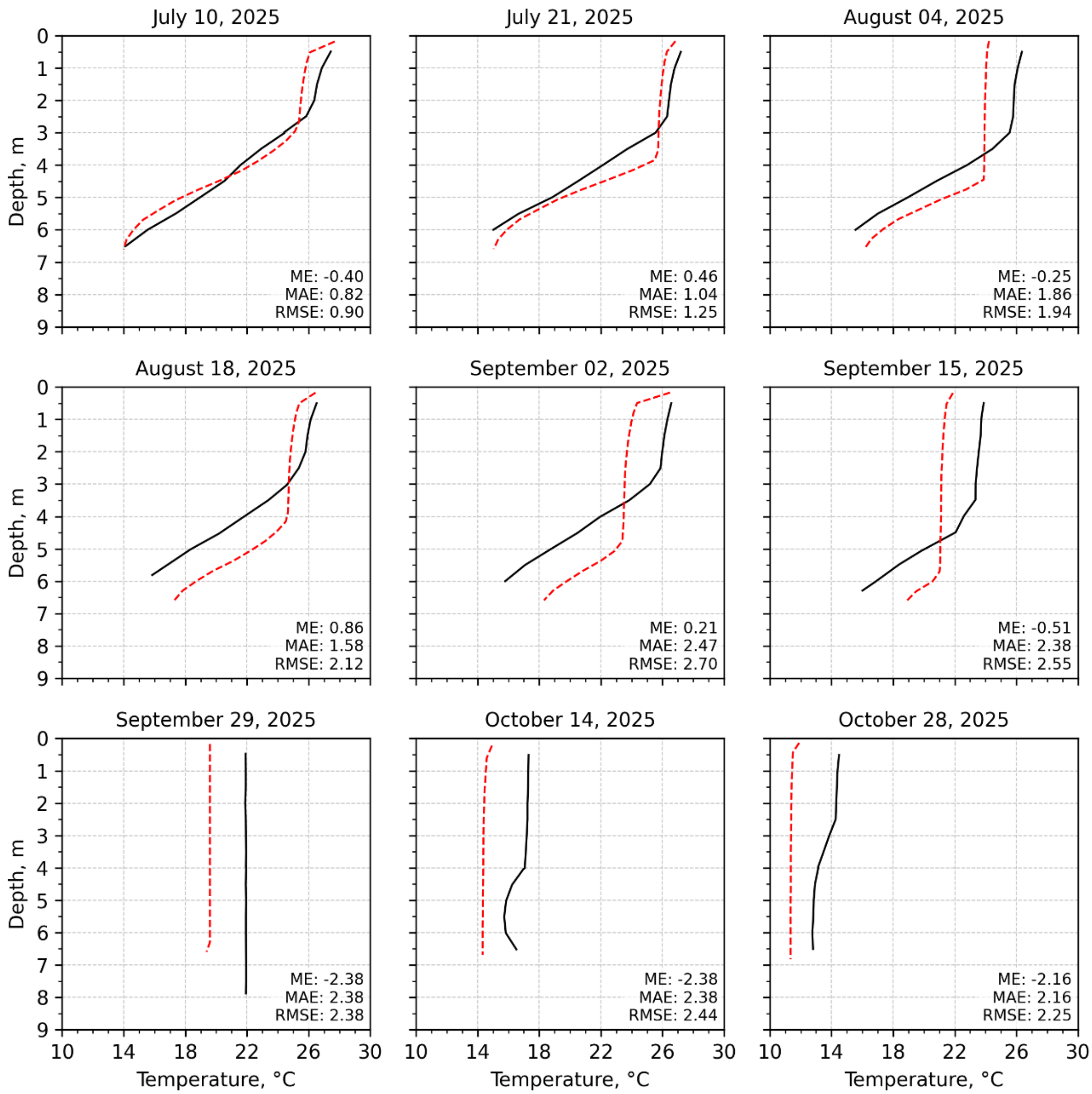

Figure 31. Comparison of observed (black line) and modeled (red dashed line) Clackamette Cove temperature profiles.

Model Scenarios

Six model scenarios were developed for the W2 model to evaluate the potential to increase water exchange between the River and the Cove (e.g., "flushing" of the Cove) through select engineering efforts. Modeled scenarios included the modification of River and Cove bathymetry to simulate dredging at the Cove inlet and in the Clackamas River along the south channel of the gravel bar, nearest the Cove inlet. Model scenarios were also developed to simulate a new Cove-River connection at the northeast corner of the Cove. These scenarios are detailed below:

- **Scenario 1 – Deepen the South Channel of the Gravel Bar**
  - Deepen the bathymetry of the south channel of the gravel bar (segment 24-26 of branch 3, represented as the red region in Figure 32) by 2 feet (0.60 meters), simulating a dredging effort to increase the duration of Cove-River summer connectivity during low flows.
- **Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar**
  - Deepen the bathymetry of the south channel of the gravel bar (branch 3) by 2 feet (0.60 meters) and widen by 30 feet (9.1 meters), simulating a more intensive dredging effort (compared to Scenario 1) to increase the duration of Cove-River summer connectivity during low flows.
- **Scenario 3 – Scenario 2 and Deepen the Cove Inlet**
  - In addition to Scenario 2, deepen the Cove inlet (segments 49-51 of branch 5, represented as the yellow region in Figure 32) by 2 feet (0.60 meters) to encourage greater exchange of Cove bottom water.
- **Scenario 4 – Add a 10 cfs Inflow from the River to the Cove**
  - Add a 10 cfs tributary connection from segment 16 (branch 1) to segment 37 (branch 5) representing an additional flow connection with the Clackamas River at the northeast corner of the Cove.
- **Scenario 5 – Add a 20 cfs Inflow from the River to the Cove**
  - Similar to Scenario 4, double the tributary flow to 20 cfs.
- **Scenario 6 – Combine Scenarios 3 and 5**
  - Combine Scenarios 3 and 5, representing a maximum mitigation effort to encourage Cove-river connectivity and increase exchange between the two water bodies.

A visual representation of the above scenarios is presented in Figure 32.

The calibrated (Baseline) model was used a reference for determine the change in Cove-River water exchange resulting from the implementation of select management strategies. Cove water level, flow rate, velocity (at 0.5-meter depth), water temperature, and water age in each scenario were compared to the Baseline output. Modeled water temperature and water age profiles across the Cove (at the Cove inlet, middle of the Cove, and furthest southeast extent of the Cove) and water surface elevation do not substantial differ spatially across the Cove in the Baseline model or developed scenarios. Therefore, modeled water temperature vertical profiles, water age profiles, and water elevation are compared to observations in the middle of the Cove (segment 45) alone. Modeled velocity profiles are depicted at both the Cove inlet (segment 49) and the middle of the Cove for comparison. The locations of Baseline-Scenario model comparisons are visually presented in the inset map of Figure 32 and detailed in Table 11.

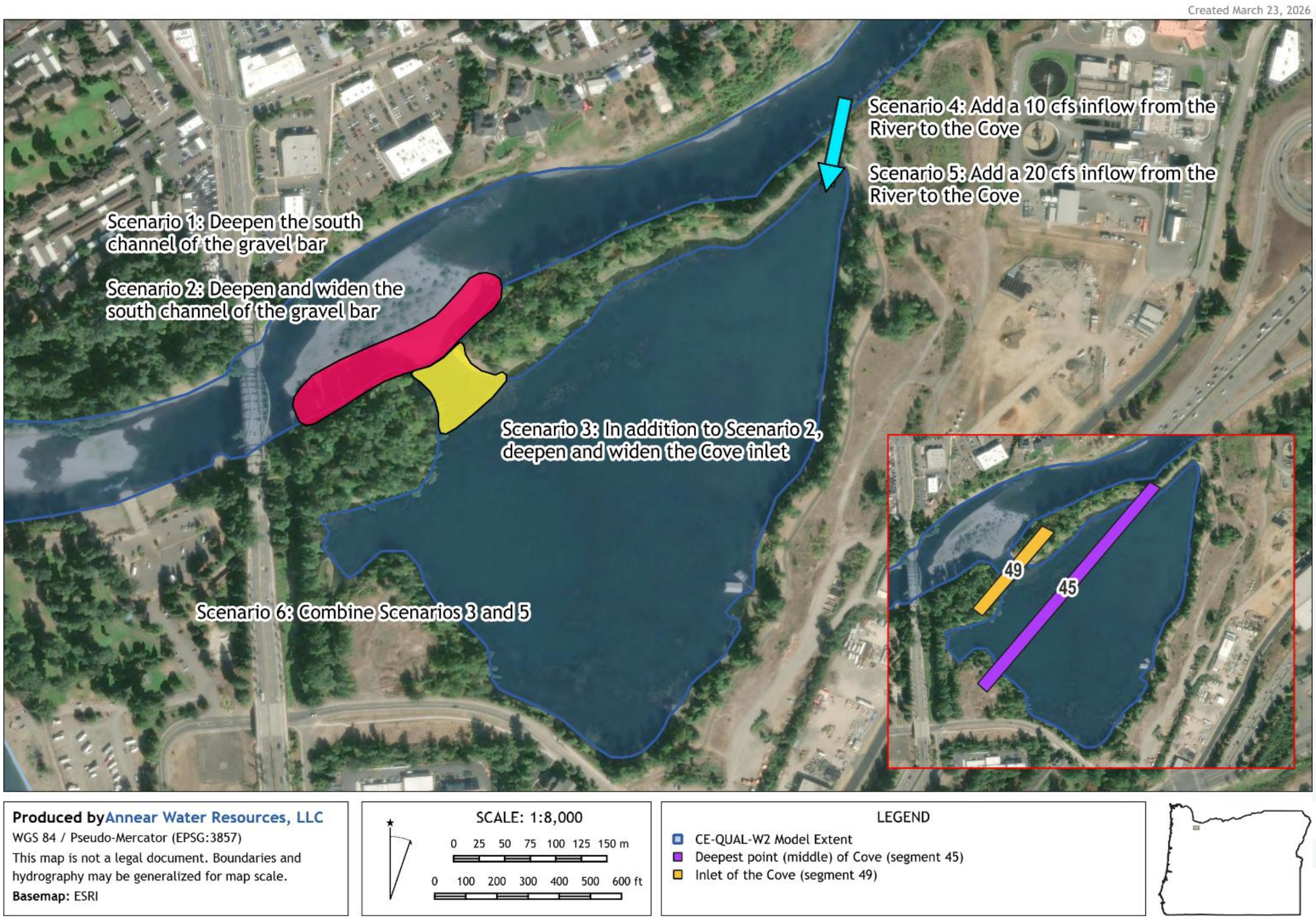

Figure 32. Overview of modeled scenarios and the location of Baseline-scenario comparison.

Table 11. Locations (segments) of calibrated (Baseline) model and scenario comparisons and corresponding model parameter(s) evaluated.

Segment	Description	Model Parameter (units)	Parameter Description
49	Inlet of the Cove	Flow Rate (cfs)	The volumetric rate of water entering and leaving the Cove at the inlet, indicative of water exchange between the two water bodies.
		Velocity (ft./s)	The speed at which water enters or leaves the Cove at the inlet, 0.5-meter depth.
45	Deepest point (middle) of the Cove	Velocity (ft./s)	The speed at which water flows across the Cove, 0.5-meter depth.
		Water Level Elevation (m., NAVD88)	Indicative of the total volume of water in the Cove.
		Water Temperature (°C)	Supports evaluations of the timing and degree of thermal stratification.
		Water Age (days)	The amount of time water remains in the Cove, indicative of Cove-River water exchange and residence time.

Results

Table 12 presents comparisons of the calibrated (Baseline) model timeseries to the output of modeled Scenarios when the Cove is generally disconnected from the River (July 1 through September 30). Table 13 and Table 14 presents the difference in water age profiles for the same dates as Table 13. Simulated profiles were output in the middle of each day (12:00 PM) to support direct comparison. The Scenarios demonstrate an over 100-day decrease in the average age of the water column compared to the Baseline by the end of the model simulation period, though differences from the Baseline in Scenarios 4 through 6 are more pronounced than Scenarios 1 through 3. Maximum water age, as presented in later sections, consistently occur at the bottom of the vertical profile. The change in the maximum water age at the Cove bottom is relatively low (less than a five (5) day difference) up until August 1.

Table 14 present comparisons of Baseline and Scenario model temperature and water age profiles over the entire simulation period (May 1 through October 28, 2025). All three tables include a column dedicated to the change in the overall average model output between the Baseline and each Scenario. As noted in the "Parameter Description" column of Table 11, comparisons of each of the modeled parameters are intended to inform different aspects of the potential changes in Cove-River water exchange as a result of channel modifications and the introduction of a new connection between the two waterbodies.

Changes in flow rate are presented at the Cove inlet. As a result of the alignment of the model grid representing the Cove, positive values denote flow out of the Cove (Cove to River) while negative values represent flow into the Cove (River to Cove). A positive increase in the average flow rate between the Baseline and a given Scenario therefore represents a net increase in the total volumetric rate of water leaving the Cove over the model simulation period. The respective addition of a 10 cfs and 20 cfs tributary in Scenario 4 and Scenario 5, for example, are captured in the proportional increase in flows out of the Cove (10.01 and 20.01 cfs) between the Baseline and Scenario averages (Table 12).

Modification of the Cove and River bathymetry under Scenarios 1 through 3 results in a net increase in the hourly average flow and increase in the volume of flows entering and leaving the Cove compared to the Baseline (e.g., the Scenarios result in more negative hourly minimum and more positive hourly maximum flows). These changes are less pronounced in Scenarios 4 and 5, corresponding to the addition of a 10 cfs and 20 cfs tributary. The combination of both an intensive dredging effort and the 20 cfs Cove-River tributary mirrors the results of Scenarios 1 through 3, but increased by 20 cfs.

The change in water velocity at a depth of 0.5 meters may be interpreted similarly to flow rate. Positive values denote flow out of the Cove; negative values denote flow into the Cove. Table 12 shows negligible variation in the water velocity at the Cove inlet between the Baseline and Scenarios, and no change in the velocity of water in the center of the Cove as a result of a dredging effort, creation of a new Cove-River connection, or combination of the two.

The change in water surface elevations between the Baseline and Scenarios at the center of the Cove is similarly small (maximum difference of -0.24 m NAVD88). Dredging the south channel of the gravel bar, the primary barrier to Cove-River water exchange, by 0.60 meters (in in Scenarios 1 through 3) results in a decrease in simulated average water level elevations over the simulation period. The addition of a new Cove-River connection increases average water level marginally. Dredging the south channel and adding a new Cove-River connection in Scenario 6 results in the smallest change in simulated water level elevations compared to the difference between the other alternative Scenarios and the Baseline model.

Table 12. Comparison of hourly averaged timeseries model statistics over the simulation period (July 1 through September 30, 2025).

Model Scenario, Grouped by Parameter	Hourly Average Model Output (July 1 to September 30)			
	Minimum	Maximum	Average	Change from Baseline avg.
*Flow rate at the Cove inlet (segment 49), cfs **				
Baseline model	-33.55	4.24	-0.25	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	-105.86	48.82	-0.12	+0.13
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	-106.03	49.44	-0.11	+0.14
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	-105.86	49.44	-0.11	+0.14
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	-19.95	14.21	9.77	+10.02
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	-2.12	23.66	19.77	+20.02
Scenario 6 – Combine Scenarios 3 and 5	-91.11	71.78	19.85	+20.10
*0.5-meter depth water velocity at the Cove inlet (segment 49), ft./s **				
Baseline model	0	0.03	0	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	-0.07	0.07	0.01	+0.01
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	-0.07	0.07	0.01	+0.01
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	-0.03	0.07	0.01	+0.01
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	0	0.02	0	0
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	0	0.03	0	0
Scenario 6 – Combine Scenarios 3 and 5	-0.06	0.03	0.01	+0.01
*0.5-meter depth water velocity in the middle of the Cove (segment 45), ft./s **				
Baseline model	-0.03	0.03	0	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	-0.03	0.03	0	0
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	-0.03	0.03	0	0
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	-0.03	0.03	0	0
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	-0.02	0.03	0	0
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	-0.02	0.03	0	0
Scenario 6 – Combine Scenarios 3 and 5	-0.02	0.03	0	0
Water level elevation in the middle of the Cove (segment 45), m NAVD88				
Baseline model	3.30	3.38	3.32	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	2.99	3.34	3.09	-0.23
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	2.98	3.34	3.08	-0.24
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	2.98	3.34	3.08	-0.24
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	3.39	3.46	3.41	+0.09
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	3.46	3.52	3.48	+0.16
Scenario 6 – Combine Scenarios 3 and 5	3.11	3.43	3.19	-0.13

** Negative values represent flow into the Cove; positive values denote flow out of the Cove.*

Table 13 presents the difference in water temperature profiles between the Baseline and modeled Scenarios on six (6) dates spanning the model simulation period. A decrease in water temperatures across the water column between the Baseline and a given scenario represents the greater influence of cool Clackamas River flows on Clackamette Cove, and thus a greater degree of Cove-River water exchange. Similarly, a decrease in water age profiles between the Baseline and a given Scenario is indicative of decreased residence times in the Cove and greater Cove-River water exchange.

As presented in Table 13 and Table 14 presents the difference in water age profiles for the same dates as Table 13. Simulated profiles were output in the middle of each day (12:00 PM) to support direct comparison. The Scenarios demonstrate an over 100-day decrease in the average age of the water column compared to the Baseline by the end of the model simulation period, though differences from the Baseline in Scenarios 4 through 6 are more pronounced than Scenarios 1 through 3. Maximum water age, as presented in later sections, consistently occur at the bottom of the vertical profile. The change in the maximum water age at the Cove bottom is relatively low (less than a five (5) day difference) up until August 1.

Table 14, each Scenario results in a successively greater degree of modeled Cove-River water exchange, with Scenario 6 resulting in the greatest flushing of the Cove. Scenarios 1 through 3 are less than 1°C colder than Baseline profiles over the simulation period, while Scenarios 4 through 6 are up to 3°C colder. These statistics, however, do not capture the degree of change in thermal stratification which would be required to decrease internal phosphorous loading from Cove sediments, which can promote algal summer cyanobacteria blooms.

Table 13. Comparison of discrete mid-day water temperature profile model statistics at the deepest point (middle) of the Cove (segment 45).

Model Scenario, Grouped by Profile Date	Water Temperature, °C			
	Minimum	Maximum	Average	Change from Baseline avg. (%)
June 1				
Baseline model	10.50	18.57	14.57	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	10.39	17.47	13.98	-0.58 (4.00%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	10.39	17.47	13.99	-0.58 (3.98%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	10.39	17.74	14.06	-0.50 (3.45%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	10.38	18.07	13.77	-0.79 (5.44%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	10.27	17.58	13.41	-1.15 (7.92%)
Scenario 6 – Combine Scenarios 3 and 5	10.21	17.49	13.54	-1.02 (7.03%)
July 1				
Baseline model	13.11	25.90	19.93	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	13.22	26.42	19.46	-0.47 (2.35%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	13.22	26.45	19.46	-0.47 (2.35%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	13.29	26.60	19.50	-0.43 (2.17%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	12.88	26.46	18.67	-1.26 (6.31%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	12.73	25.68	18.14	-1.79 (8.97%)
Scenario 6 – Combine Scenarios 3 and 5	12.94	25.60	18.40	-1.53 (7.65%)
August 1				
Baseline model	15.94	25.69	22.79	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	16.65	24.70	22.37	-0.42 (1.85%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	16.67	24.71	22.37	-0.42 (1.84%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	16.83	24.72	22.32	-0.47 (2.05%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	15.41	24.55	21.09	-1.69 (7.44%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	15.18	24.73	20.75	-2.03 (8.93%)
Scenario 6 – Combine Scenarios 3 and 5	15.93	24.80	20.99	-1.80 (7.89%)
September 1				
Baseline model	18.22	24.01	22.73	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	19.81	23.43	22.55	-0.17 (0.76%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	19.84	23.42	22.55	-0.18 (0.78%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	19.70	23.40	22.48	-0.25 (1.10%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	17.25	23.11	21.04	-1.69 (7.44%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	17.03	22.83	20.61	-2.11 (9.30%)
Scenario 6 – Combine Scenarios 3 and 5	17.93	22.97	20.77	-1.96 (8.62%)
October 1				
Baseline model	18.54	18.56	18.55	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	18.14	18.17	18.16	-0.39 (2.12%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	18.13	18.16	18.15	-0.40 (2.18%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	18.13	18.16	18.15	-0.41 (2.19%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	14.42	17.39	16.13	-2.43 (13.07%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	14.41	16.64	15.62	-2.93 (15.81%)
Scenario 6 – Combine Scenarios 3 and 5	14.41	16.54	15.55	-3.00 (16.16%)
October 15				
Baseline model	14.13	14.69	14.21	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	13.27	14.49	13.40	-0.81 (5.72%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	13.25	13.87	13.35	-0.87 (6.10%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	13.25	13.86	13.34	-0.87 (6.15%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	10.72	13.71	12.35	-1.86 (13.09%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	10.70	13.48	11.96	-2.25 (15.84%)
Scenario 6 – Combine Scenarios 3 and 5	10.72	13.34	11.85	-2.37 (16.65%)

Table 14 presents the difference in water age profiles for the same dates as Table 13. Simulated profiles were output in the middle of each day (12:00 PM) to support direct comparison. The Scenarios demonstrate an over 100-day decrease in the average age of the water column compared to the Baseline by the end of the model simulation period, though differences from the Baseline in Scenarios 4 through 6 are more pronounced than Scenarios 1 through 3. Maximum water age, as presented in later sections, consistently occur at the bottom of the vertical profile. The change in the maximum water age at the Cove bottom is relatively low (less than a five (5) day difference) up until August 1.

Table 14. Comparison of discrete mid-day water age profile model statistics at the deepest point (middle) of the Cove (segment 45).

Model Scenario, Grouped by Profile Date	Water Age, days			
	Minimum	Maximum	Average	Change from Baseline avg. (%)
June 1				
Baseline model	15.21	33.50	25.51	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	7.75	33.50	20.66	-4.85 (19.03%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	7.72	33.50	20.64	-4.87 (19.08%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	7.20	33.47	19.07	-6.44 (25.26%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	9.49	33.18	18.18	-7.33 (28.75%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	6.29	33.17	15.76	-9.75 (38.23%)
Scenario 6 – Combine Scenarios 3 and 5	4.58	33.24	14.35	-11.16 (43.75%)
July 1				
Baseline model	39.76	63.42	49.15	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	12.74	63.24	29.10	-20.05 (40.79%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	12.59	63.23	28.98	-20.17 (41.03%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	10.98	62.46	27.19	-21.96 (44.68%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	10.85	59.51	26.73	-22.42 (45.61%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	6.30	59.31	22.63	-26.52 (53.95%)
Scenario 6 – Combine Scenarios 3 and 5	4.62	59.26	19.79	-29.36 (59.73%)
August 1				
Baseline model	72.17	93.13	77.52	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	17.88	86.84	32.56	-44.96 (58.00%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	17.67	86.74	32.32	-45.19 (58.30%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	14.63	83.13	30.43	-47.08 (60.74%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	6.85	80.13	30.48	-47.03 (60.68%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	5.26	80.75	25.32	-52.20 (67.34%)
Scenario 6 – Combine Scenarios 3 and 5	4.30	76.21	20.65	-56.87 (73.36%)
September 1				
Baseline model	101.69	119.70	105.26	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	22.10	73.48	29.46	-75.80 (72.01%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	21.84	72.66	29.09	-76.17 (72.36%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	20.92	72.82	29.16	-76.10 (72.30%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	7.15	80.65	25.14	-80.12 (76.11%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	4.76	80.69	19.48	-85.78 (81.49%)
Scenario 6 – Combine Scenarios 3 and 5	3.19	58.55	13.08	-92.18 (87.57%)
October 1				
Baseline model	130.29	130.30	130.30	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	38.38	38.39	38.38	-91.91 (70.54%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	37.88	37.89	37.88	-92.41 (70.93%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	37.33	37.33	37.33	-92.97 (71.35%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	0.33	22.83	11.35	-118.95 (91.29%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	0.25	12.17	5.66	-124.64 (95.66%)
Scenario 6 – Combine Scenarios 3 and 5	0.25	11.46	5.43	-124.87 (95.83%)
October 15				
Baseline model	138.86	138.93	138.86	n/a
Scenario 1 – Deepen the South Channel of the Gravel Bar	33.18	33.22	33.18	-105.68 (76.10%)
Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar	32.64	32.66	32.64	-106.22 (76.49%)
Scenario 3 – Scenario 2 and Deepen the Cove Inlet	31.97	31.99	31.98	-106.89 (76.97%)
Scenario 4 – Add a 10 cfs Inflow from the River to the Cove	0.72	21.60	11.98	-126.89 (91.37%)
Scenario 5 – Add a 20 cfs Inflow from the River to the Cove	0.61	11.41	6.13	-132.73 (95.59%)
Scenario 6 – Combine Scenarios 3 and 5	0.68	9.16	5.13	-133.73 (96.31%)

The following sections provide visual depictions of and additional comments regarding the resulting change in simulated Cove-River water exchange from the Baseline model for each Scenario.

Scenario 1 – Deepen the South Channel of the Gravel Bar

Figure 33 through Figure 38 present the Scenario 1 model output, simulating the dredging of the south channel of the Clackamas River gravel bar, alongside the Baseline model. Dredging increases flow rates at the Cove inlet, velocities at the inlet and center of the Cove, and a decrease in water levels, water temperatures, and water age compared to the Baseline.

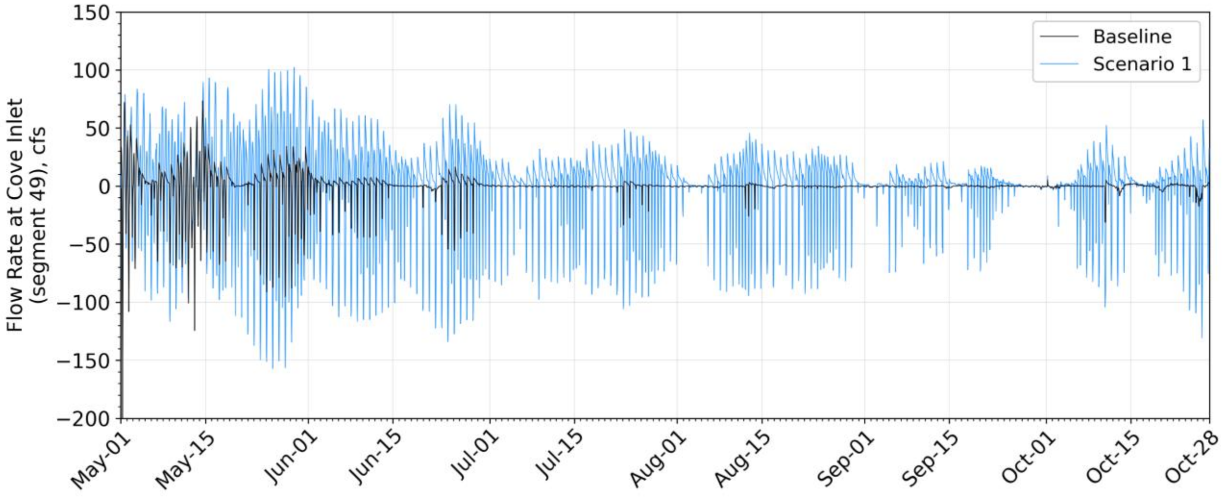

Figure 33. Comparison of Baseline and Scenario 1 flow rates at the Cove inlet (segment 49).

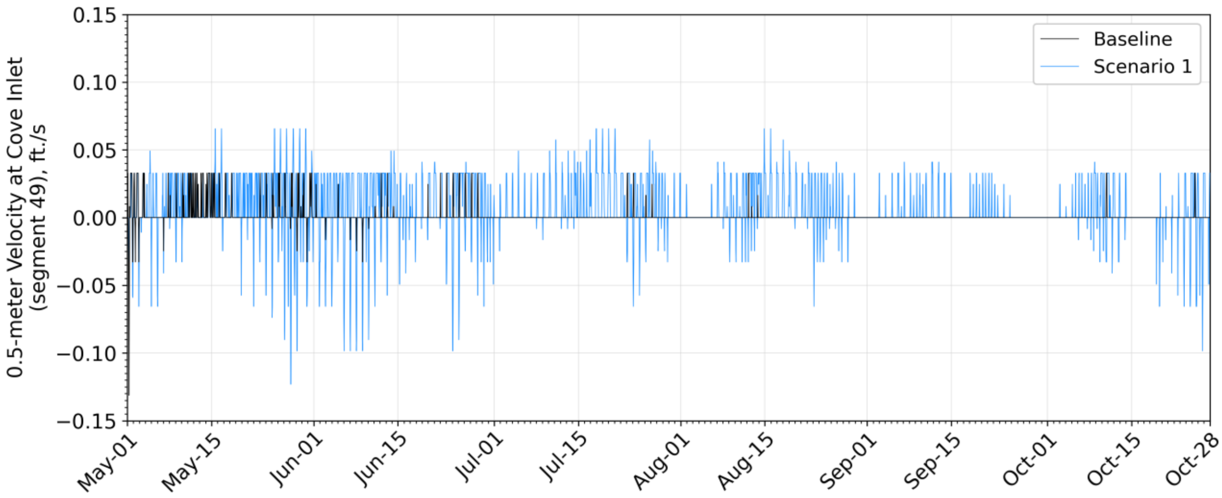

Figure 34. Comparison of Baseline and Scenario 1 0.5-meter depth water velocity at the Cove inlet (segment 49).

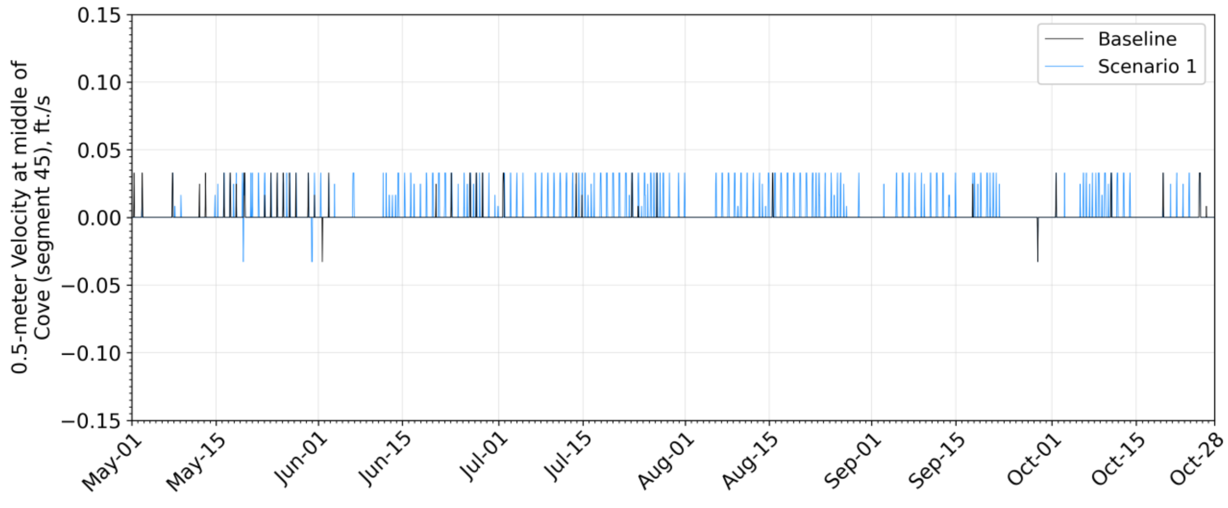

Figure 35. Comparison of Baseline and Scenario 1 0.5-meter depth water velocity at the deepest point (middle) of the Cove (segment 45).

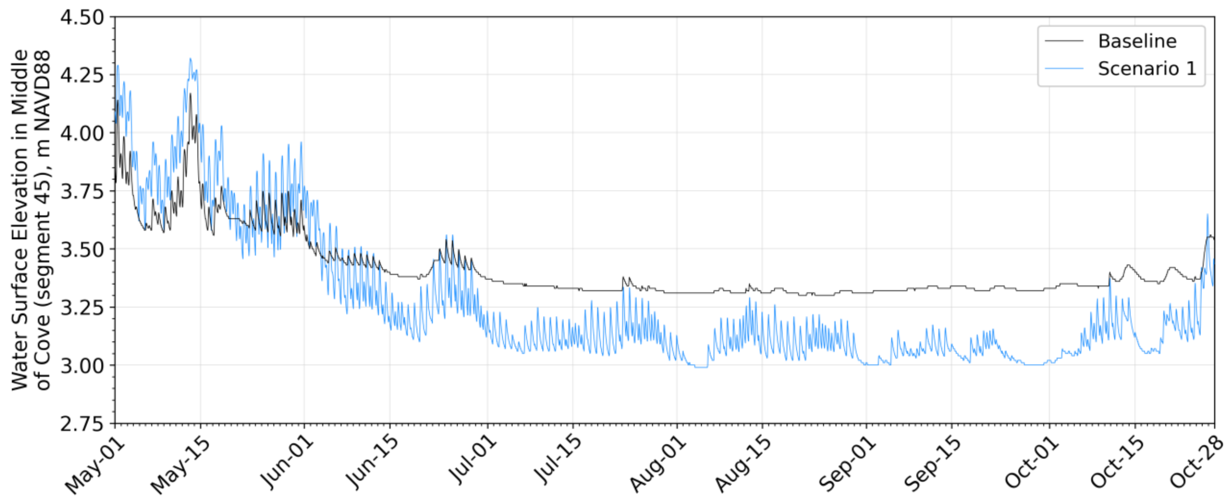

Figure 36. Comparison of Baseline and Scenario 1 water level elevations at the deepest point (middle) of the Cove (segment 45).

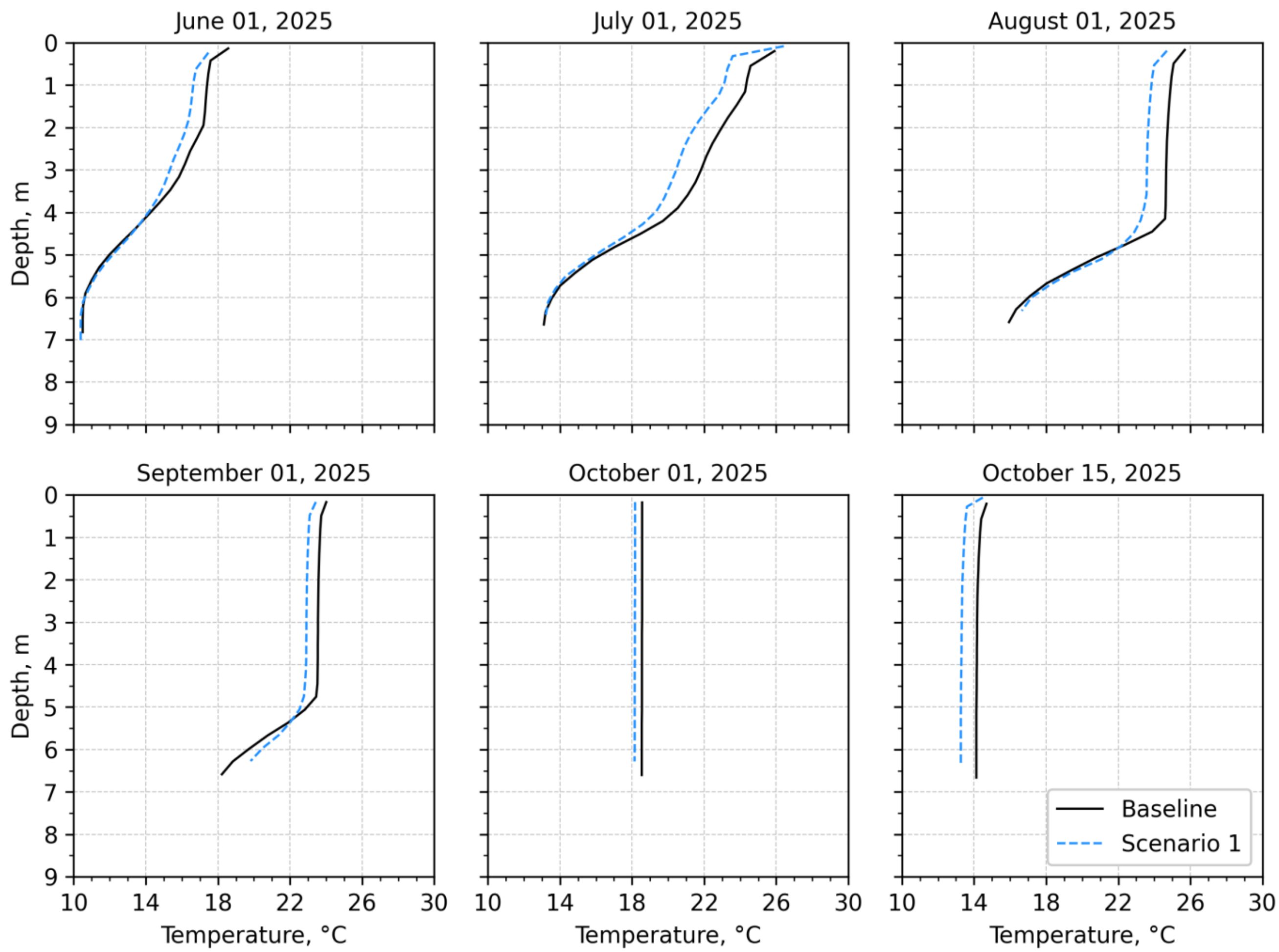

Figure 37. Comparison of Baseline and Scenario 1 water temperature profiles at the deepest point (middle) of Clackamette Cove (segment 45).

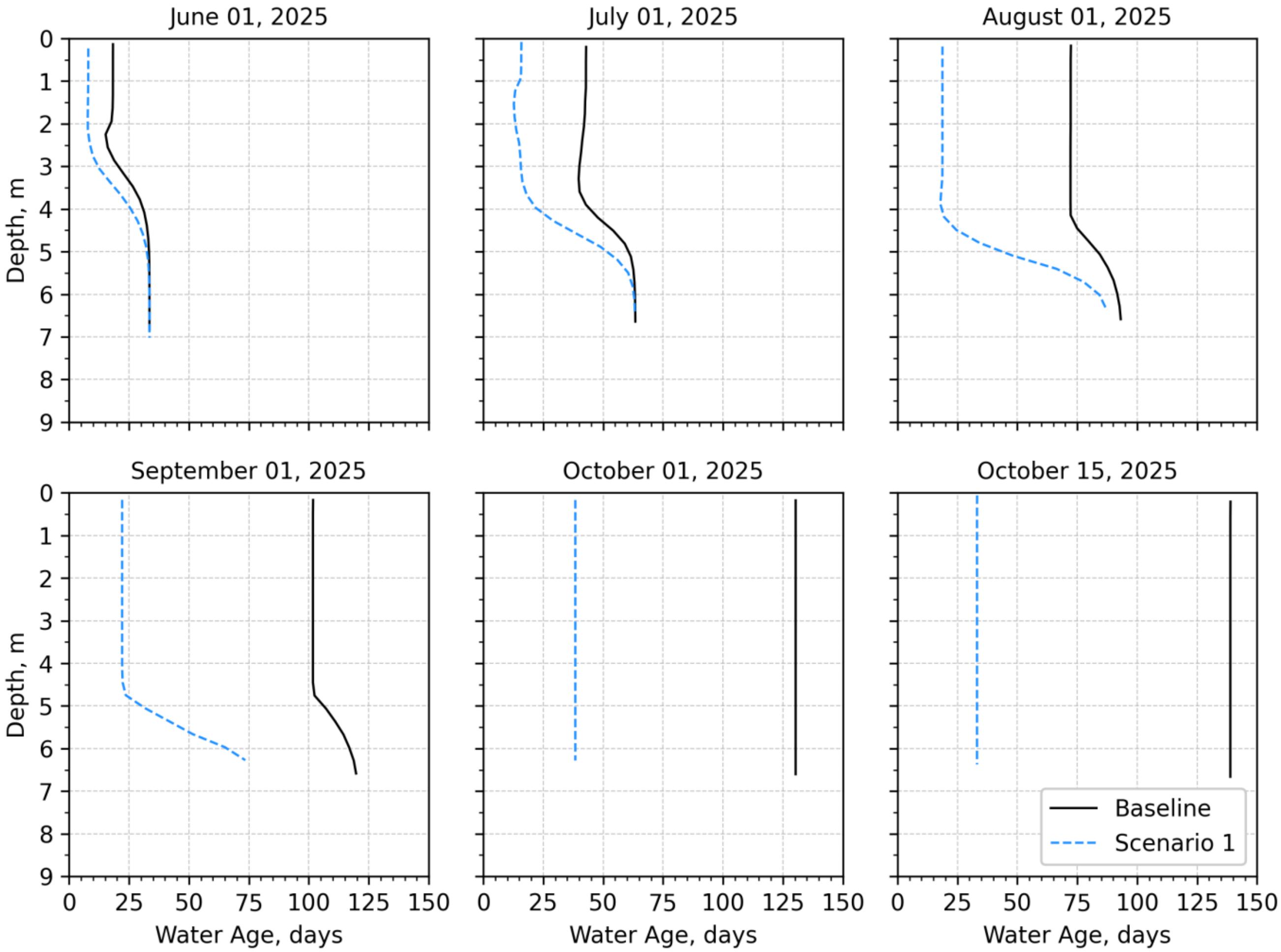

Figure 38. Comparison of Baseline and Scenario 1 water age profiles at the deepest point (middle) of Clackamette Cove (segment 45).

Scenario 2 – Deepen and Widen the South Channel of the Gravel Bar

Figure 39 through Figure 44 present the Scenario 2 model output, simulating the dredging and widening of the south channel of the Clackamas River gravel bar, alongside the Baseline model. Dredging increases flow rates at the Cove inlet, velocities at the inlet and center of the Cove, and a decrease in water levels, water temperatures, and water age compared to the Baseline. This change is similar to the result from widening the south channel of the gravel bar alone (Scenario 1).

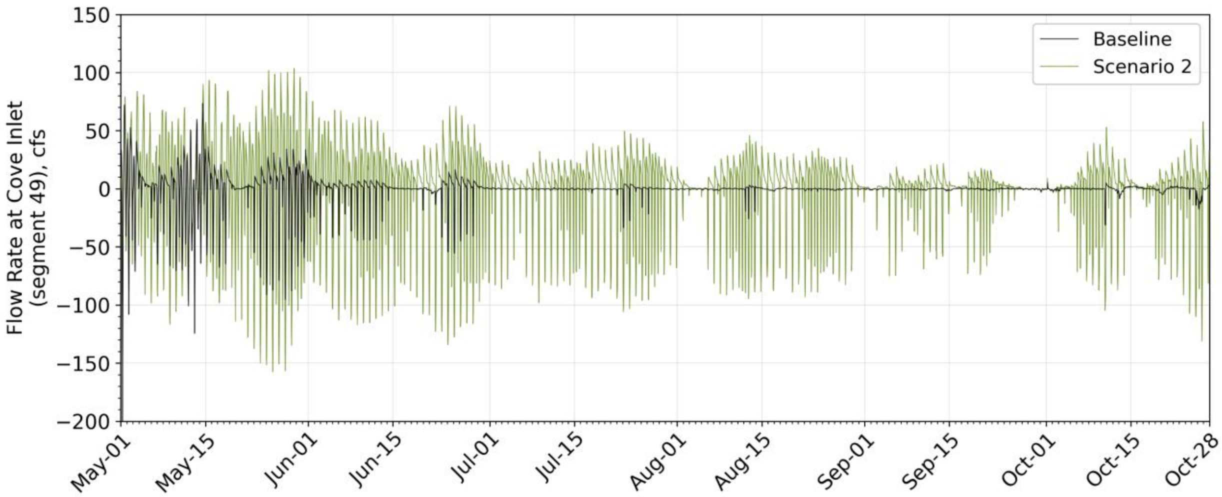

Figure 39. Comparison of Baseline and Scenario 2 flow rates at the Cove inlet (segment 49).

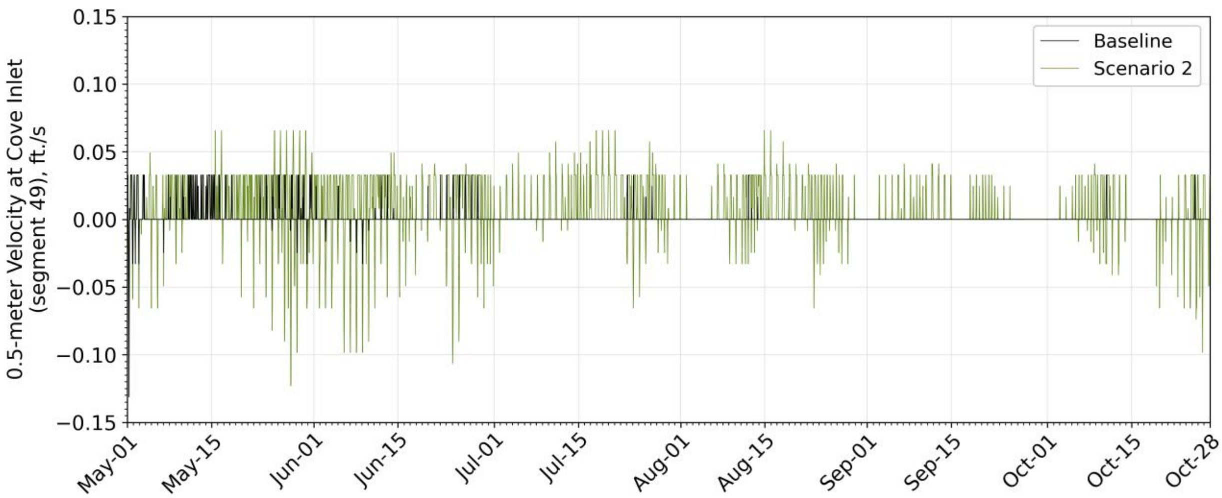

Figure 40. Comparison of Baseline and Scenario 2 0.5-meter depth water velocity at the Cove inlet (segment 49).

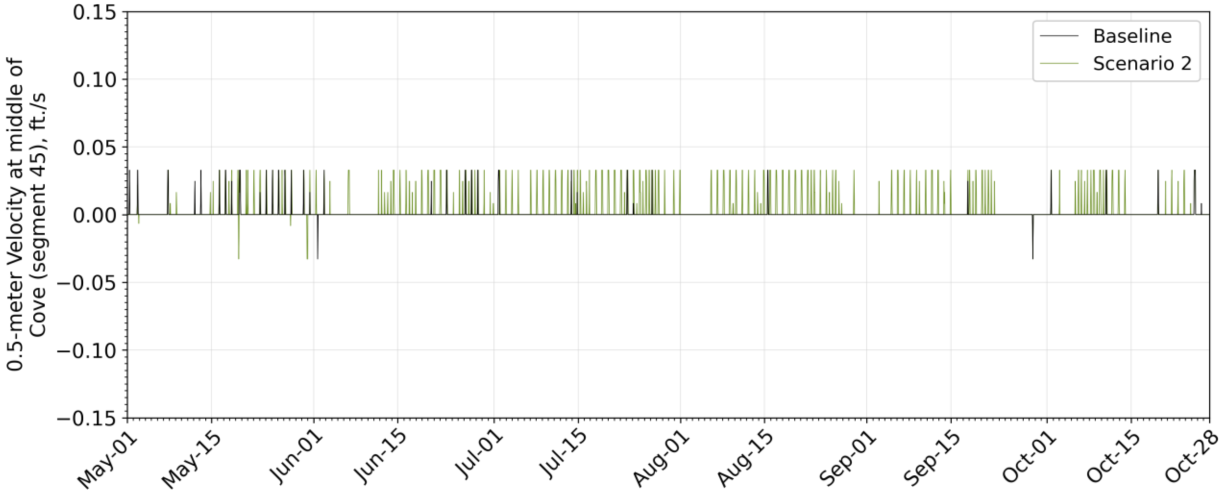

Figure 41. Comparison of Baseline and Scenario 2 0.5-meter depth water velocity at the deepest point (middle) of the Cove (segment 45).

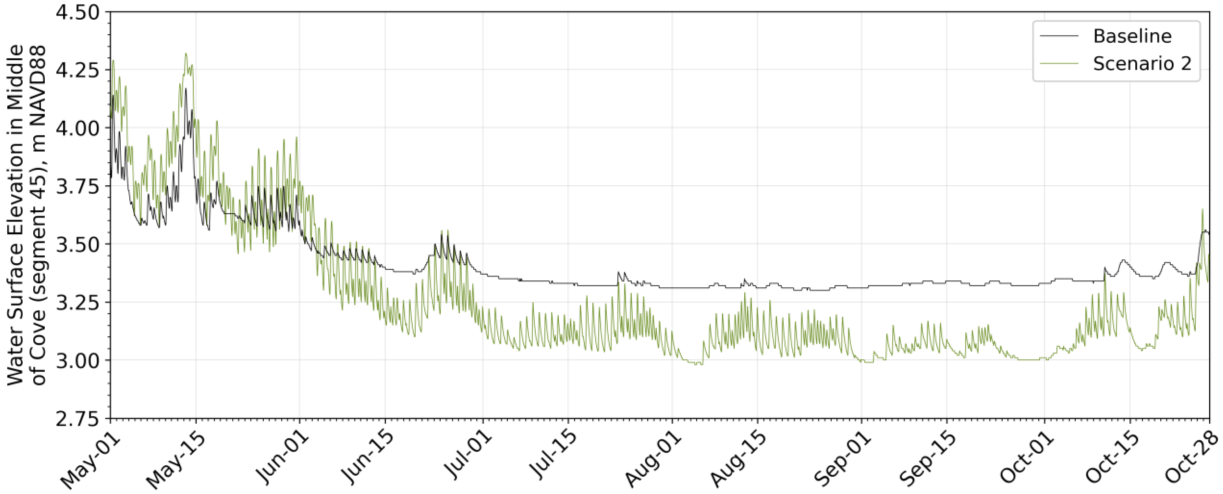

Figure 42. Comparison of Baseline and Scenario 2 water level elevations at the deepest point (middle) of the Cove (segment 45).

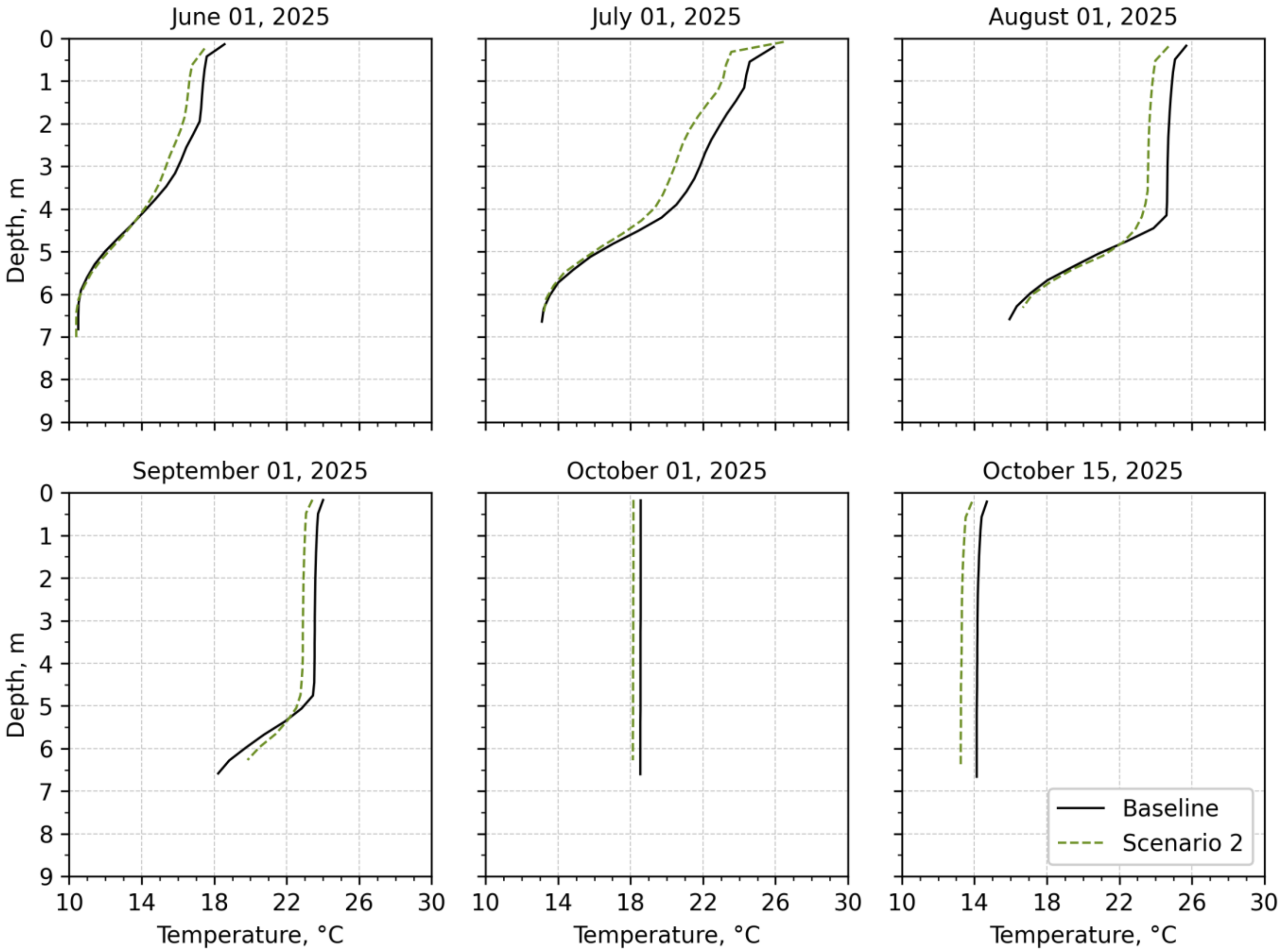

Figure 43. Comparison of Baseline and Scenario 2 water temperature profiles at the deepest point (middle) of Clackamette Cove (segment 45).

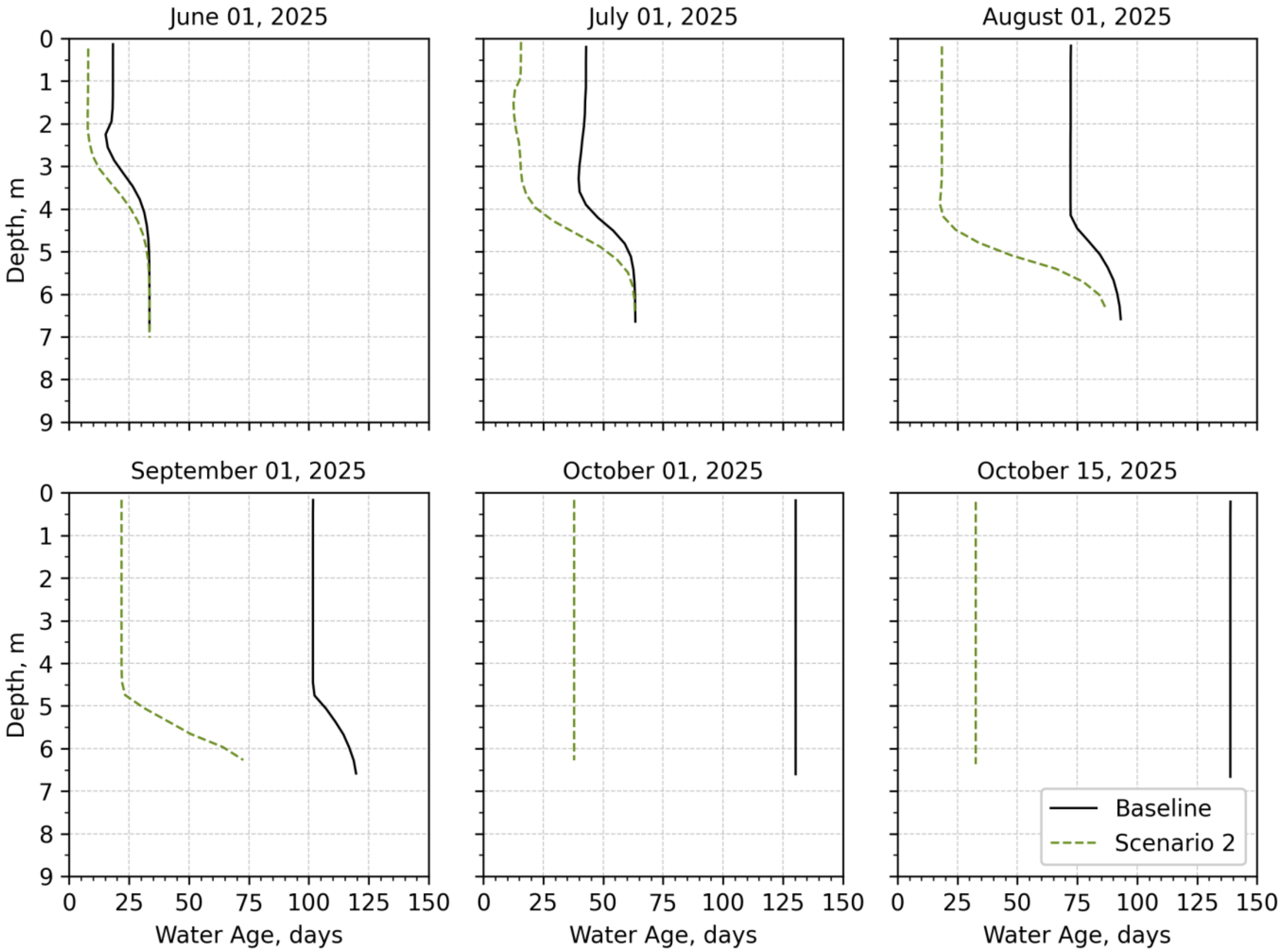

Figure 44. Comparison of Baseline and Scenario 2 water age profiles at the deepest point (middle) of Clackamette Cove (segment 45).

Scenario 3 – Scenario 2 and Deepen the Cove Inlet

Figure 45 through Figure 50 present the Scenario 3 model output, simulating the dredging and widening of the south channel of the Clackamas River gravel bar and the Cove inlet, alongside the Baseline model. Dredging increases flow rates at the Cove inlet, velocities at the inlet and center of the Cove, and a decrease in water levels, water temperatures, and water age compared to the Baseline. This change is similar to Scenarios 1 and 2.

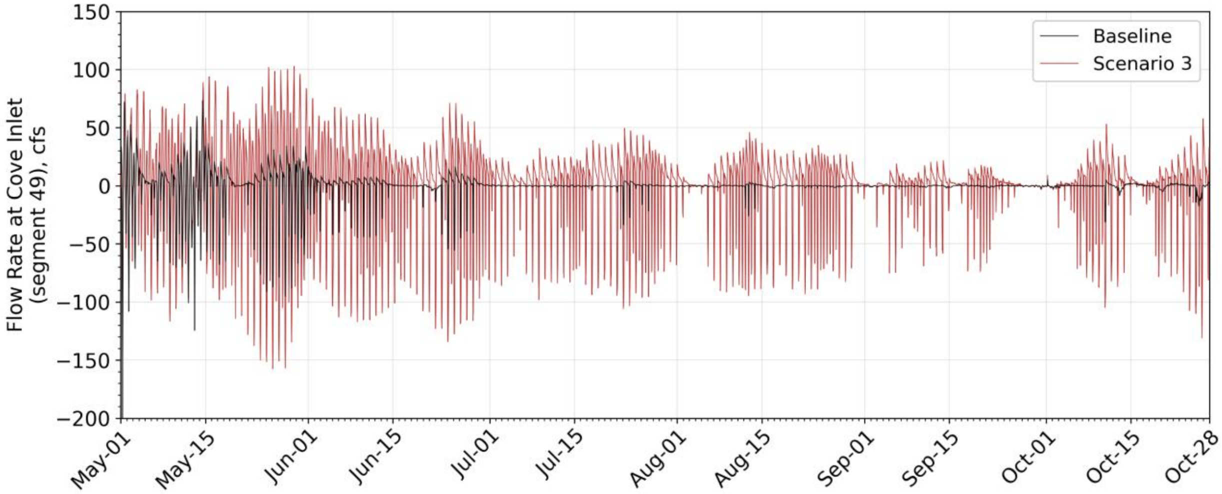

Figure 45. Comparison of Baseline and Scenario 3 flow rates at the Cove inlet (segment 49).

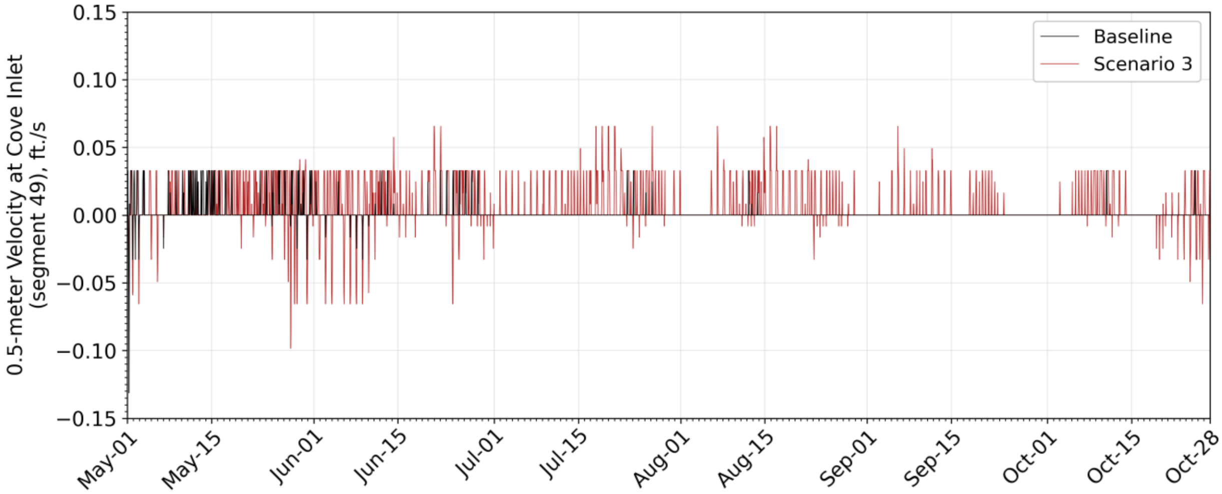

Figure 46. Comparison of Baseline and Scenario 3 0.5-meter depth water velocity at the Cove inlet (segment 49).

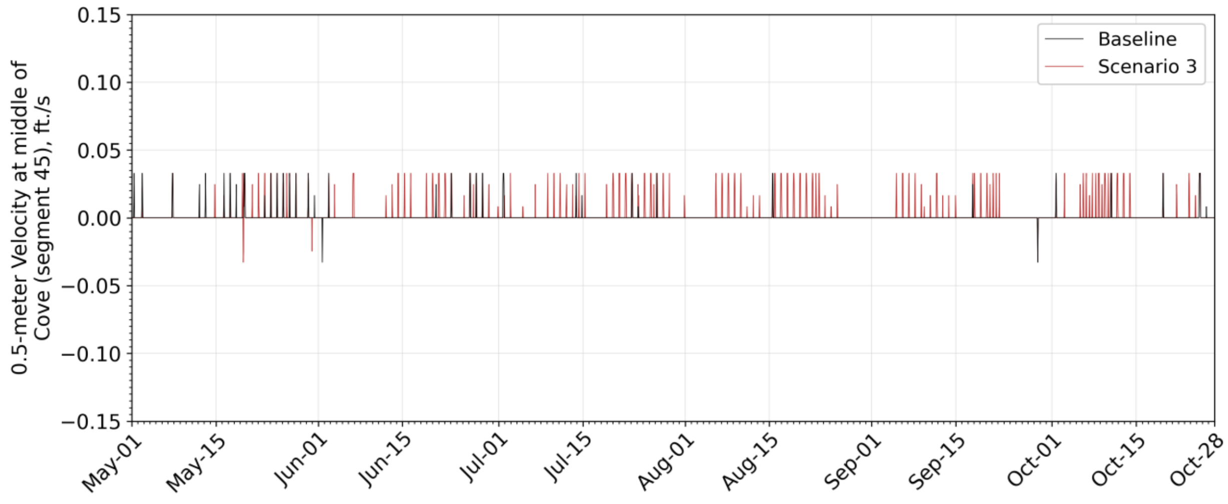

Figure 47. Comparison of Baseline and Scenario 3 0.5-meter depth water velocity at the deepest point (middle) of the Cove (segment 45).

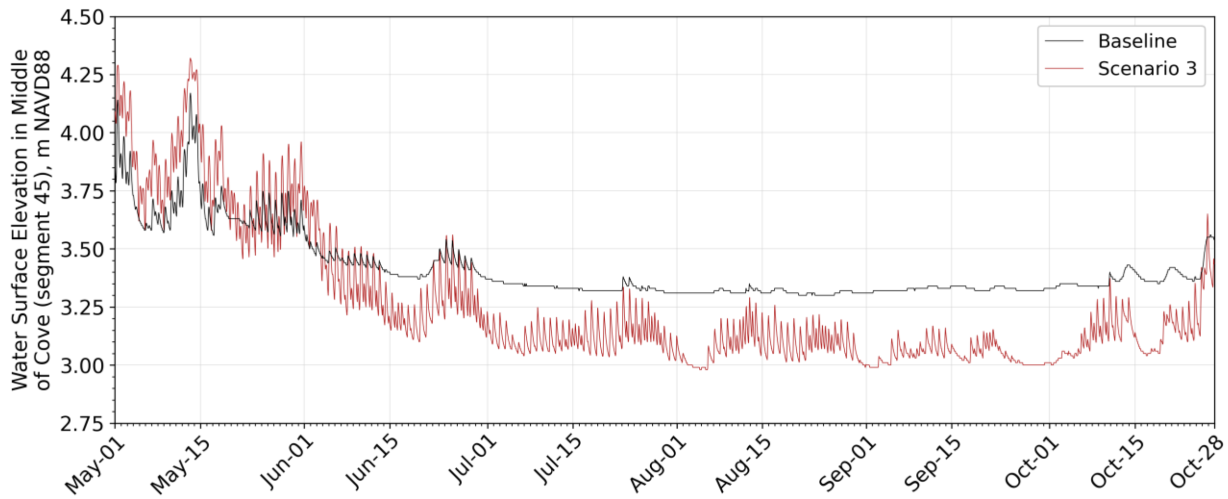

Figure 48. Comparison of Baseline and Scenario 3 water level elevations at the deepest point (middle) of the Cove (segment 45).

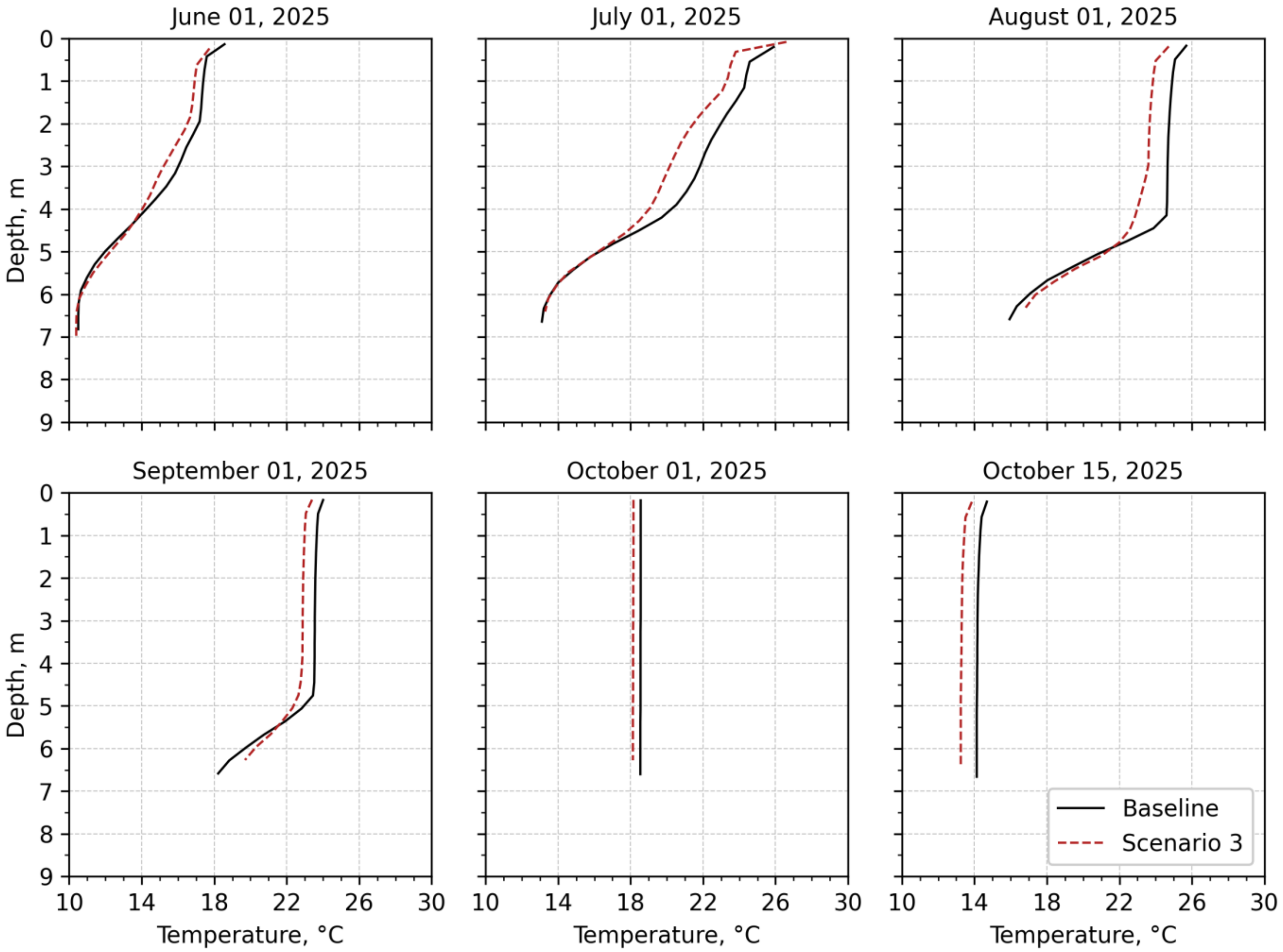

Figure 49. Comparison of Baseline and Scenario 3 water temperature profiles at the deepest point (middle) of Clackamette Cove (segment 45).

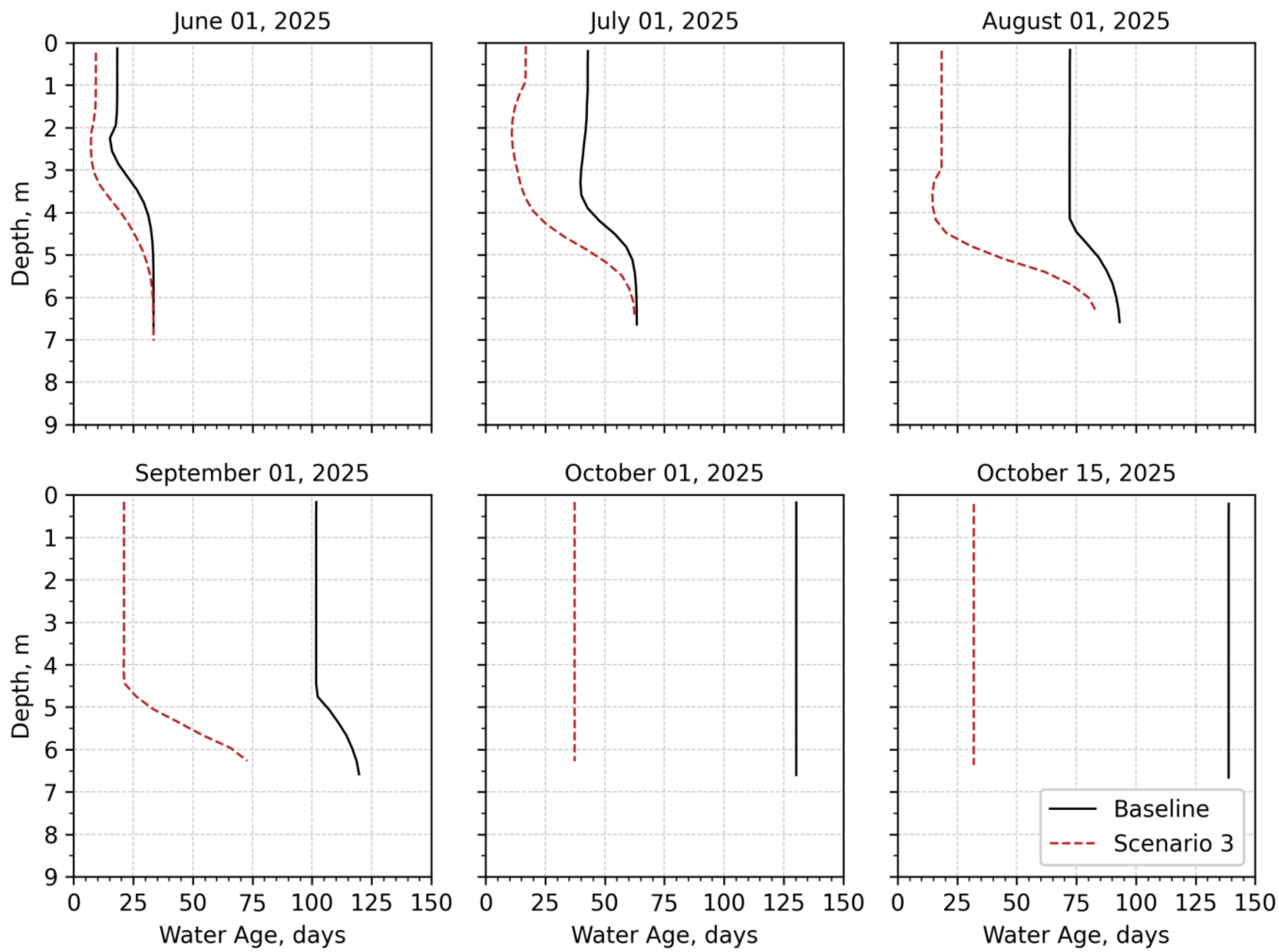

Figure 50. Comparison of Baseline and Scenario 3 water age profiles at the deepest point (middle) of Clackamette Cove (segment 45).

Scenario 4 – Add a 10 cfs Inflow from the River to the Cove

Figure 51 through Figure 56 present the Scenario 4 model output, simulating the addition of a 10 cfs connection from the Clackamas River to the Cove, alongside the Baseline model. The addition of the Cove-River connection increases the amount of water leaving the Cove, does not substantially change water velocities, increases water level elevations, and decreases water temperatures and water age compared to the Baseline. This change in water temperature and water age is substantially more pronounced in Scenario 4 than Scenarios 1 through 3.

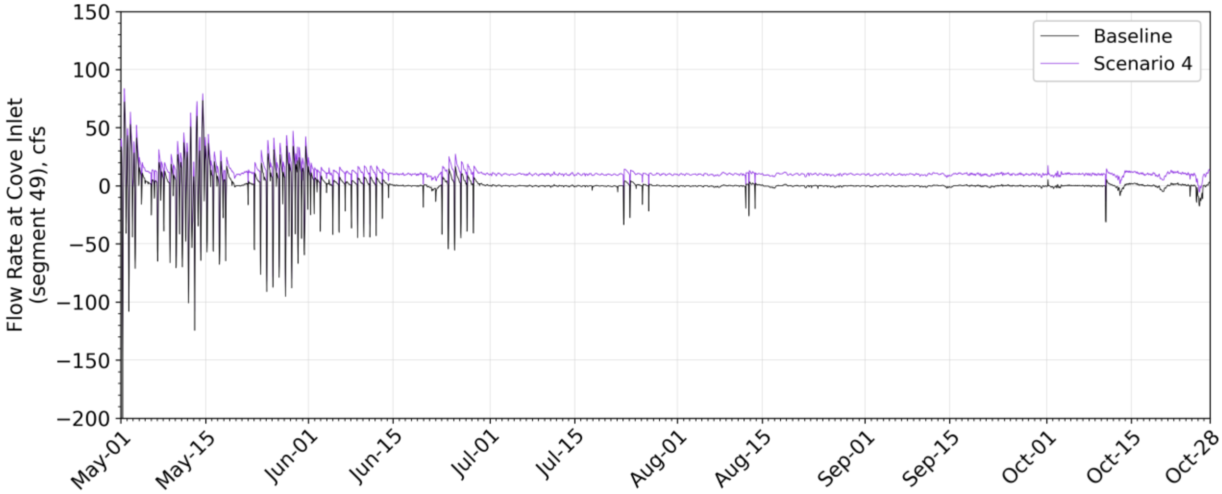

Figure 51. Comparison of Baseline and Scenario 4 flow rates at the Cove inlet (segment 49).

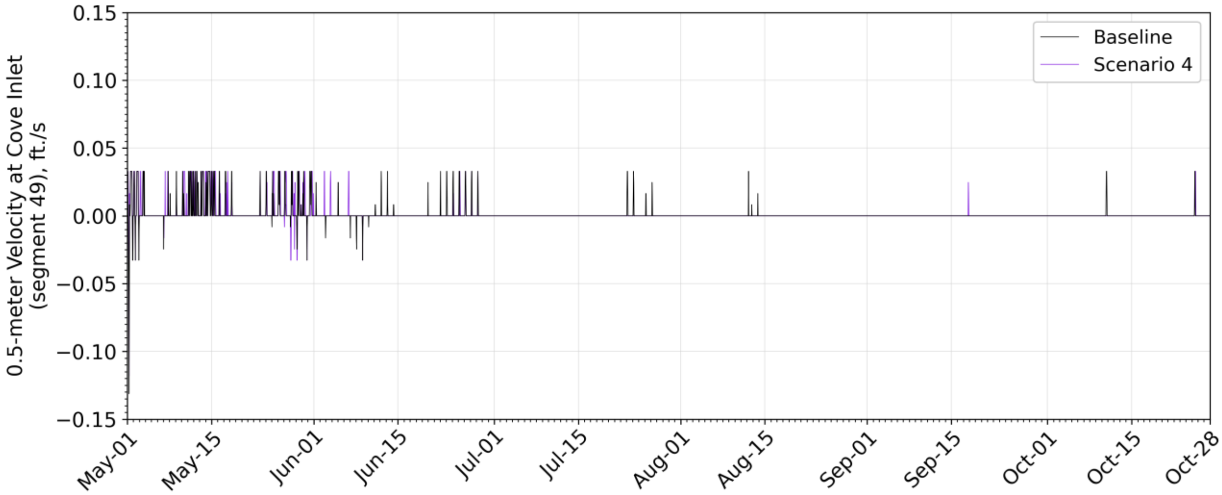

Figure 52. Comparison of Baseline and Scenario 4 0.5-meter depth water velocity at the Cove inlet (segment 49).

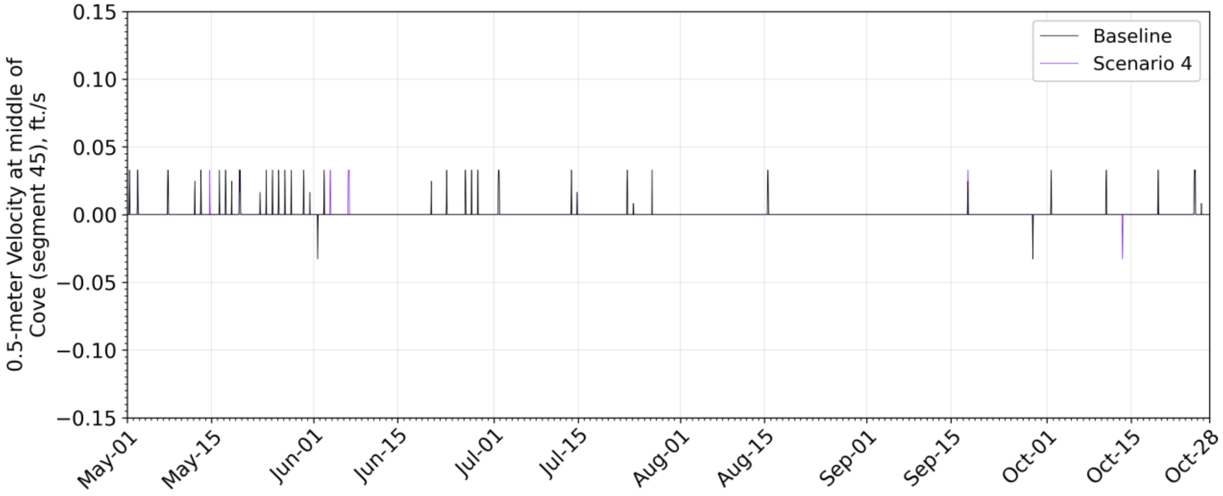

Figure 53. Comparison of Baseline and Scenario 4 0.5-meter depth water velocity at the deepest point (middle) of the Cove (segment 45).

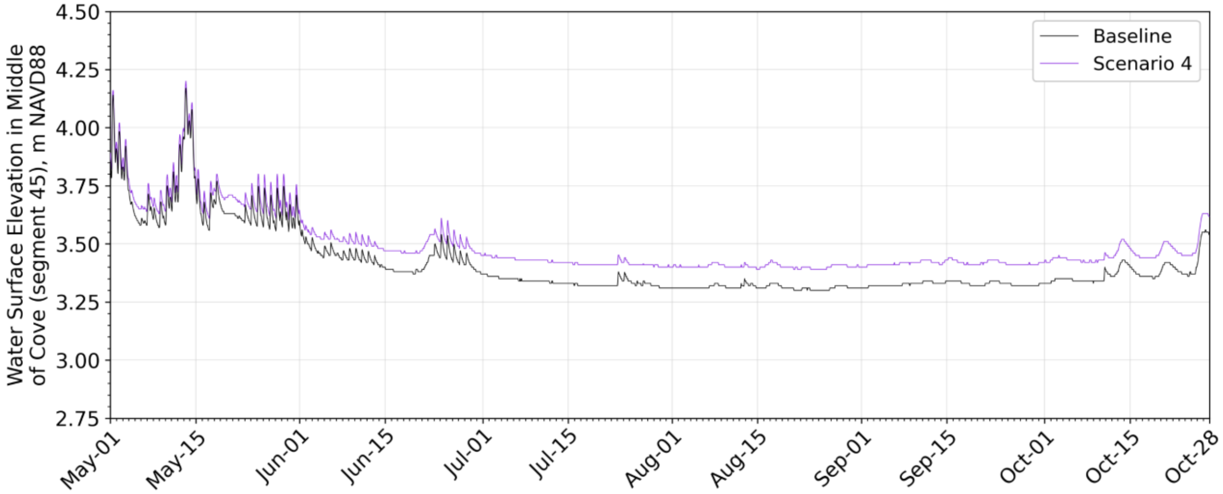

Figure 54. Comparison of Baseline and Scenario 4 water level elevations at the deepest point (middle) of the Cove (segment 45).

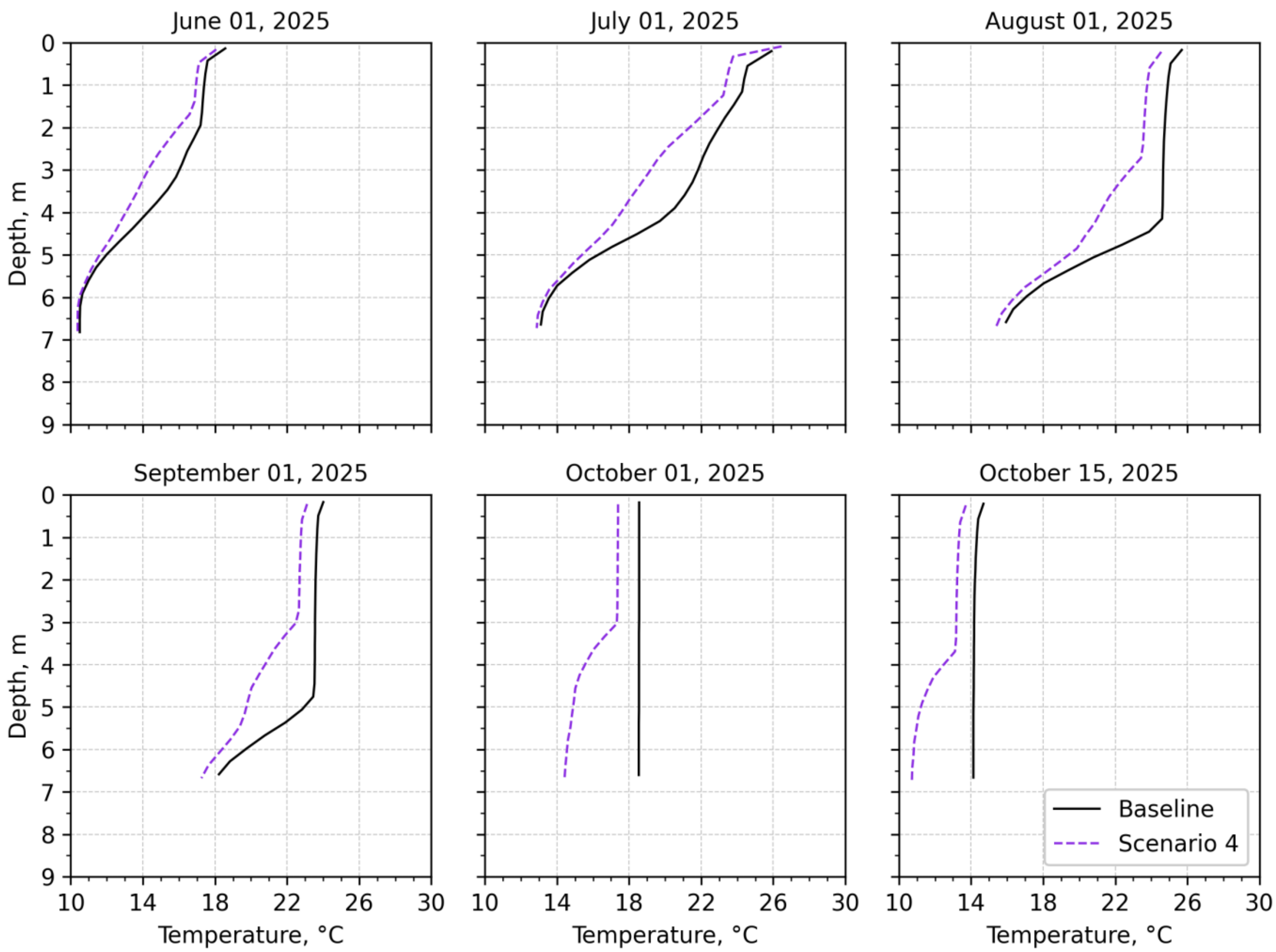

Figure 55. Comparison of Baseline and Scenario 4 water temperature profiles at the deepest point (middle) of Clackamette Cove (segment 45).

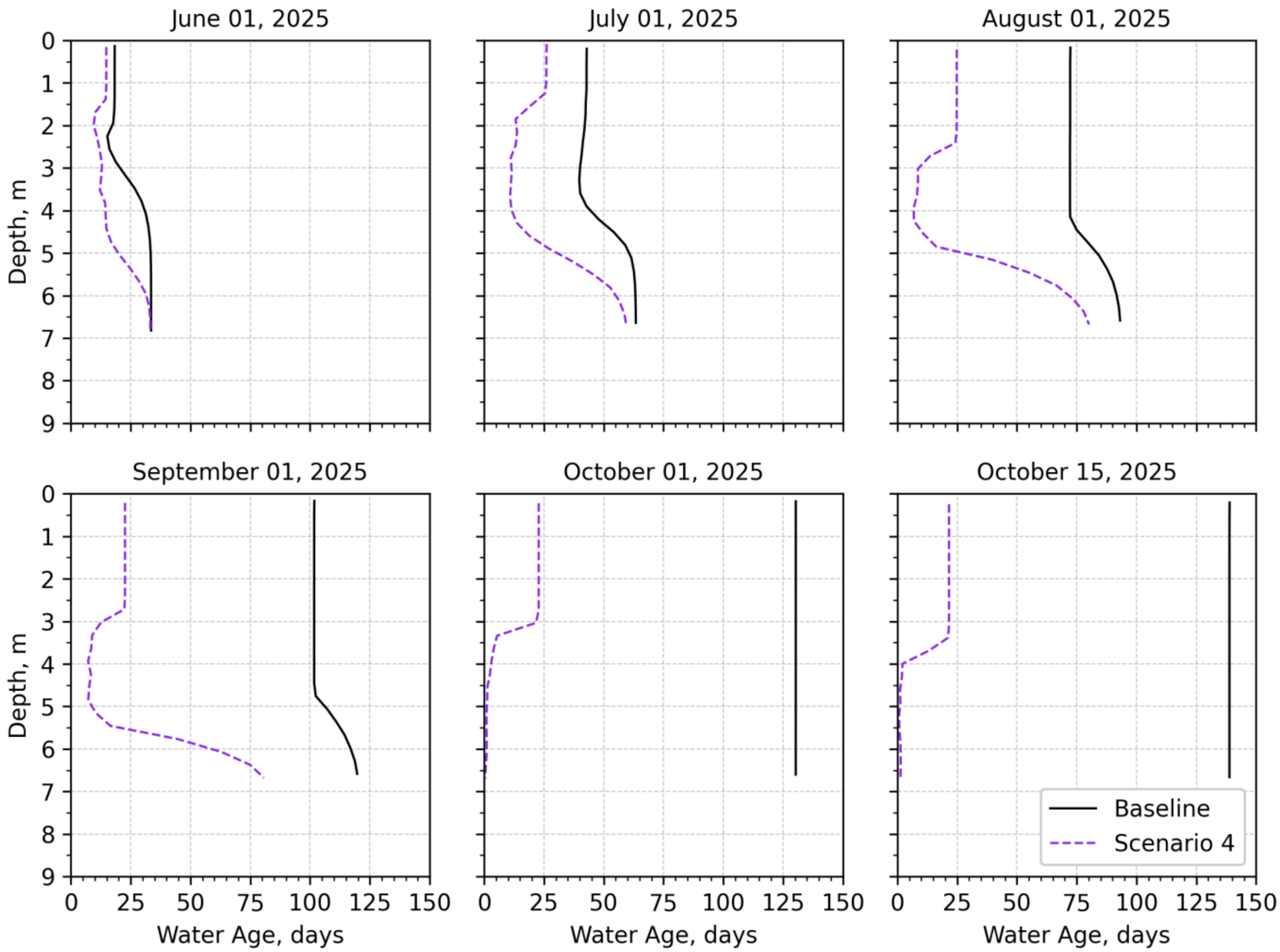

Figure 56. Comparison of Baseline and Scenario 4 water age profiles at the deepest point (middle) of Clackamette Cove (segment 45).

Scenario 5 – Add a 20 cfs Inflow from the River to the Cove

Figure 57 through Figure 62 present the Scenario 4 model output, simulating the addition of a 20 cfs connection from the Clackamas River to the Cove, alongside the Baseline model. The addition of the Cove-River connection increases the amount of water leaving the Cove, does not substantially change water velocities, increases water level elevations, and decreases water temperatures and water age compared to the Baseline. This change in water temperature and water age is more pronounced in Scenario 5 than Scenarios 1 through 4.

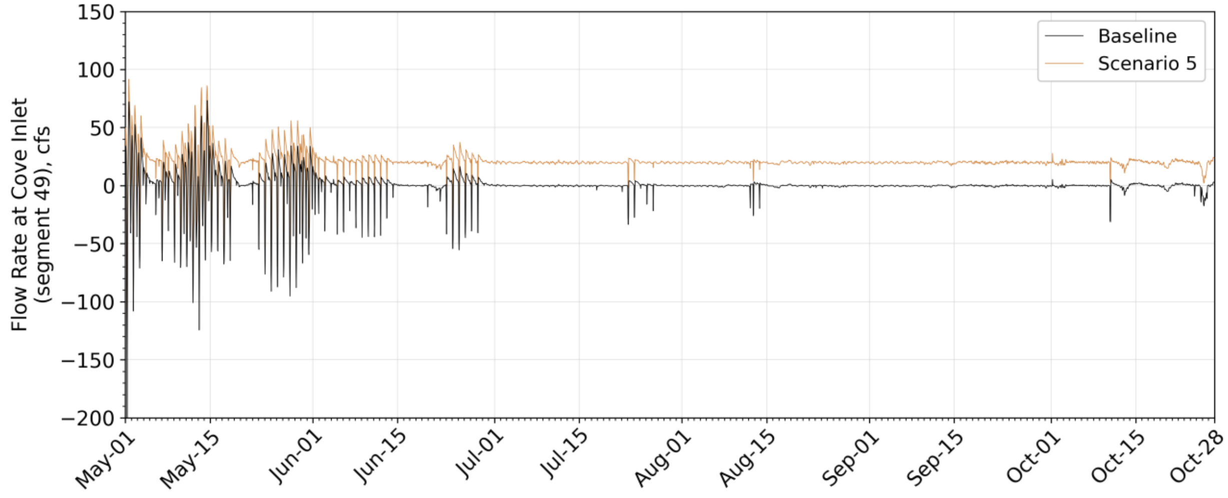

Figure 57. Comparison of Baseline and Scenario 5 flow rates at the Cove inlet (segment 49).

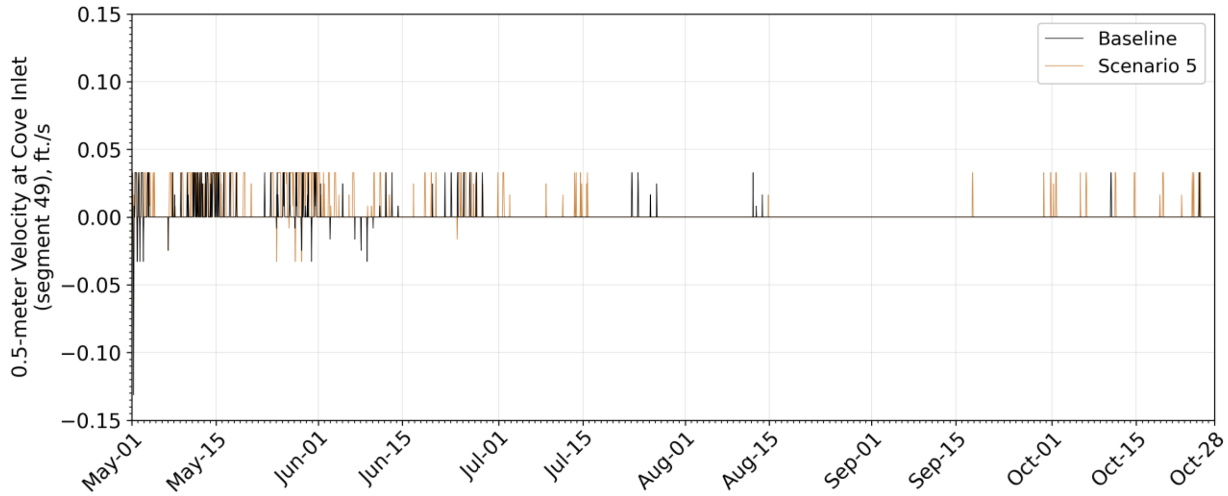

Figure 58. Comparison of Baseline and Scenario 5 0.5-meter depth water velocity at the Cove inlet (segment 49).

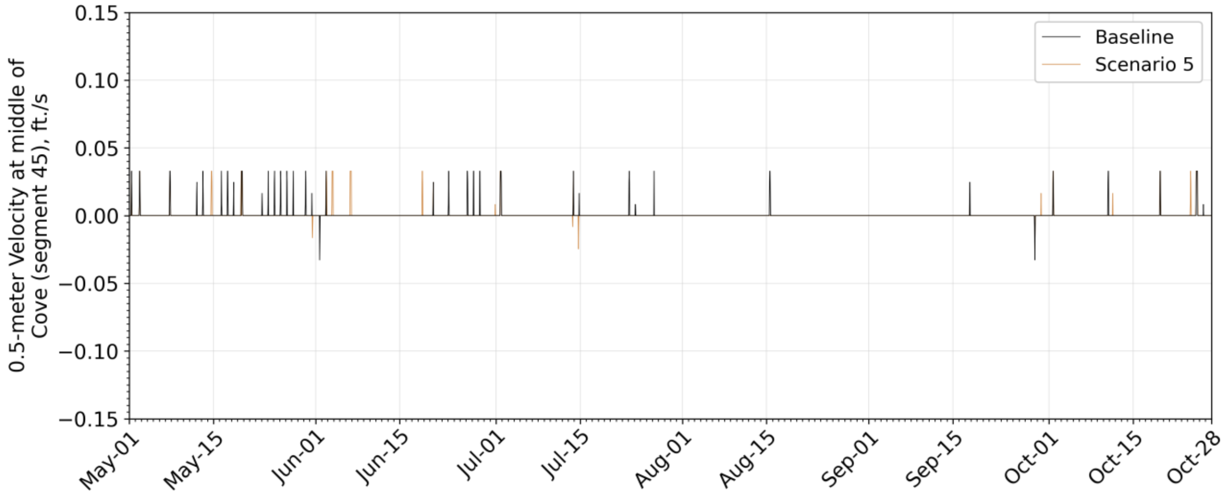

Figure 59. Comparison of Baseline and Scenario 5 0.5-meter depth water velocity at the deepest point (middle) of the Cove (segment 45).

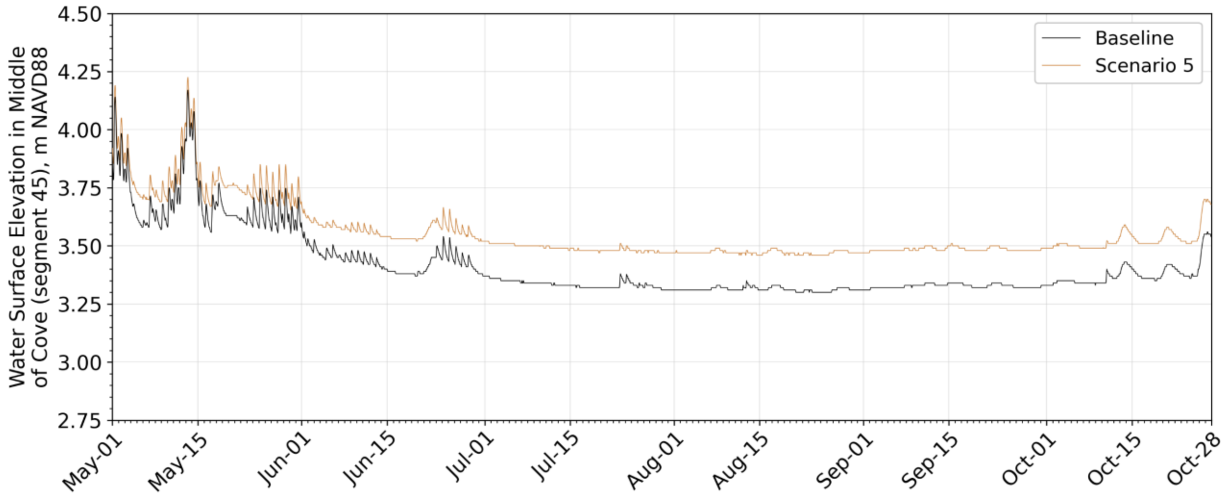

Figure 60. Comparison of Baseline and Scenario 5 water level elevations at the deepest point (middle) of the Cove (segment 45).

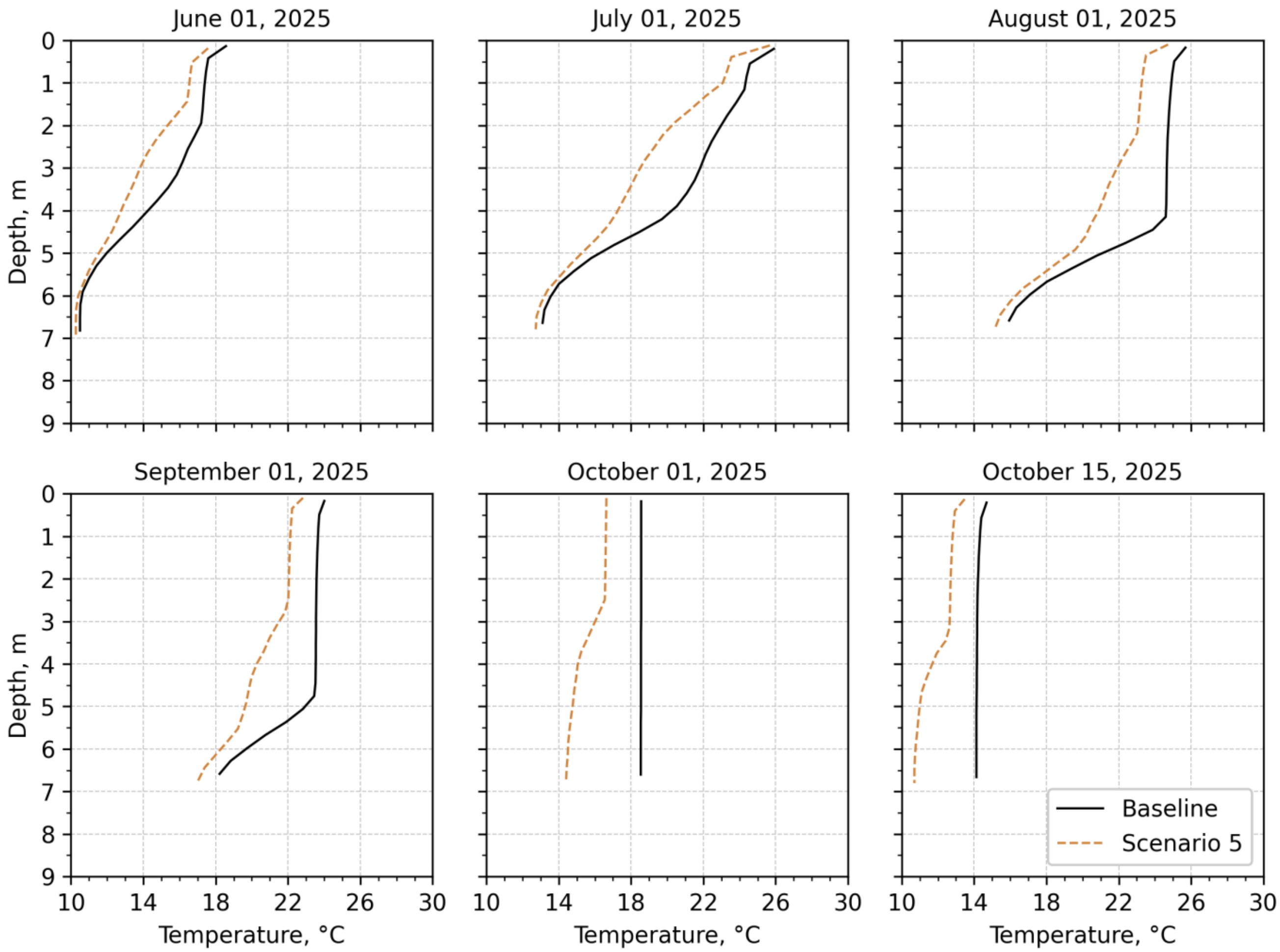

Figure 61. Comparison of Baseline and Scenario 5 water temperature profiles at the deepest point (middle) of Clackamette Cove (segment 45).

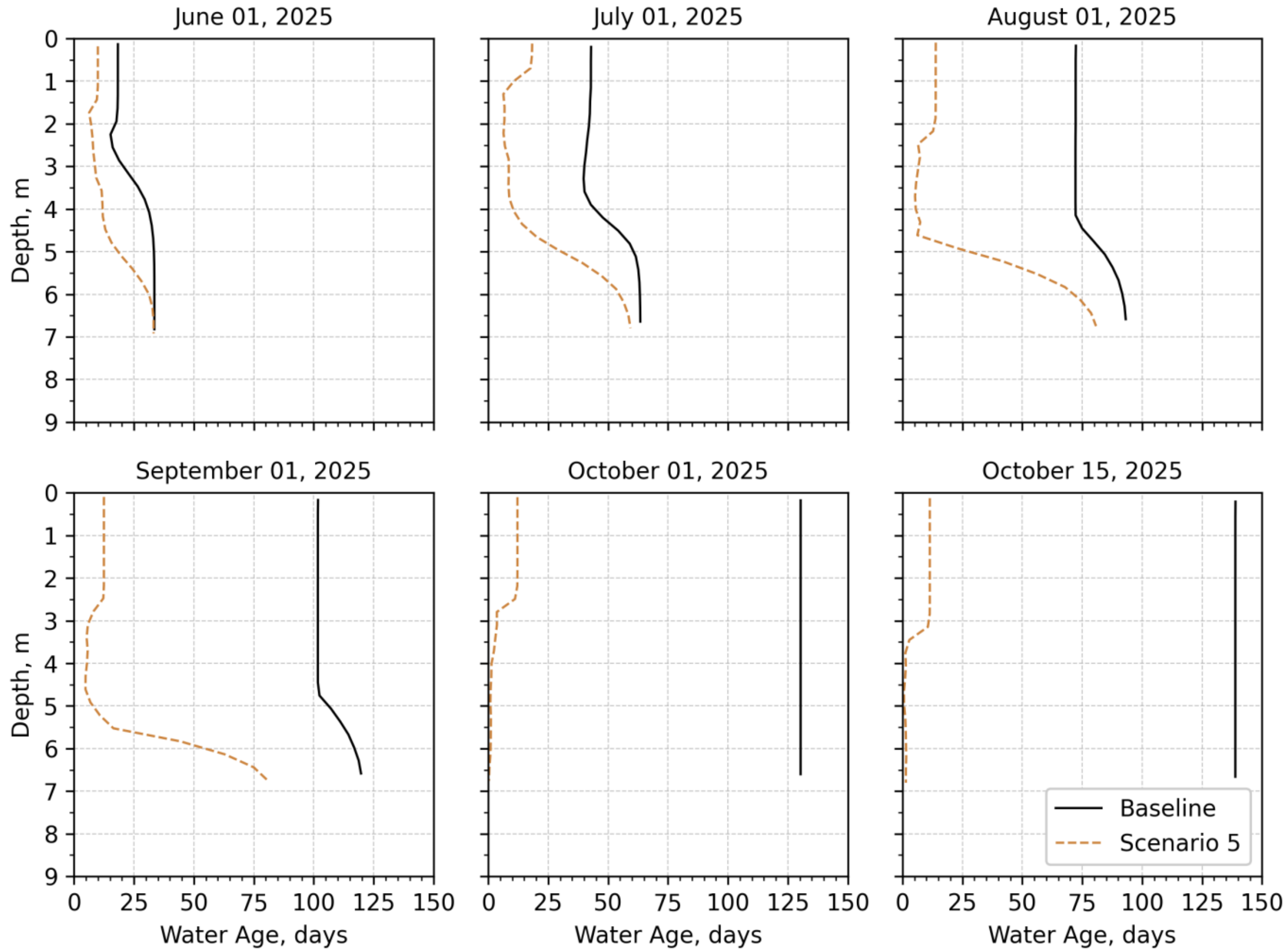

Figure 62. Comparison of Baseline and Scenario 5 water age profiles at the deepest point (middle) of Clackamette Cove (segment 45).

Scenario 6 – Combine Scenarios 3 and 5

Figure 63 through Figure 68 present the Scenario 6 model output, simulating the dredging and widening of the south channel of the Clackamas River gravel bar and the Cove inlet and the addition of a 20 cfs connection from the Clackamas River to the Cove, alongside the Baseline model. The combined changes to the gravel bar and Cove increases flow rates in and out of the Cove, increases water velocities, decreases water level elevations, and decreases water temperatures and water age compared to the Baseline. This change in water temperature and water age is more pronounced in Scenario 6 than the other scenarios.

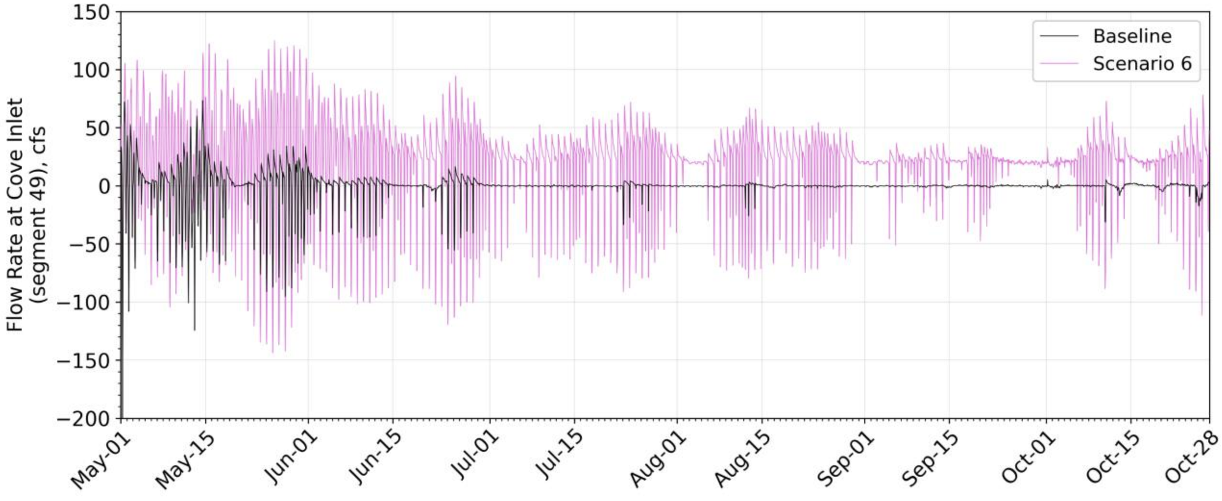

Figure 63. Comparison of Baseline and Scenario 6 flow rates at the Cove inlet (segment 49).

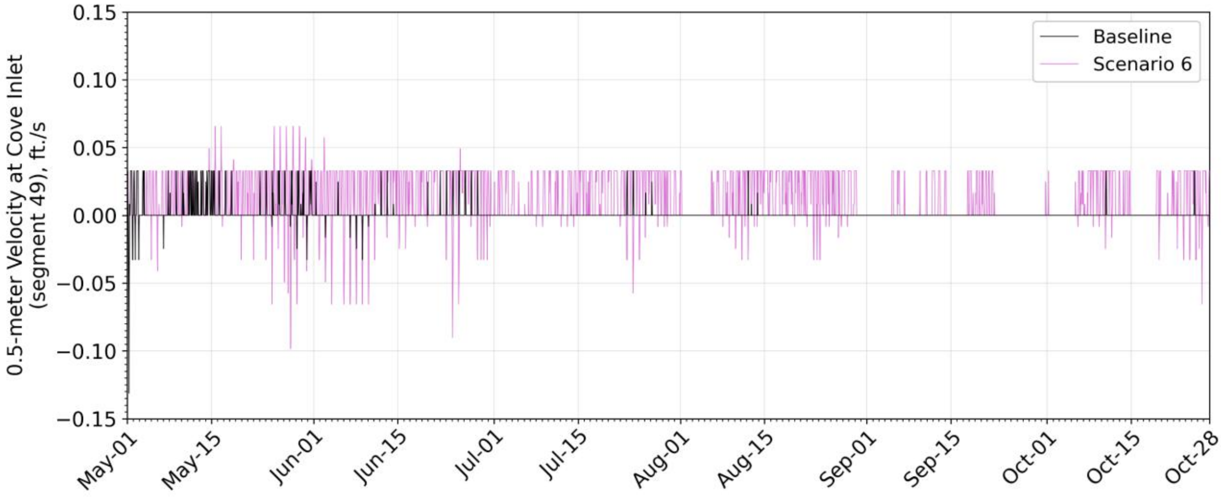

Figure 64. Comparison of Baseline and Scenario 6 0.5-meter depth water velocity at the Cove inlet (segment 49).

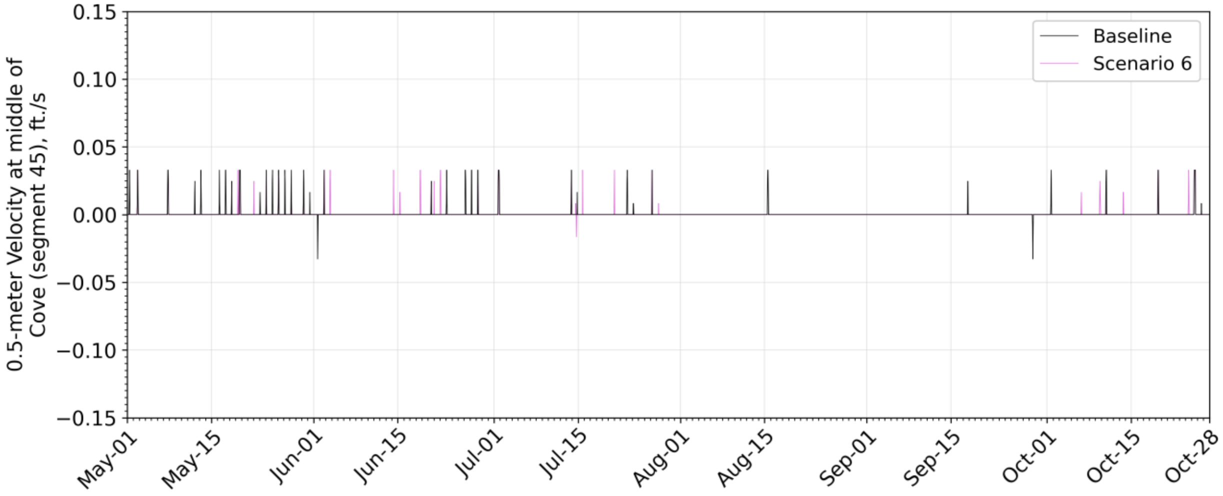

Figure 65. Comparison of Baseline and Scenario 6 0.5-meter depth water velocity at the deepest point (middle) of the Cove (segment 45).

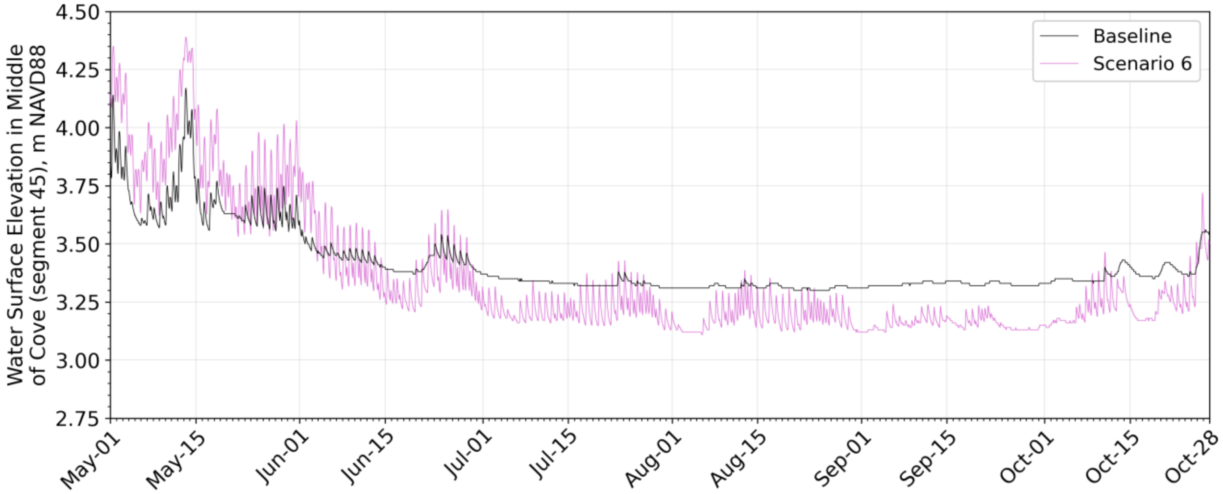

Figure 66. Comparison of Baseline and Scenario 6 water level elevations at the deepest point (middle) of the Cove (segment 45).

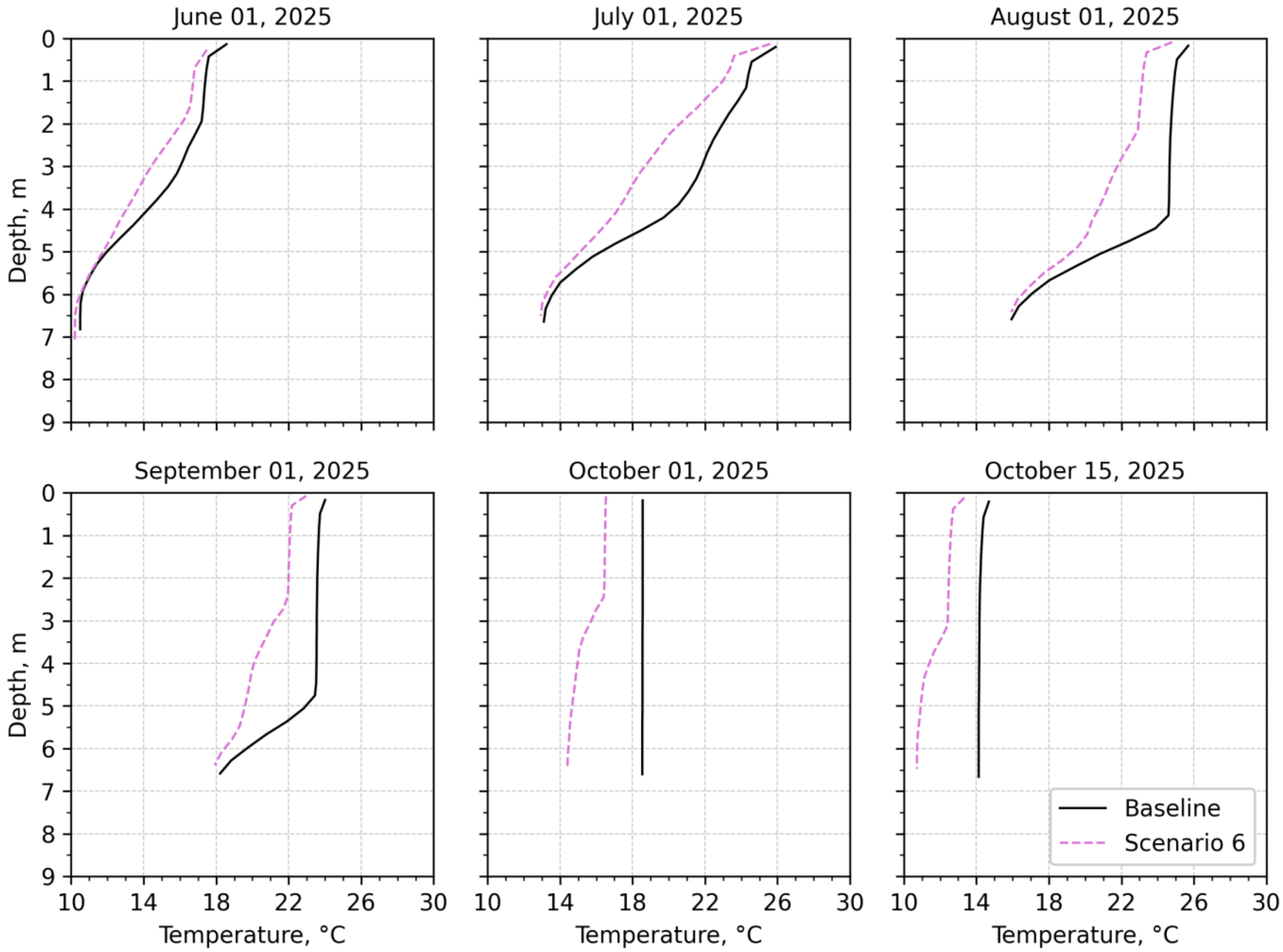

Figure 67. Comparison of Baseline and Scenario 6 water temperature profiles at the deepest point (middle) of Clackamette Cove (segment 45).

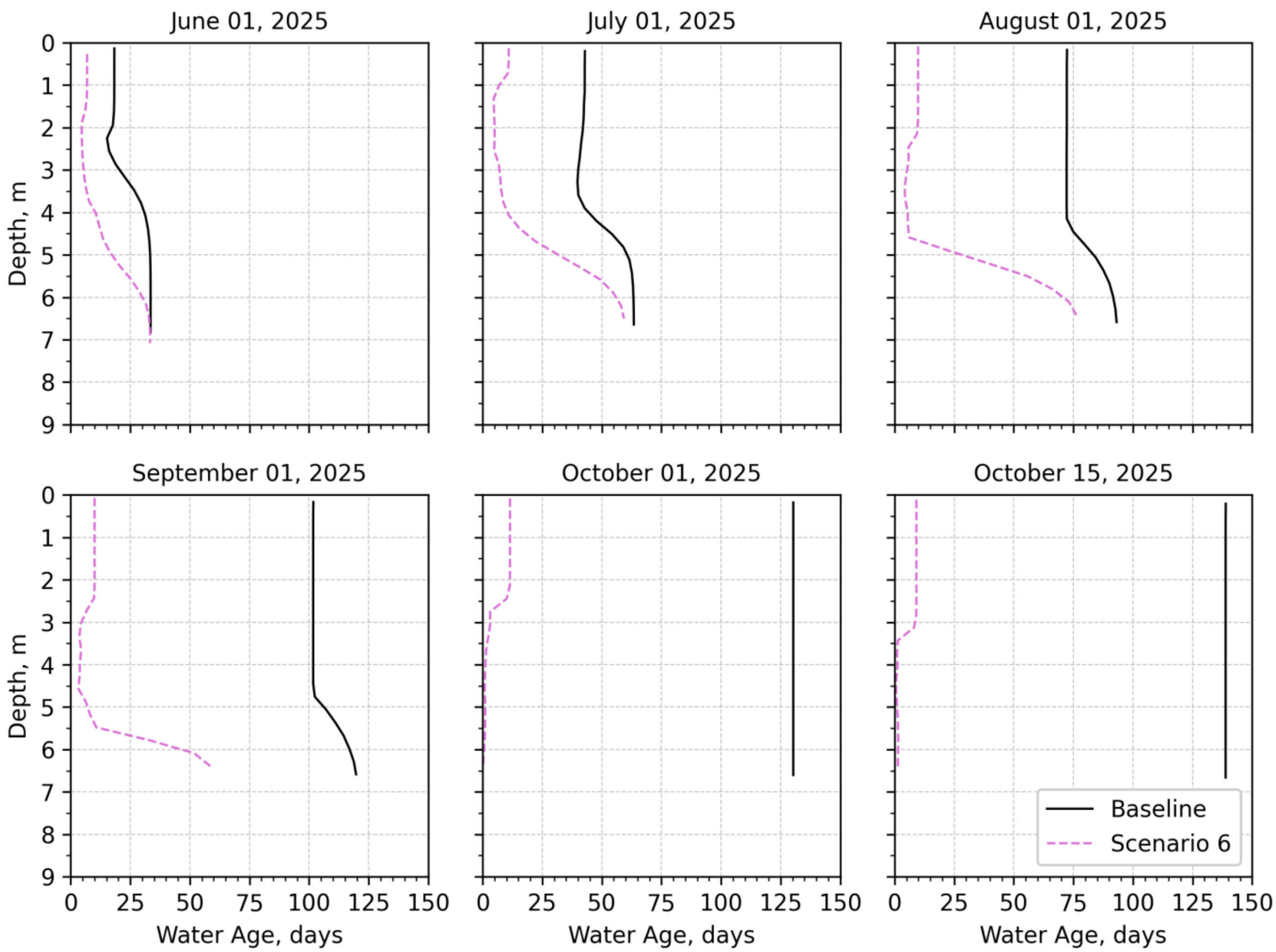

Figure 68. Comparison of Baseline and Scenario 6 water age profiles at the deepest point (middle) of Clackamette Cove (segment 45).

Summary

This report summarizes the development and calibration of the CE-QUAL-W2 hydrodynamic and temperature model for the lower Clackamas River and Clackamette Cove to evaluate the potential to improve water quality in the Cove through select management alternatives. The model was developed using a combination of data, including hydrodynamic data collected as part of the Clackamette Cove monitoring program, dedicated bathymetric surveys, and time series retrieved from local meteorological and streamflow monitoring sites.

The model was calibrated for the period of May 1 through October 28, 2025, using water level time series data collected in the Cove and River. This date range focuses on the period when the Cove transitions from being hydraulically connected to the Clackamas River and when it becomes isolated due to features of the gravel bar. A limited temperature calibration effort was also conducted to match Cove temperature timeseries and water profiles collected over the same monitoring duration. The W2 model captures overarching processes regulating the volume and temperature of water exchanged between the Clackamas River and Clackamette Cove, though additional water temperature calibration could result in better model-data agreement. Opportunities for further model refinement are outlined throughout the report. The W2 model, however, sufficiently represents the hydrodynamics (with a mean absolute water level error of less than 0.07 meters) and roughly captures the temperatures (with a mean absolute error less than 0.58°C for the temperature timeseries and 2.06°C for the Cove water temperature vertical profiles) of the two water bodies, while capturing the thermal stratification observed in the Cove.

Six model scenarios were developed for the CE-QUAL-W2 model to understand how the water exchange between the Clackamas River and Clackamette Cove could be improved through different management alternatives varying substantially in the degree of River and Cove modification. Dredging of the gravel bar (Scenario 1 and 2) as well as the Cove inlet (Scenario 3) by two (2) feet resulted in a reduction in water age, suggesting increased flushing of the Cove, but failed to substantially disrupt the thermal stratification of the water column. Scenarios 4 and 5, simulating the respective addition of a 10 cfs and 20 cfs tributary flowing from the River to the Cove, resulted in substantial reductions in water age compared to the Baseline (by over 100 days in mid-October) but a limited reduction in water temperatures (maximum difference of 2.25°C) and thermal stratification. Scenario 6 similarly did not demonstrate a substantial disruption in thermal stratification.

None of the management alternatives mitigated summer stratification which would be required to decrease internal phosphorous loading from Cove sediments which can promote summer cyanobacteria blooms. It is uncertain whether increased Cove flushing, without disrupting thermal stratification that promotes sediment phosphorus release, would cycle sufficient water to improve overall water quality by preventing algal bloom formation and accumulation during the summer.

The W2 baseline and Scenario model files are provided in a zipped folder alongside this technical report.

References

Annear, R. L., McKillip, M. L., Khan, S. J., Berger, C. J., and Wells, S. A. (2004). Willamette River Basin temperature TMDL model—Boundary conditions and model setup: Portland, Oregon, Portland State University, Department of Civil and Environmental Engineering. Technical Report EWR-01-04, 2004. Available online at http://archives.pdx.edu/ds/psu/12163

Annear Water Resources, AWR (2026). *Clackamette Cove and Clackamas River Bathymetric Data – Survey and Results* [technical memorandum].

Geosyntec Consultants (2016). *Lower Clackamas River Model Extension: Hydrodynamic Model Extension, Calibration, and Scenarios* [technical report].

Wells, S. A. (2023). *CE-QUAL-W2: A Two-Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model, Version 4.5, User Manual*, Department of Civil and Environmental Engineering, Portland State University, 1,106 pp.

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Clackamette Cove Water Quality & Alternatives Evaluation Phase 2

Oregon City Urban Renewal Commission – May 6, 2026

Today's Objectives

1. Summarize data collection findings
2. Review CE-QUAL-W2 model results and management implications
3. Review water quality management alternatives for Clackamette Cove
4. Present recommended management approach

Summer Gravel Bar Dynamics

1	As river levels decline, the gravel bar becomes exposed, reducing and eventually cutting off inflow to the Cove
2	Majority of the river flow is confined to the channel north of the gravel bar
3	The gravel bar controls Cove water levels and isolates the Cove from upstream flow and downstream tidal fluctuations
4	The Cove functions as a losing system and water levels decline from about 12 to 10 feet

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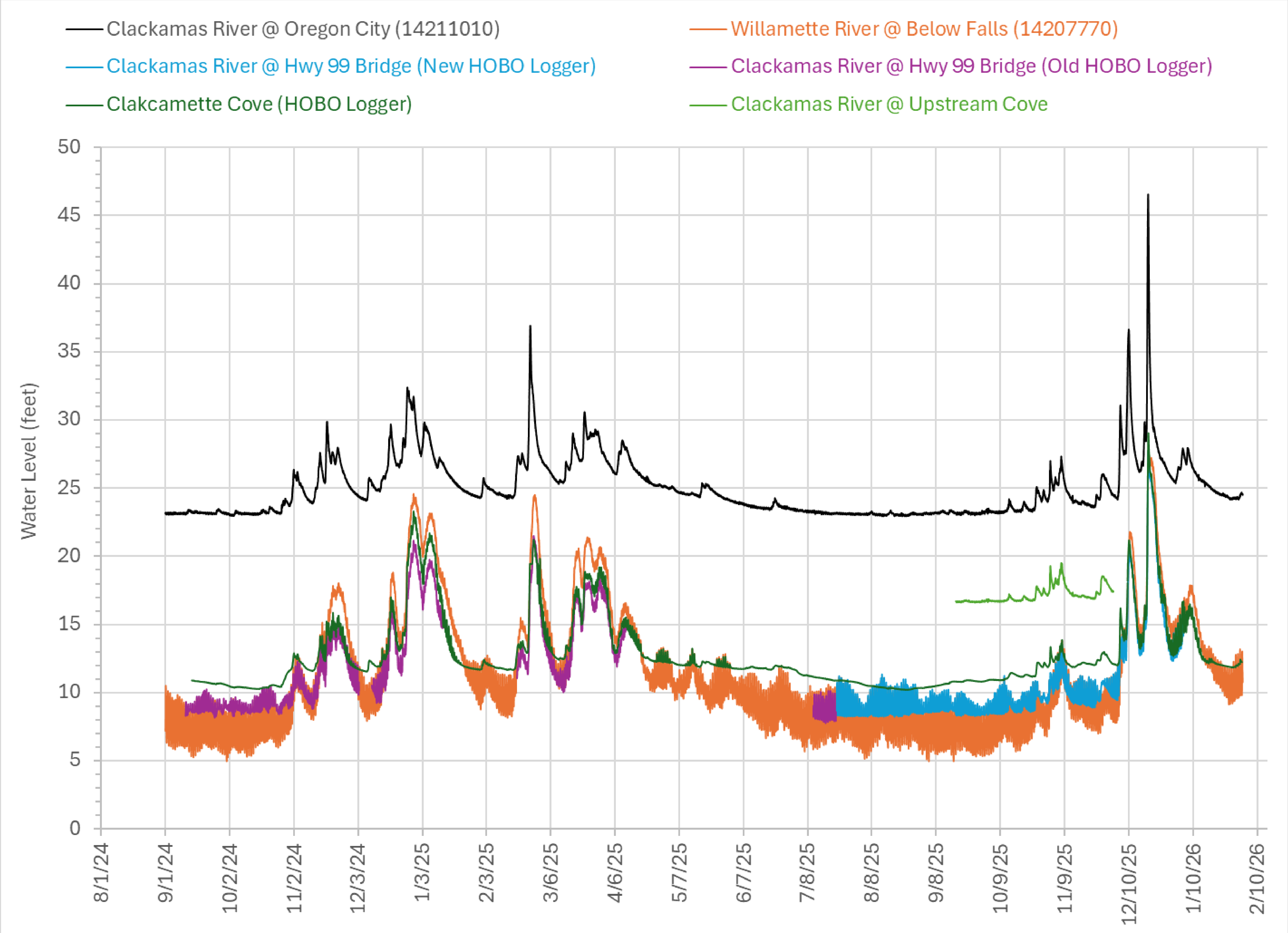
Water Level Dynamics



1	At Hwy 99 Bridge, summer water levels show daily fluctuations (~0.5–2.8 ft) consistent with tidal forcing from the Willamette River
2	The Cove does not exhibit these summer oscillations because the gravel bar reduces and eventually cuts off inflow
3	Even when hydraulically connected, tidal fluctuations in the Cove are <1 ft
4	Larger water level changes in the Cove are driven by increases in Clackamas River flow, not downstream tidal forcing

Clackamette Cove Phase 2

Cove Summer Water Quality Conditions

Thermal stratification develops and persists

- Strong surface to bottom temperature gradients, limiting vertical mixing.

Low dissolved oxygen at depth

- Stratification isolates bottom waters, leading to oxygen depletion.

Internal phosphorus release from sediments

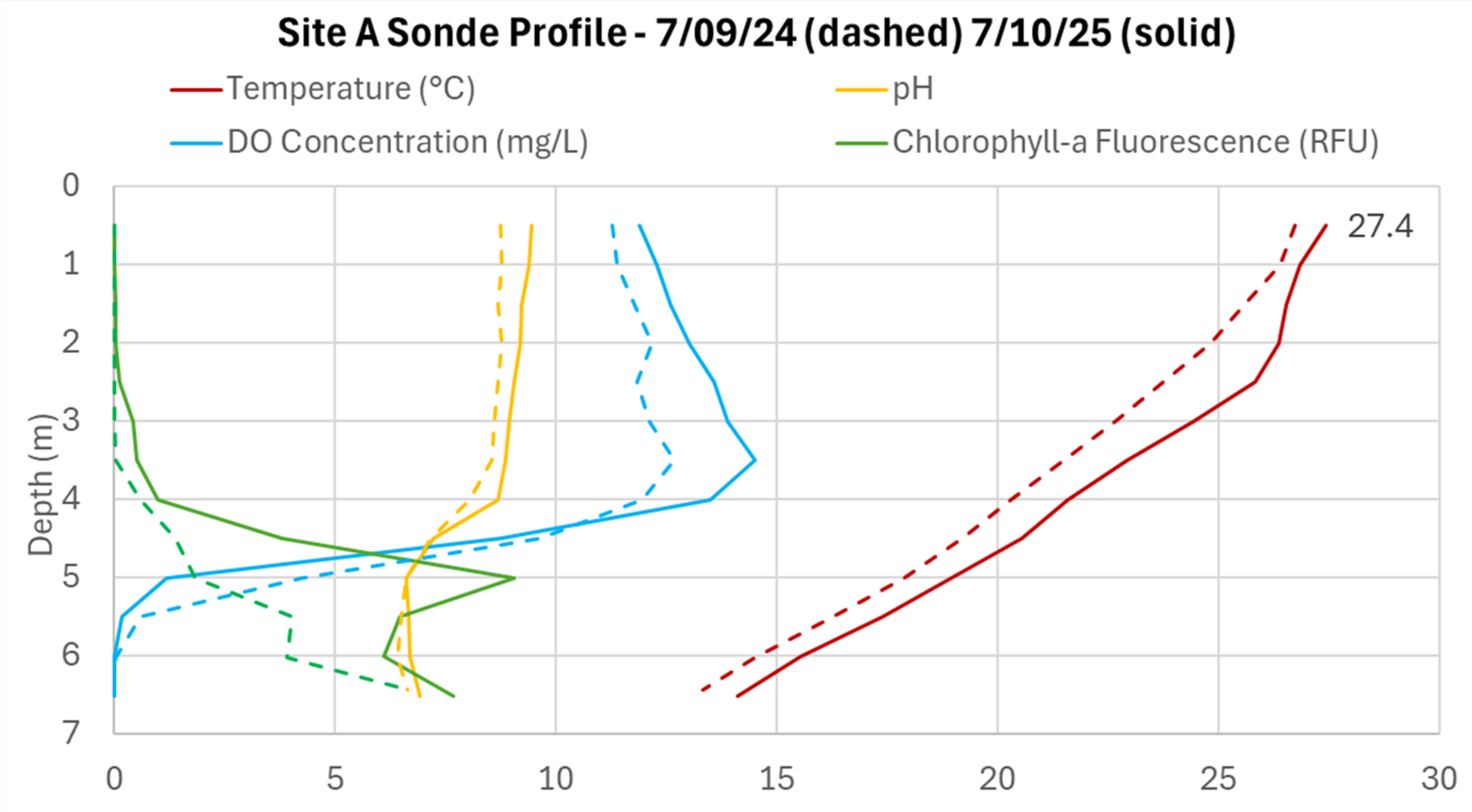
- Low oxygen conditions trigger sediment phosphorus release. Surface phosphorus levels are low.

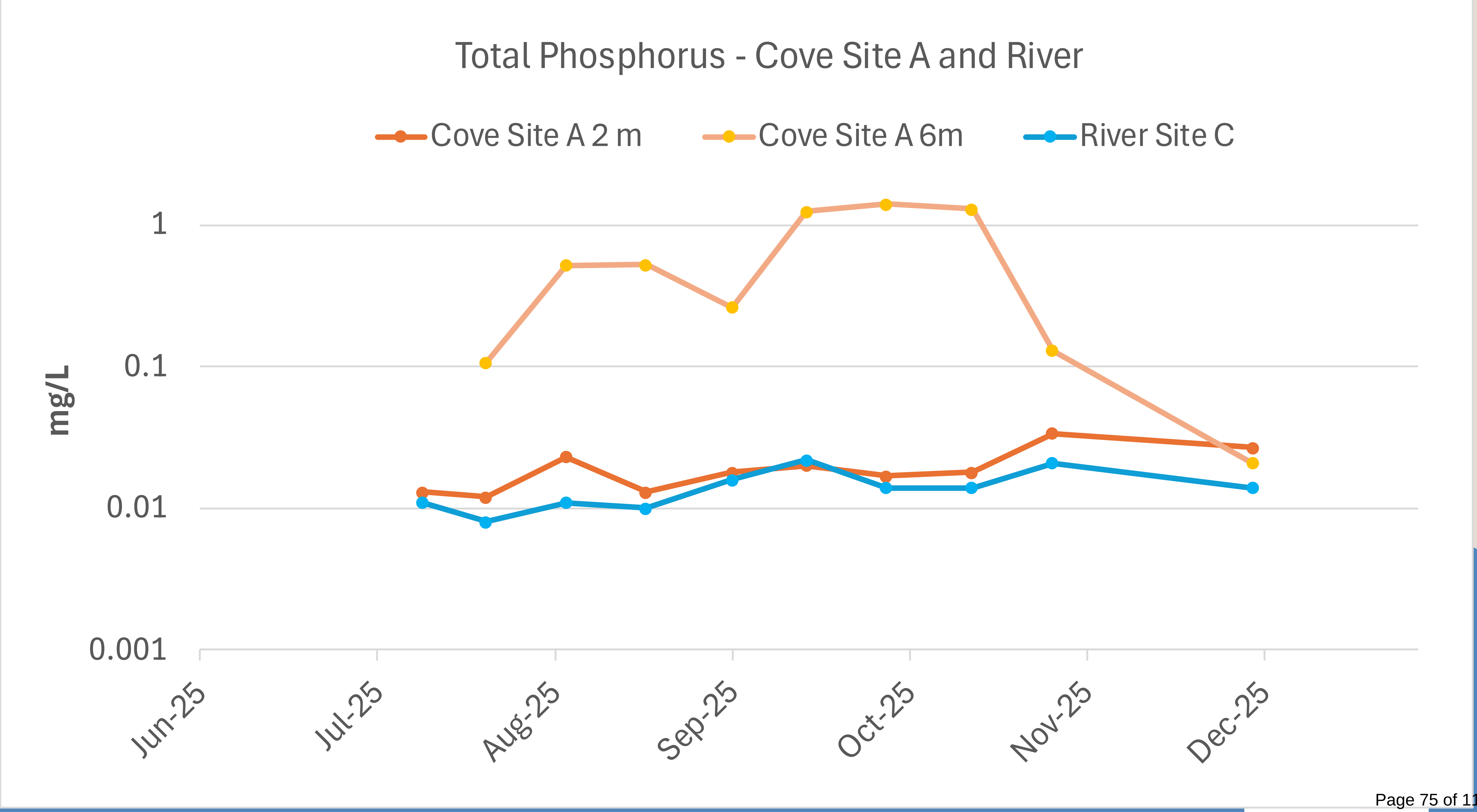
Cyanobacteria dominate algal community

- Algal biomass is dominated by cyanobacteria (primarily *Anabaena planctonica*)

Water quality driven by internal processes

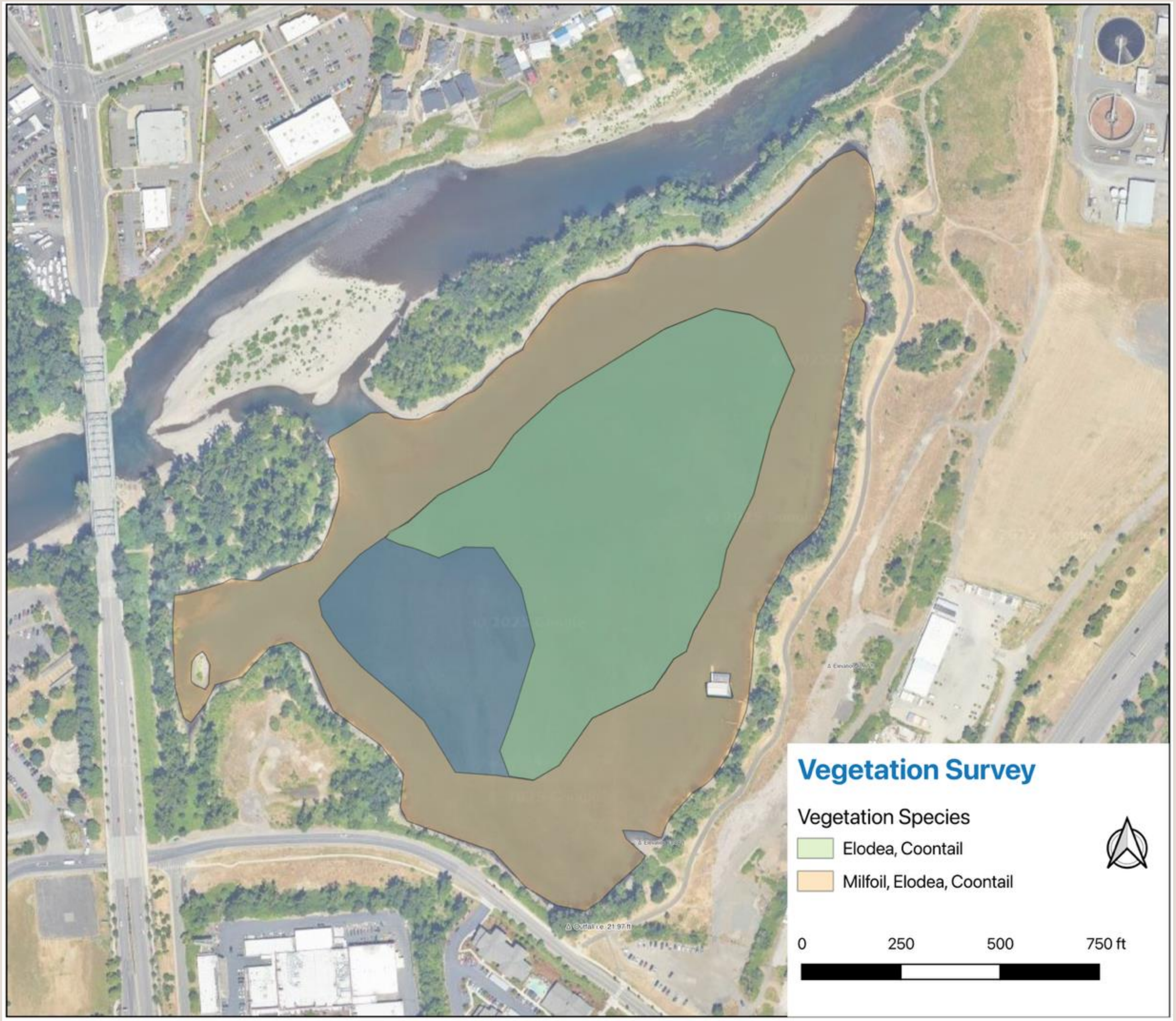
- Conditions controlled by stratification, nutrient release, and biological response rather than external inputs.





Vegetation Surveys

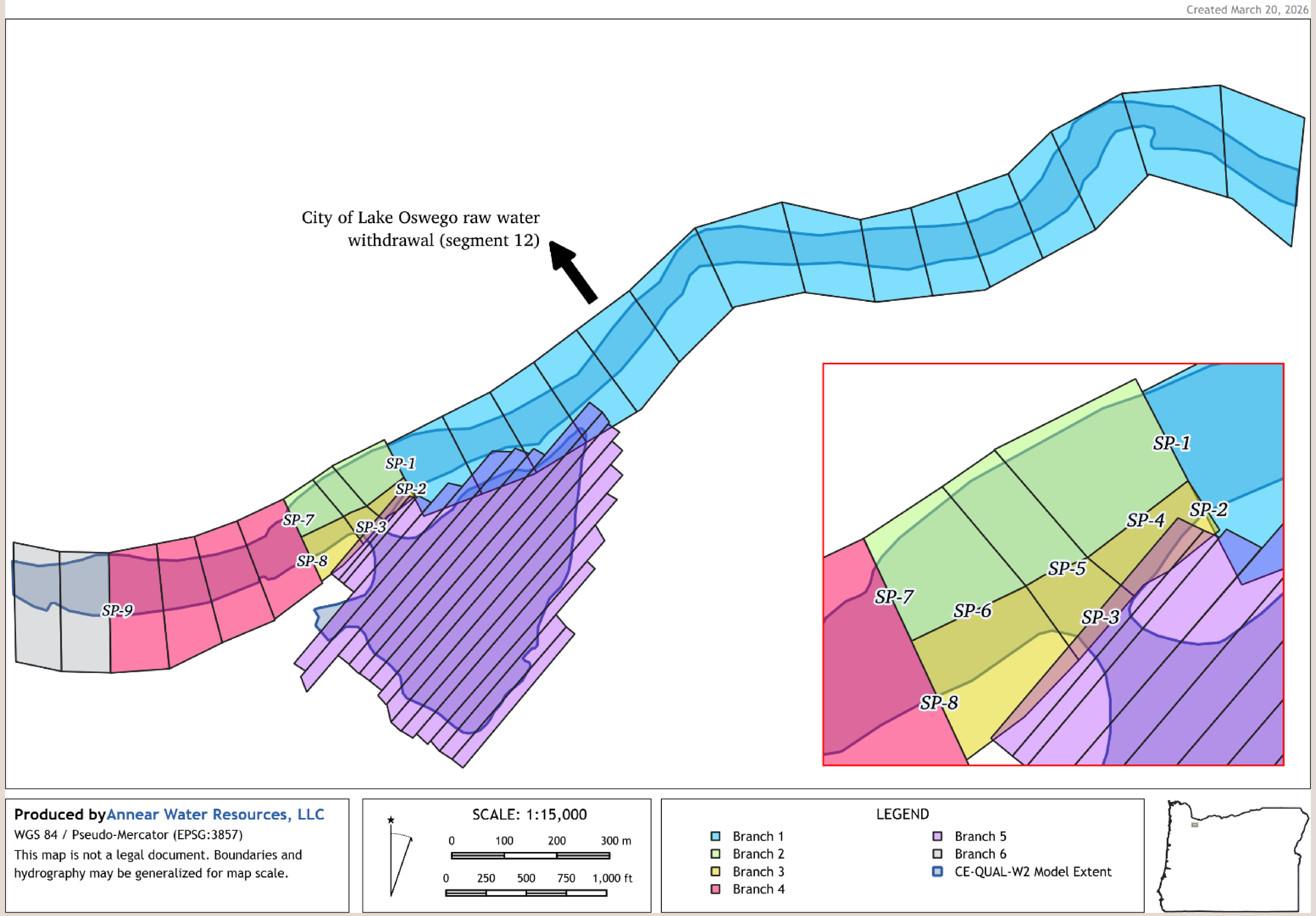
- Heavy vegetation at peak biomass with dense surface canopy
- Non-native Eurasian watermilfoil dominates shallow perimeter and forms surface mats
- Native species (coontail, Canadian waterweed) found in deeper areas
- Dense vegetation:
  - Reduces circulation
  - Can contribute to degraded water quality
  - Impairs recreation and access
  - Reduces visual appeal

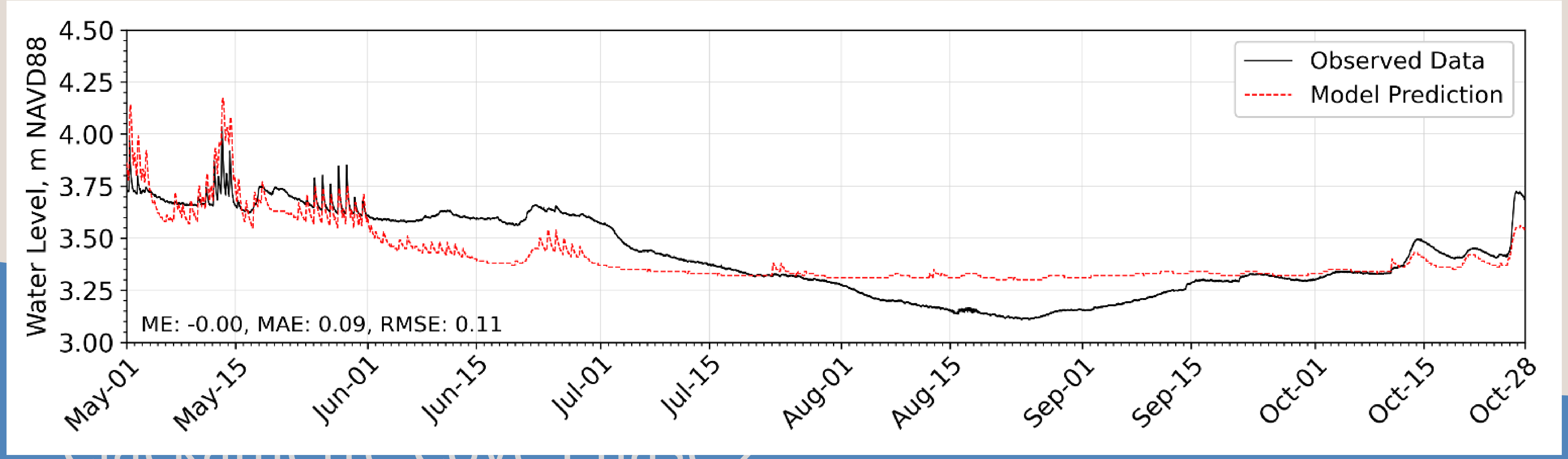


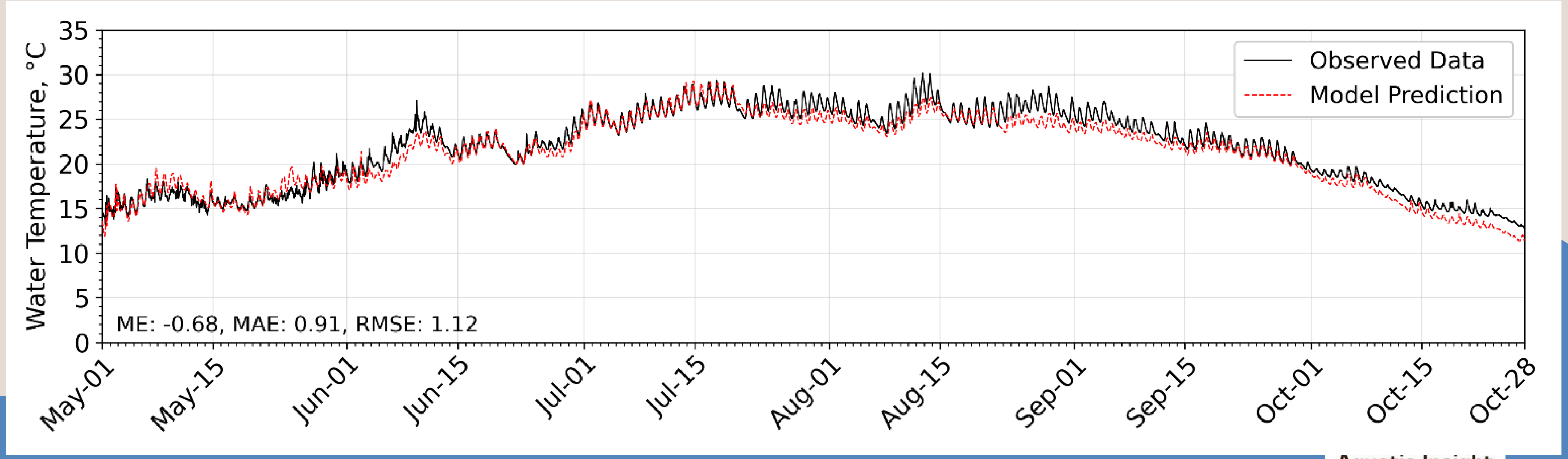
Common name	Latin name	Location	Native species
Canadian waterweed	Elodea canadensis	Throughout	Yes
Coontail	Ceratophyllum demersum	Throughout, but primarily in deeper areas	Yes
Curlyleaf pondweed	Potamogeton crispus	Present, but extent unknown	No
Eurasian watermilfoil	Myriophyllum spicatum	Throughout the shallow shoreline areas	No – ODA Class B weed

Hydrodynamic Model Overview & Calibration

- CE-QUAL-W2 two-dimensional hydrodynamic and temperature model simulating the cove and 1.67 miles of the lower Clackamas River
- Simulation period: May–October 2025, capturing the full summer Cove isolation period
- Field-collected data used to calibrate water levels and validate water temperatures
- Good water level and temperature agreement
- Baseline model used to compare against alternative scenarios



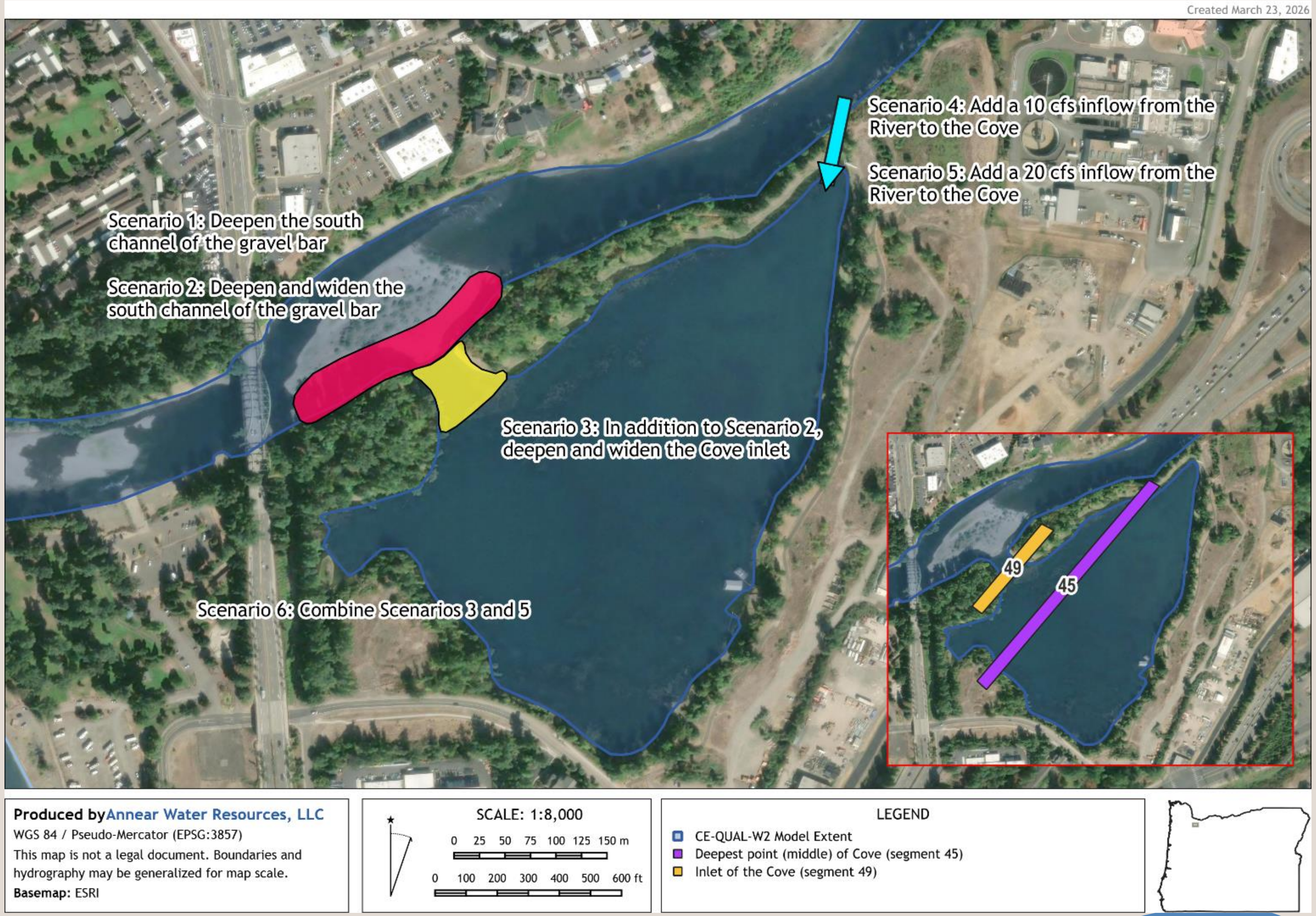




Six Alternatives Tested

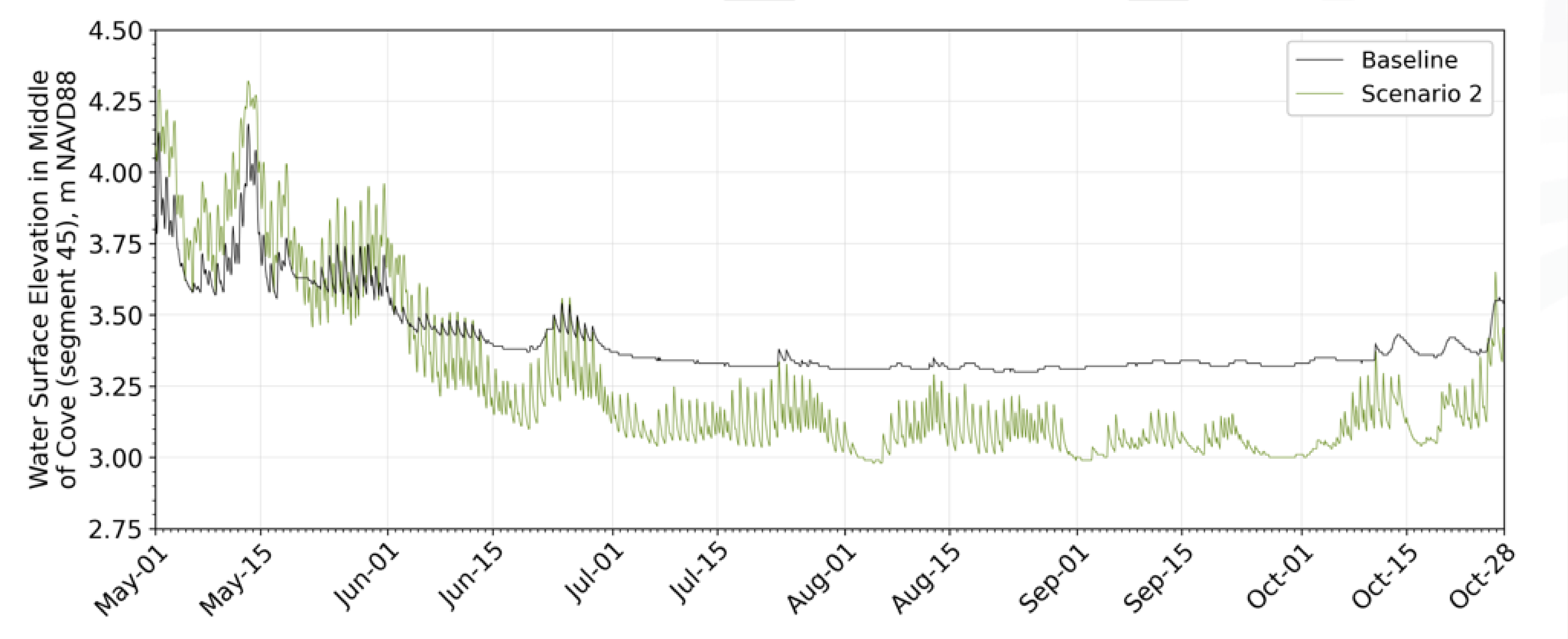
Scenario	Description
S1	**Deepen South Channel** Gravel bar south channel deepened 2 ft to extend river-cove summer connectivity
S2	**Deepen + Widen South Channel** South channel deepened 2 ft and widened 30 ft
S3	**Deepen Channel + Cove Inlet** Scenario 2 plus deepening of Cove inlet by 2 ft
S4	**New 10 cfs River Inflow** Direct connection from the River into the northeast corner of the Cove at 10 cfs
S5	**New 20 cfs River Inflow** Direct connection from the River into the northeast corner of the Cove at 10 cfs
S6	**Combined Scenario 3 + Scenario 5** South channel deepening plus 20 cfs new river connection

cfs= cubic feet per second; ft= feet



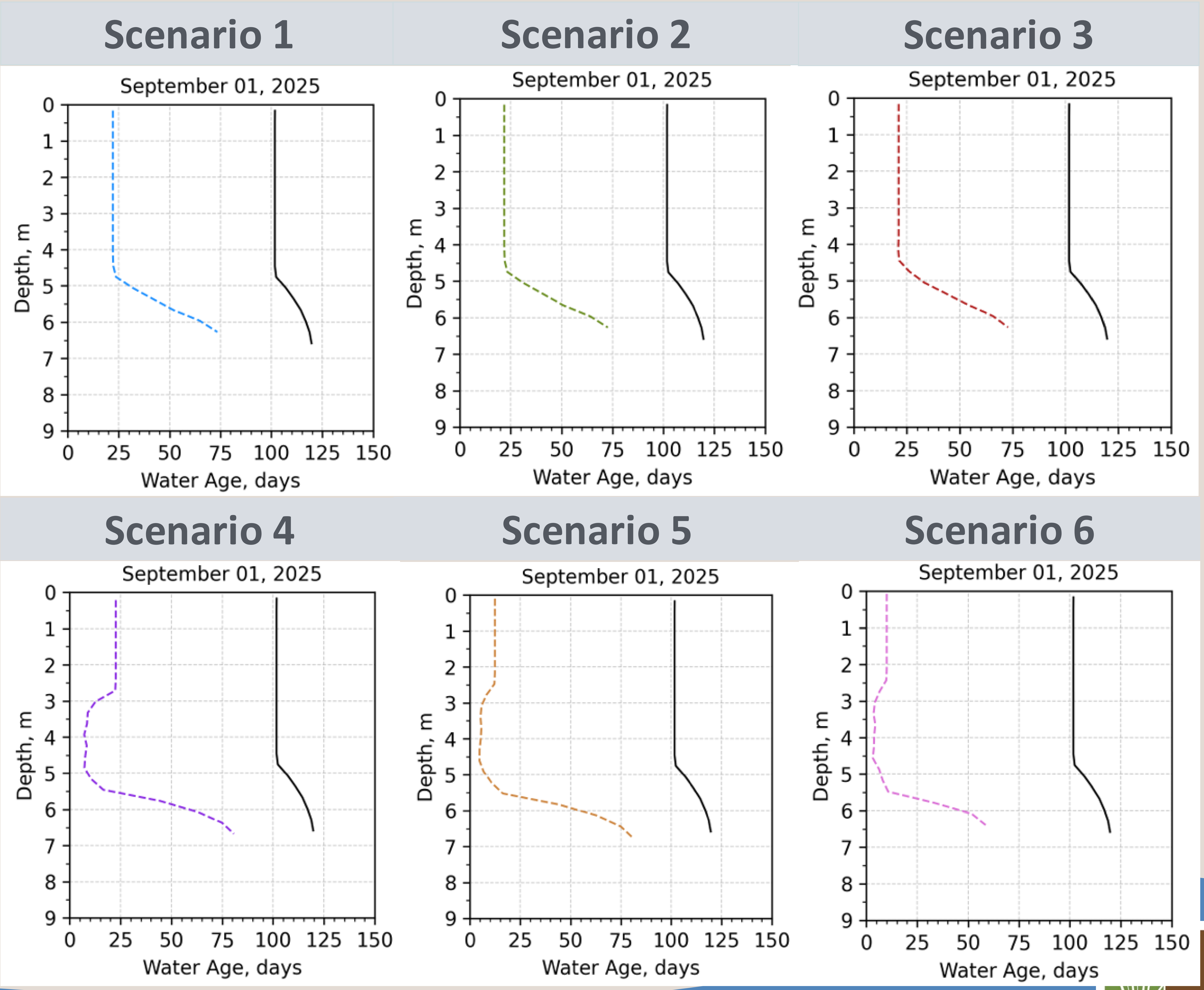
Impacts on Cove Water Levels

- Channel deepening reconnects the Cove to the River, introducing tidal fluctuations during summer (~0.5–0.7 ft range)
- Results in a lower overall summer water surface, up to 1.0 ft below baseline



Cove Summer Water Exchange Improved

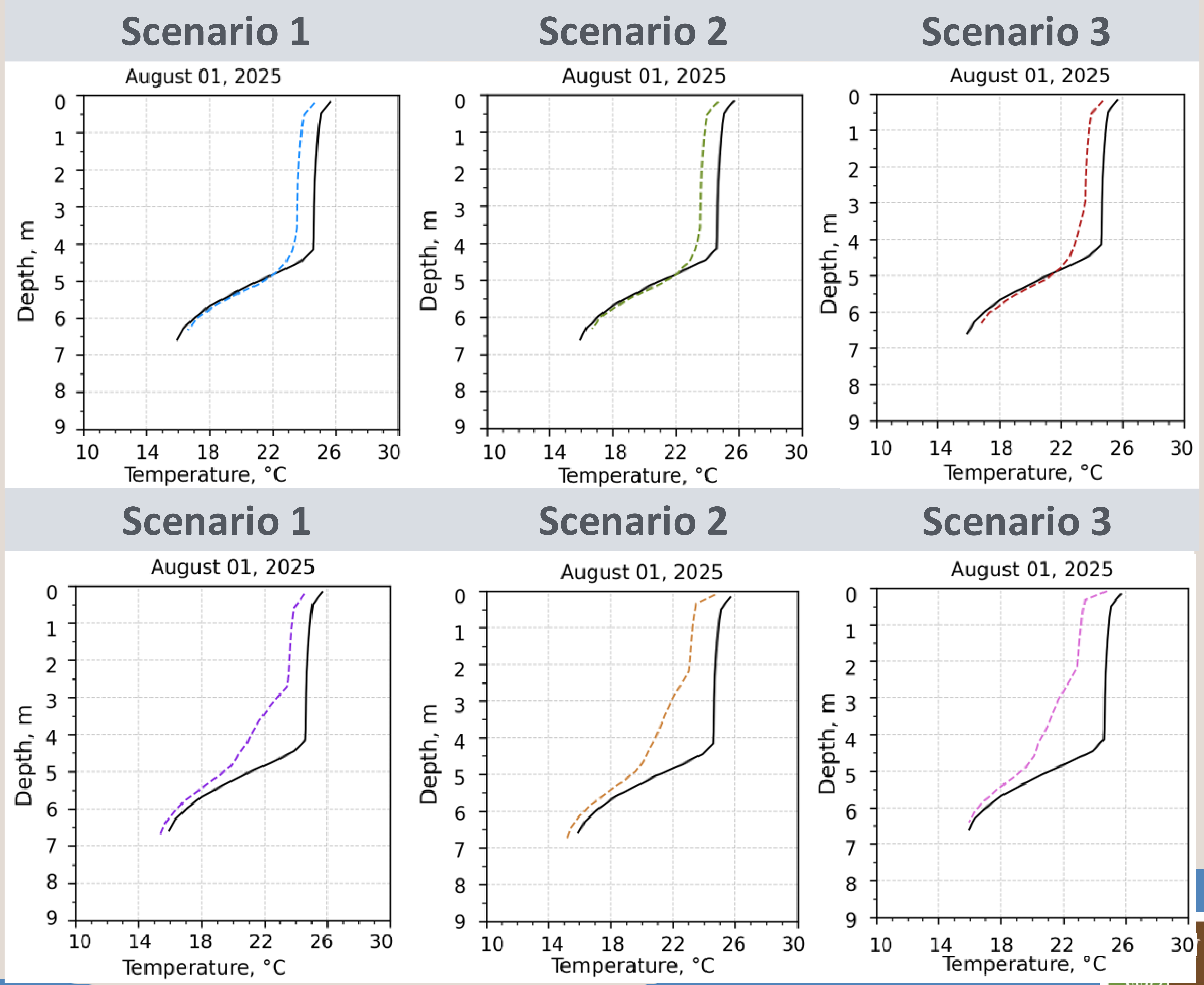
- All alternatives substantially increased water exchange compared to baseline
- Channel deepening scenarios (1–3) lowered water age to ~25 days in the upper water column
- New River connection scenarios (4–5) further reduced upper and mid depth water age to ~5–25 days
- Scenarios 6 (combined scenario) performed similarly to Scenario 5
- Bottom water age remained much higher than surface water age under all scenarios



Baseline = Solid line
Scenario = Dashed line

Temperature Stratification Persists Across All Scenarios

- Temperature profiles are broadly similar across all scenarios, with limited deviation from baseline
- Channel deepening scenarios (1–3) show minimal temperature change relative to baseline
- New River connection scenarios (4–6) produce modest cooling, most evident in the mid water column
- Vertical structure is preserved across all scenarios, with no major shifts in stratification



Baseline = Solid line
Scenario = Dashed line

What the Modeling Results Mean

Scenarios	Water Exchange	Temperature Stratification	Water Levels
Channel Deepening (Scenarios 1-3)	Increased water exchange	Unchanged	Decreased water level (~1 ft)
New River Connection (Scenarios 4-5)	Greater increase in water exchange	Minimal change in mid water column	Increased (~0.5-0.7 ft)
Combine Approach (Scenario 6)	Similar to Scenario 5	Minimal change in mid water column	Decreased (~0.7 ft)

Dredging to reconnect the Cove to the River during the summer is not supported as an effective water quality management strategy. Thermal stratification – the controlling factor for sediment nutrient release and cyanobacteria blooms risk – persisted across all scenarios.

Clackamas River Dredging

- **Not recommended for Cove water quality management**
- Modeling suggests deepening B to B’ by 2 ft is enough for summer tidal connection; no additional benefit from deepening A to A’
- Estimate of incoming bed material suggests substantial infill of dredged areas likely in 1-2 years
- Deepening more could reduce Cove water levels by ~2 ft based on water levels at Hwy 99 Bridge
- Significant permitting requirements and cost (next slide)

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Estimated Dredging Costs (Preliminary)

Category	Cost[1, 2]	Includes
Permitting[3,4]	$240,000	Pre-application meetings and agency scoping (USACE Portland District, Oregon DSL, ODFW, NMFS); sediment sampling and lab. analysis; environmental documentation including ESA Biological Assessment; hydraulic and technical analysis; alternatives analysis; joint permit application preparation and drawings; DSL Removal-Fill individual permit; agency coordination; permitting fees.
Design	$130,000	Dredge footprint and volume design; side slope and stability analysis; dewatering and sediment management plan; erosion and turbidity control design; bathymetric survey; final plans, specifications, and bid package.
Construction[5]	$300,000	Dredging of appx. 4,000 cubic yards; spoil handling, dewatering, and upland or off-site disposal; turbidity monitoring; silt curtain installation and removal.
Subtotal	**$670,000**	
Contingency (planning level, 50%)	$340,000	
Planning Level Cost	**$1.1 Million**	

1 All costs in 2026 U.S. dollars rounded to $10,000.

2 Excludes costs for on-going maintenance dredging.

3 Permitting cost assumes a USACE individual permit for ongoing maintenance with NMFS consultation and ESA biological assessment; final effort and cost will be determined during initial consultation and may be reduced if prior permit work can be leveraged or if eligible under programmatic consultations (STU or Restoration), which could avoid the need for an individual Biological Assessment/Biological Opinion.

4 Permitting estimated to take 12-24 months.

5 Construction unit cost of approximately $75/CY all-in (including mobilization/demobilization) reflects site access constraints.

Alternative is to Manage Cove Like a Lake

Why managing like a lake makes sense

- Cove stratifies thermally each summer, behaving as an isolated basin rather than a flowing river reach
- Dissolved oxygen depletion at depth and sediment phosphorus release are classic lake management problems
- Established lake management tools can directly target these conditions

But there are site constraints to consider

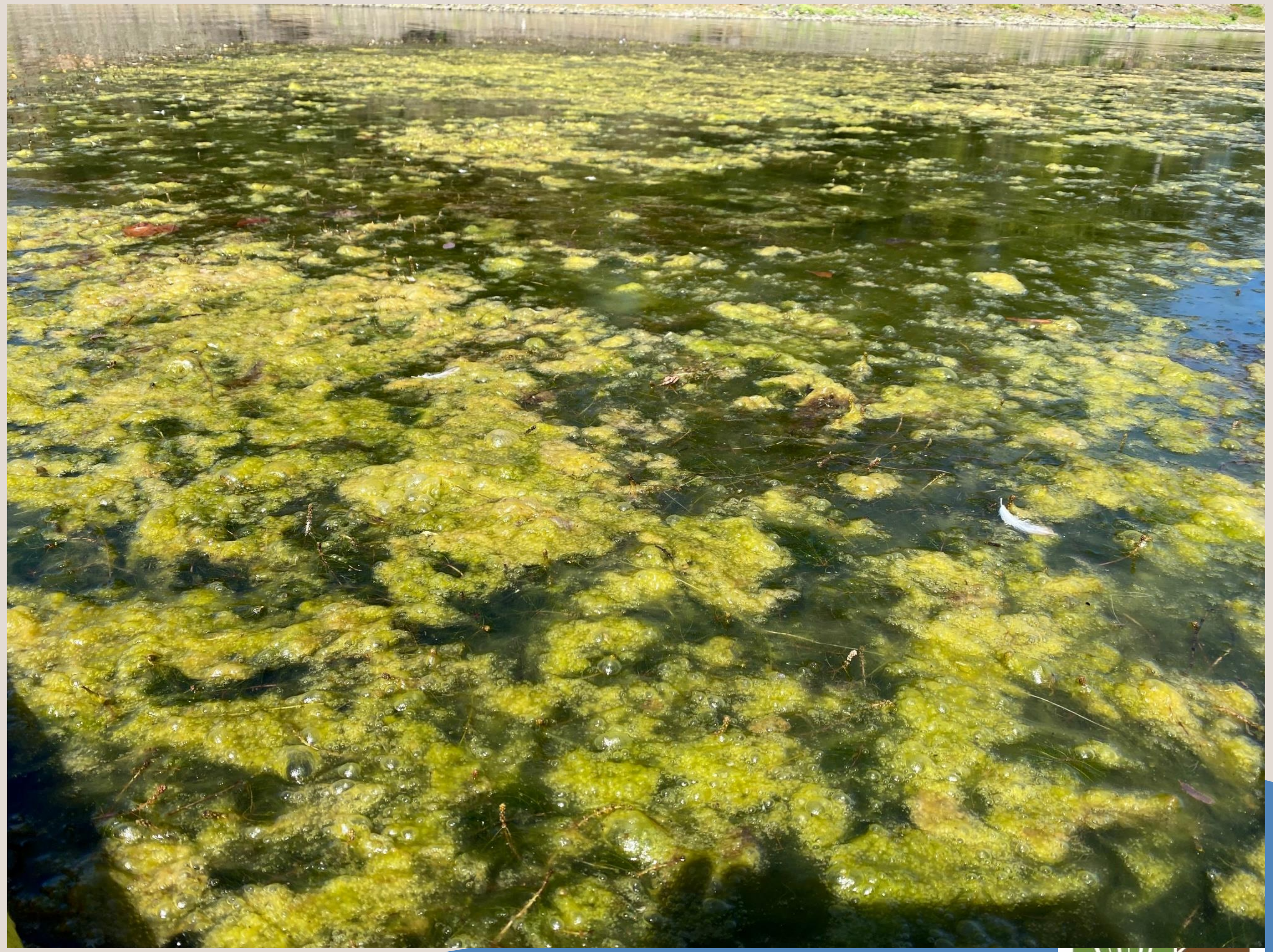
- Steep slopes with no developed boat ramp limits equipment access
- Seasonal water level fluctuations of up to 20 ft would require annual removal of floating equipment each winter
- Energetic flow conditions during high river events risk damage to floating in-lake equipment
- No current source of power
- Visible equipment in a public recreation area may be subject to vandalism or theft

Lake Management Alternatives Considered

Alternative	Rationale	Key Constraints	Status
Aquatic Vegetation Control	Improves circulation and reduces organic matter which can contribute to sediment oxygen demand. Secondary benefits like improved aesthetics and recreational access.	No constraints but may require application over multiple years to address curly leaf pondweed.	Advanced
Aeration	Disrupts thermal stratification and increases dissolved oxygen throughout the water column.	Requires power at boathouse.	Advanced
Oxygenation	Delivers oxygen directly to anoxic bottom water without disrupting surface stratification.	Requires power at boathouse.	Advanced
Sediment Treatment (Alum or lanthanum)	Binds soluble phosphorus in the water column and at the sediment surface, reducing internal loading.	Barge or boat required for application – no ramp access.	Advanced
Solar Mixing	Passive solar-powered circulation to disrupt stratification. No shore power required.	Anchoring subject to winter and flood water level fluctuations. Seasonal removal required. Large surface footprint is visually obtrusive. High vandalism risk.	Dismissed
Floating Wetlands	Constructed floating plant systems provide nutrient uptake and habitat. Marginal phosphorus removal benefit for Cove.	Highly visible – significant vandalism risk. Seasonal removal required. Requires maintenance and periodic harvesting. Would not remove phosphorus from deeper water layers	Dismissed
Cove Sediment Dredging	Removes nutrient-rich accumulated sediment.	Permitting and regulatory approvals required. Significant access issues. High cost.	Dismissed

Aquatic Vegetation Control

- Removes excessive non-native aquatic vegetation
- Reduces organic matter buildup in sediments
- Improves open water area for circulation and recreation
- Eliminates floating mats that can impair water quality
- May require follow up treatment to maintain effectiveness



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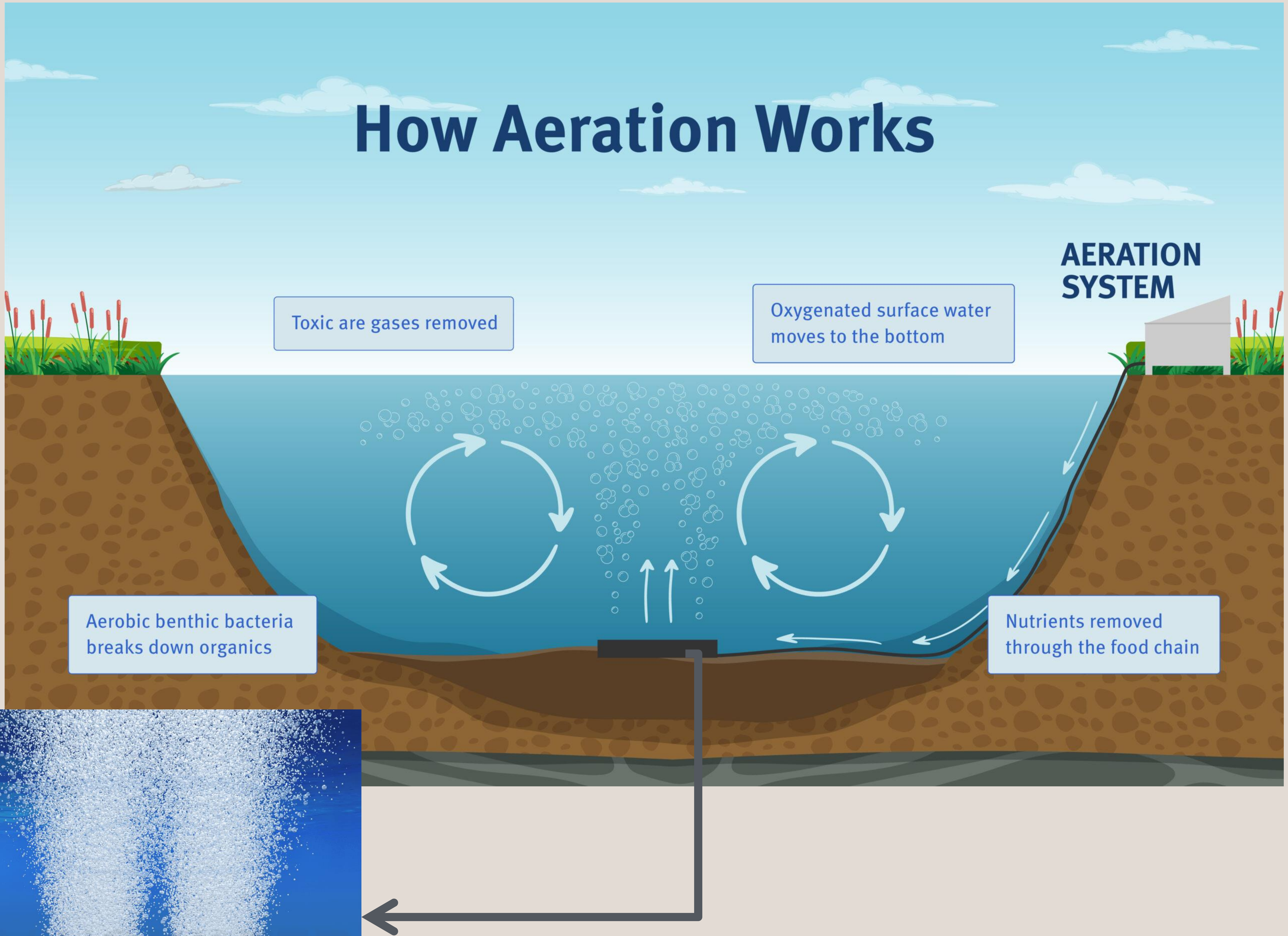
Aquatic Vegetation Control Evaluation

Criteria	Description
Effectiveness	Could improve circulation and oxygen concentration at sediment.
Technical Feasibility	Easily accomplished with small boat.
Implementation Constraints	2300-A permit required for a treatment over 20 surface acres.
Operational Considerations	May have to be repeated if complete control is not achieved.
Environmental Impacts	Could cause oxygen depletion as plant biomass degrades.
Community and Recreational Considerations	Would have to restrict access during treatment application (1 day). No use restrictions after treatment. Could provide long-term recreational improvement and better water quality if circulation is increased.
Cost[1, 2]	**Year 1: ProcellaCOR treatment for Eurasian watermilfoil: $15,000 for chemical + $2,000 for application** **Year 2: Follow-up treatment for curlyleaf: $6,000 for chemical + application**
1 - Estimate does not include any additional spot treatments that may be required to address reestablishing Eurasian watermilfoil, but it may be possible to obtain a 3-year guarantee from the chemical supplier based on an approved treatment plan. 2 - Because curlyleaf pondweed can be reestablished annually from the turion bank in the sediment, treatment may be required in multiple years to maintain control.	

Aeration

- Moves oxygenated water from surface to bottom
- Disrupts stratification to maintain mixed conditions
- Reduces phosphorus release from sediments
- Limits nutrients available for cyanobacteria
- Disrupts cyanobacteria buoyancy regulation



Aeration Evaluation

Criteria	Description
Effectiveness	Can very effectively mix oxygenated surface water to sediment.
Technical Feasibility	Simple system that involves a small compressor, air lines, air diffusers. Ideally the system would be located in the old boathouse so lines would not have to run down the bank.
Implementation Constraints	No permits or regulatory approval needed. Needs power in the boathouse or near the lake edge for the compressor. Needs secure location for compressor.
Operational Considerations	Can leave diffusers in water year around. Inspect and clean annually. Compressor serviced every 3 to 5 years.
Environmental Impacts	Will warm the water near the sediment, which reduces cold-water refuge. However, cold water refuge is currently anoxic during summer and of low quality.
Community and Recreational Considerations	Slight visual impact on lake surface. Compressors makes some noise.
Cost[1]	**CAPEX: $20,000; O&M $2,000 per year (assumes system operates April-October)**
1 - Preliminary costs assume that boathouse can be used to store compressor; does not include cost of restoring power to the boathouse.	

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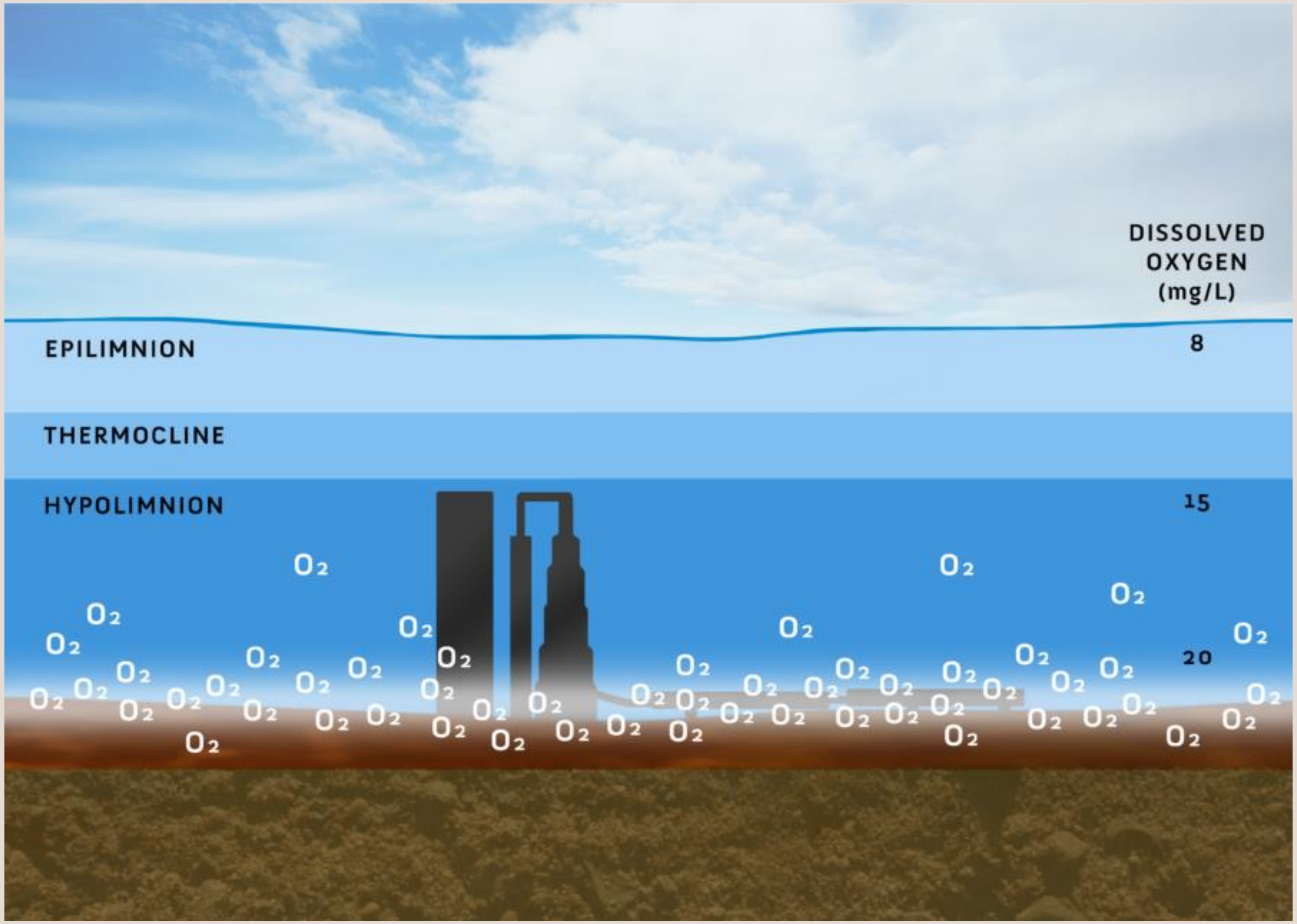
Oxygenation

- Adds oxygen directly to deeper water
- Prevents low oxygen conditions near the bottom
- Reduces phosphorus release from sediments
- Can improve overall water quality and habitat conditions
- Can retain cold water refuge



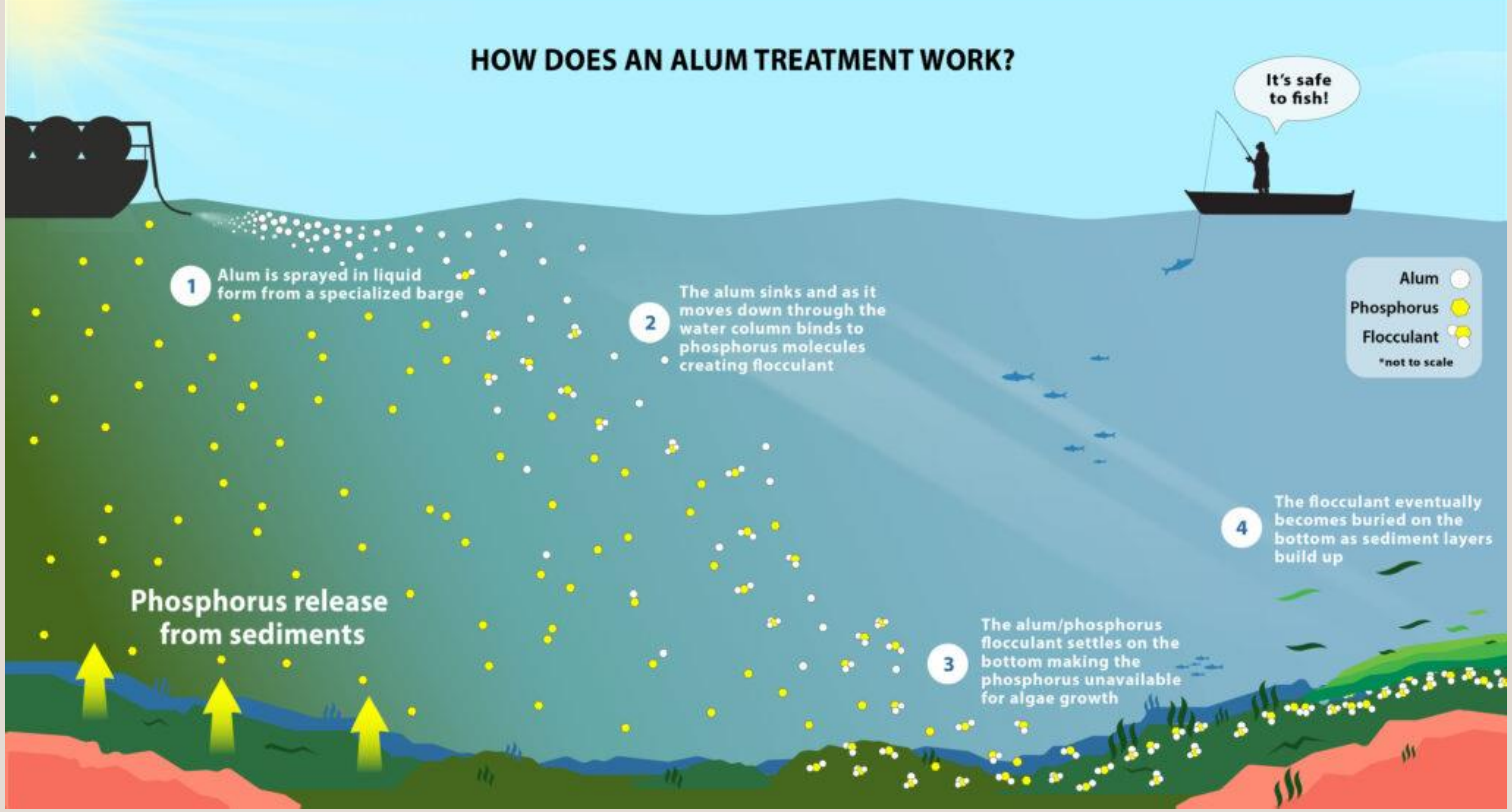
Oxygenation Evaluation

Criteria	Description
Effectiveness	Injects oxygen instead of circulating. Does not de-stratify lake.
Technical Feasibility	Package system that would only need electricity and plumbing to the lake. Needs to be near lake surface (in boathouse possibly).
Implementation Constraints	No permits or regulatory approval necessary. Can leave in place during winter if flexible lines are used or lines are disconnected.
Operational Considerations	Monthly maintenance recommended, including cleaning intake screen. Need power in boathouse.
Environmental Impacts	Could offer improvement over aeration if cold water refuge is desired.
Community and Recreational Considerations	Some noise from oxygen generator. Some bubbles visible on lake surface.
Cost[1]	**CAPEX: $20-40k + $5,000 installation; O&M $8,000 per year**
1 - Preliminary costs assume that boathouse can be used to store package system; does not include cost of restoring power to the boathouse or fish screen (if required to protect ESA species).	

Sediment Treatment

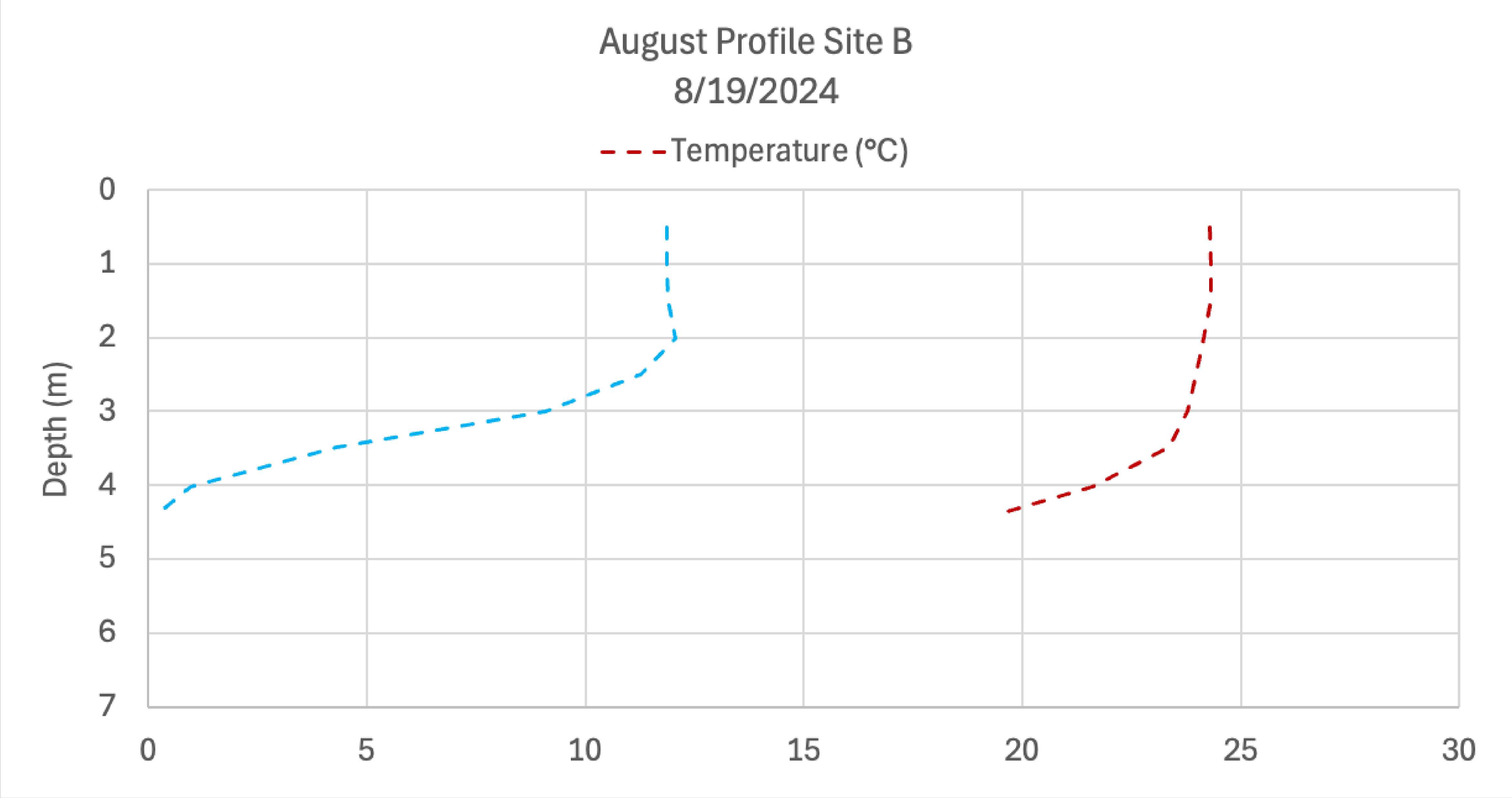
Aluminum sulfate or lanthanum

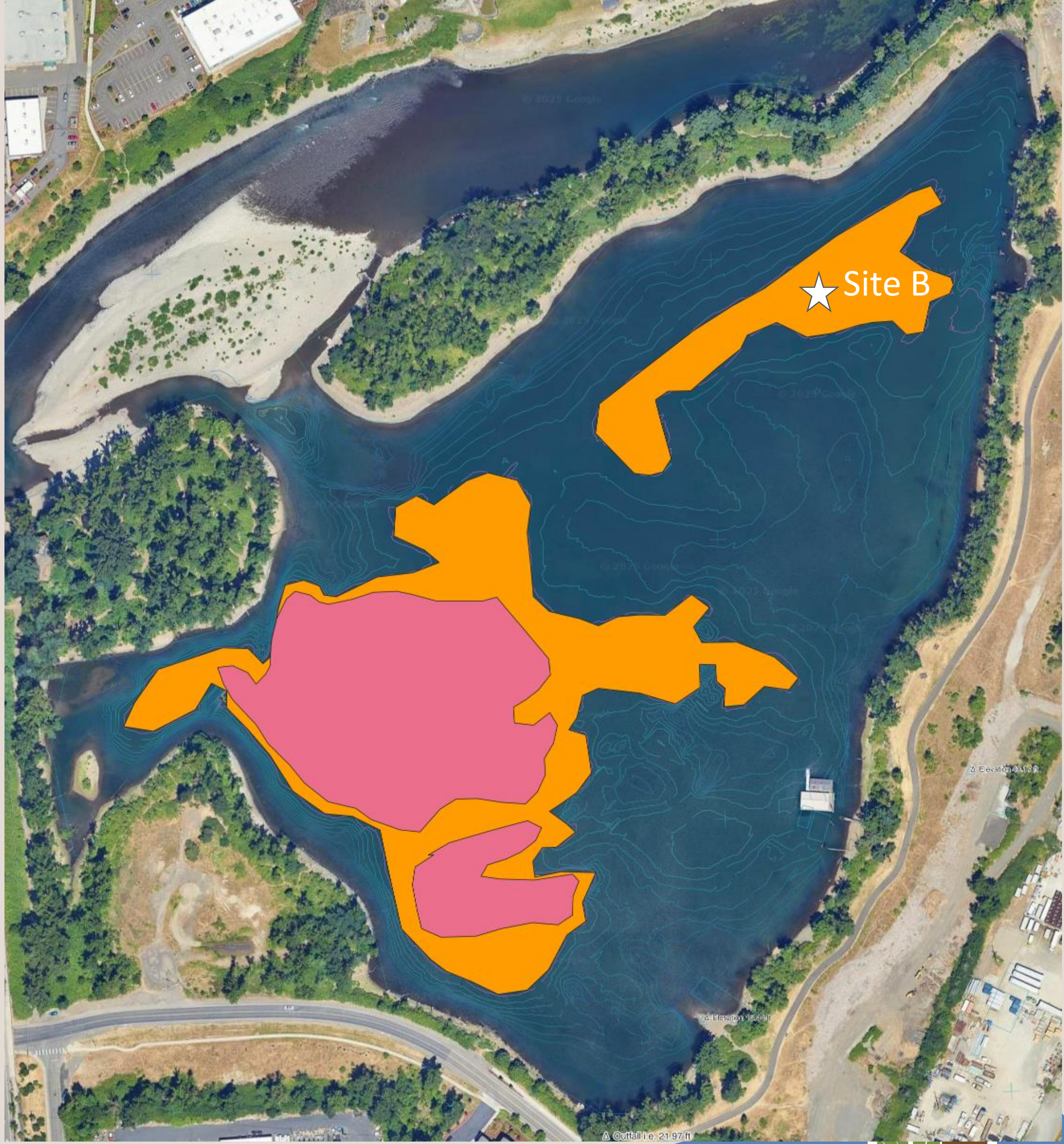
- Binds phosphorus in sediments to reduce internal loading
- Provides longer term control of internal nutrient release
- Can be applied to target areas or across the lake
- Requires specialized equipment and access for application
- Chemical treatment options include aluminum sulfate (alum) or lanthanum modified clay



Sediment Treatment Area

- Important to determine the volume of anoxic sediment
- Anoxic area at 4 meters is about 11.5 acres
- Site B showed oxygen declines starting at 2 meters
- Increasing circulation to 5 meters through vegetation removal would decreases anoxic area to about 5 acres.





Sediment Treatment Evaluation

Criteria	Description
Effectiveness	Reduces phosphorus release from sediment.
Technical Feasibility	Would be challenging to get boat and product into Cove.
Implementation Constraints	No permit necessary (none available in Oregon). Should follow Washington guidelines. Would have to close cove to public use and restrict access to walking path during application.
Operational Considerations	Could provide years of phosphorus reduction depending on external sediment load.
Environmental Impacts	If properly applied there is no environmental impact.
Community and Recreational Considerations	Would have to restrict Cove access during treatment. No use restrictions after treatment.
Cost[1]	**Alum: $250,000 for chemical + $25,000 for application** **Lanthanum: $480,000 for chemical + $25,000 for application**
1 - Assumes treatment of 11.5 acres; cost may be less if anoxic area can be reduced through vegetation control.	

Management Recommendations

Adaptive Management

Why a phased approach

- No single approach likely to achieve water quality goals alone
- Start with the most feasible and least intensive option
- Monitor performance at each step before advancing
- Adapt based on observed conditions

1 Vegetation Control

- Reduce excess vegetation and internal organic loading
- Monitor effectiveness before advancing

Expected: significant improvement in water quality & aesthetics

2 Aeration or Oxygenation

- Improve dissolved oxygen and limit internal nutrient release
- Monitor effectiveness before advancing

Only if Step 1 does not achieve acceptable results

3 Sediment Treatment (Alum or Lanthanum)

- Evaluate if additional control of internal phosphorus loading is needed
- Implement targeted treatment

Only if Steps 1 & 2 are insufficient

Management Objectives

Water quality for beneficial uses

Keep conditions suitable for contact recreation and general public use, including reducing frequency and severity of nuisance algal growth

Human health protection

Minimize exposure risk from harmful algal toxins

Ecological function

Maintain or improve habitat quality and the physical and chemical conditions needed to support aquatic life

Recreational experience and visual quality

Maintain a usable, enjoyable, and visually acceptable waterbody for the community

Sustainable long-term management

Implement actions that are feasible to operate and maintain over time, with flexibility to adjust based on monitoring and changing conditions

Next Steps & Questions

- Alternatives Analysis Technical Report
  - Finalizing River dredging and power connection costs
  - Final Technical Report by June 30, 2026
- ProcellaCOR treatment for Eurasian watermilfoil (if approved)
  - June 2026
- **Questions?**

625 Center Street
Oregon City, OR 97045
503-657-0891

CITY OF OREGON CITY

Staff Report

To: Urban Renewal Commission **Agenda Date:** May 6, 2026
From: Dayna Webb, Public Works Director

SUBJECT:
Item 3.b. - Personal Services Agreement with Aquatic Insights for the Clackamette Cove Vegetation Management (PS 26-012)

STAFF RECOMMENDATION:
Award the contract and authorize the Executive Director to execute the Personal Services Agreement with Aquatic Insights in the amount of $25,347.00 for the Clackamette Cove Vegetation Management (PS 26-012).

EXECUTIVE SUMMARY:

The Clackamette Cove (Cove) has experienced harmful algal blooms (HAB) in the past, but little water-quality data was available to determine the cause. Two years of data collection have determined the source is from bottom sediments and thermal stratification of the water column. The goal of the Clackamette Cove Water Quality Analysis program has been to evaluate conditions in the Cove, develop alternatives for HAB and provide recommendations for improving water quality conditions to support recreational use, aesthetic qualities and future development of the Cove property.

As a part of the water quality monitoring in Clackamette Cove (Cove), a vegetation survey completed in August 2025 found that the Cove is dominated by Eurasian watermilfoil (*Myriophyllum spicatum*) and Curlyleaf pondweed (*Potamogeton crispus*), highly invasive, non-native aquatic plant that out competes native, beneficial species.

The Cove behaves as a lake and managing aquatic vegetation is necessary to maintain this function, support water circulation, address concerns about aesthetics, water quality, and recreational use.

This contract provides for systemic aquatic herbicide treatment targeting Milfoil and a non-selective herbicide for Curlyleaf. Treating both aquatic plants is necessary to allow space for native vegetation to recover the bottom sediment and encourage oxygen production at depth. Milfoil treatment will occur in summer 2026, with a curlyleaf survey and treatment scheduled for March 2027.

BACKGROUND:

The Clackamette Cove (Cove) has experienced harmful algal blooms (HAB) in the past, but little water-quality data was available to determine the cause. Two years of data collection have determined the source is from bottom sediments and thermal stratification of the water column. The goal of the Clackamette Cove Water Quality Analysis program has been to evaluate conditions in the Cove, develop alternatives for HAB and provide recommendations for improving water quality conditions to support recreational use, aesthetic qualities and future development of the Cove property.

In concurrence of the data collection to address water quality concerns in the Cove, a vegetation survey was completed in August 2025. It showed that the Cove is dominated by Eurasian watermilfoil (*Myriophyllum spicatum*), a non-native highly invasive plant that out competes native, beneficial species. Milfoil had reached the surface and formed surface mats across the northern two-thirds of the cove, as well as around the boat ramp and the cove inlet. These mats restrict recreational use by limiting the areas available to swimmers and paddlers and reduce water circulation, contributing to warming and degrading water quality.

Additional vegetation included native elodea (*Elodea canadensis*) and coontail (*Ceratophyllum demersum*), along with the non-native curlyleaf pondweed (*Potamogeton crispus*). It is recommended that the curlyleaf also be treated to prevent it from overtaking native vegetation once the milfoil population has been reduced. Curlyleaf begins vigorous growth when the water temperature reaches 10 C, which could be as early as March in the cove.

During the aquatic herbicide treatment, no recreational restrictions are expected, including swimming or fishing. A seven-day non-agricultural irrigation restriction applies, although there are no known irrigation intakes in the Cove. By late June, minimal flow exits the Cove, and dilution by the Clackamette and Willamette rivers should adequately reduce the aquatic herbicide concentrations.

For planning purposes, the anticipated curlyleaf treatment is 20 acres, though the actual extent will be confirmed by a March 2027 survey. The survey results will provide guidance for the treatment later that month. Curlyleaf produces tubers (turions) that persist in sediments, meaning multiple years of treatment may be required.

Schedule of services:

- July 2026 – Apply aquatic herbicide to invasive milfoil
- April 2027 – Apply aquatic herbicide to invasive curlyleaf

This procurement follows Oregon City Municipal Code 2.40.020, which allows use of the Attorney General Model Rules for Engineering and Architectural Services. OAR 137-048-0200, a direct appointment procedure of Related Services to an Architectural and Engineering Services procurement, when the total contract value is under $100,000. The total contract amount is $25,347.00.

OPTIONS:

1. Approve Personal Services Agreement with Aquatic Insights for the Clackamette Cove

Vegetation Management (PS 26-012).
2. Approve Personal Services Agreement with Aquatic Insights for the Clackamette Cove Vegetation Management (PS 26-012) with Amendments.
3. Deny Personal Services Agreement with Aquatic Insights for the Clackamette Cove Vegetation Management (PS 26-012) and provide further direction.

BUDGET IMPACT:

Amount	$25,347.00
Fiscal Year(s):	2025/2026 & 2026/2027
Funding Source(s):	Urban Renewal

CITY OF OREGON CITY URBAN RENEWAL AGENCY (URA)
PERSONAL SERVICES AGREEMENT

CLACKAMETTE COVE VEGETATION MANAGEMENT (PS 26-012)

This PERSONAL SERVICES AGREEMENT ("Agreement") is entered into between the CITY OF OREGON CITY URBAN RENEWAL AGENCY ("URA") and **AQUATIC INSIGHTS, LLC** ("Consultant").

RECITALS

A. URA requires services that Consultant is capable of providing under the terms and conditions hereinafter described.

B. Consultant is able and prepared to provide such services as URA requires under the terms and conditions hereinafter described.

The parties agree as follows:

AGREEMENT

1. Term. The term of this Agreement shall be from the date the contract is fully executed until **May 5, 2027**, unless sooner terminated pursuant to provisions set forth below. However, such expiration shall not extinguish or prejudice URA's right to enforce this Agreement with respect to (i) breach of any warranty; or (ii) any default or defect in Consultant's performance that has not been cured.

2. Compensation. URA agrees to pay Consultant on a time-and-materials basis for the services required. Total compensation, including reimbursement for expenses incurred, shall not exceed **twenty-five thousand, three-hundred, forty-seven dollars and no/100 cents ($25,347.00)**.

3. Scope of Services. Consultant's services under this Agreement shall consist of services as detailed in **Exhibit A**, attached hereto and by this reference incorporated herein.

4. Standard Conditions. This Agreement shall include all of the standard conditions as detailed in **Exhibit B**, attached hereto and by this reference incorporated herein.

5. Schedule. The components of the project described in the Scope of Services shall be completed according to Term, above.

6. Integration. This Agreement, along with the description of services to be performed attached as Exhibit A and the Standard Conditions to Oregon City URA Personal Services Agreement attached as Exhibit B, contain the entire agreement between and among the parties, integrate all the terms and conditions mentioned herein or incidental hereto, and supersede all prior written or oral discussions or agreements between the parties or their predecessors-in-interest with respect to all or any part of the subject matter hereof.

7. Notices. Any notices, bills, invoices, reports or other documents required by this Agreement shall be sent by the parties by United States mail, by hand delivery or by electronic means. All notices shall be in writing and shall be effective when delivered. If mailed, notices shall be

deemed effective forty-eight (48) hours after mailing, unless sooner received.

To CITY OF OREGON CITY URBAN RENEWAL AGENCY:	City of Oregon City Urban Renewal Agency 13895 Fir Street Oregon City, OR 97045 Attention: Dayna Webb, P.E.
To Consultant:	Aquatic Insights, LLC 4207 SE Woodstock Blvd. #535 Portland, OR 97206 Attention: Mark Rosenkranz, Owner

Consultant shall be responsible for providing the URA with a current address. Either party may change the address set forth in this Agreement by providing notice to the other party in the manner set forth above.

8. Governing Law. This Agreement shall be governed and construed in accordance with the laws of the state of Oregon without resort to any jurisdiction's conflicts of law, rules or doctrines.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed by their duly appointed officers on this ________________day of_______________, 2026.

CITY OF OREGON CITY URBAN RENEWAL AGENCY

By: ____________________________________

Name: Dayna Webb, P.E. ______________________

Title: Public Works Director__________________

DATED: _________________________________, 2026.

By: ____________________________________

Name: Anthony J. Konkol III

Title: Executive Director

DATED: _________________________________, 2026.

APPROVED AS TO LEGAL SUFFICIENCY:

By: ____________________________________
Urban Renewal Agency Attorney

AQUATIC INSIGHT, LLC

By: ____________________________________

Name: ____________________________________

Title: ____________________________________

DATED: _________________________________, 2026.

ORIGINAL URBAN RENEWAL APPROVAL (IF APPLICABLE):

DATE: ____________________________________

Proposal:

Clackamette Cove Vegetation Treatment

February 22, 2026

Submitted to:

City of Oregon City

Marcos Kubow

Submitted by:

Aquatic Insight LLC
Mark Rosenkranz
503-515-864
mark@aquaticinsight.com

Introduction

A vegetation survey in August 2025 showed Clackamette Cove is dominated by Eurasian watermilfoil (*Myriophyllum spicatum*), a non-native highly invasive plant that outcompetes native, beneficial species. Milfoil had reached the surface and formed surface mats in the northern 2/3 of the cove in addition to the area around the boat ramp and the cove inlet. The dense vegetation restricts recreational activities by limiting the areas available to swimmers and paddlers. In addition, the reduced circulation and warming created by the surface mats leads to water quality degradation.

Other vegetation present were native elodea (*Elodea canadensis*) and coontail (*Ceratophyllum demersum*) and non-native curlyleaf pondweed (*Potamogeton crispus*). Curlyleaf should also be treated to prevent it from overtaking native vegetation once the milfoil population has been reduced. Curlyleaf starts producing vigorous growth when the water temperature reaches 10 C, which could be as early as March in the cove.

Treatment

There are various methods of treating milfoil, including hand-pulling, bottom barriers, diver assisted suction dredging, and aquatic herbicides. The manual control methods require repeated treatments over multiple years and are most appropriate for small, isolated populations within larger waterbodies. Since milfoil spreads by fragmentation any manual removal activity will have to retain all fragments to keep the plant from spreading. For waterbodies with extensive milfoil growth, it is best to use a systemic aquatic herbicide that kills the entire plant.

Milfoil has been successfully treated using the aquatic herbicide ProcellaCOR, manufactured by SePRO corporation. It is systemic and semi-selective to milfoil, will have limited impact on native elodea, but will reduce the population of coontail. Milfoil breaks dormancy when the water temperature reaches 15° C, which is late June in the cove. Treatment will take place in early July to ensure adequate plant structure has emerged for chemical uptake. The treatment target will be areas with water depth up to four meters as shown in green on the map below. Total area to be treated is 32 acres.

Method

A small boat with spray tank and boom will be lowered down the ramp at the SE corner of the cove. Signs will be placed on the ramp alerting people of the treatment. The process will take most of the day between mobilizing, demobilizing, and cleaning. The abandoned boat house will be used as a staging area for tank filling and post-treatment rinsing.

Restrictions

There are no recreational restrictions, including swimming or fishing. There is a non-agriculture irrigation restriction of seven days but there are no known irrigation intakes in the cove. By late June there is little water flowing out of the cove into the river so dilution by the Clackamette and Willamette rivers should be adequate to reduce the concentration below the 2 ppb threshold. The product label is included on the following pages.

Spring 2027 Curlyleaf Treatment

The extent of curlyleaf growth will not be known until a survey is conducted, but for planning purposes a treatment area of 20 acres is used. Curlyleaf will be treated in late March or early April 2027. A survey in early March will confirm the extent of curlyleaf growth and provide guidance for the treatment later that month. Curlyleaf produces tubers that sprout in the fall, overwinter as small rosettes, and start growing stems in early spring. The goal is to apply herbicide before turion production starts, but this is likely to be a multiple year process due to the number of turions already in the sediment.

Budget

This budget assumes a milfoil treatment in June 2026 and a curlyleaf survey and treatment in March 2027.

Milfoil Treatment	Cost
ProcellaCOR chemical cost	16,632
Equipment use	175
Labor	1,970
2026 Total	**18,777**
Curlyleaf Treatment	
Curlyleaf Survey (2027)	2,440
Treatment Chemical (diquat)	2,400
Treatment Labor	1,730
2027 Total	**6,570**
Grand Total	**25,347**

Thank you

Mark Rosenkranz

STANDARD CONDITIONS TO CONTRACTS FOR GOODS, SERVICES, PERSONAL SERVICES OR PUBLIC IMPROVEMENT CONTRACTS FOR LESS THAN $50,000

This Standard Condition Agreement shall be applicable to all public contracts for goods, services, personal services, and public improvement projects including:

- Professional services, as referenced in Oregon City Municipal Code (OCMC) Section 2.40.020, and Oregon Revised Statutes (ORS) 279C; or
- Architectural, engineering, photogrammetric mapping, transportation planning or land surveying or related services; or
- Public improvement contracts (capital improvement projects) that cost less than $50,000, except for solar panels or other solar system installations.

1) <u>**Definitions of Terms**</u>: In this Standard Conditions Agreement, the following terms shall be as defined below:

a) **Agent** means a person who is authorized to act on behalf of the Contractor or the Owner.

b) **Applicable Laws** means all federal, state and local laws, codes, rules, regulations and ordinances, as amended applicable to the Work to the Contract or to the Parties individually.

c) **Architectural, Engineering, Photogrammetric Mapping, Transportation Planning or Land Surveying Services** means professional services that are required to be performed by an architect, engineer, photogrammetrist, transportation planner or land surveyor as defined in Oregon Revised Statutes (ORS) Chapter 279C.

d) **Amendment** means a written alteration, to include a change order, which, when fully executed by the Parties of the Contract, constitutes a change to the contract price, contract time or contract scope. An Amendment shall not be effective until executed by both parties.

e) **Contract or Agreement,** as used interchangeably throughout, means an agreement between two or more Persons which creates an obligation to do or not do a particular thing. Its essentials are competent parties, subject matter, legal consideration, mutuality of agreement and mutuality of obligation.

f) **Contract or Agreement Documents** means the full and complete contract for goods or services including the Goods or Personal Services Agreement, Scope of Work and these Standard Conditions and these terms are used interchangeably, unless otherwise specified.

g) **Contractor or Consultant,** as used interchangeably throughout, means the Person awarded the Contract or Agreement for the Work contemplated and includes a Person providing architectural, engineering, photogrammetric mapping, transportation planning or land surveying services contracted for the provision of services, unless otherwise specified.

h) **Design-Build** means an alternative form of procurement for public improvements in which the Contractor provides or obtains specified design services, participates in the project team with the Owner, and manages both design and construction.

i) **Goods** means supplies, equipment, materials, personal property, and include any tangible, intangible and intellectual property, rights and licenses.

j) **Owner** means the City of Oregon City or any component unit thereof including the City of Oregon City Urban Renewal Agency (URA). Owner may elect, by written notice to Contractor, to delegate certain duties to more than one agent.

k) **Parties** means any person, group or organization who execute a written agreement to complete Work to be done.

l) **Person** means a natural person or entity doing business as a sole proprietorship, a partnership, a joint venture, a corporation, a limited liability company, a nonprofit, a trust, or any other entity possessing the legal capacity to enter into a contract.

m) **Project** means the total undertaking to be accomplished for Owner by architectural, engineering, photogrammetric mapping, transportation planning or land surveying service providers, Contractors, and others, including planning study, design, construction, testing, commissioning, start-up, of which the Work to be performed under the Contract Documents is a part.

n) **Public Improvement (Capital Improvement)** means contracts for construction, reconstruction or major renovation of real property by or for the Owner, per ORS 279A.

o) **Professional Services** means contracts for professional personal services such as financial, accounting, personnel, risk management, insurance, real estate and economics, architect, engineer, photogrammetrist, transportation planner or land surveyor as defined in Oregon Revised Statutes (ORS)

Chapter 279C as well as non- professional services such as a short-term Consultant or services for office maintenance.

p) **Subcontractor** means a Person having a direct contract with the Contractor, or another Subcontractor of any tier, to perform one or more items of Work.

q) **Work** means the furnishing of all materials, equipment, labor, transportation, services, incidentals, those permits, and regulatory approvals not provided by the Owner necessary to successfully comply with any individual items or the entire Contract and the carrying out of duties and obligations imposed by the Contract Documents for the Project.

2) **<u>Contractor Identification.</u>** Contractor shall furnish to Owner its taxpayer identification number, as designated by the Internal Revenue Service, or Contractor's social security number, as Owner deems applicable.

3) **<u>Oregon Corporation Registration, Valid Oregon City Business License, and Other Professional Certification Required.</u>** Contractor agrees and certifies that it is licensed to do business in the State of Oregon and that, if Contractor is a corporation, that the corporation is in good standing within the State of Oregon. For the duration of this Contract, Contractor shall maintain a valid Oregon City Business License as per Oregon City Municipal Code Chapter 5.04, or a Metro business license for qualifying projects, and any professional occupation licenses required by state or local law and shall furnish proof to Owner upon request.

4) **<u>Payment.</u>**

a) Invoices submitted in connection with this Contract shall be properly documented and shall identify the pertinent agreement and/or purchase order numbers.

b) Owner agrees to pay Contractor within thirty (30) days after receipt of Contractor itemized statement, unless the parties agree to payment to be made on other specified terms. Amounts disputed by Owner may be withheld pending settlement.

c) Owner certifies that sufficient funds are available and authorized for expenditure to finance the cost of the materials, equipment, labor, and/or services to be provided pursuant to this Contract.

d) Owner shall not pay any amount in excess of the compensation amounts set forth in this Contract nor shall Owner pay Contractor any fees or costs that Owner reasonably disputes.

e) With respect to Public Improvement Contracts, Owner may withhold retainage not to exceed 5% of the payment due. Retainage shall be released in accordance with ORS 279.C.570 and applicable laws.

5) **<u>Independent Contractor Status</u>.**

a) Contractor is an independent contractor as defined in ORS 670.600 and is free from direction and control over the means and manner of providing labor or services, subject only to the specifications of the desired results.

b) Contractor represents that it is customarily engaged in an independently established business and is licensed under ORS chapter 671 or 701, if the services provided require such a license. Contractor maintains a business location that is separate from, and not affiliated with, the offices of the Owner and bears the risk of loss related to the Contractor's business as demonstrated by the fixed price nature of the contract, requirement to fix defective work, warranties provided and indemnification and insurance provisions of this Contract. Contractor provides services for two or more persons within a 12-month period or routinely engages in advertising, solicitation or other marketing efforts. Contractor makes a significant investment in the business by purchasing tools or equipment, premises or licenses, certificates or specialized training and Contractor has the authority to hire or fire persons to provide or assist in providing the services required under this Contract.

c) Contractor shall furnish the tools or equipment necessary for the contracted labor or services.

d) Contractor agrees and certifies that:

i) Contractor is not eligible for any federal social security or unemployment insurance payments. Contractor is not eligible for any Public Employee Retirement System (PERS) or workers' compensation benefits from compensation or payments made to Contractor under this Agreement.

6) **Early Termination.**
   a) This Contract may be terminated without cause prior to the expiration of the agreed upon term by mutual written consent of the parties or by the Owner upon ten (10) days written notice to the Contractor, delivered by certified mail, email, or in-person prior to the stated expiration date.
   b) Upon receipt of notice of early termination, Contractor shall immediately cease work and submit a final statement of services for all services performed and expenses incurred since the date of the last statement of services.
   c) Any early termination of this Contract shall be without prejudice to any obligation or liabilities of either party already accrued prior to such termination.
   d) The rights and remedies of the Owner provided in this Contract and relating to defaults by Contractor shall not be exclusive and are in addition to any other rights and remedies provided by law or under this Contract.

7) **No Third-Party Beneficiaries**. Owner and Contractor are the only parties to this Agreement and are the only parties entitled to enforce its terms. Nothing in this Agreement gives, is intended to give, or shall be construed to give or provide, any benefit or right, whether directly or indirectly or otherwise, to third parties unless such third parties are individually identified by name herein and expressly described as intended beneficiaries of the terms of this Agreement.

8) **Payment of Laborers; Payment of Taxes.**
   a) Contractor shall:
      i) Make payments promptly, as due, to all persons supplying to Contractor labor and materials for the prosecution of the services to be provided pursuant to this Contract.
      ii) Pay all contributions and amounts due to the State Accident Insurance Fund incurred in the performance of this Contract.
      iii) Not permit any lien or claim to be filed or prosecuted against the Owner on account of any labor or materials furnished.
      iv) Be responsible for all federal, state, and local taxes applicable to any compensation or payments paid to the Contractor under this Contract and, unless Contractor is subject to back-up withholding, the Owner will not withhold from such compensation or payments any amount(s) to cover Contractor's federal or state tax obligation.
      v) Pay all employees at least time and one-half for all overtime worked in excess of forty (40) hours in any one week, except for individuals excluded under ORS 653.100 to 653.261 or under 29 U.S.C. §§ 201 to 209 from receiving overtime.
   b) If the Contractor fails, neglects or refuses to make prompt payment of any claim for labor or services furnished by any person in connection with this Contract as such claim becomes due, the Owner may pay such claim to the person furnishing the labor or services and shall charge the amount of the payment against funds due or to become due to the Contractor by reason of this Contract.
   c) The payment of a claim in this manner shall not relieve Contractor or Contractor's surety from obligations with respect to any unpaid claims.
   d) Contractor and its subcontractors, if any, are subject employers under the Oregon workers' compensation law and shall comply with ORS 656.017, which requires provision of workers' compensation coverage for all workers.
   e) With respect to Public Improvement Contracts or Professional Service Agreements, all hours of labor shall comply with ORS 279C.520 and overtime pay provided as specified in ORS 279C.540.

9) **Subcontractors and Assignment.** Contractor shall neither subcontract any of the work, nor assign any rights acquired hereunder, without obtaining prior written approval from the Owner. The Owner, by this Contract, incurs no liability to third parties for payment of any compensation provided herein to the Contractor.

10) **Access to Records.** Contractor shall maintain all books, documents, papers and records, in paper or electronic form, for a period of no less than three years from the date of substantial completion for the purpose of making audit, examination, excerpts and transcripts. Owner shall have access to all books,

documents, papers and records of Contractor, existing in paper or electronic form, that are pertinent to this Contract for the purpose of making audits, examinations, excerpts and transcripts.

11) **Confidentiality**. During the course of completing Work, Contractor or its Agent(s), employees, or consultants, may receive confidential information. Contractor agrees to use its best efforts to maintain the confidentiality of such information and to inform each agent and employee performing Work of the confidentiality obligation that pertains to such information.

12) **Ownership of Work Product; License.** All work products of Contractor that result from this Contract (the "Work Products") are the exclusive property of Owner. In addition, if any of the Work Products contain intellectual property of Contractor that is or could be protected by federal copyright, patent, or trademark laws, or state trade secret laws, Contractor hereby grants Owner a perpetual, royalty-free, fully paid, nonexclusive and irrevocable license to copy, reproduce, deliver, publish, perform, dispose of, use and re-use, in whole or in part (and to authorize others to do so), all such Work Products and any other information, designs, plans, or works provided or delivered to Owner or produced by Contractor under this Contract. The parties expressly agree that all works produced (including, but not limited to, any taped or recorded items) pursuant to this Contract are work specially commissioned by Owner, and that any and all such work shall be work made for hire in which all rights and copyrights belong exclusively to Owner. Contractor shall not publish, republish, display or otherwise use any work or Work Products resulting from this Contract without the prior written agreement of Owner. No reports, information and/or data given to or prepared or assembled by the Contractor under this contract shall be made available to any individual or organization by the Contractor without the prior written approval of the Owner.

13) **Compliance with Applicable Law.** Contractor shall comply with all applicable federal, state, and local laws and ordinances applicable to the Work to be performed pursuant to this Agreement, including, without limitation, the provisions of ORS 279B.220, 279B.230, 279B.235, 279B.270 and 279C.515. Without limiting the generality of the foregoing, Contractor expressly agrees to comply with (i) Titles VI and VII of the Civil Rights Act of 1964, as amended; (ii) Sections 503, 504 and 508 of the Rehabilitation Act of 1973, as amended; (iii) the Americans with Disabilities Act of 1990, as amended; (iv) the Health Insurance Portability and Accountability Act of 1996; (v) the Age Discrimination in Employment Act of 1967, as amended, and the Age Discrimination Act of 1975, as amended; (vi) the Vietnam Era Veterans' Readjustment Assistance Act of 1974, as amended; (vii) ORS Chapter 659, as amended; (viii) all regulations and administrative rules established pursuant to the foregoing laws; and (ix) all other applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations.

14) **Use of Recycled Products; Demolition Contracts to Require Material Salvage; Lawn and Landscape Maintenance Contracts to Require Composting or Mulching.** Contractors are encouraged to use recycled products, including recycled paper, recycled oil and recycled PETE products, whenever possible and appropriate in completing the Work. In accordance with ORS 279C.510, contractor shall salvage or recycle construction and demolition debris, if feasible and cost-effective. To the extent applicable to scope of work, Contractor shall compost or mulch yard waste material at an approved site, if feasible and cost-effective.

15) **Professional Standards.** With respect to contracts for Professional Services, Contractor shall be responsible to the level of competency presently maintained by others practicing in the same type of services in Owner's community, for the professional and technical soundness, accuracy and adequacy of all services and materials furnished under this Contract

16) **Completion and Correction of Work.** Work shall be completed in compliance with the terms set forth in the Contract Documents. Owner shall have the right to reject in writing any Work that does not comply with Contract Document specifications. The Contractor shall perform such additional work as may be necessary to correct Contractor's errors without undue delays and without additional cost.

17) **Modification, Supplements, Change Orders or Amendments**. No modification, change, supplement or amendment of the provisions of this Agreement shall be valid unless it is in writing and signed by the parties

hereto.

18) **Indemnity and Insurance**.

a) Indemnity.

i) Contractor acknowledges responsibility for liability arising out of Contractor's negligent performance of this Agreement and shall hold Owner, its officers, agents, consultants, and employees harmless from, and indemnify them for, any and all liability, settlements, loss, costs, and expenses, including reasonable attorney fees, in connection with any action, suit, or claim caused or alleged to be caused by the negligent acts, omissions, activities or services by Contractor, or the agents, consultants or employees of Contractor provided pursuant to this Agreement.

ii) Notwithstanding any other provision of this Contract the foregoing, person(s) providing architectural, engineering, photogrammetric mapping, transportation planning or land surveying services shall not be required to defend the Owner against a professional negligence claim resulting from the professional services provided under this Contract, except to the extent that such liability or fault is determined by adjudication, alternative dispute resolution or resolved by mutual settlement agreement, and shall not to exceed the person's proportionate fault.

b) Workers' Compensation Coverage. Contractor certifies that Contractor has or is qualified for and will maintain workers' compensation as required by the State of Oregon, ORS Chapter 656. Contractor shall provide the Owner, within ten (10) days after full execution of this Contract, a certificate of insurance evidencing coverage of all subject workers under Oregon's workers' compensation statutes. The insurance certificate and policy shall indicate that the policy shall not be terminated by the insurance carrier without thirty (30) days' advance written notice to Owner, pursuant to OAR 836-043-0001. All agents or consultants of Contractor shall maintain such insurance.

c) General Liability and Commercial Automobile Insurance Coverage. Contractor shall maintain general liability and commercial automobile liability insurance for the protection of Contractor and Owner, insuring against liability for bodily injury or property damage, including loss of use, and occurring as a result of, or in any way related to, Contractor's operation. General Liability policy shall be in an amount not less than $2,000,000, per and $2,000,000 combined single limit coverage under the Commercial Automobile policy. Such insurance shall name Owner, its directors, officers, agents, and employees, as an additional insured, with the stipulation that Contractor insurance, as to the interest of Owner, shall not be invalidated by any act or neglect or breach of this Agreement by Contractor.

d) Professional Liability Insurance:
Contractor shall provide Owner with evidence of professional liability insurance for the protection of Contractor and its employees, insuring against claims for damage arising out of Contractor's negligent acts, omissions, activities or services in an amount not less than $1,000,000 per claim and in the aggregate. If professional liability insurance is cancelled or discontinued prior to Work or Services under this Contract, then Contractor shall implement a supplemental reporting period (tail) of no less than 3 years. Contractor shall maintain in force such coverage for not less than six (6) years following completion of the project.

Within ten (10) days after the full execution of the Contract, Contractor shall furnish Owner with a certificate evidencing the dates, amounts, and type of insurance that have been procured pursuant to this Agreement. Contractor will provide for not less than thirty (30) days' written notice to Owner before the policies may be revised, canceled, or allowed to expire. Contractor shall not alter the terms of any policy with prior written authorization from Owner. The provisions of the subsections fully apply to Contractor and its consultants or agents.

e) Such insurance will include contractual liability.

19) **Legal Expenses.** In the event legal action is brought by Owner or Contractor against the other to enforce any of the obligations hereunder or arising out of any dispute concerning the terms and conditions hereby created, the losing party shall pay the prevailing party such reasonable amounts for attorney fees, costs, and expenses as may be set by a court. "Legal action" shall include matters subject to arbitration and appeals.

20) **Severability.** The parties agree that, if any term or provision of this Agreement is declared by a court to be illegal or in conflict with any law, the validity of the remaining terms and provisions shall not be affected.

21) **Number and Gender.** In this Agreement, the masculine, feminine or neutral gender, and the singular or plural number, shall be deemed to include the others or other whenever the context so requires.

22) **Captions and Headings.** The captions and headings of this Agreement are for convenience only and shall not be construed or referred to in resolving questions of interpretation or construction.

23) **Hierarchy.** The conditions contained in this document are applicable to every Personal Services Agreement entered into by the Owner in the absence of contrary provisions. To the extent there is a conflict, the terms of the Personal Services Agreement will control the terms of the standard conditions. To the extent there is a conflict between the terms of the standard conditions and any other document, including the scope of services, the terms of the standard conditions shall control those other terms.

24) **Calculation of Time.** All periods of time referred to herein shall include Saturdays, Sundays and legal holidays in the State of Oregon, except that if the last day of any period falls on any Saturday, Sunday or legal holiday, the period shall be extended to include the next day that is not a Saturday, Sunday or legal holiday.

25) **Notices.** Any notices, bills, invoices, reports or other documents required by this Contract shall be sent by the parties by United States mail with postage prepaid, personally delivered to the addresses listed in the Agreement attached hereto, or sent electronically. All notices shall be in writing and effective when delivered. If mailed, notices shall be deemed effective forty-eight (48) hours after mailing, unless sooner received.

26) **Nonwaiver.** The failure of Owner to insist upon or enforce strict performance by Contractor of any of the terms of this Agreement or to exercise any rights hereunder shall not be construed as a waiver or relinquishment to any extent of its rights to assert or rely upon such terms or rights of any future occasion.

27) **Information and Reports.** Contractor shall, at such time and in such form as Owner may require, furnish such periodic reports concerning the status of the project, such statements, certificates, approvals, and copies of proposed and executed plans and claims, and other information relative to the project as may be requested by Owner. Contractor shall furnish Owner, upon request, with copies of all documents and other materials prepared or developed in relation with or as a part of the project. Working papers prepared in conjunction with the project are the property of Owner but shall remain with Contractor. Copies as requested shall be provided free of cost to Owner.

28) **Owner's Responsibilities.** Owner shall furnish Contractor with all available necessary information, data, and materials pertinent to the execution of this Contract. Owner shall cooperate with Contractor in carrying out the work herein and shall provide adequate staff for liaison with Contractor.

29) **Arbitration.**
All disputes arising out of or under this Agreement shall be timely submitted to nonbinding mediation prior to commencement of any other legal proceedings. The subsequent measures apply if disputes cannot be settled in this manner.
   a) Any dispute arising out of or under this Agreement shall be determined by binding arbitration.
   b) The party desiring such arbitration shall give written notice to that effect to the other party and shall in such notice appoint a disinterested person of recognized competence in the field as arbitrator on its behalf. Within fifteen (15) days thereafter, the other party may, by written notice to the original party, appoint a second disinterested person of recognized competence as arbitrator on its behalf. The arbitrators thus appointed shall appoint a third disinterested person of recognized competence, and the three arbitrators shall, as promptly as possible, determine such matter, provided, however, that:
      i) If the second arbitrator is not appointed as described above, then the first arbitrator shall proceed to determine such matter; and

ii) If the two arbitrators appointed by the parties are unable to agree, within fifteen (15) days after the second arbitrator is appointed, on the appointment of a third arbitrator, they shall give written notice of such failure to agree to the parties and, if the parties fail to agree on the selection of the third arbitrator within fifteen (15) days after the arbitrators appointed by the parties give notice, then, within ten (10) days thereafter, either of the parties, on written notice to the other party, may request such appointment by the presiding judge of the Clackamas County Circuit Court.

c) Each party shall each be entitled to present evidence and argument to the arbitrators. The determination of the majority of the arbitrators or the sole arbitrator, as the case may be, shall be conclusive on the parties, and judgment on the same may be entered in any court having jurisdiction over the parties. The arbitrators or the sole arbitrator, as the case may be, shall give written notice to the parties, stating the arbitration determination, and shall furnish to each party a signed copy of such determination. Arbitration proceedings shall be conducted pursuant to ORS 33.210 et seq. and the rules of the American Arbitration Association, except as provided otherwise.

d) Each party shall pay the fees and expenses of the arbitrator appointed by such party and one-half of the fees and expenses of the third arbitrator, if any.

30) **Governing Law.** This Agreement shall be governed and construed in accordance with the laws of the state of Oregon without resort to any jurisdiction's conflicts of law, rules or doctrines.

31) **Counterparts and Electronic Signatures.** This Agreement may be executed in counterparts. Electronic signatures using an electronic verification system approved by the Owner shall be considered as valid signatures.

32) **Entire Agreement.** This Contract signed by both parties is the parties' final and entire Agreement and supersedes all prior contemporaneous oral or written communications between the Parties, their agents and representatives. There are no representations, promises, terms, conditions or obligations other than those contained herein.