




University of Washington

Energy Renewal Plan

PHASE 3 - IMPLEMENTATION PLAN

December 20, 2024

Affiliated Engineers

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1.0 Executive Summary

The University of Washington (UW) Energy Renewal Plan (ERP) lays out a plan for implementing the long-term goal of decarbonizing the UW Campus. The ERP provides a phased decarbonization of UW's campus utility and energy infrastructure, with the goal of significantly reducing greenhouse gas emissions (GHG).

To fulfill the goals of UW's Energy Strategy, the current campus heating system using fossil fuel-based combustion boilers with steam distribution to the buildings will be transitioned to an electrified system that uses heat pump technology to recover energy from sources within and adjacent to the campus and distribute the energy to the campus buildings through a new medium-temperature hot water system.

This Phase III report represents the culmination of the ERP process, building on the work presented in the Phase I Baseline Assessment Report issued on February 16, 2024[1], and Phase II Project Identification Report issued on December 20, 2024[2]. The Phase III report documents an implementation plan, including funding and debt pathways, and project schedules.

The goals of the Phase III Implementation Plan included:

- Documenting potential schedules of project work.
- Identifying outside funding opportunities and the necessary steps to secure them.
- Identifying a plan for completing projects with alternate funding pathways including sources of debt and public-private partnerships (P3s).
- Performing lifecycle cost analyses to compare the ERP and business-as-usual (BAU) costs under multiple funding scenarios.

[1] See the Phase I report for an analysis of the existing and future campus load characteristics and a discussion of concepts explored in the Phase II Project Identification and Prioritization Report.
[2] See the Phase II report for detailed description of projects included in the ERP that form the basis for the Phase III Implementation Plan.

Lifecycle cost analyses were performed for the following funding scenarios:

- Scenario 1 (S1) — Four Biennia Funding Period (Average $454M / Biennia)
- Scenario 2 (S2) — Five Biennia Funding Period (Average $377M / Biennia)
- Scenario 3 (S3) — Eight Biennia Funding Period (Average $250M / Biennia)
- Scenario 4 (S4) – Seven Biennia Funding Period with P3 Partnerships (Average $247M / Biennia)

These scenarios were developed in collaboration with UW to develop an array of timelines based on potential state funding schedules. The shorter Biennia Funding scenarios require higher levels of investment per period.

Figure 1.0-1 illustrates a comparison between the ERP and BAU cases with representative ongoing operational and renewal costs associated with each. The duration of the life cycle cost analysis extends 50 years.

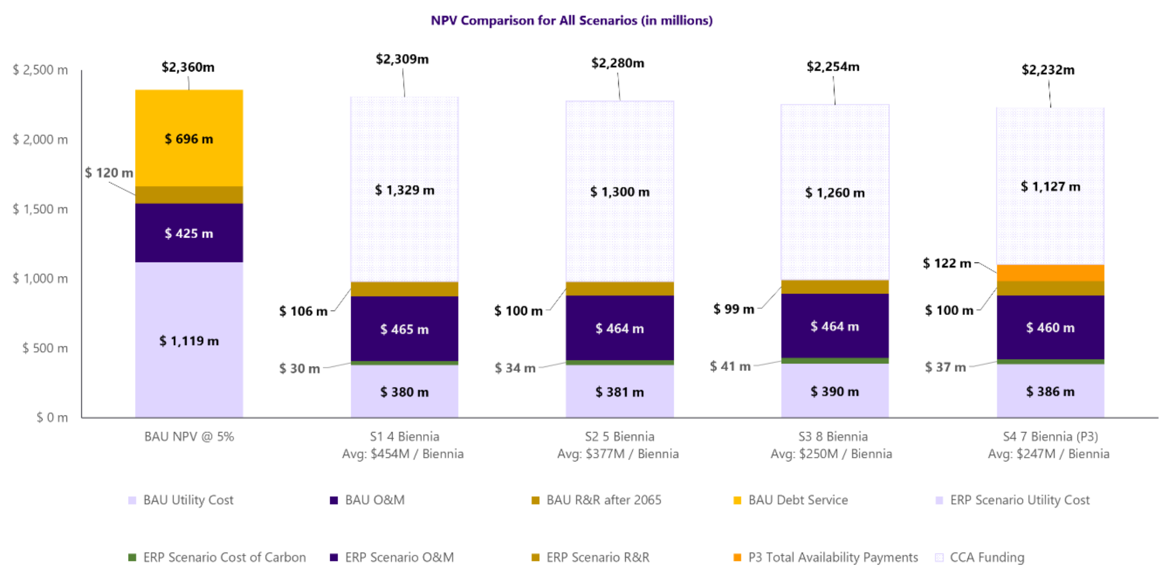

Figure 1.0-1: *Net Present Value (NPV) comparison of the Business-As-Usual (BAU) case to the ERP under four varying funding timeline scenarios.*

It can be seen from Figure 1.0-1 that each of the ERP funding scenarios have positive net present values relative to the BAU. Refer to Section 4, Financial Modeling, for details on assumptions and data sources. An important metric for this analysis is the incremental NPV cost of the proposed plan relative to the carbon emissions being offset over the life of the study. The resulting value is $147 /

MTCO2e avoided. As a point of comparison, the University of California system requires their energy projects to be evaluated with an equity-weighted social cost of carbon factor of $265/MTCO2e (as of 2025 and escalated 1.5% annually), so the UW Energy Renewal Plan compares favorably (lower cost / higher effectiveness). Refer to Section 5 Life Cycle Cost Analysis for additional detail.

Annual utility costs are presented in Table 1.0-1, showing that once the ERP systems are fully implemented, a utility cost savings of approximately $5.5 million per year will be realized comparing the ERP with conventional natural gas (NG) to the BAU with conventional NG. Greenhouse gas emission reductions for the ERP compared to the BAU using conventional natural gas are shown in Table 1.0-2. Refer to section 5.0, Life Cycle Cost Analysis, for additional details.

Table 1.0-1: Annual Utility Cost Summary for the year 2050 in 2024 dollars.
Costs are Normalized Against 13,700,000 Square Feet (SF) of Buildings Connected to WCUP and PP

	Annual	$/sf
ERP with Conventional NG	$ 13,355,517	$ 0.97
ERP with Renewable NG	$ 14,893,326	$ 1.12
BAU with Conventional NG	$ 18,879,396	$ 1.38
BAU with Renewable NG	$ 27,345,562	$ 2.00

Table 1.0-2: Annual Greenhouse Gas Emission Summary.

	Annual MTONs CO2	Notes
ERP Campus	23,692	Contiguous campus. Includes gas consumption at buildings and emissions from process steam which remains on natural gas. Does not take credit for renewable natural gas.
BAU Campus	80,800	

First costs (in 2024 dollars) used for determining the funding requirements are shown in Table 1.0-3. These dollar amounts do not directly compare to the funding schedule values since they are in present day dollars and the funding requirement increases over time due to escalation. These costs have been divided into categories based on the following critical areas of need for the campus:

- Decarbonization of campus energy systems (P3 opportunities segregated)
- Electrical system upgrades to meet the needs of a tier-one research university
- Climate adaptation to address the impact of rising summer temperatures

Table 1.0-3: First Costs for the Energy Renewal Plan (in 2024 Dollars)

Decarbonization	Public-Private Partnership Opportunities	Electrical System Upgrades	Climate Adaptation
$1,183 million	$179 million	$50 million	$178 million

The first cost data provided in Table 1.0-2 defines the relative amounts being invested for each category. However, all analyses of lifecycle costs and funding plans are based on the total scope, including each of the categories above.

Table 1.0-4 shows the anticipated financing required for different funding scenarios in each biennium appropriation cycle, based on accomplishing all of the projects associated with the costs in Table 1.0-3. Refer to section 3.0 Implementation Plan and Appendix 10.4.1 for details on which projects are associated with these funding cycles.

Table 1.0-4: Funding Cycle Appropriations

Funding Cycle	Scenario 1: Four Biennia	Scenario 2: Five Biennia	Scenario 3: Eight Biennia	Scenario 4: Seven Biennia
2025-2027	$292.6 million*	$292.6 million*	$292.6 million*	$292.6 million*
2027-2029	$701,378,783	$433,346,589	$244,363,826	$244,083,918
2029-2031	$613,438,773	$436,853,076	$294,094,771	$295,957,265
2031-2033	$208,730,806	$271,249,040	$270,674,500	$281,006,700
2033-2035		$452,467,620	$279,924,844	$274,277,272
2035-2037			$279,938,183	$178,269,938
2037-2039			$270,349,261	$159,510,416
2039-2041			$66,165,944	
Totals	$1,816,148,363	$1,886,516,326	$1,998,111,328	$1,725,705,509

***Notes:**

The 2025-2027 funding cycle occurred early during the creation of this report. The ERP team supported UW in developing a group of projects (including budget and schedule) for this funding cycle. Refer to section 3.2.1 for additional details on this first phase of the project.

Based on assessments of IRA tax credit eligibility for the projects developed for the ERP, the potential tax credit estimate for the project has a low range estimate of $3.5 million and a high range estimate of $27.7 million, depending on the project factors described in this report. Refer to section 4.0, Financial Modeling and section 6.0, Funding Guidance for additional details.

The Energy Renewal Program is anticipated to begin design in late 2025 upon receipt of capital from the first biennium funding period. Based on schedules developed as part of this report (refer to Appendix 10.4, Project Preliminary Milestone Schedules), the ERP could be completed as soon as 2034, in the fastest Funding Scenario 1 (Four Biennium funding cycles). Conversely, the longest timeline is shown in Funding Scenario 3 (Eight Biennium funding cycles) would be completed in 2042.

Figure 1.0-2 shows a partial snapshot of the schedule for Funding Scenario 1 as an example. Refer to section 3.0, Implementation Plan, for more details on other scenarios, individual projects, and sequencing activities. Refer to Appendix 10.4 for high-level and detailed milestone schedules.

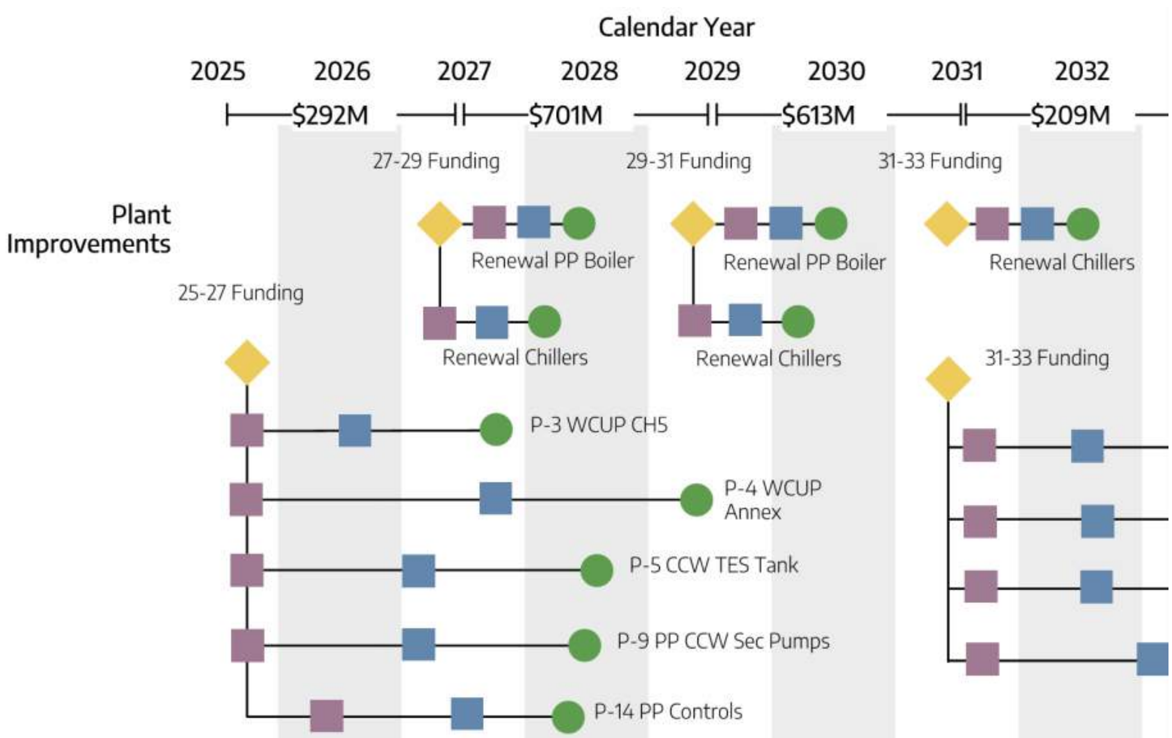

Figure 1.0-2: *Excerpt of a high-level Energy Renewal Plan schedule and funding plan. Refer to Appendix 10.4 for the full set of schedule scenarios.*

2.0 Introduction

2.1 Project Definition and Goals

The University of Washington (UW) Energy Renewal Plan (ERP) aims to advance concepts developed from studies dating back to 2009 into a set of actionable plans that will meet the long-term goal of decarbonizing the UW campus. Plans will address items like budgeting, funding, and logistics.

This report documents the work completed during Phase III of the ERP process. Phase III evaluated various scenarios for phasing the work based on such issues as logical workflow, impacts on campus life, and funding opportunities. This report identifies an implementation plan and schedule for achieving the University's goals and defines a budget, funding plan, and anticipated construction duration for the combined scenarios.

The primary drivers for this report include:

- Delivering projects identified in the Phase II report, which will provide reliable and resilient thermal and electrical utilities to the campus.
- Maximizing funding from outside sources to reduce the need for state funding and required debt issuance.
- Continued commitment from UW students, faculty, and administration to be leaders in the reduction of greenhouse gas emissions on college campuses.
- Compliance with Washington State House Bill 1390, which requires the development of a plan to decarbonize district heating systems by 2050.
- The Phase I report, issued on February 16, 2024, which provided the baseline assessment of existing conditions.

The UW Campus includes buildings owned and leased beyond the footprint of what is traditionally considered the UW campus. The ERP excludes leased buildings, undeveloped sections of the East Campus, Husky Stadium, and other properties outside an agreed-upon proximity to existing district energy utilities. Refer to Appendix 9.2 in the Phase II report for a site plan of buildings excluded from the study and those identified as provisioned for future connection (e.g., housing/athletics, facilities with stand-alone systems).

2.2 Integration with the Building Renewal Plan (BRP)

The University engaged a separate team, led by Miller Hull, to generate a Building Renewal Plan (BRP) for prioritizing the removal, renovation, or replacement of existing buildings. This study primarily focused on optimizing the utilization of campus building stock and reducing deferred maintenance of existing facilities to an acceptable level. The ERP and BRP teams coordinated efforts through a series of workshops that informed prioritization needs for deferred maintenance and the campus energy system transition.

While ERP-related work is considered the near-term funding priority for the campus, remodeling, renovation, and replacement projects may occur during ongoing ERP work. Together, the ERP and BRP teams determined how to incorporate the mechanical systems renovations into the early building work, allowing for integration with minimal disruption once the ERP systems are available in the building.

Refer to Appendix 10.2 for specific details on the BRP and ERP efforts.

2.3 Background

In addition to the work documented in the Phase I Baseline Assessment report, the following studies, assessments, and reports inform the history of campus infrastructure and building master plans for the ERP study:

- 2011 University of Washington South of Pacific Avenue Master Infrastructure Review
- 2014 University of Washington Hot Water Conversion Study
- 2017 University of Washington Hot Water Conversion Study: Phase II
- 2016 South Campus Study
- 2019 University of Washington Seattle Campus Master Plan
- 2021-22 ISES Facilities Condition Assessment
- 2022 Utilities Infrastructure Assessment
- UW Cultural Resources Report

2.4 Process and Collaboration with University of Washington Staff

The University of Washington supported the planning effort with a highly developed oversight and governance structure, dedicated staff providing daily direction and oversight, and Project Working Teams.

Project Working Teams (PWTs) supported knowledge transfer, data gathering, review of proposed concepts, task prioritization, and outreach strategy formation for external entities. Both the ERP consulting team and the UW internal team of experts were integrated into the PWTs. These teams met regularly from the baseline assessment through the project identification phase with a focus on:

- Funding and Financing
- Central Plant, Thermal Energy Storage, and Distribution
- Thermal Transfer (Lake Interface and Sewer Heat Recovery)
- Buildings
- Electrification

The University's internal team of experts included staff with experience in operations, engineering, sustainability, energy conservation, data management, and transitioning university campuses from steam to hot water. The ERP consulting team consisted of firms with specialty knowledge and experience, including:

- Affiliated Engineers, Inc. (AEI) – Prime consultant and mechanical and electrical master planning and engineering
- KPFF – Civil engineering and site utilities planning
- Whiting-Turner (W-T) – Cost estimating, phasing, and logistics analysis
- Shannon & Wilson (S&W) – Lake water technical and permitting specialists
- Ernst & Young (EY) – Financial analysis and funding plans
- Makai Ocean Engineering – Subject matter experts in pipeline design for lakes and oceans
- Rolluda Architects – Architectural and site development concepts and campus planning

2.5 Commonly Used Terms

Campus Cooling Water (CCW)	Term used to refer to the existing district cooling system on the UW campus.
Coefficient of Performance (COP)	Measure of system efficiency. For chillers and heat recovery chillers, it is the ratio of useful heating provided to work (energy) required. Higher COPs are more energy efficient.
East Receiving Station (ERS)	Electrical distribution point located at the Power Plant.
Heat Recovery Chiller (HRC)	A device that can produce useful heating and cooling in the form of heated or cooled water at a campus scale.
Inflation Reduction Act (IRA)	A federal law established in 2022 to increase investment in domestic energy production and promote clean energy.
MBH	1,000 British Thermal Units (BTUs), an imperial unit measurement of heat energy. MBH is commonly used in heating applications to quantify thermal energy and evaluate energy consumption and efficiency.
Magnusson Health Science Center (MHSC)	A science complex made up of many buildings, located adjacent to the Medical Center.
Megawatt (MW)	An International System (SI) measurement of power, typically used for electrical systems (1 MW = 1,000 Kilowatts = 1,000,000 Watts).
Megawatts thermal (MWth)	Measurement of thermal power. The "th" is used as a clarifier to denote heat rather than electrical.
Primary Heating Water (PHW)	Term used to refer to the new district heating system on the UW campus.
Power Plant (PP)	The original central utility plant, located on the east side of campus.
University of Washington Medical Center (UWMC)	The University of Washington's healthcare facility.
West Campus Utility Plant (WCUP)	The most recent campus utility plant, located on the west side of campus serving facilities with critical cooling loads.
West Receiving Station (WRS)	Main point of entry for power from Seattle City Light.

3.0 Implementation Plan

The following section identifies implementation scenarios and schedules for achieving the University's goals in developing the final implementation plan. Budgets, funding plans, and anticipated construction durations for the scenarios are also presented. The projects that make up this plan are defined in the Phase II Project Identification report.

Phasing of the projects must ensure occupied buildings have heating and cooling available and disruptions to campus operations are minimized. This detailed effort is beyond the scope of this study.

This plan was developed in coordination with Building Renewal efforts across campus. Refer to Appendix 10.2, Building Renewal Plan Integration, for more details.

3.1 Project Sequencing

Due to the uncertainty surrounding what level of funding will be available from the state per biennium, multiple scenarios for project sequencing / funding were developed to give a range of possibilities once there is more clarity.

The sequence of project work across each scenario is driven by some key factors:

- The University's desire to re-use existing tunnels for hot water distribution where possible.
- Extended permit durations associated with the Lake Water Interface project.
- Reliability and redundancy requirements for critical buildings in the South of Pacific region.

The reuse of the existing tunnels has the largest impact on the work sequence due to the need to remove and replace existing heating and cooling piping services with new services in the same position. Further, this drives the need for buildings to be converted as the distribution work occurs. New heating systems will also need to be placed to serve the buildings along the tunnel's route.

Alternate project scenarios focusing on buried piping rather than tunnel reuse were studied from a cost standpoint but have not been evaluated for their impact on the project schedule. Overall, buried piping implementation offers greater flexibility. The buried piping would run parallel to the tunnel's existing piping, removing the dependency between the building conversion effort and the distribution's installation.

The project sequence begins with plant enhancements, followed by the distribution and building conversion work, which progresses from the buildings nearest to the plants to those farthest away. Implementation of the two energy sources, Lake Interface and Sewer Heat Recovery is prioritized earlier in the project sequences. The final phases of the project sequences involve completing the distribution and building conversions along the central arteries of the campus and addressing elements that will eliminate the remaining 10-20% of fossil fuel usage associated with the heating systems.

For more details on the timing associated with each project, Table 3.1-1 provides a list of projects included within each biennium across the four funding scenarios. Refer to Appendix 10.4, Project Preliminary Milestone Schedules, for project schedules, including more specific dates and a breakdown of pre-construction and construction activities.

Table 3.1-1: Funding Cycle and Project Completion Years for ERP Project Elements

Project #	Project Description	Scenario 1: Four Biennia	Scenario 2: Five Biennia	Scenario 3: Eight Biennia	Scenario 4: Seven Biennia
Equipment Renewal	Existing Boiler Replacements	Funded: 2027, 2029, 2031 Complete: 2028, 2030, 2032	Funded: 2029, 2031, 2033 Complete: 2030, 2032, 2034	Funded: 2027, 2035, 2037 Complete: 2028, 2036, 2038	Funded: 2029, 2031, 2033 Complete: 2030, 2032, 2034
Equipment Renewal	Existing Chiller and Cooling Tower Replacements	Funded: 2027, 2029 Complete: 2028, 2030	Funded: 2029, 2031 Complete: 2030, 2032	Funded: 2035, 2037 Complete: 2036, 2038	Funded: 2031, 2033 Complete: 2032, 2034
P-1	Convert CCW to Year-Round Operation	Funded: 2029 Complete: 2031	Funded: 2027 Complete: 2029	Funded: 2027 Complete: 2029	Funded: 2027 Complete: 2029
P-2	Power Plant Add CH-8 and CT-14	Funded: 2031 Complete: 2034	Funded: 2033 Complete: 2036	Funded: 2037 Complete: 2040	Funded: 2031 Complete: 2034
P-3	WCUP CH-5 and CT-5	Funded: 2025 Complete: 2028	Funded: 2025 Complete: 2028	Funded: 2025 Complete: 2028	Funded: 2025 Complete: 2028

Table 3.1-1: Funding Cycle and Project Completion Years for ERP Project Elements

Project #	Project Description	Scenario 1: Four Biennia	Scenario 2: Five Biennia	Scenario 3: Eight Biennia	Scenario 4: Seven Biennia
P-4	WCUP Annex	Funded: 2025 Complete: 2030	Funded: 2025 Complete: 2030	Funded: 2025 Complete: 2030	Funded: 2025 Complete: 2030
P-5	CCW TES Tank	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029
P-6	PHW TES Tank	Funded: 2029 Complete: 2032	Funded: 2031 Complete: 2034	Funded: 2031 Complete: 2034	Funded: 2029 Complete: 2032
P-7	WCUP HRCs and Cooling Towers	Funded: 2029 Complete: 2032	Funded: 2029 Complete: 2032	Funded: 2029 Complete: 2032	Funded: 2029 Complete: 2032
P-8	Power Plant Heat Recovery Chillers	Funded: 2027 Complete: 2031	Funded: 2031 Complete: 2035	Funded: 2031 Complete: 2035	Funded: 2031 Complete: 2035
P-9	CCW Header and Secondary Pumping System	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029
P-10	Power Plant PHW System	Funded: 2027 Complete: 2031	Funded: 2027 Complete: 2031	Funded: 2027 Complete: 2031	Funded: 2027 Complete: 2031
P-11	PP Electric Boilers and Emergency Generator Heat Recovery	Funded: 2031 Complete: 2035	Funded: 2033 Complete: 2037	Funded: 2039 Complete: 2043	Funded: 2033 Complete: 2037
P-12	WCUP Electric Boilers	Funded: 2031 Complete: 2034	Funded: 2033 Complete: 2036	Funded: 2039 Complete: 2042	Funded: 2033 Complete: 2036
P-13	WCUP Generators	Funded: 2031 Complete: 2034	Funded: 2033 Complete: 2036	Funded: 2039 Complete: 2042	Funded: 2031 Complete: 2034
P-14	PP Controls Upgrades	Funded: 2025 Complete: 2028	Funded: 2025 Complete: 2028	Funded: 2025 Complete: 2028	Funded: 2025 Complete: 2028
E-1	UW Substation	Funded: 2025 Complete: 2030	Funded: 2025 Complete: 2030	Funded: 2025 Complete: 2030	Funded: 2025 Complete: 2030

Table 3.1-1: Funding Cycle and Project Completion Years for ERP Project Elements

Project #	Project Description	Scenario 1: Four Biennia	Scenario 2: Five Biennia	Scenario 3: Eight Biennia	Scenario 4: Seven Biennia
E-2	PP Ring Bus and Express Feeders	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029
B-1	Chiller Replacements - South of Pacific	Funded: 2031 Complete: 2035	Funded: 2033 Complete: 2037	Funded: 2037 Complete: 2041	Funded: 2035 Complete: 2039
B-1	Chiller Replacements – Central	Funded: 2031 Complete: 2035	Funded: 2033 Complete: 2037	Funded: 2037 Complete: 2041	Funded: 2035 Complete: 2039
B-1	Chiller Replacements – North	Funded: 2031 Complete: 2035	Funded: 2033 Complete: 2037	Funded: 2037 Complete: 2041	Funded: 2035 Complete: 2039
B-8,9,10	Building PHW Conversions – Central Campus West Tunnel	Funded: 2029 Complete: 2032	Funded: 2033 Complete: 2036	Funded: 2033 Complete: 2036	Funded: 2033 Complete: 2036
B-8,9,10	Building PHW Conversions – Central/Lower Campus	Funded: 2027 Complete: 2030	Funded: 2027 Complete: 2030	Funded: 2037 Complete: 2040	Funded: 2037 Complete: 2040
B-8,9,10	Building PHW Conversions – East Campus	Funded: 2029 Complete: 2032	Funded: 2031 Complete: 2034	Funded: 2033 Complete: 2036	Funded: 2031 Complete: 2034
B-8,9,10	Building PHW Conversions – North Campus	Funded: 2029 Complete: 2033	Funded: 2027 Complete: 2031	Funded: 2029 Complete: 2033	Funded: 2029 Complete: 2033
B-8,9,10	Building PHW Conversions – South from Power Plant	Funded: 2029 Complete: 2033	Funded: 2033 Complete: 2036	Funded: 2027 Complete: 2030	Funded: 2027 Complete: 2030
B-8,9,10	Building PHW Conversions – South from WCUP	Funded: 2027 Complete: 2030	Funded: 2027 Complete: 2030	Funded: 2035 Complete: 2039	Funded: 2035 Complete: 2039
B-8,9,10	Building PHW Conversions – West Campus	Funded: 2027 Complete: 2030	Funded: 2027 Complete: 2030	Funded: 2027 Complete: 2030	Funded: 2027 Complete: 2030
B-6	Energy Metering	Funded: 2027 Complete: 2029	Funded: 2029 Complete: 2031	Funded: 2035 Complete: 2037	Funded: 2027 Complete: 2029

Table 3.1-1: Funding Cycle and Project Completion Years for ERP Project Elements

Project #	Project Description	Scenario 1: Four Biennia	Scenario 2: Five Biennia	Scenario 3: Eight Biennia	Scenario 4: Seven Biennia
B-11	Satellite Steam Plants	Funded: 2027 Complete: 2031	Funded: 2027 Complete: 2031	Funded: 2027 Complete: 2031	Funded: 2027 Complete: 2031
S-1	Lake Water Interface	Funded: 2027 Complete: 2032	Funded: 2027 Complete: 2032	Funded: 2029 Complete: 2034	Funded: N/A Complete: 2033
S-2	Sewer Heat Recovery	Funded: 2027 Complete: 2030	Funded: 2027 Complete: 2030	Funded: 2027 Complete: 2030	Funded: N/A Complete: 2032
D-C-1	Central Campus Piping	Funded: 2029 Complete: 2033	Funded: 2029 Complete: 2033	Funded: 2033 Complete: 2037	Funded: 2033 Complete: 2037
D-C-2	Central Campus Piping West Tunnel	Funded: 2031 Complete: 2034	Funded: 2033 Complete: 2036	Funded: 2037 Complete: 2040	Funded: 2037 Complete: 2040
D-N-1	North Campus Piping	Funded: 2029 Complete: 2033	Funded: 2027 Complete: 2031	Funded: 2029 Complete: 2033	Funded: 2029 Complete: 2033
D-S-1	WCUP to South Campus Piping	Funded: 2027 Complete: 2031	Funded: 2027 Complete: 2031	Funded: 2027 Complete: 2031	Funded: 2027 Complete: 2031
D-S-2	PP to South Campus Piping	Funded: 2029 Complete: 2033	Funded: 2033 Complete: 2037	Funded: 2035 Complete: 2039	Funded: 2035 Complete: 2039
D-W-1	West Campus Piping	Funded: 2025 Complete: 2030	Funded: 2025 Complete: 2030	Funded: 2025 Complete: 2030	Funded: 2025 Complete: 2030
D-W-2	Sewer Heat Recovery Piping	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029	Funded: 2025 Complete: 2029
D-E-1	Piping from PP to East and SE Campus	Funded: 2027 Complete: 2032	Funded: 2031 Complete: 2036	Funded: 2033 Complete: 2038	Funded: 2031 Complete: 2036

***Notes:**

The 2025-2027 funding cycle occurred during the creation of this report. The ERP team supported the University of Washington in developing a group of projects (including budget and schedule) for this funding cycle. Additional project design scope associated with Power Plant upgrades will be pulled forward as part of the P-5 CCW TES tank project to maintain the project schedule, with the additional cost being requested in the 2027-2029 biennium funding cycle. Refer to section 3.2.1 for additional details on this first phase of the project.

3.2 Biennium Funding Requests

Table 3.2-1 shows the anticipated financing required for different funding and debt scenarios in each biennium appropriation cycle.

Table 3.2-1: Funding Cycle Appropriations

Funding Cycle	Scenario 1: Four Biennia	Scenario 2: Five Biennia	Scenario 3: Eight Biennia	Scenario 4: Seven Biennia
2025-2027	$292.6 million*	$292.6million*	$292.6million*	$292.6million*
2027-2029	$701,378,783	$433,346,589	$244,363,826	$244,083,918
2029-2031	$613,438,773	$436,853,076	$294,094,771	$295,957,265
2031-2033	$208,730,806	$271,249,040	$270,674,500	$281,006,700
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2035-2037			$279,938,183	$178,269,938
2037-2039			$270,349,261	$159,510,416
2039-2041			$66,165,944	
Totals	$1,816,148,363	$1,886,516,326	$1,998,111,328	$1,725,705,509

***Notes:**

The 2025-2027 funding cycle occurred early during the creation of this report. The ERP team supported UW in developing a group of projects (including budget and schedule) for this funding cycle. Refer to section 3.2.1 for additional details on this first phase of the project.

3.2.1 2025-2027 Biennium Funding Request

The 2025-2027 funding cycle occurred during the early phases of the creation of this report. The ERP team supported the University of Washington in developing a group of projects (including budget and schedule) for this funding cycle.

The funding amounts requested for the projects in this cycle are shown in Table 3.2.1-1. Due to the timing of this request being in advance of finalized conceptual estimates for the project scope developed in the Phase II Project Identification report, preliminary estimates were utilized. These individual project costs do not necessarily match the final estimates developed as part of Phase II and III, and some reallocation of funding between the projects will be required.

Table 3.2.1-1: 2025-2027 ERP Funding Requests

2025-2027 Project #	Project Title	Budget	Notes
1	Chilled Water Thermal Energy Storage	$73.3 million	Elements of this project are now represented in projects P-5, P-9, and B-1. Timing of this project will require additional funding in the 27-29 biennium to complete.
2	Power Plant Boiler Removal	$2 million	Scope is incorporated into P-8.
3	Micro-district West Campus	$76.4 million	Scope is incorporated into D-W-1. Additional funding will be required in the 27-29 biennium.
4	Micro-district South of Pacific	$31.1 million	Scope is incorporated into D-S-1. Additional funding will be required in the 27-29 biennium.
5	Sewer Heat Recovery Site Piping	$14.7 million	Scope is incorporated into D-W-2.
6	WCUP Heating System Improvements	$28.6 million	Scope is incorporated into P-4. Additional funding will be required in the 27-29 biennium.
7	West Receiving Station Electrical Infrastructure Upgrade	$50.1 million	Scope is incorporated into E-1. Final amount is dependent upon negotiations with SCL for cost-sharing.
8	Chiller Installation	$13.5 million	Scope is incorporated into P-3.
9	District Energy Standards/Basis of Design	$1.9 million	Scope is incorporated into P-1.
10	Lake Interface Advancement	$1 million	Scope is incorporated into S-1.
Total		$292.6 million	

3.3 Project Delivery Methods

Several delivery methods are available for executing projects defined in the ERP. The methods employed will depend on how much risk the University is willing to accept in the overall project cost weighed against the authority the University will have in the design.

The following sections provide considerations for each of the likely project delivery methods, from the highest level of financial risk and authority in design to the lowest level of financial risk and authority.

Design-Bid-Build

Design-Bid-Build gives the University the most design authority, defining precisely the project requirements. However, with no contractor involvement during the design stage or ahead of the bid process, there is a much higher risk of construction cost escalation.

The University hires the architect/engineer during pre-construction, and the contractor is awarded through the bid process. During the bid process, the low-bid contractor is required to be selected. Since no budgetary feedback is provided prior to finalizing the design, there is a risk that all bids may exceed the project budget.

This delivery method is typically used on technically complex projects with a straightforward execution.

General Contractor / Construction Manager (GC/CM)

The General Contractor/Construction Manager delivery method involves selecting the architect/engineer during pre-construction and bringing the general contractor on board early in the design process. This method provides the University with a high level of design authority. Moreover, contractor involvement during the design stage provides value in constructability feedback, alternative cost-effective solutions, and the early cost estimating stage, helping to reduce the risk of high construction costs.

This method should be used for projects requiring significant contractor input during design. Trade partners can be brought on board early if the value of the work exceeds $3 million.

Progressive Design-Build

The Progressive Design-Build delivery method traditionally involves hiring the general contractor and architect as a team during pre-construction and then selecting the engineering team alongside the University. For the ERP, the general contractor and engineering team should be selected as a team to streamline the process. The project definition can be kept fairly high-level as the design-build team will be heavily involved with the Owner in the definition of the project within the budgetary constraints.

During the design process, the design team working under the contractor develops the design to an adequate level to help define the contract's Guaranteed Maximum Price (GMP). This method provides a reasonable level of design authority to the University, though the contractor has more authority in defining the quality of materials used. The GMP provides a level of certainty regarding the total project cost for the University.

The scope must be flexible in this method if the contingency is exhausted. In recent years, a high rate of projects has been delivered on the UW campus using this method. The University has seen value in having cost certainty while maintaining flexibility on scope and schedule.

This method should be used for projects requiring significant contractor input during design. Trade partners can be brought on board early if the value of the work exceeds $3 million.

Traditional Design-Build

The Traditional Design-Build delivery method involves hiring the general contractor and architectural/engineering team during pre-construction. A more specific project definition is required with the traditional method compared to the progressive design-build delivery method since the design-build team will set the GMP at the time of selection rather than develop alongside the Owner.

This method provides a low level of authority for the University in setting project criteria and is more heavily focused on meeting a set budget determined at an earlier stage in the project than progressive design-build.

Recent history at the UW has seen this method rarely being used. It is not anticipated to offer advantages over other delivery methods and is not recommended for any of the projects associated with the ERP.

Public-Private Partnership (P3)

The Public-Private Partnership (P3) delivery method involves selecting a private developer to engage in a contract whereby the University agrees to pay a commodity rate for energy delivered by the developer’s project. This commodity rate is set at a value that allows the developer to recoup their development, maintenance, and utility costs while also earning a profit.

While this method provides the University with a low level of design authority, it offers a high level of cost certainty and scope flexibility. Performance specifications for schedule, efficiency, performance, and reliability would be set as part of the advertisement to developers. The UW has used this delivery method on recent projects (e.g., Benjamin Hall).

The P3 method is recommended for its potential benefits as an alternate financing strategy for certain projects.

Public-Public-Partnership

Although similar to the P3 delivery method, the Public-Public-Partnership method involves an agreement between the University and another public entity. Regarding UW’s ERP projects, this method only applies to the E-1 UW Substation scope of work as an agreement between UW and Seattle City Light.

UW will negotiate an electrical utility rate with Seattle City Light for the power provided by the improved UW Substation system. This rate will cover the cost of power delivery, the development of the UW Substation site, and any renewal costs that will be realized over the life of the system.

Recommendations

Table 3.3-1 provides a recommended list of project delivery method options for each project (as defined in Phase II Project Identification report). These recommendations are based on optimizing the benefits of the delivery methods outlined above per the specific project characteristics and constraints.

Table 3.3-1: Recommended Project Delivery Methods by Project

Project #	Project Name	Recommended Project Delivery Methods: Design-Bid-Build	GC/CM	Progressive D-B	Traditional D-B	P3	Public-Public Partnership
B-1	Chiller Replacements			✓	✓		
B-6	Metering Program	✓	✓				
B-8,9,10	HHW Conversions		✓	✓			
B-11	Local Satellite Steam Plants		✓	✓			
D-X	Distribution Piping Scope – All		✓	✓			
E-1	UW Substation		✓	✓			✓
E-2	PP Ring Bus & Express Feeders		✓	✓			
P-1	Convert CCW to Year-round Operation	✓	✓				
P-2	Add CH-8_CT-14			✓			
P-3	WCUP CH5 & CT			✓	✓		
P-4	WCUP Annex		✓	✓			
P-5	CCW TES Tank		✓	✓			
P-6	PHW TES Tank		✓	✓			
P-7	WCUP HRCs and Cooling Tower		✓	✓			
P-8	Power Plant Heat Recovery Chillers		✓	✓			
P-9	CCW Header and Secondary Pumping System		✓	✓			
P-10	Power Plant PHW System		✓	✓			
P-11	PP Elec. Boilers & EM Gen Heat Rec.		✓	✓			
P-12	WCUP Electric Boilers		✓	✓			
P-13	WCUP Generators	✓		✓	✓		
P-14	PP Controls Upgrades	✓	✓				
S-1	Lake Interface System		✓	✓		✓	
S-2	Sewer Heat Recovery Equipment Bldg.		✓	✓		✓	

3.4 ERP Program Integration and Oversight

The scope of work for UW's Energy Renewal Plan is large, multifaceted, and will likely involve numerous Contractors and Engineers to complete over the 10-year timeframe. In order to provide integration and consistency in design standards and construction methods, it is recommended that the University select an entity to oversee the projects across the UW campus. This firm would be responsible for:

1. Providing a staff of design and construction professionals with experience in implementing campus district energy transitions.
2. Providing technical specifications and a basis of design for district energy systems.
3. Providing peer review of the design and construction submittals for project work across the campus to maintain consistency with the established district energy system standards.

In lieu of an outside firm the UW could find an internal group focused on the issues identified above.

4.0 Financial Modeling

4.1 Background and Introduction

4.1.1 Project Overview

The University of Washington Energy Renewal Program (ERP) is a significant infrastructure initiative aimed at modernizing and optimizing the university's energy systems. As part of the ERP Phase III analysis, a financial analysis was developed to assess the economic viability and financial implications of the proposed ERP projects.

The ERP comprises 44 projects, ranging from building-level projects, power infrastructure enhancements, central campus modernization, distribution system improvements, and development of new energy generation facilities.

Table 4.1.1-1: List of Planned Projects under Energy Renewal Program

Project Category	Project Name
Buildings	B-1 Chiller Replacements- South of Pacific
	B-1 Chiller Replacements- Central
	B-1 Chiller Replacements- North
	B-6 Metering Program
	B-8,9,10 HHW Conversions- Central Campus West Tunnel Scope Zone
	B-8,9,10 HHW Conversions- Central/ Lower Distribution Scope Zone
	B-8,9,10 HHW Conversions- East Campus Distribution Scope Zone
	B-8,9,10 HHW Conversions- North Distribution Scope Zone
	B-8,9,10 HHW Conversions- South from Power Plant (PP) Scope Zone
	B-8,9,10 HHW Conversions- South from WCUP Scope Zone
	B-8,9,10 HHW Conversions- West Distribution Scope Zone
	B-11 Local Satellite Steam Plants
Electrical Infrastructure	E-1 UW Substation
	E-2 PP Ring Bus & Express Feeders

Project Category	Project Name
Plants	P-1 Convert CCW to Year-round Operation P-2 Add CH-8_CT-14 P-3 WCUP CH5 & CT P-4 WCUP Annex P-5 CCW TES Tank P-6 PHW TES Tank P-7 WCUP HRCs and Cooling Tower P-8 Power Plant Heat Recovery Chillers P-9 CCW Header and Secondary Pumping System P-10 Power Plant PHW System P-11 PP Elec. Boilers & EM Gen Heat Rec. P-12 WCUP Electric Boilers P-13 WCUP Generators P-14 PP Controls Upgrades
Site Distribution	D-C1 Central Campus Piping D-C2 Central Campus Piping West Tunnel D-N1 North Campus Piping D-S1 PHW Piping from WCUP to South Campus D-S2 South of Pacific Campus Piping from PP D-W1 West Campus CCW & PHW Piping- Phase 1 D-W2 Sewer Heat Recovery Piping D-E1 PHW Piping from PP to East and SE Campus D-W1 West Campus CCW & PHW Piping- Phase 2
Source Facilities	S-1 Lake Interface System- Phase 1 S-2 Sewer Heat Recovery Equipment Bldg- Phase 1 S-1 Lake Interface System- Phase 2 S-2 Sewer Heat Recovery Equipment Bldg- Phase 2
CPAT	CPAT- Lake Advancement CPAT- District Energy Stands/Basis of Design CPAT- PP Boiler Removal

4.1.2 Financial Analysis Objectives

The primary objectives of the ERP financial analysis are:

1. To serve as a baseline representation of the project's financial envelope and projected cashflows;
2. To establish the funding and financing requirements for the implementation of the ERP projects, as well as identifying different financing options and scenarios; and
3. To develop and analyze multiple scenarios relating to funding and financing sources to inform UW's project and financial planning during the execution of the ERP and provide a foundation for further financial analysis as the project evolves and responds to changes in the funding landscape.

Figure 4.1.2-1: *General framework of the financial analysis*

4.2 Methodology and Key Inputs

The financial analysis of the Energy Renewal Program (ERP) evaluates multiple scenarios and considers various inputs, including project timelines, capital costs, operational costs, tax credits and incentives, delivery models, inflation/escalation rates, and financial parameters.

The analysis follows these general principles and methodologies:

- **Phasing:** Each ERP implementation phase is assumed to correspond to a 2-year period, aligning with the State of Washington's biennial appropriation cycles. The analysis currently covers scenarios that include a range of four to eight phases for the comprehensive implementation of the full set of ERP projects.
- **Scenario Analysis:** The analysis includes multiple defined scenarios, allowing for comparison between different implementation strategies and funding / financing approaches.

- **Discounted Cashflows:** The financial assessment uses discounted cash flow analysis of capital and operations & maintenance expenditures through the longest term of the projected debt.
- **Federal Tax Credits:** Assumptions and estimates regarding applicable federal tax credits are incorporated into the analysis. These assumptions can be updated as additional IRS guidelines are released or as project design and technology evolve.
- **Balancing Sources & Uses:** The analysis aims to balance the sources and uses of funds to estimate funding and financing requirements through each phase. It considers the sequencing of available funding from state, local or federal grants, tax credit receipts, and, in the case of public-private partnership scenarios, potential developer capital contributions. Any remaining unfunded capital expenses are assumed to be financed through UW long-term debt.

Key inputs informing the financial analysis include:

1. **Cost Estimates from AEI and Whiting Turner**
    - Includes significant R&R costs ($865M for BAU) treated as CapEx
    - All CapEx assumed to be debt financed, except where CCA or IRA funding applies
    - Project duration and sequencing
    - Business as Usual (BAU) Operating Expenditure (OpEx) cost profile: Projected operational costs if the current energy systems are maintained.
    - Energy Renewal Program (ERP) OpEx cost profile: Projected operational costs after implementation of the ERP projects.
2. **Inflation Reduction Act (IRA) Tax Credit Provisions and IRS Guidance**
    - Incorporation of tax credit opportunities provided by the IRA.
    - Utilization of IRS guidance to inform tax credit analysis regarding potential project eligibility and credit values.
3. **Financing Inputs and Assumptions**
    - A set of financing inputs and assumptions as outlined in 4.3.5.
    - UW financing rates based on data provided from the University's Internal Lending Program ("ILP").
    - Private financing rates based on recent market precedents and S&P Capital IQ corporate yield curve indices.

4.3 Key Assumptions

The developed ERP financial analysis is founded upon, and informed by, a set of key assumptions. These assumptions are based on information available at the time of analysis and may be subject to change as the project progresses and more detailed information becomes available and/or macroeconomic and financing conditions change over time.

4.3.1 Project Phasing

The ERP is structured as a multi-phase initiative designed to optimize implementation and manage the interdependencies between various project components. The program has been modeled into four distinct phases, each aligning with the state's biennial appropriation cycles.

Table 4.3.1-1: Project Phases

Period	Start Date	End Date
Biennial Budget Period 1 - Phase 1	01-07-25	30-06-27
Biennial Budget Period 2 - Phase 2	01-07-27	30-06-29
Biennial Budget Period 3 - Phase 3	01-07-29	30-06-31
Biennial Budget Period 4 - Phase 4	01-07-31	30-06-33
Biennial Budget Period 5 - Phase 5	01-07-33	30-06-35
Biennial Budget Period 5 - Phase 6	01-07-35	30-06-37
Biennial Budget Period 5 - Phase 7	01-07-37	30-06-39
Biennial Budget Period 5 - Phase 8	01-07-39	30-06-41

Table 4.3.1-2 illustrates the project sequencing, the ERP encompasses a wide range of projects. Based on the latest guidance from UW and the technical advisory team, the ERP projects are currently distributed across the first four phases. The following table illustrates the phasing of ERP projects across the four biennium cycles. Checkmarks (✓) indicate the phase in which funding availability is requested for each project.

Table 4.3.1-2: Example of Phased Implementation of the ERP.
Source: AEI and Whiting Turner Sequencing of Projects

Project Phase Selection (Enter 1-Select or 0-Deselect)									
Project	Check	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
B-1 Chiller Replacements- South of Pacific	Ok	×	×	×	×	×	✓	×	×
B-1 Chiller Replacements- Central	Ok	×	×	×	×	✓	×	×	×
B-1 Chiller Replacements- North	Ok	×	×	✓	×	×	×	×	×
B-6 Metering Program	Ok	×	✓	×	×	×	×	×	×
B-8,9,10 HHW Conversions- Central Campus West Tunnel Scope	Ok	×	×	×	×	×	×	✓	×
B-8,9,10 HHW Conversions- Central/ Lower Distribution Scope Z	Ok	×	×	×	×	✓	×	×	×
B-8,9,10 HHW Conversions- East Campus Distribution Scope Zo	Ok	×	×	×	✓	×	×	×	×
B-8,9,10 HHW Conversions- North Distribution Scope Zone	Ok	×	×	✓	×	×	×	×	×
B-8,9,10 HHW Conversions- South from Power Plant(PP) Scope	Ok	×	×	×	×	×	✓	×	×
B-8,9,10 HHW Conversions- South from WCUP Scope Zone	Ok	×	✓	×	×	×	×	×	×
B-8,9,10 HHW Conversions- West Distribution Scope Zone	Ok	×	✓	×	×	×	×	×	×
B-11 Local Satellite Steam Plants	Ok	×	✓	×	×	×	×	×	×
E-1 UW Substation	Ok	✓	×	×	×	×	×	×	×
E-2 PP Ring Bus & Express Feeders	Ok	✓	×	×	×	×	×	×	×
P-1 Convert CCW to Year-round Operation	Ok	×	✓	×	×	×	×	×	×
P-2 Add CH-8_CT-14	Ok	×	×	×	✓	×	×	×	×
P-3 WCUP CH5 & CT	Ok	✓	×	×	×	×	×	×	×
P-4 WCUP Annex	Ok	✓	×	×	×	×	×	×	×
P-5 CCW TES Tank	Ok	✓	×	×	×	×	×	×	×
P-6 PHW TES Tank	Ok	×	×	✓	×	×	×	×	×
P-7 WCUP HRCs and Cooling Tower	Ok	×	×	✓	×	×	×	×	×
P-8 Power Plant Heat Recovery Chillers	Ok	×	×	×	✓	×	×	×	×
P-9 CCW Header and Secondary Pumping System	Ok	✓	×	×	×	×	×	×	×
P-10 Power Plant PHW System	Ok	×	✓	×	×	×	×	×	×
P-11 PP Elec. Boilers & EM Gen Heat Rec.	Ok	×	×	×	×	✓	×	×	×
P-12 WCUP Electric Boilers	Ok	×	×	×	×	✓	×	×	×
P-13 WCUP Generators	Ok	×	×	×	✓	×	×	×	×
P-14 PP Controls Upgrades	Ok	✓	×	×	×	×	×	×	×
D-C1 Central Campus Piping	Ok	×	×	×	×	✓	×	×	×
D-C2 Central Campus Piping West Tunnel	Ok	×	×	×	×	×	×	✓	×
D-N1 North Campus Piping	Ok	×	×	✓	×	×	×	×	×
D-S1 PHW Piping from WCUP to South Campus	Ok	×	✓	×	×	×	×	×	×
D-S2 South of Pacific Campus Piping from PP	Ok	×	×	×	×	×	✓	×	×
D-W1 West Campus CCW & PHW Piping- Phase 1	Ok	✓	×	×	×	×	×	×	×
D-W2 Sewer Heat Recovery Piping	Ok	✓	×	×	×	×	×	×	×
D-E1 PHW Piping from PP to East and SE Campus	Ok	×	×	×	✓	×	×	×	×
S-1 Lake Interface System- Phase 1	Ok	×	×	✓	×	×	×	×	×
S-2 Sewer Heat Recovery Equipment Bldg- Phase 1	Ok	×	×	✓	×	×	×	×	×
CPAT- Lake Advancement	Ok	✓	×	×	×	×	×	×	×
CPAT- District Energy Stands/Basis of Design	Ok	✓	×	×	×	×	×	×	×
CPAT- WCUP CH & CT	Ok	✓	×	×	×	×	×	×	×
CPAT- PP Boiler Removal	Ok	✓	×	×	×	×	×	×	×
D-W1 West Campus CCW & PHW Piping- Phase 2	Ok	×	✓	×	×	×	×	×	×
S-1 Lake Interface System- Phase 2	Ok	×	×	×	✓	×	×	×	×
S-2 Sewer Heat Recovery Equipment Bldg- Phase 2	Ok	×	×	✓	×	×	×	×	×

This phased approach allows for:

- Strategic allocation of resources and capital over time
- Flexibility to adjust later phases based on outcomes and learnings from earlier phases
- Alignment with the university's broader development plans and funding availability

The sequencing strategy provides that foundational infrastructure is in place before dependent systems are implemented, enhancing efficiency, and reducing potential conflicts or rework. It also allows the university to spread capital investments over a manageable timeframe and the opportunity to align with state funding cycles and financial planning horizons.

As part of the financial analysis, the ERP phasing is a foundational component of the modeled capital investments and associated cash flow projections, financing needs, and the realization of operational and financial benefits over time.

4.3.2 Business-as-Usual Scenario

To analyze the potential financial impacts of the ERP, a Business-as-Usual (BAU) scenario is necessary in order to compare the ERP's projected cashflows to the University's projected cashflows should it not implement the ERP projects. The BAU scenario reflects a projection of the on-going costs associated with operating and maintaining UW's existing utility infrastructure.

To establish the BAU scenario, the financial analysis incorporates key assumptions regarding necessary Renewal and Replacement (R&R) costs for existing UW assets that have reached, or are reaching, the end of their useful life, as well as on-going routine O&M costs and utility input costs (e.g., natural gas, water, electricity). The BAU scenario assumes no direct regulatory cost of carbon. This is because the analysis assumes the use of renewable natural gas in the BAU case to achieve compliance with State of Washington regulations (see further detail in Section 6.9.3). Under this approach, the BAU scenario includes a cost premium for renewable natural gas (as compared to traditional natural gas) and such premium provides for the indirect costs related with compliance to the State of Washington's regulatory framework. In contrast, the ERP scenarios assume the use of traditional natural gas and therefore include a direct regulatory cost of carbon.

A significant amount of up-front R&R investments, totaling over $600 million, is assumed under the BAU scenario based on AEI's analysis. The analysis addresses the up-front R&R costs as being financed through UW long-term debt (30-year term), rather than fully funded by UW up-front and assumes that such improvements would not be eligible for CCA funding. This approach provides a smoother baseline cashflow profile, which allows for more direct comparisons with the proposed ERP scenarios.

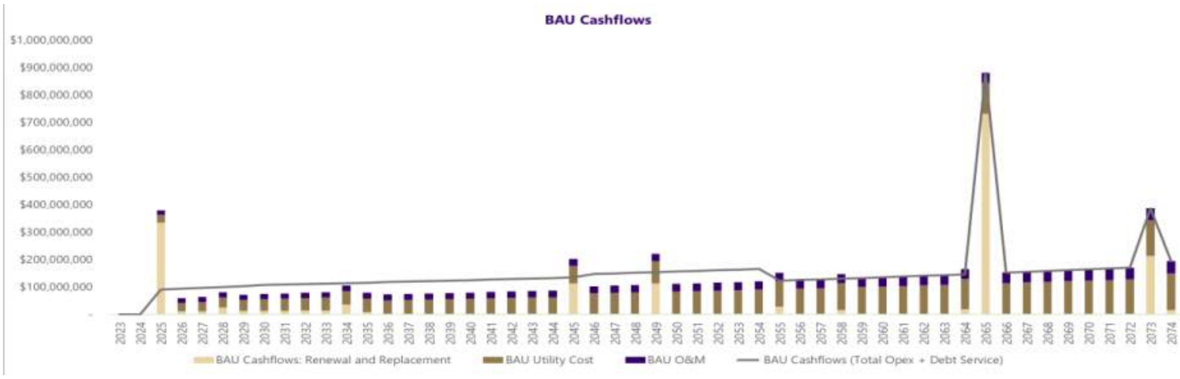

Figure 4.3.2-1: *Establishing a BAU scenario (gray line) based on Whiting-Turner and AEI cost and sequencing estimates.*

4.3.3 ERP Capital Costs

ERP capital cost estimates are based on the detailed cost breakdowns provided by AEI and Whiting-Turner. Cost escalation is assumed at 3% per annum for the duration of the project implementation. Figure 4.3.3-1 and 4.3.3-2 illustrate the timing of anticipated CapEx funding appropriations by phase as well as the estimated timing of actual expenditures under different implementation timeline scenarios. CapEx committed represents the total project costs approved to begin in a given biennial cycle (Figure 4.3.3-1 to 4.3.3-4), regardless of when the actual spending occurs (i.e., if a project commences within a certain project phase, but its duration encompasses multiple phases, a CapEx commitment for 100% of the costs is reflected in the phase during which the project commences). In contrast, CapEx spend reflects the actual projected cash outflows, which may extend beyond the project's starting biennial cycle and can include expenditures from projects initiated in previous cycles (Figure 4.3.3-5 to 4.3.3-8).

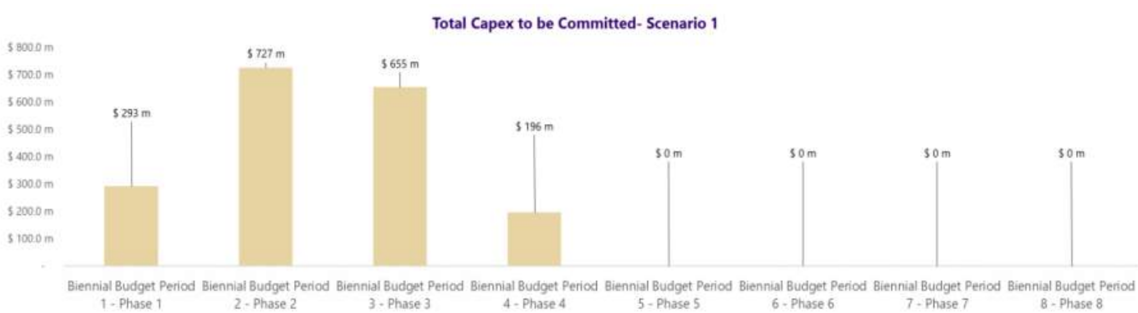

Figure 4.3.3-1: *ERP CapEx by biennial periods. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. The allocations correspond to a Scenario 1: 4 Biennia and includes all projects under the ERP scope.*

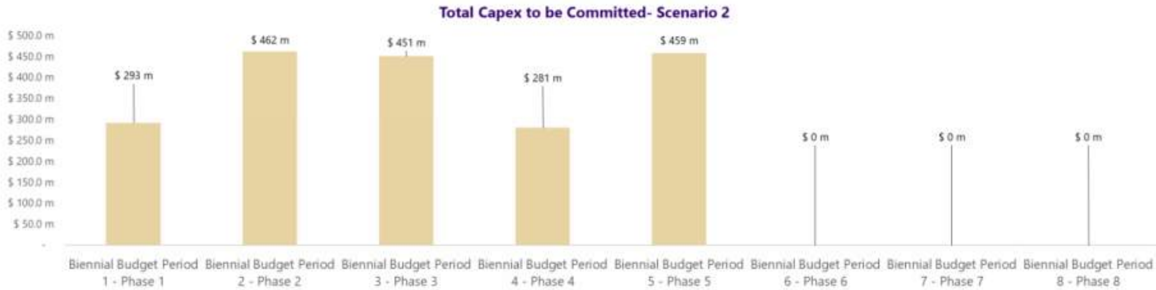

Figure 4.3.3-2: *ERP CapEx by biennial periods. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. The allocations correspond to a Scenario 2: 5 Biennia and includes all projects under the ERP scope.*

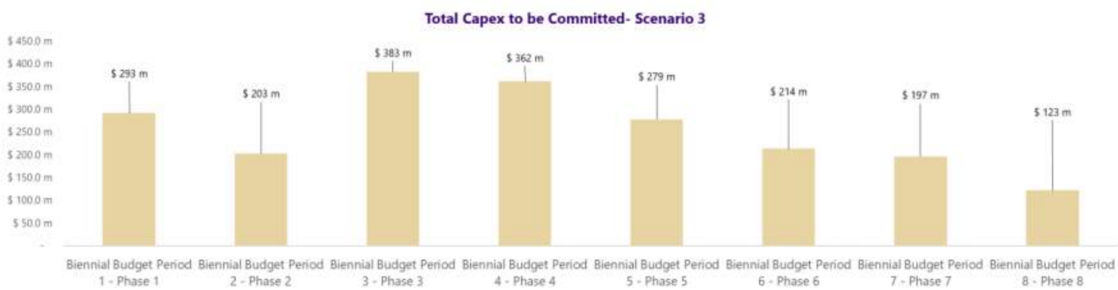

Figure 4.3.3-3: ERP CapEx by biennial periods. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. The allocations correspond to a Scenario 3: Rev Fund Sched <300M and includes all projects under the ERP *scope.*

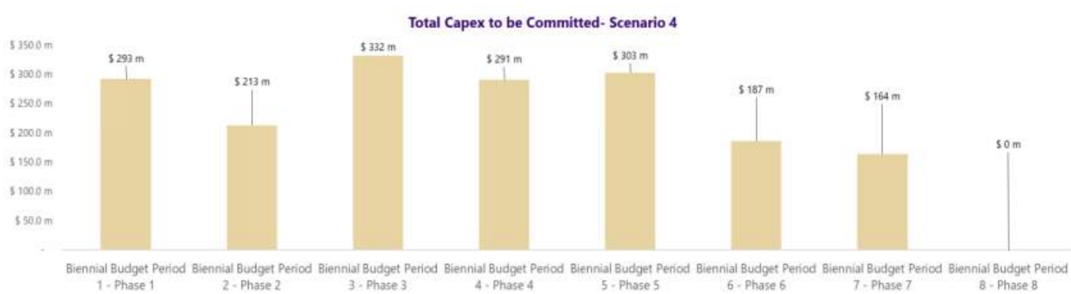

Figure 4.3.3-4: *ERP CapEx by biennial periods. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. The allocations correspond to a Scenario 4: Rev Fund Sched <300M (P3) and includes all projects under the ERP scope.*

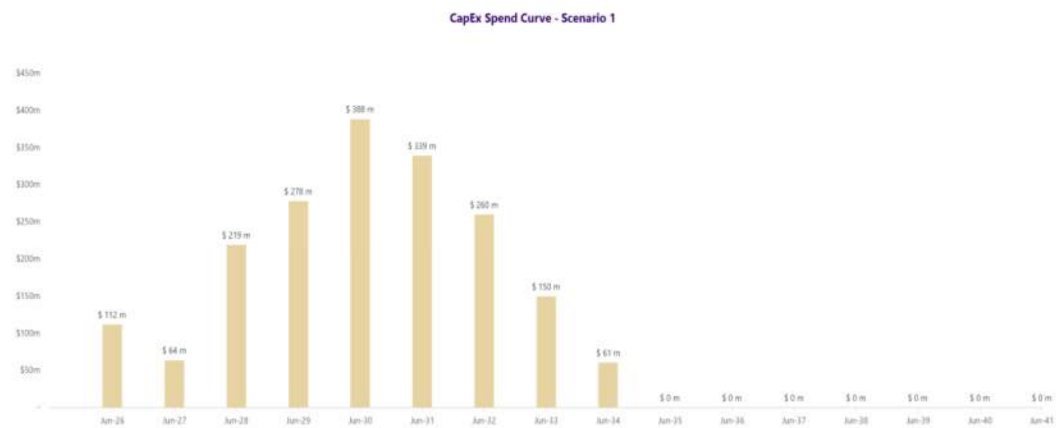

Figure 4.3.3-5: *ERP CapEx spend curve. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. This spend curve corresponds to Scenario 1: 4 Biennia.*

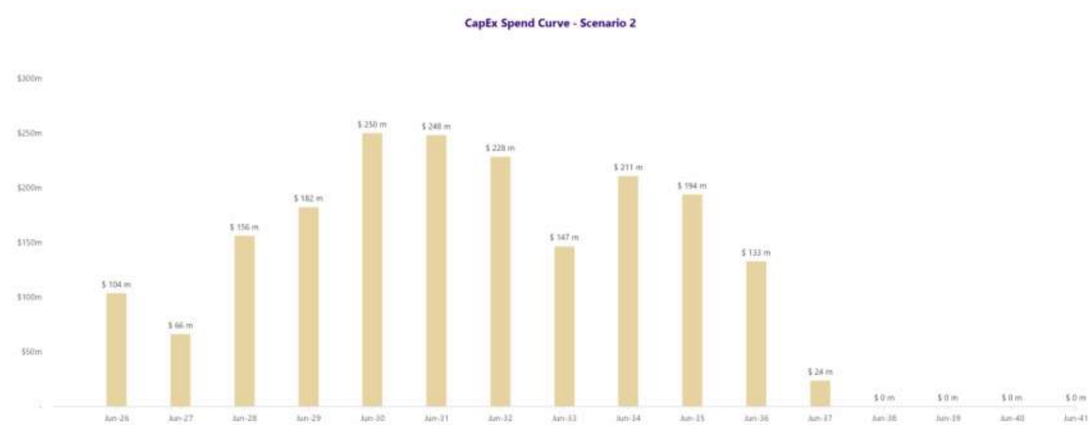

Figure 4.3.3-6: *ERP CapEx spend curve. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. This spend curve corresponds to a Scenario 2: 5 Biennia.*

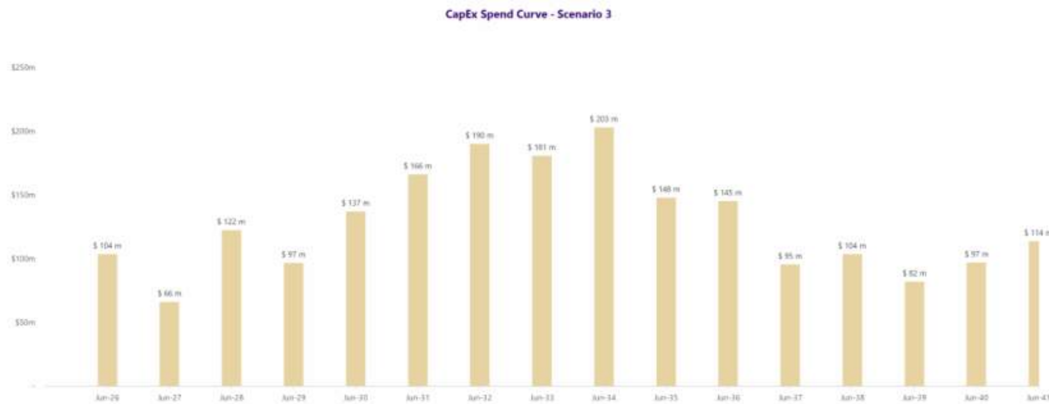

Figure 4.3.3-7: ERP CapEx spend curve. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. This spend curve corresponds to a S3 8 Biennia

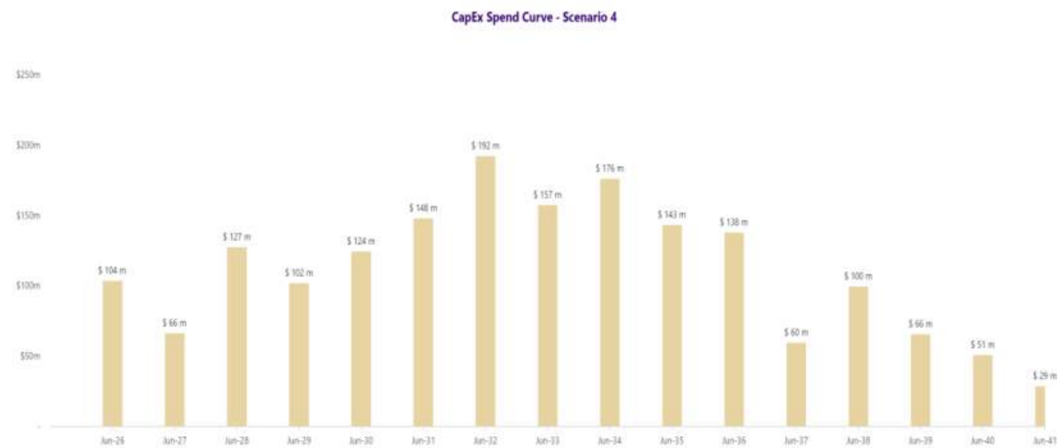

Figure 4.3.3-8: ERP CapEx spend curve. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. This spend curve corresponds to a S4 7 Biennia (P3*)*

4.3.4 ERP Operating and Lifecyle Renewal & Replacement Costs

ERP operating costs assumptions are based on technical inputs provided by AEI. Operational cost projections include utility costs based on energy consumption estimates, operation and maintenance, regulatory cost of carbon, and R&R costs over a 50-year period. The 2% inflation factor aligns with the Federal Reserve's long-term inflation target, which has been consistently communicated as their policy goal for price stability in the U.S. economy.

Given that the financial analysis comprises several scenarios, the financial model includes multiple OpEx profiles aligned to the projects being analyzed. The aggregate OpEx profile represents the total operational expenditures across all projects in the ERP, providing a comprehensive view of operational costs. In addition to this profile, more granular OpEx profiles were created to bifurcate for the OpEx costs for specific projects or delivery models (e.g., P3 components), which show detailed operational costs for particular segments of the program, allowing for more granular analysis of different project elements or delivery approaches in isolation. The aggregate OpEx profile is presented in Figure 4.3.4-1 to 4.3.4-4. The spikes in the Replacement and Renewal costs represent scheduled major infrastructure upgrades and equipment replacements, reflecting the long-term lifecycle management needs of the Energy Renewal Program.

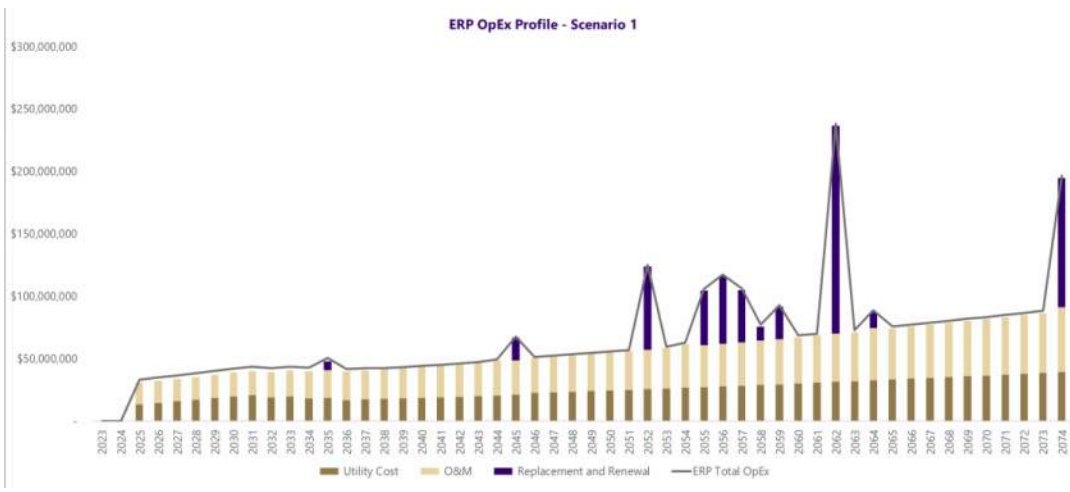

Figure 4.3.4-1: *ERP OpEx profile. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. This spend curve corresponds to S1 4 Biennia, Avg: $454M / Biennia*

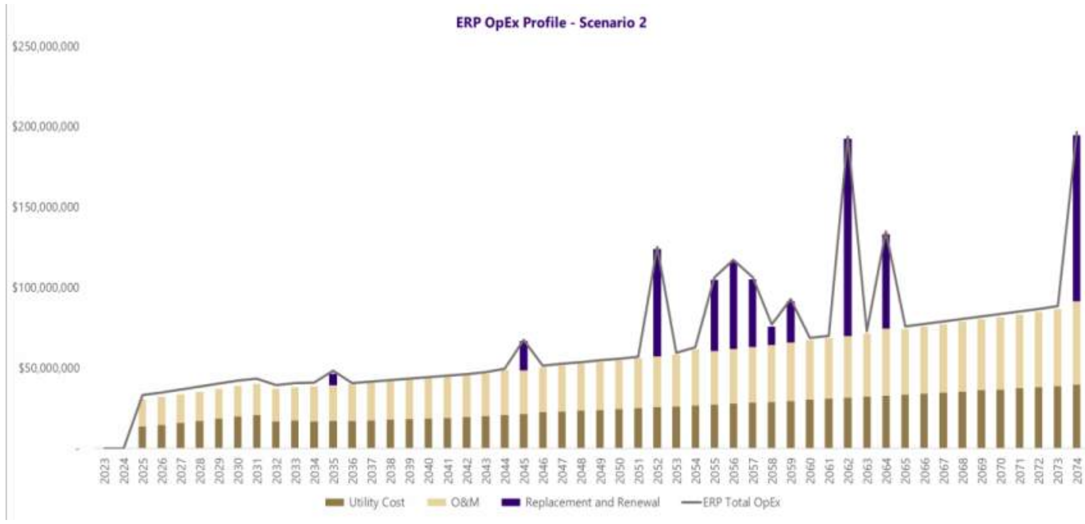

Figure 4.3.4-2: *ERP OpEx profile. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. This spend curve corresponds to S2 5 Biennia, Avg: $377M / Biennia*

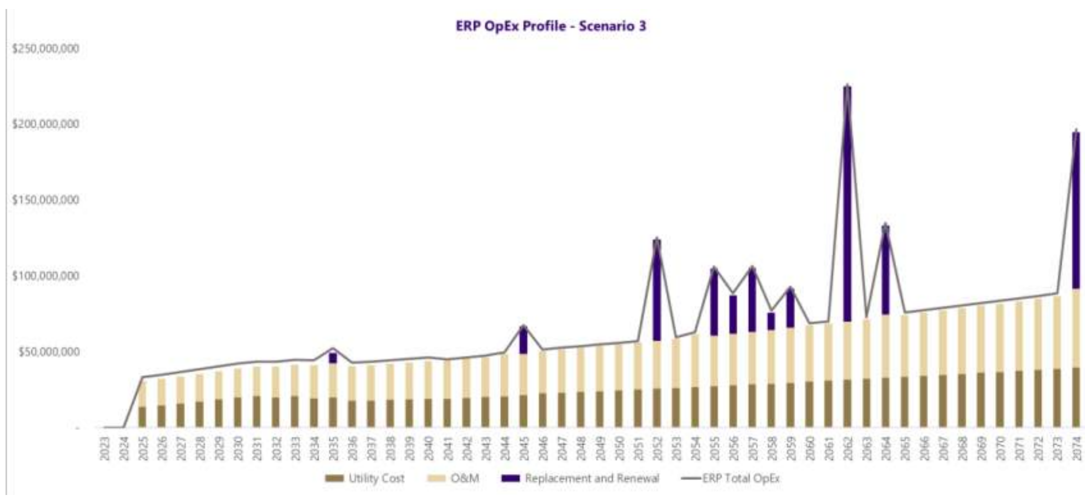

Figure 4.3.4-3: *ERP OpEx profile. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. This spend curve corresponds to S3 8 Biennia, Avg: $250M / Biennia*

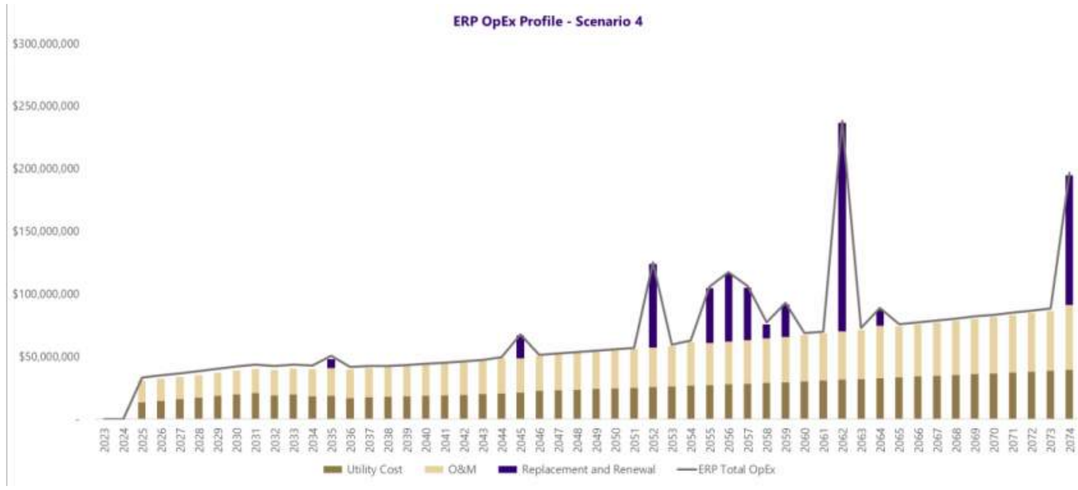

Figure 4.3.4-4: *ERP OpEx profile. Source Whiting-Turner and AEI cost and sequencing estimates and assumptions. This spend curve corresponds to S4 7 Biennia (P3), Avg: $247M / Biennia*

Based on UW guidance, the financial analysis evaluated two ERP projects (S-1 Lake Interface System and S-2 Sewer Heat Recovery Equipment Building) for potential delivery under a public-private partnership (P3) delivery model. The P3 OpEx profile for S-1 and S-2 projects is isolated from the overall ERP OpEx data to account for the additional operating margin required by private developers, allowing for a more accurate representation of costs specific to the P3 delivery model while maintaining consistency with the aggregate OpEx profile for the rest of the program. Accordingly, the financial model incorporates a specific OpEx profile for these two projects as shown in Figure 4.3.4-5 for such P3 scenarios. The periodic spikes in the Total OpEx profile indicate planned major refurbishment and equipment replacement cycles are assumed to take place within the P3 agreement.

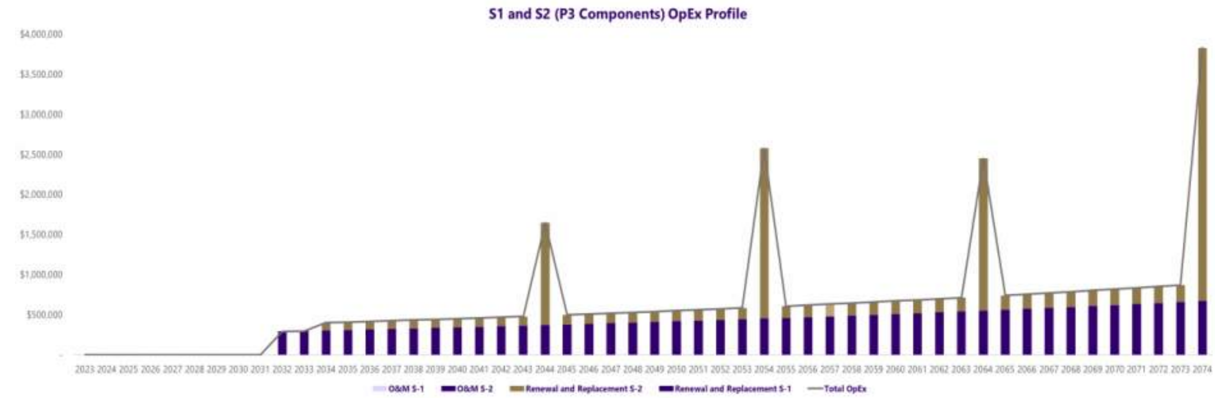

Figure 4.3.4-5: *ERP S-1 and S-2 OpEx Profiles.*

4.3.5 Summary of Scenarios, Funding, and Financing Assumptions

The financial analysis incorporates multiple scenarios to evaluate different approaches to funding, financing, and delivery. This section provides an overview of the key scenarios' assumptions.

- **Business as Usual (BAU) Scenario**: Serves as the baseline for comparison, projecting costs of maintaining existing infrastructure without ERP implementation.
- **Scenario 1: Full ERP Implementation with CCA Funding**: Assumes full implementation of ERP projects over 4 biennial periods, funded through Climate Commitment Act (CCA) grants.
- **Scenario 2: Full ERP Implementation with Debt Financing**: Assumes full implementation of ERP projects over 5 biennial periods, funded through CCA grants.
- **Scenario 3: Full ERP Implementation with Debt Financing**: Assumes full implementation of ERP projects over 8 biennial periods, funded through CCA grants.
- **Scenario 4: Partial P3 Implementation**: A hybrid approach with select projects (S-1 and S-2) delivered through a P3, and remaining projects implemented over 7 biennial period funded through CCA grants.

The model considers multiple funding and financing scenarios, including state funding, debt financing, and private financing through potential P3s. Table 4.3.5-1 summarizes key financing assumptions and sources of inputs.

Table 4.3.5-1: Financing Assumptions

Category	BAU	S1 4 Biennia Avg: $454M / Biennia	S2 5 Biennia Avg: $377M / Biennia	S3 8 Biennia Avg: $250M / Biennia	S4 7 Biennia (P3) Avg: $247M / Biennia	
					Non-P3 Components	P3 Components
Total CapEx (escalated)	$1.74 billion	$ 1.87 billion	$ 1.95 billion	$ 2.05 billion	$ 1.73 billion	$236.49 million
Primary Funding / Financing Source	UW long-term debt	CCA funding	CCA funding	CCA funding	CCA funding	Private financing
Secondary Funding Source	N/A	Direct pay tax credits	Direct pay tax credits	Direct pay tax credits	Direct pay tax credits	Developer tax credit passthrough
P3 Component	No	No	No		No	Yes (S-1 and S-2 projects)
OpEx Profile	BAU O&M and utility costs	ERP O&M, R&R, utility costs and carbon costs	ERP O&M, R&R, utility costs and carbon costs	ERP O&M, R&R, utility costs and carbon costs	ERP O&M, R&R, utility costs and carbon costs	P3 O&M with 10% margin
Debt Service	For R&R costs	None	None	None	None	For P3 Developer financing
P3 Availability Payments	N/A	N/A	N/A	N/A	N/A	For S-1 and S-2 projects
Tax-Exempt Long-term Interest Rate	4.00%	N/A	N/A	N/A	N/A	4.35%
Long-term Interest Rate (Taxable)	N/A	N/A	N/A	N/A	N/A	5.60%
Debt Tenor	30 years	N/A	N/A	N/A	N/A	30 years
Equity Rate of Return	N/A	N/A	N/A	N/A	N/A	11.00%
Debt: Equity Gearing	100% debt	N/A	N/A	N/A	N/A	90% Debt, 10% Equity
WACC	N/A	N/A	N/A	N/A	N/A	6.14% (Assuming taxable debt)

4.3.6 Clean Energy Tax Credits

The Energy Renewal Program (ERP) has the potential to benefit from federal tax credits, including through elective pay (also referred to as "direct pay") as provided by the Inflation Reduction Act (IRA). The preliminary analysis of potential Investment Tax Credit (ITC) eligibility for components of the ERP yields estimates ranging from approximately $3.5 million to $27.7 million in total potential tax credits. These estimates are subject to change as project design and cost detail may progress and evolve.

Key Factors and Assumptions Affecting Tax Credit Eligibility and Estimated Values:

1. Feasibility Estimate Reduction: A reduction factor of 80% (low scenario) to 95% (high scenario) is applied to the eligible project capex to account for uncertainties in the feasibility estimates.
2. Prevailing Wage and Apprenticeship Requirements: Meeting these requirements can significantly increase the base credit rate from 6% to 30% for eligible projects.
3. Domestic Content Requirements: Projects using a certain percentage of U.S.-made materials may qualify for an additional 2-10% credit. This bonus increases over time, reaching 10% for projects beginning construction in 2025 or later.
4. Energy Community Designation: Projects located in energy communities may be eligible for an additional 2-10% credit. However, the preliminary assessment indicates that the UW campus is unlikely to qualify as an energy community.
5. Phaseout for Elective Payment: For tax-exempt entities like universities using the direct pay option, there's a potential phaseout of the credit **if domestic content requirements are not met**. This phaseout begins at 15% for projects starting construction in 2024 and increases to 100% for projects starting after 2025. However, if domestic content requirements are met, or the tax-exempt entity successfully receives a waiver of the domestic content requirement, then the elective pay credits will not be affected.
6. Tax-Exempt Financing Adjustment: The use of tax-exempt bonds to finance projects may reduce the eligible credit amount by up to 15%.

Table 4.3.6-1: Summary of ITC Potential – Preliminary Assessment

Project	Eligible Project Capex	Low Estimate	High Estimate	Notes
S-2 Sewer Heat Recovery	$41,463,704	$1,990,258	$15,756,208	*Assumes construction begins in 2025; eligible under Section 48E*
P5 CCW TES Tank	$17,360,239	$833,291	$6,596,891	*Assumes construction begins in 2026; eligible under Section 48E*
P6 PHW TES Tank	$14,100,443	$676,821	$5,358,168	*Assumes construction begins in 2030; eligible under Section 48E*
S-2 Lake Interface System	Not Qualified	Not Qualified	Not Qualified	*Uses surface water, not eligible under current IRS guidance*
Total Estimated ITC		**$3,500,370**	**$27,711,266**	

The S-2 Sewer Heat Recovery project represents a significant portion of the potential tax credits. Table 4.3.6-2 details the ITC calculation for this component, illustrating how factors such as prevailing wage requirements, apprenticeship programs, and domestic content can affect the final credit amount.

Table 4.3.6-2: Preliminary Assessment - S-2 Sewer Heat Recovery[3]

S-2 Sewer Heat Recovery - Cost Summary		
Total Costs		
Eligible Direct		$21,081,703
Total Eligible		$21,081,703
Ineligible		$6,033,693
Indirect Cost Allocation		
Eligible		$21,081,703
Ineligible		$6,033,693
Indirect cost allocation percentage		78%
Indirect costs (see CSI summary)		$26,215,435
Allocated Indirect		$20,382,001
Tax Credit Elegibility S-2		
Cost Scenario	**Low**	**High**
Eligible Project Capex	$41,463,704	$41,463,704
Reduction for feasibility estimate	80%	95%
Eligible Cost Basis	$33,170,963	$39,390,519
Base ITC (6%)	$1,990,258	$2,363,431
Enhanced ITC if Prevailing Wage and Apprenticeship(+24%)[2]		$9,453,725
Total ITC:	$1,990,258	$11,817,156
Additional ITC if Project in an Energy Community (2-10%)[3]	$0	$0
Additional ITC if Project Meets Domestic Content Requirements (2-10%)[4]	$0	$3,939,052
Total ITC:	$1,990,258	$15,756,208
Phaseout for elective payment[6] (15% for construction beginning in 2025)	($298,539)	$0
Total ITC - Direct Pay:	$1,691,719	$15,756,208
Tax exempt financing[7]: on total credit	**$1,691,719**	**$13,392,776**

1 Under Section 48E, a clean electricity investment credit for any taxable year is an amount equal to the applicable percentage of the qualified investment for such taxable year with respect to any qualified facility and any energy storage technology, including thermal energy storage.

2. The "prevailing wage" requirement is generally met if any laborers and mechanics employed by the taxpayer or any contractor or subcontractor in the construction of such energy project, and for the 5-year period beginning on the date such project is originally placed in service, the alteration or repair of such project, are paid wages at rates not less than the prevailing rates for construction, alteration, or repair of a similar character in the locality in which such project is located as most recently determined by the Secretary of Labor. The "apprenticeship" requirement is generally met if with respect to the construction of any qualified facility, not less than the applicable percentage (generally 10-15%) of the total labor hours of the construction, alteration, or repair work (including such work performed by any contractor or subcontractor) with respect to such facility is performed by qualified apprentices. The "output" requirement is generally met if the project has a maximum net output of less than 1 megawatt of electrical (as measured in alternating current).

3 An "energy community" is generally defined as (i) a brownfield site, (ii) a metropolitan statistical area or non-metropolitan statistical area which has (or, at any time during the period beginning after December 31, 2009, had) 0.17 percent or greater direct employment or 25 percent or greater local tax revenues related to the extraction, processing, transport, or storage of coal, oil, or natural gas (as determined by the Secretary), and has an unemployment rate at or above the national average unemployment rate for the previous year (as determined by the Secretary), or (iii) a census tract in which after December 31, 1999, a coal mine has closed, after December 31, 2009, a coal-fired electric generating unit has been retired, which is directly adjoining to any such census 3 (continued from previous page) tracts. The 10% additional ITC applies if the prevailing wage/apprenticeship/output criteria in

The P-5 CCW TES (Chilled Water Thermal Energy Storage) Tank project represents ERP component eligible for tax credits. Table 4.3.6-3 breaks down the ITC calculation for this thermal storage solution, which has a total project cost of over $64 million.

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footnote 2 are satisfied. Alternatively, the 2% additional ITC applies if the prevailing wage/apprenticeship/output criteria in footnote 2 are NOT satisfied.

4. The "domestic content" requirements are generally satisfied if any steel, iron, or manufactured product which is a component of the project (upon completion of construction) was produced in the United States. The 10% additional ITC applies if the prevailing wage/apprenticeship/output criteria in footnote 2 are satisfied. Alternatively, the 2% additional ITC applies if the prevailing wage/apprenticeship/output criteria in footnote 2 are NOT satisfied.

5. This additional 10% ITC may apply in case of any qualified solar and wind facility with respect to which the Secretary makes an allocation of environmental justice solar and wind capacity limitation. No later than January 1, 2025, the Secretary shall establish a program to allocate amounts of environmental justice capacity limitation to applicable facilities.

6. In 2024 and beyond, taxpayers that make the direct pay election will be subject to credit phaseout under Section and 48E if the domestic content requirement is not satisfied. Credit phaseout may be avoided by meeting the domestic content requirements or if an exception is granted.

Under direct pay, the Secretary may provide exceptions to domestic content requirements if: a) sourcing components domestically will increase the overall cost of construction of qualified facilities by more than 25%; b) relevant steel, iron, or manufactured products are not produced to a satisfactory level of quality in the US, or in sufficient or reasonably available quantities. The direct pay phaseout for projects beginning construction in 2025 is 15%. After 2025, projects beginning construction would be completely phased out.

7. Financing with Tax-Exempt Bonds: Please note that tax law under Sec.45(b)(3) requires that credit is reduced for tax exempt bonds. So, in situation when the investment is possible due to tax exempt bond financing, the benefit is reduced by lesser of 15% or a fraction of bond financing value to the facility investment cost. Faction, more specifically is: (A)the numerator of which is the sum, for the taxable year and all prior taxable years, of proceeds of an issue of any obligations the interest on which is exempt from tax under section 103 and which is used to provide financing for the qualified facility, and (B)the denominator of which is the aggregate amount of additions to the capital account for the qualified facility for the taxable year and all prior taxable years. For example, a 30% credit would be reduced by 15% to avoid double tax benefit, resulting credit would be 25.5%. For the purposes of the estimate, the reduction is calculated on the total credit estimated and the 15% is used. However, analysis would need to be performed on the lesser of the 15% and the fraction as discussed above. The calculation is performed on the total credit value per Sec. 45(b)(3).

Table 4.3.6-3: Preliminary Assessment -P5 CCW TES Tank

P5 CCWTES Tank - Cost Summary		
P5 Costs		**$34,821,007**
Eligible Direct		$6,652,500
Allocate between P5 and P6		$4,190,340
Eligible allocated		2514204
Total Eligible		$9,166,704
P5 Indirect Cost Allocation		
Eligible direct and allocated		$9,166,704
Ineligible		$23,978,168
Indirect cost allocation percentage		28%
Indirect costs (see CSI summary)		$29,626,098
Allocated Indirect		$8,193,535
Total Eligible Capex		$17,360,239
Tax Credit Assessment P5		
Cost Scenario	**Low**	**High**
Eligible Project Capex	$17,360,239	$17,360,239
Reduction for feasibility estimate	80%	95%
Eligible Cost Basis	$13,888,191	$16,492,227
Base ITC (6%)	$833,291	$989,534
Enhanced ITC if Prevailing Wage and Apprenticeship(+24%)[2]		$3,958,134
Total ITC:	$833,291	$4,947,668
Additional ITC if Project in an Energy Community (2-10%)[3]	-	-
Additional ITC if Project Meets Domestic Content Requirements (2-10%)	-	$1,649,223
Total ITC:	$833,291	$6,596,891
Phaseout for elective payment[6] (100% for construction beginning after 2	($833,291)	-
Total ITC - Direct Pay:	-	$6,596,891
Tax exempt financing[7]: on total credit	-	$5,607,357

The P-6 PHW TES (Primary Hot Water Thermal Energy Storage) Tank project is another component of the ERP eligible for tax credits. Table 4.3.6-4 outlines the ITC calculation for this hot water storage solution, which has a total project cost of approximately $14.3 million.

Table 4.3.6-4: Preliminary Assessment - P6 PHW TES Tank

P6 PHW TES Tank - Cost Summary		
P6 Costs		**$7,041,250**
Eligible Direct		$6,114,500
Allocated from P5		$1,676,136
Total Eligible		$7,790,636
Ineligible		$926,750
P6 Indirect Cost Allocation		
Eligible Direct (excluding allocated)		$6,114,500
Ineligible		$926,750
Indirect cost allocation percentage		87%
Indirect costs (see CSI summary)		$7,266,159
Allocated Indirect		$6,309,807
Total Eligible Capex		$14,100,443
Tax Credit Assessment P6		
Cost Scenario	**Low**	**High**
Eligible Project Capex	$14,100,443	$14,100,443
Reduction for feasibility estimate	80%	95%
Eligible Cost Basis	$11,280,354	$13,395,420
Base ITC (6%)	$676,821	$803,725
Enhanced ITC if Prevailing Wage and Apprenticeship(+24%)[2]		$3,214,901
Total ITC:	$676,821	$4,018,626
Additional ITC if Project in an Energy Community (2-10%)[3]	-	-
Additional ITC if Project Meets Domestic Content Requirements (2-10%)[4]	-	$1,339,542
Total ITC:	$676,821	$5,358,168
Phaseout for elective payment[6] (100% for construction beginning after 2025)	($676,821)	-
Total ITC - Direct Pay:	**-**	**$5,358,168**
Tax exempt financing[7]: on total credit	**-**	**$4,554,443**

Ineligible Components

- **S-2 Lake Interface System:** The analysis concluded that this component is unlikely to be eligible for the ITC as it uses lake water, which is considered surface water rather than groundwater.

  The project was considered for possible qualification under Section 48 as "equipment which uses the ground or ground water as a thermal energy source to heat a structure or as a thermal energy sink to cool a structure." The key item for the qualification was whether there is explicit language or argument that lake water may be considered ground water.

  The analysis explored the question of whether the project involving a heat exchange on water extracted from Lake Washington can qualify for credits under Section 48 as "equipment which uses the ground or ground water as a thermal energy source to heat a structure or as a thermal energy sink to cool a structure." Accordingly, the analysis explored the definition of "ground water" as well as of the "lake."

Based on various sources, lake would be considered surface water as opposed to ground water. The Washington Department of Natural Resources noted that "water bodies in Washington State, such as rivers, streams, reservoirs, and lakes, are connected to aquifers," as such the analysis sought to confirm the source of water for the lake in scope.

As AEI confirmed, lake water is not primarily fed by ground water. It is primarily from snow melt/precipitation.

As the lake water does not primarily come from an aquifer, the project was deemed to be unlikely to qualify under the definitions of qualified property under Section 48.

More general background on the assumptions of these estimates can be found in section 4.5, Financial Analysis Supporting Information.

A midpoint estimate for tax credit eligibility was utilized for the financial modeling summarized in this report, resulting in a potential total of $16.9 million in tax credits.

4.3.7 Carbon Pricing and Regulatory Environment

The model inputs account for the existing regulatory cost of carbon in the State of Washington under the state's Climate Commitment Act (CCA) as follows:

- Business as Usual Scenarios: The BAU scenario assumes renewable natural gas is utilized for CCA compliance, resulting in a higher cost of renewable natural gas as compared to regular natural gas within the modeled OpEx costs. Utilizing renewable natural gas would be anticipated to reduce UW's emissions below the CCA's threshold for having to participate in the CCA auction.
- ERP Scenarios: A cost of carbon assumption was developed by AEI based on historical CCA auction prices and the modeled consumption of natural gas under ERP scenarios.

4.4 Results and Observations

As previously noted, the ERP financial model incorporates multiple scenarios to evaluate different funding, financing, and delivery model assumptions. Note that with regard to the input commodity costs across all BAU and ERP scenario, a set of sensitivity analyses regarding the long-term cost projections of natural gas and electricity costs was performed looking at "low", "medium", and "high" commodity pricing scenarios. Following the University's guidance, all results within this report reflect the "medium" scenario for natural gas and electricity costs.

The key scenarios outlined within this report and their assumptions are as follows:

4.4.1 Business as Usual (BAU) Scenario

The BAU scenario is the baseline scenario against which the ERP scenarios can be compared. The BAU scenario projects the on-going costs associated with operating and maintaining UW's existing utility infrastructure without the implementation of the proposed ERP projects. The following are key characteristics of this scenario:

Table 4.4.1-1: BAU Summary

Category	Details
CapEx (escalated)	• $1.74 billion of CapEx reflecting the estimated R&R costs for deferred maintenance and component replacement of the existing utility system. No ERP projects included.
Funding / Financing Sources	• The up-front R&R costs are financed through UW long-term debt, repaid over a 30-year term with UW funds. • It is assumed that the University would use the Internal Lending Program and therefore the cost of debt corresponds to the ILP rate. • It is assumed the R&R costs under this scenario would not be eligible for CCA funding.
OpEx Profile	• BAU operating expenses (O&M and Utility Costs) plus debt service for equipment replacement.

Figure 4.4.1-1 presents the total NPV for the BAU scenario, which considers the issue of debt to pay for replacement and renewal work, O&M expenses, and utility costs. This scenario will serve as the basis for comparisons for each analysis scenario.

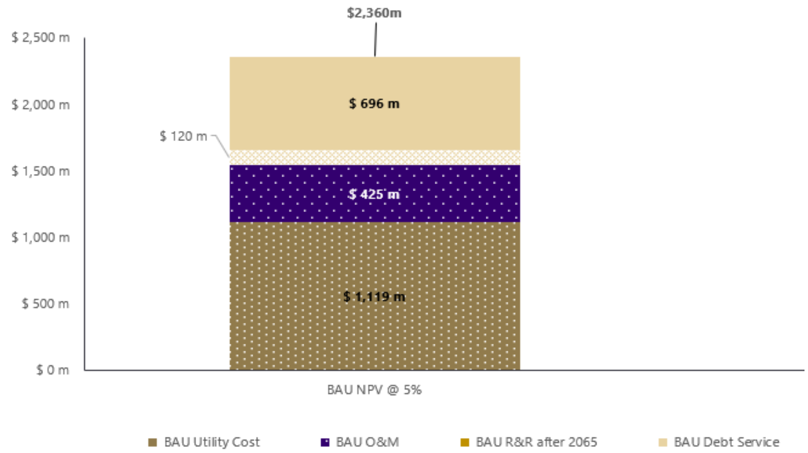


Figure 4.4.1-1: *BAU scenario in NPV*

4.4.2 Scenario 1: 4 Biennia, Avg: $454M / Biennia (with CCA Funding)

Scenario 1 assumes CCA funding availability in each biennial appropriation cycle to fund the ERP projects. The following are key characteristics of this scenario:

Table 4.4.2-1: Summary of Scenario 1

Category	Details
CapEx (escalated)	• $ 1.87 billion; capturing the capital expenditures for the comprehensive set of ERP projects.
Funding Sources	• All CapEx funded through CCA funding.
OpEx Profile	• ERP operating expenses (O&M, Renewal and Replacement, Utility Costs).

Table 4.4.2-2 presents the list of projects that are considered active for Scenario 1.

Table 4.4.2-2: Total Uses - Scenario 1. Source: AEI and Whiting Turner estimates

Project	Total Cost
Last updated: 9/17/2024	*In millions*
B-1 Chiller Replacements- South of Pacific	$ 6.4 m
B-1 Chiller Replacements- Central	$ 11.3 m
B-1 Chiller Replacements- North	$ 7.4 m
B-6 Metering Program	$ 10.1 m
B-8,9,10 HHW Conversions- Central Campus West Tunnel Scope Zone	$ 56.5 m
B-8,9,10 HHW Conversions- Central/ Lower Distribution Scope Zone	$ 72.0 m
B-8,9,10 HHW Conversions- East Campus Distribution Scope Zone	$ 9.7 m
B-8,9,10 HHW Conversions- North Distribution Scope Zone	$ 49.7 m
B-8,9,10 HHW Conversions- South from Power Plant(PP) Scope Zone	$ 81.8 m
B-8,9,10 HHW Conversions- South from WCUP Scope Zone	$ 42.7 m
B-8,9,10 HHW Conversions- West Distribution Scope Zone	$ 2.9 m
B-11 Local Satellite Steam Plants	$ 71.2 m
E-1 UW Substation	$ 34.4 m
E-2 PP Ring Bus & Express Feeders	$ 14.1 m
P-1 Convert CCW to Year-round Operation	$ 5.7 m
P-2 Add CH-8_CT-14	$ 20.7 m
P-3 WCUP CH5 & CT	$ 12.7 m
P-4 WCUP Annex	$ 55.7 m
P-5 CCW TES Tank	$ 77.8 m
P-6 PHW TES Tank	$ 17.6 m
P-7 WCUP HRCs and Cooling Tower	$ 139.6 m
P-8 Power Plant Heat Recovery Chillers	$ 153.9 m
P-9 CCW Header and Secondary Pumping System	$ 13.0 m
P-10 Power Plant PHW System	$ 12.5 m
P-11 PP Elec. Boilers & EM Gen Heat Rec.	$ 69.0 m
P-12 WCUP Electric Boilers	$ 20.8 m
P-13 WCUP Generators	$ 8.1 m
P-14 PP Controls Upgrades	$ 4.6 m
D-C1 Central Campus Piping	$ 97.4 m
D-C2 Central Campus Piping West Tunnel	$ 77.7 m
D-N1 North Campus Piping	$ 105.4 m
D-S1 PHW Piping from WCUP to South Campus	$ 55.6 m
D-S2 South of Pacific Campus Piping from PP	$ 66.8 m
D-W1 West Campus CCW & PHW Piping- Phase 1	$ 93.6 m
D-W2 Sewer Heat Recovery Piping	$ 11.1 m
D-E1 PHW Piping from PP to East and SE Campus	$ 69.7 m
S-1 Lake Interface System- Phase 1	$ 27.2 m
S-2 Sewer Heat Recovery Equipment Bldg- Phase 1	$ 10.5 m
CPAT- Lake Advancement	$ 1.1 m
CPAT- District Energy Stands/Basis of Design	$ 2.0 m
CPAT- PP Boiler Removal	$ 2.2 m
D-W1 West Campus CCW & PHW Piping- Phase 2	$ 12.4 m
S-1 Lake Interface System- Phase 2	$ 135.0 m
S-2 Sewer Heat Recovery Equipment Bldg- Phase 2	$ 52.8 m
	$ 1,871.1 m

Table 4.4.2-3 Provides the funding sources for Scenario 1, highlighting state direct funding as the primary source.

Table 4.4.2-3: Summary of sources under Scenario 1

Source Particualrs	Total	Non P3	P3
Last updated: 9/12/2024	*In millions*	*In millions*	*In millions*
State Direct Funding Disbursement	$ **1,854.4 m**	$ 1,854.44 m	-
Capex Funded by Tax Credits Receipts	$ **16.7 m**	$ 16.69 m	-
Short Term Loan Disbursement	**-**	-	-
UW LT Debt Disbursement / LT Private Debt	**-**	-	-
Equity	**-**	-	-
	$ **1,871.1 m**	$ **1,871.13 m**	**-**

Table 4.4.2-4 displays the distribution of CapEx by biennial budget periods under Scenario 1, with the majority of spending in Phase 2 and 3.

Table 4.4.2-4: CapEx by Biennial Budget Period under Scenario 1

Period	Start Date	End Date	Total Capex to be Committed
Biennial Budget Period 1 - Phase 1	7/1/2025	6/30/2027	$ 292.6
Biennial Budget Period 2 - Phase 2	7/1/2027	6/30/2029	$ 727.1
Biennial Budget Period 3 - Phase 3	7/1/2029	6/30/2031	$ 655.2
Biennial Budget Period 4 - Phase 4	7/1/2031	6/30/2033	$ 196.2
Biennial Budget Period 5 - Phase 5	7/1/2033	6/30/2035	$ -
Biennial Budget Period 6 - Phase 6	7/1/2035	6/30/2037	$ -
Biennial Budget Period 7 - Phase 7	7/1/2037	6/30/2039	$ -
Biennial Budget Period 8 - Phase 8	7/1/2039	6/30/2041	$ -
Total Commitments			**$ 1,871.1 m**

Figure 4.4.2-1 compares the net present value (NPV) between the BAU scenario and Scenario 1.

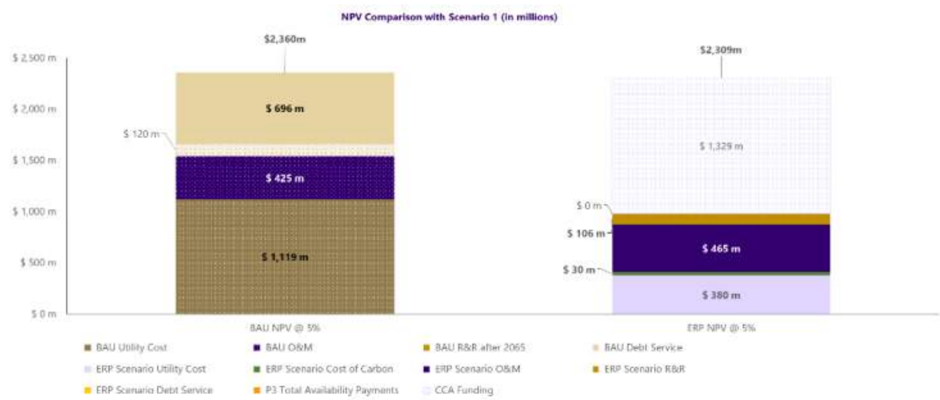


Figure 4.4.2-1: *NPV Comparison between BAU and Scenario 1*

Figure 4.4.2-2 shows the cash flow projections under Scenario 1, reflecting steady outflows over time for project expenditures.

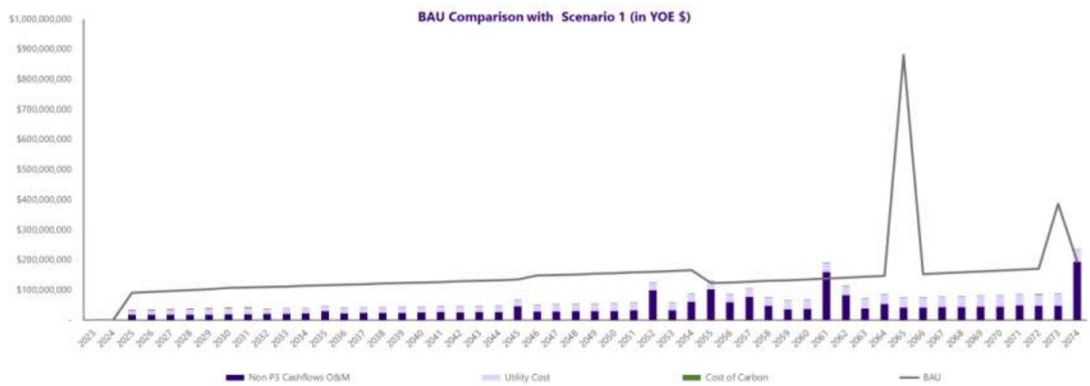


Figure 4.4.2-2: *Project Cashflows under Scenario 1*

4.4.3 Scenario 2: 5 Biennia: Avg: $377M / Biennia (with CCA Funding)

Scenario 2 assumes that CCA funding is available to fund projects. However, this scenario assumes an implementation over 5 biennium periods.

Table 4.4.3-1: Summary of Scenario 2

Category	Details
CapEx (escalated)	• $ 1.95 billion; capturing the capital expenditures for the comprehensive set of ERP projects.
Funding Sources	• All CapEx funded through CCA funding.
OpEx Profile	• ERP operating expenses (O&M, Renewal and Replacement, Utility Costs).

Table 4.4.3-2 summarizes the project costs for Scenario 2, presenting the same expenditure structure as Scenario 1.

Table 4.4.3-2: Summary of uses under Scenario 2

Project	Total Cost
Last updated: 9/17/2024	*In millions*
B-1 Chiller Replacements- South of Pacific	$ 7.2 m
B-1 Chiller Replacements- Central	$ 12.7 m
B-1 Chiller Replacements- North	$ 7.4 m
B-6 Metering Program	$ 10.1 m
B-8,9,10 HHW Conversions- Central Campus West Tunnel Scope Zone	$ 63.6 m
B-8,9,10 HHW Conversions- Central/ Lower Distribution Scope Zone	$ 72.0 m
B-8,9,10 HHW Conversions- East Campus Distribution Scope Zone	$ 10.3 m
B-8,9,10 HHW Conversions- North Distribution Scope Zone	$ 46.8 m
B-8,9,10 HHW Conversions- South from Power Plant(PP) Scope Zone	$ 92.1 m
B-8,9,10 HHW Conversions- South from WCUP Scope Zone	$ 42.7 m
B-8,9,10 HHW Conversions- West Distribution Scope Zone	$ 2.9 m
B-11 Local Satellite Steam Plants	$ 71.2 m
E-1 UW Substation	$ 34.4 m
E-2 PP Ring Bus & Express Feeders	$ 14.1 m
P-1 Convert CCW to Year-round Operation	$ 5.3 m
P-2 Add CH-8_CT-14	$ 22.0 m
P-3 WCUP CH5 & CT	$ 12.7 m
P-4 WCUP Annex	$ 55.7 m
P-5 CCW TES Tank	$ 77.8 m
P-6 PHW TES Tank	$ 18.7 m
P-7 WCUP HRCs and Cooling Tower	$ 139.6 m
P-8 Power Plant Heat Recovery Chillers	$ 173.2 m
P-9 CCW Header and Secondary Pumping System	$ 13.0 m
P-10 Power Plant PHW System	$ 12.5 m
P-11 PP Elec. Boilers & EM Gen Heat Rec.	$ 73.2 m
P-12 WCUP Electric Boilers	$ 22.1 m
P-13 WCUP Generators	$ 8.6 m
P-14 PP Controls Upgrades	$ 4.6 m
D-C1 Central Campus Piping	$ 97.4 m
D-C2 Central Campus Piping West Tunnel	$ 82.4 m
D-N1 North Campus Piping	$ 99.3 m
D-S1 PHW Piping from WCUP to South Campus	$ 55.6 m
D-S2 South of Pacific Campus Piping from PP	$ 75.2 m
D-W1 West Campus CCW & PHW Piping- Phase 1	$ 93.6 m
D-W2 Sewer Heat Recovery Piping	$ 10.5 m
D-E1 PHW Piping from PP to East and SE Campus	$ 78.4 m
S-1 Lake Interface System- Phase 1	$ 20.3 m
S-2 Sewer Heat Recovery Equipment Bldg- Phase 1	$ 10.5 m
CPAT- Lake Advancement	$ 1.1 m
CPAT- District Energy Stands/Basis of Design	$ 2.0 m
CPAT- PP Boiler Removal	$ 2.2 m
D-W1 West Campus CCW & PHW Piping- Phase 2	$ 13.2 m
S-1 Lake Interface System- Phase 2	$ 150.7 m
S-2 Sewer Heat Recovery Equipment Bldg- Phase 2	$ 56.0 m
	$ 1,945.6 m

Table 4.4.3-3 highlights the sources of funding for Scenario 2, using primarily CCA funding and tax credits available.

Table 4.4.3-3: Summary of sources under Scenario 2

Source Particualrs	Total		Non P3	P3
Last updated: 9/12/2024		*In millions*	*In millions*	*In millions*
State Direct Funding Disbursement	**$**	**1,928.9 m**	$ 1,928.89 m	-
Capex Funded by Tax Credits Receipts	**$**	**16.7 m**	$ 16.69 m	-
Short Term Loan Disbursement		**-**	-	-
UW LT Debt Disbursement / LT Private Debt		**-**	-	-
Equity		**-**	-	-
	$	**1,945.6 m**	**$ 1,945.58 m**	**-**

Table 4.4.3-4 outlines the distribution of CapEx over the biennial budget periods under Scenario 2, with a flatter distribution of costs across phases.

Table 4.4.3-4: CapEx by Biennial Budget Period under Scenario 2

Period	Start Date	End Date	Total Capex to be Committed	
Biennial Budget Period 1 - Phase 1	7/1/2025	6/30/2027	$	292.6
Biennial Budget Period 2 - Phase 2	7/1/2027	6/30/2029	$	462.3
Biennial Budget Period 3 - Phase 3	7/1/2029	6/30/2031	$	451.0
Biennial Budget Period 4 - Phase 4	7/1/2031	6/30/2033	$	280.6
Biennial Budget Period 5 - Phase 5	7/1/2033	6/30/2035	$	459.0
Biennial Budget Period 6 - Phase 6	7/1/2035	6/30/2037	$	-
Biennial Budget Period 7 - Phase 7	7/1/2037	6/30/2039	$	-
Biennial Budget Period 8 - Phase 8	7/1/2039	6/30/2041	$	-
Total Commitments			**$**	**1,945.6 m**

Figure 4.4.3-1 compares the NPV between the BAU scenario and Scenario 2.

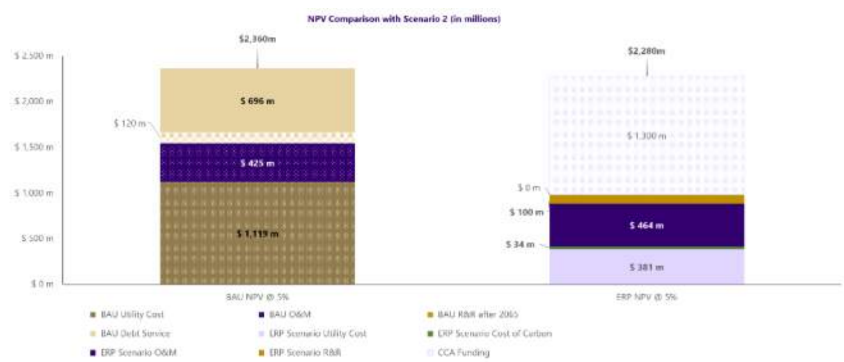


Figure 4.4.3-1: *NPV Comparison between BAU and Scenario 2.*

Figure 4.4.3-2 projects cash flows under Scenario 2.

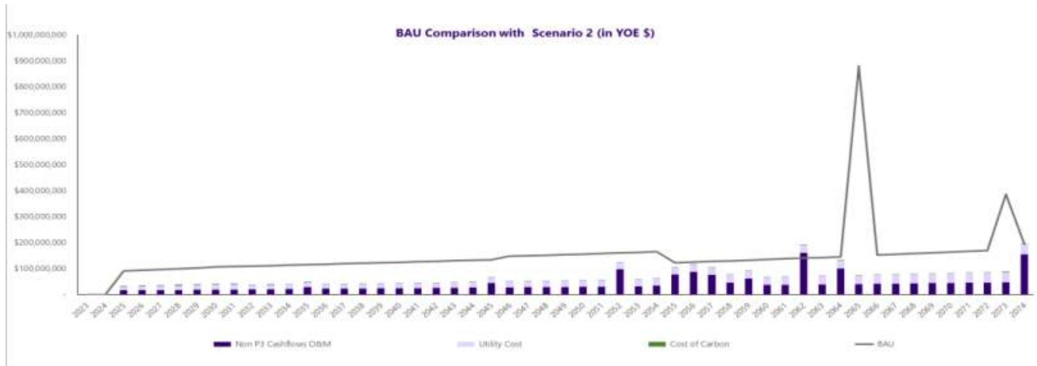


Figure 4.4.3-2: *Project Cashflows under Scenario 2*

4.4.4 Scenario 3: 8 Biennia, Avg: $250M / Biennia (with CCA funding)

Scenario 3 assumes that CCA funding is available to fund all projects over 8 biennium periods. Table 4.4.4-1 presents the summary of this scenario.

Table 4.4.4-1: Summary of Scenario 3

Category	Details
CapEx (escalated)	• $2.05 billion ; capturing the capital expenditures for the comprehensive set of ERP projects.
Funding Sources	• All CapEx funded through CCA funding.
OpEx Profile	• ERP operating expenses (O&M, Renewal and Replacement, Utility Costs).

Table 4.4.4-2 summarizes the project costs for Scenario 3.

Table 4.4.4-2: Summary of uses under scenario 3

Project	Total Cost
Last updated: 9/17/2024	*In millions*
B-1 Chiller Replacements- South of Pacific	$ 8.1 m
B-1 Chiller Replacements- Central	$ 13.5 m
B-1 Chiller Replacements- North	$ 8.8 m
B-6 Metering Program	$ 12.7 m
B-8,9,10 HHW Conversions- Central Campus West Tunnel Scope Zone	$ 71.6 m
B-8,9,10 HHW Conversions- Central/ Lower Distribution Scope Zone	$ 85.9 m
B-8,9,10 HHW Conversions- East Campus Distribution Scope Zone	$ 10.3 m
B-8,9,10 HHW Conversions- North Distribution Scope Zone	$ 49.7 m
B-8,9,10 HHW Conversions- South from Power Plant(PP) Scope Zone	$ 99.3 m
B-8,9,10 HHW Conversions- South from WCUP Scope Zone	$ 42.7 m
B-8,9,10 HHW Conversions- West Distribution Scope Zone	$ 2.9 m
B-11 Local Satellite Steam Plants	$ 71.2 m
E-1 UW Substation	$ 34.4 m
E-2 PP Ring Bus & Express Feeders	$ 14.1 m
P-1 Convert CCW to Year-round Operation	$ 5.3 m
P-2 Add CH-8_CT-14	$ 24.7 m
P-3 WCUP CH5 & CT	$ 12.7 m
P-4 WCUP Annex	$ 55.7 m
P-5 CCW TES Tank	$ 77.8 m
P-6 PHW TES Tank	$ 18.7 m
P-7 WCUP HRCs and Cooling Tower	$ 139.6 m
P-8 Power Plant Heat Recovery Chillers	$ 173.2 m
P-9 CCW Header and Secondary Pumping System	$ 13.0 m
P-10 Power Plant PHW System	$ 12.5 m
P-11 PP Elec. Boilers & EM Gen Heat Rec.	$ 86.6 m
P-12 WCUP Electric Boilers	$ 26.1 m
P-13 WCUP Generators	$ 10.2 m
P-14 PP Controls Upgrades	$ 4.6 m
D-C1 Central Campus Piping	$ 109.6 m
D-C2 Central Campus Piping West Tunnel	$ 92.7 m
D-N1 North Campus Piping	$ 105.4 m
D-S1 PHW Piping from WCUP to South Campus	$ 55.6 m
D-S2 South of Pacific Campus Piping from PP	$ 79.8 m
D-W1 West Campus CCW & PHW Piping- Phase 1	$ 93.6 m
D-W2 Sewer Heat Recovery Piping	$ 10.5 m
D-E1 PHW Piping from PP to East and SE Campus	$ 83.2 m
S-1 Lake Interface System- Phase 1	$ 21.6 m
S-2 Sewer Heat Recovery Equipment Bldg- Phase 1	$ 11.1 m
CPAT- Lake Advancement	$ 1.1 m
CPAT- District Energy Stands/Basis of Design	$ 2.0 m
CPAT- PP Boiler Removal	$ 2.2 m
D-W1 West Campus CCW & PHW Piping- Phase 2	$ 13.2 m
S-1 Lake Interface System- Phase 2	$ 159.9 m
S-2 Sewer Heat Recovery Equipment Bldg- Phase 2	$ 56.0 m
	$ 2,054.1 m

Table 4.4.4-3: Lists funding sources for Scenario 3, distinguishing between CCA Funding required and the availability of tax credits according to the eligibility assessment of the ERP components.

Table 4.4.4-3: Summary of sources under Scenario 3

Source Particualrs	Total	Non P3	P3
Last updated: 9/12/2024	*In millions*	*In millions*	*In millions*
State Direct Funding Disbursement	**$ 2,037.4 m**	$ 2,037.45 m	-
Capex Funded by Tax Credits Receipts	**$ 16.7 m**	$ 16.69 m	-
Short Term Loan Disbursement	**-**	-	-
UW LT Debt Disbursement / LT Private Debt	**-**	-	-
Equity	**-**	-	-
	$ 2,054.1 m	**$ 2,054.14 m**	**-**

Table 4.4.4-4 shows CapEx commitments by biennial budget periods for Scenario 3.

Table 4.4.4-4: CapEx by Biennial Budget Period under Scenario 3

Period	Start Date	End Date	Total Capex to be Committed
Biennial Budget Period 1 - Phase 1	7/1/2025	6/30/2027	$ 292.6
Biennial Budget Period 2 - Phase 2	7/1/2027	6/30/2029	$ 203.4
Biennial Budget Period 3 - Phase 3	7/1/2029	6/30/2031	$ 383.3
Biennial Budget Period 4 - Phase 4	7/1/2031	6/30/2033	$ 362.0
Biennial Budget Period 5 - Phase 5	7/1/2033	6/30/2035	$ 278.7
Biennial Budget Period 6 - Phase 6	7/1/2035	6/30/2037	$ 214.1
Biennial Budget Period 7 - Phase 7	7/1/2037	6/30/2039	$ 197.1
Biennial Budget Period 8 - Phase 8	7/1/2039	6/30/2041	$ 122.9
Total Commitments			**$ 2,054.1 m**

Figure 4.4.4-1 displays the NPV comparison between BAU and Scenario 3.

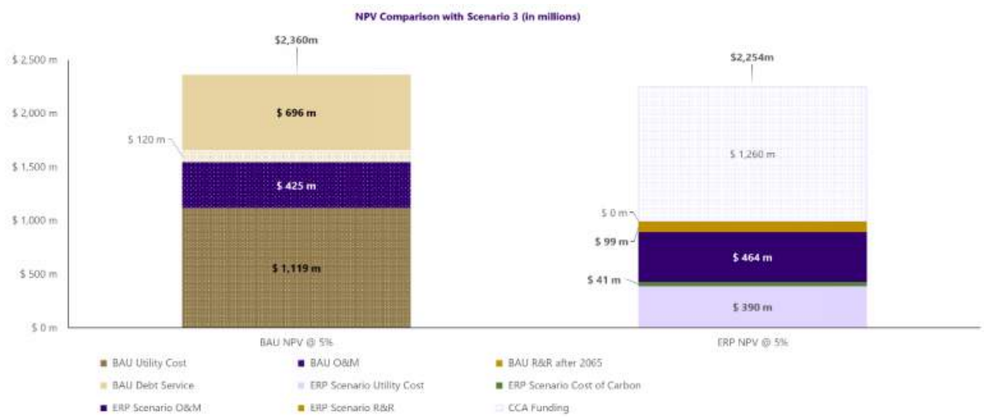


Figure 4.4.4-1: NPV Comparison between BAU and Scenario 3

Figure 4.4.4-2 compares the cashflow outlay between the BAU scenario and Scenario 3.

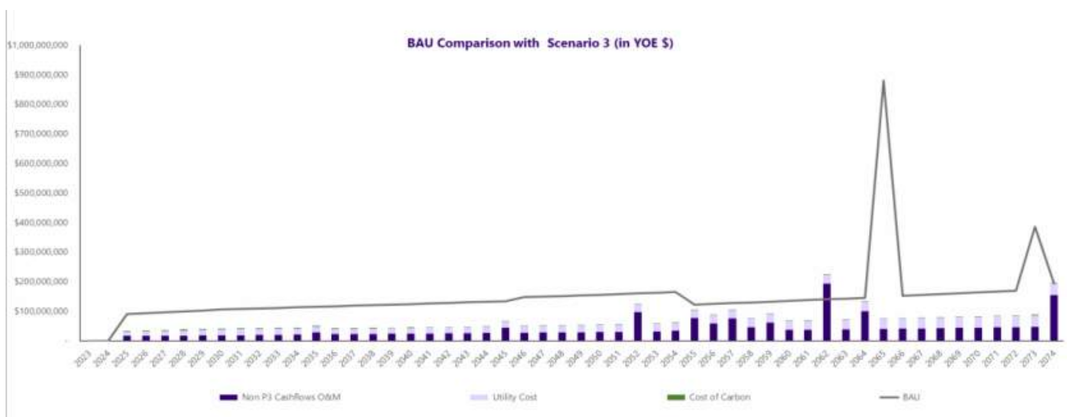


Figure 4.4.4-2: *Project Cashflows under Scenario 3*

4.4.5 Scenario 4: 7 Biennia (P3), Avg: $247 M / Biennia (with CCA funding)

Scenario 4 represents a hybrid delivery approach, whereby the University utilizes P3 delivery for a subset of the ERP projects. In this scenario, most of the CapEx of the S-1 (Lake Interface System) and S-2 (Sewer Heat Recovery) projects are delivered through a P3, and the up-front cost of the P3 projects is privately financed by a P3 developer. In turn, the University commits to pay availability payments to the P3 developer after the commencement of operations – these payments include the developer's capital costs as well as the cost of on-going O&M for the assets (associated commodity costs are assumed to remain a UW obligation). The remainder of the ERP projects are assumed to be UW-delivered and funded with CCA funds. The following are the key characteristics of this scenario:

Table 4.4.5-1: Summary of Scenario 3

Category	Details
Financing	• Private financing for S-1 and S-2 projects; • No UW financing required for the remaining ERP projects. Remaining projects funded through CCA funds.
CapEx (escalated)	• $2.02 billion in total; Project delivery is nonetheless different for a portion of the CaPex (P3): o $236 million for P3-delivered projects. o $1.78 billion representing the remaining capital expenditures for the full set of ERP projects.
Funding Sources	• CapEx for non-P3 projects funded through CCA funds;
OpEx Profile	• The OpEx profile is bifurcated: o Non-P3 OpEx: Base ERP operating expenses excluding costs for P3 components; o P3 OpEx: Operating expenses for S-1 and S-2 projects with a 10% profit margin assumed for the private developer.
Availability Payment Calculations	• P3 availability payments are calculated to cover the developer's operational costs, operating margin, and capital charges, providing sufficient capital for debt repayment and modeled equity returns.

Table 4.4.5-2 summarizes the project costs for Scenario 4, noting the incorporation of P3 components.

Table 4.4.5-2: Summary of uses under scenario 4

Project	Total Cost		Non P3
Last updated: 9/17/2024		*In millions*	*In millions*
B-1 Chiller Replacements- South of Pacific	$	7.6 m	7.6
B-1 Chiller Replacements- Central	$	12.7 m	12.7
B-1 Chiller Replacements- North	$	7.4 m	7.4
B-6 Metering Program	$	10.1 m	10.1
B-8,9,10 HHW Conversions- Central Campus West Tunnel Scope Zone	$	71.6 m	71.6
B-8,9,10 HHW Conversions- Central/ Lower Distribution Scope Zone	$	85.9 m	85.9
B-8,9,10 HHW Conversions- East Campus Distribution Scope Zone	$	10.3 m	10.3
B-8,9,10 HHW Conversions- North Distribution Scope Zone	$	49.7 m	49.7
B-8,9,10 HHW Conversions- South from Power Plant(PP) Scope Zone	$	99.3 m	99.3
B-8,9,10 HHW Conversions- South from WCUP Scope Zone	$	42.7 m	42.7
B-8,9,10 HHW Conversions- West Distribution Scope Zone	$	2.9 m	2.9
B-11 Local Satellite Steam Plants	$	71.2 m	71.2
E-1 UW Substation	$	34.4 m	34.4
E-2 PP Ring Bus & Express Feeders	$	14.1 m	14.1
P-1 Convert CCW to Year-round Operation	$	5.3 m	5.3
P-2 Add CH-8_CT-14	$	20.7 m	20.7
P-3 WCUP CH5 & CT	$	12.7 m	12.7
P-4 WCUP Annex	$	55.7 m	55.7
P-5 CCW TES Tank	$	77.8 m	77.8
P-6 PHW TES Tank	$	17.6 m	17.6
P-7 WCUP HRCs and Cooling Tower	$	139.6 m	139.6
P-8 Power Plant Heat Recovery Chillers	$	173.2 m	173.2
P-9 CCW Header and Secondary Pumping System	$	13.0 m	13.0
P-10 Power Plant PHW System	$	12.5 m	12.5
P-11 PP Elec. Boilers & EM Gen Heat Rec.	$	73.2 m	73.2
P-12 WCUP Electric Boilers	$	22.1 m	22.1
P-13 WCUP Generators	$	8.1 m	8.1
P-14 PP Controls Upgrades	$	4.6 m	4.6
D-C1 Central Campus Piping	$	109.6 m	109.6
D-C2 Central Campus Piping West Tunnel	$	92.7 m	92.7
D-N1 North Campus Piping	$	105.4 m	105.4
D-S1 PHW Piping from WCUP to South Campus	$	55.6 m	55.6
D-S2 South of Pacific Campus Piping from PP	$	79.8 m	79.8
D-W1 West Campus CCW & PHW Piping- Phase 1	$	93.6 m	93.6
D-W2 Sewer Heat Recovery Piping	$	10.5 m	10.5
D-E1 PHW Piping from PP to East and SE Campus	$	78.4 m	78.4
S-1 Lake Interface System- Phase 1	$	12.7 m	12.7
S-2 Sewer Heat Recovery Equipment Bldg- Phase 1		-	-
CPAT- Lake Advancement	$	1.1 m	1.1
CPAT- District Energy Stands/Basis of Design	$	2.0 m	2.05
CPAT- PP Boiler Removal	$	2.2 m	2.22
D-W1 West Campus CCW & PHW Piping- Phase 2	$	13.2 m	13.20
S-1 Lake Interface System- Phase 2	$	169.4 m	-
S-2 Sewer Heat Recovery Equipment Bldg- Phase 2	$	67.1 m	-
	$	**2,020.1 m**	**$ 1,783.6 m**

Table 4.4.4-3: Lists funding sources for Scenario 4, distinguishing between non-P3 and P3 financing.

Table 4.4.5-3: Summary of sources under Scenario 4

Source Particualrs	Total	Non P3	P3
Last updated: 9/12/2024	*In millions*	*In millions*	*In millions*
State Direct Funding Disbursement	**$ 1,766.9 m**	$ 1,766.89 m	-
Capex Funded by Tax Credits Receipts	**$ 16.7 m**	$ 16.69 m	-
Short Term Loan Disbursement	**-**	-	-
UW LT Debt Disbursement / LT Private Debt	**$ 212.8 m**	-	$ 212.84 m
Equity	**$ 23.6 m**	-	$ 23.65 m
	$ 2,020.1 m	**$ 1,783.58 m**	**$ 236.49 m**

Table 4.4.5-4 shows CapEx commitments by biennial budget periods for Scenario 4, with allocations for both non-P3 and P3 components.

Table 4.4.5-4: CapEx by Biennial Budget Period under Scenario 4

Period	Start Date	End Date	Total Capex to be Committed
Biennial Budget Period 1 - Phase 1	7/1/2025	6/30/2027	$ 292.6
Biennial Budget Period 2 - Phase 2	7/1/2027	6/30/2029	$ 213.4
Biennial Budget Period 3 - Phase 3	7/1/2029	6/30/2031	$ 332.3
Biennial Budget Period 4 - Phase 4	7/1/2031	6/30/2033	$ 290.7
Biennial Budget Period 5 - Phase 5	7/1/2033	6/30/2035	$ 303.4
Biennial Budget Period 6 - Phase 6	7/1/2035	6/30/2037	$ 186.7
Biennial Budget Period 7 - Phase 7	7/1/2037	6/30/2039	$ 164.3
Biennial Budget Period 8 - Phase 8	7/1/2039	6/30/2041	$ -
Total Commitments			**$ 1,783.6 m**

Table 4.4.5-5 shows the anticipated availability payments to be paid to the private developer, assuming a P3 agreement period of 30 years.

Table 4.4.5-5: CapEx by Biennial Budget Period under Scenario 4

Period	Start Date	End Date	Total Availability Payments
Biennial Budget Period 1	7/1/2025	6/30/2027	-
Biennial Budget Period 2	7/1/2027	6/30/2029	-
Biennial Budget Period 3	7/1/2029	6/30/2031	-
Biennial Budget Period 4	7/1/2031	6/30/2033	21.16
Biennial Budget Period 5	7/1/2033	6/30/2035	21.19
Biennial Budget Period 6	7/1/2035	6/30/2037	21.22
Biennial Budget Period 7	7/1/2037	6/30/2039	21.25
Biennial Budget Period 8 and beyond	7/1/2033	6/30/2074	299.61
Total AP			**$ 384.4 m**

Figure 4.4.5-1 displays the NPV comparison between BAU and Scenario 4.

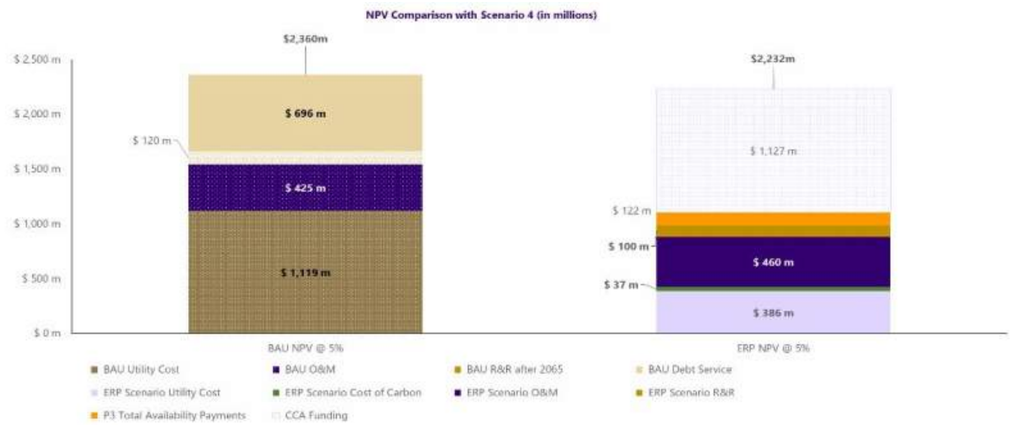


Figure 4.4.5-1: *NPV Comparison between BAU and Scenario 3*

Figure 4.4.5-2 shows cashflow projections under Scenario 4, separating P3 availability payments and other costs. Please note, that the P3 arrangement is assumed to expire following thirty years of operations, at which point the assets would revert to the UW for operations, and the OpEx profile reflects full UW operations all of ERP assets.

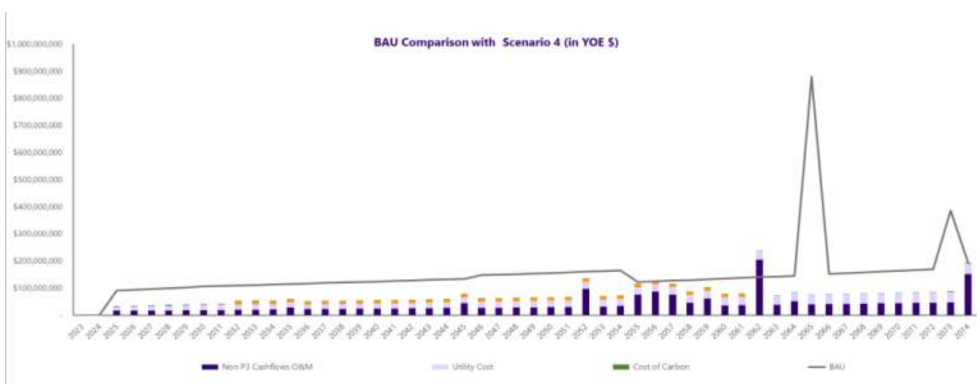


Figure 4.4.5-2: *Project Cashflows under Scenario 3*

4.5 Financial Analysis Supporting Information

4.5.1 BAU Cashflows

BAU Cashflows	Total	2025	2030	2035	2040	2045	2050	2055	2060	2074
Utility Costs	4,032,867,847	28,811,531	43,369,456	50,508,380	57,366,578	65,070,358	83,711,516	92,924,255	102,228,375	133,777,294
O&M	1,407,664,564	16,643,113	18,375,342	20,287,862	22,399,439	24,730,791	27,304,792	30,146,696	33,284,388	43,918,044
Debt Service	1,359,236,371	45,307,879	45,307,879	45,307,879	45,307,879	45,307,879	45,307,879	-	-	-
BAU Cashflow	7,760,501,619	90,762,523	107,052,677	116,104,122	125,073,896	135,109,028	156,324,187	123,070,951	135,512,763	177,695,338

4.5.2 Cashflow Summaries – Scenario 1

BAU Cashflows	Total	2025	2030	2035	2040	2045	2050	2055	2060	2074
BAU Cashflow	7,760,501,619	90,762,523	107,052,677	116,104,122	125,073,896	135,109,028	156,324,187	123,070,951	135,512,763	177,695,338
Scenario Cashflows	**Total**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**	**2074**
Utility Costs	1,262,400,843	13,580,557	19,884,662	16,672,814	18,639,302	21,278,029	24,505,013	27,296,358	30,345,804	39,742,184
Cost of Carbon	75,531,867	2,675,659	3,192,822	688,070	825,616	985,257	1,169,455	1,345,096	1,484,898	1,959,177
O&M	1,561,084,820	17,185,980	19,111,539	22,548,282	24,895,126	27,486,230	30,347,019	33,505,561	36,992,847	48,811,276
Replacement and Renewal	587,689,764	-	-	6,907,442	-	17,951,552	-	68,766,886	-	144,670,165
Debt Service	-	-	-	-	-	-	-	-	-	-
P3 Total Availability Payments	-	-	-	-	-	-	-	-	-	-
Project Casfhlow	3,486,707,293	33,442,196	42,189,024	46,816,607	44,360,044	67,701,068	56,021,487	130,913,902	68,823,549	235,182,802

4.5.3 Cashflow Summaries – Scenario 2

BAU Cashflows	Total	2025	2030	2035	2040	2045	2050	2055	2060	2074
BAU Cashflow	7,760,501,619	90,762,523	107,052,677	116,104,122	125,073,896	135,109,028	156,324,187	123,070,951	135,512,763	177,695,338
Scenario Cashflows	**Total**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**	**2074**
Utility Costs	1,263,843,269	13,579,196	19,881,605	17,003,796	18,634,480	21,271,521	24,496,824	27,285,564	30,321,603	39,705,966
Cost of Carbon	81,686,009	2,675,659	3,192,822	2,108,805	825,616	985,257	1,169,455	1,345,096	1,484,898	1,959,177
O&M	1,560,875,920	17,185,980	19,111,539	22,473,680	24,895,126	27,486,230	30,347,019	33,505,561	36,992,847	51,753,182
Replacement and Renewal	553,776,197	-	-	6,907,442	-	17,951,552	-	43,972,244	-	103,456,569
Debt Service	-	-	-	-	-	-	-	-	-	-
P3 Total Availability Payments	-	-	-	-	-	-	-	-	-	-
Project Casfhlow	3,460,181,394	33,440,835	42,185,967	48,493,723	44,355,222	67,694,560	56,013,297	106,108,466	68,799,349	196,874,894

4.5.4 Cashflow Summaries – Scenario 3

BAU Cashflows	Total	2025	2030	2035	2040	2045	2050	2055	2060	2074
BAU Cashflow	7,760,501,619	90,762,523	107,052,677	116,104,122	125,073,896	135,109,028	156,324,187	123,070,951	135,512,763	177,695,338
Scenario Cashflows	Total	2025	2030	2035	2040	2045	2050	2055	2060	2074
Utility Costs	1,277,489,634	13,579,196	19,881,605	19,874,284	19,063,240	21,271,506	24,496,824	27,285,564	30,321,603	39,705,966
Cost of Carbon	93,412,523	2,675,659	3,192,822	3,082,034	2,533,127	985,257	1,169,455	1,345,096	1,484,898	1,959,177
O&M	1,560,395,906	17,185,980	19,111,539	22,473,680	24,812,758	27,486,230	30,347,019	33,505,561	36,992,847	51,753,182
Replacement and Renewal	557,416,750	-	-	6,907,442	-	17,951,552	-	43,972,244	-	103,456,569
Debt Service	-	-	-	-	-	-	-	-	-	-
P3 Total Availability Payments	-	-	-	-	-	-	-	-	-	-
Project Casfhlow	3,488,714,813	33,440,835	42,185,967	52,337,440	46,409,125	67,694,546	56,013,297	106,108,466	68,799,349	196,874,894

4.5.5 Cashflow Summaries – Scenario 4

BAU Cashflows	Total	2025	2030	2035	2040	2045	2050	2055	2060	2074
BAU Cashflow	7,760,501,619	90,762,523	107,052,677	116,104,122	125,073,896	135,109,028	156,324,187	123,070,951	135,512,763	177,695,338
Scenario Cashflows	Total	2025	2030	2035	2040	2045	2050	2055	2060	2074
Utility Costs	1,271,182,014	13,579,196	19,881,605	18,581,566	18,604,484	21,271,448	24,496,824	27,285,564	30,321,603	39,590,737
Cost of Carbon	86,346,271	2,675,659	3,192,822	2,669,625	825,616	985,257	1,169,455	1,345,096	1,484,898	1,958,514
O&M	1,549,049,729	17,185,980	19,111,539	22,162,836	24,551,929	27,107,314	29,928,665	33,043,664	36,482,875	51,753,182
Replacement and Renewal	545,626,593	-	-	6,807,661	-	17,829,920	-	43,823,975	-	100,298,663
Debt Service	-	-	-	-	-	-	-	-	-	-
P3 Total Availability Payments	334,701,313	-	-	11,062,929	11,098,517	11,137,809	11,181,191	11,229,088	11,281,970	-
Project Casfhlow	3,786,905,921	33,440,835	42,185,967	61,284,616	55,080,547	78,331,748	66,776,134	116,727,387	79,571,347	193,601,096

5.0 Life Cycle Cost Analysis

5.1 Net Present Value Calculations

Lifecycle cost analyses were performed for different funding pathways and debt source scenarios for the UW Energy Renewal Plan. Costs were compared to a Business-as-Usual (BAU) case representing ongoing costs and renewal required if the UW does not move forward with the ERP. The duration of the analysis extends 50 years. Refer to Section 4, Financial Modeling, for details on assumptions and data sources. The following funding pathways and debt source scenarios were determined:

- Scenario 1 (S1) — Four Biennia Funding Period (Average $454M / Biennia)
- Scenario 2 (S2) — Five Biennia Funding Period (Average $377M / Biennia)
- Scenario 3 (S3) — Eight Biennia Funding Period (Average $250M / Biennia)
- Scenario 4 (S4) – Seven Biennia Funding Period with P3 Partnerships (Average $247M / Biennia)

Figure 5.1-1 illustrates a comparison between the ERP and BAU cases with representative ongoing operational and renewal costs associated with each.

Figure 5.1-1: *Net Present Value (NPV) comparison of the Business-As-Usual (BAU) case to the ERP under four varying funding timeline scenarios.*

It can be seen from Figure 5.1-1 that each of the ERP funding scenarios with have positive net present values relative to the BAU. The accelerated timeline in Scenario 1 is meant to reflect compliance with the ten-year timeline initially set by the UW Energy Strategy while the other scenarios are meant to extend the timeline to fit better within the University's funding requests. Refer to Section 4, Financial Modeling, for details on assumptions and data sources.

The BAU scenario identifies the level of investment required to maintain the status quo of delivering heating and cooling to campus with the existing infrastructure and technologies. Doing so allows for a comparison of the incremental cost of the ERP relative to the BAU and helps identify additional benefits that the ERP provides such as improved resiliency and operational reliability, reduced maintenance needs stemming from major electrical infrastructure improvements, thermal energy storage, and consolidation of distributed building cooling systems.

The criteria for the BAU were developed in conjunction with UW which assumes central steam is maintained with gas-fired boilers. The BAU uses renewable natural gas to produce steam in lieu of participating in the CCA auctions or paying penalties for non-compliance with other carbon emissions regulations (such as Seattle BEPS). The combination of campus CCW and building-level cooling systems is maintained with an electrical curtailment strategy in summer during peak cooling times. No significant electrical infrastructure upgrades are included in the BAU. Moving forward, new buildings have standalone code-compliant HVAC systems and decentralized heating and cooling. PP CCW remains seasonal only and no cooling is added to existing buildings without cooling.

5.1.1 Operation & Maintenance Inputs

Life cycle operation and maintenance (O&M) costs were estimated for the ERP and BAU case including the costs associated with routine maintenance, service, and repair. These costs are in addition to ongoing utility costs and equipment replacement and renewal costs which are detailed in upcoming sections.

The O&M costs in this category were estimated from a variety of sources. Estimated maintenance costs for new equipment related to the ERP were primarily provided by the equipment representatives based on estimated costs of service contracts that would be representative of the level of maintenance that would be provided by UW operational staff. This includes heat recovery chillers, conventional chillers and cooling towers, heat exchangers, and sewer and lake interface systems.

Information about existing O&M costs (2022-2024) for major infrastructure serving the WCUP and PP were provided by UW Facilities via cost of power plant operations summary tables including direct payroll, operation, distribution and tunnel maintenance, and additional minor projects. The direct payroll numbers were further refined with input from the CE&U team based on recent labor negotiations and anticipated increase in staffing associated with the new systems defined in the ERP. The 2013 UW modified obsolescence plan was also referenced for ongoing O&M costs associated with maintaining energy infrastructure on campus as this source was used in the 2017 University of Washington Hot Water Conversion Study: Phase II.

The approach taken for O&M cost analysis includes estimating the overall magnitude of O&M costs relative to capital project costs and ongoing utility costs, as well as identifying major O&M cost differences between the ERP and BAU cases. Examples of major O&M costs associated solely with the BAU case include combustion boilers, steam turbine generator, absorption chiller, steam and condensate piping distribution, and distributed building cooling systems. Examples of major O&M costs associated solely with the ERP include heat pump chillers, electrode boilers, thermal energy storage tanks, increased water treatment, and sewer and lake interface systems.

Refer to section 6.2 of the Phase II report for additional discussion on the impacts of the ERP on staff resources and operational complexity.

5.1.2 Equipment Replacement & Renewal Value

Equipment replacement and renewal projects are assumed to be major capital projects that fully replace, upgrade, or modernize equipment at the end of its useful life. Given the 50-year period for life cycle cost analysis, all major equipment and infrastructure are assumed to require major renovations (in the case of thermal energy storage tanks) or be fully replaced at least once with typical equipment life ranging from 25 years to 40 years depending on the system type.

Like the approach taken for O&M costs, estimating equipment renewal costs focuses on the overall magnitude of renewal costs and major cost differences between the ERP and BAU cases. Examples of major renewal costs associated with the BAU case include combustion boilers, steam turbine generators, absorption chiller, steam and condensate piping distribution, and distributed building cooling systems. Examples of major renewal costs associated solely with the ERP include heat pump chillers, electrode boilers, thermal energy storage tanks, increased water treatment, and sewer and lake interface systems. The water-cooled chillers and pumps in the Power Plant and WCUP are replaced in both the BAU and ERP scenarios.

5.2 Energy Modeling Results

Energy, utility costs, and greenhouse gas emissions used as the basis for the full life cycle cost analysis (LCCA) are described in this section. These results reflect the fully implemented ERP and all distributed building cooling loads added to the campus cooling water (CCW) system. Future climate impacts are captured assuming RCP4.5 future weather scenario. Annual system operation and performance results shown below are for the year and climate of 2050 unless specified otherwise.

The heating generation curve in Figure 5.2-1 shows how heat source utilization varies based on the magnitude of the demand. The figure shows the number of hours over a year where the heating load and heat generation are at least the values shown. The impact of thermal energy storage (TES) is included, and the campus load demand curve relative to the equipment heat generation is shown. The figure illustrates how the TES shifts load from peak times to lower demand hours. This allows for more utilization of heat recovery and minimizing the use of the backup boilers. Some hours with minimal heating demand during the summer are eliminated completely because of the daily discharge of the heating TES; over the year there is a reduction in trim boiler operation of 567 hours. This analysis assumes that resiliency is being managed through the power reliability improvements at the UW Substation and that the TES is available for charging and discharging cycles throughout the year.

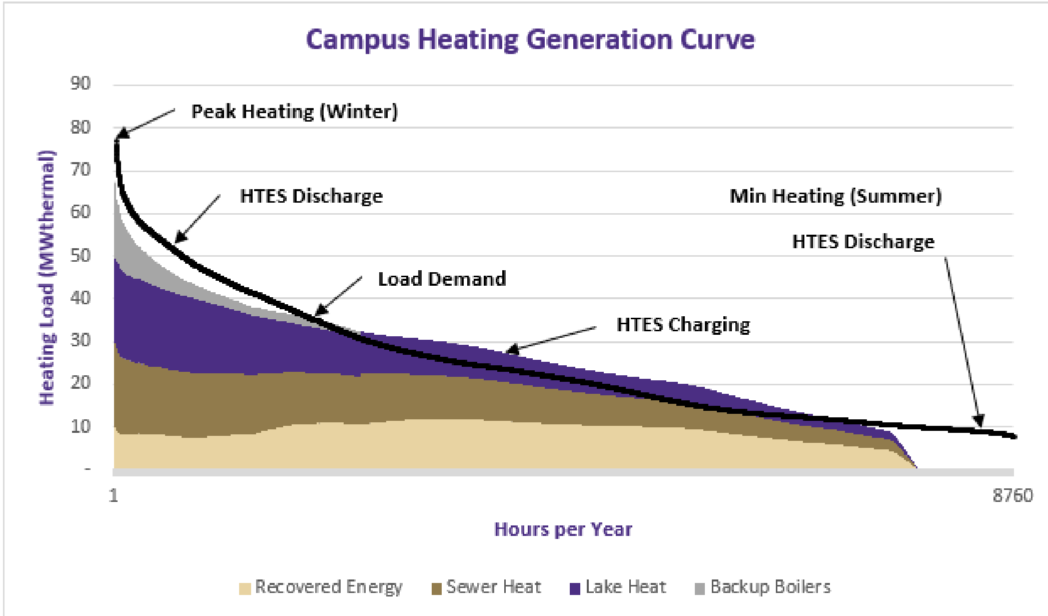


Figure 5.2-1: *Campus heating generation (plant equipment) curve and campus load demand curve for year 2050.*

Table 5.2-1 summarizes the electrified heating system's annual heating energy performance. For these model results, process steam generation was assumed to be natural gas and is a significant energy consumer. HRCs handle 53% of the hot water load running in simultaneous heating and cooling mode while only 4% of the hot water is generated from trim boilers.

Together, recovered energy and sewer heat sources produce 78% of the annual heating load while lake source heating produces 18% of the total output. The HRCs have improved performance when utilizing the sewer because it is a higher-temperature heat source. Using the lake as a heat source yields the lowest performance relative to recovered energy or sewer heat.

Table 5.2-1: System Heating Energy Performance Summary for the Year 2050. Note that process steam will continue to utilize natural gas combustion.

	% Annual Heating Output	Heating Energy MWH	% Heating Energy	Peak MW	Average Heating COP	Run Hours
Simultaneous	53%	36,398	43%	12.6	3.1	6,775
Sewer	25%	22,885	27%	7.4	3.7	3,771
Lake	18%	16,597	20%	10.2	3.0	3,948
Trim	4%	8,849	10%	24.0	-	1,611

Figure 5.2-2 shows the cooling generation curve against the campus load demand curve. During the warmer months, lake water is used to cool the condenser water loops of the water-cooled chillers via heat exchangers. This improves the overall energy efficiency of the water-cooled chiller plant while saving a large amount of water. During the rest of the year, when the lake water is used for heat generation, heat is rejected from the condenser water loop via cooling towers. The impact of the chillers utilizing lake water for cooling is broken out separately.

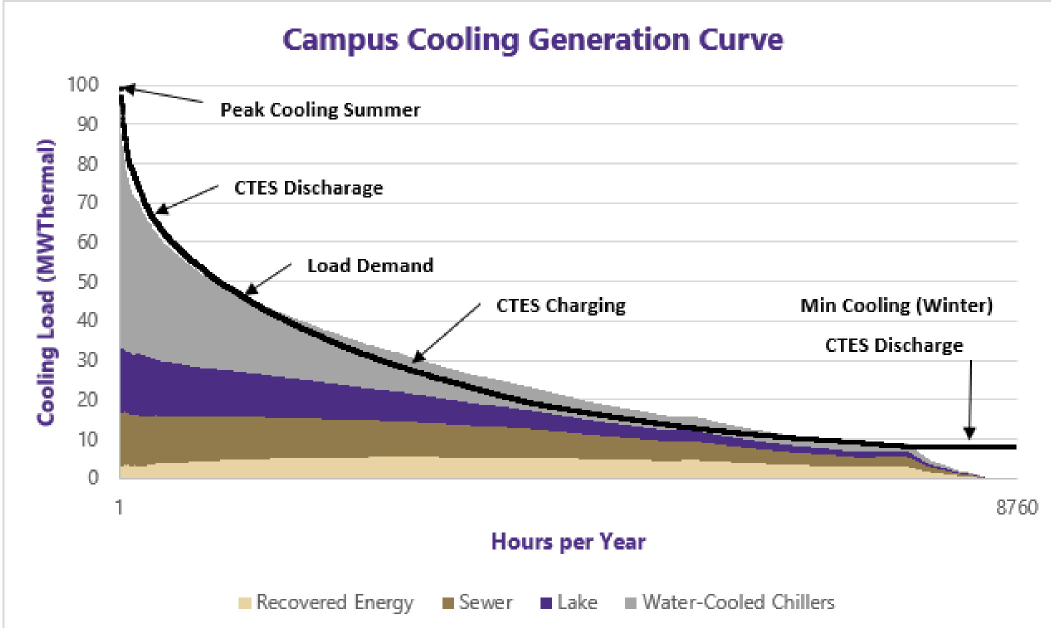


Figure 5.2-2: *Campus cooling generation (plant equipment) curve and campus load demand curve for the year 2050.*

Table 5.2-2 summarizes the annual cooling energy performance, illustrating how different cooling sources are utilized based on the annual cooling demand.

Table 5.2-2: System Cooling Energy Performance Summary for the Year 2050

	% Annual Cooling Output	COP	Run Hours	Cooling Energy MWh	% Cooling Energy	Peak MW
Simultaneous	35%	2.1	6775	Energy is associated with heating; cooling is free		
Sewer	28%	7.4	4973	8306	41%	2.3
Lake	14%	8.2	2081	3680	18%	2.6
Conventional Water-Cooled Chillers	24%	6.0	6555	8133	40%	15.9

Simultaneous heat recovery and sewer sources handle 63% of the annual cooling demand. The HRCs have improved performance when using the sewer because the temperature is generally lower than that of the water-cooled chiller condenser water loops. Utilizing lake cooling yields the greatest efficiency because of the decreased water temperatures.

The entire ERP plant will have a system COP of 4.1, considering both heating and cooling loads and energy but excluding the gas process steam. When the gas process steam is accounted for the system COP is 2.6.

Anticipated campus daily electrical peak demand is shown in Figure 5.2-3 for both a business-as-usual (BAU) case and the ERP scenario. The BAU case is a baseline that reflects the campus operation today, utilizing the existing natural gas steam system and conventional water-cooled chillers for heating and cooling. It includes the energy demand and consumption of the building-level chillers as well.

The BAU case has a peak campus electrical demand of 49MW, while the ERP scenario has a peak of 71MW, resulting in a delta of 22MW to fully electrify the campus heating and cooling systems. It also shifts the campus peak demand from the summer cooling season to the winter heating season. These results include the impact of the TES which discharges during high demand periods, thereby reducing electrical demand. Excluding the TES operation yields a peak demand of 76MW. The baseline data is based on measured data from Seattle City Light meters in 2023.

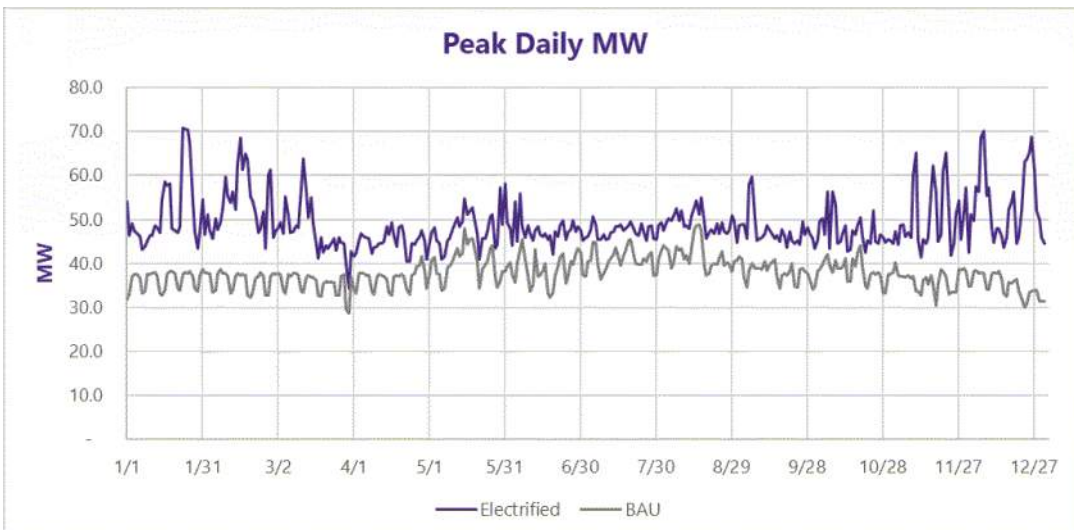


Figure 5.2-3: *Existing campus electrical demand, calculated as the peak demand over 15-minute intervals, compared to the calculated future ERP scenario.*

Figure 5.2-4 provides the ERP heating and cooling energy consumption broken down by equipment type. This analysis assumed that process steam would remain on the combustion-based steam system; the CO_2 emission impacts of process steam are summarized at the end of this section. The HRCs make up 75% of the electrical energy consumption utilizing heat pump technology, while trim boilers make up 9%. Process steam is not included in the figure below, but a comparison of electrical vs natural gas energy consumption is provided in the next figure.

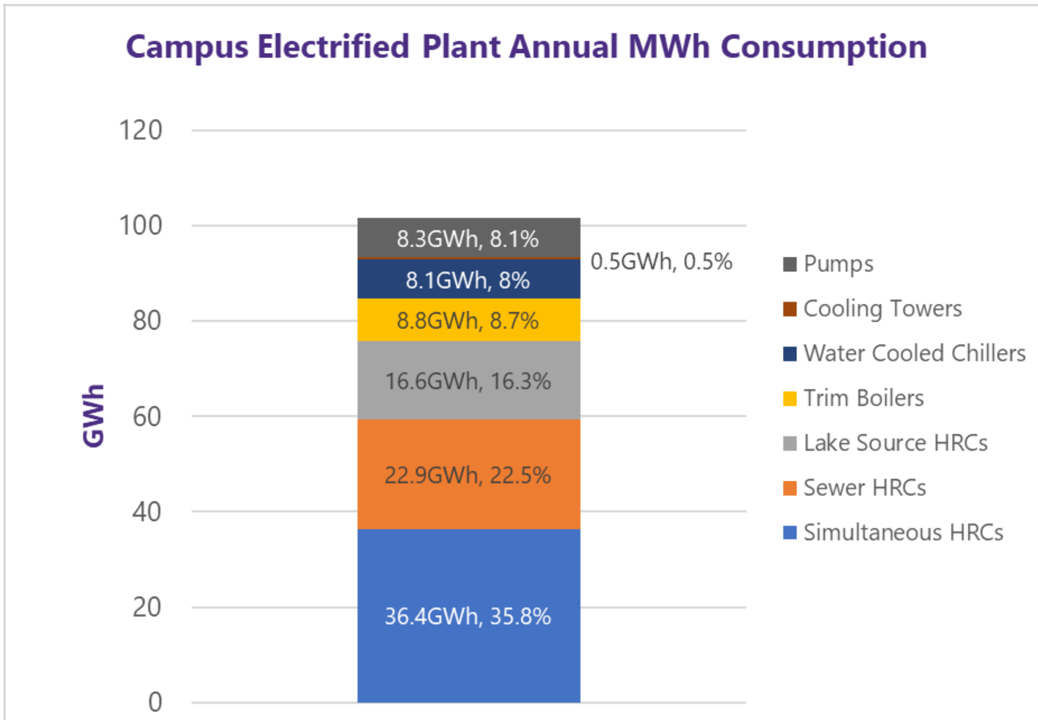


Figure 5.2-4: *Campus ERP plant annual electricity consumption by end-use category. Note that process steam is excluded since it will remain on the combustion system. These results are for the year 2050.*

Figure 5.2-5 compares the energy consumption of the ERP heating and cooling systems against the natural gas consumption associated with the remaining process steam on campus (refer to Phase II report section 3.2.2 for assumptions behind steam process load). Process steam is a significant load and will constitute 45% of the system energy consumption post-electrification. Moving some or all of this load to an electrified system would increase the required electrical demand significantly.

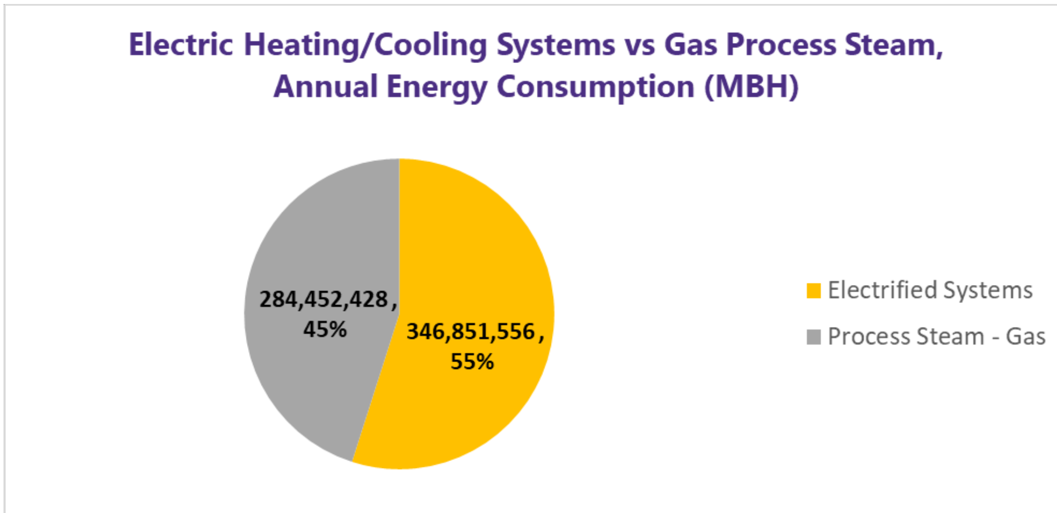


Figure 5.2-5: *Energy consumption of electrified systems vs gas consumption of process steam for ERP for the year 2050.*

Figure 5.2-6 shows the energy consumption over the life span of the campus for scenario S2 – 5 Biennia (refer to section 4.0 Financial Modeling for more information on this and other funding scenarios). Total energy consumption begins to decrease in the year 2030 as parts of the steam distribution transition to hot water with the HRCs coming online for WCUP and PP in 2032 and 2034 respectively. The final portion of the steam distribution for heating is moved over to the electrified hot water system in 2034 and the electric boilers come online in 2036. The remaining gas consumption after 2036 is from process steam. Future weather predictions with a warming climate are accounted for but have a small impact on annual energy consumption. The campus heating and cooling EUI reduces from 124 to 43 because of the ERP electrification effort.

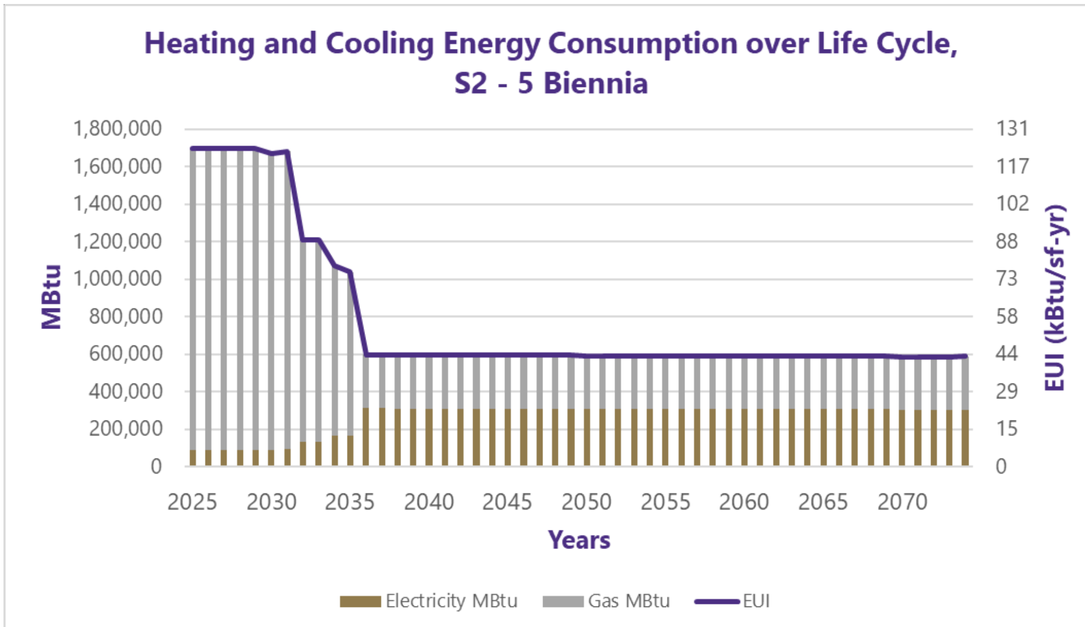


Figure 5.2-6: *Energy consumption of ERP over life cycle. EUI is calculated based on 13,700,000sf of buildings connected to the WCUP and PP.*

Figure 5.2-7 shows the EUI of the campus before and after electrification. Energy consumption of the PP and WCUP is included as well as building-level energy consumption which was inventoried in the Phase I Baseline Assessment report. The business-as-usual (BAU) has a campus EUI of 188 while the ERP has a campus EUI of 106. The EUI target for the Clean Buildings Performance Standard (CBPS) is 165, putting the ERP well below the target. These EUIs are based on the 13.7 million square feet of buildings connected to WCUP and PP since this is the focus of the ERP effort. This is a subset of the contiguous campus which will ultimately comply via the campus pathway as defined in the Clean Building Performance Standard (refer to section 7.0, Regulatory Planning). The substantial energy reduction is a result of the high-performance ERP design which utilizes heat pumps, heat recovery, and TES.

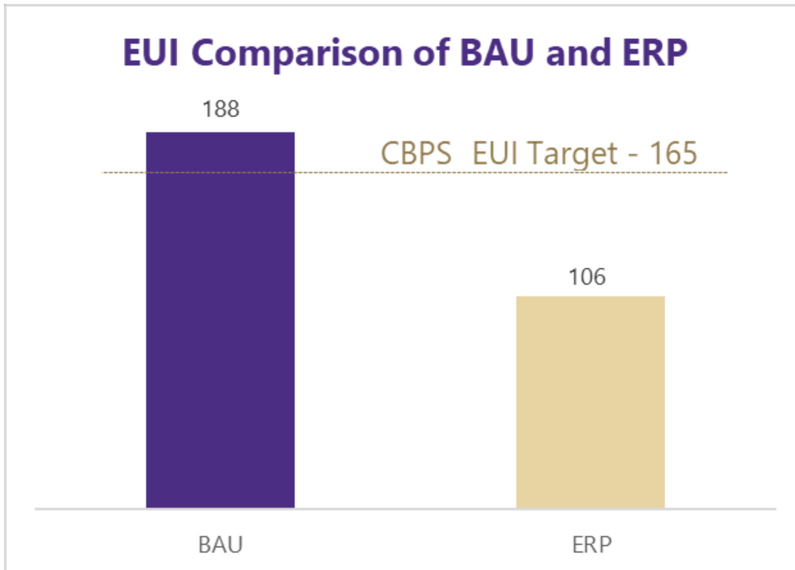


Figure 5.2-7: *Comparison of campus EUI before and after electrification effort. The campus CBPS target is also shown.*

Table 5.2-3 shows the annual utility cost of the ERP against the BAU baseline for the year 2050 with 2024 utility rates. The BAU continues to use inefficient natural gas steam boilers and, therefore, has a higher utility cost. Scenarios for BAU with and without renewable natural gas (RNG) were included. The BAU uses RNG to eliminate carbon emissions and comply with the Climate Commitment Act; RNG was estimated to be 2x more expensive than conventional natural gas from recent PSE pricing. The process steam in the ERP is served by conventional natural gas. The cost of carbon for the ERP and BAU with conventional natural gas was assumed to be $30/MTCO2e. If the BAU utilizes conventional natural gas by paying for CCA auction allowances in lieu of RNG, the ERP scenario is still cheaper albeit the savings are significantly decreased. Conventional natural gas is 3-4x cheaper per unit of energy than electricity and the ERP scenario has superior utility costs because of its higher efficiency.

Table 5.2-3: Annual Utility Cost Summary for the year 2050 in 2024 dollars.
Costs are Normalized Against 13,700,000 Square Feet (SF) of Buildings Connected to WCUP and PP

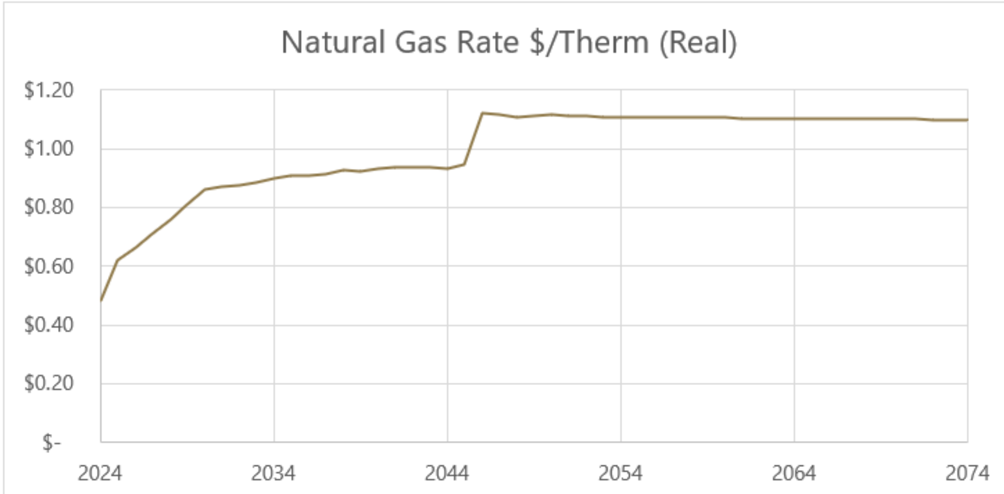
	Annual	$/sf
ERP with Conventional NG	$ 13,355,517	$ 0.97
ERP with Renewable NG	$ 14,893,326	$ 1.12
BAU with Conventional NG	$ 18,879,396	$ 1.38
BAU with Renewable NG	$ 27,345,562	$ 2.00

Utility rates used to calculate energy costs come from Seattle City Light (SCL) for electricity and Puget Sound Energy (PSE) for gas. These are summarized in Table 5.2-4. Recent utility pricing was also provided by UW showing variability over the past 12-18 months. The calculated blended rate for electricity is $0.0977 / kWh including demand charges. The gas rate is for conventional natural gas and is on the higher side of pricing observed over the past 12-18 months.

Table 5.2-4: Utility Rate Summary for the year 2024

Electricity - Per kWh	Peak	$ 0.10
	Off-Peak	$ 0.06
Electricity - Per kW	Peak	$ 4.88
	Off-Peak	$ 0.31
Natural Gas - Per Therm		$ 0.70
Sewer Heat Exchanger - Per MMBTU		$ 0.42
Water - Per Makeup Gal		$ 0.009
Sewer - Per Gal		$ 0.0245

The escalation rates for electricity and natural gas assumed for this analysis are given in Figure 5.2-8. These are “real” rates which exclude inflation, isolating the projected true increase or decrease in the cost of energy over time in today’s dollars. These projections are based on the short-term rate increases reported by SCL and PSE and then extrapolated out based on predictions from the Energy Information Administration (EIA). Natural gas rates increase significantly over the next decade then jump in 2045, coinciding with utility carbon neutrality goals and legislation from Washington and California. The projected real electricity rate increases for the next decade, plateauing in 2034. General inflation is added to these utility costs in the LCCA.



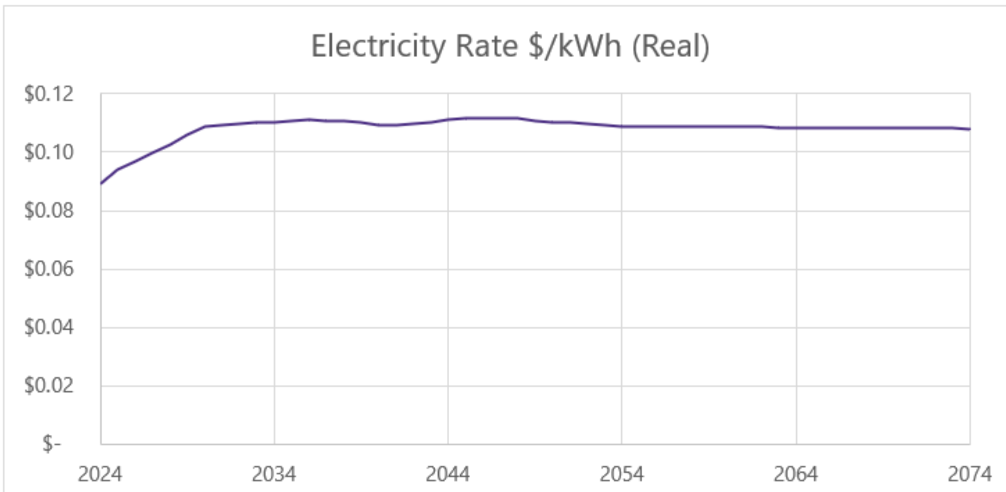


Figure 5.2-8: *Escalated rates for electricity and gas, excluding inflation (real rates).*

Table 5.2-5 compares the CO2 emissions before and after ERP electrification. The emissions rates are 0.0064 MTCO2e / kWh for SCL and 11.7 lbs CO2 / Therm for natural gas. Emissions are shown for the plants, contiguous campus — including the building-level gas systems — and the process steam.

Since the process steam is a large annual load, continuing to use natural gas as the generation source would greatly diminish the buffer between campus emissions post-electrification and the 25,000 MTCO2e target for the Climate Commitment Act. If the process steam continues to be supplied by natural gas systems and the building-level gas systems are left in place, the emissions are estimated to be 23,692 MTCO2e per year placing UW just below the CCA limit of 25,000 MTC02e. If RNG were used in the ERP for process steam then the CO2 emissions for CCA compliance would reduce to 6,104 MTCO2e per year, yielding a significant buffer against the CCA threshold.

Table 5.2-5: CO2 Emissions Summary

	Annual MTONs CO2	Notes
ERP Plants	304	Emissions from WCUP and PP Only. Excludes Process Steam.
BAU Plants	57,412	
ERP Campus	23,692	Contiguous campus. Includes gas consumption at buildings and emissions from process steam which remains on natural gas. Does not take credit for renewable natural gas.
BAU Campus	80,800	
Process Steam - Natural Gas Boilers	17,588	Impact of keeping process steam (25,000 pph) on natural gas boilers; includes steam distribution and makeup loss of 23% total

Figure 5.2-9 shows a graphical representation of the data in Table 5.2-5.

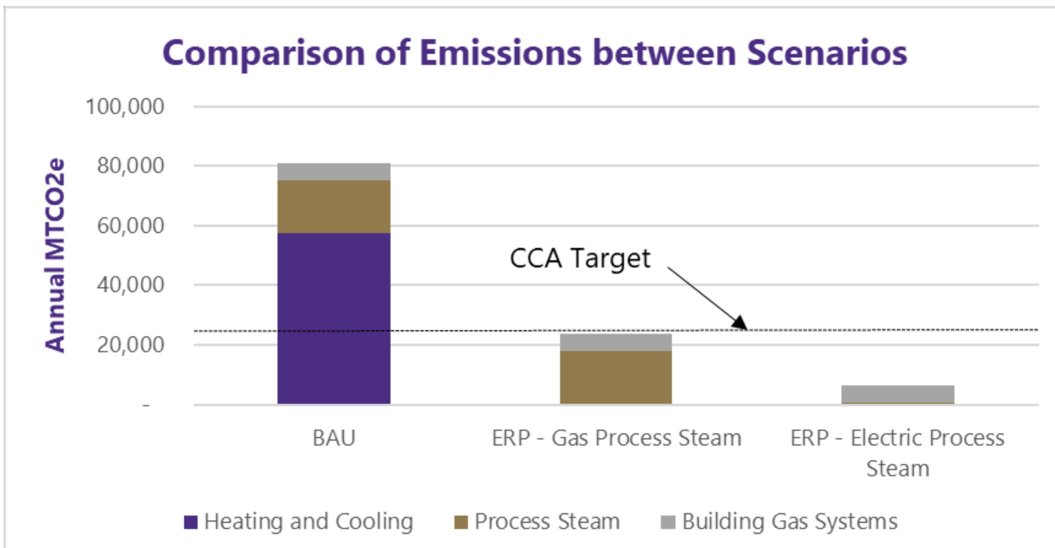


Figure 5.2-9: *Comparison of the BAU And ERP scenarios.*

The incremental NPV cost of the carbon emission reduction is given below in Table 5.2-6. This analysis compares the difference in the total NPV cost of capital, operations & maintenance, utility costs, equipment renewals, and cost of carbon over the period of the study for both the ERP (Scenario 2) and the BAU with conventional natural gas, and divides that by the avoided carbon emissions over that same period. The cost of the CO_2 emission reduction comes out to $147 per MTCO2e avoided which is favorable compared to a recent EPA social cost of carbon benchmark of $190 per MTCO2e avoided. As another reference, this result also compares well with the benchmark of $265/MTCO2e utilized by the University of California system for the equity-weighted social cost of carbon (as of 2025 and escalated 1.5% annually).

Table 5.2-6: Life cycle CO_2 emissions and incremental NPV cost of avoided emissions.

	BAU (Conventional NG)	ERP - S2 5 Biennia (Conventional NG)	Delta
Total NPV	$ 1,869,500,000	$ 2,280,000,000	$ 410,500,000
MTCO2e	4,192,696	1,396,132	(2,796,564)
NPV Cost per MTCO2e Avoided	$ 147		

6.0 Funding Guidance

6.1 Ernst & Young Disclaimer

Any U.S. tax advice contained in this report was not intended or written to be used, and cannot be used, for the purpose of avoiding penalties that may be imposed under the Internal Revenue Code ("IRC") or applicable state or local tax law provisions.

We expressly authorize disclosure of this document to any and all persons; however, this document is provided solely for your benefit, and it is not to be relied on by any other person. If you disclose this information to others, you must inform them that they may not rely on it. We assume no responsibility for tax or other consequences to any other person; instead, all other persons should consult and rely on the views and advice of their own advisors.

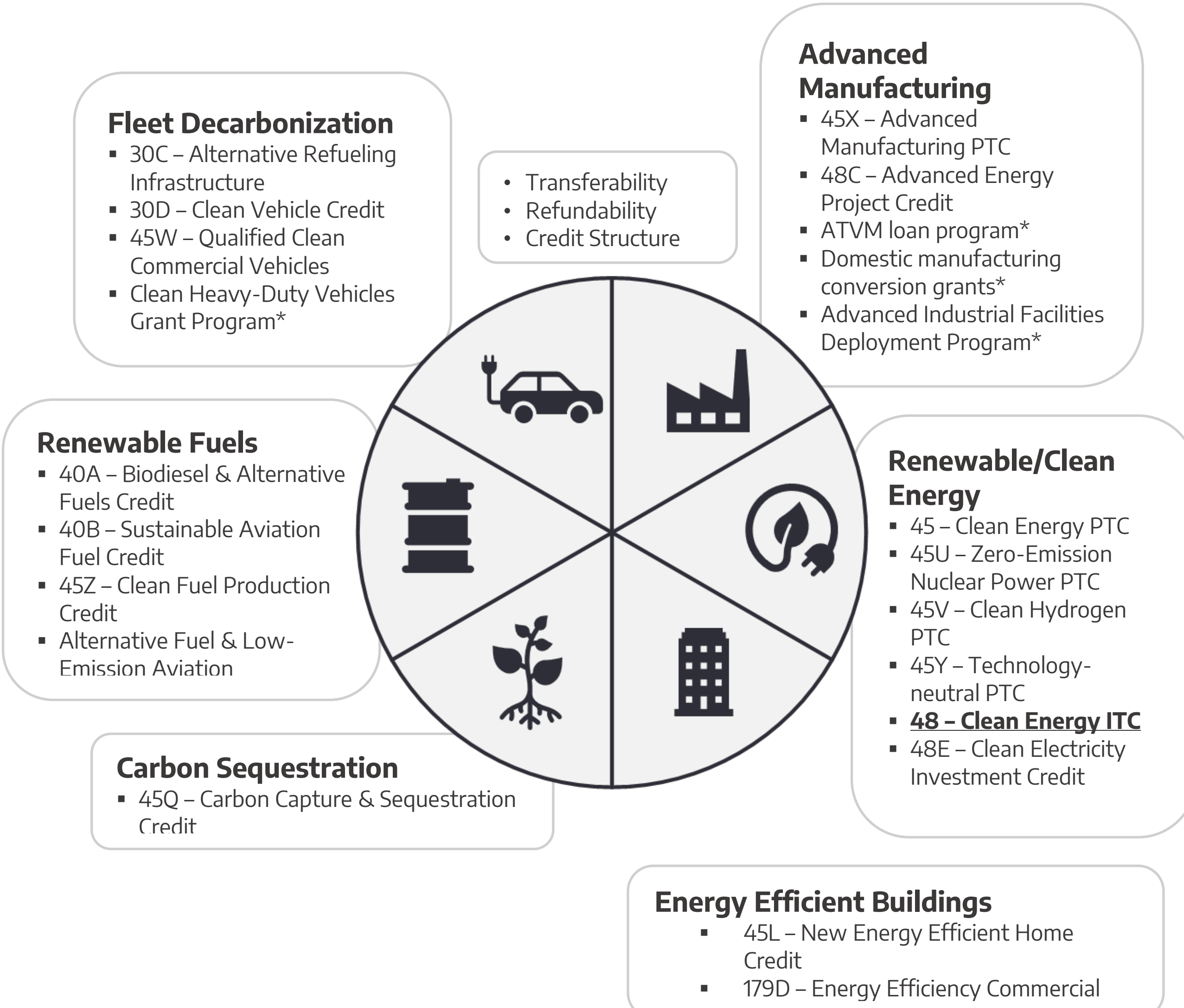
No conclusions have been reached as to the likelihood that the taxpayer will prevail on the merits, with respect to each tax issue considered in this written advice. All references to terms indicating levels of comfort such as "reasonable," "should" or "likely" are to be interpreted merely as an aid in the readers' understanding of the issues and are not intended or written to be used, and cannot be used, as an evaluation of the probability of success on the merits of the issues.

Based upon the data provided and representations by University of Washington personnel, we have taken the data supplied and analyzed it in accordance with Inflation Reduction Act statutes, regulations, notices, and other applicable guidance. We have not performed an independent audit of the data UW has provided. Each IRC Section considered herein is subject to change upon the issuance of additional guidance from IRS or the Treasury Department and such change may be applied retrospectively. We assume no responsibility to update this written advice if the applicable law changes.

The tax advice set forth herein addresses specific US federal income tax issues. This report does not consider any other US federal income tax issues; any non-income tax issues; any state, local or foreign tax issues; or the application of normalization rules under Sections 168(i)(9) and 168(i)(10). Accordingly, we do not reach any conclusions regarding any other US federal income tax; non-income tax; state, local or foreign tax issues; or normalization rules. Furthermore, we express no opinion on non-tax issues, such as corporate or securities law matters. We express no opinion other than as stated herein, and neither this analysis nor any prior statements are intended to imply, or to be an opinion on, any other matters. We assume no responsibility for the tax issues beyond the issues to which this report is devoted. Additionally, we do not opine on any of the following issues: (1) any impact of future legislation, IRS or Treasury Guidance, or other changes in the law, whether retroactive in nature or not; (2) any issues specifically excluded; (3) any state or local taxes, or any non-US taxes in jurisdictions not specifically mentioned; or (4) any taxes not specifically mentioned.

6.3 General Overview of IRA

Inflation Reduction Act ("IRA") is enforced as a law to create opportunities for domestic projects. As part of the implementation of this law, Department of Treasury is providing tax incentives for clean energy projects. A general overview of IRA is as depicted in the picture below:



6.4 Section 48

Section 48 refers to the input tax credits (ITC) from clean energy and electricity projects. This section details about the ITC overview, definition of “Thermal Energy Storage as Energy Property”, example of credit calculation, additional considerations for tax exempt financing, investment credit timelines and next steps in securing tax credits.

6.4.1 Section 48 Clean Energy ITC/Section 48E Clean Electricity ITC (Credit Overview)

	Section 48 Clean Energy ITC	Section 48E Clean Electricity ITC

Overview	• The Inflation Reduction Act (IRA) Extends the ITC for most projects that begin construction before January 1, 2025
	• Tax credit is available for the cost of qualified energy property in the year its placed in service:
	  o Base credit of 6% of the basis of qualified energy property (or 2% for certain technologies, e.g., microturbine)
	  o Maximum bonus credit rate of 30% of the basis of qualified energy property (or 10% for certain technologies) if taxpayer meets the prevailing wage and apprenticeship requirements
	    ▪ Certain exceptions apply, including for energy property with a maximum net output of less than 1 MW electrical energy (AC) or thermal energy and if property begins construction prior to 1/29/2023
	• IRA expands the eligible property (from qualified solar energy, CHP, waste energy recovery properties, among others) to include 3 new technologies:
	  o Standalone energy storage
		• Effective for facilities placed in service after December 31, 2024, and until 2032, then subject to a 3-year phaseout
		• Tax credit is available for the cost of qualifying facilities and energy storage technologies in the year its placed in service:
		  o Base credit amount of 6% or a bonus credit of 30% (same rules as 48 apply)
		  o Taxpayers eligible for a 10% bonus for each of the following:
		    ▪ if certain domestic content requirements are met, or
		    ▪ the facility or energy storage technology is located in an energy community
		• A qualifying facility is used to generate electricity, and the greenhouse gas (GHG) emissions rate is not greater than zero
		• Energy storage technology is property that receives, stores, and delivers energy for conversion to electricity and has a nameplate capacity > 5 kWh. The definition

	Section 48 Clean Energy ITC	Section 48E Clean Electricity ITC
	○ Qualified biogas property ○ Microgrid controller • Incremental bonus credit rates available: ○ 10% for meeting domestic content requirements ○ 10% for projects located in "energy communities" – e.g., brownfield sites, certain census tracts with former coal mine or coal power plants ○ 10-20% for certain solar and wind property located in a low-income community, and which have a maximum net output of less than 5 MW – requires an application to be granted limited low-income community funds • Credit utilization: the ITC is eligible for direct pay election for applicable entities, is transferrable (one-time; paid in cash), and is eligible for a modified 3-year carryback period	also includes thermal energy storage property.
Timeline	Only available for projects which begin construction before January 1, 2025 Available for projects using the ground as a source/sink for heating and cooling if construction begins before January 1, 2035	Only available for projects placed in service after December 31, 2024; 3-year phase-out starts the later of: • 12/31/2032, or • Year in which when US GHG emissions from electricity are 25% of 2022 emissions or lower

	Section 48 Clean Energy ITC	Section 48E Clean Electricity ITC
Eligible Property	Certain energy property (e.g., fuel cell, solar, geothermal, small wind, energy storage, biogas, microgrid controllers, CHP)	• Any tangible property used as an integral part of an electricity-generating facility with a GHG emissions rate not greater than zero (technology-neutral) • Qualified energy storage technologies*
Credit Rate	Base credit of 6% of the basis of qualified energy property (or bonus credit of 30% for projects meeting prevailing wage/apprenticeship requirements)	Base credit of 6% of the basis of qualified energy property (or bonus credit of 30% for projects meeting prevailing wage/apprenticeship requirements)
Bonus Credit Rates	Additional bonus credit rates available for projects located in energy communities (10%), which meet domestic content requirements (10%), or certain technologies that meet low-income community requirements (10%)	Additional bonus credit rates available for projects located in energy communities (10%) and projects which meet domestic content requirements (10%)
Additional Considerations	Transferrable; Direct pay for tax-exempt entities only	Transferrable; Direct pay for tax-exempt entities only

***Note:** "Energy storage technology" has the same meaning as given by Section 48.

6.4.2 Section 48E Energy Property: Thermal Energy Storage Property ("TES")

Definition of Thermal Energy Storage

Under IRC Sec. 48E the term "energy storage technology" has the meaning given such term in section 48(c)(6) (except the termination provision). Section 48 provides:

- Thermal energy storage property is defined as property comprising a system which:

  - is directly connected to a heating, ventilation, or air conditioning ("HVAC") system
  - removes heat from, or adds heat to, a storage medium for subsequent use, and
  - provides energy for the heating or cooling of the interior of a residential or commercial building.
- Example eligible TES property may include the following types of systems:
  - Thermal ice storage systems that use electricity to run a refrigeration cycle to produce ice that is later connected to the HVAC system as an exchange medium for air conditioning the building.
  - Heat pump systems that store thermal energy in an underground tank or borehole field to be extracted for later use for heating and/or cooling, and electric furnaces that use electricity to heat bricks to high temperatures and later use the stored energy to heat a building through the HVAC system.
- Property placed in service or beginning construction in 2025 or later would be eligible under Section 48E.
- **Eligible Costs**
  - Total eligible project costs include all costs that are integral to the operation of the system and exclude costs allocable to land or to a building and its structural components.
  - The following costs are examples of those that are not eligible: site work, some interconnection, landscaping, irrigation, fencing, barbed wire, insurance, managerial expenses, back up electric boilers to support the system, etc.
  - Alternatively, the following costs are examples of those that are eligible: installation of heat exchange equipment, labor for installation of eligible property, allocated engineering and design costs, etc.

6.4.3 Applicability to University of Washington Energy Renewal Project

Projects that are deemed qualified as Thermal Energy Storage Property under Sec. 48E based on data provided:

- **P-5: New Thermal Energy Storage ("TES") (chilled water) tank and future location for a second (hot water)**
  - Work is intended to occur in the 2025-2027 first biennium of the Energy Renewal Program. According to project sequencing diagram, the estimate is end of 2026 for begin construction.
  - Based on timing, the project would not fall under Section 48 as it requires that projects that begin construction before January 1, 2025. As such the analysis was performed under 48E Clean Electricity ITC.
- **P-6: New Thermal Energy Storage (hot water) tank adjacent to existing chilled water TES tank**
  - Work is intended to occur after SOW-P-5 CCW TES Tank. According to project sequencing diagram, the estimate is end of 2030 for begin construction.
  - Based on timing, the project would not fall under Section 48 as it requires that projects that begin construction before January 1, 2025. As such the analysis was performed under 48E Clean Electricity ITC.
- **S-2: Sewer Heat Recovery Equipment Building, Wet Well and Sewer Tie-In**
  - Work includes Sewer Water Heat Recovery Equipment Building sewer water wet well, sewer main piping intercept, and all interconnecting piping.
  - According to project sequencing diagram, the estimate is end of 2029 for begin construction.
  - Based on timing, the project would not fall under Section 48 as it requires that projects that begin construction before January 1, 2025. As such the analysis was performed under 48E Clean Electricity ITC.
  - D-W2 piping from sewer heat recovery building to campus buildings was considered but did not fall withing the qualified equipment definition.

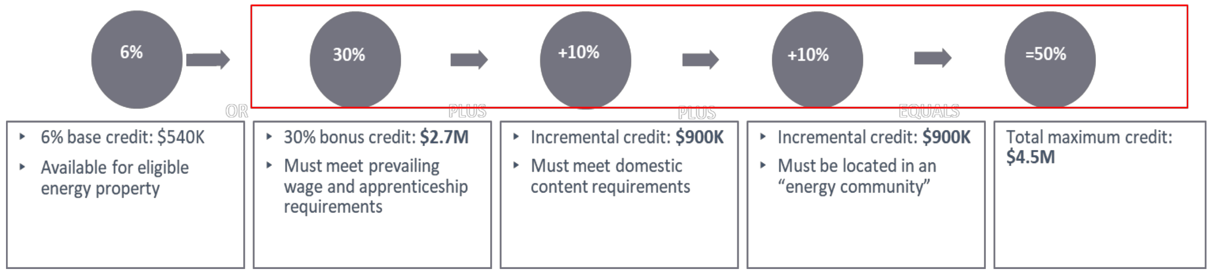
Projects that are deemed <u>NOT</u> qualified under Sec. 48E based on data provided:

- **S-1: Lake Interface System**
  - The analysis concluded that this component is unlikely to be eligible for the ITC as it uses lake water, which is considered surface water rather than groundwater.
  - The project was considered for possible qualification under Section 48 as "equipment which uses the ground or ground water as a thermal energy source to heat a structure or as a thermal energy sink to cool a structure." The key item for the qualification was whether there is explicit language or argument that lake water may be considered ground water.
  - The analysis explored the question of whether the project involving a heat exchange on water extracted from Lake Washington can qualify for credits under Section 48 as "equipment which uses the ground or ground water as a thermal energy source to heat a structure or as a thermal energy sink to cool a structure." Accordingly, the analysis explored the definition of "ground water" as well as of the "lake."
  - Based on various sources, lake would be considered surface water as opposed to ground water. The Washington Department of Natural Resources noted that "water bodies in Washington State, such as rivers, streams, reservoirs, and lakes, are connected to aquifers," as such the analysis sought to confirm the source of water for the lake in scope.
  - As AEI confirmed, lake water is not primarily fed by ground water. It is primarily from snow melt/precipitation.
  - As the lake water does not primarily come from an aquifer, the project was deemed to be unlikely to qualify under the definitions of qualified property under Section 48.

6.5 Section 48 Clean Energy ITC /Section 48E Clean Electricity ITC: Example credit calculation

- Section 48 ITC available for the cost of qualified energy property taken in the year the asset is placed in service
- ***Facts:*** A taxpayer constructs and places in service eligible energy property; total spend: **$10M**

- ***Assumptions:*** 90% of costs are eligible **($9M),** construction begins in 2024
- ***Total potential credit range: $540K - $4.5M***



- Credit monetization:
  - "Applicable entities" (including not-for-profit entities) may elect the direct pay option, but there may be a 2–3-year lag before receiving the cash refund from the IRS after the energy property was placed in service due to FYE implications of making the election on an extended return.
  - The ITC is also transferrable for "eligible taxpayers" (one-time; paid in cash), but the cash benefit may not be realized until up to 2+ years after the asset is placed in service, and there will be a discount on the value when it is transferred to an unrelated party. "Eligible taxpayers" does not include "applicable entities."

6.6 Additional Considerations and Tax-Exempt Bond Financing

Use of tax-exempt bond proceeds

- Subject to a partial reduction of up to 15% where tax-exempt bond proceeds were used to provide financing for qualified assets.
- The tax credit calculated under subsection (a) for any facility using tax exempt bond financing in a given tax year will be decreased. The reduction amount is the initial credit multiplied by either 15% or a ratio, whichever is less. The ratio is the bond proceeds spent on the project (numerator) divided by the total capital invested in the facility (denominator).
  - the numerator is the sum for the taxable year, and all prior taxable years, of proceeds of an issue of any obligations the interest on which is exempt

from tax under section 103, and which is used to provide financing for the qualified facility, and

- the denominator is the aggregate number of additions to the capital account for the qualified facility for the taxable year and all prior taxable years.

6.7 48 and 48E Investment Credit Timeline

2022

Passage of the Inflation Reduction Act

- Standalone energy storage is now eligible for the ITC and geothermal heat pump equipment is eligible
- Provides up to a 6% base credit rate and an enhanced credit rate at 5 times the base rate if PWA requirements are met.

2023

Projects must begin to meet PWA requirements to achieve the enhanced credit rate

- Projects beginning construction prior to January 29, 2023, are automatically considered to have met PWA requirements.
- Projects beginning construction after this date must meet the 1-megawatt requirement or pay prevailing wages and hire apprentices.

2024

Section 48 ITC eligibility

- Most types of projects must begin construction to be eligible for the Sec. 48 ITC (geothermal excepted)

Credit phase-out begins for projects that begin construction in 2024 and will utilize the direct pay election.

- 10% phaseout reduction in credit if projects don't meet domestic content requirements, have a maximum output of less than 1 megawatt, or don't meet other exceptions.

2025

Section 48 ITC

- Projects beginning construction in 2025 are not eligible for the Section 48 ITC; Projects that began construction in prior years and are placed in service in 2025 and beyond may still be eligible under section 48
- Geothermal heat pump projects beginning construction in 2025 remain eligible

Section 48E Clean Electricity ITC

- Projects placed in service in 2025 are eligible for the Section 48E clean electricity ITC (electricity generating technology with $\leq$ zero GHG emissions and energy storage technology projects remain eligible)

Direct Pay Implications

- Under 48E, the direct pay phase-out reduction for projects that don't meet domestic content requirements or exceptions remains applicable and increases from 10% to 15%
- Geothermal projects are still eligible for credit under Section 48; the section 48 code does not describe the direct pay phase-out past 2024
- The IRS has not provided further guidance or a technical correction with respect to direct pay election phase out percentage with respect to geothermal heat pump property that begins after 2025 (see slide 10 for additional detail)

2026

Under 48E, projects beginning construction that will utilize direct pay must meet domestic content requirements or exceptions; otherwise, the phase-out increases to 100%, reducing the credit to $0 The applicable year will be the later of 2032 or when the Treasury Secretary determines that annual GHG emissions from electricity production in the US are $\leq$ 25% of the annual GHG from such production for 2022

2032

First possible "applicable year" where the Section 48E credit would be fully available, but in two years would begin phasing out:

- First year following the applicable year — 0% phaseout
- Second year following the applicable year — 25% phaseout
- Third year following the applicable year — 50% phaseout
- After the third year — 100% phaseout

2035

Geothermal heat pump projects beginning construction in 2035 and beyond are no longer eligible for credit.

6.8 Next Steps and Securing Credit

Next steps involved in the project to secure tax credits include:

- Full analysis to be performed on:
  - Facility eligibility under Sec. 48E. (Effective for facilities placed in service after 12/31/2024, and until 2032. Phase-out starts the later of 2032 or when U.S. greenhouse gas emissions from electricity are 25% of 2022 emissions or lower).
  - Capital expenditures, including the qualifying direct costs, allocable costs, and indirect costs
  - PWA requirements, incremental credit increase (such as domestic content)
  - Domestic content applicability to direct pay phase out
  - Implications of specific value of tax-exempt financing, if appliable
- Complete online filing registration with IRS for the credit, obtain registration number at least 120 days prior tax return due date.
  - For taxpayers with 6/30/X1 tax year end, the extended due date would be 5/15/X2 (the following year), thus 120 days would be 1/15/X2
- File direct pay election by the due date of the tax return for the taxable year in which the election is made.
  - For taxpayers with 6/30/X1 tax year end, form 990 is due 15th day of the 5th month after the organization's accounting period ends due date is (11/15/X1), and the extended due date would be 5/15/X2.
- Compete forms as required by IRS and file with timely filed tax return (including extension)

6.9 Prevailing Wage and Apprenticeship Requirements

6.9.1 Inflation Reduction Act Credits: Prevailing Wage and Apprenticeship ("PWA") Requirements

IRA deploys a two-tiered credit structure: a lower base credit and bonus credit rates up to five times.

- Applies to credits under Section 30C, Section 45, Section 45L*, Section 45Q, Section 45U*, Section 45V, Section 45Y, Section 45Z, Section 48C, Section 48, Section 48E, and Section 179D.
- Increased rate can be achieved when projects meet the following two requirements:
  - **Prevailing wage**: Any laborer or mechanic (not including apprentices) employed by the taxpayer and/or its contractors or subcontractors must receive wages equal to or greater than the locality's prevailing wage rates for construction, alteration, or repair of the **qualified facility.**
    - Sufficient records, including books of accounts and records of work must be kept.
    - Local rates are determined by the Department of Labor ("DOL") via the bicentennial census *at the time the contract for construction, alteration or repair of the facility is executed between the taxpayer and the prime contractor (so this applies to all subcontractors of that prime contractor).* Local rates are published on the Secretary of Labor website (SAM.gov) for the geographic area and type of construction applicable to the facility by labor classification.
    - If the taxpayer executes separate contracts with more than one contractor, then the prevailing wage rates apply to each such contract. The same rules apply when there is alteration or repair of a facility.
  - **Apprenticeship:** Taxpayer and its contractors or subcontractors that work on the **qualified facility** during construction only (**NOT** during alteration or repair after its placed in service) must satisfy **three** requirements; if any one of the three are not met, then penalties could apply to cure the failure to meet the apprenticeship requirement
  - *(see slide 5 for additional details on curing failures):*

- ***Labor Hours Requirement*:** A minimum percentage of total labor hours on the project (i.e., for the entire qualified facility) is required to be performed by qualified apprentices:
    - 10% for projects where construction began in 2022
    - 12.5% for projects where construction begins in 2023
    - 15% for projects where construction begins in 2024
- ***Ratio Requirement:*** The number of apprentices and journey workers (as defined by the DOL in 29 CFR 29.2) at the project site (i.e., per facility) must comply with ratio requirements for each occupation established by DOL or applicable agency for the apprenticeship program.
    - Measured per day - if the minimum ratio requirement for the day is not met, the apprentices in excess of the ratio must be paid the applicable prevailing wage (specific apprentices can be selected by the Taxpayer), and the hours worked by any qualified apprentice(s) in excess of the ratio will not count as apprenticeship hours toward the Labor Hours Requirement.
    - This requirement is for apprentices to have the appropriate oversight to ensure adequate safety and supervision.
- ***Participation Requirement:*** Each owner, contractor or subcontractor employing four or more laborers to construct the qualified facility (*regardless of time or location*) must employ at least one qualified apprentice from registered apprenticeship programs, as defined in Section 3131(e)(3)(B): https://www.apprenticeship.gov/about-us/apprenticeship-system
    - This requirement is to encourage taxpayers to use apprentices across a full range of labor types performed at the facility.

6.9.2 Inflation Reduction Act Credits PWA Requirements: Definitions

PWA applies to construction, alteration or repair work performed at the primary construction site of the qualified facility and applicable secondary sites.

- **Construction, alteration, or repair**
    - Altering, remodeling, installation on-site of items fabricated off-site
    - Painting and decorating
    - Manufacturing or furnishing materials, articles, supplies, or equipment
    - Improvements, adaptations, or restorations of functionality as a result of inoperability

- Does not include ordinary and regular maintenance

- **Primary construction site**
  - The physical place where the qualified facility will be placed in service and remain

- **Secondary construction site**
  - A work site where:
    - A significant portion (one or more entire portions or modules of the facility with minimal construction work remaining; does not include materials or prefabricated components) of the qualified facility is constructed, altered, or repaired, AND
    - Is established specifically for, or dedicated exclusively for a specific period of time (weeks, months or more) to, the construction, alteration or repair of the facility.

6.9.3 Inflation Reduction Act Credits: Cures for Failure to meet PWA Requirements: Prevailing Wage Requirements

IRA establishes certain options to rectify the failure to satisfy prevailing wage requirements:

- Cure provision: penalty and correction payment
  - Taxpayer is penalized by paying a $5,000 per laborer fine to the IRS (paid at time of filing tax return to claim credit) and paying laborer the difference, plus interest in the amount of the federal short-term rate plus 6%
- Waiver of the penalty
  - Fine may be waived if taxpayer makes a correction payment by the last day of the first month following the calendar quarter in which the failure occurred --AND--
    - Laborer must have received prevailing wages for over 90% of the calendar year pay periods; --OR--
    - The difference between actual wages paid and required prevailing wage to be paid during the calendar year (or part thereof) is not greater than 5%
- Fine may be waived if work was performed pursuant to qualified collective bargaining agreement

- Preservation of increased credit eligibility:
  - Even if corrective payments are not made on a timely basis to avoid penalties, the final regulations confirm that the taxpayer must make the correction and penalty payments within 180 days after the final determination from the IRS to be eligible for the increased credit amount.
  - Note: If the taxpayer does not make the required correction and penalty payments, and therefore is not allowed the increased credit amount, no penalty is assessed
- Increased penalties for intentional disregard
- If the IRS determines that any failure to satisfy prevailing wage requirements is due to intentional disregard (knowing or willful) of the requirement, the correction is increased to:
  - 3 times the sum of the correction payments
  - Increased fine of $10,000 per laborer
- Intentional disregard factors examples: whether regular reviews of the applicable prevailing wage rate were performed; if steps were taken to regularly review and determine appropriate classification of laborers based on actual job titles; existence of procedures and requirements for regular reviews of payroll information from contractors and reporting suspected failures, etc.
- Rebuttable presumption exists of no intentional disregard if the taxpayer makes correction and penalty payments before receiving an IRS notice of examination.

6.9.4 Inflation Reduction Act Credits Curing PWA Requirements: Apprenticeship Requirement and Good Faith Effort Exception

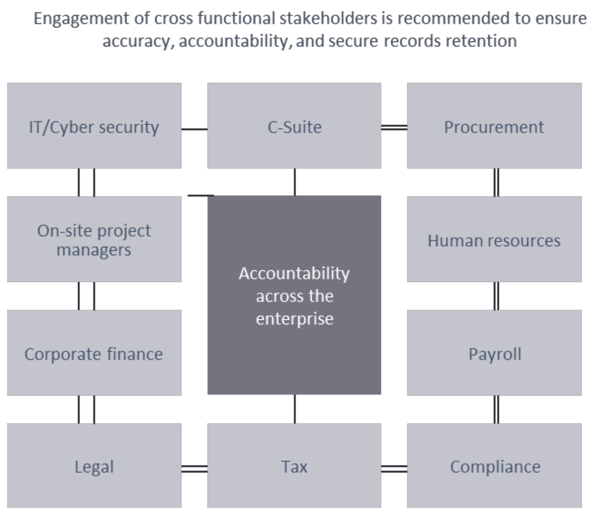
IRA establishes options to rectify the failure to satisfy apprenticeship requirements:

- Cure provision: penalty
  - Good Faith Effort (GFE) Exception: Taxpayer is penalized a $50 per missed apprentice labor hour fine to the IRS (paid at time of filing tax return to claim credit) for which the Labor Hours or the Participation Requirement was not satisfied.

- Taxpayer penalized $500 per missed apprentice labor hour related to intentional disregard (knowing or willful)
- Intentional disregard factors examples: if the failure was part of a pattern of conduct; if taxpayer had procedures in place for reporting suspected failures; whether the taxpayer sought to promptly cure any failures; if there was regular follow up with registered programs to request apprentices, etc.
- No penalty for failing to employ qualified apprentices if taxpayer shows it reached out to at least one registered apprenticeship program and either was denied an apprentice --OR-- did not receive a response within 5 business days.
- A qualified registered apprenticeship program is one that:
  - Has a geographic area of operation that includes the location of the facility or that can reasonably be expected to provide apprentices to the location of the facility;
  - Trains apprentices in the occupations needed by the taxpayer; --AND--
  - Has a usual and customary business practice of entering into agreements with employers for the placement of apprentices in the occupation for which they are training.
- Written request must be made at least 45 days before the qualified apprentice was requested to start work at the facility, and include:
  - Dates of employment, occupation or classification needed, location and type of work to be performed, number of apprentices needed, number of hours apprentices will work, and name/contact information of person making the request
  - Statement that request for apprentices is made with the intent to employ apprentices in the occupation for which they are being trained and in accordance with the requirements and standards of the registered apprenticeship program
- Taxpayer will likely need to reach out to more than one qualified apprenticeship program to satisfy GFE Exception based on project size and labor type needed. Any subsequent requests to the same program must be made at least 14 days before qualified apprentices are requested to begin work.
- The GFE Exception applies for 365 days from the date of request; after 365 days, taxpayer should submit an additional request.

6.9.5 Inflation Reduction Act Credits: Prevailing Wage and Apprenticeship ("PWA") Requirements: Documentation best practices

- Responsibility to maintain documentation is on the taxpayer benefiting from the credit, even if using contractors or subcontractors.



- Key per-employee-level (apprentices included) documentation needed:
  - Identifying information of employee (employee ID, name, etc.)
  - Project assigned to and county worked in
  - Job classification and associated pairing to DOL wage determination
  - Basic wage pay and fringe benefits paid or contributed per pay period
  - Hours worked in the specified job classification per pay period
  - Registered apprenticeship and corresponding applicable wage rates
  - Amount (including supporting calculations) and timing of correction payments, if applicable
- Key apprenticeship documentation needed:
  - Written requests to registered apprenticeship programs
  - Agreements with registered apprenticeship programs, including documents reflecting the standards of the program and ratio requirements
  - Apprenticeship program sponsorship

- Verification of apprenticeship program participation by each apprentice
- Daily ratio of apprentices to journey workers
- Payroll records
- Maintain documentation contemporaneously (weekly, bi-weekly, monthly, quarterly, etc.)

6.9.6 Inflation Reduction Act Credits: Prevailing Wage and Apprenticeship ("PWA") Requirements: EPC Contracts

It is important to note that UW construction contracts and general conditions currently include prevailing wage and apprenticeship requirements. These existing PWA requirements can be leveraged to meet IRA enhanced credit eligibility, but UW need to ensure that the current reporting templates meet the requirements of the IRS. For reference, below are examples of typical PWA provisions found in EPC contracts:

- rep and warranty that contractor and any subcontractors employed by contractor will pay prevailing wages and meet the apprenticeship requirements (or at least the good faith effort);
- info sharing provision under which contract, and any subs will share required information for the Company to confirm that such requirements have been met; and
- indemnity provision in case the Company comes under audit and cannot substantiate the PWA requirements due to incomplete records, incorrect/inaccurate information, etc.

Sample PWA requirement data that should be maintained pursuant to EPC contracts:

- Project name
- Location of the Project (county, state)
- Project construction type (building, heavy, highway,
- Identifying information of employee, including name, social security or tax identification number, address, telephone number, and email address

residential) – pick list from SAM.gov

- Type of worker – pick list from SAM.gov
- Employee Status (Full-time, Part-time, Adjunct, Apprentice)
- Job title(s) – can be multiple per employee; % of time spent on each
- Employee hire date and end date
- Employee hourly rate and gross pay per pay period
- Employee actual hours incurred per pay period
- Fringe benefits paid or contributed per pay period
- Apprenticeship (Y/N) and program name
- Daily ratio of apprentices to journey workers

6.10 Incremental Credits – Energy Communities & Domestic Content Requirements

6.10.1 48 Clean Energy ITC /Section 48E Clean Electricity ITC, Incremental credits: Energy Communities

- Energy communities (.gov database) are defined as:
  - A brownfield site – defined in Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA);
  - A metropolitan or non-metropolitan area which has (or at any time after 2009, had) at least 0.17% direct employment or at least 25% local tax revenues related to the extraction, processing, transport, or storage of coal, oil, or natural gas and has an unemployment rate at or above the national average unemployment rate for the previous year (see table below for listing of eligible areas)*; or*
  - A census tract in which either (after 1999) a coal mine has closed, or (after 2009) a coal-fired electric generating unit has been retired; or a census tract directly adjoining to either of those previously mentioned census tracts (see Table 6.9.1-1).

- Projects placed in service within an energy community are eligible for an additional 2% credit or, if PWA requirements are met, an additional 10% credit.

Table 6.9.1-1: Census Tracts

Release date	MSAs and non-MSAs for IRA (for delineation purposes only)	MSAs and non-MSAs that meet the Fossil Fuel Employment threshold	MSAs and non-MSAs with an unemployment rate at or above the national average	Census tracts that meet coal mine closure/retirement requirements
2023-29	IRS Appendix A	IRS Appendix B	*Not provided*	IRS Appendix C
2023-47	*No further updates*	IRS Appendix 1	IRS Appendix 2	IRS Appendix 3
2024-30	*No further updates*	IRS Appendix 1	IRS Appendix 2	*No further updates*

6.10.2 48 Clean Energy ITC /Section 48E Clean Electricity ITC, Incremental credits: Domestic Content – Requirements Overview

The IRA provides a bonus tax credit of up to 10% under Sections 45/45Y and 48/48E for projects that meet certain domestic content requirements.

- Bonus credit equivalent to 10% for 48/48E projects that meet one of the following, in addition to domestic content requirements:
  - Project has a max. net output less than 1MW;
  - Project construction begins before January 29, 2023; OR
  - Project satisfies prevailing wage and apprenticeship requirements

- Domestic content bonus credit is reduced from 10% to 2% if at least one of the above requirements is not met.
- Taxpayers may meet the domestic content requirements with respect to an Applicable Project by certifying that any steel, iron, or manufactured product which is a component of the Applicable Project upon completion of construction was produced in the US.
- Adjusted Percentage Rule: Manufactured products are deemed to have been produced in the US if an applicable percentage of the total costs of all manufactured products are attributable.
- To manufactured products (including components) which are mined, produced, or manufactured in the US
  - Sec. 48: Adjusted Percentage is 40% for projects that begin construction before 2025
  - Sec. 48E:
    - Adjusted Percentage is 45% for projects that begin construction during 2025
    - Adjusted Percentage is 50% for projects that begin construction during 2026
    - Adjusted Percentage is 55% for projects which begin construction after 2026

6.10.3 48 Clean Energy ITC /Section 48E Clean Electricity ITC, Incremental credits: Domestic Content – IRS Notice 2023-28 Overview

IRS Notice 2023-28 provides guidance on domestic content requirements for Sections 45/45Y and 48/48E. See next slide for definitions of Manufactured Product, Manufactured Product Component, and other terms.

Steel or Iron Requirement

- Requirement is met if all manufacturing processes with respect to any steel/iron items that are Applicable Project Components take place in the US, except metallurgical processes involving refinement of steel additives
- Applies to Applicable Project Components that are construction materials made primarily of steel/iron and are structural in function (i.e., items such as nuts, bolts, screws, washers, clamps, tie wire, and other similar items that are made primarily of steel/iron but are not structural in function are not subject to this requirement)

- Does NOT apply to steel/iron used in Manufactured Product Components or subcomponents of Manufactured Product Components

Manufactured Products Requirement

- Requirement is met if all Applicable Project Components that are Manufactured Products are produced in the US or are deemed to be produced in the US (i.e., meet the Adjusted Percentage Rule)
- A Manufactured Product is considered produced in the US if:
  - All the manufacturing processes for the Manufactured Product take place in the US; and
  - All the Manufactured Product Components of the Manufactured Product are of US origin (i.e., if it is manufactured in the US, regardless of the origin of its subcomponents)

6.10.4 48 Clean Energy ITC /Section 48E Clean Electricity ITC, Incremental credits: Domestic Content – IRS Notice 2023-28 Definitions

- *Applicable Project Componen*t: any article, material, or supply, whether manufactured or unmanufactured, that is directly incorporated into an Applicable Project; an Applicable Project Component may qualify as steel, iron, or a Manufactured Product
- *Manufactured Product:* an item produced as a result of the manufacturing process
- *Manufactured Product Component:* any article, material, or supply, whether manufactured or unmanufactured, that is directly incorporated into an Applicable Project Component that is a Manufactured Product
- *Manufactured:* produced as a result of the manufacturing process
- *Manufacturing Process:* the application of processes to alter the form or function of materials or elements of a product in a manner adding value and transforming those materials or elements so that they represent a new item functionally different from that which would result from mere assembly of the elements or materials
- *Mined:* derived from the extraction of ores or materials from the ground or from waste or residue of prior mining

- *Produced:* has the same meaning as the term "manufactured"
- *Direct costs: (as defined by § 1.263A-1(e)(2)(i))* producers must capitalize *direct material costs* and *direct labor costs*
- *Direct material costs:* include the cost of those materials that become an integral part of specific property produced and those materials that are consumed in the ordinary course of production and that can be identified or associated with particular units of property produced.
- *Direct labor costs:* include the costs of labor that can be identified or associated with units of specific property produced. For this purpose, labor encompasses full-time and part-time employees, as well as contract employees and independent contractors. Direct labor costs include all elements of compensation other than employee benefit costs. Elements of direct labor costs include basic compensation, overtime pay, vacation pay, holiday pay, sick leave pay, shift differential, payroll taxes, and payments to a supplemental unemployment benefit plan.

6.10.5 48 Clean Energy ITC /Section 48E Clean Electricity ITC, Incremental credits: Domestic Content – Calculating Domestic Cost Percentage

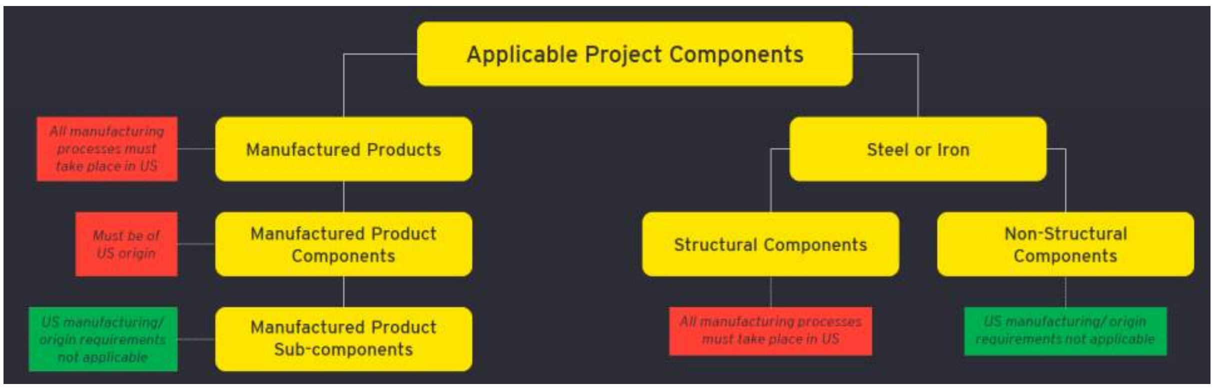
$$\frac{Domestic\ Manufactured\ Products\ and\ Components\ Cost}{Total\ Manufactured\ Products\ Cost} = Domestic\ Cost\ Percentage$$

- Adjusted Percentage Rule met if the Domestic Cost Percentage for an Applicable Project equals or exceeds the applicable adjusted percentage
- Domestic Manufactured Products and Components Cost is equal to the sum of the costs of an Applicable Project's:
  - US Manufactured Products that are Applicable Project Components, and
  - Manufactured Product Components of non-US Manufactured Products that are Applicable Project Components if the Manufactured Product Components are mined, produced, or manufactured in the US
    - Only includes direct costs (i.e., direct materials and direct labor costs) that are paid or incurred to produce the US Manufactured Product or by the non-US Manufactured Product's manufacturer to produce or acquire the US Component

- Total Manufactured Products Cost is the sum of the costs of each Applicable Project Component that is a Manufactured Product
  - Only includes direct costs that are paid or incurred by the manufacturer of the Manufactured Product to produce the Manufactured Product

6.10.6 48 Clean Energy ITC /Section 48E Clean Electricity ITC, Calculating Domestic Cost Percentage

- Taxpayers should assess the applicable project components that are required to meet the domestic content rules (i.e., identifying manufactured products, manufactured product components, and structural components)



6.10.7 48 Clean Energy ITC /Section 48E Clean Electricity ITC, Incremental credits: Domestic Content – Calculating Domestic Cost Percentage Example

Notice 2023-38 provides the following example on calculating the Domestic Cost Percentage and applying the Adjusted Percentage Rule:

- Taxpayer purchases Project A from Contractor under an engineering, procurement, and construction contract and places Project A in service. Project A has two Applicable Project Components that are Manufactured Products. Project A begins construction in 2025.
- Contractor performed the manufacturing process that produced Project A's first manufactured product (Manufactured Product 1). Manufactured Product 1 is manufactured in the US and has two Manufactured Product Components (Components 1A and 1B) that are manufactured in the US. Manufactured

Product 1 is a US Manufactured Product because it and both of its Manufactured Product Components are produced in the US.

- Supplier performed the manufacturing process that produced Project A's second manufactured product (Manufactured Product 2). Contractor purchased Manufactured Product 2 from Supplier. Manufactured Product 2 is manufactured in the US and has three Manufactured Product Components. Manufactured Product 2's first Manufactured Product Component (Component 2A) is manufactured in the US, its second Manufactured Product Component (Component 2B) is manufactured in the US, and its third Manufactured Product Component (Component 2C) is manufactured outside of the US. Manufactured Product 2 is a Non-US Manufactured Product because Component 2C is manufactured outside of the US. Components 2A and 2B are US Components because they are manufactured in the US.
- All costs shown in Table 6.9.7-1 are the direct costs of producing the Manufactured Product or producing or acquiring the Manufactured Product Component that were paid or incurred by the manufacturer of the Manufactured Product. Contractor is the manufacturer of Manufactured Product 1, and Supplier is the manufacturer of Manufactured Product 2

Table 6.9.7-1: Direct Costs Examples

Asset	Cost	Asset	Cost
Manufactured Product 1 (Domestic)	**$100**	**Manufactured Product 2 *(Non-US)***	**$200**
Component 1A (Domestic)	$30	Component 2A ***(Domestic)***	$30
Component 1B (Domestic)	$45	Component 2B ***(Domestic)***	$50
		Component 2C ***(Non-US)***	$100

- Project A's ***Domestic*** Manufactured Products and Components Cost consists of the cost of Manufactured Product 1 ($100), Component 2A ($30), and Component 2B ($50) for a total of **$180**. Project A's Total Manufactured Products Cost consists of the cost of Manufactured Product 1 ($100) and Manufactured Product 2 ($200), for a total of $300. Project A's ***Domestic*** Cost

Percentage is 60% ($180 divided by $300). Project A satisfies the Adjusted Percentage Rule because its ***Domestic*** Cost Percentage of 60% exceeds the required adjusted percentage of 45%.* Thus, Manufactured Product 1 and Manufactured Product 2 are both **deemed** to have been produced in the US under the Adjusted Percentage Rule.

**Adjusted Percentage for projects that begin construction in 2025 is 45%.*

6.10.8 Domestic Content Requirements IRS Notice 2023-38 and Notice 2024-41 Safe Harbors

Notice 2023-38

- Treasury and IRS identified certain Applicable Project Components that may be found in utility-scale photovoltaic systems; land-based wind facility, offshore wind facility and battery energy storage technology.
- The categorization of each item listed within the Notice 2023-38 is accepted by the IRS for those Applicable Project Components and Manufactured Product Components, however, may not be an exhaustive set of all Applicable Project Components.

Notice 2024-41

- ***Notice 2024-41*** created a safe harbor for determining whether domestic content requirements have been met. The Department of Energy used data from a variety of sources to assign a percentage value for each type of manufactured component representing that component's relative cost compared to other components in the system.
- Taxpayers identify which manufactured products and components from the table provided by the IRS are part of their **solar**, **wind, or battery energy storage system**. The corresponding percentage value for each component that was manufactured in the US is summed. Any component not included in the taxpayer's property or not manufactured in the US is excluded from the summation. The total percentage of US manufactured projects is then used as the domestic cost percentage that is then compared to the adjusted percentage for the year the project began construction.
- ***Would not apply Thermal Energy Storage (TES) tanks at this time (pending any future legislation).***

6.10.9 Domestic Content Requirements Documentation and Support Suggestions

For Section 48/48E eligible systems where Notice 2024-41 Safe Harbor doesn't apply, taxpayers may need to work with their manufacturer/supplier to document and obtain information that will reasonably support eligibility for the bonus credit. Substantiation of domestic content requirements must show the cost and country of origin (i.e., manufacturing location) of manufactured products and their components (subcomponents to the components are not within the scope of domestic content requirements). Although guidance does not list what should be kept, best practices to support and document the bonus credit *may* include the following:

Manufactured Products

- A list of manufactured products and the total associated costs (direct and indirect)
- Support for where each manufactured product component undergoes manufacturing
- Support for the origin of direct materials and direct labor costs of each manufactured product component
- A document signed by an authorized representative of the supplier of materials used for manufacture of components with regard to domestic content of such materials.

Structural Steel and Iron

- A list of all structural steel or iron components (e.g., racking, piles, steel or iron rebar in foundation, wind towers) that are Applicable Project Components
- The manufacturing location of all structural steel or iron components
- Certification from the manufacturer that such products were manufactured at its facilities in the United States

6.10.10 Domestic Content Requirements Reporting Requirements

- Taxpayers must submit a statement to the IRS for each Applicable Project certifying that any steel/iron items subject to the Steel/Iron Requirement or Manufactured Product that is a component of the Applicable Project upon completion of construction was produced in the US
- **Domestic Content Certification Statement** must be attached to Form 3468 (ITC) filed with the taxpayer's annual return for the first taxable year in which the taxpayer reports a domestic content bonus credit amount for the Applicable Project; must include the following information:
  - Project Type (i.e., Utility-Scale PV System)
  - Location (coordinates/address)
  - Placed-in-Service date
  - Total Domestic Content Bonus Credit amount
  - Any additional info required by applicable forms/instructions
  - Signature/statement
- Taxpayer must also meet general recordkeeping requirements under Code Section 6001

6.11 Direct Pay

6.11.1 Direct Pay (Section 6417) Overview

- Certain eligible entities can make a direct pay election which effectively makes certain credits, including the section 48 ITC, refundable.
  - Eligible entities include "applicable entities" that are exempt from federal tax under subtitle A, state or local governments (also water and school districts, economic development agencies, etc.), the Tennessee Valley Authority, Indian tribal governments or an Alaska Native Corporation. Applicable entities do not include partnerships or S Corporations, even if they are tax-exempt or governments.

- Clean energy credits generated per sections 45Q, 45V, and 45X allow any entity to make the election.

- Direct pay election treats the credit as a payment of tax on a filed return with the overpayment being refunded.
- **Limitations:**
  - Direct pay may only be utilized for a 5-year period for non-applicable entities
  - Only the taxpayer that produces the eligible components may utilize direct pay
  - The election must be made by the due date of the tax return for the taxable year in which the election is made
  - Taxpayers that elect Direct pay *cannot* transfer the credits for the same year in which the direct pay election is in effect
  - Under section 48/48E, taxpayers making the direct pay election are subject to the following phaseout percentages if domestic content requirements are not met for projects beginning construction after December 31, 2023. Phase out percentages are listed on slide 37.
- For a partnership or S Corporation that directly holds an eligible facility/property, the election must be made at the entity level, not at the shareholder level.

6.11.2 Direct Pay (Section 6417) Pre-Filing Registration

What is Pre-Filing Registration?

Taxpayers making an elective payment or credit transfer election must provide a registration number on their annual return as part of making a valid election for elective pay and transfer provisions

- To obtain a registration number, eligible taxpayers submit a registration request prior to filing their return ("Pre-Filing Registration") through the IRA/CHIPS Pre-Filing Registration tool at http://www.irs.gov/eptregister*
  - This "Registers" the taxpayer's intention to make an election to the IRS
  - Registration does not determine the amount or validity of tax credit being claimed

- The IRS has provided a user guide at https://www.irs.gov/pub/irs-pdf/p5884.pdf

Timing

Pursuant to Treas. Reg. § 1.6418–4 project that will generate the credit must have a registration number prior to making the direct pay election and must provide the placed in-service date. In effect, the property must have been placed in service before the taxpayer can submit a pre-filing registration request for an elective payment.

- The IRS' current recommendation is to submit pre-filing registration at least 120 days prior to when the organization or entity plans to file its tax return
- The IRS intends to review and process registrations in the order submissions are received, though may consider a taxpayer's tax period ending date when managing its caseload
  - The IRS will work to issue registration numbers even when the submission is made close to the taxpayer's filing deadline
  - To mitigate risk of fraud or duplication, requests made close to such deadline may be subject to heightened scrutiny

6.11.3 Direct Pay (Section 6417) Pre-Filing Registration Process

Registration Package

- Taxpayers submitting a registration request ("Registrants") are allowed one registration package per annual accounting period, which can include multiple elections, facilities, and properties
  - This can be amended after the registration package has been fully processed to include additional properties (amending will require re-submission for review)
- Registrants must provide project specific information with respect to the credit(s) being claimed. Required documentation will vary depending on how many and which credits will be claimed
  - Foreign entity of concern relationships
  - Election choice (direct pay or transferability)

- Beginning of construction and placed in service dates
- Sources of funding
- Upload of supporting documentation (permits, life cycle analysis, engineering certification, evidence of ownership, coordinates of project locations, memo supporting eligibility, etc.)

Data entry for registration

- Separate registration numbers will be required for each facility/property
- Bulk upload of facility/property information via excel will be allowed
  - A template is available through the portal once the bulk upload option is selected
- Supporting documents cannot be uploaded as part of bulk uploading

Submission and IRS Review

- Once submitted, Registrants will be locked out from making changes until the IRS processes the request
- The IRS may request additional information through the pre-filing registration tool (Registrants are encouraged to check the portal monthly) and Registrants should respond within 35 days
  - After 35 days, the registration request may not retain its place in line for review

Registration Process
- Place the project in service   - A registration request cannot be submitted before a project has been placed in service   - Fill out pre-filing registration submission   - Property must have been placed in service   - Recommended to be completed 120 days prior to tax return filing   - Submit registration package   - Taxpayers will be locked out from making revisions once the registration is submitted and until the IRS' review is completed   - Check back monthly for portal updates   - Respond to additional information requests or correct errors within 35 days

Registration Process
○ If not responded to within 35 days, the registration will not retain its place in line for review ○ Once submitted, taxpayers will once again be locked out of the registration • If/once approved, taxpayers will receive a registration number ○ Update registrations as necessary ▪ Additions of facilities/property ▪ Removal of facilities/property ▪ Change of facility/property information

6.11.4 Direct Pay (Section 6417) Pre-Filing Registration Package Documentation Examples*

Example documentation required:

- Section 48E Credit
  - Supporting documents would include brief documents such as:
    - Proof of ownership of the facility/property with respect to which the credit is computed.
    - Construction permit showing commencement of construction.
    - Permits to operate from utility (only if connected to the grid, or if not connected to the grid electrical permits to operate from an authority having jurisdiction).
    - Do not attach contractual agreements.

6.11.5 Direct Pay (Section 6417) Additional Guidance

- The taxpayer then includes registration number on annual tax return in order to claim credit, along with completing source credit forms, Form 3800 General Business Credit, and any additional information or supporting calculations.
- A registration number is valid only for the taxable year in which it is obtained; if the election will be made after the year in which the registration number is obtained, the taxpayer must renew the registration before electing direct pay.

- A taxpayer that elects direct pay will be treated as having made such election for the taxable year in which it is made and each of the four subsequent taxable years ending before January 1, 2033.
  - The taxpayer may revoke the election for a subsequent year, but such revocation is permanent and cannot be reapplied.
- ***Denial of double benefit:*** Entity first computes federal income tax liability (or in the case of tax exempts, UBIT) and allowed amount of all IRC Section 38 credits (general business credits) for the tax year, inclusive of credit carryforwards. Entity then applies its allowed IRC Section 38 credits against its current year tax liability and determines any amount of excess or unused current-year credits. Finally, entity reduces its direct-pay-eligible amount by the amount (if any) allowed as a credit under IRC Section 38.
- If it is determined the amount of a payment related to the direct payment was excessive, the taxpayer will be subject to an additional 20% penalty, unless taxpayer can show reasonable cause. The most important factor in determining reasonable cause is the taxpayer's efforts to determine the validity of the credit claimed. Other factors include:
  - Reasonable reliance on representations from the eligible taxpayer that the total specified credit portion does not exceed the total eligible credit
  - Review of the eligible taxpayer's records on determination of and substantiation for the eligible credit
  - Reasonable reliance on third-party expert reports
- Taxpayers that make the direct pay election will be subject to a credit phaseout for credit programs under Sections 45, 45Y, 48, and 48E if the domestic content requirements are not satisfied.
- Per Sec. 48/48E, the following phaseout percentages may apply for projects beginning construction after December 31, 2023:
  - Before January 1, 2024 (section 48) 100%
  - In calendar year 2024 (section 48) 90%
  - In calendar year 2025 (section 48E) 85%
  - After calendar year 2025 (section 48E) 0%
- Domestic content requirements: 100% of the steel and iron and 40-55% (depending on the begin construction date of the qualified project) of the total

cost of all manufactured products (including components) are mined, produced, or manufactured in the United States.

- Exception/Waiver: Under direct pay, the Secretary may provide exceptions to domestic content requirements if:
  - Facility has maximum net output of less than 1 megawatt; or
  - Sourcing components domestically will increase the overall cost of construction of qualified facilities by more than 25%; or
  - Relevant steel, iron, or manufactured products are not produced to a satisfactory level of quality in the US, or in sufficient or reasonably available quantities

6.12 Placed In Service Date

6.12.1 Placed In Service (PIS) Date Considerations

IRS's definition of placed in service in general

- Treas. Reg. Section 1.46-3(d)(1) provides that IRC Section 38 business property is placed in service in the earlier of the tax year in which depreciation begins, or when the property is placed in a condition or state of readiness and availability for a specifically assigned function.
- In Rev. Rul. 76-256 (specific to electric generation property), the IRS interpreted a "state of readiness and availability" based on when the following events had occurred:
  - Permits and licenses had been approved
  - Critical testing for various components had been completed
  - The generating unit had been placed in the control of the taxpayer by the contractor
  - The generating unit had been synchronized to the taxpayer's power grid for its function in the business of generating electric energy for the production of income

- Daily operation of the generating unit had begun, notwithstanding further testing, elimination of defects, and further construction to the project outside the scope of the asset in question.

Example

- As an example of "state of readiness" – if a coal-fired electric generating unit required the use of a dam of sufficient height to carry out certain waste disposal functions. The dam was not complete when the five events listed above had occurred, but the IRS still considered the project as having been placed in service because the dam was constructed to a sufficient height for the electric generating unit to function.

6.13 Beginning of Construction

6.13.1 Physical Work test vs. 5% Safe Harbor test

- Per Notice 2018-59, the construction of energy property under Section 48 begins in the year in which 1) physical work of a significant nature has begun ("Physical Work Test") or 2) the taxpayer has paid or incurred 5% or more of the total cost of the energy property ("5% Safe Harbor"), whichever is first.
- **Physical Work Test -** Construction of property begins when physical work of a significant nature begins under a binding written contract. Certain preliminary activities (e.g. planning/design, permitting, grading/excavating) are excluded; activities such as equipment manufacturing and certain engineering services can be included for the physical work test. The determination depends on the facts and circumstances specific to the installation of the energy property.
    - **Documentation: Secure documentation to substantiate the timing and legal enforceability of the contract(s) (i.e. master services agreement, purchase orders), as well as evidence that payments have initiated the supplier's work. Obtain verification that the equipment manufactured off-site is custom-made for Taxpayer's project, rather than being part of the vendor's standard inventory. If applicable, acquire independent engineering assessments to confirm that specific engineering tasks have been completed.**
- **5% Safe Harbor Test -** Construction of the project begins at the time the taxpayer incurs or pays more than 5% of the total eligible cost of the property

included in the depreciable basis, excluding the cost of land and preliminary activities like planning, designing, securing financing, exploring, or researching. IRS Notice 2020-41 permits a taxpayer to consider the all-events test met with regard to economic performance of paying/incurring the 5% liability if the taxpayer receives the services or property within 3.5 months after the date of payment.

  - **Documentation: To ensure the establishment of a definitive and legally binding agreement between the taxpayer and vendor. This includes obtaining comprehensive descriptions of the equipment, such as model and serial numbers, to eliminate any uncertainty about the specific items being acquired. The aim is also to authenticate the financial engagement of the taxpayer by securing records of non-refundable deposits and payments. This documentation should detail the amounts, dates, and confirmations of payment transfers to demonstrate the taxpayer's financial involvement in the project and compliance with the payment terms set forth in the MSAs or POs. Lastly, the delivery and the consequent transfer of title for the energy property, particularly when the payment and delivery transpire within the same calendar year would need to be evaluated.**

- **Continuity Requirement**
  - Each of the methods (1 & 2 above) requires the taxpayer makes continuous progress towards completion once construction has begun.
  - Continuity Safe Harbor – the energy property must be placed in service no more than 4 years after the year construction began, otherwise continuity will be determined based on facts and circumstance.

Begin Construction Documentation – 5% Safe Harbor

- **Master service agreements or purchase orders. These documents should:**
  - Meet the definition of a binding written contract – confirm with advisors
  - Identify the equipment model and actual serial numbers
  - Specify the date of expected delivery
  - Specify the location of expected delivery
  - Specify a total contract price
  - Not limit damages to less than 5% of the total contract price

- **Evidence of non-refundable deposits and payments made.**
  - Provide the amount of the payment
  - Provide the date of the payment (or date deposit becomes nonrefundable)
  - Provide the wire confirmation that the payment was made
  - Provide the corresponding MSA or PO pursuant to which the payment was made
- **Total Cost of Energy Property**
  - Provide reference to the deposit in the PO or MSA, this will need to be compared to total cost of energy property once the project is completed to ensure it equals or exceeds 5% of the total costs of the energy property utilized in the project.
    - Provide reference to the estimated project costs
    - Is the project experiencing cost overruns? If so, reference updated budget.
- **Delivery Completion and Title Transfer**
  - If payment occurs in same calendar year as delivery of energy property
    - Provide evidence delivery of energy property was completed
      - Bill of lading
      - Receipt at warehouse
      - Delivery completion certificate
      - Identify the equipment model and actual serial numbers
- **Assignment**
  - If energy property is going to be used by an entity other than the entity that procured it, then provide a copy of the executed assignment agreement.

Begin Construction Documentation – Off-Site Physical Work of a Significant Nature

- **Master service agreements or purchase orders. These documents should:**
  - Be a binding written contract – confirm with advisors
  - Identify the equipment model and serial numbers
  - Specify the date of expected delivery

- Specify the location of expected delivery
- Specify a total contract price
- Not limit damages to less than 5% of the total contract price

- **Supplier Certifications, Representations and Documentation by Independent Engineers**
  - Provide reference to MSA or PO that no physical work of a significant nature was performed prior to executing binding written contract
  - Provide evidence of beginning of construction Provide the wire confirmation that the payment was made
    - From supplier if available
    - From independent engineer if engaged**
  - Provide reference to section of MSA or PO indicating that energy property is custom and not normally held in inventory
- **Assignment**
  - If energy property is going to be used by an entity other than the entity that procured it, then provide a copy of the executed assignment agreement.

*** A report by an independent engineer should include both written observations of construction or manufacturing in process and visual evidence such as photographs. If the report documents manufacturing of equipment identification of serial numbers or other similar markings is encouraged.*

7.0 Regulatory Planning

The scale of the Energy Renewal Plan includes systems that will be governed by many different regulatory agencies. This section provides a summary of the major regulations impacting the Implementation Plan, with details expanded upon within appendices as noted in each section.

Table 7.0-1 provides a high-level summary of permitting requirements and next steps for the project work included in the Energy Renewal Plan.

Table 7.0-1: Permitting requirements summary table

Permitting Agency	Permitting / Regulatory Item	Projects Impacted	Timeline	Next Steps
Various	**Lake Water Permitting and Approvals**	Lake Interface (S-1)	Refer to Appendix 10.6	Refer to Appendix 10.6
Washington Department of Commerce	**Climate Commitment Act Regulations**	Campus-wide	Ongoing	On-going participation in cap-and-trade auctions.
Washington Department of Commerce	**Clean Building Performance Standards**	Campus-wide	Ongoing	UW Resource Conservation group is managing deadlines for Tier 1 building compliance with deadlines beginning June 2026. Compliance will continue to be demonstrated on a 5-year period.
Washington Department of Commerce	**House Bill 1390 District Energy System Decarbonization**	Campus-wide	Ongoing	Submission of the UW Energy Renewal Plan to Department of Commerce by July 1, 2025.
City of Seattle Department of Construction and Inspections (SDCI)	**Building Permits and Substantial Alterations**	Building Conversion work (B-1, 8, 9, 10, 11)	Design begins 2027	UW to establish a Memo of Understanding (MOU) ahead of project work in 2027. Define general project pathways to streamline review process and avoid pitfalls during review period.

Table 7.0-1: Permitting requirements summary table

Permitting Agency	Permitting / Regulatory Item	Projects Impacted	Timeline	Next Steps
City of Seattle	**Building Emissions Performance Standard (BEPS)**	Campus-wide	N/A	The University is currently exempt under the provisions of the CCA as a covered entity. Should the University's emissions drop below that threshold, the UW should be well positioned to comply with the Seattle BEPS.
King County Wastewater Treatment Division	**Sewer Heat Recovery Pilot Program Acceptance**	Sewer Heat Recovery System (S-1)	2027 along current biennium funding timeline, begin earlier if possible.	Submit a 30% Design to KC to be accepted into pilot program. UW looking for alternate pathways to funding a 30% design package to move this project forward.

7.1 Lake Water

The interface with Lake Washington and the Ship Canal is anticipated to be the largest regulatory hurdle facing the Energy Renewal Plan. There are many agencies with jurisdiction over the lake given it is a Water of the United States, a navigable water, a water of the state, a habitat for federally listed species, a Shoreline of Statewide Significance, state-owned aquatic land, a designated temperature impairment area, and in some areas a federal works project. In addition to the natural environment considerations, the lake and Ship Canal provide important functions for commerce, navigation, and recreation. The multi-agency approval process will be lengthy, and approval is not guaranteed.

There are currently no known large non-residential uses of Lake Washington as a source of heating, cooling, or consumptive uses. The University of Washington Medical Center has an existing surface water right for use of Lake Union / Portage Bay for heating and cooling, which is not directly useful for this endeavor, but shows a previous allowance for institutional use of a natural body of water.

The approach for agency approval is to demonstrate that the proposed system will, at a minimum, “do no harm.” Some of the options for the outfall of the lake water may even present a potential benefit to environmental conditions and the University would be willing to consider operating the system in a way that enhances the environmental benefit if it was proven to exist. These claims may be difficult to prove so care must be taken to demonstrate that the complexities and relationships of ecological, hydrological, and chemical effects of the project are understood, and adverse effects are appropriately avoided, minimized, and finally mitigated. A higher bar may be set by the Department of Ecology to show a betterment / measured improvement to the impaired area of the Ship Canal.

Refer to Appendix 10.6, Preliminary Permitting & Environmental Considerations – Phase 3 for additional details.

7.2 State Regulations

7.2.1 Washington State Climate Commitment Act (CCA)

Recent State of Washington legislation (in effect as of Jan 1, 2023) referred to as the Climate Commitment Act (CCA) caps and reduces greenhouse gas (GHG) emissions from Washington’s largest emitting sources, which includes the University of Washington’s Seattle Campus.

As a covered entity, the University must purchase GHG emission allowances to cover at least 30% of its 2023 emissions by November 2024. Each subsequent year requires the same allowance up to November 2027, at which point the remaining 70% of emissions must be covered, inclusive of all emissions in 2023 and later. UW’s present approach to compliance with CCA is to purchase 100% of its expected annual allowances in the respective year that the emissions occurred. Purchasing of emissions allowances is done in a quarterly auction format, with special provisions for public entities that provide a flat price not available to the private industry. Recent CCA auction pricing is shown below in Figure 7.2.1-1 with one allowance being equal to one metric ton of carbon dioxide-equivalent emissions.

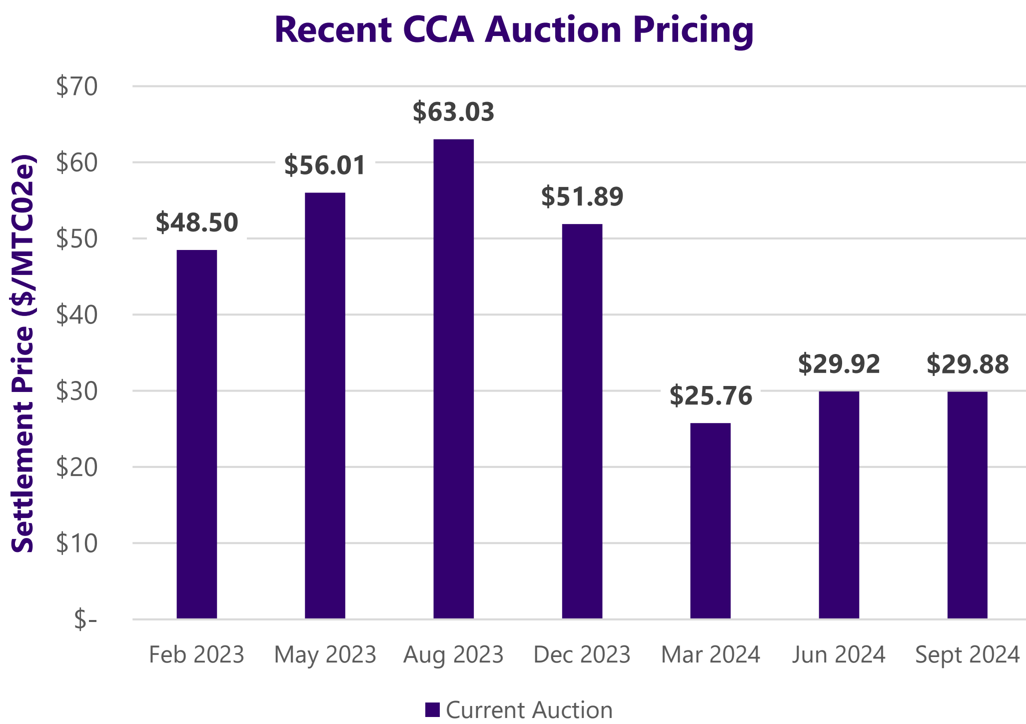


Figure 7.2.1-1: *Recent Climate Commitment Act (CCA) auction pricing for carbon emission allowances*

Known as the Cap-and-Invest program, the money collected by the State is circulated back to CCA-covered entities through the legislature and is expected to act as a source of funding for projects associated with the ERP for the University.

If the University reduces its carbon emissions below the threshold of 25,000 equivalent metric tons of CO2 per year, then it would no longer be a covered entity and would be exempt from these regulations. This depends on a few key factors:

- Installation of electric boilers to transition fossil fuel boilers to a standby/emergency role. This transition is currently planned to occur in the last part of the ERP.
- Either the reduction of steam process demands, conversion to electrically generated steam, or transition to Renewable Natural Gas as a fuel source (refer to section 5.2 and Table 5.2-5).

7.2.2 Washington State Clean Buildings Performance Standard

Washington state passed the Clean Buildings Act (HB1257) in 2019 which created the Clean Buildings Performance Standard (CBPS) and requires existing commercial and state-owned buildings to comply with energy usage targets based on building type. The State has released an overlay of ASHRAE 100 – 2018 for this standard. Compliance is staggered based on building floor area with larger buildings having to comply earlier. The thresholds and deadlines for compliance are given below:

- Greater than 220,000 sf – June 1st, 2026
- 90,000 to 220,000 sf – June 1st, 2027
- 50,000 to 90,000 sf – June 1st, 2028

Building owners must submit their buildings for compliance every five years for the foreseeable future with energy use targets becoming more stringent over time. Newly constructed buildings (defined as buildings permitted to the 2015 Seattle Energy Code or later) must be 15% more efficient than the EUI targets established in the standard. Buildings that are served by a campus district energy system will comply differently as discussed in the section below.

While the original intent of the standard was for buildings to comply based on EUI targets for individual building types (office, educational, retail, etc.) the Standard has been updated such that buildings on university campuses may comply with the College/University EUI target which includes classrooms, libraries, laboratory classrooms, offices, cafeterias, maintenance facilities, arts facilities, athletic facilities, and residential areas. Research laboratories where the primary activities are of scientific research, measurement, and experiments are performed can utilize the Laboratory building type.

The University of Washington intends to submit for campus-level compliance using a mix of building types that include College/University, Laboratory (research), and Hospital. The University has communicated with the Department of Commerce to establish the UW "Montlake Campus" which is a collection of buildings in Seattle that will be covered under campus-level compliance with the Clean Buildings Performance Standard. A single Energy Management Plan (EMP) and Operations & Maintenance (O&M) plan can be submitted for the entire campus if it captures the attributes of all buildings on campus. These plans shall be submitted based on the original compliance dates, beginning June 1st, 2026, and may be further developed and/or implemented in an incremental fashion to cover all buildings on campus.

7.2.3 Washington State House Bill 1390 – District Energy Systems

Another recent legislative provision known as House Bill 1390, effective July 2023, concerns state-owned campus district energy systems. The CBPS has been updated to include a compliance pathway under Normative Annex W for district energy system decarbonization.

Owners of a state campus district energy system must develop a decarbonization plan that provides a strategy for up to 15 years for the decarbonization of the district energy system by 2040. This plan must begin development no later than June 30, 2024, and be submitted to the Department of Commerce no later than June 30, 2025. Subsequently, every five years after the plan is submitted, the plan must be resubmitted along with a progress report on the status of implementation. The final report of the Energy Renewal Plan will inform contents of the House Bill 1390 Decarbonization Plan; however, it is not anticipated to be directly used for that purpose.

Decarbonization in this context relates to the replacement of fossil fuels and reducing operational carbon emissions for district heating, cooling, or heating and cooling systems. Fossil fuel or electric resistance sources may account for a maximum of 10 percent of a district energy system heating plant's annual output.

The campus-level compliance pathway for College/University is allowable under CBPS Normative Annex W for district energy system decarbonization and may include both buildings connected to the district energy system and standalone buildings. An approved decarbonization plan extends energy target compliance for all buildings on the campus to the 15-year decarbonization plan timeline. The campus-level energy management and operations and maintenance plan must still be submitted based on the original compliance schedule for CBPS (2026-2028). The University intends to submit the UW Montlake Campus for campus-level compliance under this district energy system decarbonization pathway.

7.3 City Regulations

7.3.1 Seattle Department of Construction and Inspections (SDCI) – Substantial Alterations

The City of Seattle requires existing building projects that meet the requirements of a Substantial Alteration to fully upgrade the building to the current building energy code. Substantially extending the useful physical and/or economic life of the building is a common definition that gets applied. Capital funding for substantial alterations is rarely available to support the viability of the original existing building project which can become a roadblock to phased implementation of district energy infrastructure and building system improvements.

The Building Renewal Plan includes a wide variety of renovations from full building gut and remodels, to minor improvement projects, to everything in between. There will also be thermal conversion projects at almost all buildings as part of the Energy Renewal Plan implementation including district energy system connections and building HVAC system modification in many buildings.

The University, as part of the BRP and ERP efforts, is seeking to develop a memo of understanding with SDCI to support the permitting of necessary upgrade projects to address deferred maintenance, comply with Washington State legislature, and comply with City of Seattle codes and standards, wherein projects that are implemented as part of the ERP (and relevant BRP projects) do not get classified by SDCI as Substantial Alterations and can be implemented in a phased and logical manner. UW with assistance from the BRP and ERP teams and other consultants specializing in permitting within the City of Seattle will aim to reach an agreement prior to work commencing for these projects.

Permits for building, mechanical, electrical, and structural work may each be required on a building-by-building basis depending on the extent of the conversion work for each building. After preliminary reviews of the codes and non-project specific discussions with the City of Seattle Energy Code Advisor, projects that are solely being done to execute the energy renewal/decarbonization plan are not expected to trigger Substantial Alteration provisions, which would incur significant cost and disruption. Additionally, exceptions exist for district energy systems under the provisions of the Energy Code that would normally require the addition of new building-level heating and cooling equipment. The memo of understanding will aim to expand upon this, allowing the University of Washington to continue to utilize VAV systems to continue the standardized approach to building maintenance with the intent to comply with the electrification requirements through decarbonization of the central utility system.

By the end of the campus conversion project, there will be hundreds of permits required to be processed by SDCI for the work within the buildings and tunnels. Another outcome of the memo of understanding with SDCI is to streamline this permitting process and to find and discuss any surprise provisions before they appear on the critical path of project work.

SDCI will also require structural permits for any new underground walkable tunnel sections.

7.3.2 Seattle Department of Construction and Inspections (SDCI) – Seattle Building Emissions Performance Standard

Passed by the Seattle City Council and Mayor's office in 2023, the Seattle Building Emissions Performance Standards (BEPS) is meant to complement the state's energy performance standard (CBPS) with a GHG emission standard to decarbonize existing buildings in Seattle. The goal is to reach net-zero emissions by 2045-2050 with 5-year reporting periods and emissions targets that decrease over time. The City's next phase is to develop the Director's Rule which will contain details such as required documentation, processes for compliance, and other key elements. This technical rulemaking is currently underway with a timeline of Q2 2025 for publishing of the adopted final rule.

Covered buildings that are subject to and comply with the requirements under RCW 70A.65 Climate Commitment Act are exempt from compliance with the Seattle BEPS, which includes the University of Washington since the University is currently a covered entity under the CCA. If the University falls below the 25,000 MTC02e threshold for CCA-covered entities, the University may be required to comply with the Seattle BEPS in the future. However, achieving this level of decarbonization under the CCA threshold would mean the University is well positioned for compliance with Seattle BEPS.

The current rulemaking process includes representatives from the Department of Commerce to provide consistency between CBPS, state district energy system decarbonization, and Seattle BEPS. The ordinance says building owners with a building portfolio, district campus, or connected buildings may use an aggregate standard greenhouse gas emissions intensity for compliance. This approach under Seattle BEPS would be like the campus-level approach under CBPS which includes a mix of greenhouse gas intensity targets for College/University, Laboratory, and Hospital. Additionally, the current rulemaking indicates a compliance pathway for multiple buildings under the district campus decarbonization compliance plan where a district campus can demonstrate that upgrades to the district campus plant will generate cumulative emissions reductions from 2028-2050 that are equal to or greater than the cumulative emissions reductions that would be achieved by meeting standard or alternate greenhouse gas intensity targets under Seattle BEPS.

7.3.3 Seattle Department of Transportation (SDOT) ROW

Installing direct buried district energy system piping and buried electrical duct banks on the UW campus will not require city permits unless walk-through tunnels are proposed, which will require a building (-CN) permit from the Seattle Department of Construction and Inspection (SDCI).

Permits will be required, however, for direct buried mechanical or electrical systems or tunnel systems in the public right-of-way (ROW). These permits will be issued by the Seattle Department of Transportation and require two separate permits outlined below:

- Long-term annual renewable permit. This Term Permit needs to be approved by the City Council. Refer to SDOT AG 1088: Private Utility Infrastructure - Transportation (available on SDOT's website) for an outline of the permitting process.
- Right-of-Way Utility permit also known as a Utility Major Permit (UMP). This permit is for the construction of direct buried utilities and is only approved after the long-term permit passes through the council and is approved by SDOT. Refer to SDOT Utility Work in the Right of Way – Transportation (available on SDOT's website) for an outline of the permit requirements.

Refer to Phase II Project Identification Report Appendix 9.5, Civil Engineering Technical Report for more discussion on permitting of utilities in the public right-of-way.

7.4 King County Sewer

Interfacing with the King County sewer main as a source of low-grade heat for the campus will require coordination and permitting approval from local agencies, including:

- King County's Wastewater Treatment Division (WTD)
- Seattle Department of Transportation (SDOT)

King County WTD is, at the time of this report, accepting applications for two additional projects across its system to allow the use of the sewer as a source for heating and cooling. The pilot project is a test run for wider use of this strategy across their system. King County WTD requires a 30% Design Review document set to begin the process for application into their sewer heat recovery pilot program and will be involved throughout the design and construction process to review and approve all work related to the connection to their pipeline and transference of sewer water to and from the pipe.

In order to make the connection to the sewer pipe, private utilities will need to be run in the SDOT right-of-way which requires multiple permits to be granted by SDOT with annual renewal. Refer to Section 7.3.3 above for additional details on SDOT compliance.

8.0 Risk Assessment

The risk register in Table 8.0-1 outlines a series of high-level risks associated with the work proposed in this report.

Table 8.0-1: Project Risk Register

Risk Category	Risk Title	Risk Type	Risk Description	Mitigation Opportunities
Energy Sources	Lake Water Permitting	Regulatory	Numerous permits and stakeholders are involved in approving the lake water use and construction. Any single entity opposing may impact viability.	The early engagement of stakeholders through the ERP effort (led by Shannon & Wilson) plus the anticipated ongoing advancement through an effort funded in the 2025-2027 biennium funding period will identify obstacles as early as possible and give the team adequate time for discussion and negotiation.
Energy Sources	In-lake Construction	Community	Temporary construction activities may be opposed by area residents.	Community outreach programs. The support of other areas of the community may be beneficial.
Energy Sources	Sewer Water Bldg. Locations	Planning/ Financial	Final location of buildings and systems to support sewer water heat recovery not finalized. Each potential site has issues to address.	Continue preliminary discussions between UW Real Estate and the owners of potential sites.
Energy Sources	Availability of Low-Carbon / Carbon-Neutral Combustion Fuels	Technology	If low-carbon / carbon-neutral combustion fuel sources become readily available and cost-competitive with electricity, the investment in electrified technologies could become less cost-effective.	By maintaining combustion equipment (boilers at Power Plant) as part of the long-term plan, the University has flexibility to incorporate combustion boilers into the operational scheme should these fuels become available and cost-effective. Additionally, the least efficient electric heating equipment (electric boilers) is provided in the back end of the plan and could be omitted or delayed in response to changes in availability of said fuels.

Table 8.0-1: Project Risk Register

Risk Category	Risk Title	Risk Type	Risk Description	Mitigation Opportunities
Plant Upgrades	WCUP Expansion	Planning	WCUP expansion has not been fully approved. Without expansion, space is not available to house necessary Heat Recovery Chillers and related equipment.	Begin discussions with stakeholders (City of Seattle). Pre-application meetings ahead of design submittals.
Plant Upgrades	Power Plant Upgrades	Space, Financial	Significant upgrades are required in the Power Plant to improve operational control and house additional equipment.	Coordination between staff and design teams to daylight existing conditions and avoid unforeseen circumstances.
Plant Upgrades	UW Substation	Planning	UW Substation site at Northlake building site has not been fully approved by UW or Seattle City Light. Without this site, another location between the University Substation and WRS must be chosen. Most other options have a higher lost development opportunity.	Continued coordination with Seattle City Light. Discussions with UW real estate.
Distribution	Direct Buried Pipe Routing	Financial	Unforeseen underground obstacles could cause significant cost increases to piping installation.	Early engagement with contractors in the design process for field survey and constructability review. Structure contract with appropriate contingencies to allow for agile responses in construction to avoid schedule delays.
Distribution	Direct Buried Pipe Routing	Campus Operations	Installation of underground piping will impact flow of students and staff during construction activities. Temporary road closure in areas is also anticipated.	Messaging around the purpose of the work is important to gain a better understanding from the community that is impacted by this work.

Table 8.0-1: Project Risk Register

Risk Category	Risk Title	Risk Type	Risk Description	Mitigation Opportunities
Distribution	Piping in Tunnels	Logistic/ Financial	The desire to reuse tunnels for PHW distribution requires complex logistical control and potential for utility outages at buildings.	Engage a design/construction team with experience in working with complex critical environments. Explore direct-bury alternatives when impacts to operations or from temporary equipment are high.
Building Systems	Building Conversion work	Logistic/ Financial	Building conversion work is historically the most difficult element to estimate in a hot water conversion project. Estimates may vary from those shown herein and logistical impact may occur in affected buildings.	Engage a design/construction team with experience in working with complex critical environments. Mitigation through learned experience as projects occur. After the first few projects are executed, benchmarks will be established.
Cost Estimating	Escalation	Financial	Given the anticipated length of the implementation period (approximately 10 years) for the project accurately predicting escalation costs is difficult.	Market escalation is challenging to manage on a long-term project. Some measures that can be taken: • Early procurement of major equipment. • A high level of management of the design and construction team with transparency and an appropriate level of detail in project estimates. • Proactive approach to cost control with an understanding of cost impacts at the time of decision-making rather than at milestone estimates. • Track metrics for project cost relative to construction cost.
Cost Estimating	Accuracy	Financial	Estimates prepared are based on pre-concept design information. Detailed design activities may identify additional requirements that increase costs.	Carry appropriate contingencies until designs are developed.

Table 8.0-1: Project Risk Register

Risk Category	Risk Title	Risk Type	Risk Description	Mitigation Opportunities
Funding	CCA Repeal	Financial	Repeal of the CCA in Washington is a ballot initiative in November 2024. If repealed a significant funding source would be eliminated.	Refer to section 4.0, Financial Modeling for alternative pathways without CCA funds available.
Funding	IRA Funding	Financial	The implementation of the IRA is in its early stages and many IRS interpretations are yet to be finalized. Assumption on available funding from this source may be impacted.	Refer to section 4.0, Financial Modeling for sensitivity analysis on tax credit availability.

9.0 Business Equity Enterprise (BEE) Inclusion Opportunities

The Energy Renewal Plan is an extensive initiative, impacting nearly every building on campus and encompassing significant infrastructure upgrades. Ideally, these projects will be managed by contractors with experience in major infrastructure projects at comparable universities or large campuses.

There will be opportunities for BEE firms in areas of the project that allow for a more focused approach or shorter-term contracts, which are more manageable for companies that typically handle smaller-scale projects. Specifically, the Building Conversion scope, including the Building Chiller Replacements and Building Hot Water Conversion projects, presents suitable opportunities for BEE firms. A larger pool of qualified BEE companies is likely available to execute these smaller projects, either in part or in whole.

For larger-scale portions of the project, such as the Distribution and Plant projects, BEE firms are more likely to participate as subcontractors, subconsultants, or suppliers.

10.0 Appendices

10.1 Acknowledgements

University of Washington Team

- Dave Woodson, Executive Director, Campus Energy, Utilities, and Operations (CEU&O)
- Mark Kirschenbaum, Assistant Director, CEU&O
- Norm Mentor Assistant Director, Energy & Resources Conservation, CEU&O
- Ryan Trickett, WCUP & Utility Distribution Utilities Manager, CEU&O
- Warren Midkiff, Power Plant Operations & Maintenance Manager, CEU&O
- Jeremy Park, Electrical Utilities Manager, CEU&O
- Guarrin Sakagawa, Environmental Controls Manager, CEU&O
- Kristine Kenney, Executive Director, Campus Architecture + Planning (CAP)
- Victoria Buker, Assistant Director of Campus Asset Renewal, CAP
- Julie Blakeslee, University Environmental & Land Use Planner, CAP
- Robbie Avila, Manager, Engineering Services
- Casey Cockerham, Engineering Services
- Alex Bruder, Engineering Services

Affiliated Engineers, Inc.

- Geoff McMahon – Principal in Charge and Lead Planner
- Robby Oylear – Project Manager, Mechanical Utility Systems
- Phillip Atwater – Electrical Engineer
- Bruce Colony – Electrical Utility Systems
- Tim Halder – Mechanical Engineer
- Lyle Keck – Building Performance
- Mike Prier – Building Performance

Subconsultant Team

- Shannon & Wilson – Amy Summe
- Whiting-Turner – Steve Thomas, Kodiak Waldal, Adam Smith, Jake Giannandrea
- KPFF Consulting Engineers – Marty Chase
- Ernst & Young – Tom Budescu
- Makai Ocean Engineering – Alex Le Bon
- Rolluda Architects – Alex Rolluda, Matthew Budinger

10.2 Building Renewal Plan Integration

Buildings identified for renewal, removal, or replacement by the Building Renewal Plan (BRP) represent an opportunity to address the energy efficiency and load reduction measures discussed in the Phase II Project Identification report. Energy recovery on high outdoor air ventilation systems and removal of aged HVAC systems that rely on simultaneous heating and cooling will specifically be addressed.

The Building Renewal Plan was issued in August 2024. Figure 10.2-1 shows a visual timeline of the BRP 10-year plan, based on 150% increase in building renewal funding, which coincides with the ERP implementation plan timeline. The BRP's categories were overlaid on top of the ERP plan to identify areas where potential synergies exist and avoid rework of ERP and BRP projects.

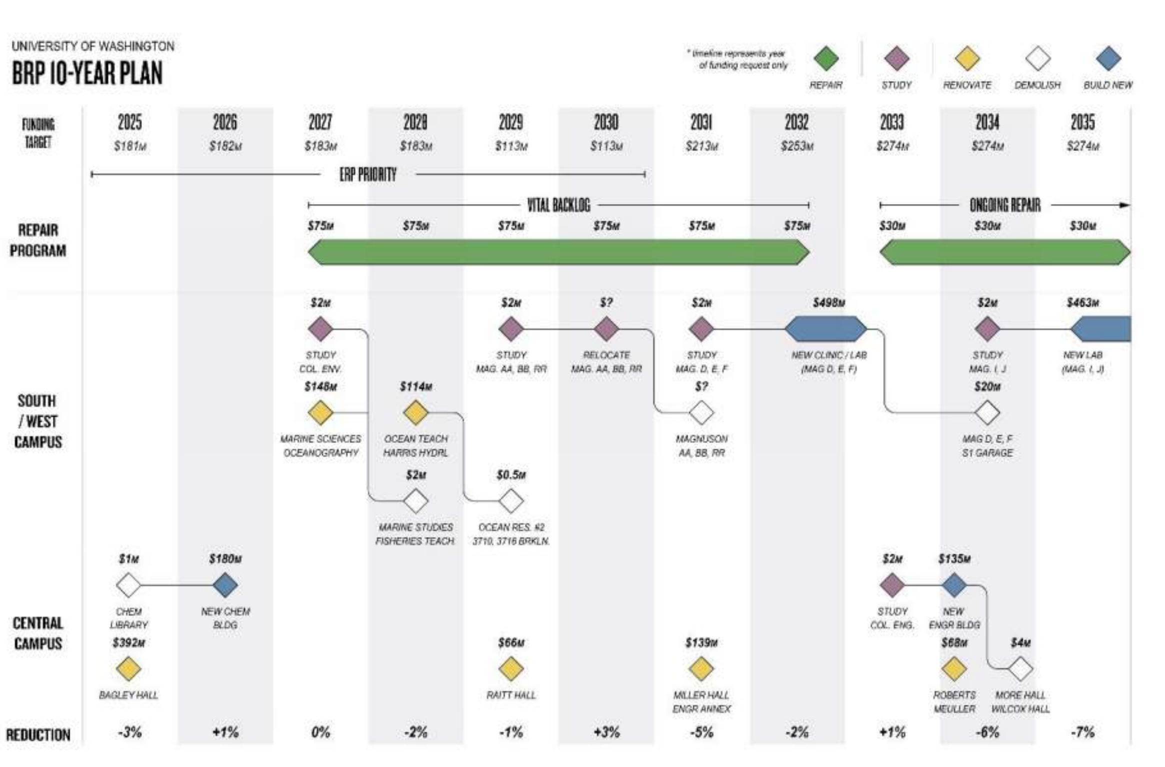


Figure 10.2-1: *Building Renewal Plan for the initial ten years of the Energy Renewal Plan (2025 – 2035).*

10.2.1 Buildings Scheduled for Demolition

Within the 10-year window of the ERP, the following buildings are considered for demolition / replacement or divesting to the UWMC:

- Magnuson Health Sciences Center Buildings:
  - 1175 – RR Wing (2031) – divested to UWMC
  - 1222 – AA Wing (2031) – divested to UWMC
  - 1223 – BB Wing (2031) – divested to UWMC
  - 1225 – E Wing (2034)
  - 1226 – F Wing (2034)
  - 1328 – D Wing (2034)
- 1171 - More Hall (2035)
- 1345 – Wilcox Hall (2035)

If this schedule holds, the ERP piping distribution work within the tunnels serving the above buildings will occur ahead of their demolition (2029 for MHSC and 2032 for More/Wilcox). The total project cost associated with the conversion work is estimated to be $22 million, with most of the value being in Magnusson Health Sciences Center.

The timing of the distribution and tunnel work does not follow the critical path of other project elements and could be pushed into later years to align with the demolition of MHSC buildings. However, modifying the schedule for the distribution and tunnel work would have cascading impacts. It would specifically affect the WCUP Annex project and potentially reduce the impact of the Sewer Water Heat Recovery system until the South of Pacific work is completed.

For the purposes of the ERP implementation plan, the demolition schedule for the MHSC buildings noted above is not considered solidified enough to justify a later completion date for the ERP work within the South of Pacific Avenue region (from WCUP to MHSC).

10.2.2 Buildings Scheduled for Renovation

The following buildings are likely candidates for renovation within the ERP's 10-year window:

- 1206 - Bagley Hall (2025)
- 1138 – Marine Sciences Building (2027)
- 1352 – Oceanography Building (2027)

- 1141 - Oceanography Teaching Building (2028)
- 1186 - Harris Hydraulics Laboratory (2028)
- 1301 - Raitt Hall (2029)
- 1182 - Engineering Annex (2031 – after ERP)
- 1192 - Miller Hall (2031 – after ERP)
- 1109 - Mueller Hall (2034 – after ERP)
- 1191 - Roberts Hall (2034 – after ERP)

In estimating the renovation costs for the above projects, the BRP team accounted for a full-system “gut renovation” to install entirely new mechanical systems within existing buildings. This would go above and beyond the cost assumed for the ERP work.

The ERP team has priced only the work required to convert these buildings from steam to hot water as they currently exist. The total project cost associated with the ERP conversion work is estimated at $29 million, with most of the value being in Bagley Hall ($18.6 million).

Approximately $5 million of this work is scheduled to occur before the ERP activities. In these cases, the BRP work is ahead of the ERP implementation plan. Funds from the Energy Renewal Plan effort will likely be distributed to these BRP projects to address the conversion from campus steam to campus hot water systems and initiate work to streamline the transition when the ERP work occurs.

Buildings renovated ahead of the ERP conversion work will be required to plan space for the future water-to-water heat exchangers and any new pumps or hydronic specialties. Buildings with distributed steam systems (Bagley Hall, Oceanography) should be converted to hot water systems during these major BRP renovations.

Electrification or renovation associated with steam process demands and removal of distributed chillers would be done later, in sequence with the ERP scope.

10.2.3 New Buildings

Buildings constructed ahead of the ERP distribution of primary heating water (PHW) and campus cooling water (CCW) will be required to plan space for the future water-to-water heat exchangers and any new pumps or hydronic specialties. The only new building anticipated to be designed and constructed during the course of the ERP work is the new Chemical Sciences Building (2025 design with a 2028 completion).

New buildings will be required to plan space for future ERP work. This extends to general administration, education, and athletics projects. Housing buildings are not included in the ERP implementation, except as noted in the Phase II report regarding connections for domestic hot water system preheat. Cooling has not been provisioned for housing buildings.

The ERP team was not involved in the planning for any of the following new building projects, which were in the design and/or construction stages at the time of this report:

- Interdisciplinary Engineering Building (IEB)
- Haggett Hall
- Intercollegiate Athletics Basketball Training Facility

At this point, it is assumed that these buildings will not be integrated into the ERP district energy systems as they are being designed and constructed under codes that encourage building-level systems.

The BRP team is leading an effort to develop a Memo of Understanding (MOU) with the City of Seattle's Department of Construction and Inspections (SDCI). The MOU aims to streamline the approach to permitting while establishing a pathway for compliance using UW's current preferred mechanical system type (VAV AHUs with single duct terminal units with hot water reheat). The understanding would be that once completed, the ERP system will meet all the current code provisions.

10.3 Detailed Cost Estimates

The following cost estimates have been revised since the Phase II Project Identification Report and should be considered as the final cost estimates for the project.

The "Executive Cost Summary – Updates to Phase II/III Report" includes cost deltas based on final scope adjustments to the electrical system (switch secondary service out of UW Substation from 13.8 kV to 26 kV). These cost deltas have been applied to the data shown elsewhere in this report (Executive Summary, Financial Modeling, etc.). It is necessary to apply these factors to the individual cost estimate summaries that follow within this section.

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Project Name:	University of Washington - Energy Renewal Plan (ERP)
Type of Estimate:	Initial Concept Budget - Phase II Rev 3
Estimate Date:	October 7, 2024
Project Location:	Seattle, WA
Client:	AEI
Client Contact:	Robby Oylear
Architect/Engineer:	AEI
Whiting-Turner Contact:	Steve Thomas / Adam Smith / Patrick Kantor / Kodiak Waldal
Document Set:	Phase II Documents (33 project SOW documents, dates vary)
Project Description:	Phase II of the University of Washington Energy Renewal Program includes 33 different projects aimed at decarbonizing UW Energy Systems. Projects are broken down into five core components: Building, Electrification, Plant, Site Distribution, and Source.

University of Washington - Energy Renewal Plan (ERP)

Initial Concept Budget - Updates to Phase II / III Report

December 13, 2024

EXECUTIVE COST SUMMARY - UPDATES TO PHASE II/III REPORT

PRELIMINARY CONCEPTUAL ESTIMATES

UPDATED PROJECTS	ESTIMATE - 10/7/2024	ESTIMATE - 12/13/2024	DELTA - $	DELTA - %
E-1 UW Substation	$166,493,664	$169,439,467	$2,945,803	1.8%
E-2 PP Ring Bus & Express Feeders	$14,804,555	$12,918,972	-$1,885,583.00	-12.7%
P-4 WCUP Annex	$46,588,197	$50,649,532	$4,061,335.00	8.7%
P-5 CCW TES Tank	$64,447,105	$58,747,771	-$5,699,334.00	-8.8%
P-7 WCUP HRCs and Cooling Tower	$64,058,692	$61,202,986	-$2,855,706.00	-4.5%
P-12 WCUP Electric Boilers	$25,350,492	$15,949,079	-$9,401,413.00	-37.1%
S-2 Sewer Heat Recovery Equipment Bldg	$53,330,831	$54,545,627	$1,214,796.00	2.3%
TOTAL PROJECT COST - ALL PROJECTS	$1,785,506,413	$1,773,886,311	-$11,620,102.00	-0.7%

General Notes:

1. Estimate values are in Total Project Cost.
2. Cost estimates are in 2024 dollars and do not include escalation beyond 2024.
3. Cost estimates do not include Builder's Risk, we have assumed this to be by UW.
4. Estimates dated 12/13/24 are based on SOW updates provided on 12/3/24 and corresponding follow-up discussions.

University of Washington - Energy Renewal Plan (ERP)

Initial Concept Budget - Phase II Rev 3

October 7, 2024

EXECUTIVE COST SUMMARY - ALL PROJECT COSTS

PRELIMINARY CONCEPTUAL ESTIMATES

BUILDINGS	Component ($)
B-1 Chiller Replacements	$20,573,390
B-6 Metering Program	$8,799,745
B-7 Controls Upgrades	$180,922,993
B-8,9,10 HHW Conversions	$260,097,167
B-11 Local Satellite Steam Plants	$60,469,792
ELECTRIFICATION (All Projects Combined)	$181,298,219
PLANT (All Projects Combined)	$396,052,694
SITE DISTRIBUTION (All Projects Combined)	$486,784,041
SOURCE (All Projects Combined)	$190,508,371
Energy Renewal Plan TOTAL	**$1,785,506,413**

Building HHW Conversion Category Average		
Low	Medium	High
$692,785	$2,037,014	$4,055,220

Note: Building HHW conversion costs based on completing conversion of five (5) buildings at a time. See Building Conversion Summary by Region for cost summaries based on individual building locations.

General Notes:

1. See attached breakdown summaries for B-1, B-6, B-7, B-8 & B-11 .
2. Building HHW conversion costs based on completing conversion of five (5) buildings at a time.
3. Cost estimates are in 2024 dollars and do not include escalation beyond 2024.
4. Cost estimates do not include Builder's Risk, we have assumed this to be by UW.
5. Cost estimates do not include lane use/closure permits and fees, we have assumed this to be by UW.

University of Washington - Energy Renewal Plan (ERP)

Initial Concept Budget - Phase II Rev 3

October 7, 2024

EXECUTIVE COST SUMMARY - EXCLUDES CONTROLS UPGRADES, SCL COSTS & P3 PARTNER COSTS

PRELIMINARY CONCEPTUAL ESTIMATES

BUILDINGS	Component ($)
B-1 Chiller Replacements	$20,573,390
B-6 Metering Program	$8,799,745
B-7 Controls Upgrades	Excluded
B-8,9,10 HHW Conversions	$260,097,167
B-11 Local Satellite Steam Plants	$60,469,792
ELECTRIFICATION (All Projects Combined)	$42,390,209
PLANT (All Projects Combined)	$396,052,694
SITE DISTRIBUTION (All Projects Combined)	$486,784,041
SOURCE (All Projects Combined)	$10,170,268
Energy Renewal Plan TOTAL	**$1,285,337,306**

Building HHW Conversion Category Average		
Low	Medium	High
$692,785	$2,037,014	$4,055,220

Note: Building HHW conversion costs based on completing conversion of five (5) buildings at a time. See Building Conversion Summary by Region for cost summaries based on individual building locations.

General Notes:

1. See attached breakdown summaries for B-1, B-6, B-7, B-8 & B-11 .
2. Building HHW conversion costs based on completing conversion of five (5) buildings at a time.
3. Cost estimates are in 2024 dollars and do not include escalation beyond 2024.
4. Cost estimates do not include Builder's Risk, we have assumed this to be by UW.
5. Cost estimates do not include lane use/closure permits and fees, we have assumed this to be by UW.

University of Washington - Energy Renewal Plan (ERP)
Initial Concept Budget - Phase II Rev 3
October 7, 2024

BUILDING CONVERSION SUMMARY BY REGION

PRELIMINARY CONCEPTUAL ESTIMATES

B-1 Chiller Replacements	QTY	UNIT	UNIT RATE	TOTAL PROJECT COST
South of Pacific	22	EA	$235,342.60	$5,177,537
Central	24	EA	$387,806.51	$9,307,356
North	10	EA	$608,849.69	$6,088,497
B-1 Chiller Replacements TOTAL	56	EA	$367,381.97	$20,573,390

B-8,9,10 HHW Conversions	QTY	UNIT	UNIT RATE	TOTAL PROJECT COST
Central Campus West Tunnel Scope Zone	15	EA	$3,063,897.95	$45,958,469
Central/Lower Distribution Scope Zone	32	EA	$1,939,349.10	$62,059,171
East Campus Distribution Scope Zone	5	EA	$1,574,479.22	$7,872,396
North Distribution Scope Zone	30	EA	$1,306,379.08	$39,191,372
South From Power Plant (PP) Scope Zone	30	EA	$2,184,550.56	$65,536,517
South from WCUP Scope Zone	12	EA	$3,076,470.49	$36,917,646
West Distribution Scope Zone	3	EA	$853,865.01	$2,561,595
B-8,9,10 HHW Conversions TOTAL	127	EA	$2,048,009.19	$260,097,167

UW ENERGY RENEWAL PLAN

Initial Concept Budget - Phase II Rev 3 - 10/07/2024

UW COST SUMMARY - AEI COST BREAKOUTS

		GENERAL CONTRACTOR COSTS					UNIVERSITY OF WASHINGTON COSTS										TOTALS
KEY #	DESCRIPTION	COST OF WORK (MACC)	DESIGN CONTINGENCY	CONSTRUCTION CONTINGENCY	ESCALATION CONTINGENCY	OTHER DESIGN & CONSTRUCTION INDIRECT COSTS	UWF PROJECT MANAGEMENT	AEI SOFT COSTS	LAND ACQUISITION FEES	UWF IN-PLANT SERVICES	COMMISSIONING SERVICES	TESTING & INSPECTION SERVICES	OTHER	ALTA & TOPOGRAPHIC SURVEY	LANE CLOSURE FEES	BUILDER'S RISK INSURANCE	TOTAL PROJECT COST
	Energy Sources																
1	Lake Water Interface System	$ 78,365,828	$ 9,199,941	$ 5,059,967	$ -	$ 38,026,079	$ 3,473,552	$ 1,000,000	$ -	$ 261,304	$ 783,658	$ 156,732	$ 26,130	$ 209,043	$ 287,434	$ 327,871	$ 137,177,539
2	Sewer Heat Recover system	$ 27,115,396	$ 3,242,325	$ 1,783,279	$ -	$ 15,594,902	$ 1,861,837	$ -	$ 3,001,500	$ 95,472	$ 271,154	$ 54,231	$ 9,547	$ 76,377	$ 105,019	$ 119,793	$ 53,330,831
	Energy Sources Subtotal:	**$ 105,481,224**	**$ 12,442,266**	**$ 6,843,246**	**$ -**	**$ 53,620,981**	**$ 5,335,389**	**$ 1,000,000**	**$ 3,001,500**	**$ 356,775**	**$ 1,054,812**	**$ 210,962**	**$ 35,678**	**$ 285,420**	**$ 392,453**	**$ 447,664**	**$ 190,508,371**
	Plant & Electrical System Upgrades																
3	Power Plant Improvements	$ 88,516,609	$ 10,431,367	$ 5,737,252	$ -	$ 47,752,493	$ 6,393,265	$ 1,900,000	$ -	$ 304,875	$ 885,166	$ 575,358	$ 30,488	$ 243,900	$ 335,363	$ 381,259	$ 163,487,395
4	WCUP Improvements	$ 83,761,392	$ 9,916,868	$ 5,454,278	$ -	$ 46,051,558	$ 6,010,561	$ -	$ -	$ 290,368	$ 837,614	$ 544,449	$ 29,037	$ 232,295	$ 319,405	$ 362,960	$ 153,810,785
5	Thermal Energy Storage System	$ 41,862,257	$ 5,001,287	$ 2,750,708	$ -	$ 24,885,957	$ 2,930,325	$ -	$ -	$ 149,000	$ 418,623	$ 272,105	$ 14,900	$ 119,200	$ 163,900	$ 186,251	$ 78,754,514
6	UW Substation and West Receiving Station Upgrades	$ 94,959,532	$ 11,291,196	$ 6,210,158	$ -	$ 47,871,543	$ 3,906,409	$ -	$ -	$ 320,665	$ 949,595	$ 189,919	$ 32,066	$ 151,935	$ 208,911	$ 401,733	$ 166,493,664
7	East Receiving Station Upgrades	$ 6,791,270	$ 899,784	$ 494,881	$ -	$ 5,608,746	$ 753,632	$ -	$ -	$ 27,589	$ 137,947	$ 27,589	$ 2,759	$ 10,866	$ 14,941	$ 34,551	$ 14,804,555
	Plant & Electrical System Upgrades Subtotal:	**$ 315,891,061**	**$ 37,540,503**	**$ 20,647,277**	**$ -**	**$ 172,170,297**	**$ 19,994,192**	**$ 1,900,000**	**$ -**	**$ 1,092,498**	**$ 3,228,945**	**$ 1,609,420**	**$ 109,250**	**$ 758,197**	**$ 1,042,520**	**$ 1,366,754**	**$ 577,350,913**
	Mecahnical Site Distribution																
8	Mechanical Site Distribution	$ 266,110,367	$ 31,867,571	$ 17,527,164	$ -	$ 146,685,625	$ 16,347,355	$ -	$ -	$ 924,381	$ 2,661,104	$ 1,729,717	$ 90,328	$ 722,060	$ 984,995	$ 1,133,373	$ 486,784,041
	Mecahnical Site Distribution Subtotal:	**$ 266,110,367**	**$ 31,867,571**	**$ 17,527,164**	**$ -**	**$ 146,685,625**	**$ 16,347,355**	**$ -**	**$ -**	**$ 924,381**	**$ 2,661,104**	**$ 1,729,717**	**$ 90,328**	**$ 722,060**	**$ 984,995**	**$ 1,133,373**	**$ 486,784,041**
	Building Upgrades and Conversions																
9	Building Heating System Conversions	$ 131,957,675	$ 16,027,091	$ 8,814,900	$ -	$ 83,915,327	$ 16,068,068	$ -	$ -	$ 481,430	$ 1,319,577	$ 857,725	$ 48,143	$ -	$ -	$ 607,231	$ 260,097,167
10	Building Chiller Replacements	$ 10,130,525	$ 1,224,401	$ 673,421	$ -	$ 6,717,990	$ 1,571,374	$ -	$ -	$ 37,493	$ 101,305	$ 65,848	$ 3,749	$ -	$ -	$ 47,284	$ 20,573,390
11	Local Steam Plants	$ 31,375,790	$ 3,770,106	$ 2,073,558	$ -	$ 18,712,986	$ 3,755,475	$ -	$ -	$ 111,865	$ 313,758	$ 203,943	$ 11,186	$ -	$ -	$ 141,125	$ 60,469,792
12	Building Controls, Metering, and System Analytics (CONTROLS EXCLUDED)	$ 2,797,080	$ 349,693	$ 192,331	$ -	$ 2,737,627	$ 578,187	$ 2,070,000	$ -	$ 12,153	$ 27,971	$ 18,181	$ 1,215	$ -	$ -	$ 15,307	$ 8,799,745
	Building Upgrades and Conversions Subtotal:	**$ 176,261,070**	**$ 21,371,292**	**$ 11,754,211**	**$ -**	**$ 112,083,929**	**$ 21,973,104**	**$ 2,070,000**	**$ -**	**$ 642,941**	**$ 1,762,611**	**$ 1,145,697**	**$ 64,294**	**$ -**	**$ -**	**$ 810,947**	**$ 349,940,094**
	UW ERP Project Cost Total:	**$ 863,743,721**	**$ 103,221,632**	**$ 56,771,897**	**$ -**	**$ 484,560,832**	**$ 63,650,040**	**$ 4,970,000**	**$ 3,001,500**	**$ 3,016,596**	**$ 8,707,471**	**$ 4,695,797**	**$ 299,550**	**$ 1,765,676**	**$ 2,419,969**	**$ 3,758,738**	**$ 1,604,583,419**

UW ENERGY RENEWAL PLAN

Initial Concept Budget - Phase II Rev 3 - 10/07/2024

UW COST SUMMARY - BREAKOUTS BY INDIVIDUAL PROJECTS

		GENERAL CONTRACTOR COSTS					UNIVERSITY OF WASHINGTON COSTS										TOTALS
KEY #	DESCRIPTION	COST OF WORK (MACC)	DESIGN CONTINGENCY	CONSTRUCTION CONTINGENCY	ESCALATION CONTINGENCY	OTHER DESIGN & CONSTRUCTION INDIRECT COSTS	UWF PROJECT MANAGEMENT	AEI SOFT COSTS	LAND ACQUISITION FEES	UWF IN-PLANT SERVICES	COMMISSIONING SERVICES	TESTING & INSPECTION SERVICES	OTHER	ALTA & TOPOGRAPHIC SURVEY	LANE CLOSURE FEES	BUILDER'S RISK INSURANCE	TOTAL PROJECT COST
	Energy Sources																
1	S-1 Lake Interface System	$ 78,365,828	$ 9,199,941	$ 5,059,967	$ -	$ 38,026,079	$ 3,473,552	$ 1,000,000	$ -	$ 261,304	$ 783,658	$ 156,732	$ 26,130	$ 209,043	$ 287,434	$ 327,871	$ 137,177,539
2	S-2 Sewer Heat Recovery Equipment Bldg	$ 27,115,396	$ 3,242,325	$ 1,783,279	$ -	$ 15,594,902	$ 1,861,837	$ -	$ 3,001,500	$ 95,472	$ 271,154	$ 54,231	$ 9,547	$ 76,377	$ 105,019	$ 119,793	$ 53,330,831
	Energy Sources Subtotal:	**$ 105,481,224**	**$ 12,442,266**	**$ 6,843,246**	**$ -**	**$ 53,620,981**	**$ 5,335,389**	**$ 1,000,000**	**$ 3,001,500**	**$ 356,775**	**$ 1,054,812**	**$ 210,962**	**$ 35,678**	**$ 285,420**	**$ 392,453**	**$ 447,664**	**$ 190,508,371**
	Plant & Electrical System Upgrades																
3	P-1 Convert CCW to Year-round Operation	$ 1,265,000	$ 152,297	$ 83,763	$ -	$ 1,053,387	$ 181,408	$ 1,900,000	$ -	$ 5,109	$ 12,650	$ 8,223	$ 511	$ 4,087	$ 5,620	$ 6,410	$ 4,678,465
3	P-2 Add CH-8_CT-14	$ 8,404,730	$ 997,899	$ 548,845	$ -	$ 4,821,223	$ 772,914	$ -	$ -	$ 29,545	$ 84,047	$ 54,631	$ 2,955	$ 23,636	$ 32,500	$ 37,072	$ 15,809,997
3	P-8 Power Plant Heat Recovery Chillers	$ 47,171,128	$ 5,520,287	$ 3,036,158	$ -	$ 22,723,488	$ 2,550,960	$ -	$ -	$ 156,902	$ 471,711	$ 306,612	$ 15,690	$ 125,522	$ 172,592	$ 196,128	$ 82,447,178
3	P-9 CCW Header and Secondary Pumping System	$ 14,197,791	$ 1,679,445	$ 923,695	$ -	$ 8,060,129	$ 1,155,211	$ -	$ -	$ 49,722	$ 141,978	$ 92,286	$ 4,972	$ 39,778	$ 54,694	$ 62,153	$ 26,461,854
3	P-10 Power Plant PHW System	$ 5,484,350	$ 653,933	$ 359,663	$ -	$ 3,519,394	$ 570,027	$ -	$ -	$ 20,035	$ 54,844	$ 35,648	$ 2,003	$ 16,028	$ 22,038	$ 25,043	$ 10,763,007
3	P-11 PP Elec. Boilers & EM Gen Heat Rec.	$ 9,929,360	$ 1,181,344	$ 649,739	$ -	$ 6,105,104	$ 901,912	$ -	$ -	$ 35,731	$ 99,294	$ 64,541	$ 3,573	$ 28,585	$ 39,304	$ 44,664	$ 19,083,151
3	P-14 PP Controls Upgrades	$ 2,064,250	$ 246,162	$ 135,389	$ -	$ 1,469,767	$ 260,833	$ -	$ -	$ 7,831	$ 20,643	$ 13,418	$ 783	$ 6,265	$ 8,614	$ 9,789	$ 4,243,743
4	P-3 WCUP CH5 & CT	$ 6,085,703	$ 724,288	$ 398,358	$ -	$ 3,608,852	$ 603,644	$ -	$ -	$ 21,634	$ 60,857	$ 39,557	$ 2,163	$ 17,308	$ 23,798	$ 27,043	$ 11,613,206
4	P-4 WCUP Annex	$ 24,651,453	$ 2,954,923	$ 1,625,207	$ -	$ 14,808,916	$ 1,766,603	$ -	$ -	$ 88,081	$ 246,515	$ 160,234	$ 8,808	$ 70,465	$ 96,889	$ 110,101	$ 46,588,197
4	P-7 WCUP HRCs and Cooling Tower	$ 36,282,973	$ 4,252,384	$ 2,338,811	$ -	$ 17,905,769	$ 2,163,457	$ -	$ -	$ 121,560	$ 362,830	$ 235,839	$ 12,156	$ 97,248	$ 133,716	$ 151,950	$ 64,058,692
4	P-12 WCUP Electric Boilers	$ 13,773,803	$ 1,624,409	$ 893,425	$ -	$ 7,514,832	$ 1,114,401	$ -	$ -	$ 47,613	$ 137,738	$ 89,530	$ 4,761	$ 38,090	$ 52,374	$ 59,516	$ 25,350,492
4	P-13 WCUP Generators	$ 2,967,460	$ 360,865	$ 198,476	$ -	$ 2,213,189	$ 362,456	$ -	$ -	$ 11,480	$ 29,675	$ 19,288	$ 1,148	$ 9,184	$ 12,628	$ 14,350	$ 6,200,199
5	P-5 CCW TES Tank	$ 34,821,007	$ 4,135,569	$ 2,274,563	$ -	$ 19,915,677	$ 2,205,995	$ -	$ -	$ 122,294	$ 348,210	$ 226,337	$ 12,229	$ 97,835	$ 134,523	$ 152,867	$ 64,447,105
5	P-6 PHW TES Tank	$ 7,041,250	$ 865,719	$ 476,145	$ -	$ 4,970,280	$ 724,330	$ -	$ -	$ 26,707	$ 70,413	$ 45,768	$ 2,671	$ 21,365	$ 29,377	$ 33,383	$ 14,307,409
6	E-1 UW Substation	$ 94,959,532	$ 11,291,196	$ 6,210,158	$ -	$ 47,871,543	$ 3,906,409	$ -	$ -	$ 320,665	$ 949,595	$ 189,919	$ 32,066	$ 151,935	$ 208,911	$ 401,733	$ 166,493,664
7	E-2 PP Ring Bus & Express Feeders	$ 6,791,270	$ 899,784	$ 494,881	$ -	$ 5,608,746	$ 753,632	$ -	$ -	$ 27,589	$ 137,947	$ 27,589	$ 2,759	$ 10,866	$ 14,941	$ 34,551	$ 14,804,555
	Plant & Electrical System Upgrades Subtotal:	**$ 315,891,061**	**$ 37,540,503**	**$ 20,647,277**	**$ -**	**$ 172,170,297**	**$ 19,994,192**	**$ 1,900,000**	**$ -**	**$ 1,092,498**	**$ 3,228,945**	**$ 1,609,420**	**$ 109,250**	**$ 758,197**	**$ 1,042,520**	**$ 1,366,754**	**$ 577,350,913**
	Mecahnical Site Distribution																
8	D-C1 Central Campus Piping	$ 43,938,305	$ 5,225,756	$ 2,874,166	$ -	$ 23,235,223	$ 2,510,321	$ -	$ -	$ 150,547	$ 439,383	$ 285,599	$ 15,055	$ 120,438	$ 165,602	$ 188,899	$ 79,149,292
8	D-C2 Central Campus Piping West Tunnel	$ 33,043,517	$ 3,930,564	$ 2,161,810	$ -	$ 17,266,201	$ 2,069,444	$ -	$ -	$ 112,804	$ 330,435	$ 214,783	$ 11,280	$ 90,243	$ 124,085	$ 141,541	$ 59,496,707
8	D-N1 North Campus Piping	$ 45,993,352	$ 5,479,296	$ 3,013,613	$ -	$ 24,634,392	$ 2,596,197	$ -	$ -	$ 158,241	$ 459,934	$ 298,957	$ 15,824	$ 126,593	$ 174,065	$ 198,553	$ 83,149,018
8	D-S1 PHW Piping from WCUP to South Campus	$ 24,928,584	$ 3,026,825	$ 1,664,754	$ -	$ 14,979,744	$ 1,783,239	$ -	$ -	$ 89,200	$ 249,286	$ 162,036	$ 9,657	$ 77,259	$ 106,232	$ 121,177	$ 47,197,992
8	D-S2 South of Pacific Campus Piping from PP	$ 28,752,950	$ 3,479,735	$ 1,913,854	$ -	$ 17,287,007	$ 1,970,838	$ -	$ -	$ 102,867	$ 287,529	$ 186,894	$ 10,422	$ 83,378	$ 114,645	$ 130,774	$ 54,320,894
8	D-W1 West Campus CCW & PHW Piping	$ 52,246,408	$ 6,249,521	$ 3,437,236	$ -	$ 28,497,462	$ 2,832,158	$ -	$ -	$ 180,861	$ 522,464	$ 339,602	$ 15,121	$ 120,968	$ 166,331	$ 189,731	$ 94,797,862
8	D-W2 Sewer Heat Recovery Piping	$ 4,527,518	$ 578,169	$ 317,993	$ -	$ 3,380,125	$ 518,543	$ -	$ -	$ 17,608	$ 45,275	$ 29,429	$ 1,761	$ 13,519	$ 10,751	$ 22,070	$ 9,462,761
8	D-E1 PHW Piping from PP to East and SE Campus	$ 32,679,734	$ 3,897,705	$ 2,143,738	$ -	$ 17,405,473	$ 2,066,615	$ -	$ -	$ 112,253	$ 326,797	$ 212,418	$ 11,208	$ 89,661	$ 123,284	$ 140,628	$ 59,209,514
	Mecahnical Site Distribution Subtotal:	**$ 266,110,367**	**$ 31,867,571**	**$ 17,527,164**	**$ -**	**$ 146,685,625**	**$ 16,347,355**	**$ -**	**$ -**	**$ 924,381**	**$ 2,661,104**	**$ 1,729,717**	**$ 90,328**	**$ 722,060**	**$ 984,995**	**$ 1,133,373**	**$ 486,784,041**
	Building Upgrades and Conversions																
9	B-8/9/10 HHW Conversions	$ 131,957,675	$ 16,027,091	$ 8,814,900	$ -	$ 83,915,327	$ 16,068,068	$ -	$ -	$ 481,430	$ 1,319,577	$ 857,725	$ 48,143	$ -	$ -	$ 607,231	$ 260,097,167
10	B-1 Chiller Replacements	$ 10,130,525	$ 1,224,401	$ 673,421	$ -	$ 6,717,990	$ 1,571,374	$ -	$ -	$ 37,493	$ 101,305	$ 65,848	$ 3,749	$ -	$ -	$ 47,284	$ 20,573,390
11	B-11 Local Satellite Steam Plants	$ 31,375,790	$ 3,770,106	$ 2,073,558	$ -	$ 18,712,986	$ 3,755,475	$ -	$ -	$ 111,865	$ 313,758	$ 203,943	$ 11,186	$ -	$ -	$ 141,125	$ 60,469,792
12	B-6 Metering Program	$ 2,797,080	$ 349,693	$ 192,331	$ -	$ 2,737,627	$ 578,187	$ 2,070,000	$ -	$ 12,153	$ 27,971	$ 18,181	$ 1,215	$ -	$ -	$ 15,307	$ 8,799,745
12	B-7 Building Controls Upgrades (EXCLUDED)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Building Upgrades and Conversions Subtotal:	**$ 176,261,070**	**$ 21,371,292**	**$ 11,754,211**	**$ -**	**$ 112,083,929**	**$ 21,973,104**	**$ 2,070,000**	**$ -**	**$ 642,941**	**$ 1,762,611**	**$ 1,145,697**	**$ 64,294**	**$ -**	**$ -**	**$ 810,947**	**$ 349,940,094**
	UW ERP Project Cost Total:	**$ 863,743,721**	**$ 103,221,632**	**$56,771,897**	**$ -**	**$ 484,560,832**	**$ 63,650,040**	**$ 4,970,000**	**$3,001,500**	**$3,016,596**	**$ 8,707,471**	**$4,695,797**	**$299,550**	**$ 1,765,676**	**$2,419,969**	**$ 3,758,738**	**$ 1,604,583,419**

UW ENERGY RENEWAL PLAN

Initial Concept Budget - Phase II Rev 3 - 10/7/2024

UW COST SUMMARY - COST SEGREGATION 10/7/2024

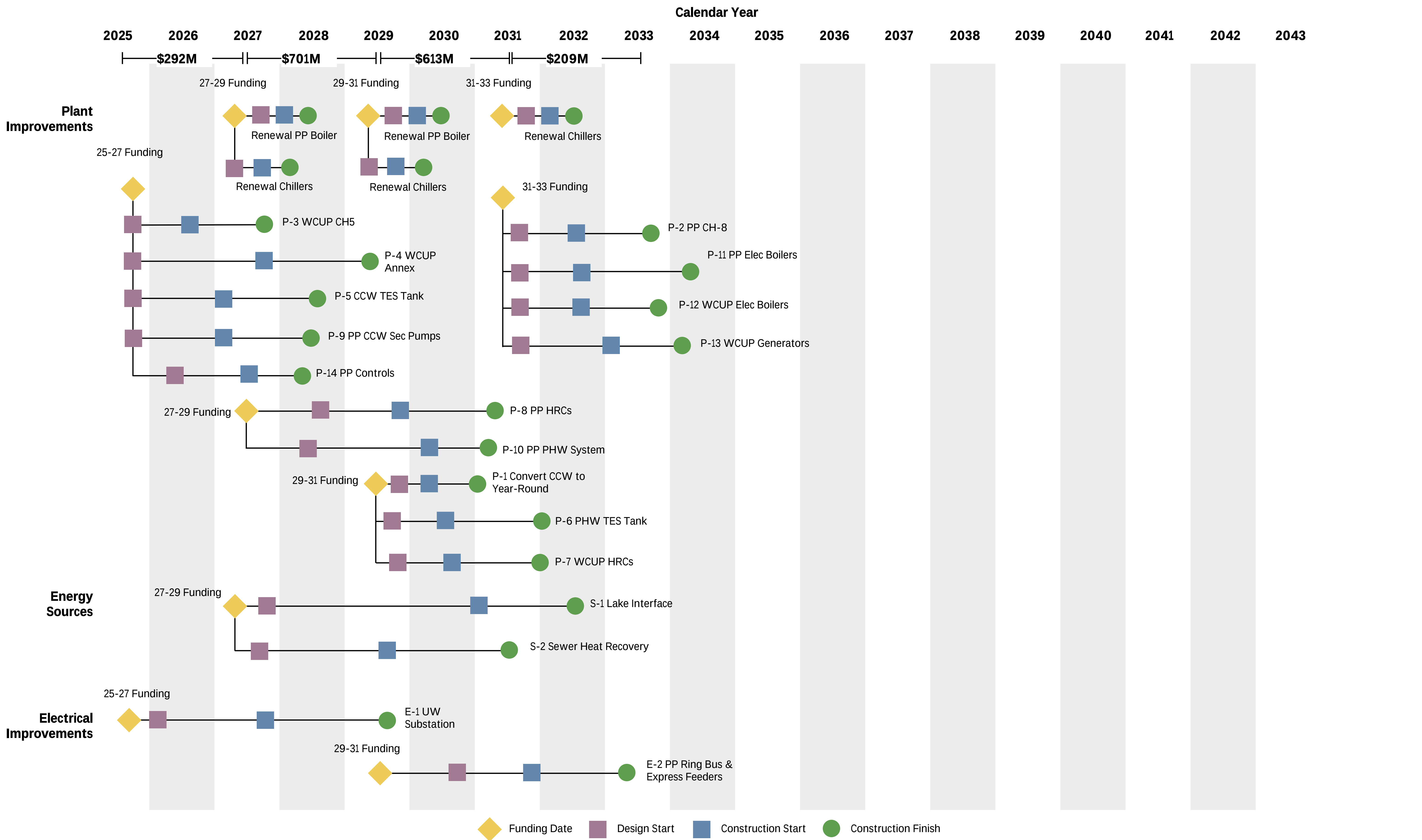
	GENERAL CONTRACTOR COSTS					UNIVERSITY OF WASHINGTON COSTS											TOTALS
DESCRIPTION	COST OF WORK (MACC)	DESIGN CONTINGENCY	CONSTRUCTION CONTINGENCY	ESCALATION CONTINGENCY	OTHER DESIGN & CONSTRUCTION INDIRECT COSTS	UWF PROJECT MANAGEMENT	AEI SOFT COSTS	AEI RENEWAL COSTS	LAND ACQUISITION FEES	UWF IN-PLANT SERVICES	COMMISSIONING SERVICES	TESTING & INSPECTION SERVICES	OTHER	ALTA & TOPOGRAPHIC SURVEY	LANE CLOSURE FEES	BUILDER'S RISK INSURANCE	TOTAL PROJECT COST
Decarbonization																	
AEI Renewal Costs - 2027: Overhaul/Replace Existing Boiler	By AEI	By AEI	By AEI	$ -	By AEI	By AEI	By AEI	$ 33,750,000	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	$ 33,750,000
AEI Renewal Costs - 2029: Overhaul/Replace Existing Boiler	By AEI	By AEI	By AEI	$ -	By AEI	By AEI	By AEI	$ 33,750,000	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	$ 33,750,000
AEI Renewal Costs - 2031: Overhaul/Replace Existing Boiler	By AEI	By AEI	By AEI	$ -	By AEI	By AEI	By AEI	$ 33,750,000	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	$ 33,750,000
B-1 Chiller Replacements: Fluke, Foege, MHSC (All Wings), Chemistry Building, EE/CSE & Mary Gates Hall	$ 2,011,750	$ 243,145	$ 133,730	$ -	$ 1,334,079	$ 319,064	$ -	$ -	$ -	$ 7,445	$ 20,118	$ 13,076	$ 745	$ -	$ -	$ 9,390	$ 4,092,541
B-8/9/10 HHW Conversions	$ 131,957,675	$ 16,027,091	$ 8,814,900	$ -	$ 83,915,327	$ 16,068,068	$ -	$ -	$ -	$ 481,430	$ 1,319,577	$ 857,725	$ 48,143	$ -	$ -	$ 607,231	$ 260,097,167
B-11 Local Satellite Steam Plants	$ 31,375,790	$ 3,770,106	$ 2,073,558	$ -	$ 18,712,986	$ 3,755,475	$ -	$ -	$ -	$ 111,865	$ 313,758	$ 203,943	$ 11,186	$ -	$ -	$ 141,125	$ 60,469,792
B-6 Metering Program	$ 2,797,080	$ 349,693	$ 192,331	$ -	$ 2,737,627	$ 578,187	$ 2,070,000	$ -	$ -	$ 12,153	$ 27,971	$ 18,181	$ 1,215	$ -	$ -	$ 15,307	$ 8,799,745
P-1 Convert CCW to Year-round Operation	$ 1,265,000	$ 152,297	$ 83,763	$ -	$ 1,053,387	$ 181,408	$ 1,900,000	$ -	$ -	$ 5,109	$ 12,650	$ 8,223	$ 511	$ 4,087	$ 5,620	$ 6,410	$ 4,678,465
P-8 Power Plant Heat Recovery Chillers	$ 47,171,128	$ 5,520,287	$ 3,036,158	$ -	$ 22,723,488	$ 2,550,960	$ -	$ -	$ -	$ 156,902	$ 471,711	$ 306,612	$ 15,690	$ 125,522	$ 172,592	$ 196,128	$ 82,447,178
P-9 CCW Header and Secondary Pumping System	$ 14,197,791	$ 1,679,445	$ 923,695	$ -	$ 8,060,129	$ 1,155,211	$ -	$ -	$ -	$ 49,722	$ 141,978	$ 92,286	$ 4,972	$ 39,778	$ 54,694	$ 62,153	$ 26,461,854
P-10 Power Plant PHW System	$ 5,484,350	$ 653,933	$ 359,663	$ -	$ 3,519,394	$ 570,027	$ -	$ -	$ -	$ 20,035	$ 54,844	$ 35,648	$ 2,003	$ 16,028	$ 22,038	$ 25,043	$ 10,763,007
P-11 PP Elec. Boilers & EM Gen Heat Rec.	$ 9,929,360	$ 1,181,344	$ 649,739	$ -	$ 6,105,104	$ 901,912	$ -	$ -	$ -	$ 35,731	$ 99,294	$ 64,541	$ 3,573	$ 28,585	$ 39,304	$ 44,664	$ 19,083,151
P-14 PP Controls Upgrades	$ 2,064,250	$ 246,162	$ 135,389	$ -	$ 1,469,767	$ 260,833	$ -	$ -	$ -	$ 7,831	$ 20,643	$ 13,418	$ 783	$ 6,265	$ 8,614	$ 9,789	$ 4,243,743
P-4 WCUP Annex	$ 24,651,453	$ 2,954,923	$ 1,625,207	$ -	$ 14,808,916	$ 1,766,603	$ -	$ -	$ -	$ 88,081	$ 246,515	$ 160,234	$ 8,808	$ 70,465	$ 96,889	$ 110,101	$ 46,588,197
P-7 WCUP HRCs and Cooling Tower	$ 36,282,973	$ 4,252,384	$ 2,338,811	$ -	$ 17,905,769	$ 2,163,457	$ -	$ -	$ -	$ 121,560	$ 362,830	$ 235,839	$ 12,156	$ 97,248	$ 133,716	$ 151,950	$ 64,058,692
P-12 WCUP Electric Boilers	$ 13,773,803	$ 1,624,409	$ 893,425	$ -	$ 7,514,832	$ 1,114,401	$ -	$ -	$ -	$ 47,613	$ 137,738	$ 89,530	$ 4,761	$ 38,090	$ 52,374	$ 59,516	$ 25,350,492
P-5 CCW TES Tank	$ 34,821,007	$ 4,135,569	$ 2,274,563	$ -	$ 19,915,677	$ 2,205,995	$ -	$ -	$ -	$ 122,294	$ 348,210	$ 226,337	$ 12,229	$ 97,835	$ 134,523	$ 152,867	$ 64,447,105
P-6 PHW TES Tank	$ 7,041,250	$ 865,719	$ 476,145	$ -	$ 4,970,280	$ 724,330	$ -	$ -	$ -	$ 26,707	$ 70,413	$ 45,768	$ 2,671	$ 21,365	$ 29,377	$ 33,383	$ 14,307,409
D-W1 West Campus (PHW & SWHR Piping Only)	$ 42,527,356	$ 5,117,831	$ 2,814,807	$ -	$ 24,191,552	$ 2,518,166	$ -	$ -	$ -	$ 149,303	$ 425,274	$ 276,428	$ 11,965	$ 95,721	$ 131,617	$ 150,133	$ 78,410,154
D-W2 Sewer Heat Recovery Piping	$ 4,527,518	$ 578,169	$ 317,993	$ -	$ 3,380,125	$ 518,543	$ -	$ -	$ -	$ 17,608	$ 45,275	$ 29,429	$ 1,761	$ 13,519	$ 10,751	$ 22,070	$ 9,462,761
D-N1 North Campus Piping (PHW Piping Only)	$ 31,727,410	$ 3,793,402	$ 2,086,371	$ -	$ 17,452,299	$ 2,046,386	$ -	$ -	$ -	$ 110,119	$ 317,274	$ 206,228	$ 11,012	$ 88,095	$ 121,131	$ 138,172	$ 58,097,899
D-C1 Central Campus Piping (PHW Piping Only)	$ 31,591,568	$ 3,766,185	$ 2,071,402	$ -	$ 17,001,648	$ 2,025,754	$ -	$ -	$ -	$ 108,862	$ 315,916	$ 205,345	$ 10,886	$ 87,089	$ 119,748	$ 136,594	$ 57,440,996
D-C2 Central Campus Piping West Tunnel (PHW Piping Only)	$ 28,318,526	$ 3,376,236	$ 1,856,930	$ -	$ 15,039,695	$ 1,870,574	$ -	$ -	$ -	$ 97,183	$ 283,185	$ 184,070	$ 9,718	$ 77,746	$ 106,901	$ 121,940	$ 51,342,705
D-E1 PHW Piping from PP to East and SE Campus (PHW Piping Only)	$ 23,828,412	$ 2,862,431	$ 1,574,337	$ -	$ 13,335,833	$ 1,685,182	$ -	$ -	$ -	$ 83,202	$ 238,284	$ 154,885	$ 8,303	$ 66,420	$ 91,328	$ 104,176	$ 44,032,792
D-S1 PHW Piping from WCUP to South Campus (Includes All Piping)	$ 24,928,584	$ 3,026,825	$ 1,664,754	$ -	$ 14,979,744	$ 1,783,239	$ -	$ -	$ -	$ 89,200	$ 249,286	$ 162,036	$ 9,657	$ 77,259	$ 106,232	$ 121,177	$ 47,197,992
D-S2 South of Pacific Campus Piping from PP (PHW Piping Only)	$ 22,983,154	$ 2,788,139	$ 1,533,476	$ -	$ 14,043,531	$ 1,692,300	$ -	$ -	$ -	$ 82,697	$ 229,832	$ 149,391	$ 8,405	$ 67,242	$ 92,458	$ 105,465	$ 43,776,089
S-1 Lake Interface System - 42" CCW S/R (By UW)	$ 5,810,000	$ 682,079	$ 375,143	$ -	$ 2,819,233	$ 257,527	$ 74,139	$ -	$ -	$ 19,373	$ 58,100	$ 11,620	$ 1,937	$ 15,498	$ 21,310	$ 24,308	$ 10,170,268
Decarbonization Subtotal:	**$ 581,067,188**	**$ 69,647,803**	**$ 38,306,292**	**$ -**	**$ 336,990,422**	**$ 48,713,602**	**$ 4,044,139**	**$ 101,250,000**	**$ -**	**$ 2,052,023**	**$ 5,810,672**	**$ 3,750,792**	**$ 203,093**	**$ 1,133,858**	**$ 1,551,218**	**$ 2,549,093**	**$ 1,197,070,195**
Climate Adaptation																	
AEI Renewal Costs - 2027: Replace (3) Existing Chillers & Cooling Towers	By AEI	By AEI	By AEI	$ -	By AEI	By AEI	By AEI	$ 18,540,000	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	$ 18,540,000
AEI Renewal Costs - 2029: Replace (3) Existing Chillers & Cooling Towers	By AEI	By AEI	By AEI	$ -	By AEI	By AEI	By AEI	$ 18,540,000	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	By AEI	$ 18,540,000
B-1 Chiller Replacements: Balance of Building Not Included in Decarbonization	$ 8,118,775	$ 981,256	$ 539,691	$ -	$ 5,383,911	$ 1,252,310	$ -	$ -	$ -	$ 30,047	$ 81,188	$ 52,772	$ 3,005	$ -	$ -	$ 37,894	$ 16,480,849
P-2 Add CH-8_CT-14	$ 8,404,730	$ 997,899	$ 548,845	$ -	$ 4,821,223	$ 772,914	$ -	$ -	$ -	$ 29,545	$ 84,047	$ 54,631	$ 2,955	$ 23,636	$ 32,500	$ 37,072	$ 15,809,997
P-3 WCUP CH5 & CT	$ 6,085,703	$ 724,288	$ 398,358	$ -	$ 3,608,852	$ 603,644	$ -	$ -	$ -	$ 21,634	$ 60,857	$ 39,557	$ 2,163	$ 17,308	$ 23,798	$ 27,043	$ 11,613,206
D-W1 West Campus (CCW Piping Only)	$ 9,719,052	$ 1,131,689	$ 622,429	$ -	$ 4,305,909	$ 313,991	$ -	$ -	$ -	$ 31,558	$ 97,191	$ 63,174	$ 3,156	$ 25,247	$ 34,714	$ 39,598	$ 16,387,707
D-N1 North Campus Piping (CCW Piping Only)	$ 14,265,942	$ 1,685,894	$ 927,242	$ -	$ 7,182,093	$ 549,811	$ -	$ -	$ -	$ 48,122	$ 142,659	$ 92,729	$ 4,812	$ 38,498	$ 52,935	$ 60,382	$ 25,051,119
D-C1 Central Campus Piping (CCW Piping Only)	$ 12,346,737	$ 1,459,571	$ 802,764	$ -	$ 6,233,575	$ 484,568	$ -	$ -	$ -	$ 41,685	$ 123,467	$ 80,254	$ 4,169	$ 33,348	$ 45,854	$ 52,305	$ 21,708,296
D-C2 Central Campus Piping West Tunnel (CCW Piping Only)	$ 4,724,991	$ 554,328	$ 304,880	$ -	$ 2,226,505	$ 198,870	$ -	$ -	$ -	$ 15,621	$ 47,250	$ 30,712	$ 1,562	$ 12,497	$ 17,184	$ 19,601	$ 8,154,002
D-E1 PHW Piping from PP to East and SE Campus (CCW Piping Only)	$ 8,851,322	$ 1,035,274	$ 569,401	$ -	$ 4,069,640	$ 381,433	$ -	$ -	$ -	$ 29,051	$ 88,513	$ 57,534	$ 2,905	$ 23,241	$ 31,956	$ 36,452	$ 15,176,722
D-S2 South of Pacific Campus Piping from PP (CCW Piping Only)	$ 5,769,795	$ 691,597	$ 380,378	$ -	$ 3,243,475	$ 278,538	$ -	$ -	$ -	$ 20,170	$ 57,698	$ 37,504	$ 2,017	$ 16,136	$ 22,188	$ 25,309	$ 10,544,806
Climate Adaptation Subtotal:	**$ 78,287,047**	**$ 9,261,796**	**$ 5,093,988**	**$ -**	**$ 41,075,184**	**$ 4,836,079**	**$ -**	**$ 37,080,000**	**$ -**	**$ 267,436**	**$ 782,870**	**$ 508,866**	**$ 26,744**	**$ 189,911**	**$ 261,128**	**$ 335,655**	**$ 178,006,704**
Electrical																	
E-1 UW Substation - UW Costs	$ 15,733,457	$ 1,870,792	$ 1,028,936	$ -	$ 7,931,640	$ 647,237	$ -	$ -	$ -	$ 53,130	$ 157,335	$ 31,467	$ 5,313	$ 25,174	$ 34,614	$ 66,562	$ 27,585,654
E-1 UW Substation - SCL Costs	$ 79,226,076	$ 9,420,404	$ 5,181,222	$ -	$ 39,939,903	$ 3,259,172	$ -	$ -	$ -	$ 267,535	$ 792,261	$ 158,452	$ 26,754	$ 126,762	$ 174,297	$ 335,172	$ 138,908,010
E-2 PP Ring Bus & Express Feeders	$ 6,791,270	$ 899,784	$ 494,881	$ -	$ 5,608,746	$ 753,632	$ -	$ -	$ -	$ 27,589	$ 137,947	$ 27,589	$ 2,759	$ 10,866	$ 14,941	$ 34,551	$ 14,804,555
P-13 WCUP Generators	$ 2,967,460	$ 360,865	$ 198,476	$ -	$ 2,213,189	$ 362,456	$ -	$ -	$ -	$ 11,480	$ 29,675	$ 19,288	$ 1,148	$ 9,184	$ 12,628	$ 14,350	$ 6,200,199
B-7 Building Controls Upgrades (EXCLUDED)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Electrical Subtotal:	**$ 104,718,262**	**$ 12,551,846**	**$ 6,903,515**	**$ -**	**$ 55,693,478**	**$ 5,022,497**	**$ -**	**$ -**	**$ -**	**$ 359,734**	**$ 1,117,217**	**$ 236,797**	**$ 35,973**	**$ 171,985**	**$ 236,480**	**$ 450,634**	**$ 187,498,418**
Partner Costs (P3)																	
S-1 Lake Interface System - P3 Partner Costs	$ 72,555,828	$ 8,517,862	$ 4,684,824	$ -	$ 35,206,846	$ 3,216,025	$ 925,861	$ -	$ -	$ 241,931	$ 725,558	$ 145,112	$ 24,193	$ 193,545	$ 266,124	$ 303,563	$ 127,007,271
S-2 Sewer Heat Recovery Equipment Bldg	$ 27,115,396	$ 3,242,325	$ 1,783,279	$ -	$ 15,594,902	$ 1,861,837	$ -	$ -	$ 3,001,500	$ 95,472	$ 271,154	$ 54,231	$ 9,547	$ 76,377	$ 105,019	$ 119,793	$ 53,330,831
Partner Costs (P3) Subtotal:	**$ 99,671,224**	**$ 11,760,187**	**$ 6,468,103**	**$ -**	**$ 50,801,748**	**$ 5,077,862**	**$ 925,861**	**$ -**	**$ 3,001,500**	**$ 337,403**	**$ 996,712**	**$ 199,342**	**$ 33,740**	**$ 269,922**	**$ 371,143**	**$ 423,356**	**$ 180,338,102**
UW ERP Project Cost Total:	**$ 863,743,721**	**$ 103,221,631**	**$ 56,771,897**	**$ -**	**$ 484,560,832**	**$ 63,650,040**	**$ 4,970,000**	**$ 138,330,000**	**$ 3,001,500**	**$ 3,016,596**	**$ 8,707,471**	**$ 4,695,797**	**$ 299,550**	**$ 1,765,676**	**$ 2,419,969**	**$ 3,758,738**	**$ 1,742,913,419**

10.4 Project Preliminary Milestone Schedules

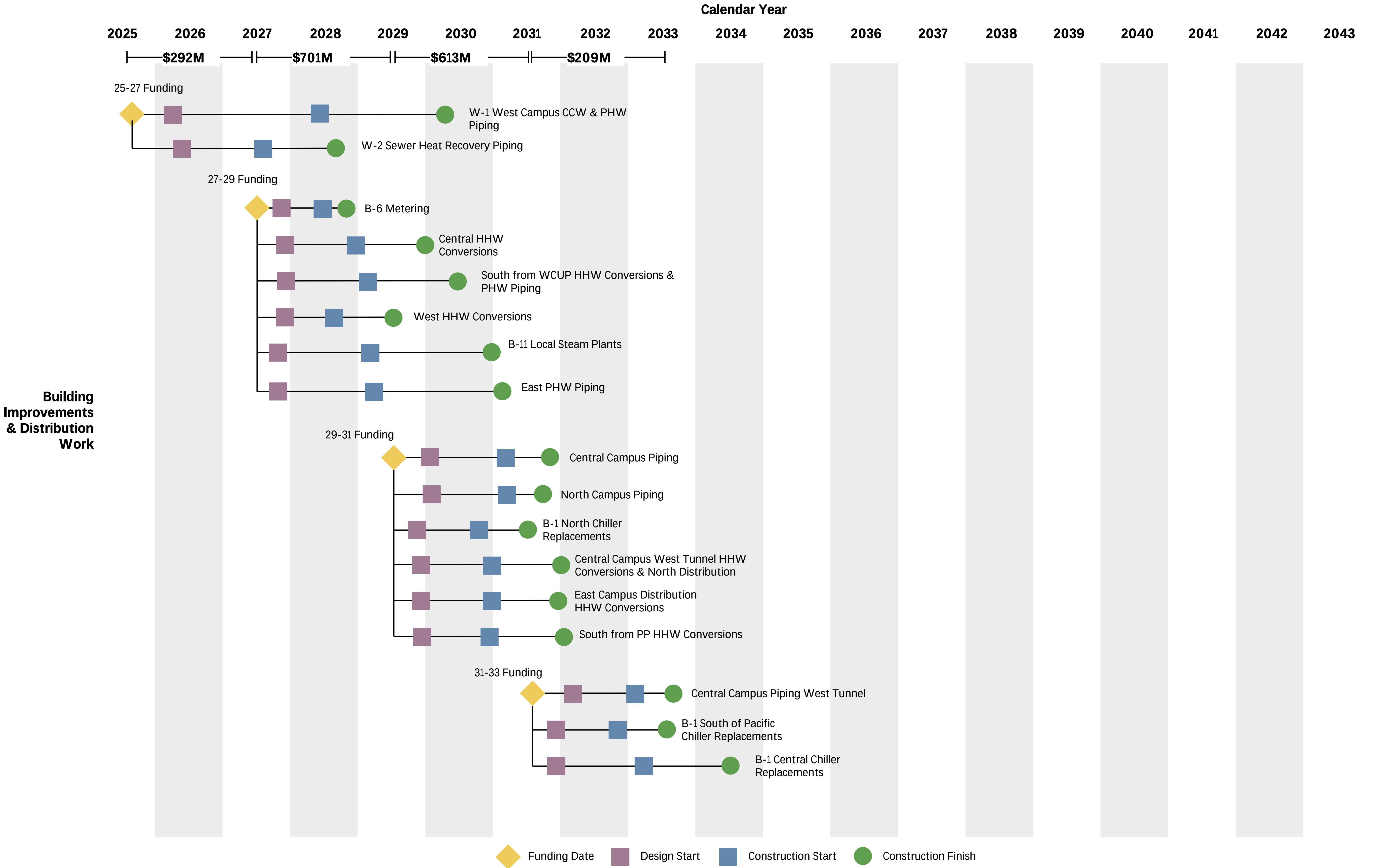
10.4.1 Project Sequence Diagrams

The following project sequence diagrams provide a high-level view of the potential funding, design, and construction timelines for each of the four scenarios studied for this report (as described in Section 3.0 Implementation Plan).

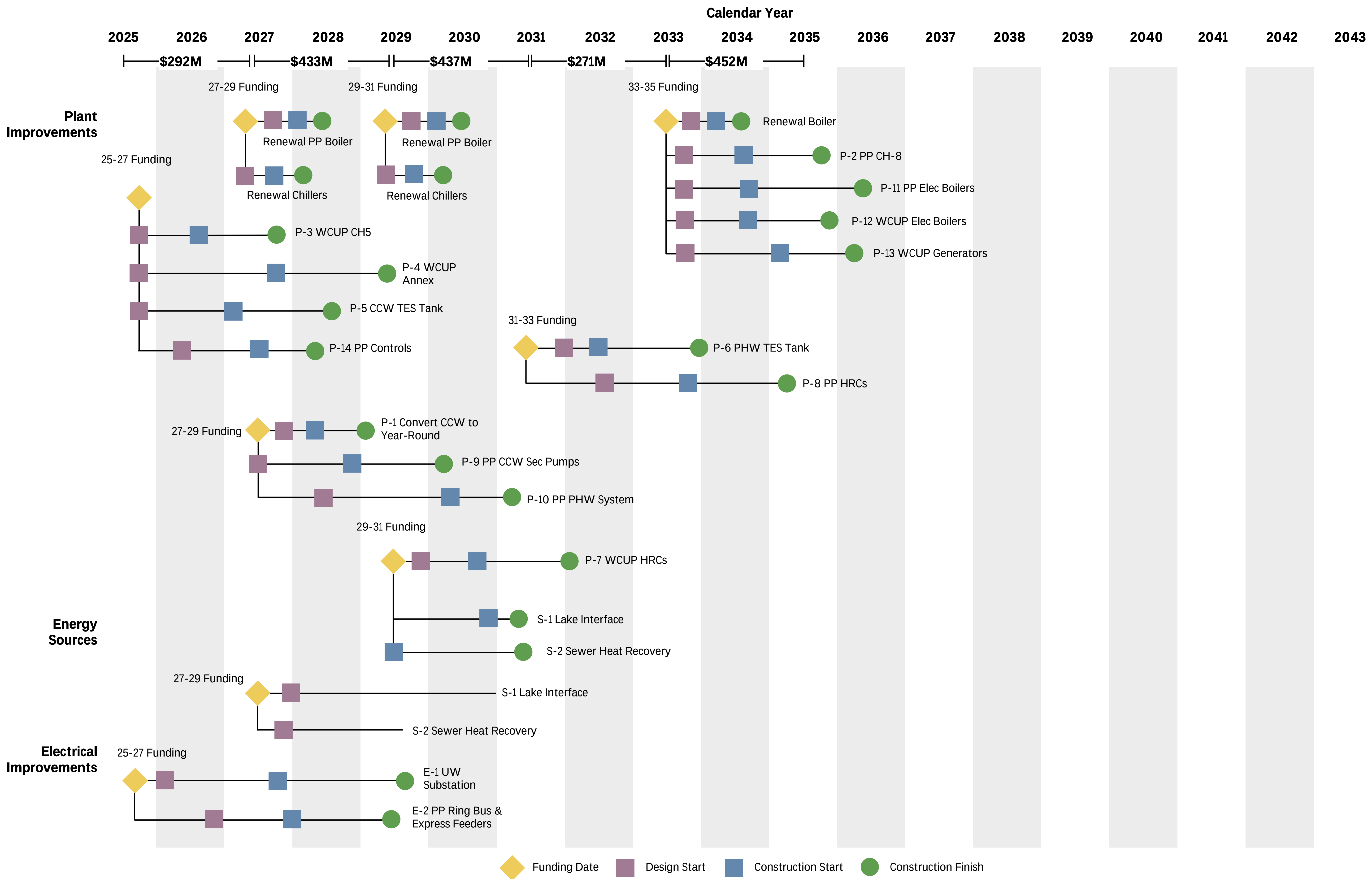
Appendix 10.4.1 - Project Sequence Diagrams: Funding Scenario 1 - 4 Biennia



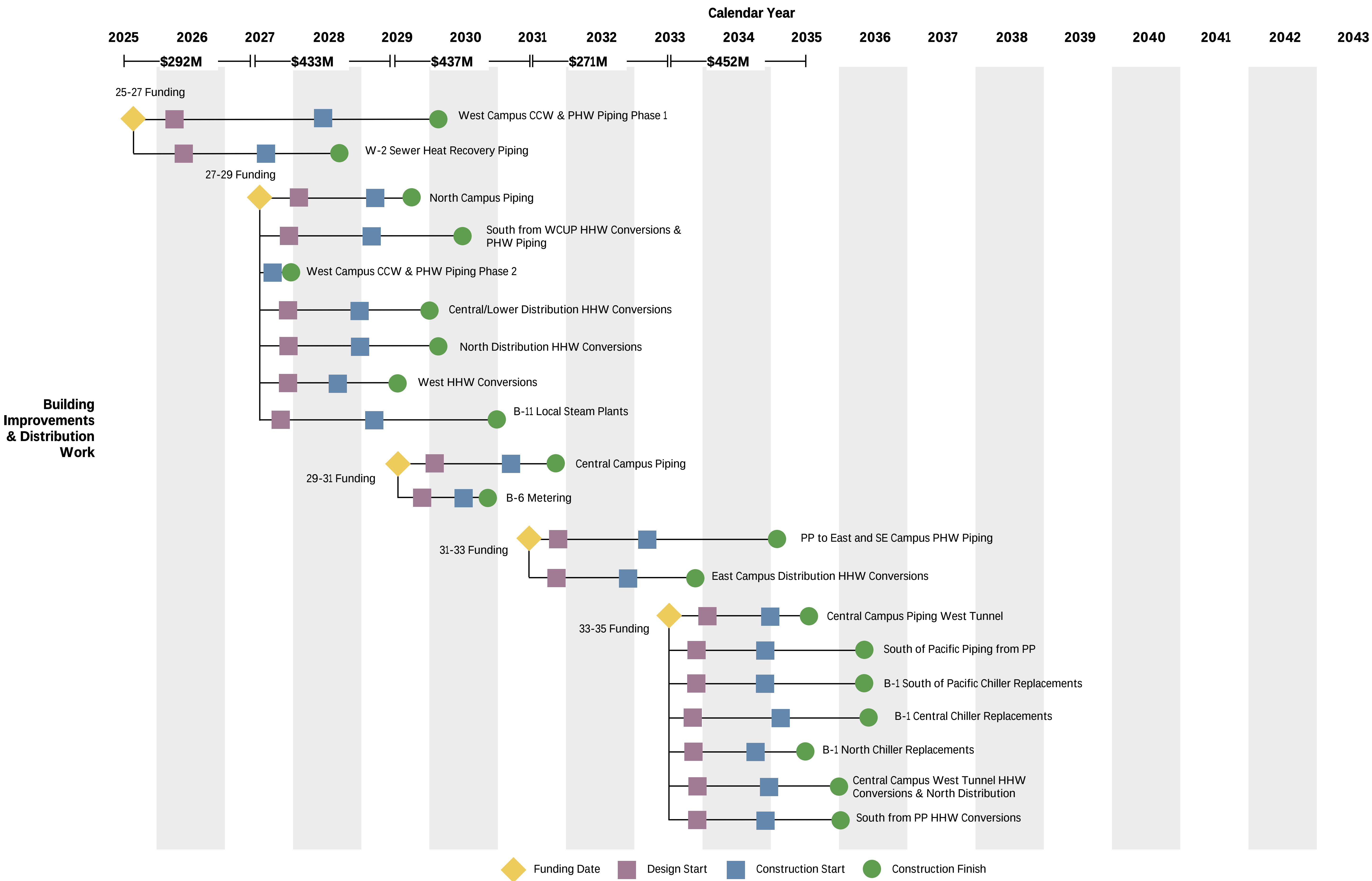
Appendix 10.4.1 - Project Sequence Diagrams: Funding Scenario 1 - 4 Biennia



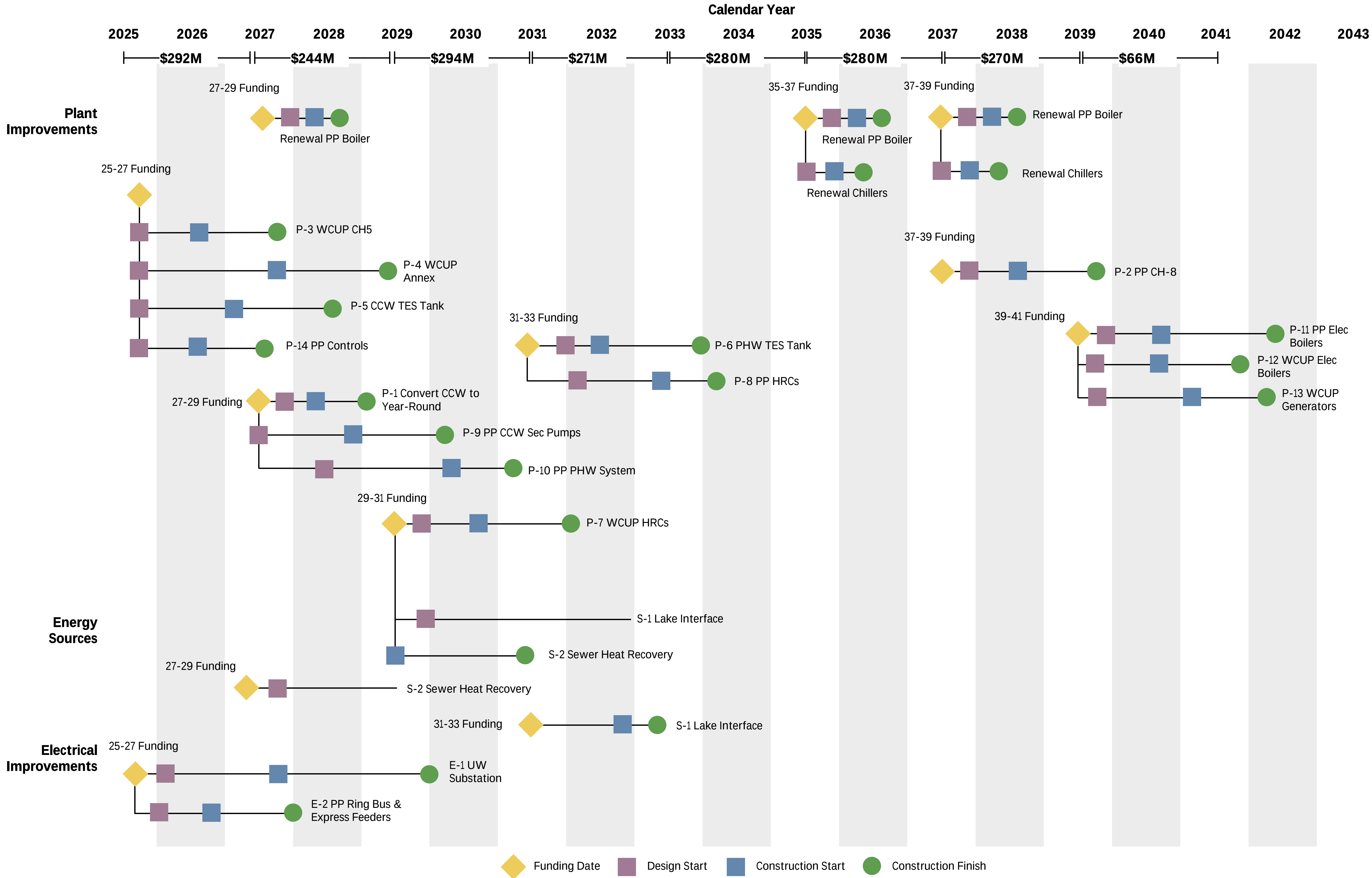
Appendix 10.4.1 - Project Sequence Diagrams: Funding Scenario 2 - 5 Biennia



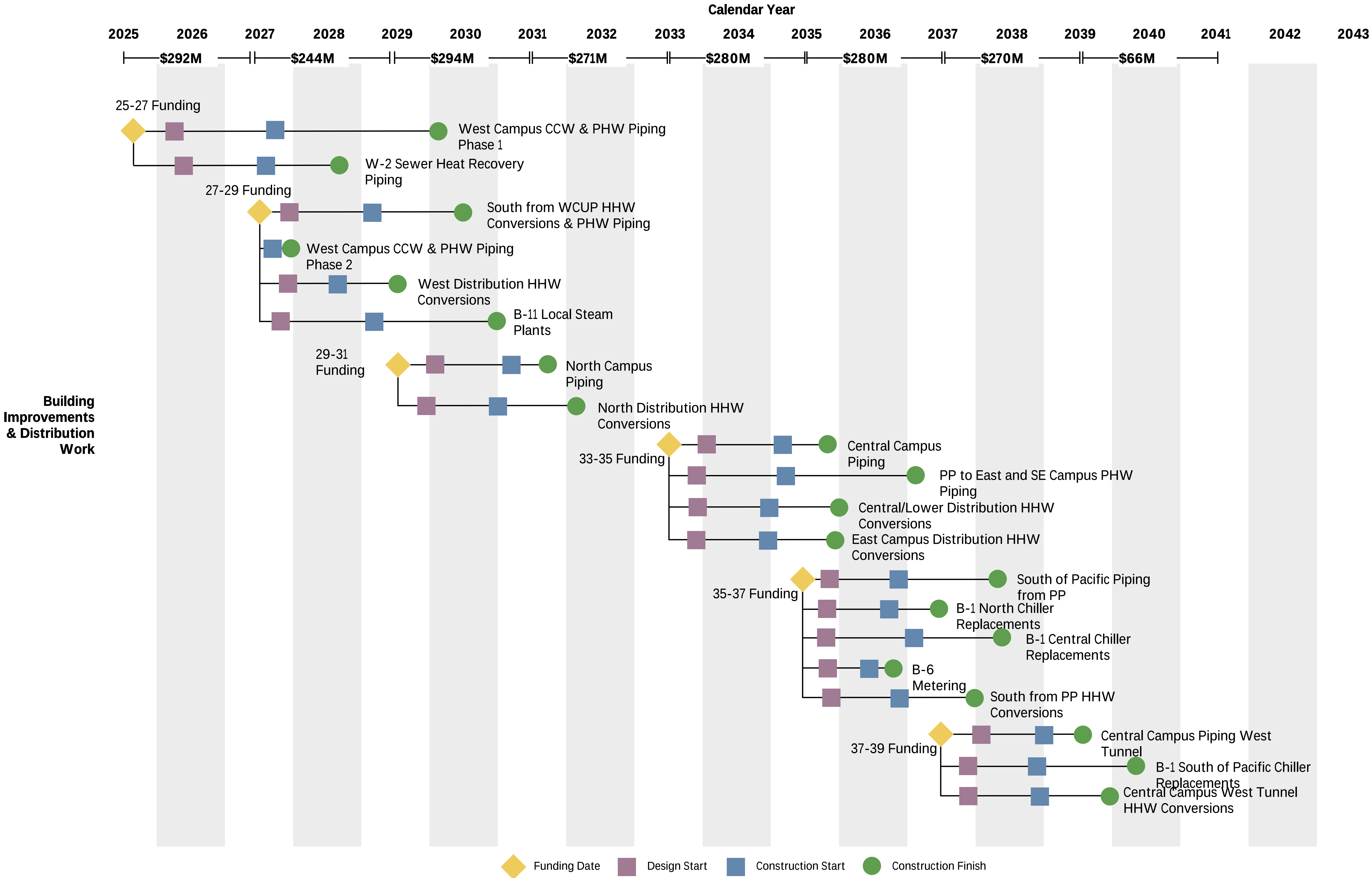
Appendix 10.4.1 - Project Sequence Diagrams: Funding Scenario 2 - 5 Biennia



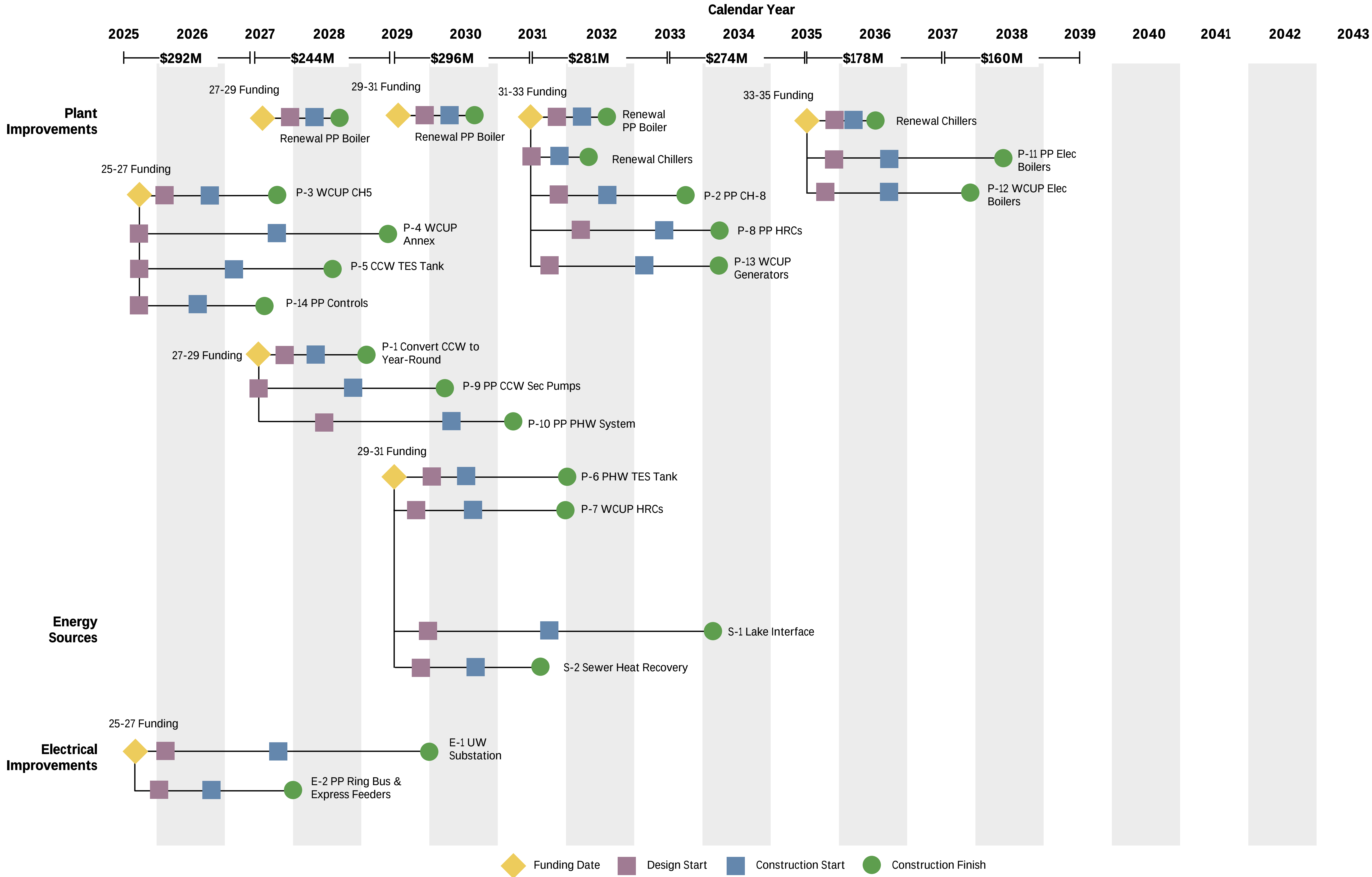
Appendix 10.4.1 - Project Sequence Diagrams: Funding Scenario 3 - 8 Biennia



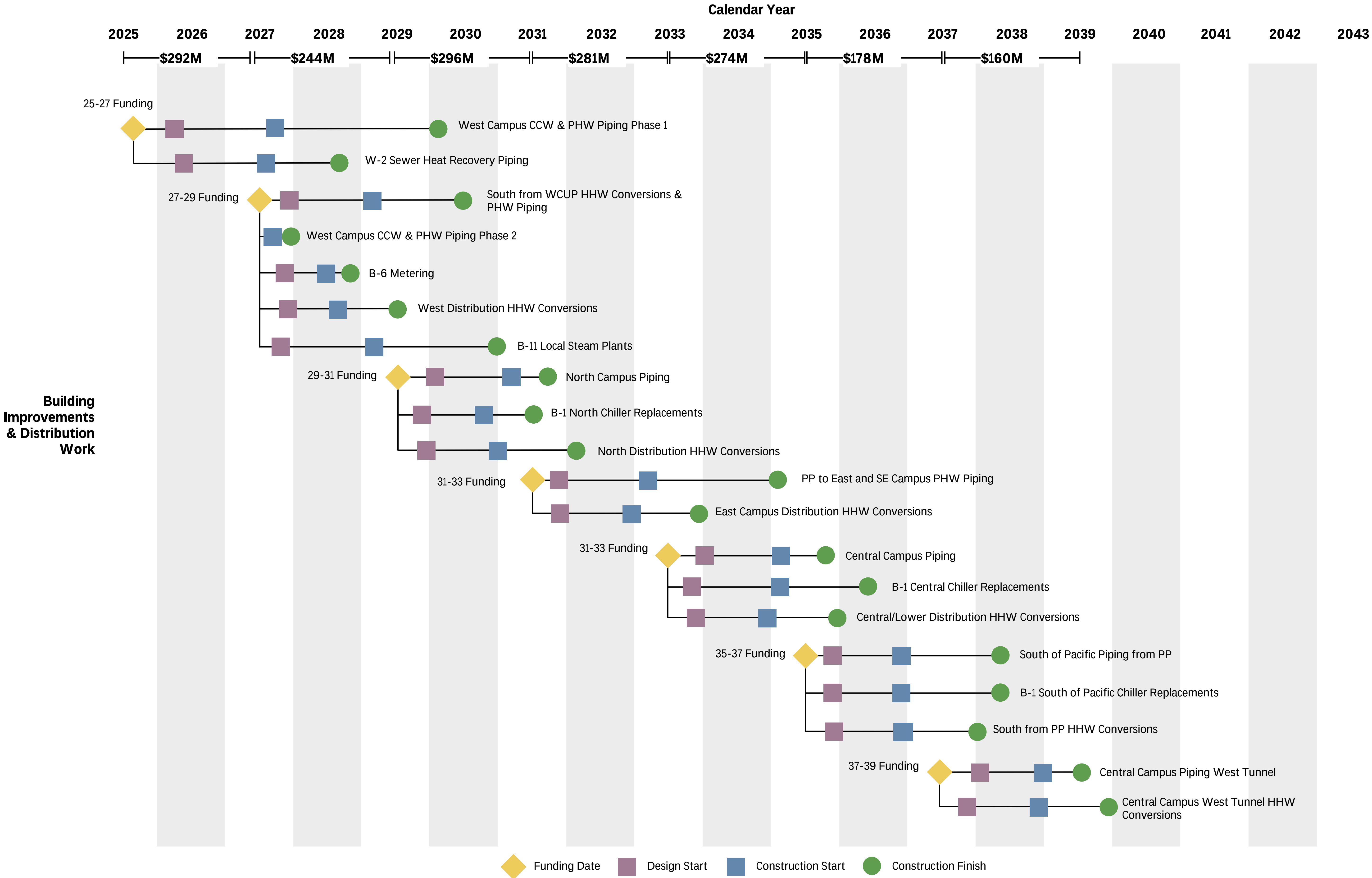
Appendix 10.4.1 - Project Sequence Diagrams: Funding Scenario 3 - 8 Biennia



Appendix 10.4.1 - Project Sequence Diagrams: Funding Scenario 4 - 7 Biennia (P3)



Appendix 10.4.1 - Project Sequence Diagrams: Funding Scenario 4 - 7 Biennia (P3)



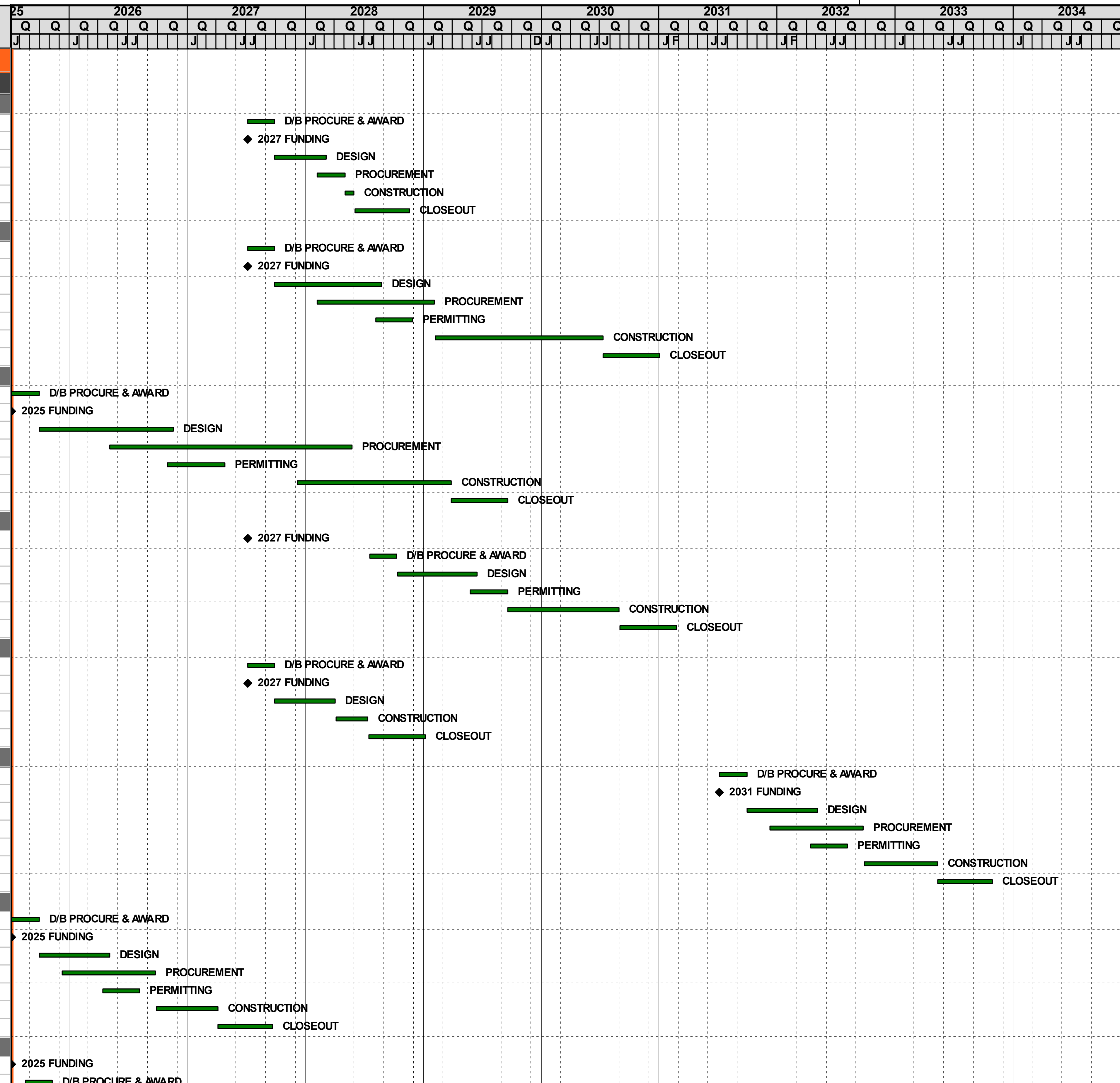
10.4.2 Project Preliminary Milestone Schedules

The following milestone summary schedule reflects a potential schedule associated with Scenario 1 and has been revised since the Phase II Project Identification Report. Detailed summary schedules are not provided for the other scenarios and will be developed by the University once one of the scenarios is chosen. Refer to Phase II report for detailed milestone schedules for individual projects.

UW - Energy Renewal Program (ERP) Phase 3 Submission
Summary Schedule

Data Date: 07-Jul-25
Print Date: 24-Sep-24
Page 1 of 6

Activity ID	Activity Name	Orig Dur	Start	Finish
UW - Energy Renewal Program (ERP) Phase 3 Submission		2350d	07-Jul-25	11-Oct-34
SUMMARY		2350d	07-Jul-25	11-Oct-34
B-6 COMPREHENSIVE METERING PROGRAM		350d	06-Jul-27	20-Nov-28
B6CMP.SUM-1540	D/B PROCURE & AWARD	60d	06-Jul-27	28-Sep-27
B6CMP.SUM-1610	2027 FUNDING	0d	06-Jul-27*	
B6CMP.SUM-1550	DESIGN	110d	29-Sep-27	07-Mar-28
B6CMP.SUM-1560	PROCUREMENT	60d	09-Feb-28	03-May-28
B6CMP.SUM-1580	CONSTRUCTION	20d	04-May-28	01-Jun-28
B6CMP.SUM-1590	CLOSEOUT	120d	02-Jun-28	20-Nov-28
B-11 LOCAL SATELITE STEAM PLANT FOR PROCESS LOADS		880d	06-Jul-27	02-Jan-31
B11LSSP.SUM-1840	D/B PROCURE & AWARD	60d	06-Jul-27	28-Sep-27
B11LSSP.SUM-1920	2027 FUNDING	0d	06-Jul-27*	
B11LSSP.SUM-1850	DESIGN	230d	29-Sep-27	25-Aug-28
B11LSSP.SUM-1860	PROCUREMENT	250d	09-Feb-28	05-Feb-29
B11LSSP.SUM-1870	PERMITTING	80d	07-Aug-28	29-Nov-28
B11LSSP.SUM-1880	CONSTRUCTION	360d	06-Feb-29	10-Jul-30
B11LSSP.SUM-1890	CLOSEOUT	120d	11-Jul-30	02-Jan-31
E-1 UW SUBSTATION		1060d	07-Jul-25	18-Sep-29
E1UWSUB.SUM-1900	D/B PROCURE & AWARD	60d	07-Jul-25	29-Sep-25
E1UWSUB.SUM-1980	2025 FUNDING	0d	07-Jul-25	
E1UWSUB.SUM-1910	DESIGN	290d	30-Sep-25	20-Nov-26
E1UWSUB.SUM-1920	PROCUREMENT	520d	06-May-26	26-May-28
E1UWSUB.SUM-1930	PERMITTING	120d	02-Nov-26	26-Apr-27
E1UWSUB.SUM-1940	CONSTRUCTION	330d	07-Dec-27	28-Mar-29
E1UWSUB.SUM-1950	CLOSEOUT	120d	29-Mar-29	18-Sep-29
E-2 PP RING BUS & EXPRESS FEEDERS		917d	06-Jul-27	24-Feb-31
E2FEEDERS.SUM-2030	2027 FUNDING	0d	06-Jul-27*	
E2FEEDERS.SUM-1960	D/B PROCURE & AWARD	60d	19-Jul-28	11-Oct-28
E2FEEDERS.SUM-1970	DESIGN	170d	12-Oct-28	15-Jun-29
E2FEEDERS.SUM-1990	PERMITTING	80d	25-May-29	18-Sep-29
E2FEEDERS.SUM-2000	CONSTRUCTION	240d	19-Sep-29	30-Aug-30
E2FEEDERS.SUM-2010	CLOSEOUT	120d	03-Sep-30	24-Feb-31
P-1 CONVERT CCW TO YEAR-ROUND OPERATION		380d	06-Jul-27	08-Jan-29
P1CCWYROP.SUM-2080	D/B PROCURE & AWARD	60d	06-Jul-27	28-Sep-27
P1CCWYROP.SUM-2140	2027 FUNDING	0d	06-Jul-27*	
P1CCWYROP.SUM-2090	DESIGN	130d	29-Sep-27	04-Apr-28
P1CCWYROP.SUM-2120	CONSTRUCTION	70d	05-Apr-28	14-Jul-28
P1CCWYROP.SUM-2130	CLOSEOUT	120d	17-Jul-28	08-Jan-29
P-2 ADD CH-8_CT-8		590d	07-Jul-31	27-Oct-33
P2CH8_CT8.SUM-2140	D/B PROCURE & AWARD	60d	07-Jul-31	29-Sep-31
P2CH8_CT8.SUM-2220	2031 FUNDING	0d	07-Jul-31*	
P2CH8_CT8.SUM-2150	DESIGN	150d	30-Sep-31	04-May-32
P2CH8_CT8.SUM-2160	PROCUREMENT	200d	11-Dec-31	24-Sep-32
P2CH8_CT8.SUM-2170	PERMITTING	80d	14-Apr-32	05-Aug-32
P2CH8_CT8.SUM-2180	CONSTRUCTION	160d	27-Sep-32	12-May-33
P2CH8_CT8.SUM-2190	CLOSEOUT	120d	13-May-33	27-Oct-33
P-3 WCUP CH5 & CT		560d	07-Jul-25	23-Sep-27
P3WCUPCH5.SUM-2200	D/B PROCURE & AWARD	60d	07-Jul-25	29-Sep-25
P3WCUPCH5.SUM-2280	2025 FUNDING	0d	07-Jul-25	
P3WCUPCH5.SUM-2210	DESIGN	150d	30-Sep-25	05-May-26
P3WCUPCH5.SUM-2220	PROCUREMENT	200d	11-Dec-25	25-Sep-26
P3WCUPCH5.SUM-2230	PERMITTING	80d	15-Apr-26	06-Aug-26
P3WCUPCH5.SUM-2240	CONSTRUCTION	130d	28-Sep-26	05-Apr-27
P3WCUPCH5.SUM-2250	CLOSEOUT	120d	06-Apr-27	23-Sep-27
P-4 WCUP ANNEX		1000d	07-Jul-25	22-Jun-29
P4WCUPANX.SUM-2340	2025 FUNDING	0d	07-Jul-25	
P4WCUPANX.SUM-2260	D/B PROCURE & AWARD	60d	18-Aug-25	10-Nov-25



UW - Energy Renewal Program (ERP) Phase 3 Submission
Summary Schedule

Data Date: 07-Jul-25
Print Date: 24-Sep-24

Activity ID	Activity Name	Orig Dur	Start	Finish
P4WCUPANX.SUM-2270	DESIGN	370d	11-Nov-25	03-May-27
P4WCUPANX.SUM-2280	PROCUREMENT	230d	26-Oct-26	23-Sep-27
P4WCUPANX.SUM-2290	PERMITTING	150d	04-May-27	06-Dec-27
P4WCUPANX.SUM-2300	CONSTRUCTION	270d	07-Dec-27	03-Jan-29
P4WCUPANX.SUM-2310	CLOSEOUT	120d	04-Jan-29	22-Jun-29
P-5 CCW TES TANK		**855d**	**07-Jul-25**	**22-Nov-28**
P5CCWTESTK.SUM-2400	2025 FUNDING	0d	07-Jul-25	
P5CCWTESTK.SUM-2320	D/B PROCURE & AWARD	60d	07-Oct-25	05-Jan-26
P5CCWTESTK.SUM-2330	DESIGN	210d	06-Jan-26	30-Oct-26
P5CCWTESTK.SUM-2340	PROCUREMENT	170d	21-Aug-26	26-Apr-27
P5CCWTESTK.SUM-2350	PERMITTING	80d	12-Oct-26	05-Feb-27
P5CCWTESTK.SUM-2360	CONSTRUCTION	335d	08-Feb-27	05-Jun-28
P5CCWTESTK.SUM-2370	CLOSEOUT	120d	06-Jun-28	22-Nov-28
P-6 PHW TES TANK		**640d**	**02-Jul-29**	**16-Jan-32**
P6PHWTESTK.SUM-2380	D/B PROCURE & AWARD	60d	02-Jul-29	25-Sep-29
P6PHWTESTK.SUM-2460	2029 FUNDING	0d	02-Jul-29*	
P6PHWTESTK.SUM-2390	DESIGN	170d	26-Sep-29	30-May-30
P6PHWTESTK.SUM-2400	PROCUREMENT	170d	20-Feb-30	21-Oct-30
P6PHWTESTK.SUM-2410	PERMITTING	80d	23-May-30	16-Sep-30
P6PHWTESTK.SUM-2420	CONSTRUCTION	190d	22-Oct-30	24-Jul-31
P6PHWTESTK.SUM-2430	CLOSEOUT	120d	25-Jul-31	16-Jan-32
P-7 WCUP HRCS AND COOLING TOWER		**650d**	**02-Jul-29**	**30-Jan-32**
P7WCUPHRCS.SUM-2440	D/B PROCURE & AWARD	60d	02-Jul-29	25-Sep-29
P7WCUPHRCS.SUM-2520	2029 FUNDING	0d	02-Jul-29*	
P7WCUPHRCS.SUM-2450	DESIGN	110d	26-Sep-29	05-Mar-30
P7WCUPHRCS.SUM-2460	PROCUREMENT	200d	21-Nov-29	09-Sep-30
P7WCUPHRCS.SUM-2470	PERMITTING	80d	27-Feb-30	20-Jun-30
P7WCUPHRCS.SUM-2480	CONSTRUCTION	230d	10-Sep-30	07-Aug-31
P7WCUPHRCS.SUM-2490	CLOSEOUT	120d	08-Aug-31	30-Jan-32
P-8 POWER PLANT HEAT RECOVERY CHILLERS		**907d**	**06-Jul-27**	**10-Feb-31**
P8PPHRC.SUM-2580	2027 FUNDING	0d	06-Jul-27*	
P8PPHRC.SUM-2500	D/B PROCURE & AWARD	60d	13-Jun-28	06-Sep-28
P8PPHRC.SUM-2510	DESIGN	170d	07-Sep-28	10-May-29
P8PPHRC.SUM-2520	PROCUREMENT	200d	04-Dec-28	18-Sep-29
P8PPHRC.SUM-2530	PERMITTING	80d	20-Apr-29	13-Aug-29
P8PPHRC.SUM-2540	CONSTRUCTION	230d	19-Sep-29	16-Aug-30
P8PPHRC.SUM-2550	CLOSEOUT	120d	19-Aug-30	10-Feb-31
P-9 CCW HEADER AND SECONDARY PUMPING SYSTEM		**740d**	**07-Jul-25**	**12-Jun-28**
P9CCWHEAD.SUM-2560	D/B PROCURE & AWARD	60d	07-Jul-25	29-Sep-25
P9CCWHEAD.SUM-2640	2025 FUNDING	0d	07-Jul-25	
P9CCWHEAD.SUM-2570	DESIGN	230d	30-Sep-25	27-Aug-26
P9CCWHEAD.SUM-2580	PROCUREMENT	200d	22-Apr-26	05-Feb-27
P9CCWHEAD.SUM-2590	PERMITTING	80d	07-Aug-26	01-Dec-26
P9CCWHEAD.SUM-2600	CONSTRUCTION	220d	08-Feb-27	20-Dec-27
P9CCWHEAD.SUM-2610	CLOSEOUT	120d	21-Dec-27	12-Jun-28
P-10 POWER PLANT PHW SYSTEM		**887d**	**06-Jul-27**	**13-Jan-31**
P10PPPHW.SUM-2700	2027 FUNDING	0d	06-Jul-27*	
P10PPPHW.SUM-2620	D/B PROCURE & AWARD	60d	13-Jun-28	06-Sep-28
P10PPPHW.SUM-2630	DESIGN	230d	07-Sep-28	06-Aug-29
P10PPPHW.SUM-2640	PROCUREMENT	200d	29-Mar-29	15-Jan-30
P10PPPHW.SUM-2650	PERMITTING	80d	17-Jul-29	06-Nov-29
P10PPPHW.SUM-2660	CONSTRUCTION	130d	16-Jan-30	19-Jul-30
P10PPPHW.SUM-2670	CLOSEOUT	120d	22-Jul-30	13-Jan-31
P-11 PP ELECTRIC BOILERS + EMERG GEN HEAT RECOVERY		**690d**	**07-Jul-31**	**16-Mar-34**
P11PPBOIL.SUM-2680	D/B PROCURE & AWARD	60d	07-Jul-31	29-Sep-31
P11PPBOIL.SUM-2760	2031 FUNDING	0d	07-Jul-31*	
P11PPBOIL.SUM-2690	DESIGN	170d	30-Sep-31	02-Jun-32

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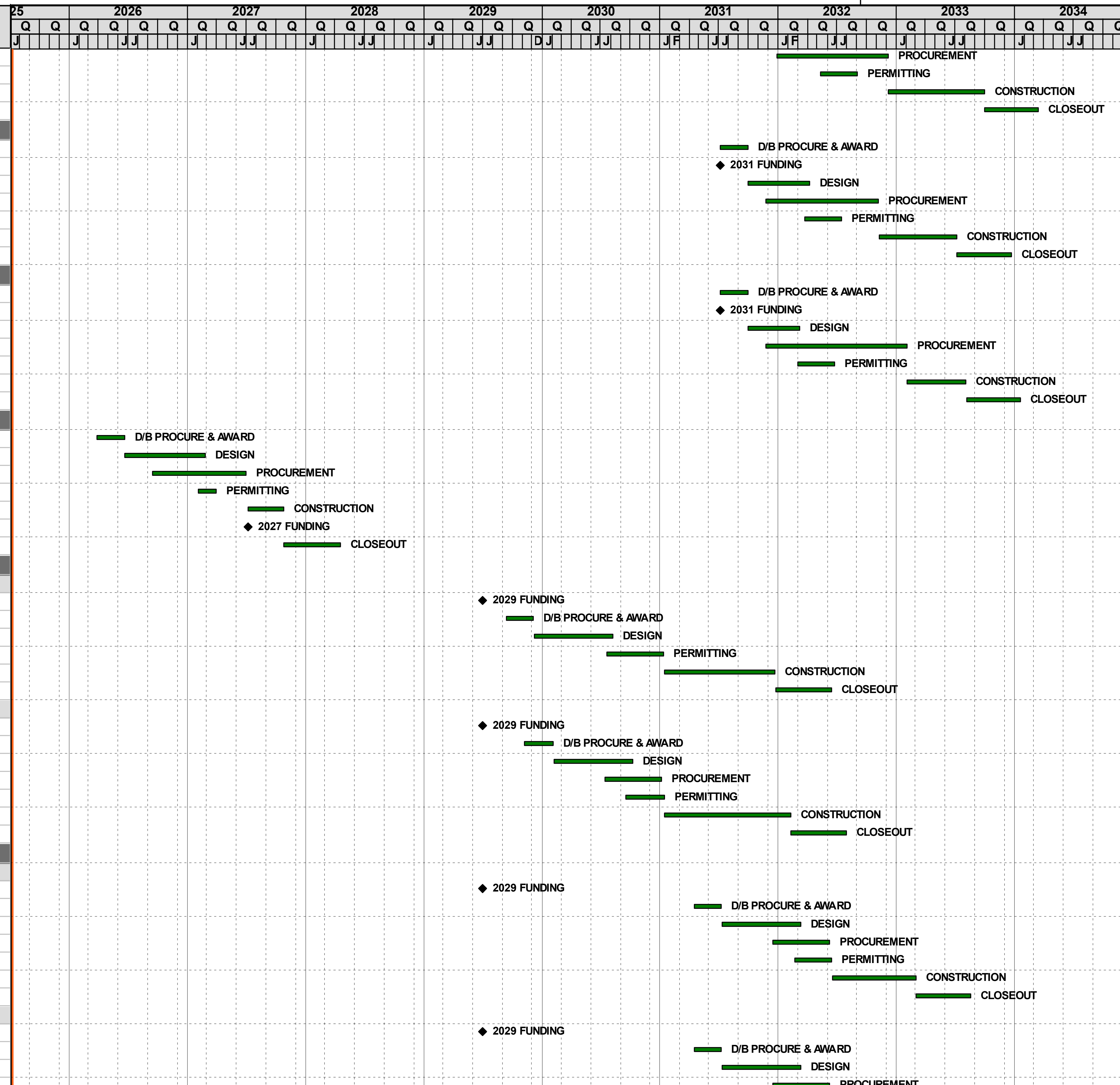
P11PPBOIL.SUM-2700	PROCUREMENT	240d	29-Dec-31	07-Dec-32
P11PPBOIL.SUM-2710	PERMITTING	80d	12-May-32	02-Sep-32
P11PPBOIL.SUM-2720	CONSTRUCTION	210d	08-Dec-32	29-Sep-33
P11PPBOIL.SUM-2730	CLOSEOUT	120d	30-Sep-33	16-Mar-34
P-12 WCUP ELECTRIC BOILERS		630d	07-Jul-31	22-Dec-33
P12CUPBOIL.SUM-2740	D/B PROCURE & AWARD	60d	07-Jul-31	29-Sep-31
P12CUPBOIL.SUM-2820	2031 FUNDING	0d	07-Jul-31*	
P12CUPBOIL.SUM-2750	DESIGN	130d	30-Sep-31	06-Apr-32
P12CUPBOIL.SUM-2760	PROCUREMENT	240d	25-Nov-31	05-Nov-32
P12CUPBOIL.SUM-2770	PERMITTING	80d	23-Mar-32	15-Jul-32
P12CUPBOIL.SUM-2780	CONSTRUCTION	170d	08-Nov-32	07-Jul-33
P12CUPBOIL.SUM-2790	CLOSEOUT	120d	08-Jul-33	22-Dec-33
P-13 WCUP GENERATORS		650d	07-Jul-31	19-Jan-34
P13WCUPGEN.SUM-2800	D/B PROCURE & AWARD	60d	07-Jul-31	29-Sep-31
P13WCUPGEN.SUM-2880	2031 FUNDING	0d	07-Jul-31*	
P13WCUPGEN.SUM-2810	DESIGN	110d	30-Sep-31	08-Mar-32
P13WCUPGEN.SUM-2820	PROCUREMENT	300d	25-Nov-31	03-Feb-33
P13WCUPGEN.SUM-2830	PERMITTING	80d	02-Mar-32	23-Jun-32
P13WCUPGEN.SUM-2840	CONSTRUCTION	130d	04-Feb-33	04-Aug-33
P13WCUPGEN.SUM-2850	CLOSEOUT	120d	05-Aug-33	19-Jan-34
P-14 PP CONTROLS UPGRADES		520d	27-Mar-26	19-Apr-28
P14PPCTUP.SUM-2860	D/B PROCURE & AWARD	60d	27-Mar-26	22-Jun-26
P14PPCTUP.SUM-2870	DESIGN	170d	23-Jun-26	24-Feb-27
P14PPCTUP.SUM-2880	PROCUREMENT	200d	17-Sep-26	02-Jul-27
P14PPCTUP.SUM-2890	PERMITTING	40d	04-Feb-27	01-Apr-27
P14PPCTUP.SUM-2900	CONSTRUCTION	80d	06-Jul-27	26-Oct-27
P14PPCTUP.SUM-2940	2027 FUNDING	0d	06-Jul-27*	
P14PPCTUP.SUM-2910	CLOSEOUT	120d	27-Oct-27	19-Apr-28
D-C-1 CENTRAL CAMPUS PIPING		776d	02-Jul-29	29-Jul-32
DISTRIBUTION		745d	02-Jul-29	15-Jun-32
DC1CCP.SUM-2990	2029 FUNDING	0d	02-Jul-29*	
DC1CCP.SUM-2920	D/B PROCURE & AWARD	60d	12-Sep-29	06-Dec-29
DC1CCP.SUM-2930	DESIGN	170d	07-Dec-29	09-Aug-30
DC1CCP.SUM-2950	PERMITTING	120d	22-Jul-30	13-Jan-31
DC1CCP.SUM-2960	CONSTRUCTION	240d	14-Jan-31	23-Dec-31
DC1CCP.SUM-2970	CLOSEOUT	120d	24-Dec-31	15-Jun-32
BUILDING HHW CONVERSIONS		776d	02-Jul-29	29-Jul-32
DC1CCP.SUM-3250	2029 FUNDING	0d	02-Jul-29*	
DC1CCP.SUM-3260	D/B PROCURE & AWARD	60d	08-Nov-29	06-Feb-30
DC1CCP.SUM-3280	DESIGN	170d	07-Feb-30	08-Oct-30
DC1CCP.SUM-3290	PROCUREMENT	120d	16-Jul-30	07-Jan-31
DC1CCP.SUM-3300	PERMITTING	80d	18-Sep-30	14-Jan-31
DC1CCP.SUM-3310	CONSTRUCTION	270d	15-Jan-31	09-Feb-32
DC1CCP.SUM-3330	CLOSEOUT	120d	10-Feb-32	29-Jul-32
D-C-2 CENTRAL CAMPUS PIPING WEST TUNNEL		1245d	02-Jul-29	24-May-34
DISTRIBUTION		1045d	02-Jul-29	17-Aug-33
DC2CCPWT.SUM-3050	2029 FUNDING	0d	02-Jul-29*	
DC2CCPWT.SUM-2980	D/B PROCURE & AWARD	60d	16-Apr-31	10-Jul-31
DC2CCPWT.SUM-2990	DESIGN	170d	11-Jul-31	12-Mar-32
DC2CCPWT.SUM-3140	PROCUREMENT	120d	17-Dec-31	08-Jun-32
DC2CCPWT.SUM-3010	PERMITTING	80d	23-Feb-32	15-Jun-32
DC2CCPWT.SUM-3020	CONSTRUCTION	180d	16-Jun-32	02-Mar-33
DC2CCPWT.SUM-3030	CLOSEOUT	120d	03-Mar-33	17-Aug-33
BUILDING HHW CONVERSIONS		1100d	02-Jul-29	02-Nov-33
DC2CCPWT.SUM-3060	2029 FUNDING	0d	02-Jul-29*	
DC2CCPWT.SUM-3070	D/B PROCURE & AWARD	60d	16-Apr-31	10-Jul-31
DC2CCPWT.SUM-3090	DESIGN	170d	11-Jul-31	12-Mar-32
DC2CCPWT.SUM-3150	PROCUREMENT	120d	17-Dec-31	08-Jun-32



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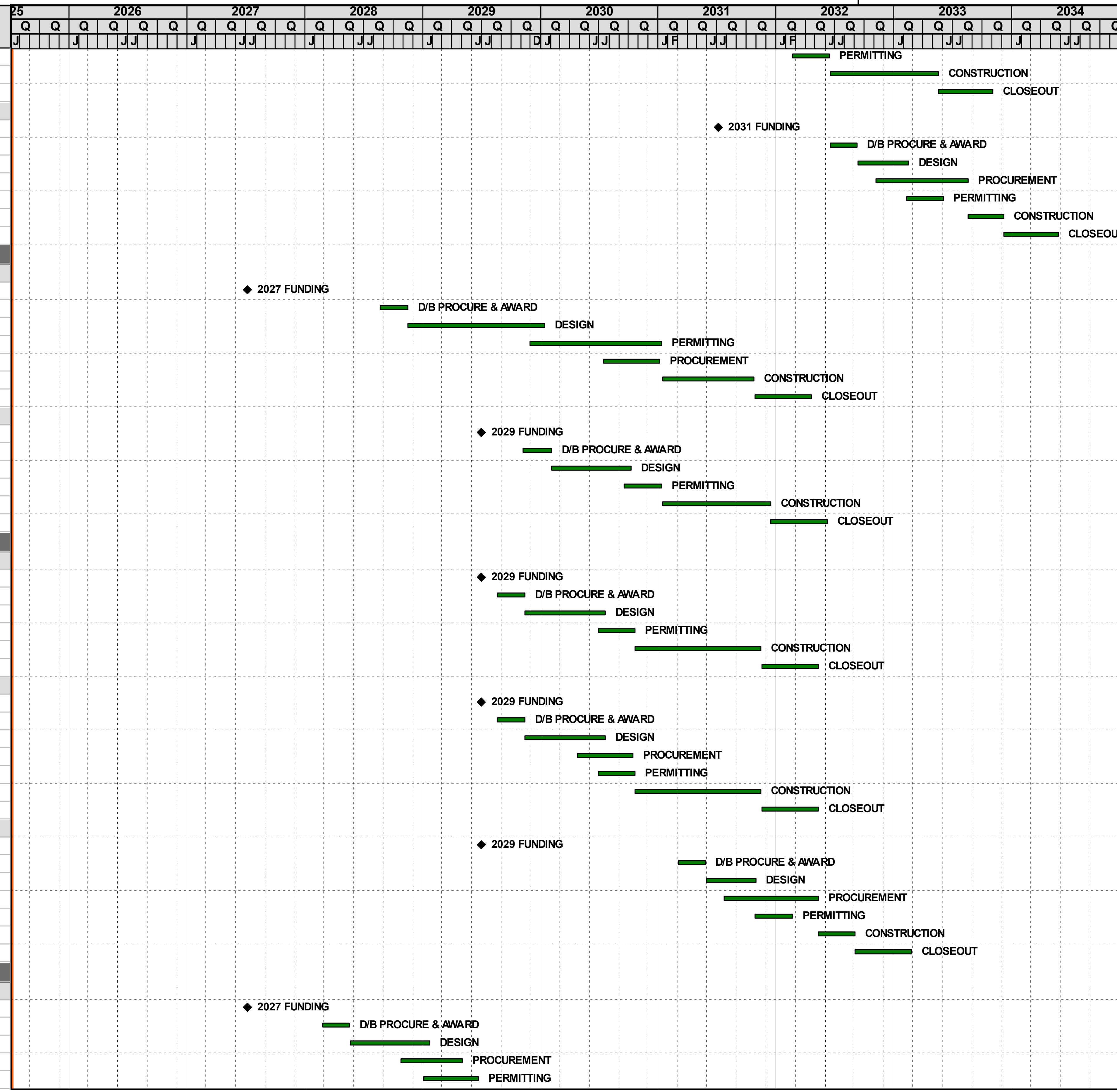
DC2CCPWT.SUM-3100	PERMITTING	80d	23-Feb-32	15-Jun-32
DC2CCPWT.SUM-3110	CONSTRUCTION	235d	16-Jun-32	18-May-33
DC2CCPWT.SUM-3130	CLOSEOUT	120d	19-May-33	02-Nov-33
CHILLER REPLACEMENTS		739d	07-Jul-31	24-May-34
DC2CCPWT.SUM-3420	2031 FUNDING	0d	07-Jul-31*	
DC2CCPWT.SUM-3340	D/B PROCURE & AWARD	60d	16-Jun-32	09-Sep-32
DC2CCPWT.SUM-3350	DESIGN	110d	10-Sep-32	16-Feb-33
DC2CCPWT.SUM-3370	PROCUREMENT	200d	05-Nov-32	17-Aug-33
DC2CCPWT.SUM-3360	PERMITTING	80d	10-Feb-33	01-Jun-33
DC2CCPWT.SUM-3380	CONSTRUCTION	80d	18-Aug-33	07-Dec-33
DC2CCPWT.SUM-3390	CLOSEOUT	120d	08-Dec-33	24-May-34
D-E-1 DISTRIBUTION PIPING FROM POWER PLANT TO EAST & SOUTHEAST CAMP		1242d	06-Jul-27	08-Jun-32
DISTRIBUTION		1207d	06-Jul-27	19-Apr-32
DE1DPPPSEC.SUM-3350	2027 FUNDING	0d	06-Jul-27*	
DE1DPPPSEC.SUM-3280	D/B PROCURE & AWARD	60d	23-Aug-28	15-Nov-28
DE1DPPPSEC.SUM-3290	DESIGN	290d	16-Nov-28	15-Jan-30
DE1DPPPSEC.SUM-3300	PERMITTING	280d	30-Nov-29	13-Jan-31
DE1DPPPSEC.SUM-3440	PROCUREMENT	120d	15-Jul-30	06-Jan-31
DE1DPPPSEC.SUM-3320	CONSTRUCTION	200d	14-Jan-31	24-Oct-31
DE1DPPPSEC.SUM-3330	CLOSEOUT	120d	27-Oct-31	19-Apr-32
BUILDING HHW CONVERSIONS		740d	02-Jul-29	08-Jun-32
DE1DPPPSEC.SUM-3360	2029 FUNDING	0d	02-Jul-29*	
DE1DPPPSEC.SUM-3370	D/B PROCURE & AWARD	60d	07-Nov-29	05-Feb-30
DE1DPPPSEC.SUM-3390	DESIGN	170d	06-Feb-30	07-Oct-30
DE1DPPPSEC.SUM-3400	PERMITTING	80d	17-Sep-30	13-Jan-31
DE1DPPPSEC.SUM-3410	CONSTRUCTION	235d	14-Jan-31	16-Dec-31
DE1DPPPSEC.SUM-3430	CLOSEOUT	120d	17-Dec-31	08-Jun-32
D-N-1 NORTH CAMPUS PIPING		920d	02-Jul-29	23-Feb-33
DISTRIBUTION		720d	02-Jul-29	10-May-32
DN1NCP.SUM-3110	2029 FUNDING	0d	02-Jul-29*	
DN1NCP.SUM-3040	D/B PROCURE & AWARD	60d	21-Aug-29	13-Nov-29
DN1NCP.SUM-3050	DESIGN	170d	14-Nov-29	19-Jul-30
DN1NCP.SUM-3070	PERMITTING	80d	28-Jun-30	21-Oct-30
DN1NCP.SUM-3080	CONSTRUCTION	270d	22-Oct-30	14-Nov-31
DN1NCP.SUM-3090	CLOSEOUT	120d	17-Nov-31	10-May-32
BUILDING HHW CONVERSIONS		720d	02-Jul-29	10-May-32
DN1NCP.SUM-3340	2029 FUNDING	0d	02-Jul-29*	
DN1NCP.SUM-3350	D/B PROCURE & AWARD	60d	21-Aug-29	13-Nov-29
DN1NCP.SUM-3370	DESIGN	170d	14-Nov-29	19-Jul-30
DN1NCP.SUM-3380	PROCUREMENT	120d	25-Apr-30	14-Oct-30
DN1NCP.SUM-3390	PERMITTING	80d	28-Jun-30	21-Oct-30
DN1NCP.SUM-3400	CONSTRUCTION	270d	22-Oct-30	14-Nov-31
DN1NCP.SUM-3420	CLOSEOUT	120d	17-Nov-31	10-May-32
CHILLER REPLCEMENTS		920d	02-Jul-29	23-Feb-33
DN1NCP.SUM-3500	2029 FUNDING	0d	02-Jul-29*	
DN1NCP.SUM-3430	D/B PROCURE & AWARD	60d	04-Mar-31	28-May-31
DN1NCP.SUM-3440	DESIGN	110d	29-May-31	31-Oct-31
DN1NCP.SUM-3460	PROCUREMENT	200d	25-Jul-31	10-May-32
DN1NCP.SUM-3450	PERMITTING	80d	27-Oct-31	20-Feb-32
DN1NCP.SUM-3470	CONSTRUCTION	80d	11-May-32	01-Sep-32
DN1NCP.SUM-3480	CLOSEOUT	120d	02-Sep-32	23-Feb-33
D-S-1 PHW PIPING FROM WCUP TO SOUTH CAMPUS		902d	06-Jul-27	03-Feb-31
DISTRIBUTION		887d	06-Jul-27	13-Jan-31
DS1PHWCPSC.SUM-3180	2027 FUNDING	0d	06-Jul-27*	
DS1PHWCPSC.SUM-3100	D/B PROCURE & AWARD	60d	25-Feb-28	19-May-28
DS1PHWCPSC.SUM-3110	DESIGN	170d	22-May-28	24-Jan-29
DS1PHWCPSC.SUM-3120	PROCUREMENT	130d	26-Oct-28	03-May-29
DS1PHWCPSC.SUM-3130	PERMITTING	120d	04-Jan-29	22-Jun-29



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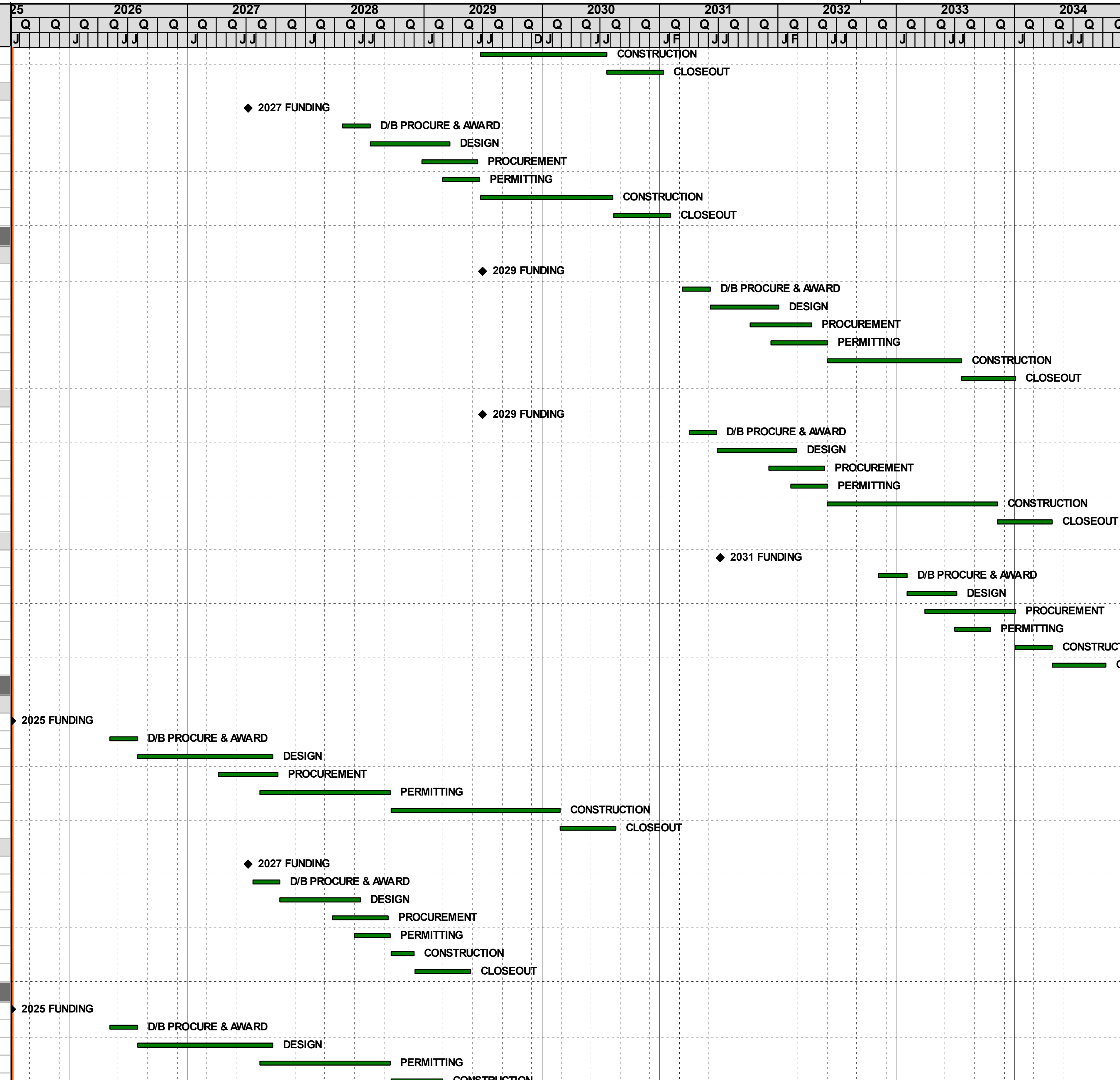
Activity ID	Activity Name	Orig Dur	Start	Finish
DS1PHWCPSC.SUM-3140	CONSTRUCTION	270d	25-Jun-29	19-Jul-30
DS1PHWCPSC.SUM-3150	CLOSEOUT	120d	22-Jul-30	13-Jan-31
BUILDING HHW CONVERSIONS		902d	06-Jul-27	03-Feb-31
DS1PHWCPSC.SUM-1890	2027 FUNDING	0d	06-Jul-27*	
DS1PHWCPSC.SUM-1870	D/B PROCURE & AWARD	60d	24-Apr-28	18-Jul-28
DS1PHWCPSC.SUM-1900	DESIGN	170d	19-Jul-28	21-Mar-29
DS1PHWCPSC.SUM-1910	PROCUREMENT	120d	27-Dec-28	15-Jun-29
DS1PHWCPSC.SUM-1920	PERMITTING	80d	01-Mar-29	22-Jun-29
DS1PHWCPSC.SUM-1930	CONSTRUCTION	285d	25-Jun-29	09-Aug-30
DS1PHWCPSC.SUM-1950	CLOSEOUT	120d	12-Aug-30	03-Feb-31
D-S-2 SOUTH OF PACIFIC CAMPUS PIPING FROM PP		1345d	02-Jul-29	11-Oct-34
DISTRIBUTION		1145d	02-Jul-29	04-Jan-34
DS2SPCPPP.SUM-3240	2029 FUNDING	0d	02-Jul-29*	
DS2SPCPPP.SUM-3160	D/B PROCURE & AWARD	60d	11-Mar-31	04-Jun-31
DS2SPCPPP.SUM-3170	DESIGN	145d	05-Jun-31	02-Jan-32
DS2SPCPPP.SUM-3180	PROCUREMENT	130d	06-Oct-31	12-Apr-32
DS2SPCPPP.SUM-3190	PERMITTING	120d	10-Dec-31	01-Jun-32
DS2SPCPPP.SUM-3200	CONSTRUCTION	290d	02-Jun-32	20-Jul-33
DS2SPCPPP.SUM-3210	CLOSEOUT	120d	21-Jul-33	04-Jan-34
BUILDING HHW CONVERSIONS		1225d	02-Jul-29	26-Apr-34
DS2SPCPPP.SUM-3510	2029 FUNDING	0d	02-Jul-29*	
DS2SPCPPP.SUM-3430	D/B PROCURE & AWARD	60d	01-Apr-31	25-Jun-31
DS2SPCPPP.SUM-3440	DESIGN	170d	26-Jun-31	27-Feb-32
DS2SPCPPP.SUM-3460	PROCUREMENT	120d	03-Dec-31	24-May-32
DS2SPCPPP.SUM-3450	PERMITTING	80d	09-Feb-32	01-Jun-32
DS2SPCPPP.SUM-3470	CONSTRUCTION	370d	02-Jun-32	09-Nov-33
DS2SPCPPP.SUM-3480	CLOSEOUT	120d	10-Nov-33	26-Apr-34
CHILLER REPLACEMENT		839d	07-Jul-31	11-Oct-34
DS2SPCPPP.SUM-3340	2031 FUNDING	0d	07-Jul-31*	
DS2SPCPPP.SUM-3350	D/B PROCURE & AWARD	60d	05-Nov-32	02-Feb-33
DS2SPCPPP.SUM-3370	DESIGN	110d	03-Feb-33	06-Jul-33
DS2SPCPPP.SUM-3380	PROCUREMENT	200d	31-Mar-33	04-Jan-34
DS2SPCPPP.SUM-3390	PERMITTING	80d	30-Jun-33	19-Oct-33
DS2SPCPPP.SUM-3400	CONSTRUCTION	80d	05-Jan-34	26-Apr-34
DS2SPCPPP.SUM-3420	CLOSEOUT	120d	27-Apr-34	11-Oct-34
D-W-1 WEST CAMPUS CCW & PHW PIPING		1290d	07-Jul-25	16-Aug-30
DISTRIBUTION		1290d	07-Jul-25	16-Aug-30
DW1WCCWPW.SUM-3300	2025 FUNDING	0d	07-Jul-25	
DW1WCCWPW.SUM-3220	D/B PROCURE & AWARD	60d	06-May-26	30-Jul-26
DW1WCCWPW.SUM-3230	DESIGN	290d	31-Jul-26	23-Sep-27
DW1WCCWPW.SUM-3240	PROCUREMENT	130d	06-Apr-27	07-Oct-27
DW1WCCWPW.SUM-3250	PERMITTING	280d	12-Aug-27	20-Sep-28
DW1WCCWPW.SUM-3260	CONSTRUCTION	360d	21-Sep-28	26-Feb-30
DW1WCCWPW.SUM-3270	CLOSEOUT	120d	27-Feb-30	16-Aug-30
BUILDING HHW CONVERSIONS		477d	06-Jul-27	24-May-29
DW1WCCWPW.SUM-3510	2027 FUNDING	0d	06-Jul-27*	
DW1WCCWPW.SUM-3430	D/B PROCURE & AWARD	60d	22-Jul-27	14-Oct-27
DW1WCCWPW.SUM-3440	DESIGN	170d	15-Oct-27	19-Jun-28
DW1WCCWPW.SUM-3460	PROCUREMENT	120d	24-Mar-28	13-Sep-28
DW1WCCWPW.SUM-3450	PERMITTING	80d	30-May-28	20-Sep-28
DW1WCCWPW.SUM-3470	CONSTRUCTION	50d	21-Sep-28	01-Dec-28
DW1WCCWPW.SUM-3480	CLOSEOUT	120d	04-Dec-28	24-May-29
D-W-2 SEWER HEAT RECOVERY PIPING		1040d	07-Jul-25	20-Aug-29
DW2SHRP.SUM-3350	2025 FUNDING	0d	07-Jul-25	
DW2SHRP.SUM-3280	D/B PROCURE & AWARD	60d	06-May-26	30-Jul-26
DW2SHRP.SUM-3290	DESIGN	290d	31-Jul-26	23-Sep-27
DW2SHRP.SUM-3310	PERMITTING	280d	12-Aug-27	20-Sep-28
DW2SHRP.SUM-3320	CONSTRUCTION	110d	21-Sep-28	28-Feb-29



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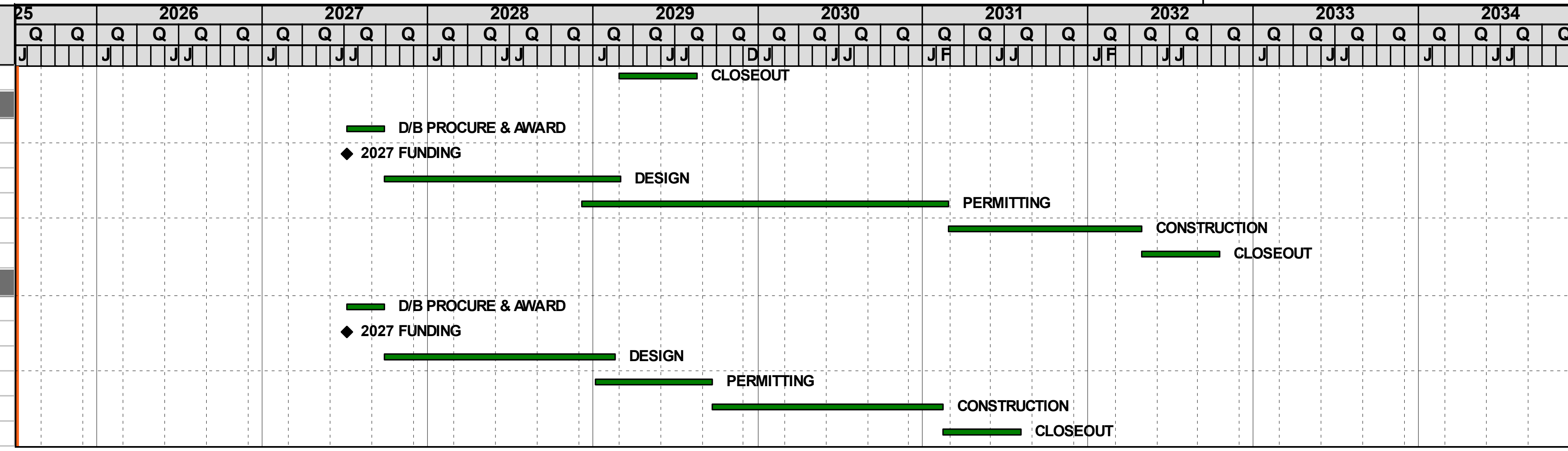
DW2SHRP.SUM-3330	CLOSEOUT	120d	01-Mar-29	20-Aug-29
S-1 LAKE INTERFERENCE SYSTEM		1335d	06-Jul-27	19-Oct-32
S1LIS.SUM-3340	D/B PROCURE & AWARD	60d	06-Jul-27	28-Sep-27
S1LIS.SUM-3410	2027 FUNDING	0d	06-Jul-27*	
S1LIS.SUM-3350	DESIGN	360d	29-Sep-27	05-Mar-29
S1LIS.SUM-3370	PERMITTING	560d	07-Dec-28	27-Feb-31
S1LIS.SUM-3380	CONSTRUCTION	295d	28-Feb-31	29-Apr-32
S1LIS.SUM-3390	CLOSEOUT	120d	30-Apr-32	19-Oct-32
S-2 SEWER HEAT RECOVERY EQUIPMENT BLDG		1030d	06-Jul-27	05-Aug-31
S2SHREB.SUM-3400	D/B PROCURE & AWARD	60d	06-Jul-27	28-Sep-27
S2SHREB.SUM-3470	2027 FUNDING	0d	06-Jul-27*	
S2SHREB.SUM-3410	DESIGN	350d	29-Sep-27	19-Feb-29
S2SHREB.SUM-3430	PERMITTING	180d	09-Jan-29	21-Sep-29
S2SHREB.SUM-3440	CONSTRUCTION	350d	24-Sep-29	13-Feb-31
S2SHREB.SUM-3450	CLOSEOUT	120d	14-Feb-31	05-Aug-31



10.5 High Level Constructability & Logistics Commentary

UW ENERGY RENEWAL PLAN
CONSTRUCTABILITY COMMENTARY

The following section represents high level constructability commentary regarding the currently proposed projects aimed at decarbonizing University of Washington's district energy system. Constructability commentary has been broken down by project type (i.e. Buildings, Electrification, Plant, Site Distribution and Source). While comments are generally high level at this point, we expect as projects go through the design phases a number of these concerns can be made known and impacts assessed.

BUILDINGS

- It is recommended that building level modifications be completed in conjunction with site distribution projects to maximize the use of temporary, regional boilers. This will streamline coordination between the sequencing of existing steam demolition, new PHW installation and mechanical room modifications.
- Performing construction activities in occupied buildings will necessitate significant field investigation and coordination to verify existing MEP systems and prevent inadvertent impacts to building systems, occupants, and building function.
- Wherever possible, it is recommended that existing storage rooms and/or underutilized spaces be considered for conversion to new mechanical rooms to accommodate PHW equipment. This will facilitate the entire buildout of the mechanical room prior to disrupting existing steam services and mitigate the usage of temporary steam services. The original mechanical rooms may be converted to other use upon completion if possible.

ELECTRIFICATION

- General Note: Routing of new duct banks across active campus will require extensive coordination, scheduling and communication in order to perform work while keeping pedestrians safe and minimizing traffic flow disruptions.
- E-1 New UW Substation and Connection to Existing WRS
    - Ongoing coordination with SCL, TBD requirements, and systems impact study to be issued by SCL.
    - SCL Transformer lead for private development is 6-8 years out from release. Assuming UW and SCL will be able to mitigate.

PLANT

- General Note: Procurement times for equipment of the sizes contemplated for these projects continue to be long lead items and ultimately vary depending on manufacturer (if multiple acceptable per design) and will potentially remain in constant flux until fully released.
- General Note: Restrictions on access required to maneuver new and old equipment, piping, and other support components in and out of the existing facilities. May require removal and reinstallation of existing systems to remain in order to complete work and will not likely be known until further into design process.
- General Note: Commissioning time required for project as equipment, piping, controls components will be intensive with several operation modes and sequences required to be tested out.
- General Note: Identifying and addressing hazardous materials such as contaminated soils, lead and asbestos insulation, mastics, paint, etc., PCBs, etc.
- P-1 Convert CCW system to year-round operation:
    - Unknown of exact and specific control system programming changes required to fully implement.
    - Exposing unforeseen conditions and issues with existing systems, valves, components, etc.

throughout implementation.

- P-4 WCUP Annex project:
    - Coordination of shutdown impacts for switch over of SCL and UW duct banks under existing footprint.
    - Proper support and protection required of existing WCUP fuel tank immediately adjacent to the WCUP Annex expansion.
    - Coordination and timing of adjacent tunnel and W27 project construction timelines.
- P-5 CCW TES Tank:
    - Existing structure capacity to support new piping on roof and within coal storage areas of the Power Plant.
- P-6 PHW TES Tank:
    - Existing structure capacity to support new piping on roof and within coal storage areas of the Power Plant.
- P-14 Power Plant Controls Upgrade:
    - Unknown of exact and specific control system programming changes required and/or hardware upgrades required to fully implement.

SITE DISTRIBUTION

- Reuse of existing tunnels will trigger confined space requirements and limit trade partner productivity. Demolished materials and new materials must be hoisted into and out of existing vaults and carted to a given work area. Ultimately, materials will need to be moved inside of existing tunnels in an assembly line fashion as the tunnels are too narrow to allow for carts to pass by one another. Furthermore, in cases in which existing vaults are over 200 LF from a work area, productivity will be especially reduced.
- Due to limited space in existing tunnels, steam will need to be demolished in short sequences to limit the effected buildings. Use of regional steam plants noted under the Building conversions will greatly improve the overall construction efficiency and schedule duration of existing tunnel work as well as minimize the amount of coordination required.
- Due to utilization of steam tunnels, PHW will need to be installed very linearly. This will limit how many buildings can go online over time.
- In cases where steam demolition and PHW install are sequenced to maintain a steam loop and heating services to other buildings, steam valves and PHW valves must be installed at building lateral locations. Although this solution will mitigate the need for temporary steam boilers to keep existing buildings online, the project team will run into inefficiencies associated with flushing as PHW piping will be flushed in suboptimal distances.
- It is inevitable that temporary steam boilers will be required to maintain heating services to existing buildings. As a result, significant field investigation will be necessary at the design phase to understand each building’s mechanical room, MEP systems and connections to existing tunnels. It is recommended that regional boilers be considered to temporarily feed multiple buildings at a time and allow for several crews to work within existing tunnels to demolish existing steam piping and install new PHW piping.
- Several schematic tunnel sections show cases in which existing pipe shown to be demolished is currently installed in close proximity to existing pipe that is shown to remain. It is recommended that existing pipes be abandoned to reduce costs and mitigate potential for inadvertent impacts to existing, live systems.
- Given the significant quantity of pipe required for the Energy Renewal Plan, it is recommended that offsite lots be made available to the General Contractor for equipment staging, jobsite trailers and material laydown. This will facilitate pipe deliveries to a location that is near the work area and pipe can then be quickly transported as needed. Ultimately, it would be extremely inefficient to deliver materials directly to

the work area due to site space constraints. Whether the project involves a new, direct-bury trench in the ROW or reuse of existing tunnels in the heart of the campus, it is unlikely that there will be necessary room to store large quantities of pipe.

- Installation of new tunnels will lead to significant impacts on surrounding vehicle and pedestrian traffic. Discussions with UW Metro and SDOT should be started far before construction to coordinate traffic control measures. Furthermore, it is recommended that night work be considered when major streets such as Pacific St. must be shut down.

SOURCE

- S-2 Sewer Heat Recovery Project – SHARC heat exchangers of the size being contemplated are under development and will not be available until mid/late 2026 at the earliest.
- S-2 Sewer Heat Recovery Project – Through conversations with various trade partners, it assumed that installing new sewer water intake piping and pumped sewer water return pipe in such close proximity to existing larger water mains and Benjamin Hall Interdisciplinary Research Building and Publications Services Building would be infeasible. As a result, the alternate Pasadena Place connection point is strongly recommended and is the basis of the attached estimate.

UW ENERGY RENEWAL PLAN
LOGISTICS COMMENTARY

The following section represents general project logistics commentary regarding the currently proposed projects aimed at decarbonizing University of Washington's district energy system. Logistics commentary has been broken down by project type (i.e. Buildings, Electrification, Plant, Site Distribution and Source). Following this are some general site logistics plans to depict the construction presence and impact on campus. While comments are general at this point, the projects are quite impactful to campus operations and recommend a CMAR procurement process. This will allow for impact concerns to be formally addressed and mitigated during the design and construction execution phasing of the projects.

LOGISTICS COMMENTARY

- **Distribution**
  - Coordinating timing with street use permits will be critical in keeping the flow of the distribution work progressing.
  - Due to congestion and lack of open space on campus, multiple laydown locations will need to be utilized for construction office space and material laydown.
  - At intermittent tunnel entrance locations there will be smaller construction sites set up with fence areas for tools and material storage to facilitate continuous access/egress of the tunnel (confined space).
  - Consistent air flow at open manholes and hole watches will be present at all work times to maintain safe working environments.
  - Where new tunnels are being installed trenches will need to be particularly wide and will disrupt many nearby trees that will need to be demoed and replanted after completion.
  - Some utilities will need to be relocated to facilitate tunnel installation.
  - There will be large sections of the Burke Gilman Trail that will be closed and require rerouting pedestrian traffic to nearby street sidewalks and will require temporary bike lanes to be added.
  - The Burke Gilman Trail South of the WCUP will require shutdown for both the WCUP electrical feeders and the future connection where the tunnel running West on the Burke Gilman will be mined underneath both University and Brooklyn streets.
  - Setting up temporary heating means for the buildings (depending on construction time of year and building needs) will be critical in keeping the construction flow efficient where the steam is being replaced in the tunnels. The tunnels do not have the space to install new PHW piping adjacent to live steam.

- **Building Conversions**
  - Close coordination with building engineers and occupants will be critical from early project planning through completion.
  - There will be multiple short duration building shutdowns of multiple utilities to facilitate the conversions. For example, installing new breakers in electrical panels for new equipment, making new HHW connections to building services, installing new HHW coils in existing AHU's, etc. These likely can take place at times of minimal disruption but won't be determined until scope and timing of project is further defined.
  - Most of the laydown space needed can occur in mechanical rooms, or adjacent back of house locations.

- Trailer complexes to facilitate GC and subcontractor laydown and parking will be required to sustain conversions of several buildings.
- More difficult buildings will require routing passing through occupied spaces. Tenants will need to be relocated, or some work will need to be off hours to facilitate this type of routing work.
- Most mechanical rooms contain work that can occur on day shift hours. Noise generating activities such as drilling of anchors and metal cutting should prior to or after daily class/building occupant schedules.

- **Plant**
    - Work in both power plant and WCUP will require close coordination with facilities to plan and sequence shutdowns for utility tie ins and replacement of equipment.
    - WCUP expansion, PHW tank, and CCW tank will require large sections of land to be fenced off to facilitate construction access and activities.
    - The work within the existing plants will require some space to be made available for laydown and prep space.

- **Electrical**
    - Coordination with SCL provides the biggest challenge to the electrical scope.
    - SCL transformer procurement is unpredictable and can be 2 years or potentially more.
    - Like the distribution projects, work in existing utility vaults is required.
    - At intermittent tunnel entrance locations there will be small sites set up with fences for tools and material storage to facilitate constant entering and exiting of confined spaces.
    - Consistent air flow at open manholes and hole watches will need to be present to maintain safe working environments.
    - Crossing of utilities will prove to be challenging due to limited space.

- **Source**
    - The sewer heat recovery building and the lake interface equipment building will require significant footprints to be fenced off to facilitate construction.
    - Close coordination with the lake interface environmental impact planning and approvals will be crucial to facilitate construction of both the Lake water work and the lake interface equipment building.
    - The sewer water intake piping will prove to be a challenge. Significant potholing will be required to locate and determine a plan to not undermine the adjacent water mains.

10.6 Lake Interface Preliminary Environmental & Permitting considerations

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PRELIMINARY PERMITTING/ENVIRONMENTAL CONSIDERATIONS – PHASE 3

UW Energy Renewal Plan – Deep Lake Cooling

UNIVERSITY OF WASHINGTON, SEATTLE, WASHINGTON

March 18, 2025

Shannon & Wilson No: 111679-P3-5

Submitted To: Affiliated Engineers NW, Inc.
Westlake Center Office Tower
1601 Fifth Avenue, Suite 1400
Seattle, WA 98101
Attn: Geoff McMahon

Subject: PRELIMINARY PERMITTING/ENVIRONMENTAL CONSIDERATIONS – PHASE 3, UW ENERGY RENEWAL PLAN – DEEP LAKE COOLING, UNIVERSITY OF WASHINGTON, SEATTLE, WASHINGTON

Shannon & Wilson prepared this report and participated in this project as a subconsultant to Affiliated Engineers NW, Inc. (AEI). Our scope of services was specified in the Subconsultant Agreement with AEI, dated November 14, 2023, and amended June 4, 2024. This is an updated version of the August 16, 2024, report that summarized Phases 1 and 2 findings regarding preliminary permitting and environmental considerations, and reflects the continued discussions and analysis that took place during Phase 3. This Phase 3 report will support AEI and the University of Washington's (UW's) consideration of a deep lake cooling component of the Energy Renewal Plan, and was prepared by the undersigned.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON

Amy Summe, PWS
Associate, Senior Biologist/Permitting Specialist

Additional Contributors:

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ACRONYMS

AEI	Affiliated Engineers NW, Inc.
BA	Biological Assessment
BOD	biochemical oxygen demand
CFR	Code of Federal Regulations
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CRP	Cost Reimbursement Program
CSGP	Construction Stormwater General Permit
CWA	Clean Water Act
CZM	Coastal Zone Management
DAHP	Washington Department of Archaeology and Historic Preservation
DMMO	Dredged Material Management Office
DMMP	Dredged Material Management Program
DNR	Washington State Department of Natural Resources
DPS	distinct population segment
ECA	environmentally critical area
Ecology	Washington State Department of Ecology
EFH	Essential Fish Habitat
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERP	Energy Renewal Program
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FMC	Fisheries Management Council
FWHCA	fish and wildlife habitat conservation area
gpm	gallons per minute
GPS	global positioning system
HAPC	Habitat Areas of Particular Concern
HPA	Hydraulic Project Approval
LLTK	Long Live the Kings
LW-RTTM	Lake Washington Real Time Temperature Model
LWSC	Lake Washington/Ship Canal
µg/L	micrograms per liter
MGD	million gallons per day
mg/L	milligrams per liter
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MUP	Master Use Permit
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act

ACRONYMS

NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWP	Nationwide Permit
OHWM	ordinary high water mark
PCBs	polychlorinated biphenyls
PP	priority processing
QA/QC	quality assurance/quality control
RCW	Revised Code of Washington
ROE	Record of Examination
SAP	sampling and analysis plan
SEPA	State Environmental Policy Act
SHPO	State Historic Preservation Officer
SMC	Seattle Municipal Code
SMP	Shoreline Master Program
SMS	Sediment Management Standards
SR	State Route
TMDL	total maximum daily load
USFWS	U.S. Fish and Wildlife Service
USCG	U.S. Coast Guard
UW	University of Washington
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WISAARD	Washington Information System for Architectural and Archeological Records Data
WQC	Water Quality Certification
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation

1 INTRODUCTION

The University of Washington's (UW) Sustainability Action Plan includes 10 targets, one of which is to reduce greenhouse gas emissions by 45% by 2030. That ambitious goal is being pursued via the UW Energy Renewal Plan (ERP), which is currently exploring several strategies to achieve a shift in campus energy supply from fossil fuel-consumptive sources to clean electricity. In support of that effort, Shannon & Wilson is assisting Affiliated Engineers NW, Inc. (AEI) and UW in this Phase 3 assessment of opportunities to utilize deep, cold Lake Washington water as both heating and cooling sources, thus lowering the power demand associated with those uses.

This Phase 3 report summarizes environmental permitting requirements, evaluates existing lake water temperature models and data, provides a summary of data collected during Phase 3, and assesses possible water chemistry and ecological considerations. This report retains all of the key information from the Phases 1 and 2 reports, and contains both amended and new discussions that reflect information that has emerged during continued exploration of planning-level concept design and studies and continued outreach to agencies during Phase 3.

In addition to supporting UW's transition away from fossil fuels, the project could have a secondary environmental benefit if cool water could be discharged in summer into the Montlake Cut or farther west. The Ship Canal from the Hiram M. Chittenden Locks and extending east through the Montlake Cut has elevated summer-time water temperatures that are a thermal barrier to migrating salmon. Temperature and dissolved oxygen conditions, and their effects on salmon, are well-described in *Synthesis of Best Available Science: Temperature and Dissolved Oxygen Conditions in the Lake Washington Ship Canal and Impacts on Salmon* (Urgenson and others, 2021).

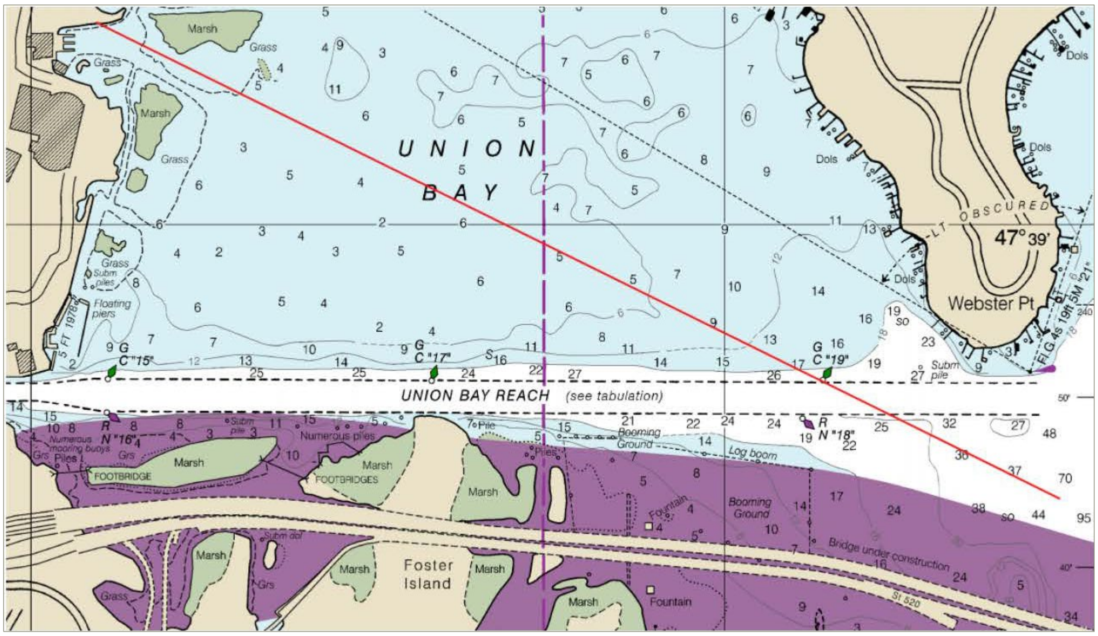
Long Live the Kings (LLTK) and the WRIA 8 Salmon Recovery Council have been engaged in a multi-phase partnership to study the low dissolved oxygen and high temperature problems in the Ship Canal, and to brainstorm and evaluate solutions. That partnership most recently produced the *Phase 2.1 Report: Addressing Temperature and Dissolved Oxygen in the Lake Washington Ship Canal* (LLTK and WRIA 8 Salmon Recovery Council, 2024), which included sub-reports that studied large-scale conceptual engineering options (Jacobs Engineering Inc., 2024) and presented hydrodynamic modeling results for several scenarios that transferred up to 300 cubic feet per second (cfs) of cold water from the main body of Lake Washington into the Ship Canal (DSI, LLC, 2023). As part of Phase 3 of this UW project, the findings of the LLTK and WRIA 8 report have been reviewed and the project team has met with LLTK and WRIA 8 representatives, including the modeling firm DSI, LLC, to discuss possible synergies.

In a meeting with the Washington State Department of Ecology (Ecology) staff held on February 11, 2025, the Water Quality Section Manager, Rachel McCrea, indicated that a discharge of cool water into the temperature-impaired waters of the Ship Canal could only be conducted after a multi-year monitoring, modeling, rule-making, and U.S. Environmental Protection Agency (EPA) approval process (McCrea, pers. comm., February 11, 2025) (see discussion in Section 3.2.1.5). Unless an alternate approval pathway is identified, Ecology's position effectively eliminates the viability of UW's preferred discharge location as well as impeding achievement of some of LLTK and WRIA 8 goals. Discharges into the Ship Canal west of the temperature-impaired water designation or back into Union Bay or the main body of Lake Washington would retain benefits to UW from reducing fossil fuel consumption, but would forgo the possible benefits of introducing cool water directly into the Ship Canal. Further investigation into an acceptable discharge location back to Lake Washington may be conducted should the University decide to pursue the lake water interface system without the benefit of cooling the Ship Canal. Although a path to a Ship Canal discharge may not be feasible in a timeline that supports UW's Energy Renewal Plan objectives, discussion of that location will be retained in this report in the event that circumstances change in the future; it will be referred to as the preferred discharge location.

Preliminary designs are not yet available at this phase of the project. However, key elements of any potential design that are relevant to our analysis follow, and the current planning-level locations of the intake, onshore equipment building, and the preferred discharge are shown in Exhibit 1-1.

Exhibit 1-1: Potential Locations of Intake, Equipment Building, and Preferred Discharge
(Provided by AEI)

- A large volume of water (approximately 22,000 gallons per minute or 50 cfs) would be withdrawn at approximately 20 meters below the Lake Washington water surface from a point east of the UW campus, between Webster Point and State Route (SR) 520 (Exhibit 1-2).



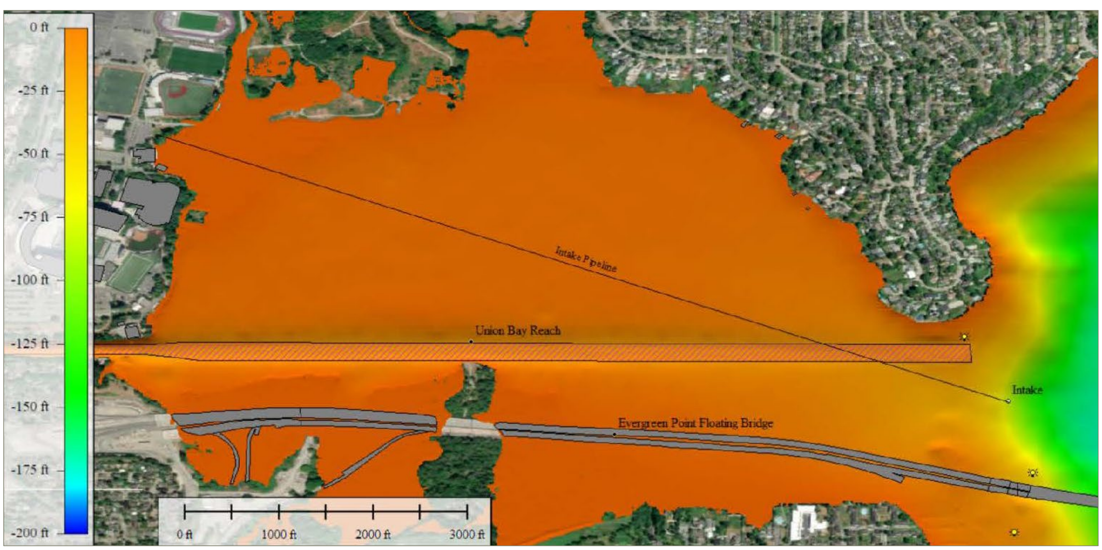
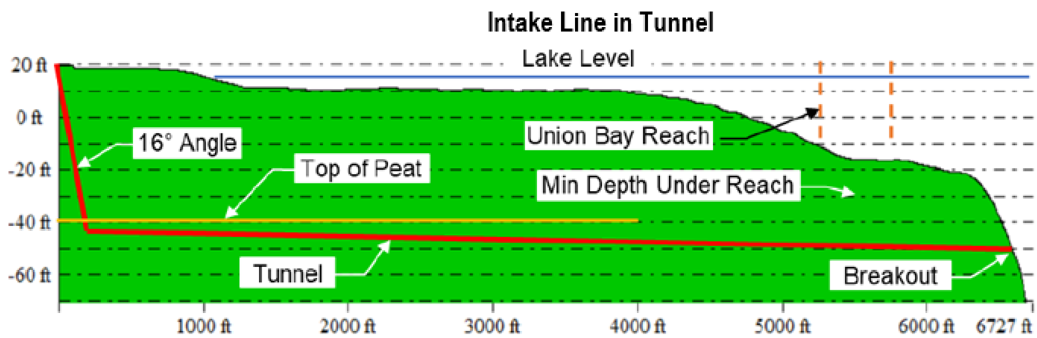


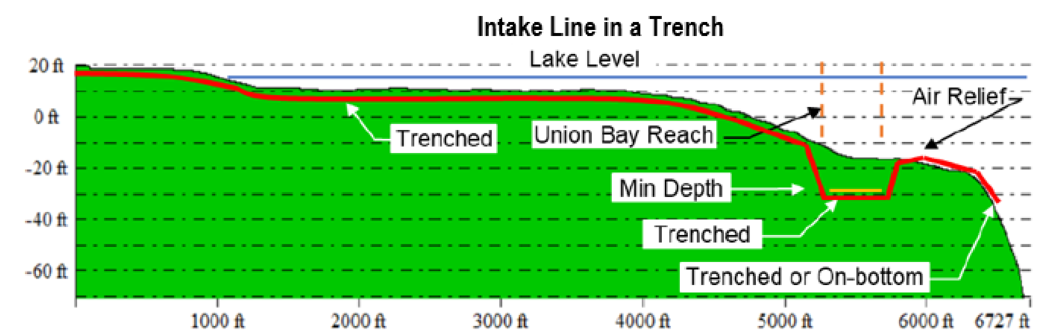
Exhibit 1-2: Nautical Chart 18447 Showing the Potential Intake Pipe Route With Soundings and Contours in Feet (Top, Red Line, Datum is Low Lake Level) and Site Elevation Color Map Showing the Potential Intake Pipe Route (Bottom, Black Line, NAVD88 [Low Lake Level is +16.75 Feet). (Figures Taken From Makai Ocean Engineering, Inc., 2024.)

- A pipe, approximately 48 inches in diameter and installed via tunneling and/or trenching methods, would carry that water to the UW campus, where it would be routed to provide heating or cooling, thereby cooling or heating the water. Other than heat, no other materials would be purposefully added to or taken from the water. During Phase 2, the interest in and likelihood of trenching increased based on substantial cost differences and high-level evaluation of construction-related risks. The conceptual tunnel, trench, and hybrid alignment is shown in Exhibit 1-2, and sections are shown in Exhibit 1-3.

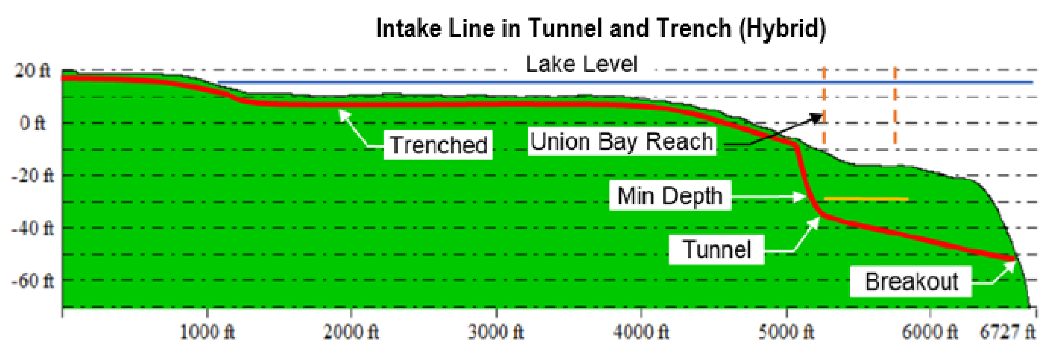
- The same volume of water, either heated or cooled, would then be discharged back into the Ship Canal or Lake Washington at one or more to-be-determined elevations. During Phase 2, the interest in a discharge specifically to the western end of the Montlake Cut or farther west increased; however, as noted above, this preferred discharge location currently has a permitting barrier.



(exhibit from Figure 3-5 in *University of Washington Lake Water Cooling and Heating Feasibility Study* by Makai Ocean Engineering, 2024)



(exhibit from Figure 3-4 in *University of Washington Lake Water Cooling and Heating Feasibility Study* by Makai Ocean Engineering, 2024)



(exhibit from Figure 3-6 in *University of Washington Lake Water Cooling and Heating Feasibility Study* by Makai Ocean Engineering, 2024)

Exhibit 1-3: Conceptual Tunnel, Trench, and Hybrid Sections of a Potential Intake Line

2 LAKE WASHINGTON SYSTEM BACKGROUND

2.1 Setting

Lake Washington is the largest lake in Water Resource Inventory Area (WRIA) 8 – Lake Washington/Cedar/Sammamish Watershed. The lake has a surface area of approximately 34 square miles and a maximum depth of 65.2 meters. Lake Washington receives water from the Cedar River, the Sammamish River, and a number of tributaries. The lake discharges into Puget Sound via the Hiram M. Chittenden Locks after passing through the Lake Union/Lake Washington Ship Canal.

The UW campus is on the west side of Union Bay and the north side of the Montlake Cut, and is in the City of Seattle, which is the first man-made constriction as lake water exits Lake Washington and enters the Ship Canal corridor (Figure 1).

2.2 History

In 1916, the U.S. Army Corps of Engineers (Corps) completed construction of the Lake Union/Lake Washington Ship Canal, which connected the formerly separate Lake Washington to Portage Bay, Lake Union, Salmon Bay, and ultimately Puget Sound (Exhibit 2-1). The canal has a mean depth of 9 to 11 meters, and is narrow (approximately 50 to 80 meters) in the Montlake and Fremont Cuts connecting the lake to the pre-existing waterbodies. The management of the locks at the downstream end of the canal resulted in the lowering of Lake Washington by about 2.7 meters to match the original height at Lake Union, eliminating miles of shoreline and wetlands. This also eliminated the lake's former Black River outlet that drained to the Duwamish River and then into Elliott Bay, and the Cedar River at the south end of the lake was diverted into the lake.

Exhibit 2-1: Map of Elements of the Lake Washington Ship Canal Project

(Source: By Dennis Bratland - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=30394306)

2.3 Fish and Wildlife Use and Habitat

The waters of Lake Washington are occupied by a diverse community of anadromous and resident fish, many of which have special status under either state or federal law. The remaining functioning riparian zones, associated wetland areas, and vegetated shallows provide important juvenile rearing and migration habitat, and also support amphibians, reptiles, waterfowl, and other wildlife. Exhibit 2-2 identifies the federally listed or proposed fish and wildlife species in the project area.

Exhibit 2-2: U.S. Fish and Wildlife Service and National Marine Fisheries Service-Listed Species and Critical Habitats Potentially Present in the Project Area

Species Common Name Scientific Name	Species			Critical Habitat	
	Management Unit	Federal Status	Present in Project Area	Status	Present in Project Area
North American Wolverine *Gulo gulo luscus*	--	Threatened	No	Not Designated	Not Applicable
Marbled Murrelet *Brachyramphus marmoratus*	--	Threatened	No	Final Designation	No
Yellow-Billed Cuckoo *Coccyzus americanus*	Western DPS	Threatened	No	Proposed	No

Species Common Name Scientific Name	Species			Critical Habitat	
	Management Unit	Federal Status	Present in Project Area	Status	Present in Project Area
Northwestern Pond Turtle *Actinemys marmorata marmorata*	--	Proposed Threatened	No	Not Designated	Not Applicable
Chinook Salmon *Oncorhynchus tshawytscha*	Puget Sound ESU	Threatened	Yes	Final Designation	Yes
Bull Trout *Salvelinus confluentus*	Coterminous United States DPS	Threatened	Yes	Final Designation	Yes
Steelhead *Oncorhynchus mykiss*	Puget Sound DPS	Threatened	Yes	Final Designation	No

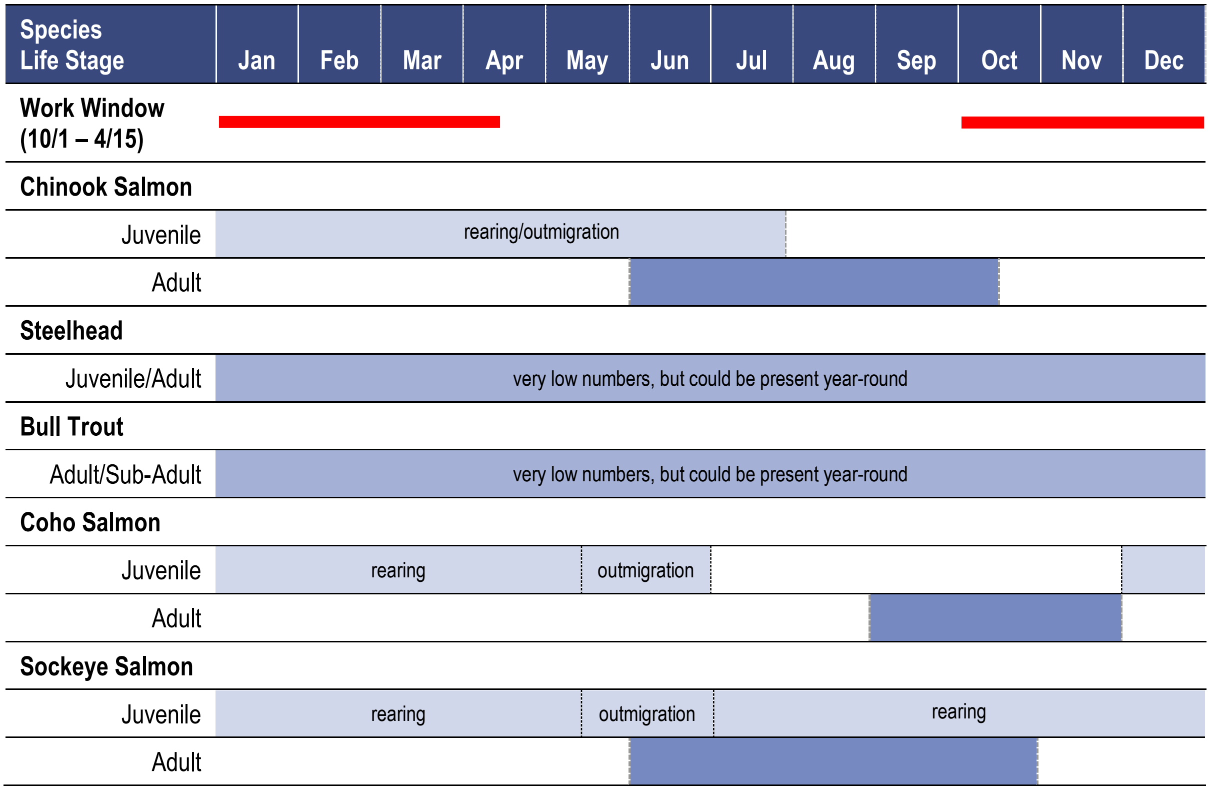
DPS = distinct population segment; ESU = evolutionarily significant unit

Sources: U.S. Fish and Wildlife Service (USFWS), 2023a; USFWS, 2023b; National Marine Fisheries Service (NMFS), 2016; NMFS, 2023; Hallock, pers. comm., June 25, 2024.

The shallow Ship Canal waters experience high temperatures in the summer months and are a thermal barrier to upstream migrating adult anadromous salmonids that have successfully navigated the fish ladder at the locks. Exhibit 2-3 shows the timing of key anadromous salmonid movements through the Ship Canal and into the lake.

The project's intake is anticipated to be located at a depth of approximately 20 meters below the water's surface and likely at least 3 meters above the bed of the lake. According to WDFW (Joseph Short, pers. comm., December 19, 2023; Overman and others, 2006), fish that might be encountered at those depths are juvenile sockeye salmon, and potentially juvenile Chinook or coho salmon. Adults of those species can also be found at those depths as they exit the Ship Canal and head towards upstream spawning areas (Short, pers. comm., December 19, 2023). Other common pelagic fish that may be found in the water column include, in decreasing order, longfin smelt, three-spine stickleback, and sculpin (Overman and others, 2006). Perch, other trout, northern pikeminnow, bass, peamouth chub, and American shad are also found in the water column (Short, pers. comm., December 19, 2023).

Exhibit 2-3: Timing of Potential Key Salmonid Species Presence in the Project Area



Source: Urgenson and others, 2021; NMFS, 2017; Seattle Public Utilities and Corps, 2008; WRIA 8 Salmon Recovery Council, 2017

2.4 Water Quantity/Hydrology

The Corps manages the water levels in the Lake Washington/Ship Canal (LWSC) system by managing the locks. A Corps Senior Water Manager confirmed that the Corps considers the LWSC as "a single system with multiple components" (Comanor, pers. comm., July 30, 2024). The water system is managed based on the water elevation in the system and not based on flow rates. However, flow rates through the LWSC were used to analyze the potential impacts of the heat exchange system. The Corps has publicly available raw data for inflow (flow rate measured at the Cedar River) and outflow through the LWSC system (measured at the locks). The data do not go through a quality assurance/quality control (QA/QC) process prior to publication, and note that the Cedar River is not the only inflow source to the LWSC system.

Exhibits 2-4 and 2-5 show LWSC inflow and outflow from the Corps Dataquery 2.0 website. Exhibit 2-3 shows data from June 2023 to June 2024, a full year. Exhibit 2-4 shows data from July 27, 2023, to September 11, 2023, which represent drier summer months, when the outflow discharge to the Puget Sound is lowest. Exhibit 2-4 also shows a line at 50 cfs that represents the potential proposed discharge from the heat exchange system. Note the data point on 8/17/23 (August 17) for the Flow Out in both figures is likely an erroneous data point as the Corps does not QA/QC their data.

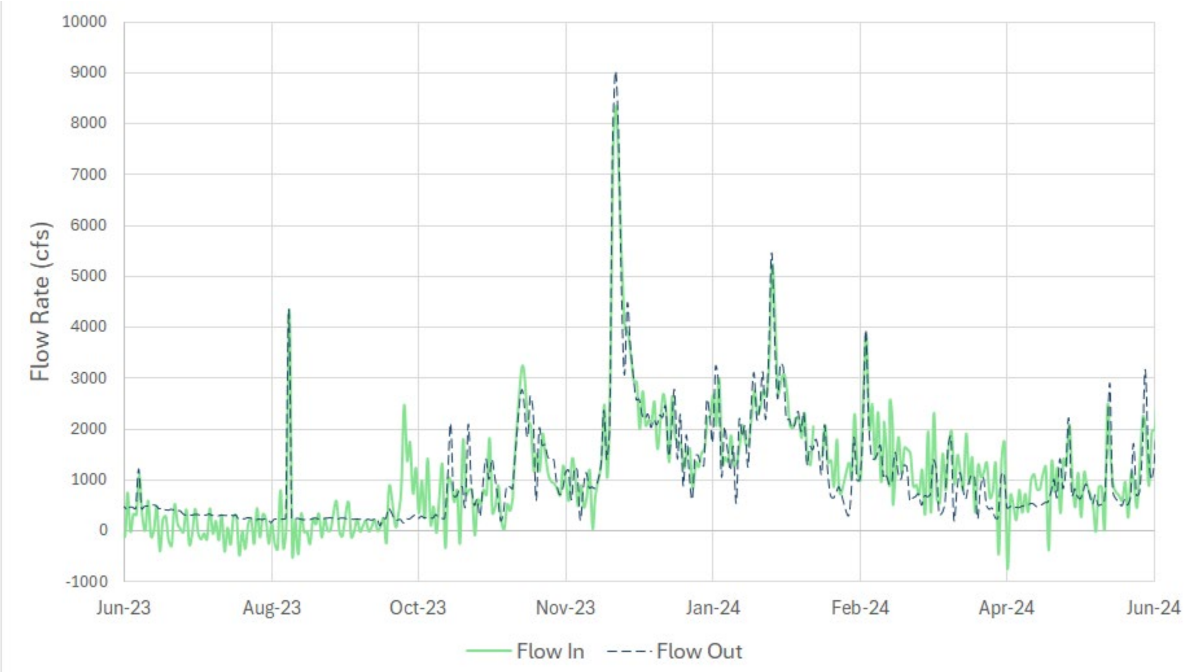


Exhibit 2-4: Lake Washington Ship Canal Flow Rates June 2023 to June 2024

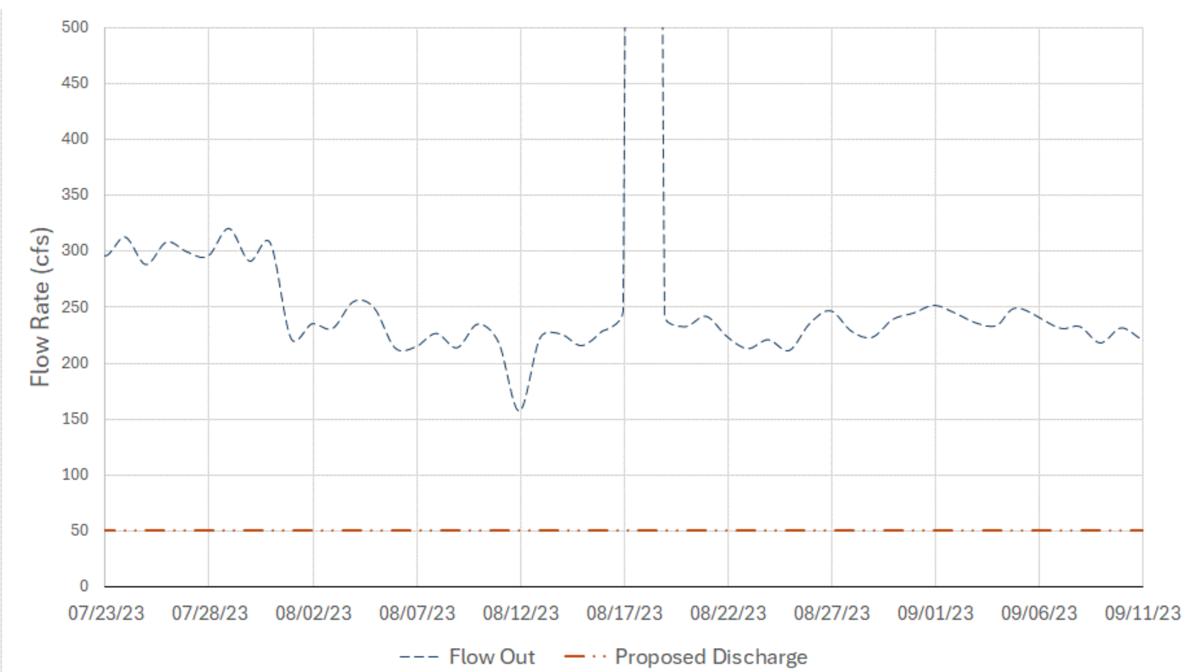


Exhibit 2-5: Lake Washington Ship Canal Flow Rates July 2023 to September 2023

During the summer months, when flow through the system is lowest, the overall flow rate in 2023 did not drop below 150 cfs and usually fluctuated between 200 and 300 cfs. Low flow conditions are pertinent to some agency concerns discussed in later sections of this report about the potential backwater and flow reversal effects of a discharge by UW of 50 cfs into the Ship Canal.

2.5 Water Quality Impairments

Ecology is charged with routinely assessing water quality in Washington waters under Section 303(d) of the federal Clean Water Act (CWA). Ecology gathers data on a variety of parameters and then sorts them into one of five categories for each tested parameter based on the results. Category 5 waters are the most polluted and require Ecology to prepare a pollution control program, such as a Total Maximum Daily Load, for that impairment. Category 5 waters make up the 303(d) list. Once a control program has been developed and is being implemented, then the water is downgraded to Category 4. Some impairments cannot be addressed through a control program for a variety of reasons and are classified as Category 4c. The project area's water quality impairments are shown on Exhibit 2-6.

Exhibit 2-6: Impaired Waters and Sediments (Source: Ecology Water Quality Atlas, 2024)

The Category 5 listing (polluted waters that require a water improvement project) for water in the Montlake Cut and Portage Bay is associated with temperature and lead (Ecology, 2024). The following "Basis Statement" included with the temperature listing provides a brief synopsis of the challenge facing migratory salmonids:

> The lake and canal system forming the Lake Washington Ship Canal constitute the only route for anadromous salmonids migrating between the saltwater of Puget Sound and the Lake Washington Basin (including the Cedar and Sammamish sub-basins). During the summer months, water temperatures in the Ship Canal likely create a thermal barrier that impedes the migration of adult Chinook salmon (*Oncorhynchus tshawytscha*) and sockeye salmon (*O. nerka*) and late-migrating Chinook smolts. Water temperatures taken in July and August in Portage Bay (2007-2011) at a monitoring station located near the downstream end of the Montlake Cut have been measured at or above 22 degrees (°) centigrade (C) throughout the entire water column. Upper areas of the water column may be as high as 25°C. During these times, water temperatures in the adjacent downstream waters of north Lake Union, although still unsuitable for salmonids, are often less extreme. Metalimnion[1] temperatures in north Lake Union can be up to 3°C lower than the entire water column temperatures at the Portage Bay station. Prolonged exposure to elevated temperatures in both areas likely causes sub-lethal and potential lethal effects to adult salmon. (Ecology, 2024)

The lead exceedances were from two samples collected in 2009 that exceeded the toxic aquatic four-day mean. No subsequent lead samples have been collected to remove this listing for lead. In addition, the Montlake Cut and Portage Bay areas are in Category 1 (meets standards) for total phosphorus, fecal coliform, and *Escherichia coli*, a sub-group of fecal coliform. The Category 1 sediment is based on results of a sediment bioassay. The purple Category 4C areas east of the UW are associated with the presence of non-native aquatic plants, specifically Eurasian water-milfoil and Brazilian elodea (Ecology, 2024).

2.6 Temperature

Ecology has designated Lake Washington and the Ship Canal as "core summer salmonid habitat" and establishes an aquatic life temperature standard of 60.8°F (16°C) as the maximum seven-day average of the daily maximum temperatures (Ecology, 2024; Washington Administrative Code [WAC] 173-201A-200(1)(c)). As noted by Urgenson and others (2021), "average daily temperatures above 15 – 16°C are associated with serious infection rates and temperatures above 15.6 – 17°C are associated with reduction in reproductive success [of salmonids]. Whereas, temperatures below 13 – 14°C are protective of adult [salmonids] holding and rearing."

[1] Metalimnion is defined as "a narrow band—colder than the upper and warmer than the lower waters—which helps to prevent mixing between the upper and lower layers" (Washington State Lake Protection Association, 2007).

Over the course of the year, water feeds into Lake Washington from the Cedar River; Sammamish River; numerous smaller tributaries, such as Little Bear, North and Swamp Creeks; numerous minor drainages; and direct precipitation. The surface of the lake is cooled or warmed by ambient air temperature conditions, and stream temperatures tend to reflect the seasons (except in spring when snow melt may reduce stream temperatures lower than ambient conditions). The lake does not freeze in winter and that results in wind-driven, shear-induced currents that drive vertical water mixing of the entire lake profile during the winter months. As the surface of the lake warms in spring, the warmer water becomes less dense and does not mix as readily with denser cooler water at greater depth in the lake, leading to lake stratification with three pronounced and defined zones: (1) a warmer upper strata (or epilimnion) in equilibrium (to a degree) with the atmosphere, (2) a colder lower strata (or hypolimnion) isolated (to a degree) from the atmosphere, and (3) a distinct interval known as the thermocline (or metalimnion) within which the temperature gradient (and associated density gradient) between the upper and lower strata exists (Kalff, 2002). During the summer months, as the thermocline develops within the lake, this interval acts as a physical mixing barrier between the epilimnion and hypolimnion, preventing mixing of the entire lake profile. Due to this physical mixing barrier present in Lake Washington during the summer months, water quality parameters (dissolved oxygen and pH) within the epilimnion and hypolimnion can vary greatly (refer to Sections 2.7 and 2.8).

Lake Washington has been limnologically described as a warm monomictic (mixes once a year from top to bottom) lake with stratification (described above) occurring seasonally from approximately June through October (Eggers and others, 1978; Kalff, 2002; and others). In summer, the epilimnion in the lake can reach up to 25°C and typically develops from the surface of the lake to a depth of approximately 15 meters below the surface by late summer/early fall (Eggers and others, 1978). The thermocline, below the epilimnion, is typically encountered within the 15– to 20-meter depth interval of the lake by early fall when it is most pronounced (Eggers and others, 1978). In winter, as the epilimnion cools to ambient air temperatures and becomes a similar temperature (and density) to the underlying hypolimnion (approximately 10°C for Lake Washington), the lake becomes unstratified allowing for full lake-profile mixing to occur from approximately November through May.

Baseline temperature conditions for Lake Washington are further discussed in Section 2.6.2.2 as measured at King County monitoring points and in the field by Shannon & Wilson scientists at the proposed intake location in the lake and at a potential discharge location in Portage Bay. The baseline conditions measured by King County and Shannon & Wilson for Lake Washington are mostly consistent with the warm monomictic limnological conditions described above (Eggers and others, 1978; and others). In summer, the data indicates the epilimnion reaches approximately 22°C (on average) while maintaining a hypolimnion temperature of approximately at or below 10°C. In winter, the data indicates an unstratified mostly uniform lake profile with a temperature of approximately 8 to 10°C.

In addition to temperature, the dissolved oxygen content and pH vary seasonally with depth in summer due to the incomplete mixing of the lake. That variation and relevance to the project is discussed in more detail in Sections 2.7 and 2.8.

2.6.1 Available Information Sources

Our research revealed the following two sources of data describing the temperature profiles in the lake.

1. Lake Washington Real Time Temperature Model (LW-RTTM) developed by DSI, LLC (DSI, LLC, 2024): The LW-RTTM is a model that predicts the spatial distribution of temperature across Lake Washington at 1-meter vertical intervals between the surface and 55 meters water depth (Exhibit 2-7). The model is accessible online and will render predictions at a given location and depth for a specified period between 2021 and 2023, or as a vertical profile at a given location for a specific date and time.
   a. Strengths:
      - The model is described as open source and a current version is available to the public by DSI upon request. The current version has a more refined calibration and uses a more recent model version than the online model, and thermal loading scenarios can be set up and be run and output processed using a proprietary graphical user interface available for a nominal fee.
      - Displays model-predicted temperatures across the full areal extent of the lake while at the same time showing the depth of the lake.
      - Depicts model-predicted temperature as a time series at a given depth (model layer), or along a vertical depth profile on a daily basis.
      - Appears to reasonably represent lake bathymetry and as such indicates that water intakes at depths exceeding 20 meters would have to be positioned east of Union Bay; east, southeast, or south of Webster Point; or north toward Wolf Bay. Exhibit 2-8 can be used to qualitatively assess how well the model simulates lake bathymetry by visually comparing the distribution of active temperature cells in the model at each simulation depth to depth soundings reported by the National Oceanographic and Atmospheric Administration (NOAA) in 2012 (NOAA, 2023).

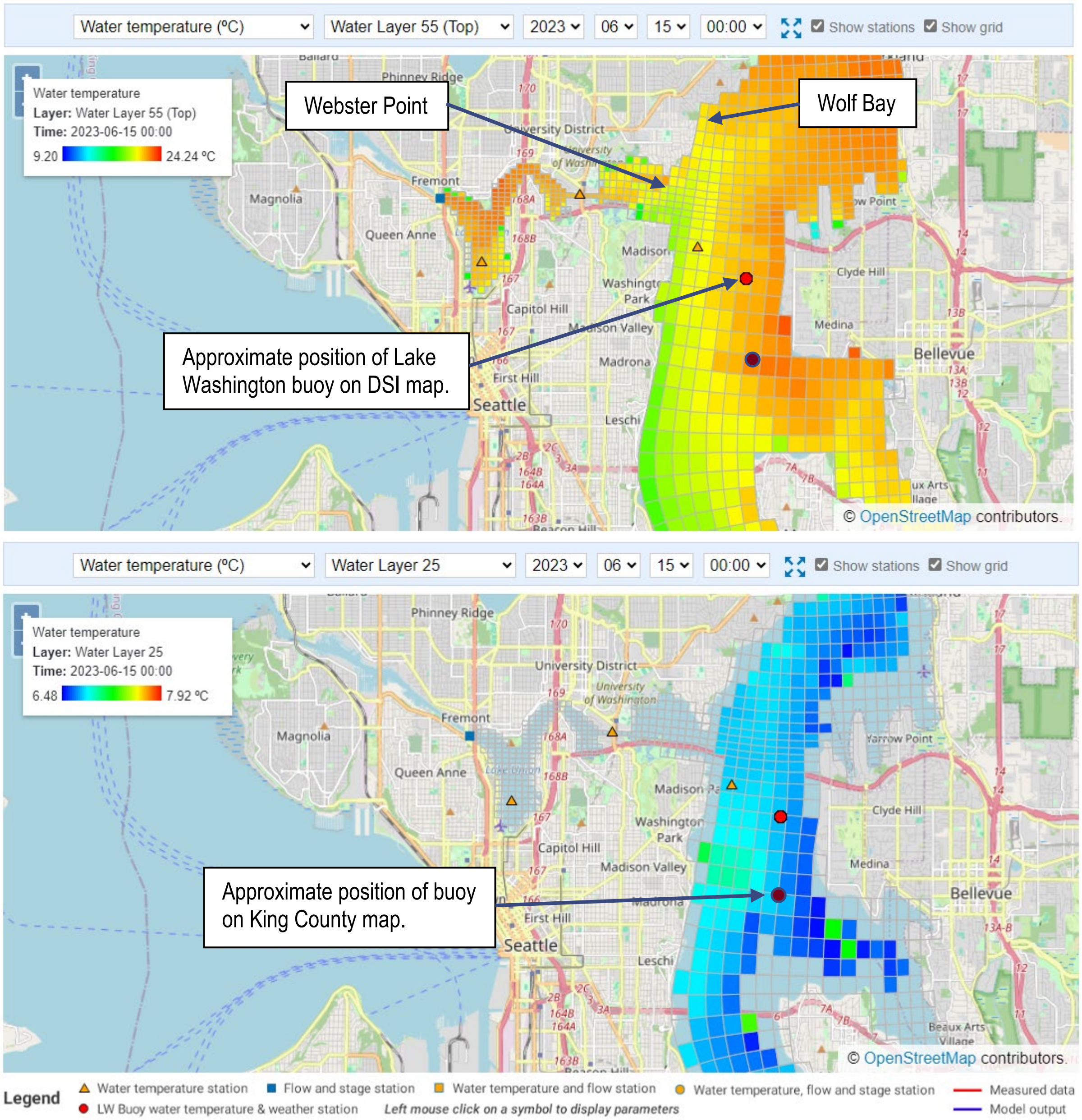


Exhibit 2-7: Maps Exported from the Lake Washington Real Time Temperature Model Showing the Spatial Distribution of Model-Predicted Lake Water Temperatures on June 15, 2023 at Midnight at the Water Surface (Top) and at Approximately 30 Meters Water Depth (Bottom) (Source: DSI, LLC, 2024)

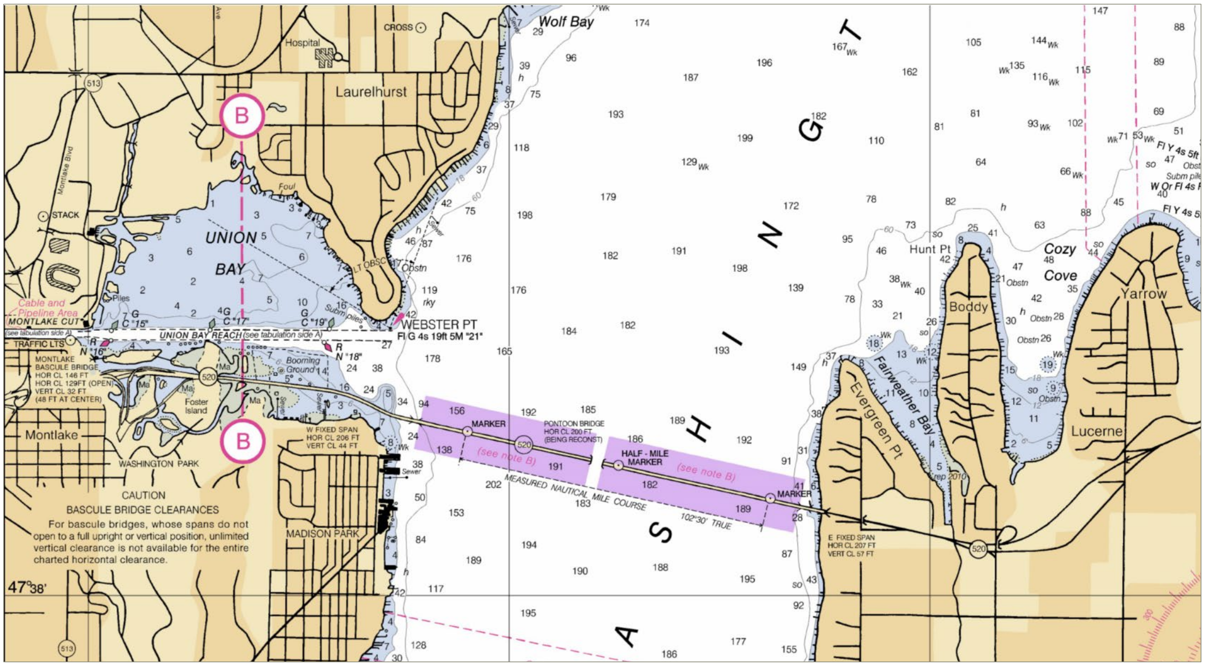


Exhibit 2-8: Bathymetry of Lake Washington in the Vicinity of the University of Washington and the Ship Canal (Soundings in Feet Relative to Local Mean Lower Low Water) (Source: NOAA, 2023)

b. Weaknesses:
   - The Lake Washington area has been calibrated primarily based on a single temperature profile recorded twice daily at the Lake Washington buoy (Station WABuoy), which is located south of the SR 520 floating bridge and approximately 2.5 miles from Webster Point. Station 0852 is also used, with approximately one reading per month.
   - The model is calibrated to a limited set of lake water temperature and meteorological data (air temperature, wind speed and wind direction). The accuracy of model predictions could be significantly enhanced if additional water temperature profiles and meteorological data were available.
   - May not reasonably account for the lateral and vertical variations in lake temperature at the desired water intake location and depth, especially during the critical summer season, because of insufficient field data, both meteorological and lake temperature, which form the basis of model calibration and predictive power.
   - Limited descriptive information available online from which to evaluate the reliability of the model predictions, and the online version presents a curtailed spatial coverage and is said to not reflect latest calibration efforts or software version. However, the latest version is available directly from DSI, LLC for direct manipulation using an available graphical user interface.

- The online model under-predicts temperature at depth during the coldest months, meaning that the lake is likely warmer than the model predicts at water depths between 20 and 30 meters depth (Exhibit 2-9).
- The model-predicted temperatures at 20 meters depth exceed measured values by 2° to 4°C between July and November and by 1° and 2°C between September and November at 30 meters depth (Exhibit 2-9).
- Based on King County's map of Station WABuoy and confirmation by County staff, the position of the buoy depicted on the LW-RTTM website is incorrect and the buoy is located farther south than what is shown and thus farther away from Webster Point (see model's and the County's locations for the buoy in Exhibit 2-6). No explanation for the location discrepancy could be found.

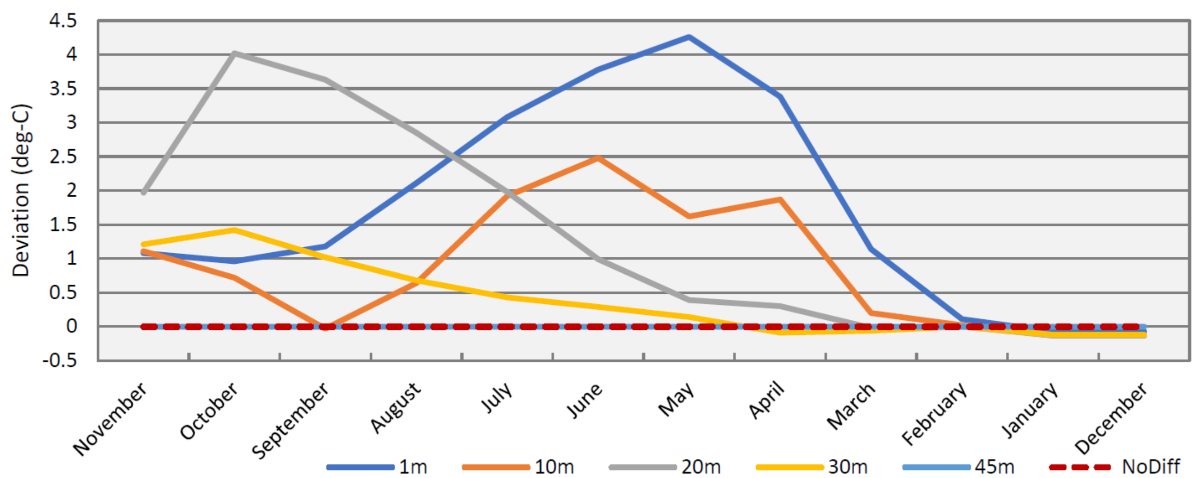


Exhibit 2-9: Difference Between Average Measured and Model-Predicted Temperatures by Depth and Month Showing the Deviation Between Model-Predicted and Measured Temperatures at 20 Meters Depth Can Exceed 2°C Between July and November and at 30 Meters Depth Can Exceed 1°C Between September and November

2. King County Data (King County, 2024) collected and provided by King County, Washington: King County has operated an array of monitoring stations and one "profiling buoy" on Lake Washington since at least 2000 as part of its *Major Lakes Monitoring Program* (Exhibit 2-10). Available data include water temperature, dissolved oxygen, pH, specific conductance, chlorophyll fluorescence, and turbidity. Data was collected at various depths from near the lake bottom to within 1 meter of the surface. The most detailed measurements were collected at the profiling buoy where data was typically collected twice per day at approximately 1-meter intervals between the surface and approximately 54 meters water depth.

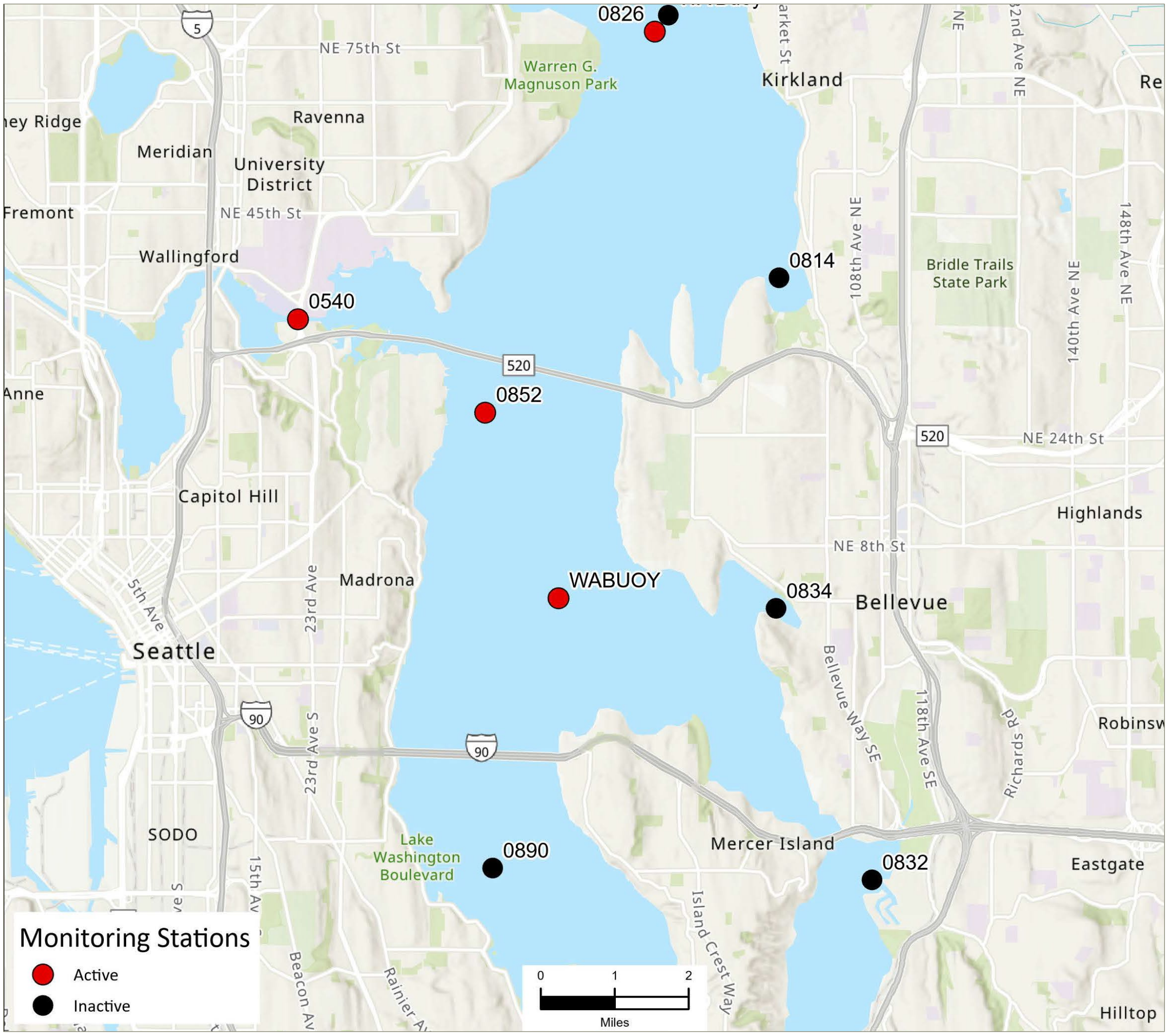


Exhibit 2-10: Location of Profiling Buoy and Stations in Lake Washington Maintained by King County and Reported on Its Website. Station 0852 is the Closest Station to Webster Point. Station WABuoy is the Profiling Buoy Used by the Lake Washington Real-time Temperature Model for Calibration. (Source: King County, 2024)

Data from the other active stations were collected more sporadically, but typically between three and six times per day at various depths. Data from the currently inactive stations were collected at various depths approximately four times per day throughout the years in which they were operated. The closest active station for which lake temperature data is available is Station 0852. Station WABuoy is the profiling buoy used by the LW-RTTM for calibration. Station 0540 is in the Ship Canal near the UW Medical Center and just west of the Montlake Bridge.

a. Strengths:
   - Provides long-term and definitive understanding of local lake water temperatures as well as basic water chemistry from surface to as deep as 54 meters water depth.
   - Identifies the location of the thermocline that develops during the summer into fall that would need to be considered for the project design.
b. Weaknesses:
   - Limited number of stations.
   - No stations located in the immediate vicinity of the probable intake pipe.

2.6.2 Baseline Conditions

2.6.2.1 Lake Washington

Probable baseline conditions in Lake Washington near the project area intake are likely best estimated from the temperature versus depth thermal profiles recorded by King County at Station 0852 because it is the closest monitoring station to the probable intake area at which lake water temperatures have been regularly recorded at depth. Station 0852 is described as the "Madison Park" station and is located close to and south of the SR 520 bridge (Exhibit 2-10). The data from Station 0852 provides temperature and water chemistry parameter values at depth from the surface down to greater than 40 meters depth measured every month of the year during 607 measurement events out of 11,494 days, or 5.3% of the days between January 1993 and June 2024. Shannon & Wilson has also collected three months of real-time baseline condition data from a potential intake location; however, due to the limited period of Shannon & Wilson monitoring, baseline conditions observed from year to year are best provided by the Station 0852 data due to the significantly longer period of monitoring (approximately 22 years).

In general, the seasonal temperature profiles collected at Station 0852 reflect the warm monomictic limnological conditions previously described for Lake Washington. At Station 0852, the coldest water temperatures were consistently recorded in February during which time lake water temperature was nearly constant with respect to depth, varying between 6 and 9°C. By June, a prominent thermocline consistently developed between 10 and 20 meters water depth; resulting with the associated development of (1) the epilimnion where temperatures ranged seasonally from approximately 9 to 24°C and (2) the hypolimnion where temperatures ranged seasonally from approximately 6 to 12°C. The average temperature of the deepest part of the lake (e.g. the hypolimnion) does not vary appreciably between the coldest and warmest seasons.

At Station 0852, a total of 1,102 temperature measurements were below 7°C. Of those 1,102 measurements, 70 were recorded during the period 2019 through 2023, all of which were recorded in the month of March. Twenty-four of 135 temperature readings recorded during that period below 24 meters water depth were below 7°C, which equates to 17.8% of the total readings recorded during that period below 24 meters depth.

A string of thermistors was deployed at a related station (Station 0852B) at water depths between 2 and 55 meters between 1998 and 2011. The string of thermistors was located closer to and likely hanging from the SR 520 bridge. Those data also indicate that lake water temperatures fall below 7°C at certain periods of the year, predominantly between the months of January and April but extending to as late as July at deeper depths. Between January 2000 and June 2011, 13,013 of 176,945 (7.4%) of the readings listed for 55 meters water depth were below 7°C and 2,027 of those readings (1.1%) were below 6.5°C. The data indicate that the majority of the coldest measurements (those below 6.5°C) occur at water depths below 35 meters.

Exhibits 2-11 and 2-12 provide temperature versus depth profiles constructed from the Station 0852 data for every month of the year.

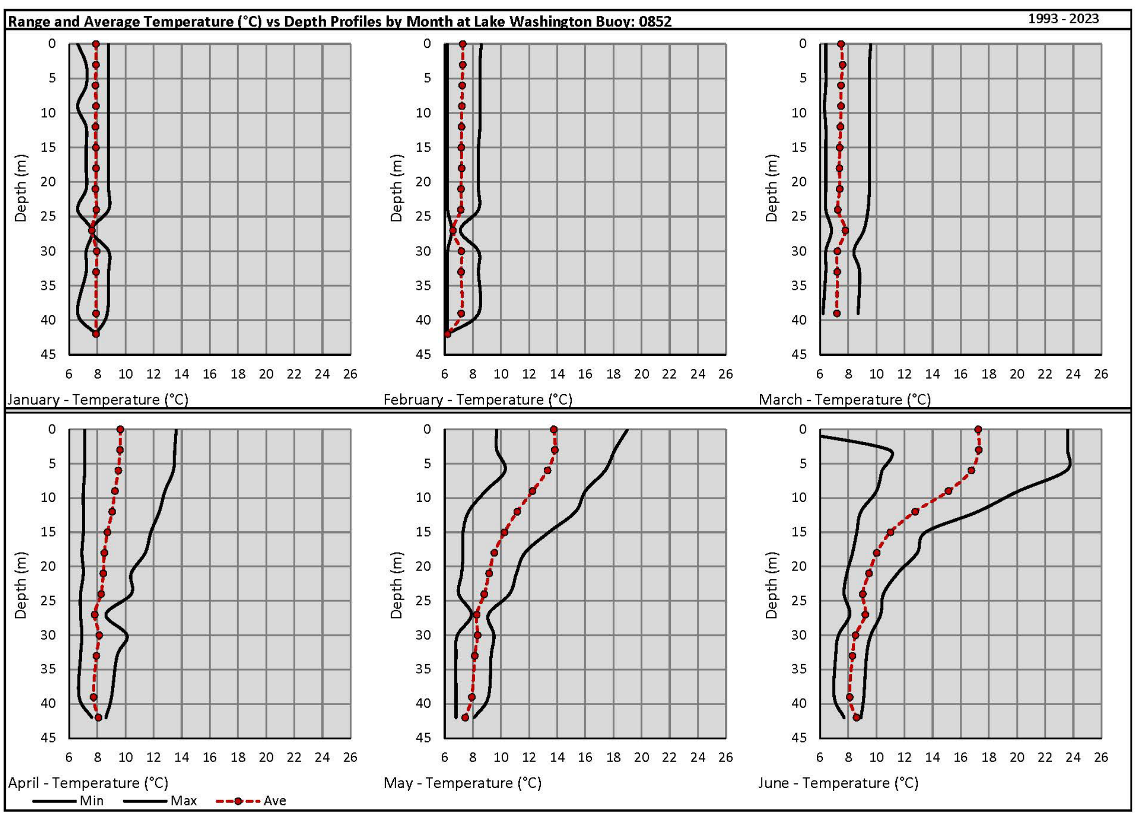


Exhibit 2-11: Temperature Versus Depth Profiles Recorded by King County at Station 0852 Showing the Range and Average of Recorded Temperatures Across 3-Meter Depth Intervals From the Surface Down to 45 Meters Depth During the 30-Year Period From 1993 to 2023 for Months January Through June.

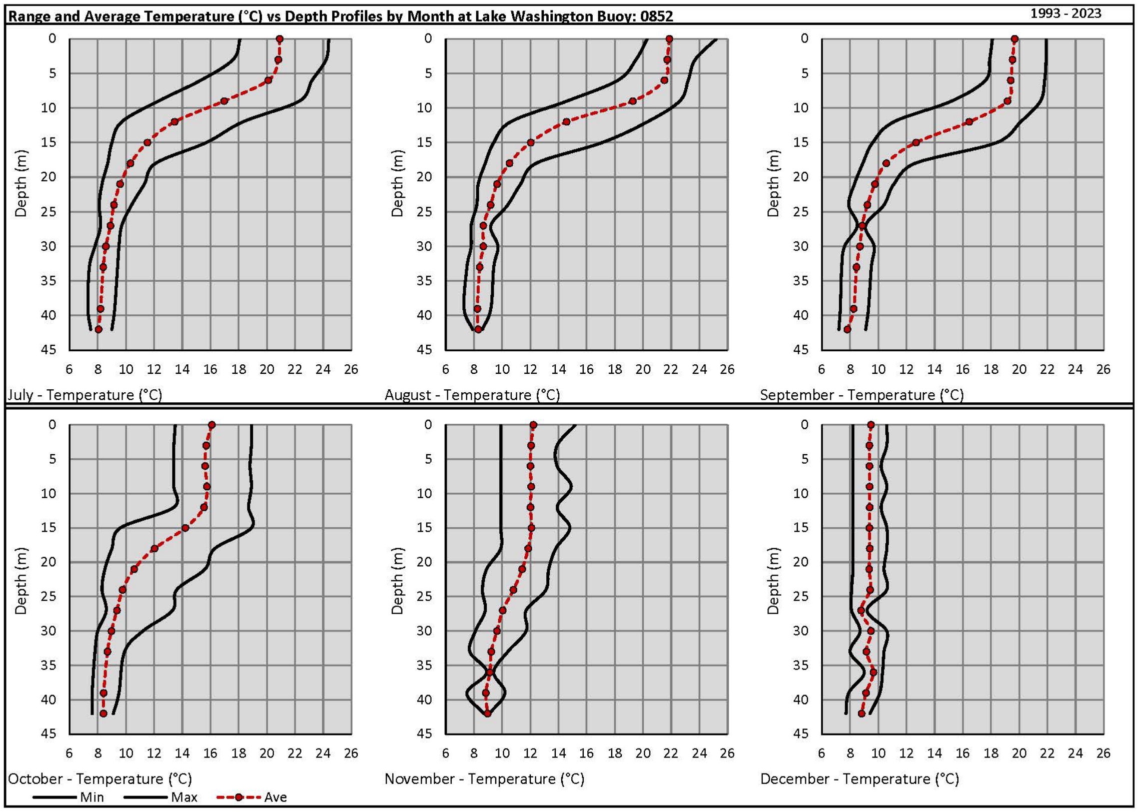


Exhibit 2-12: Temperature vs Depth Profiles Recorded by King County at Station 0852 Showing the Range and Average of Recorded Temperatures Across 3-Meter Depth Intervals from the Surface Down to 45 Meters Depth During the 30-Year Period From 1993 to 2023 for Months July Through December.

2.6.2.2 Ship Canal (Montlake Cut)

Station 0540 is described as a "Lake Union" station but is in the Ship Canal near the UW Medical Center and adjacent to the Montlake Bridge closer to the preferred discharge point (Exhibit 2-10). Temperature data has been collected monthly at that location for nearly 50 years (April 1975 through December 2023) at water depths between 0 and 10 meters. The coldest and warmest readings (3.8 to 25.3°C) were recorded in the upper 2 meters of water. Water as cold as 1.3°C was recorded in what was described as a "composite" sample. The maximum recorded water temperatures at any depth have not exceeded 14°C during the months of December through April. Maximum monthly temperatures have been consistently rising in all months across the 49-year period of record. Minimum monthly temperatures also display rising trends across the period of record during the months of January, February, August, and December but display falling trends in the other months.

Exhibits 2-13 and 2-14 provide temperature versus depth profiles constructed from the Station 0540 data for every month of the year.

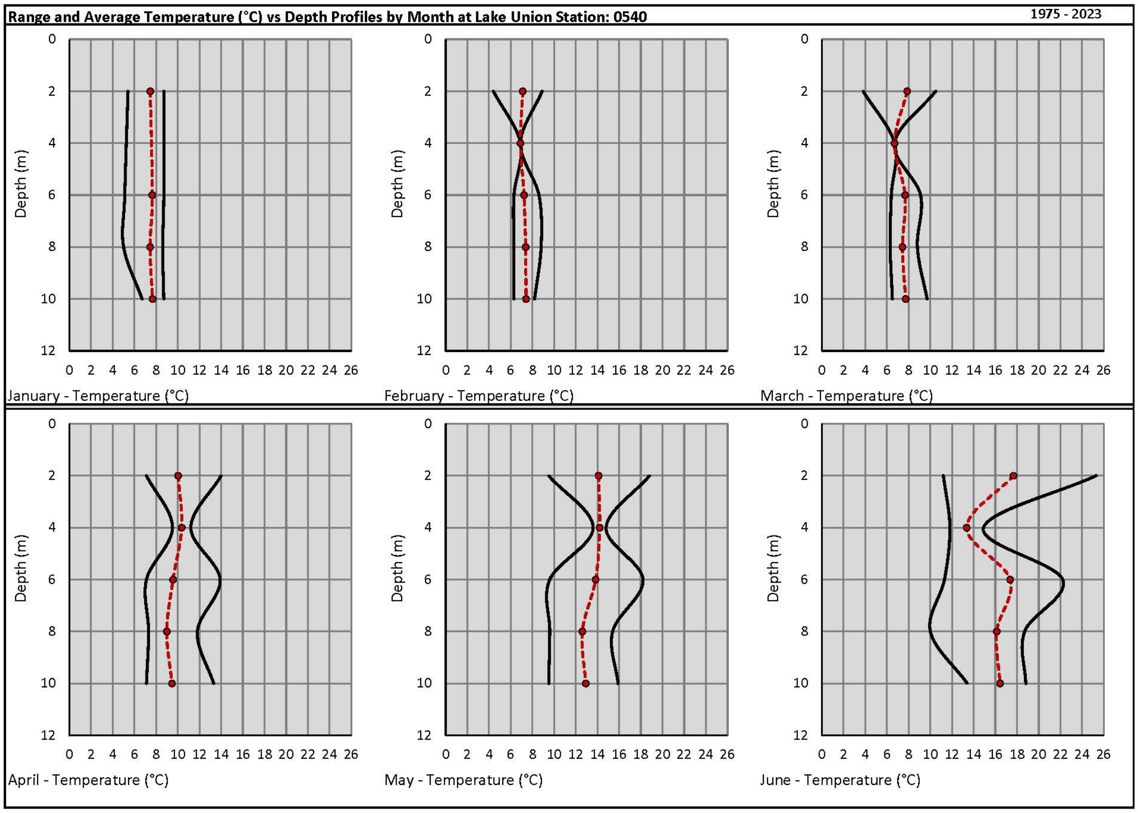


Exhibit 2-13: Temperature Versus Depth Profiles Recorded by King County at Station 0540 Showing the Range and Average of Recorded Temperatures Across 2-Meter Depth Intervals From the Surface to 10 Meters Depth During the 49-Year Period From 1975 to 2023, for Months January Through June.

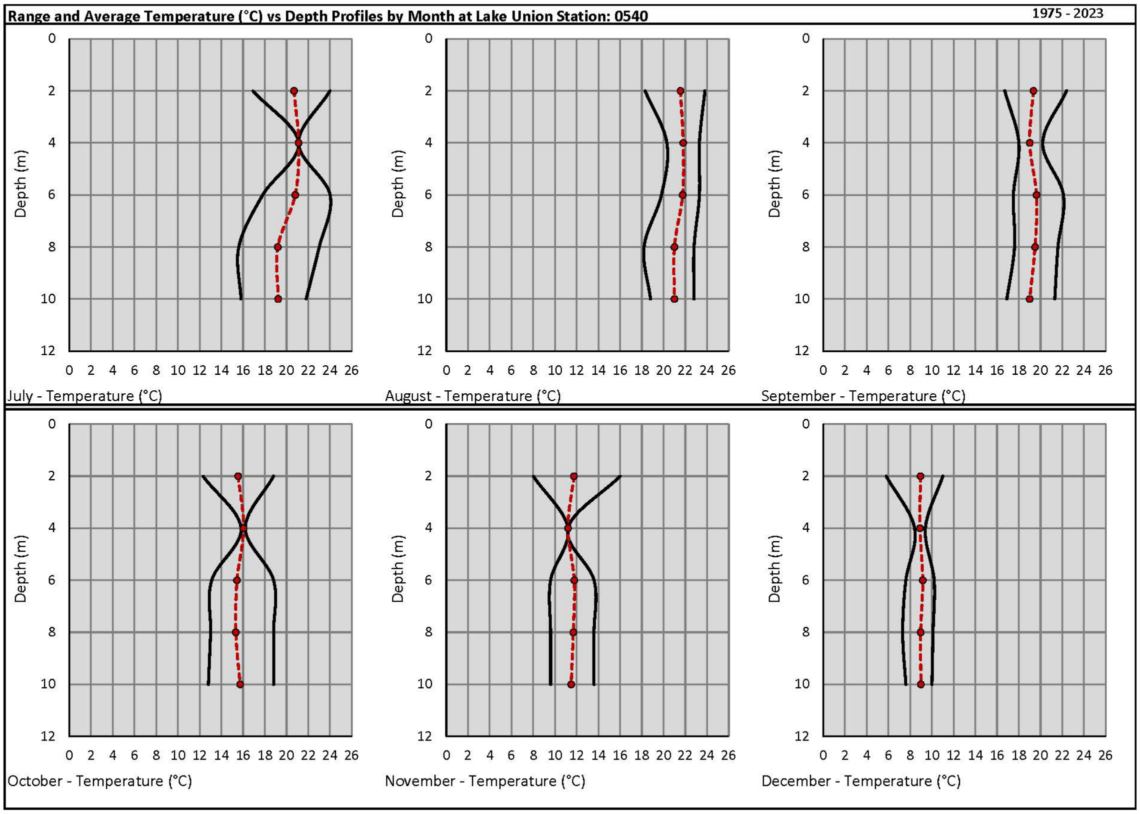


Exhibit 2-14: Temperature Versus Depth Profiles Recorded by King County at Station 0540 Showing the Range and Average of Recorded Temperatures Across 2-Meter Depth Intervals From the Surface to 10 Meters Depth During the 49-Year Period From 1975 to 2023, for Months July Through December.

2.6.2.3 Measured versus Modeled Temperature Profiles at Intake and Discharge Locations

Due to the location of the proposed intake and preferred discharge locations not being represented by the King County monitoring buoy data presented above, Shannon & Wilson scientists collected real-time temperature data from those points during three separate events between October 2024 and January 2025. Shannon & Wilson navigated a watercraft to the potential intake and preferred discharge locations in the Ship Canal and on Lake Washington using a hand-held global positioning system (GPS) and deployed a calibrated YSI Pro DSS® water quality meter to collect real-time temperature profiles at 0.6-meter (2-foot) intervals at each of the two locations. Temperature data, along with dissolved oxygen and pH (refer to Sections 2.7 and 2.8), was collected from immediately below the lake surface to the total depth of the lake at each location during each profiling event.

The real-time temperature data was collected by Shannon & Wilson to compare the proposed intake and discharge location thermal profiles to the LW-RTTM simulated thermal profiles for Lake Washington on the same date. Specifically, the following

LW-RTTM grid locations were utilized to compare the collected real-time thermal profiles against:

- Cell 659 of the LW-RTTM was selected to compare against collected real-time thermal profile at the intake location, and
- Cell 714 of the LW-RTMM was selected to compare against collected real-time thermal profile at the preferred discharge location.

Intake Location Thermal Profiles

<u>Stratified October Profiling Event</u>

On October 17, 2024, the epilimnion of the lake extended to approximately 16 meters deep and the temperature of this strata was uniformly measured to be 16.3° to 16.4°C (Exhibit 2-15). At this time, as the lake remained density stratified from the warm summer months, the thermocline was measured from approximately 16 to 22 meters deep with temperatures dropping from 16.3° to 10.3°C. Below 22 meters, the hypolimnion of the lake had a measured temperature of approximately 10.3°C.

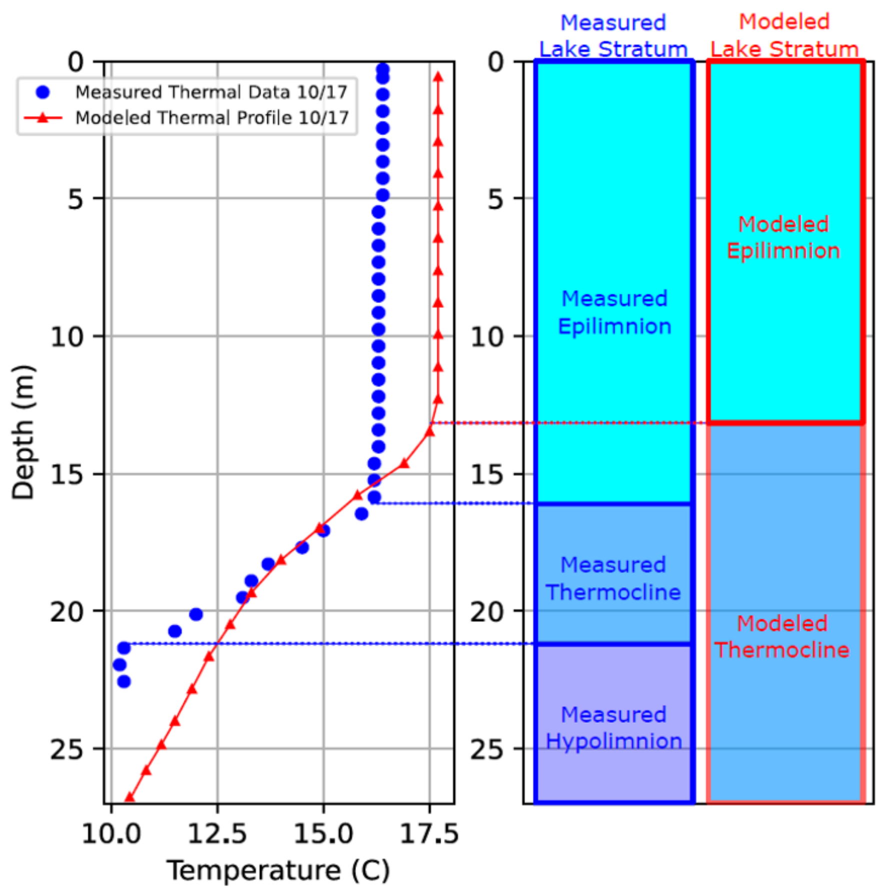


Exhibit 2-15: Measured Versus Modeled Thermal Depth Profile at Intake Location Recorded by Shannon & Wilson October 17, 2024.

In general, the modeled thermal profile for the intake location agrees with our measurements: both capture the seasonal stratification of a monomictic lake prior to winter mixing. However, the modeled thermal profile was consistently warmer than was measured at the intake location during the October profiling event (Exhibit 2-15). Within the epilimnion, temperatures were consistently modeled to be +1.5°C warmer than measured during the October profiling event. The modeled thermocline interval begins shallower than measured and has a much more gradual decrease of 5.7°C over 17.5 meters (-0.33°C per meter) compared to the measured decrease of 6°C over 5.4 meters (-1.11°C per meter). Lastly, though the modeled temperature of the hypolimnion is similar (~10°C) to the value measured during the October profiling event, the modeled depth to the cold hypolimnion (~10°C) was much deeper, at 28.7 meters depth compared to the measured 21.3 meters depth. As a result of these discrepancies, the measured versus modeled thermal profiles result in fairly large misplacement of the distinct limnological zones at the proposed intake location (especially the thermocline and hypolimnion, Exhibit 2-15).

The October 2024 data and the modeled data may differ because the model accounts for multiple years of input rather than one discrete data point. Alternately, the disparity between the warmer-modeled and cooler-measured thermal profile at the intake location during the October profiling event may be reflective of the model accounting for too much thermal loading of the lake during the summer months. The thicker modeled interval in which the thermocline exists may be reflective of the model accounting for too much mixing to occur between lake strata at this time, as observed by the difference in modeled versus measured temperature decline below the epilimnion. To design an ideal project intake depth, a better understanding of the seasonal temperature distribution at the intake location is crucial for long-term project resiliency. However, Exhibit 2-15 clearly illustrates a lack of the LW-RTTM model's ability to converge to the measured data collected during the October profiling event and would require additional calibration efforts specific to the intake location to better the model convergence to measured data (refer to Section 6.2).

Unstratified December and January Profiling Events

By December 6, 2024, the collected data at the intake location indicate mixing had begun between the shallow and deep lake layers (Exhibit 2-16). The thermocline is no longer prominent at this time, and the lake is capable of complete-profile mixing due to the lack of lake stratification. The colder winter ambient air temperatures had cooled the epilimnion in the lake until the water temperature (and associated density) became similar (10.1°C) to the cold and dense deep water (10.0°C) below, allowing mixing to occur between the strata (e.g., throughout the lake profile). This is further evidenced by the unstratified dissolved oxygen profiles collected at this time (refer to Section 2.7).

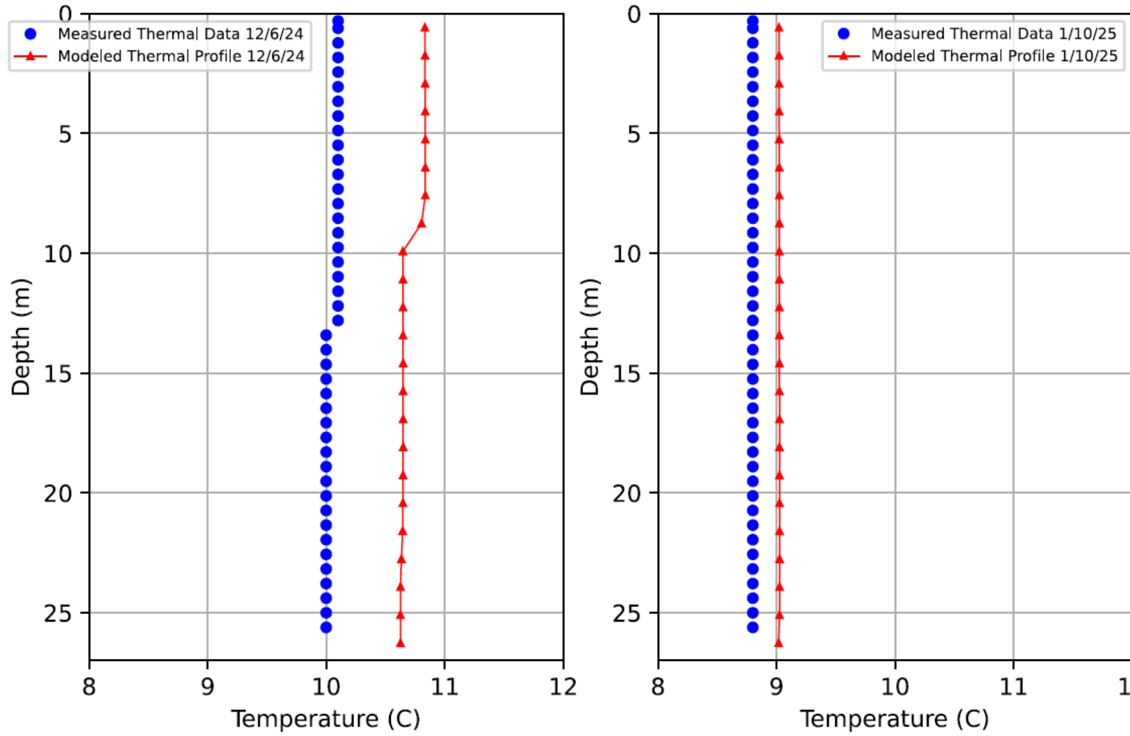


Exhibit 2-16: Measured Versus Modeled Depth Profile at Potential Intake Location Recorded by Shannon & Wilson during December and January Profiling Events

The measured versus modeled profile during December 6, 2024, in general, both capture the seasonal change from thermal lake stratification to unstratified conditions at the intake location (Exhibit 2-16). Again, however, the modeled temperature is consistently higher than was measured, this time uniformly throughout the entire profile by 0.5°C to 0.7°C. The discrepancies between the modeled and measured thermal profile at the intake location during the December profiling event can only be explained by the model accounting for too much thermal loading of the lake throughout the year; however, the measured versus modeled profiles are beginning to converge compared to the October profiles collected at the intake location (e.g., less overall temperature differences).

By January 10, 2025, the collected data at the intake location was uniformly 8.8°C throughout the entire profile of the lake, allowing for the continued winter seasonal mixing to occur due to the prevailing unstratified conditions (Exhibit 2-16).

The discrepancy between the modeled and measured thermal profiles at the intake location during January 2025 is less (0.2°C) than observed in December 2024 (0.5 - 7°C), indicating the model continues to converge to the measured thermal profile output for the intake location as the winter season advances (e.g., recalibrates from over thermal-loading).

Preferred Discharge Location Profiles

The preferred discharge location, being at a depth of just over 6 meters, does not undergo stratification as conditions remain epilimnionic year-long. As a result, and in general, the collected measured data versus modeled output capture the lack of the development of the thermocline (Exhibit 2-17). However, due to the lack of complexity of the profiles (e.g., thermal constancy with depth, except as mentioned), comparison of these locations allows for more direct observation of measured versus modeled temperature within the epilimnion (Exhibit 2-17).

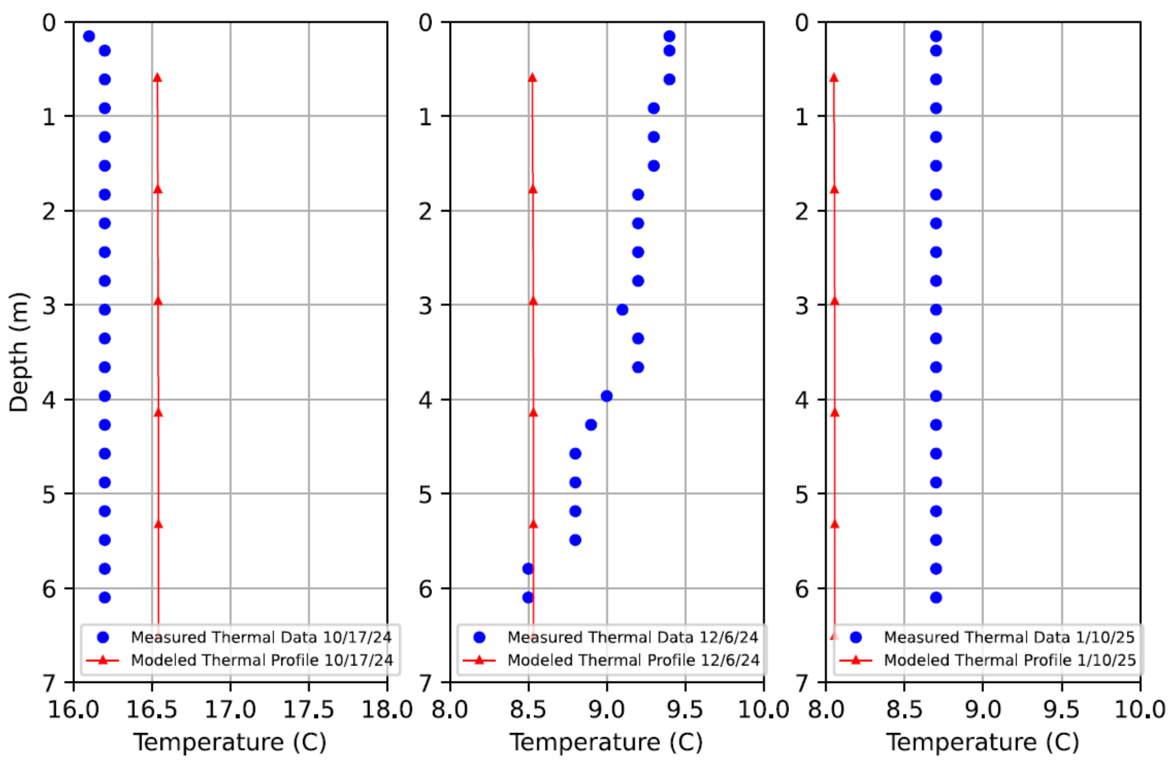


Exhibit 2-17: Measured Versus Modeled Depth Profile at Preferred Discharge Location Recorded by Shannon & Wilson during October, December, and January Profiling Events

During the October profiling event, the collected thermal data was consistently 16.2°C whereas the modeled thermal profile was consistently 16.6°C (Exhibit 2-17). Similar to the modeled profile at the intake location, the modeled profile at the discharge location was consistently higher (+0.4°C), indicating potential for the model accounting for too much thermal loading during the summer months. However, the temperature anomaly between the measured and modeled profiles at the discharge are much improved in October compared to the intake location, likely reflecting the lack of numerical complexity to account for when constrained to epilimnionic lake conditions.

During the December profiling event, the collected thermal data was inconsistent with the model profile (Exhibit 2-17). The modeled profile of a uniform 8.6°C from surface to total depth is as would be expected within the epilimnion at this time. However, the measured data may capture smaller scale weather patterns occurring prior to and during the December profiling event. The Seattle area experienced typical ambient temperatures through November and into early December 2024, with average daily temperatures of approximately 8.4°C, as was being comparably modeled within the epilimnion at this time (Exhibit 2-17). However, a warming period occurred December 5 through 6, 2024 (profiling event) where the daily high temperatures reached approximately 11°C (at time measured data was collected). The measured profile likely shows (to a degree) the warm ambient temperatures on December 5 and 6 warming the uppermost portion of the epilimnion (9.4°C), while the lowest portion of the epilimnion of the measured profile more closely matches the temperature being modeled (8.5 - 8.6 °C).

During the January profiling event, the collected thermal data was consistently 8.7°C whereas the modeled thermal profile was consistently 8.1°C. As observed in December, the shallow dynamic nature of the discharge location presents challenges for the LW-RTTM. The discharge location seems more susceptible to short term ambient warming than the LW-RTTM model is accounting for, as in January 2025, the lowest portion of the measured profile no longer matches that of the temperature being modeled, as was observed in December 2024.

2.6.3 Climate Change

Climate change is expected to cause atmospheric temperatures in Washington State to persistently increase into the near future (NOAA, 2024), and those increased air temperatures will further contribute to increased Lake Washington water temperatures. NOAA summarizes the trend of increasing atmospheric temperatures in Washington as follows.

> Since the beginning of the 20th century, temperatures in Washington have risen almost 2°F, and since 1986, all but 5 years have been above the long-term (1895–2020) average. The hottest year on record was 2015, with a statewide average temperature of 50.0°F, which was 3.7°F above the long-term average. The overall warming trend is evident in an increased number of warm nights. Since 1990, the numbers of very cold nights in Eastern Washington and freezing days in Western Washington have both been below average. However, the numbers of very warm nights in Eastern Washington and warm nights in Western Washington have both been above average since 1990. The numbers of very hot days in Eastern Washington and hot days in Western Washington have been quite variable but were both generally above

average during the 2015–2020 period, after below average numbers during the 2010–2014 period.

Increasing atmospheric temperatures and their effect on lake water temperatures should be a concern for the project. The longest period of record for lake water temperatures identified by Shannon & Wilson is the 30 years for which data has been collected by King County at Station 0852 (King County, 2024). Preliminary analysis of those data has not revealed a perceptible change in lake water temperatures over time, particularly at depth. However, Winder and Schindler (2004) found that spring-summer stratification was commencing 16 days earlier than previously based on a 40-year record. Another study published in 2004 noted that over a 34-year period, surface (0-10 meters) and entire lake volume temperatures increased by 0.045°C per year and 0.026°C per year, respectively (Arhonditsis and others, 2004). The warming trend was most pronounced between April and September, and insignificant from November through February (Arhonditsis and others, 2004).

2.7 Dissolved Oxygen

The dissolved oxygen criteria for designated "core summer salmonid habitat" are set by Ecology at a one-day minimum of 10 milligrams per liter (mg/L) or 95% saturation (WAC 173-201A-200(1)(d)). Urgenson and others (2021) report that dissolved oxygen levels less than 6 mg/L are "stressful for salmonids with potential slight production impairments." The thresholds for lethal (resulting in mortality) and critical (resulting in severe impairment) effects on salmonids have been set at less than 2 mg/L and less than 4.25 mg/L, respectively (Urgenson and others, 2021). The dissolved oxygen content of water is important for aquatic life and as water warms it can hold less oxygen than cold water. Throughout the year, the near surface of the lake is mixed by wind so that much of the upper part of the lake has good levels of dissolved oxygen in spite of warmer temperatures. When stratification does occur, the lower part of the lake can become oxygen-deprived which alters the pH. These changes can have an impact on both aquatic species and water chemistry.

Data from Station 0852 (south of SR 520), the closest data point to the potential intake location, collected one to two times per month between 2013 and 2023, show that during the summer and fall months, and even as late as December, the dissolved oxygen levels at depths of 20 meters and greater do not meet the Ecology standard (10 mg/L or 95% saturation [WAC 173-201A]). However, the levels only dropped slightly below 7 mg/L during one measurement in October 2021 (King County, 2024). However, the data from Station 0852 may not reflect the annual pattern of dissolved oxygen concentrations at the potential intake location.

Data collected at Station 0540 (in the Montlake Cut, west of the Montlake Bridge) between 2013 and 2023 show that summer dissolved oxygen concentrations in the Montlake Cut area always exceed 7 mg/L, but are lower than the Ecology standard in the summer and fall months, and into December.

Exhibit 2-18 shows the relationship between the dissolved oxygen levels at Station 0852 (a proxy for the potential intake location) and at different depths in the Montlake Cut relative to the Ecology standard.

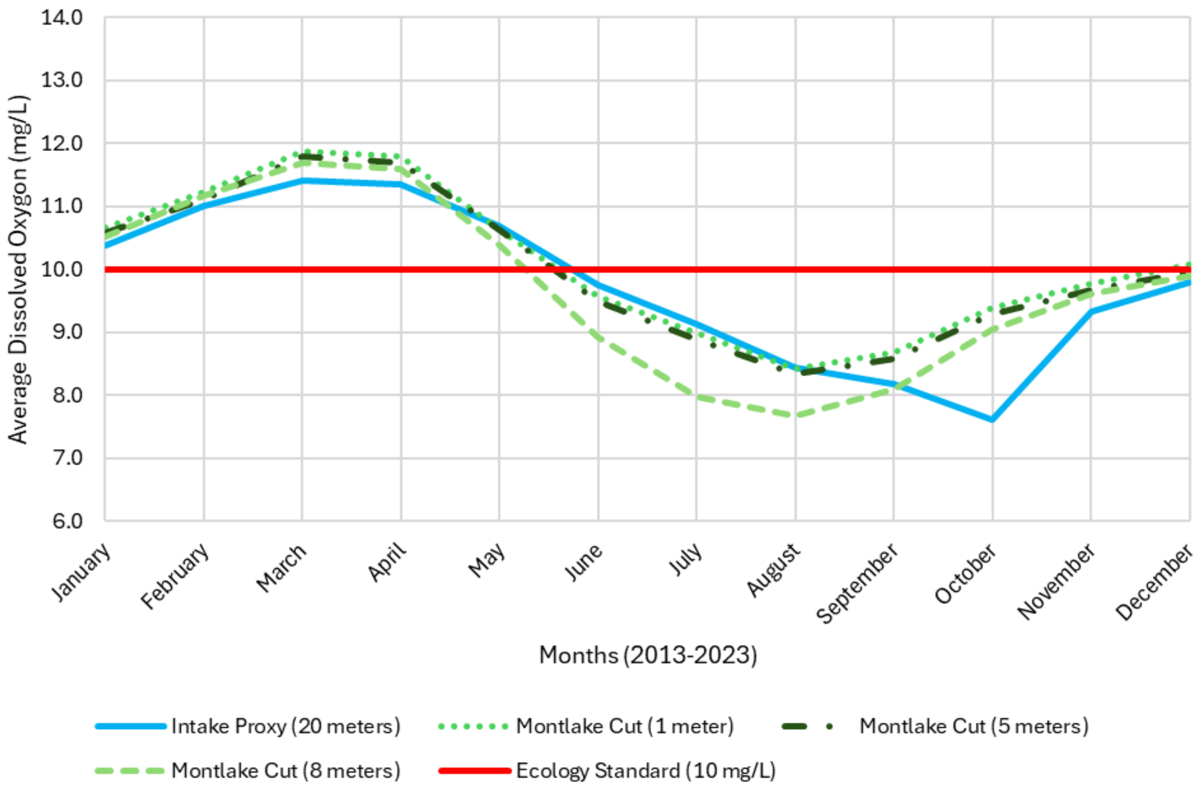


Exhibit 2-18: Dissolved Oxygen Levels at Station 0852 (Intake Proxy) and Station 0540 (Montlake Cut) From 2013 to 2023.

During the three real-time profiling events conducted by Shannon & Wilson between October 2024 and January 2025, dissolved oxygen profiles were also measured at the potential intake and preferred discharge locations at 0.6-meter (2-foot) intervals from the lake surface to total lake depth (Exhibits 2-19 and 2-20).

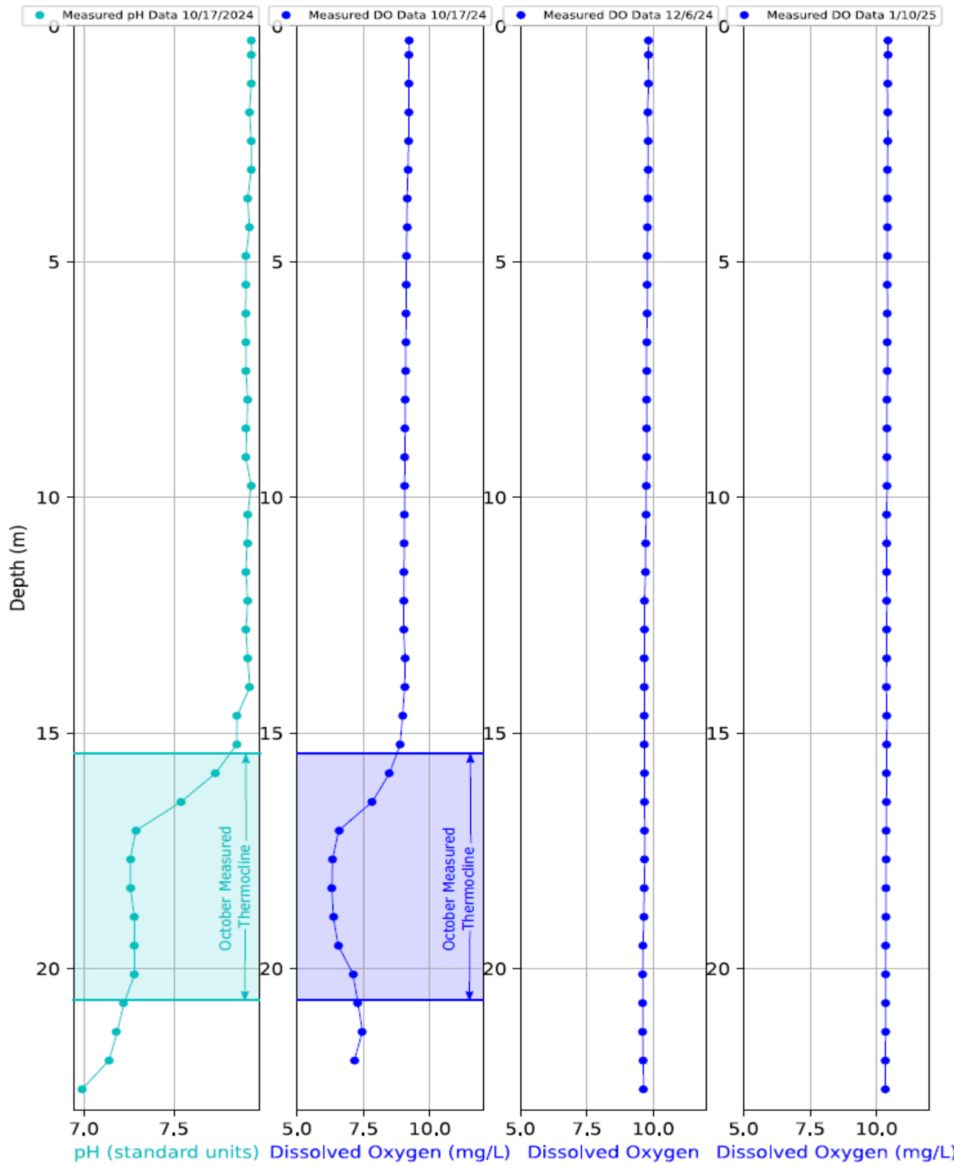


Exhibit 2-19: Measured pH (October Only) and Dissolved Oxygen at Potential Intake Location Recorded by Shannon & Wilson during October, December, and January Profiling Events

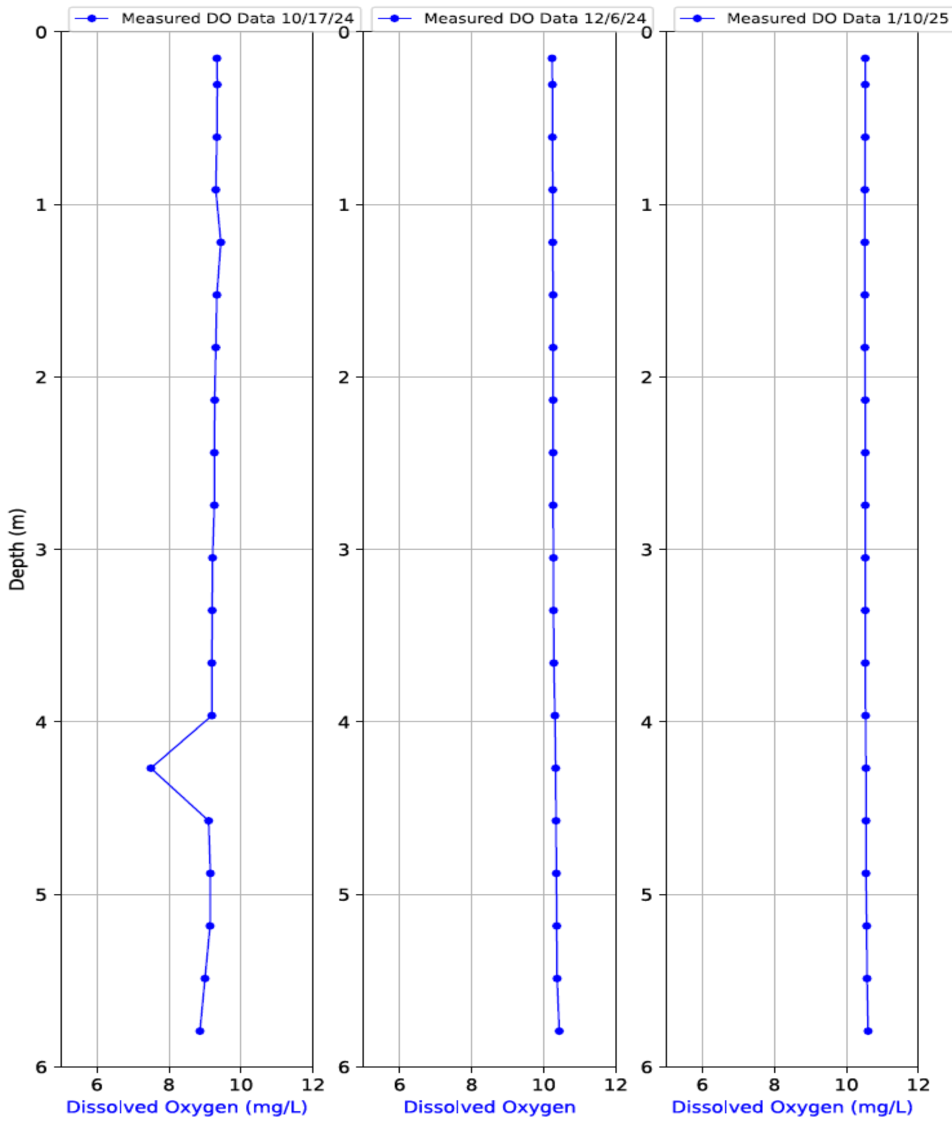


Exhibit 2-20: Measured Dissolved Oxygen at Preferred Discharge Location Recorded by Shannon & Wilson during October, December, and January Profiling Events

As expected at the potential intake location, during lake stratification, the dissolved oxygen, as with temperature varies with depth, indicating a lack of complete mixing. During the October-stratified profiling event, the dissolved oxygen within the epilimnion was consistently 9.0 to 9.2 mg/L, reflecting equilibration with warm atmospheric conditions. During this lake stratification, dissolved oxygen becomes depleted through the thermocline and into the hypolimnion (Exhibit 2-19), reaching as low as 6.1 mg/L within the thermocline and as low as 7.5 mg/L within the hypolimnion. The decrease in dissolved oxygen below the epilimnion would be expected as the thermocline and hypolimnion are isolated to a degree to atmospheric oxygen inputs during lake stratification. The potential discharge location, being confined to the epilimnion, also had a consistent dissolved oxygen profile of approximately 9 mg/L during the October profiling event (Exhibit 2-20).

During the December and January profiling events, while the lake is unstratified, the dissolved oxygen profiles generally become more consistent with depth (Exhibits 2-19 and 2-20). The dissolved oxygen content overall increases as winter progresses as cooler water temperatures allow for more dissolved gasses and the lake is capable of complete mixing (being in quasi-equilibrium with the atmosphere throughout the profile).

2.8 Other

During summer, the lower dissolved oxygen at depth also changes the pH. Exhibit 2-19 presents the intake location dissolved oxygen and pH profile collected by Shannon & Wilson during the October profiling event, and demonstrates the dissolved oxygen and pH are markedly lower in the hypolimnion compared to the overlaying epilimnion. The measured pH and dissolved oxygen of the hypolimnion were approximately 0.8 standard pH units lower in pH (e.g., more acidic) and 4.5 mg/L lower in dissolved oxygen when compared to the epilimnion during the October profiling event. This increased acidic condition can mobilize metals that are in sediments at the base of the lake. If metals are mobilized from the sediment, without mixing or currents, the metals would remain near the sediments (roughly millimeters). Currently, there has been elevated lead in water recorded in the Montlake Cut and Portage Bay area as defined in the 303(d) classification of that water. Other man-made and naturally sourced contamination exists in the sediments of Lake Washington. For example, arsenic naturally is present from weathering of the igneous rocks in the area but is also sourced by human activities. Therefore, the intake depth design needs to consider potential scouring effects and prevent disturbing the loose sediment layer at the base of the lake.

To assess if the seasonal changes to the pH profile may mobilize any metals present in the lake sediment, and to identify any man-made or naturally occurring contamination near the proposed intake and discharge locations, Shannon & Wilson sampled both locations for water quality parameters using the following analytical methods:

- Biochemical oxygen demand (BOD) by Standard Method 5210B
- Dissolved metals (As, Cu, Pb, and Zn) by EPA Method 200.8
- Diesel- and oil-range petroleum hydrocarbons by Northwest Total Petroleum Hydrocarbons-Diesel extended (Dx)
- Polychlorinated biphenyls (PCBs) by EPA Method 8082A.

The potential intake location was sampled twice for the above listed parameters (December 2024 and January 2025), and the preferred discharge location was sampled once (January 2025). Each sample was taken at the target depth using a HydraSleeve®, a passive grab-sampler made of a loose HDPE sleeve that is weighted at the bottom and sealed shut by water pressure upon upward retrieval. The samples were then placed within laboratory-supplied containers, immediately placed on ice within a cooler, and transported to Onsite Environmental Laboratory in Redmond, Washington for analyses. Results from both sampling events are included in Appendix B.

None of the analytes were detected in December 2024 at the intake, except for a low concentration of dissolved arsenic (0.658 µg/L). Samples from both the preferred discharge and potential intake points collected in January 2025 also did not contain detections of the analytes except low levels of dissolved arsenic (0.653 and 0.619 µg/L, respectively). These detected arsenic concentrations are within a normal range and below the naturally occurring levels. BOD was not detected in any of the samples, indicating that the natural processes of species and the environment are occurring as usual and using available oxygen within the system. Due to (1) the non-detectable concentrations of BOD, PCBs, copper, lead, zinc, and diesel- and heavy oil-range hydrocarbon, and (2) arsenic concentrations within normal ranges, the water at the intake and preferred discharge locations is not considered contaminated.

3 PERMITTING/APPROVALS

During Phases 1 through 3, Shannon & Wilson staff, sometimes joined by AEI or UW staff, met with representatives from many of the key regulatory agencies and the Muckleshoot Tribe to provide a high-level concept overview of the project's goals, objectives, and general design elements; to collect the agencies' initial project-related considerations and concerns; and to obtain available agency information that would help inform project development. Appendix A documents this coordination and includes agency contact(s), associated environmental permit/approvals, and dates and types of communication.

This section outlines our current understanding of the federal, state, and local permits and approvals the project may need to obtain and incorporates the associated agency and Tribe feedback received to date. Section 4 considers the information in this section and lays out a possible permitting strategy.

3.1 Federal

The project may receive several federal permits and approvals. Federal permits and approvals issued under Sections 3.1.1.1 through 3.1.1.3 and 3.1.4 are actions that require the federal agency, either the Corps or the U.S. Coast Guard (USCG), to complete an environmental review under the National Environmental Policy Act (NEPA) to assess the impact of the permitted or approved activity. The NEPA process for these approvals typically occurs in the background and is completed by the federal agency using information submitted by the applicant. If the project requires both Corps and USCG approvals, those agencies would need to communicate to determine who is the federal lead agency. In most circumstances, the Corps would be the lead; the discussions in the permitting/approvals sections below assume this would be the case for the project.

If the project were to receive federal funding, the burden of developing the NEPA documentation could shift to UW depending on the grant agency and the level of NEPA analysis that may have already been completed as part of that grant program. Again, there would need to be a decision made by all involved federal agencies about who should be the lead.

3.1.1 U.S. Army Corps of Engineers

3.1.1.1 Section 404 and Section 10

Background

The Corps' CWA Section 404 review process is required for projects involving discharges of dredge or fill materials into the waters of the U.S. Any proposed discharge of dredge or fill material in jurisdictional waters would require either a Nationwide Permit (NWP) or an Individual Permit from the Corps. Section 10 of the Rivers and Harbors Act of 1899 prohibits the unauthorized obstruction or alteration of any navigable water of the U.S. Section 10 requires approval by the Corps for the placement of structures into or over navigable waters of the U.S. and for work in or affecting navigable waters of the U.S. Work in Section 10 waters may be covered under an NWP, an Individual Permit, or a Letter of Permission (provided there is no Section 404-jurisdictional activity). Lake Washington is a water of the U.S. and a navigable water, so many activities in the lake would require approval under both statutes.

If the proposed activity does not qualify for a NWP, then an Individual Permit would be necessary. An Individual Permit is a lengthier process, starting with a pre-application meeting, continuing to development of an alternatives analysis to accompany the application, ongoing coordination with the Corps, and publication of a public notice followed by a 15- to 30-day comment period. According to the federal Section 404 guidelines, the Corps cannot approve a proposal that is not the least environmentally damaging practicable alternative. The alternatives analysis prepared to support the

Individual Permit would also inform the Corps' NEPA review. In addition, the EPA has a review role over all Individual Permits.

Projects that require or trigger a federal permit from the Corps would also require approval under the Endangered Species Act (ESA; see Section 3.1.2.1), Magnuson-Stevens Fishery Conservation and Management Act (MSA; see Section 3.1.2.2), and National Historic Preservation Act (NHPA; see Section 3.1.1.4). As the probable lead federal agency (unless the project obtains federal funding), the Corps would initiate coordination and consultation with the agencies that are charged with implementing those laws.

Application to Project

As noted by Jacalen Printz and Shane Shelburne, Section 404 leads at the Corps, without more specific design information to determine whether the activity would include any fill, the quantity and type of fill, where fill or structures would be placed, and how the fill or structures would be placed, applicability of specific NWPs or other approval mechanisms cannot be fully determined (pers. comm., December 13, 2023). However, the following NWPs could be appropriate if the activity complies with all of the specified NWP parameters:

- NWP 7 – Outfall Structures and Associated Intake Structures:
  - "Activities related to the construction or modification of outfall structures and associated intake structures, where the effluent from the outfall is authorized, conditionally authorized, or specifically exempted by, or otherwise in compliance with regulations issued under the National Pollutant Discharge Elimination System (NPDES) Program (Section 402 of the Clean Water Act). The construction of intake structures is not authorized by this NWP unless they are directly associated with an authorized outfall structure." (Corps, 2022)
- NWP 18 – Minor Discharges:
  - "Minor discharges of dredged or fill material into all waters of the United States, provided the activity meets all of the following criteria: (a) The quantity of discharged dredged or fill material and the volume of area excavated do not exceed 25 cubic yards below the plane of the ordinary high water mark or the high tide line; (b) The discharge of dredged or fill material will not cause the loss of more than 1/10-acre of waters of the United States…" (Corps, 2022) [If trenching is the method used to install the intake line, it is unlikely that this NWP would apply unless the installed line was not covered after installation.]
- NWP 19 – Minor Dredging:
  - "Dredging of no more than 25 cubic yards below the plane of the ordinary high water mark or the mean high water mark from navigable waters of the United States (i.e., Section 10 waters). This NWP does not authorize the dredging or degradation

through siltation of … sites that support submerged aquatic vegetation (including sites where submerged aquatic vegetation is documented to exist but may not be present in a given year), anadromous fish spawning areas, or wetlands…" (Corps, 2022). [If trenching is the method used to install the intake line, this NWP would not apply.]

- NWP 58 – Utility Line Activities for Water and Other Substances:
  - "This NWP authorizes discharges of dredged or fill material into waters of the United States and structures or work in navigable waters for crossings of those waters associated with the construction, maintenance, or repair of utility lines for water and other substances, including outfall and intake structures. There must be no change in pre-construction contours of waters of the United States."
  - "This NWP also authorizes temporary structures, fills, and work, including the use of temporary mats, necessary to conduct the utility line activity." (Corps, 2022)

The Corps has established the following in-water work windows that are designed to protect fish life:

- Ship Canal to East End of Montlake Cut (includes Union Bay): October 1 – April 15
- Lake Washington North of SR 520: July 16 – March 15

Schedule: The timeline for Corps permit issuance is difficult to predict without knowing whether an Individual Permit or NWP would authorize the project. However, for a project of this size and complexity that is likely to involve a time-intensive ESA review (at least two years according to the National Marine Fisheries Service [NMFS]), two to three years is a reasonable estimate. In order for the Sections 404/10 authorization to be issued, ESA and Essential Fish Habitat (EFH) consultation must be completed (Sections 3.1.2 and 3.1.3), as well as Section 408 (Section 3.1.1.2) and cultural resources/historic properties review under Section 106 (Section 3.1.1.4).

3.1.1.2 Section 408

Background

Section 14 of the Rivers and Harbors Act of 1899, as amended and codified in 33 U.S.C. § 408 (Section 408) grants the Corps authority to review actions that have potential to alter a Corps civil works project, such as the portion of the Ship Canal identified as a federal project. The Corps' Section 408 program verifies that such actions do not degrade the public interest or use of the civil works project.

Included in the Section 408 review is evaluation of whether the action crosses over or under a federal navigation channel. These channels are shown in plan view on the national channel framework, a mapping dataset of Congressionally authorized navigation channels that are maintained by the Corps. The federal government, and by extension the Corps, has the power to control and maintain the navigability of these channels, termed navigational servitude. Navigational servitude does not necessarily reach the channel bottom, but extends to a specific depth within the channel, making the regulated feature a three-dimensional shape. Proposed actions are prohibited from limiting the available navigable waterway.

Unlike the CWA Section 404 and Section 10 permits, Section 408 reviews are not performed by the Corps' regulatory program but instead occur in the separate 408 program. However, if a project requires review under more than one of these Corps authorities, all actions and decisions related to each approval must be completed before formal authorizations can be issued for any of them.

Application to Project

The most recent planning-level alignment for the intake pipe would unavoidably cross the Corps' federal navigation channel (Exhibits 1-1, 1-2, and 3-1), either in a trench or via tunnel. Accordingly, the project would require a Section 408 review. The project must avoid actions that limit the vertical or horizontal extents of the area subject to navigational servitude. However, through coordination with the Corps, the project could receive approval for design elements that are within the Ship Canal federal navigation channel but are below the authorized depth of the navigational servitude.

The Corps has shared some of the electronic files showing Ship Canal bathymetry, the three-dimensional bounds of the Ship Canal navigational channel, and upland Corps ownership or easement boundaries. According to the Corps data, the Ship Canal project extends 30 feet below the water surface, which is considered to be the low lake elevation of 16.75 feet North American Vertical Datum 1988 (NAVD88). The Corps is allowed an additional 2 feet of overdredge tolerance and an additional two feet for advance maintenance, making the effective depth of the navigation channel 34 feet (Dysart, pers. comm., May 30, 2024). Alteration of the physical limits of the navigation channel are one element of the 408 review. The final top elevation of the trenched or tunneled pipe should be deeper than 34 feet below the low lake elevation. Dana Dysart, the Corps' Section 408 lead, warned that "The Corps sees a significant number of buried pipes burst/pulled loose/damaged from barges and tugboats and other vessels dragging anchors while underway. There can be significant barge and tug traffic through Montlake Cut. It is strongly recommended you go deep to reduce risk of an incident" (Dysart, pers. comm., May 30, 2024). She also noted that any trench excavated through and under the navigation channel would likely be required to be covered.

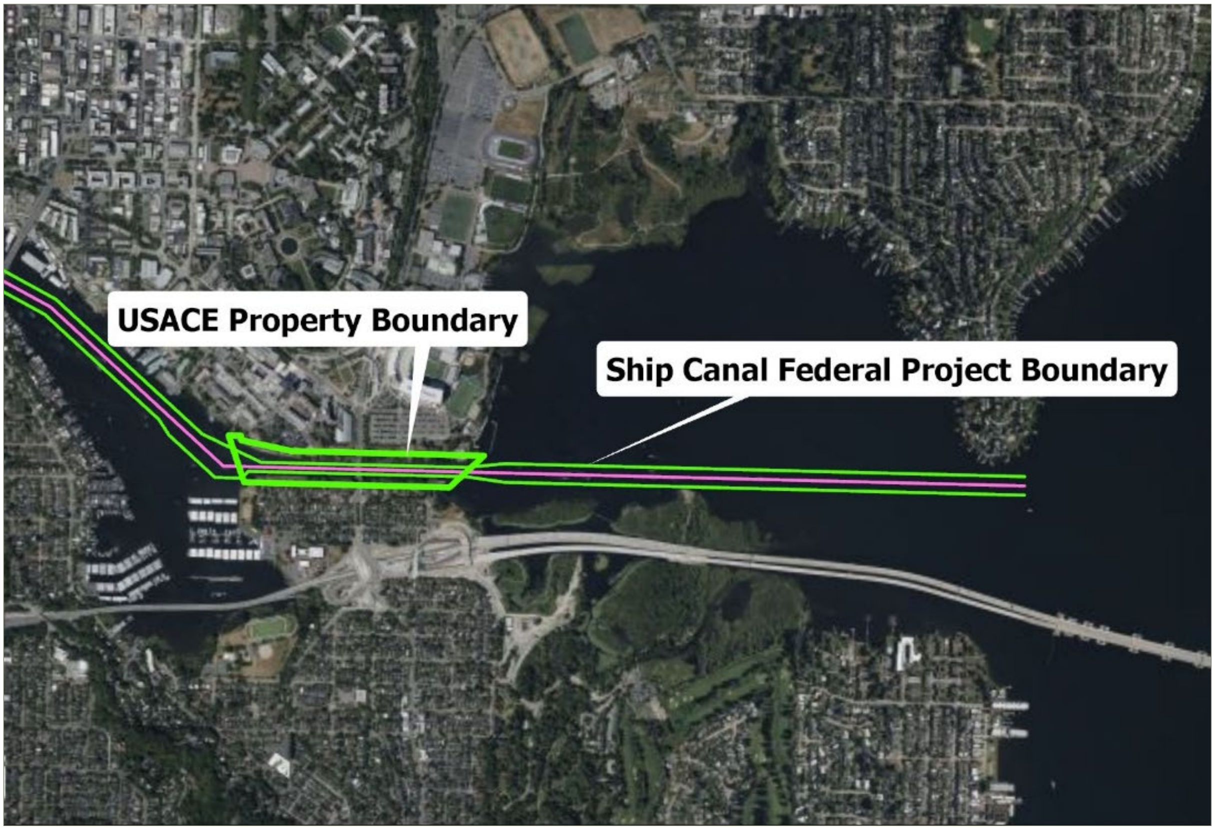


Exhibit 3-1: Plan View of the U.S. Army Corps of Engineers' (USACE) Ship Canal Federal Project Boundary (National Channel Framework) and Upland Real Estate Boundaries (Source: USACE Hydrographic Surveys (arcgis.com))

Ms. Dysart indicated that the Corps may require a hydrologic and hydraulic study to determine if and how the discharge could affect movement of water through the navigation channel (pers. comm., December 13, 2023). In a subsequent conversation with Kyle Comanor, a Corps Senior Water Manager, he indicated that a 50 cfs contribution to the western part of the Montlake Cut or points farther west would not cause any backflow issues or any changes in direction of flow (pers. comm., June 6, 2024). As described in Section 2.4, the lowest summer flows in 2023 did not drop below 150 cfs and usually fluctuated between 200 and 300 cfs. As assessed by a Shannon & Wilson hydraulic engineer, these flow rates, ranging between 150 and 300 cfs, are sufficient to prevent general backflow issues that could be caused by a discharge of 50 cfs. There is a potential for localized water mounding effects at the discharge point(s), but these would ultimately be immersed by the overall flow regime of the system.

In addition to the Corps Section 408 review, the Corps owns land in many places along the Ship Canal shoreline and project activities on this land would require a Corps right-of-way agreement or easement (Exhibit 3-1). The most recent planning-level alignment for the discharge pipe and outfall location would pass through Corps-owned upland property.

Any required real estate permissions would occur as part of the Section 408 review, or if Section 408 is not triggered, would occur independently.

This information supports decision-making about locations of the intake line and discharge in both aquatic and upland environments. Ms. Dysart indicated that the Corps would be available to work with the UW team to evaluate various alternatives.

Schedule: The Corps 408 review should occur concurrently with the 404/10 reviews; the 404/10 authorization cannot be issued until 408 has been satisfied.

3.1.1.3 Dredged Material Management Office

The Dredged Material Management Office (DMMO) is led by the Corps and is a collaboration of four agencies: Corps, Ecology, EPA, and Washington State Department of Natural Resources (DNR). The DMMO is also responsible for ESA compliance with respect to the use of open-water disposal sites and includes annual reporting to and periodic consultation with NMFS and U.S. Fish and Wildlife Service (USFWS).

Background

Dredging to place a pipe along the bed of Lake Washington requires:

- Authorization by the Corps under Sections 10 and 404 (see Section 3.1.1.1).
- Decision documents. These documents are issued by the Dredged Material Management Program (DMMP) within the DMMO. The decision documents are used by the Corps to aid with the approval of Corps permits.

A DMMP decision document is generated by the DMMP as a written outcome after a sediment quality evaluation for a project has been undertaken. The process for DMMP decisions is as follows:

- Complete and submit a Tier 1 Evaluation (which may conclude that testing is not required)
- If sediment testing is required, a proposed sampling and analysis plan (SAP) that includes the design for the proposed dredging
- Submittal of the SAP to the DMMO for their assessment and approval
- Collection of sediment samples for physical, chemical and potentially biological testing
- Completion of a report that evaluates the tested data against disposal criteria for the proposed disposal location and submittal to the DMMO for their assessment and approval
- Issuance of a Suitability Determination (which relates to open-water disposal), if relevant

- Recency Extension or other document related to sediment quality evaluations (if there is heavy deposition of sediments in the dredge area or a permit for disposal of sediments is required beyond the three years after sampling)

Application to Project

The most recent planning concepts indicate that trenching to install the connection between the water intake point and the upland heat exchanger may be required to remove sediment along the pipe alignment. This work would be considered a new sediment dredge project that requires authorization from the Corps under both Sections 404 and 10 (see Section 3.1.1.1). DMMP decision documents as outlined above would be required for the sediment that would be removed, if in-water disposal is desired, and to verify the newly exposed post-dredge sediment surface does not exceed the aquatic species exposure criteria. If the dredged materials would be disposed of in an authorized landfill, it is possible that Ecology may establish sampling and testing requirements under the state's Model Toxics Control Act with limited to no involvement by the DMMO (Dunay, pers. comm., May 29, 2024).

If pre-project sediment quality evaluation is required, rather than only testing at the time of work, the sampling itself may require its own suite of permits and approvals from the Corps (under Section 10) and state and local agencies. NWP 6 for survey activities could cover the activity, and most of the state and local regulations include exemptions for this kind of work. A conceptual scope of work and rough cost estimate for early, high-level sediment characterization to determine whether in-water disposal would be feasible is provided in Section 7.3.

<u>Schedule</u>: If trenching with in-water disposal is the confirmed construction method, once 30% plans are available showing proposed cross sections and depth of excavation, further discussion with the DMMO should be pursued (Dunay, pers. comm., May 29, 2024). The DMMO could then confirm whether additional sediment quality evaluation would be required, and would provide specific requirements for the number and locations of samples and the list of tests. Pre-project sediment quality evaluation processes can take between four months to a year or more, including the sampling and reporting.

3.1.1.4 National Historic Preservation Act

Background

Any project that is funded or authorized by a federal agency must comply with Section 106 of the NHPA. Section 106 of the NHPA requires federal agencies to consider and evaluate the effects that federal projects may have on historic properties under their jurisdiction. Historic properties include buildings, structures, historic districts, and archaeological sites or artifacts that are listed or eligible for listing on the National Register of Historic Places (NRHP). After the federal agency has reviewed the submitted information, it would coordinate with the State Historic Preservation Officer (SHPO) and initiate consultation with applicable Native American Tribes. Depending on the project's potential to affect sensitive resources and the outcome of SHPO coordination, applicants may need to enter into a Memorandum of Agreement that includes avoidance, minimization, and/or mitigation measures.

Application to Project

Washington Department of Archaeology and Historic Preservation (DAHP) maintains a public information source known as WISAARD, which stands for Washington Information System for Architectural and Archeological Records Data. WISAARD's map identifies several historic districts, buildings, and structures on and adjacent to the UW campus, including the Montlake Bridge and the Montlake Cut, that are listed on the NRHP and Washington's Heritage Register (DAHP, 2023). The project also falls within the area of interest for six Native American tribes, including the Muckleshoot Indian Tribe, the Stillaguamish Tribe of Indians, the Squaxin Island Tribe, the Tulalip Tribes, the Snoqualmie Tribe, and the Suquamish Tribe. WISAARD's mapping includes the output of a predictive model that identifies the relative potential of different areas to contain archaeological sites. The area of UW's campus adjacent to Lake Washington, the Montlake Cut, and Portage Bay has been categorized as "Survey Highly Advised: Very High Risk" (DAHP, 2023).

Based on the known presence of NRHP sites and the risk of encountering archaeological resources, a survey of historic properties and cultural resources would be required within the to-be-established Area of Potential Effects.

Schedule: The Corps 106 review should occur concurrently with the 404/10 reviews; the 404/10 authorization cannot be issued until 106 has been satisfied.

3.1.2 National Marine Fisheries Service

3.1.2.1 Endangered Species Act

Background

Section 7 of the ESA, as amended, applies to federal agency actions and sets forth requirements for consultation with NMFS. A biological assessment (BA) must be prepared to evaluate whether and how a project may affect ESA-listed endangered or threatened species or its designated critical habitat that are under NMFS jurisdiction. In the absence of federal funding sources, the Corps is the anticipated federal lead agency that would initiate consultation with NMFS using the applicant-prepared BA. If the BA concludes with May

Effect, Not Likely to Adversely Affect determinations, informal consultation would be conducted between the Corps and NMFS, resulting in a Letter of Concurrence. If the BA concludes with May Effect, Likely to Adversely Affect determinations, formal consultation would be conducted between the Corps and NMFS, resulting in a Biological Opinion with an Incidental Take Statement. The Biological Opinion would include mandatory terms and conditions, possibly including monitoring and reporting, that must be incorporated into the project.

Application to Project

As noted in Section 2 above, the waters in the project area contain two listed species under NMFS jurisdiction: Chinook salmon and steelhead. Considering the known dependency of downstream migrating juvenile Chinook salmon on shallow, nearshore habitats, and the location of the intake and discharge structures in the upstream migrating adult salmon corridor, determinations of "may affect, likely to adversely affect" Chinook salmon and Chinook salmon critical habitat are likely. NMFS would have a special interest in elements of the project that cross, intrude into, and temporarily or permanently disturb that physical environment. The location and characteristics of the intake, particularly related to screening and preventing impingement and entrainment of either adult or juvenile listed fish, would also be a concern, as would the potential effects of the discharge water's altered temperature and dissolved oxygen content. Based on the rarity of steelhead in the Lake Washington system, a determination of "may affect, not likely to adversely affect" is possible for this project.

During a conversation on February 9, 2024, Don Hubner, a fisheries biologist in the North Puget Sound Branch, confirmed that the following elements could be important to consider during design and/or to address in the BA:

- For any discharge into the Ship Canal, would there be any backflow issues (e.g., related to flow, salinity, temperature, etc.) given the volume of the discharge that could have adverse effects on the aquatic environment? [As discussed in Section 3.1.1.2, substantive backflow issues are not anticipated with the potential discharge volume of water being evaluated. It is also anticipated that the system would be designed so that it could be adaptively managed to moderate discharge volumes if pre-project modeling or post-project monitoring indicates that there are flow direction issues during certain periods (e.g., when locks maintenance reduces outflow or when summer flows drop below a certain level).]
- If other entities pursue a similar approach, at what point would the total volume of water withdrawn from Lake Washington have adverse effects on the lake's characteristics and ecology? [According to DSI, LLC, who has been working with WRIA 8 and LLTK to complete hydrodynamic modeling of possible large-scale cold water transfers from deep lake into the Ship Canal, the volume of water required to

adversely affect the main body of Lake Washington "is so gigantic that no engineering exercise would undertake it" (Mathis, pers. comm., August 1, 2024).]

- Would there be benefits, such as added flexibility, to having two intake locations at different depths with different temperature profiles?
- Address entrainment and impingement at the intake.
- Avoid creating predator habitat (e.g., installations in the shallow nearshore environment that provide cover for bass).
- Provide a realistic assessment of any measurable benefits on salmon and recognize the climate benefits of reducing fossil fuel use.
- Consider what appropriate modeling should be conducted in advance to support the design and BA, and what long-term monitoring of performance should be undertaken.

During a follow-up conversation on June 14, 2024, the potential for installing the intake line in a trench was discussed in greater detail. Mr. Hubner expressed grave concerns about the potential for trenching activity in Union Bay to have adverse effects on juvenile salmon rearing and outmigration and adult salmon immigration. Even though the project would comply with the in-water work windows, there would still be some overlap with rearing and migrating salmon. He also expressed concerns about the potential for bay sediments to be mobilized and suspended in the water column, and then flow into the Ship Canal. In addition to possible effects from turbidity, he raised concerns that the sediments may be contaminated and/or that the newly exposed and anaerobic peat could have effects on pH and dissolved oxygen content of the water. Finally, he noted that trenching activities may take longer than anticipated and suggested that we reach out to King County to learn about challenges the County faced during its North Mercer Island/Enatai Interceptor Upgrades project (Enatai project).

On July 10, 2024, we had a productive conversation with two environmental staff at King County with knowledge of the Enatai project, which included lakebed trenching between Mercer Island and Enatai Beach Park to install a sewer. The applicable information from that discussion is incorporated in appropriate places throughout this report, but of particular relevance to this section are the following required "terms and conditions" and "conservation recommendations" that were included in that project's Biological Opinion (NMFS, 2020):

- The in-water work windows were applied not just to specific construction activity, but also to use of tugboats and other vessels to minimize Chinook salmon exposure to project-related propeller wash. Considering the very shallow waters of Union Bay, propeller wash could be an even greater concern to NMFS for UW's project than for the County's project in the generally deep waters of the east channel between Mercer Island and Bellevue.

- The times during which activities that require fish salvage could be conducted were further limited to a shorter window within the in-water work window.
- The Biological Opinion required detailed monitoring and reporting of specific activities that could result in take of fish, including fish salvage, tugboat and other vessel use, and other construction activities.
- The Biological Opinion also recommended that the County's contractor install full-depth sediment curtains around excavation and fill areas and that tugboats and vessels "use the lowest safe speeds and power settings when maneuvering in shallow water close to the shoreline to minimize propeller wash and mobilization of sediments."

Schedule: ESA consultation, either formal or informal, with NMFS can be a lengthy process, particularly for a unique project and considering the typical staffing shortage. Mr. Hubner offered to provide a quick, early review of the draft BA, but indicated that ESA consultation would be lengthy, likely more than two years. The review timeline could be shortened if the BA provides a "clear, concise, and comprehensive" description of the proposed project and thorough descriptions of existing conditions in the areas to be affected directly and indirectly by project activities. ESA consultation is also initiated by the Corps during the Corps' Section 404/Section 10 review, so the schedule is somewhat dependent on the Corps' timing of the BA transmittal to NMFS.

3.1.2.2 Magnuson-Stevens Fishery Conservation and Management Act

Background

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-276) led to the formation of eight Fisheries Management Councils (FMCs) that share authority with NMFS to help regulate and oversee fishery management in federal waters (Lundgren, 2004 [revised 2021]). The MSA defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" of certain managed fisheries species (16 United States Code 1802[10]). EFH designations include descriptions of the physical and biological environment and the location of all necessary habitats. The EFH regulations clarify that "waters" may include aquatic areas and their associated physical, chemical, and biological properties that are used by the managed fish species, and those areas historically used by those species, where appropriate. "Substrate" includes sediment, hard bottom, structures underlying the waters and associated biological communities (e.g., seagrass). "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. "Spawning, breeding, feeding, and growth to maturity" covers a species' full life cycle (50 Code of Federal Regulations [CFR] § 600.10).

Federal agencies (in this case, the Corps) are required to consult with NMFS on proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH

(Section 305[b][2]). NMFS is required to provide conservation recommendations for any federal activity that would adversely affect EFH (Section 305[b][4][A]). "Adverse effects" may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR § 600.810).

In addition to EFH designations, areas called Habitat Areas of Particular Concern (HAPC) are also designated by the regional FMCs. Five HAPC have been designated for Pacific Coast Salmon: (1) complex channels and floodplain habitats, (2) thermal refugia, (3) spawning habitat, (4) estuaries, and (5) marine and estuarine submerged aquatic vegetation (Pacific Fishery Management Council, 2014b).

As noted in Section 2.3, Lake Washington and the Ship Canal contain EFH for Pacific Coast Salmon, specifically designated for Chinook salmon and coho salmon. None of the five HAPC are present in Lake Washington or the Ship Canal within the potential project boundary.

Application to Project

The BA prepared for the project would include a chapter discussing the project's impact on essential fish habitat. Much of the discussion of the project's effects on listed fish and critical habitat contained elsewhere in the BA can be referenced here, but additional consideration of specific habitat elements may be needed.

The NMFS Biological Opinion (2020) for the Enatai project included the following "conservation recommendations" to minimize effects on EFH:

- The Corps should require the County's contractor to install full-depth sediment curtains around excavation and fill areas
- The Corps should require the County's contractor to "use the lowest safe speeds and power settings when maneuvering [tugboats and vessels] in shallow waters close to the shoreline."

<u>Schedule</u>: The EFH review occurs concurrently with the ESA review; see schedule discussion at the end of Section 3.1.2.1 above.

3.1.3 U.S. Fish and Wildlife Service

Background

The ESA review process under the USFWS is the same as that described above for NMFS in Section 3.1.2.1

Application to Project

As noted in Section 2 above, the waters in the project area contain one listed species under USFWS' jurisdiction: bull trout. In other USFWS assessments of project actions in the Lake Washington system, including King County's Enatai project, USFWS has concurred with determinations of "may affect, not likely to adversely affect" bull trout or designated critical habitat. Little is known about bull trout distribution and use in Lake Washington, but fish present in the lake would likely be subadult or adults, as juveniles typically remain in cold, headwater streams until they are large enough to prey on other fish. As noted in the USFWS concurrence letter for the Enatai project, "bull trout occurrence [in Lake Washington] is rare or unlikely" (USFWS, 2018). The location and characteristics of the intake, particularly related to screening and preventing impingement and entrainment of either adult or subadult listed fish, could be a concern, as could the potential effects of the discharge water's altered temperature and dissolved oxygen content.

<u>Schedule</u>: ESA consultations for bull trout in Lake Washington are not typically as protracted as for the NMFS species because of the different level of use and the limited reliance of bull trout on the shallow nearshore areas. A discussion with USFWS was not able to be scheduled during preparation of this report. ESA consultation is also initiated by the Corps during the Corps' Section 404/Section 10 review, so the schedule is somewhat dependent on the Corps' timing of BA transmittal.

3.1.4 U.S. Coast Guard

Background

The modification of existing or construction of new bridges or causeways over navigable waters of the U.S. is regulated under Section 9 of the Rivers and Harbors Act of 1899. The USCG administers Section 9 and issues Bridge Permits.

Obtaining a USCG Bridge Permit is a multi-step process including coordination meetings with the USCG, submitting a project initiation request, submitting a navigational impact report, supporting the USCG NEPA evaluation (if not conducted by another federal lead agency), submitting the application, and supporting responses to public comments. If the

USCG is the federal lead agency, it would also require documentation to support ESA/MSA and Section 106 consultations.

Application to Project

At this time, it is considered highly unlikely that the project would require a Bridge Permit from the USCG. Two scenarios, both of which have low probability of occurrence, could trigger this requirement: 1) utilizing SR 520 or some other USCG-regulated bridge as part of the intake or discharge route, or 2) designing the intake or discharge pipe such that it passes over a navigable water. In the latter case, that section of new pipe would be considered a new bridge, and the legislative authority for the new bridge would be the General Bridge Act of 1946. Corps NWP 58 and Section 10 of the Rivers and Harbors Act of 1899 would not apply to that section of the line.

Schedule: Following submittal of a complete application, permit processing can take 10 months.

3.2 State

3.2.1 Washington State Department of Ecology

3.2.1.1 Water Right

Background

Ecology is responsible for approving and administering surface and groundwater rights under Chapter 173-152 WAC. UW currently has two surface water right certificates and one groundwater right certificate. The two surface water right permits each allow a maximum withdrawal rate of 5 cubic feet per second (2,244 gallons per minute [gpm]) for non-consumptive uses. The groundwater right provides up to 365 acre feet per year (220 gpm) for consumptive uses. One surface water certificate (Permit #10620) is currently fully beneficially used for heating and cooling purposes with a point of withdrawal in Portage Bay. It is unclear whether the other surface water certificate (Permit #15446) is being beneficially used at this time. The point of withdrawal for Permit #15446 is also Portage Bay. The groundwater certificate (#2054) appears to be for consumptive use (fish propagation). The well depth is 150 feet according to the water right certificate, but the well is not currently used.

Application to Project

An additional new surface water right would be required for this project. The purpose of use for heating and cooling is considered a non-consumptive use, which is favorable since Lake Washington is closed to new consumptive water right withdrawal uses. Ecology initially indicated that they view Lake Washington, the Montlake Cut, and Portage Bay as separate waterbodies. This complicated the argument that the project is a non-consumptive use, since water removed from Lake Washington and discharged into the Montlake Cut or Portage Bay would result in a consumptive withdrawal from Lake Washington.

In the water right pre-application meeting with Ecology on July 17, 2024, Ecology said they could be open to considering Lake Washington to Portage Bay as one waterbody if a technical argument is presented to support it. Several approaches might be applicable to developing a technical argument for one body of water:

1. The Corps manages the three waterbodies as a single pool.
2. The minor change in hydraulic head from one body to the next mimics that of a lake with an outlet.
3. Flow velocity changes between Lake Washington and the Ship Canal further support a single waterbody definition.

Mr. Comanor, the Corps' Senior Water Manager, confirmed that the Corps considers "everything upstream of the locks one body of water" (pers. comm., July 30, 2024). The Corps views it as a single system with multiple components and noted that "Moving water around upstream of the Locks won't change the volume of water." This position of the Corps was shared with Ecology during an October 2024 meeting. Although Ecology noted that additional discussion was needed, the Northwest Region Water Resources Manager, Kasey Cykler, indicated that Ecology "could likely navigate the issue" and that a discharge to the Ship Canal could be considered non-consumptive (pers. comm., October 4, 2024). For a water right with a discharge either to the preferred discharge location in the Ship Canal or back to Lake Washington, UW would need to demonstrate that implementation of the water right improves or at least does not degrade water quality conditions in the receiving waters (see discussion in Section 3.2.1.5), does not cause other environmental impacts, does not impact any existing water right holders, and is not contrary to the public interest.

The water right application process requires several steps, including:

1. Submit a water right pre-application consultation request form (completed).
2. Decide if project is eligible for priority processing (PP) or would benefit from using Ecology's Cost Reimbursement Program (CRP).
3. Prepare and submit new water right application.
4. Wait for Ecology decision on granting new water right.

Because of the current backlog of existing water right applications, normal processing of a new, non-priority, water right would take many years. The CRP is a cost-effective alternative to expedite water right review and processing by Ecology. The CRP requires the applicant to pay the full cost of processing the application which includes the preparation of a Record of Examination (ROE) by an Ecology-approved subcontractor hired by the applicant, but who represents Ecology. All technical data needed to support the preparation of the ROE must be provided by the applicant. Once the ROE is completed and submitted, Ecology reviews the recommendations in the ROE along with any comments/concerns from interested third parties like Tribal entities or senior water right holders, and then decides whether to approve or deny the application.

Technical information needed for the ROE would include evaluation of water quality impacts from the withdrawal and discharge of water on the source and receiving waterbodies, the amount of water needed, how and where it is to be obtained from Lake Washington (point of withdrawal) and impacts to existing water right holders.

A possible alternative to the CRP is to have the application accepted for PP. PP is possible if the application meets one or more of the criteria outlined in WAC 173-152-050. The criteria applicable for this project is in Section 2c: "is for a proposed water use that is nonconsumptive and if approved would substantially enhance or protect the quality of the natural environment." The discharge of cooler water into the Montlake Cut or Portage Bay may contribute to improved conditions for salmon passage into the main body of Lake Washington. For any of the potential discharge locations, the project's contribution to UW's fossil fuel reduction may also be considered an environmental betterment. Ecology stated during the July 17, 2024, pre-application meeting that they would need to make a programmatic call on whether this project would qualify under an existing heat pump policy as improving the environment.

<u>Schedule</u>: The timeline for receiving a new water right from Ecology would depend on the complexity of the application. Whether the application is processed through CRP or PP, the process could take up to two years or longer before a decision is made.

3.2.1.2 Shoreline Permit Approval

Background

As established in the Shoreline Management Act and the implementing regulations, Ecology has final approval authority over Shoreline Conditional Use Permits and Shoreline Variances. After the City has issued its conditional approval, the City's decision and the supporting application materials are provided to Ecology for final review and either approval or denial. Ecology has the option to add conditions to the City's decision.

Application to Project

Based on a current understanding of the potential project elements and the City's existing Shoreline Master Program (SMP), the proposed project would require a Shoreline Conditional Use Permit and potentially a Shoreline Variance (see discussion in Section 3.3.1).

Schedule: After receiving a complete package from the City, Ecology has 30 calendar days to issue its decision. Depending on project complexity and Ecology's workload, the review is likely to take longer than the allotted 30 days. After the decision is issued, there is a 21-day appeal period.

3.2.1.3 Section 401 Water Quality Certification

Background

Ecology has been authorized to implement Section 401 of the CWA for Water Quality Certification (WQC) in Washington. Projects requiring a CWA Section 404 permit (see Section 3.1.1.1) require a CWA Section 401 WQC. The purpose of the certification process is to ensure that federally permitted activities comply with the federal CWA, state water quality laws, and any other applicable state laws. Many of the NWPs have been pre-certified unless there is some other project element or circumstance that requires an Individual 401 WQC or individual review. Some NWPs, for example, often require an Individual 401 WQC if there is more than one NWP authorizing the project or if a certain acreage of impact is exceeded. If the Corps issues an Individual Permit, then an Individual WQC would also be required.

Application to Project

If the project is permitted under NWP 7 (Outfall Structures and Associated Intake Structures) or NWP 18 (Minor Discharges), Ecology has already pre-certified that NWP under Section 401, so additional coordination would not be required unless review is needed based on Ecology's general conditions. NWP 19 is also pre-certified but may require Ecology review and possibly an Individual WQC if the work is located in a known contaminated or cleanup site. NWP 58 (Utility Line Activities for Water and Other Substances) is also pre-certified unless the project impacts more than ⅓ acre of water or the project is authorized by the Corps under more than one NWP. In that case, an Individual WQC would be required, and a Water Quality Monitoring and Protection Plan must be submitted in addition to the standard information.

Because it would not be known with certainty ahead of Corps processing of a Section 404 application whether the Corps would issue an Individual Permit or authorize the project under one or more NWPs, submittal of a Pre-Filing Meeting Request Form followed 30 days later by a completed Request for Clean Water Act Section 401 Water Quality Certification form is recommended.

Schedule: If the Corps authorization is an NWP that is not pre-certified or otherwise requires Ecology review, Ecology has 180 calendar days from receipt of the complete application and the final Corps authorization to make its determination whether an Individual 401 WQC would be required. However, if the Corps could identify early in its process whether or which NWP(s) would authorize the project, or if an Individual Permit would be required, then Ecology could proceed with any necessary evaluations and documentation, and in some circumstances could issue an Individual 401 WQC ahead of the final Corps authorization.

3.2.1.4 Coastal Zone Management Consistency

Background

Ecology is tasked with overseeing compliance with the Coastal Zone Management Act, which regulates appropriate development of and protection of the nation's coastal resources. Under the Washington Coastal Zone Management (CZM) program, activities that occur in a coastal county and that require a federal permit must certify that they are consistent with the federal CZM program. Similar to the 401 WQC, many of the NWPs have already been determined by Ecology to be consistent with the CZM program unless there is some other project element or circumstance that is triggered. Depending on the type of Corps authorization, the *Certification of Consistency with the Washington State Coastal Zone Management Program for Activities Requiring a Federal License or Permit* form and supporting materials may need to be submitted to the Corps, who would then forward the information to Ecology for their review and confirmation of consistency.

Application to Project

For the anticipated NWPs that could authorize the project, Ecology has already concurred that they are consistent with the CZM program. However, if a Corps Individual Permit or Individual 401 WQC is required, or there are other conditions that require Ecology CMZ review, then CZM program consistency would need to be demonstrated by providing the completed form and supporting information to the Corps for transmittal to Ecology. If Ecology does not agree that the project is consistent with the CZM program, the Corps cannot issue the permit.

Schedule: When Ecology concurrence is required, Ecology requests the form and supporting materials from the Corps, and then Ecology has six months from receipt of the complete consistency submittal package to issue a decision (concurrence, concurrence with conditions, or objection). If Ecology does not respond within six months, then concurrence is assumed. Concurrence, however, cannot be issued until Ecology has received proof that all required permits and authorizations have been obtained.

3.2.1.5 National Pollutant Discharge Elimination System

Background

An NPDES permit, under Section 402 of the CWA, is required to discharge into any water body. Ecology administers the NPDES program under the state's Water Pollution Control Act and the federal CWA. WAC 173-201A is the guiding regulation on the discharge requirements. The NPDES permit describes what can be discharged, and monitoring and reporting requirements. There are a number of general permits that cover specific types of discharge, such as those related to water treatment plants or ferry terminal washing. If a discharge does not fall into any of the general permit categories, then an individual permit is required.

Separately, projects that may disturb more than one acre of land that might result in a discharge to a waterbody that exceeds water quality standards are required to obtain coverage under the NPDES's Construction Stormwater General Permit (CSGP).

Application to Project

Permitting approaches for the cooling water discharge would depend on the location of the outfall. Based on a decision provided by Ecology in February 2025, discharge of the cooling water into the Ship Canal would be difficult to permit (McCrea, pers. comm., February 11, 2025). Because the Ship Canal is not a natural waterbody and the water is impaired for temperature, a natural conditions assessment that EPA agrees to, followed by a total daily maximum load (TMDL) study, would be required to evaluate temperature impacts. According to Ecology, the process of generating a natural conditions assessment and TMDL would take approximately 15 years following the steps outlined in Exhibit 3-2.

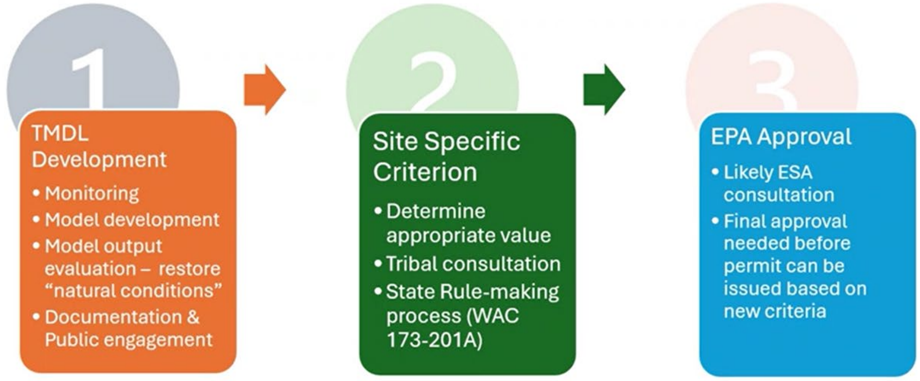


Exhibit 3-2: Process to Authorize a New Discharge into the Temperature-Impaired Ship Canal
(Source: Washington Department of Ecology)

If the discharge location were to be Lake Washington, outside of the temperature-impaired water, then the discharge permit approach would follow CWA 40 CFR 125 Subpart I – Intake Requirements.

The requirements for the discharge would be included in the NPDES permit and are unknown at this time. Given the intake location in Lake Washington, the volume of water anticipated to be cycled through the system, and the nature of non-contact cooling water, the type of discharge requirements are likely to include temperature and turbidity and may include dissolved oxygen, lead, and arsenic. Typically, the requirement for temperature is that the discharge cannot be more than 0.3°C greater than the ambient water temperature.

It is anticipated that at any discharge points into either the Ship Canal or Lake Washington, the temperature of the discharged water would be less than the ambient temperature of the receiving water during the winter. However, discharges into Lake Washington in the summer would be warmer than ambient water temperature, but still below the State aquatic life standard of 16°C, unless the discharge is substantially shallower than the intake (such as into Union Bay). Summer discharges into the Ship Canal would typically be cooler than the ambient water temperature. The technical team advised that the temperature of the discharge water can be controlled by several methods. By managing the water temperature, the discharge would be cooler than the receiving body of water on a year round basis.

In early discussions with Ecology NPDES staff (Jeanne Tran, pers. comm., December 19, 2023), it was reported that no new discharge permits have been permitted in Lake Washington over the last 15 years. Ms. Tran later reported (pers. comm., May 24, 2024) that a new non-contact water discharge would be permitted in the Lake Washington watershed. Ms. Tran also stated in May 2024 that temperature and flow rate are likely to be the requirements in the discharge permit, and that other factors may be required to be considered like scour and turbidity based on the design of the outfall.

A separate NPDES CSGP would likely not be required for the project unless more than one acre of upland area is disturbed during pipeline or heat exchanger installation work.

Schedule: If the discharge location was in Lake Washington, processing time for an individual NPDES discharge permit may range from 3 to 18 months based on Ecology staff availability. As noted above, Ecology has indicated that a discharge into the Ship Canal could take up to 15 years to authorize. An NPDES CSGP should be applied for at least 60 days prior to the anticipated start of construction to allow time for the required public notice, comment period, and Ecology review.

3.2.2 Washington Department of Fish and Wildlife

3.2.2.1 Hydraulic Project Approval

Background

As established in Chapter 220-660 WAC, Hydraulic Code Rules, WDFW issues Hydraulic Project Approval (HPA) permits for construction activities that use, obstruct, divert, or change the natural flow or bed of state waters. HPAs allow construction activities to occur provided they comply with conditions within the permit, such as in-water work windows, best management practices, and other minimization measures.

Application to Project

The following key provisions of the WAC apply to the proposed project:

- WAC 220-660-250 Water diversions and intakes. This section of code includes requirements for the intake to be screened to avoid entrainment of fish into the diversion or impingement of fish on the screen. Section 8.5 of *NOAA Fisheries West Coast Region Anadromous Salmonid Passage Design Manual* (NMFS, 2022) contains detailed screening design guidance, with specific direction for adjustments for intakes located in lakes ("quiescent areas").
- WAC 220-660-260 Outfall structures in freshwater areas. This section of code encourages consideration of alternatives to new outfalls, including use of existing lines. Discharge locations should be selected to minimize loss of aquatic habitat and riparian vegetation, and generation of scour and turbidity. The outfall design must also prevent entry of adult and juvenile fish. Where energy dissipation is needed, use of natural habitat features or vegetation is most preferred at one end of the spectrum with angular rock least preferred at the other end of the spectrum. WDFW's area habitat biologist, Laura Arber (pers. comm., December 12, 2023), noted that areas of sediments in the

Montlake Cut were known to be particularly fine and, when disturbed, result in large plumes that take a long time to settle.

- WAC 220-660-270 Utility crossings in freshwater areas. This section of the code is primarily crafted for installation of utility lines through stream settings, but the principles and some of the provisions are applicable to the lake setting. The primary point is that the utility installation should be located to minimize riparian vegetation loss, minimize destabilization of the lakeshore, and minimize substrate disturbance or permanent alteration. These objectives can be met by using trenchless technology to install lines below the lake bed, at least to a depth that avoids aquatic vegetation and high-value aquatic habitats. If the pipe is installed in a trench across Union Bay, then methods to restore the lake bed surface should be investigated. WDFW noted that installation of utility lines in waterbodies via trenching is not preferred (Arber, pers. comm., 2024).

The possible drivers of mitigation requirements were discussed during a conversation with Ms. Arber (pers. comm., December 12, 2023). Some mitigation considerations were related to whether and where the intake line rests on the lake bed, or if there is any trench installation. For example, would the pipe rest on the lakebed in a shallow area with aquatic vegetation where it could interfere with juvenile fish migration and replace habitat? Would the line be installed in an excavated trench and then covered with rock that permanently alters habitat? Some or all of the footprint, including anchoring devices, could require mitigation depending on specific conditions.

WDFW provided the following list of "things to consider" for the discharge location and design, and suggested further coordination with WDFW during design of the outfall mechanism (Laura Arber, pers. comm., January 3 and May 24, 2024):

- Returned water needs to be cool/cold with higher dissolved oxygen than what was removed. Because of the direct connection between temperature and dissolved oxygen conditions and aquatic life, discharge water should at least meet State standards and not just be better than background levels if those levels are poor.
- Create multiple release locations (four to five preferred) to distribute cooler water.
- Install roughened rock "rapids" at each site to aerate the water and increase the dissolved oxygen before returning it to the Ship Canal or Lake Washington.
- Surround the rock "rapids" with riparian vegetation to provide cover and sufficient shade to keep the air and water cool before the water returns to the Ship Canal or Lake Washington.
  - WDFW prefers the discharge not be placed in a pipe (culvert) as this would interfere with overall air mixing.
  - Rapids need to be constructed with larger rocks and drops to prevent fish from entering.

As suggested by Ms. Arber, additional discussion with WDFW would be undertaken as information about existing conditions and possible designs is developed. It is anticipated that some of these recommendations might not scale to the size of this project, but that the target objectives of these recommendations could be satisfied in other ways.

Schedule: From submittal of a complete application, WDFW has 45 calendar days to grant or deny the HPA. A complete application must include documentation of State Environmental Policy Act (SEPA) compliance (see Section 3.4).

3.2.2.2 Aquatic Invasive Species Permit

Background

The New Zealand mud snail is an invasive mollusk that was first identified in Washington State in 2002 (WDFW, 2024). WDFW's most recent map shows they have been observed in multiple locations within the Lake Washington system, including two locations downstream of the Ballard Bridge, one near Sand Point to the north, and one near Leschi to the south. This mud snail is a prohibited Level 3 species (WAC 220-640-050(6)(b)), meaning that it "may not be possessed, introduced on or into a water body or property, or trafficked, without department authorization, a permit, or as otherwise provided by rule" (RCW 77.135.040).

Application to Project

During a discussion with King County about challenges it faced during its trenching project between Mercer Island and Enatai Beach Park, County Environmental Planner Jacob Sheppard described how the mud snail affected that project (pers. comm., July 10, 2024). During initial sediment sampling of the trench alignment pre-project, no indications of live or dead mud snails were found. However, during some later sampling, empty mud snail shells were found, which triggered a substantial amount of coordination with WDFW. Because the County's project planned to dispose of its excavated sediments in Elliott Bay, WDFW was concerned that live snails could be present in those sediments and they could then spread from the disposal site if the snails could survive the saltwater conditions or possibly attach to material that floated from the disposal site to a nearby freshwater location. Even though no live snails were found in the excavated materials, the County had to obtain a permit to possess, transport, and introduce the snail to a different location. In order to obtain the permit, the County provided details about the in-water disposal methodology, the low risk of any material floating to the surface, and the low likelihood of any snails surviving the high-salinity conditions (Sheppard, pers. comm., July 10, 2024).

Although no snails have currently been mapped in Union Bay, that does not mean they are not present. If discovered during any pre-project sampling, or during project implementation, that could affect the project's sediment disposal plans and would likely also result in added efforts to decontaminate equipment that may come into contact with snails and potentially inadvertently spread them.

3.2.3 Washington State Department of Natural Resources

Background

DNR is the manager of state-owned aquatic lands, which is a patchwork of tidelands, shorelands, harbors areas, and the beds of navigable waters. Prior to commencing work occurring on or over state-owned aquatic lands, an Aquatic Use Authorization is required. For construction activities, the DNR would likely authorize short-term temporary impacts under a Right of Entry License. For the longer-term use, the state may require a lease, easement, or right-of-way. The Aquatic Use Authorization is a contractual agreement between the land-user and the state based on terms and conditions of use which may include insurance and rent requirements.

Application to Project

The following image (Exhibit 3-3) covering much of the project area was taken, with permission, from a screen share during a conversation with Trina Contreras, DNR's Aquatics Land Manager (pers. comm., December 15, 2023). The green polygons show state-owned aquatic lands and the tan areas show state-owned aquatic lands that are subject to an existing lease. This map is only an approximation, and actual boundaries and status of the aquatic lands would need to be verified by DNR's Title and Records Office. A small portion of the tan area overlapping the UW campus and extending into Lake Washington is for UW's lease that allows boat anchorage during UW football games. The blue polygon in the Montlake Cut is not a state-owned aquatic land.

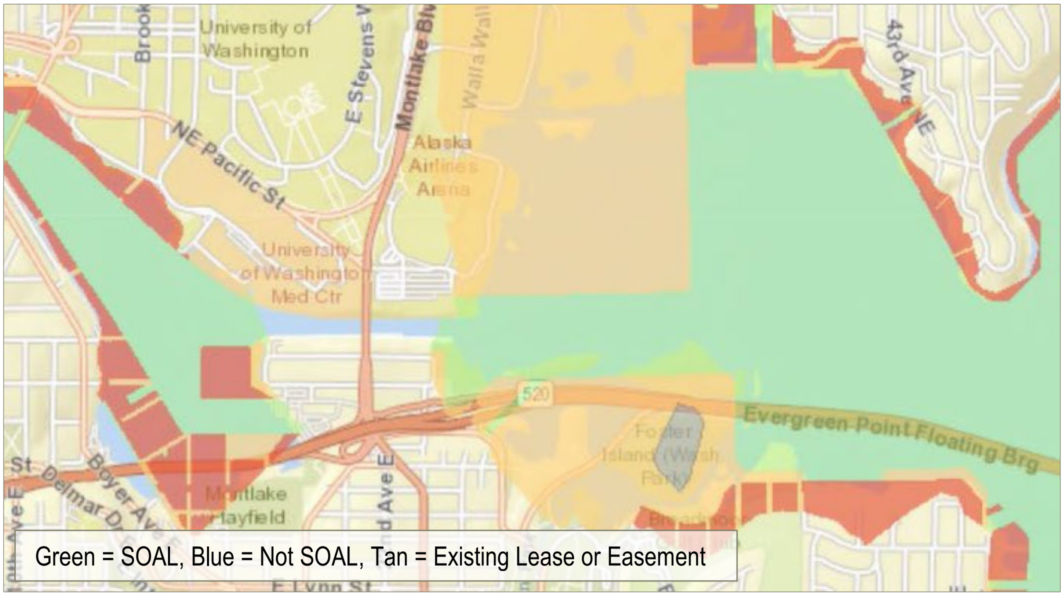


Exhibit 3-3: Generalized, Approximate Map of Washington Department of Natural Resources State-Owned Aquatic Lands (SOAL)

According to DNR, the specific Aquatic Use Authorization would be an Outfall Authorization, which would cover intakes, outfalls, and associated lines in state-owned aquatic lands. The authorization may ultimately take the form of a lease, which provides exclusive use of the lease area to UW, or more likely an easement, which would be non-exclusive. The rental cost for an authorization is related to the value of the adjacent land, which can result in expensive rates. An additional Right of Entry may be required to allow temporary use of state-owned aquatic lands during installation of the intake.

Similar to other agencies, DNR would require avoidance and minimization of impacts of a proposed use on the ecosystem. Toward that end, installation of lines below the lakebed sufficiently deep to avoid disturbance of the lakebed and aquatic vegetation should be considered. The consequences to aquatic habitat from different alignments, construction methods, anchored versus floating components, and other variables should be evaluated.

Ms. Contreras suggested that UW continue engagement with DNR as plans evolve, and suggested that additional conversation with DNR's policy team could be beneficial. Considering the objectives of the project related to reduction of fossil fuel-reliance and possible benefits to aquatic life if Ship Canal water temperatures are reduced, pursuit of a conservation easement for the in-water structures could be explored, or it may be possible to negotiate the rent to acknowledge those benefits.

<u>Schedule</u>: The review and contracting process once a complete application has been submitted can take between 6 and 12 months, depending on project complexity. Early and

frequent coordination is recommended to make sure that the state-owned aquatic land is available, that the proposed use is appropriate for public lands, and that appropriate impact avoidance and minimization measures have been incorporated. DNR cannot transmit the draft authorization for management review and finalization of the use authorization until all other permits have been received.

3.3 City of Seattle

The City of Seattle completes land use reviews that require public notice and include discretionary decisions as a Type II Master Use Permit (MUP). For the proposed project, the MUP would cover SMP compliance and Environmentally Critical Areas (ECAs) compliance. Construction permits cannot be issued until the MUP has been issued. The following discussion covers the MUP.

3.3.1 Shoreline Master Program

Background

Because Lake Washington (including the Montlake Cut and Portage Bay) is greater than 1,000 acres in size, the lake and the associated shorelands are classified as a Shoreline of Statewide Significance. The land within 200 feet of the ordinary high water mark (OHWM), plus any associated wetlands, and the lake are within shoreline jurisdiction and are regulated by the City's SMP (Chapter 23.60A Seattle Municipal Code [SMC]). Proposed activities within a Shoreline of Statewide Significance must demonstrate that they are consistent with a specific list of use preferences, in the order established in Revised Code of Washington (RCW) 90.58.020 as follows:

1. Recognize and protect the statewide interest over local interest
2. Preserve the natural character of the shoreline
3. Result in long term over short term benefit
4. Protect the resources and ecology of the shoreline
5. Increase public access to publicly owned areas of the shorelines
6. Increase recreational opportunities for the public in the shoreline
7. Provide for any other element as defined in RCW 90.58.100 deemed appropriate or necessary

Application to Project

Elements of the project that are located in Lake Washington/Montlake Cut/Portage Bay, waterward of the OHWM, have been assigned either a shoreline environment designation of Conservancy Navigation or Conservancy Preservation (Exhibit 3-4). The Conservancy

Preservation designation is also applied to the wetland and terrestrial habitat area in and east of Ravenna Creek. The upland area within shoreline jurisdiction west of Ravenna Creek has been assigned a Conservancy Management shoreline environment designation. If the discharge pipe and outfall are located at the west end of the Montlake Cut near the Muckleshoot Tribe's old salmon smolt rearing pond, then the project might also occur in an area designated Urban Commercial.

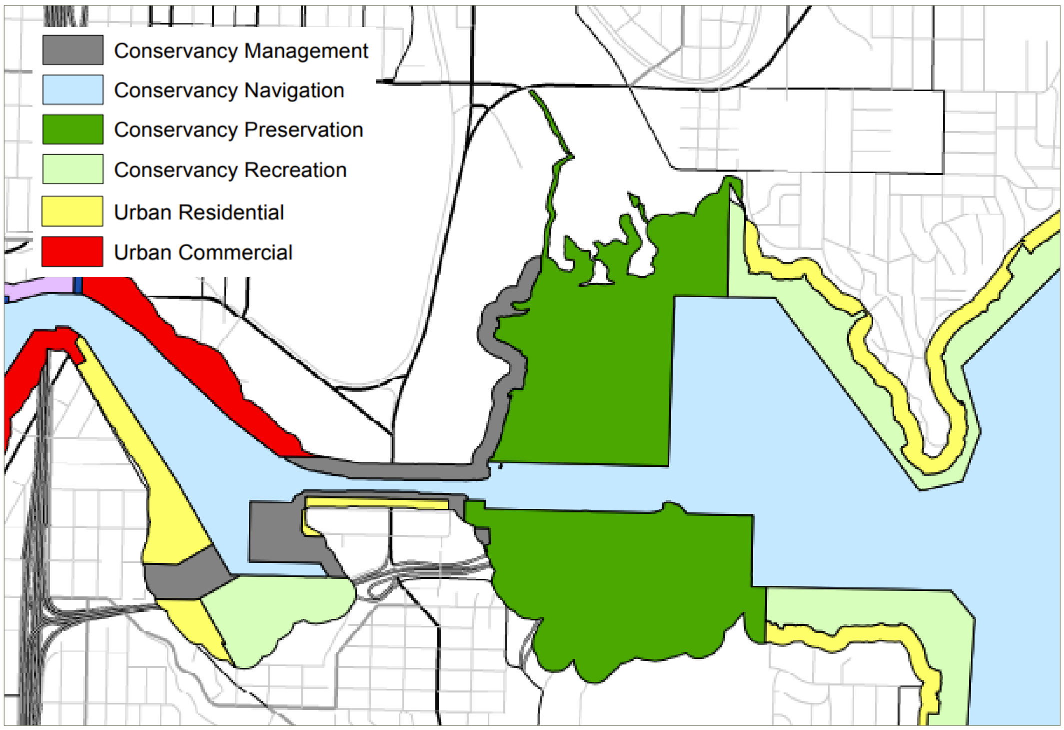


Exhibit 3-4: City of Seattle Shoreline Master Program Shoreline Environment Designations
(Source: https://seattle.gov/dpd/research/GIS/webplots/Shoreline_Zoning_Map.pdf)

Each environment designation has a unique table that identifies which uses and modifications are allowed with a Shoreline Exemption or Shoreline Substantial Development Permit, Special Use Permit, or Shoreline Conditional Use Permit, and which are prohibited outright. The permit categories for the four potential environment designations that might apply to the deep lake cooling element of the ERP, depending on design and locations of the intake and outfall, are provided in Exhibit 3-5 below.

Exhibit 3-5: Relevant Use and Modification Allowances in Project-Area Shoreline Environment Designations (Chapter 23.60A Seattle Municipal Code)

Use /Modification	Shoreline Environment Designation: Conservancy Management[1]	Conservancy Navigation[2]	Conservancy Preservation[3]	Urban Commercial[4]
Utility uses[5]	Utility service uses[6] are Permitted (if they reasonably require a shoreline location to operate)	All utility uses are Prohibited	All utility uses are Prohibited	Utility service uses[6] are Permitted (if they reasonably require a shoreline location to operate)
Utility lines[7]	Permitted	Special Use	▪ Permitted on dry land. ▪ Shoreline Conditional Use Permit in water if no feasible alternative location exists.	Permitted
Dredging to install utility lines	Permitted	Shoreline Conditional Use	Shoreline Conditional Use	Shoreline Conditional Use
Fill to install utility lines	Shoreline Conditional Use	Shoreline Conditional Use	Shoreline Conditional Use	Shoreline Conditional Use
Heat exchanger[8]	Shoreline Conditional Use, but prohibited in Lake Washington, Lake Union, and the Ship Canal	Shoreline Conditional Use, but prohibited in Lake Washington, Lake Union, and the Ship Canal	Prohibited	Shoreline Conditional Use, but prohibited in Lake Washington, Lake Union, and the Ship Canal

NOTES:
1 Adapted from SMC 23.60A.172 and SMC 23.60A.224
2 Adapted from SMC 23.60A.172 and SMC 23.60A.240
3 Adapted from SMC 23.60A.172 and SMC 23.60A.252
4 Adapted from SMC 23.60A.172 and SMC 23.60A.382
5 "Utilities" means the following uses: Communication utility major or minor; Utility service uses; Solid waste management; Recycling; Sewage treatment plant; and Power plant (SMC 23.60A.940).
6 "Utility services use" means a utility use that provides the system for transferring or delivering power, water, sewage, storm water runoff, or other similar substances. Examples include electrical substations, pumping stations, and trolley transformers (SMC 23.84A.040).
7 "Utility lines" means pipes, cables or other linear conveyance systems used to transport power, water, gas, oil, wastewater or similar items. Utility lines include outfalls and intakes (SMC 23.60A.940).
8 "Heat exchanger" means a device that uses water to cool a structure and discharges warm water into a water body (SMC 23.60A.916).

Based on the most recent concepts, the following environment designations would contain the project components listed below:

- Conservancy Management (all upland of OHWM): Intake line, a portion of the heat exchanger and equipment building (likely classified as a "utility service use"), discharge line
- Conservancy Navigation: Intake, intake line, discharge line and outfall in Ship Canal or deep Lake Washington (potentially part of the heat exchanger)
- Conservancy Preservation: Intake line
- Urban Commercial: Only discharge line and outfall (potentially part of the heat exchanger) depending on the final discharge location

All of the upland components of the project within shoreline jurisdiction would be located in the Conservancy Management environment designation with limited potential for some components extending into the Urban Commercial environment designation. The shoreline setback from the OHWM is 50 feet in Conservancy Management and 35 feet in Urban Commercial (SMC 23.60A.232.A and -390.A). According to SMC 23.60A.167.D.3.j, pipes carrying water and stormwater are allowed in the shoreline setback. At a minimum, the project would require a Shoreline Substantial Development Permit, a Special Use Approval, and a Shoreline Conditional Use Permit. The criteria for each are outlined in SMC 23.60A.030, -032, and -.034, respectively. A Shoreline Conditional Use Permit must first be approved by the City and then sent to Ecology for its 30-day review and approval. The Shoreline Substantial Development Permit and Special Use Approval are City-only decisions.

During an early conversation with Ben Perkowski, City Shoreline Planner (pers. comm., December 14, 2023), he indicated that some part of the intake or discharge lines waterward of the OHWM could be considered to fall under the "utility uses" classification, in addition to or instead of the "utility lines" classification. This would have effectively prohibited the project under the current SMP regulations since there are no permit pathways to circumvent a prohibition other than modifying the SMP itself. Mr. Perkowski consulted internally with other City staff and concluded that the intake and discharge pipes would be classified only as "utility lines."

However, in a subsequent exchange (pers. comm., February 13, 2024), the potential for discharge water temperature to exceed the receiving water temperature for limited periods of time during some potential scenarios was raised. Even though the discharge water may still meet the State's aquatic life temperature standard, Mr. Perkowski suggested that the SMP's effective prohibition on discharging "warm water" into Lake Washington or the Ship Canal could be a barrier to some potential project alternatives. It is not clear in the SMP, or to City staff, whether "warm water" is relative to the receiving water temperature or is water that is warmer than the State aquatic life temperature standard (16°C). Continued project concept planning and input from other agencies and the Muckleshoot Tribe indicates that the likely discharge locations and depths have conditions such that the receiving water is highly unlikely to be cooler than the discharge water temperature. Further, the system can be operated so that water that is warmer than the State standard would not be discharged.

On November 18, 2024, UW submitted a memo summarizing the challenge presented to the project by the SMP regulations and providing draft Director's Rule text for the City's review and consideration. The text included the following proposed interpretation of the term "warm water:"

> "Warm water" as used in the definition of "heat exchanger" in SMC 23.60A.916 is any water that exceeds Washington State Department of Ecology's aquatic life temperature criterion set in WAC 173 201A 200(1)(c). Devices involved in transfer of heat between water and structures, but that do not discharge water exceeding Ecology's temperature standard, are not considered "heat exchangers" for purposes of applying SMC 23.60A.172.C, Table A, row 9. Such devices would be permitted as components of utility uses or utility lines.

Depending on the outcome of the City's review, a potential revision to the SMP may need to be pursued or this provision would be a key factor in determining what discharge locations/depths and operations protocols may be viable.

Schedule: From submittal of a complete application to the City, approval by the City and Ecology (for a Shoreline Conditional Use Permit) could take between 10 and 18 months. The duration would vary based on City and Ecology staff workloads, project complexity, and the nature and number of public comments.

3.3.2 Environmentally Critical Areas

Background

The presence of ECAs within areas under the jurisdiction of the City's SMP requires compliance with the June 30, 2015, version of the City's ECA regulations (Chapter 25.09 SMC) adopted by reference into the SMP. ECAs located outside of shoreline jurisdiction are regulated under the most recent version of the City's ECA regulations.

Application to Project

The City has mapped the following ECAs on or adjacent to the UW campus where project elements could be located (City, 2023):

1. Wetlands: The east-facing lake fringe of the UW campus has abundant wetlands (Exhibit 3-6). Specific development standards for wetlands are found in SMC 25.09.160.

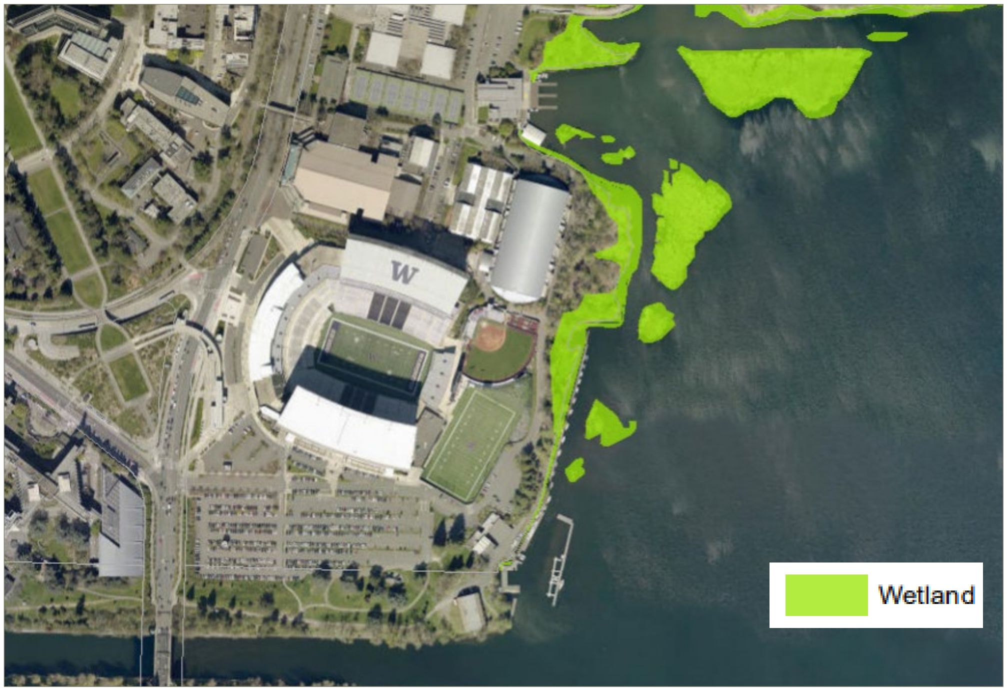


Exhibit 3-6: City of Seattle Environmentally Critical Areas – Wetlands (Source: SDCI GIS Web Map; Seattle, 2023)

2. Geologic hazard areas (specifically liquefaction-prone areas and peat settlement-prone areas): The entire campus has been mapped as a Category II peat settlement-prone area and much of the campus is also mapped as a liquefaction-prone area (Exhibit 3-7). Specific development standards for liquefaction-prone and peat settlement-prone areas are found in SMC 25.09.100 and -.110, respectively.
3. Fish and wildlife habitat conservation areas (FWHCAs): WDFW's Priority Habitats and Species on the Web application (WDFW, 2023) shows a number of priority species and priority habitats, which are regulated by the City as FWHCAs by definition (Exhibit 3-8). Other than wetlands, the primary habitat areas are waterfowl concentrations and the lake itself. Great blue heron rookeries are also mapped outside of shoreline jurisdiction and the likely project area, but the 500-foot Great Blue Heron Management Area required under Director's Rule 5-2007 could overlap some project elements. Priority fish (salmonids) are also mapped throughout the lake. Specific development standards for FWHCAs are found in SMC 25.09.200.

Exhibit 3-7: City of Seattle Environmentally Critical Areas – Geologically Hazardous Areas (Source: SDCI GIS Web Map; Seattle, 2023)

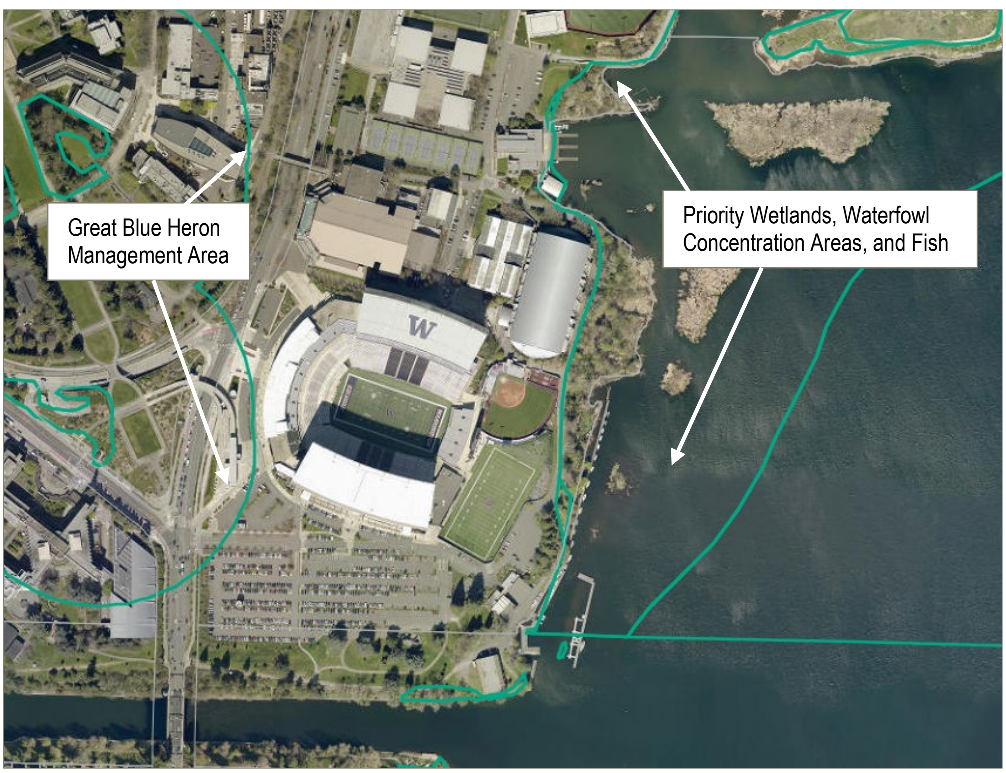


Exhibit 3-8: City of Seattle Environmentally Critical Areas – Fish and Wildlife Habitat Conservation Areas (Source: SDCI GIS Web Map; Seattle, 2023)

4. Abandoned landfills: The project may not be located on an abandoned landfill; however, it is likely that some element of the project would be in the 1,000-foot abandoned landfill buffer (Exhibit 3-9). Specific development standards for abandoned landfills are found in SMC 25.09.220.

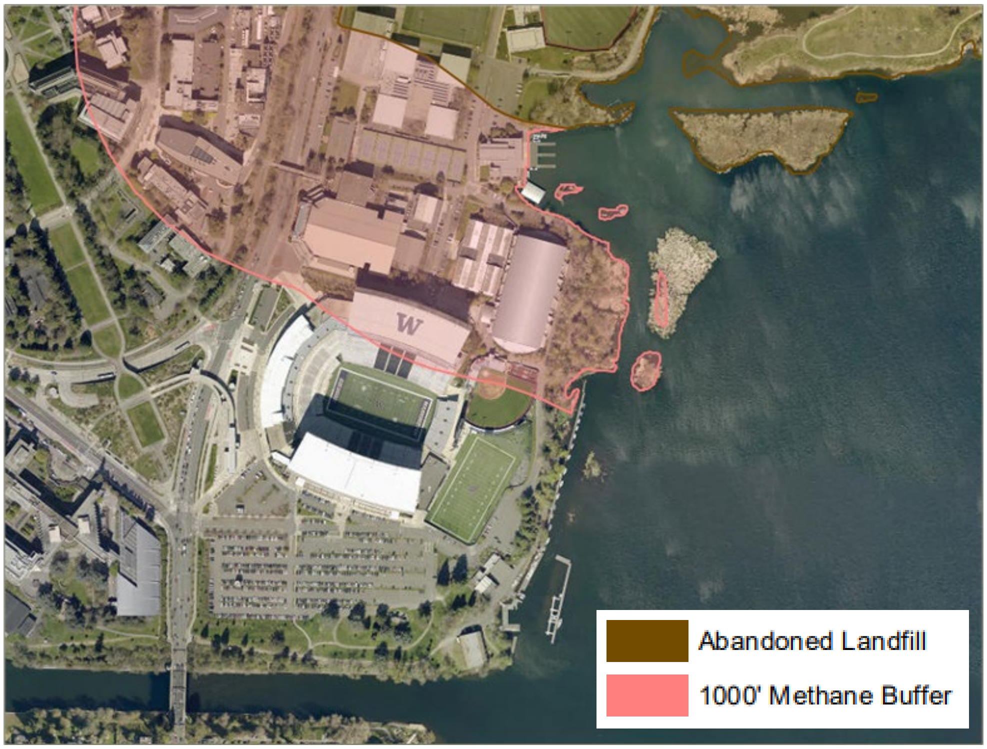


Exhibit 3-9: City of Seattle Environmentally Critical Areas – Abandoned Landfill (Source: SDCI GIS Web Map; Seattle, 2023)

Technical studies, including a wetland delineation and geotechnical report, would need to be prepared that identify and classify all ECAs within the project area, document use of mitigation sequencing, characterize and quantify unavoidable impacts, and propose any necessary mitigation. As shown in Exhibits 1-1 and 3-5, lake fringe wetlands are in close proximity to the proposed upland equipment building, and the building could be within the wetland buffer. It is possible that a Shoreline Variance and ECA Exception may be required to construct the building within the buffer. If necessary, the project could qualify for an ECA Exception under SMC 25.09.300.A.2 (public projects), provided the location in the buffer is "necessary to accommodate a public facility or public utility," there is "no reasonable alternative location," and other standards are met related to mitigation sequencing. The criteria for a Shoreline Variance are located in SMC 23.60A.036.

Schedule: The ECA reviews would occur as part of the Type II MUP in conjunction with the shoreline permitting. If a Shoreline Variance is required, then the City's approval would be followed by delivery to Ecology for its 30-day review and approval. The City could issue the MUP after the 21-day appeal period of Ecology's decision has lapsed.

3.4 University of Washington

Background

SEPA requires all governmental agencies to consider the environmental impacts of a project before making decisions, including issuing a permit, constructing a building or facility, or adopting a regulation. Typically, a SEPA checklist is prepared to help identify whether the proposal could have a significant impact on the human or natural environment. If it is likely that a significant adverse impact on one or more elements of the environment could not be avoided or mitigated to less than significant, then an environmental impact statement (EIS) must be prepared.

As specifically stated in Chapter 478-324 WAC, and consistent with RCW 43.21C and WAC 197-11, UW is the lead agency authorized to implement SEPA for UW-initiated projects. UW has a SEPA Advisory Committee established per WAC 478-324-040 whose stated mission is "to ensure that sound decision making at the university includes early consideration of environmental values and goals and timely preparation and review of environmental analysis." The Committee is regularly consulted by UW's SEPA responsible official after SEPA checklist preparation, prior to making determinations of non-significance or significance and issuing any threshold determinations, and at key points in the EIS process.

Application to Project

Based on the nature of the project and the likely level of stakeholder and public interest, Julie Blakeslee, UW's SEPA responsible official, stated that an EIS is the anticipated SEPA analysis tool (pers. comm., December 29, 2023). The formal EIS process would begin once sufficient engineering analysis, technical studies, and agency outreach have been completed to confirm proof of concept and allow development of a viable project description.
The project description may still include different options for intake and discharge locations, installation methods, and other details. The EIS process, with its required scoping and evaluation of alternatives, would help the team identify a preferred alternative.

Schedule: The formal process would begin with publication of a combined determination of significance and scoping notice, which would include a project description and preliminary alternatives. The scoping notice invites agency and public input on the topics that should be addressed in the EIS, including possible alternatives. Prior UW experience with EISs suggests that a Draft EIS should be made available for public comment within a year or so of scoping.

3.5 Tribes

The UW has a Tribal liaison that would be coordinating with area Tribes who may have an interest in the project related to both cultural and ecological considerations. To date, two meetings have been held with Eric Warner, a senior fisheries biologist for the Muckleshoot Tribe. Some of the key concepts and ideas raised during the calls included the following (pers. comm., June 24, 2024, and September 19, 2024):

- Preference for water discharge and diffusion near the bottom of the canal, rather than the surface, so that water is more likely to maintain its integrity as a cool layer for fish movement rather than being mixed.
- Potential for a portion of the cool-water discharge (possibly 2 to 3 cfs) to be integrated with the Muckleshoot Tribe's interest in restarting use of the abandoned fish pond at the west end of the Montlake Cut for smolt rearing and release (Exhibit 3-10). This might allow the Tribe to release Issaquah Hatchery fish farther downstream, bypassing the extensive predation on released fish that currently takes place between the hatchery and the pond.

Exhibit 3-10: Proximity of Preferred Discharge Location to Former Salmon Rearing Pond

- Interest in how the UW project could coordinate with the LLTK/WRIA 8 studies and possible future projects, although the projects' timelines and budgets may not align well.
- Concern about the possible effects of discharges west of the Montlake Cut interfering with flows through the cut and potentially interfering with juvenile salmon movement

from the lake to the locks. He noted that flows through the Cut are lower in summer, such that even a 50 cfs discharge by UW could be significant. He noted that the risk for larger discharges in the 200 to 300 cfs range, such as those examined as part of the LLTK/WRIA 8 studies, would be greater. UW indicated that this risk could be managed by UW's ability to turn the system off as needed.

- Emphasis on ensuring the intake design is appropriately screened to meet NMFS and other agency standards, and that dissolved oxygen levels in the discharge water are appropriate for fish.
- Concern about possibility of trenching-related turbidity during intake line installation entering the deeper water of the Corps-dredged canal east of the Montlake Cut, which may be occupied by salmon.
- Recognition that some answers regarding the relative benefits to fish of having single-point discharges versus multi-point diffused discharges are not yet available, and would require some targeted fish behavior studies.

Based on information shared by King County related to its Enatai project, possible interference with the Muckleshoot Tribe's warmwater fishery in the lake may be a concern, as well as potential disposal of excavated materials at the Corps' Elliott Bay in-water disposal site (Sheppard, pers. comm., July 10, 2024). Mr. Warner did not express any concerns on these topics during the calls. The in-water work window for activities in Union Bay and the Ship Canal may reduce those possible conflicts experienced by the Enatai project, which included summer months in its work window.

Continued outreach to the Muckleshoot, and possibly the Suquamish, Tulalip, Snoqualmie, Stillaguamish, and Squaxin Island Tribes would occur early in project concept development, as well as during environmental documentation and permit application development.

4 PERMIT STRATEGY

The project's need for a substantial quantity of cold water from a waterbody that is simultaneously a Water of the U.S., a navigable water, habitat for federally listed species, a Shoreline of Statewide Significance, state-owned aquatic land, and in some areas a federal works project, makes obtaining the environmental approvals and permits challenging. Although the agencies are operating under a number of different laws and codes, they share in common a requirement to avoid and minimize adverse impacts on the built and/or natural environment, and the burden would be on UW to demonstrate that the final proposed project would not result in avoidable or unmitigable harm.

There is also some urgency from a climate and sustainability perspective to implement a deep lake cooling project as soon as possible. As Tom Mathis of DSI, LLC heard in a multi-agency and Tribal meeting of fisheries biologists and other natural resource professionals at the conclusion of the most recent LLTK/WRIA 8 study (2024), the overwhelming need to reduce temperatures in the Ship Canal overshadows concerns about the effects of shifting water within the LWSC system from a dissolved oxygen or nutrients perspective (pers. comm., August 1, 2024). It is expected that project operations would be adaptively managed in response to performance monitoring if issues arise related to nutrients, dissolved oxygen, or other water quality parameters. While all appropriate studies would be completed, and the necessary amount of time taken to develop a sound design, certain permits or authorizations may be pursued concurrently rather than sequentially. The necessary surface water right, for example, would ideally be secured ahead of significant investments of time and energy into environmental reviews and permits. However, that could set the schedule back a year or more.

Exhibit 4-1 shows a schematic diagram of a potential permit strategy that leans heavily on early and continued coordination with agencies, and Tribes when feasible, to provide mutually beneficial opportunities to hear about the project, voice concerns, and offer and discuss alternatives. This would support the UW team's development of focused and high-quality environmental documentation, supported by the relevant data and studies. Steps 1 through 4 are generally sequential, with Step 5 occurring concurrently with Steps 1 through 3. Appendix A includes a preliminary schedule for Step 4. The total timeframe depends on the actual time it takes to collect data and conduct studies that support design and permitting, and the amount of time for engineers to develop plans to support Steps 3 and 4. This strategy and timeline assumes that there is no discharge into the temperature-impaired reach of the Ship Canal, which Ecology has indicated would take up to 15 years to receive approval.

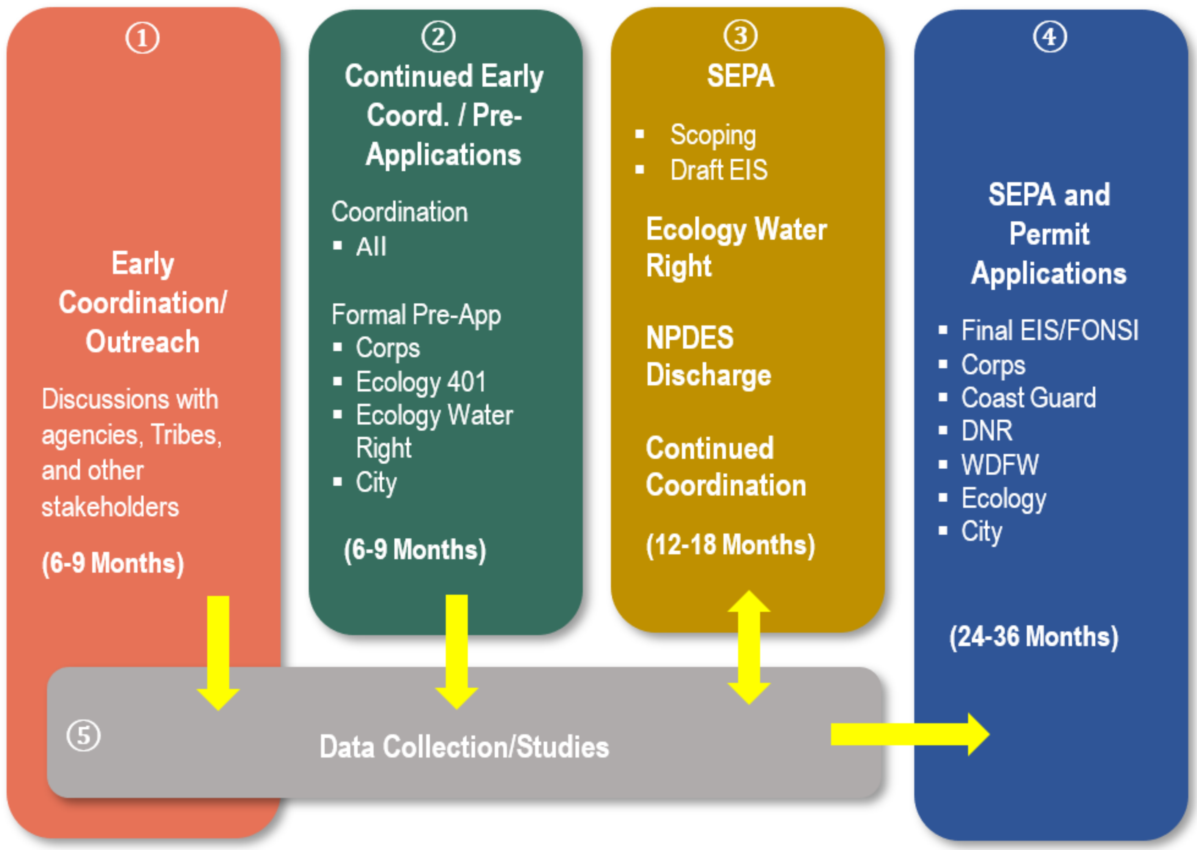


Exhibit 4-1: Conceptual Permit Strategy

1. Early Coordination/Outreach: Step 1 in the process launched in mid-November 2023 and has continued into Phase 3 of the project, initiated by an email to key agency contacts identified for most of the permits and approvals. The discussions were framed as an opportunity to introduce the agency to the project at its very preliminary stage, hear the agency's initial thoughts and reactions to the project, and learn about studies or supporting data that the agency could share or would like to receive during the future review. Discussions with the following agencies took place in one or more phases, either as phone calls or emails (see Appendix A):
   a. Corps: Section 404/10 staff, Section 408 staff, DMMO staff, water manager staff
   b. NMFS: ESA staff
   c. Ecology: NPDES water quality staff, water right staff, shoreline staff
   d. DNR: aquatic lands staff
   e. WDFW: HPA staff, aquatic invasive species staff
   f. City: Shoreline permit staff
   g. UW: SEPA staff

The discussions were at a very high level, as several of the agencies could not provide specific direction or guidance without more information. During Phases 2 and 3, meetings with WRIA 8 and LLTK representatives and meetings with the Muckleshoot Tribe were also held. Sections 3 through 6 and the permit matrix in Appendix A incorporate the information received to date.

2. Continued Early Coordination/Pre-Application: It is anticipated that engineering concept development would be advancing during Step 2, allowing more focused discussions with agencies and potentially some formal pre-application meetings. Although these meetings are only shown on the diagram once, it may be helpful to initiate a follow-up meeting in the latter half of Step 3. A pre-application meeting with the Corps could be particularly helpful, as they are often attended by USFWS, NMFS, Ecology, WDFW, EPA, and the City. A multi-agency meeting outside of the Corps framework could also be beneficial.
3. SEPA/Water Right: Step 3 should be launched once engineering has progressed to the point where approximately 15% level plans are available accompanied by a detailed project description that allows for some impact characterization and meaningful input by agencies, stakeholders, and the public into the full scope of impacts, the range of alternatives, and possible mitigation. At the point where a clear preferred alternative emerges (if that's the case) with a final intake and discharge location, pursuit of the water right could begin in earnest and elements of Step 4 could begin.
4. SEPA/Permit Applications: With a final project description and 30% level plans for the preferred alternative, permitting could commence. A preliminary schedule is provided in Appendix A.
5. Data Collection/Studies: Evaluation and collection of existing information continued through February 2025. Section 6 includes some recommendations for additional study and data gathering based on known agency requirements or design evaluation and development needs.

5 DESIGN CONSIDERATIONS

The following design considerations are focused on the specific built elements of the project, and do not include a listing of construction best management practices.

5.1 Ecological Impact-Related

- Screen the intake to avoid entrainment of fish into the diversion or impingement of fish on the screen as required by NMFS in Section 8.5 of *NOAA Fisheries West Coast Region Anadromous Salmonid Passage Design Manual* (NMFS, 2022). Screen the outfall as needed to prevent fish from attempting entry.

- Avoid and minimize disturbance of valuable nearshore and shallow-water aquatic habitats to the extent practicable and restore any necessarily disturbed areas post construction. If practicable, dredging or trenching in Union Bay should be avoided, and directional drilling or similar trenchless methods should be used to avoid disturbing high-value nearshore and shallow habitats that provide important habitat for fish and wildlife. If dredging and trenching are necessary, implement best management practices to minimize impacts to water quality and physical habitat.
- Discharges should be located at sufficient depths and designed to avoid adversely effecting high-value nearshore and shallow habitat through substrate scour, flow velocities that impede nearshore fish movements or cause avoidance behaviors, or any other modification that directly or indirectly alters aquatic vegetation communities.
- Consider the WDFW recommendations for discharge location(s) and design contained in Section 3.2.2.1 above.

5.2 Temperature-Related

- Project water intake pipe(s) would be located at approximately 20 meters water depth in the portion of the lake where temperature is relatively constant throughout the year. The final intake depth may be adjusted based on findings from temperature data collection at the potential location.
- Temperatures between 7 and 13°C are expected at the intake pipe(s) if located at a depth of 20 meters in the lake. Average summer season temperature at 20 meters depth is 10.1°C, based on the Station WABuoy data.
- Temperatures at the surface can be expected to range from 18 to 25°C in the lake and from 17 to 25°C in the Ship Canal during the months of July through September, which may factor into the evaluation of suitable discharge locations.
- Based on current regulations and Ecology's legal opinion, a discharge could not be located in the temperature-impaired reach of the Ship Canal until a TMDL has been developed and approved by the EPA (see Section 3.2.1.5).

5.3 Dissolved Oxygen-Related

- Extracting colder water from depth in the lake (which, in summer, contains less dissolved oxygen than in other months and is further warmed by passing it through the heat exchanger) may result in the dissolved oxygen concentration being too low to meet discharge requirements. If dissolved oxygen concentration is included as an NPDES discharge permit requirement and the discharged dissolved oxygen concentration is lower than the receiving water value, then consideration should be given to use of a mixing zone or the addition of an aeration mechanism to the discharge. Other agencies may also require that the dissolved oxygen level in the discharge water be at least the same as the receiving water.

5.4 Other Water Quality/Hydrology-Related

- Increase the diffusion area for the outflow discharge to reduce localized adverse flow effects of any one discharge.
- If there is a discharge into the Ship Canal, orient the discharge points to flow in the same direction as the general flow path of the LWSC system (east to west) to reduce localized mounding and backwater effects.
- Orient the discharge points away from the channel or lake bed to reduce scour of bed sediment and decrease turbidity.
- Consider potential scouring effects and prevent disturbing the loose sediment layer on the bed of the lake during intake design given man-made and naturally sourced contamination that may be present in those sediments.
- Consider building into the system controls a way to adjust the discharge volume, or simply be able to turn if off quickly, if pre-project modeling or post-project monitoring indicates that there are flow direction issues during certain periods (e.g., when locks maintenance reduces outflow or when summer flows drop below a certain level).

6 DATA GAPS AND RECOMMENDATIONS

6.1 Geotechnical

Makai Ocean Engineering, Inc. (Makai), developed a feasibility study for the proposed pipeline. Their 2024 report reviewed the lake bathymetry, Lidar data from 2016 and 2017, and subsurface geotechnical data for Union Bay available on the DNR web portal. Makai recommended performing an additional geotechnical investigation program along the final pipe route; it is our understanding that the pipeline alignment and intake pump location have not been finalized.

Prior to performing any additional drilling, we recommend completing a desktop study of the available geotechnical data in Union Bay. In addition to the Washington DNR portal, other public data sources include the Washington Department of Transportation (WSDOT) Geotechnical Web Mapping Application. Shannon & Wilson also has extensive project experience within the Project vicinity, and could review subsurface information from the following projects:

- WSDOT geotechnical borings supporting the SR 520 West Approach Bridge
- UW Pavement Evaluation Phase 3.1 ADA Parking Improvements Project
- UW Soccer Field Technology Updates

- UW Rowing Club Crew House
- UW Stadium

A desktop study would summarize the subsurface conditions and identify areas where there is limited pre-existing data. We recommend using the software program Leapfrog, developed by Seequent, to develop a geologic profile of the subsurface conditions within Union Bay. The Leapfrog models can be used during later design phases to input the pipeline alignment and support future geotechnical recommendations.

Given the preliminary design stage, we recommend a phased drilling exploration program to prioritize finalizing the intake pump location before determining the final pipeline alignment. Based on the results of the desktop study, an exploration plan should be developed to support the intake pump location alternatives. That plan could include up to four borings to a depth of 100 feet and collection of samples for laboratory testing. We assume that drilling could be completed from a barge during four daytime shifts.

Once the first phase of drilling is complete, a report could provide a summary of the exploration program and feedback on the alternatives for the intake pump location. This report would not include design recommendations but would expand on the feasibility study by Makai. After the intake pump location is finalized by the design team, a second exploration program to support the pipeline alignment should be developed.

Exhibit 6-1 provides a preliminary cost estimate to complete the work described above. These values are based on recent quotes Shannon & Wilson received from different subcontractors and are reflective of Shannon & Wilson's 2024 rates. If the work is completed in 2025 or later or by other firms, those rates must be adjusted.

Exhibit 6-1: Preliminary Cost Estimates for Geotechnical Support

Task Description	Labor	Expenses
Desktop Study	$10,000	$100
Develop Leapfrog Model	$13,000	$2,000
Intake Pump Exploration Program and Laboratory Testing	$22,000	$144,000
Conceptual Design Report and Feedback on Alternatives	$20,000	$150
TOTAL	**$63,000**	**$146,250**

6.2 Temperature

- Shannon & Wilson was unable to identify data describing lake water temperature below the surface in the probable project water intake area or in potential lake discharge locations. It is unlikely that lake water temperature below 30 meters water depth varies significantly across the lake, but the absence of data local to the project area is a significant gap in knowledge and represents a risk to the project.

- The DSI, LLC (2024) LW-RTTM model is calibrated to a limited set of lake water temperature profiling and meteorological data (air temperature, wind speed, and wind direction). The accuracy of model predictions would be directly improved if additional water temperature profiles and meteorological data were available, particularly near the location of proposed project water intake.
- Consider collecting vertical temperature (and dissolved oxygen) profiles from at least one location proximal to the target location of the lake water intake(s) and at several locations where any lake discharges could be located, with a reading frequency of at least once monthly over the span of a year or more. These temperature data, when incorporated into DSI, LLC model calibration, would improve knowledge of site-specific baseline conditions and help with developing more accurate correlations between local real-time data and updated thermal model predictions. The rough-order-of-magnitude cost based on 2025 rates to organize and conduct the work and process the data is shown in Exhibit 6-2. The estimated costs presented in Exhibit 6-2 consider that Shannon & Wilson has already collected three of 12 months of the recommended annual real-time data set. The temperature and dissolved oxygen data would provide a baseline for permit applications and also provide critical information for the design of the project.
- After target locations of the discharge pipe(s) are identified, determine if temperature modeling would be required as part of the permitting process to demonstrate the lateral and vertical extent to which a thermal plume would extend by season. Conversations with Ms. Tran at Ecology indicate temperature modeling for mixing is unlikely to be required. However, if such a model were to be required, the most current DSI, LLC hydraulic model could be customized to pose project discharge water temperatures and flow rates (50 cfs) as new simulation scenarios to evaluate potential for and extent of localized cold-water thermal plume development downstream from the proposed discharge locations to quantify project temperature reduction benefits.
- After target locations of the discharge pipe(s) are identified, determine if additional water quality parameter sampling (per Section 2.8) would be warranted in tandem with temperature data collection events. (Note: the estimated costs within Exhibit 6-2 assume no further water quality samples would be collected at this time).
- Considering the disparity between the LW-RTTM simulations compared to the real-time thermal data measured by Shannon & Wilson during the initial three profiling events, we would recommend continuing monthly data collection beginning in May 2025 through September 2025 as the lake begins to re-stratify and un-stratify to serve as a potential calibration point for DSI's model. The cost estimate within Exhibit 6-2 reflects this monitoring assumption:

Exhibit 6-2: Estimated Costs for Additional Intake Temperature Data Collection (Manual)

Task Description	Labor	Expenses
Manual temperature data collection, once per month for 5 months	$40,000	$8,500 (boat rentals, equipment and supply purchases)

6.3 Sediment Contamination

In order to have an early understanding of the possible feasibility of in-water disposal and potentially whether sediment could be sidecast during trenching, it would be beneficial to undertake some preliminary sediment sampling along the potential trench alignment route in Union Bay. The intent of the sampling and analysis would be to understand the concentration of potential chemicals within the sediment. This work would not include a formal sampling and analysis plan or submission for approval to the DMMO. Any definitive work for in-water disposal would require following the protocols of the DMMO and undertaking the work for a formal submission to the DMMO. The data generated by this proposed sampling could be incorporated into that formal DMMO submission but may not preclude the requirement for further testing or analysis.

A recommended sampling protocol would include drilling at six points to collect sediment cores from the top of the sediment to 0.5 feet below the base of a potential trench excavation. For much of the trench along the primary alignment, this is approximately 8.5 feet thickness, and increasing to approximately 24.5 feet thickness where the alignment crosses the Corps' navigation channel. Due to the limitations of the coring and the significantly increased cost of a larger vessel to undertake the work, the deeper sediment core would terminate at 20 feet below the top of sediment in the Corps' navigation channel. The sediment samples would be collected using a specialized subcontracted boat and vibrocore techniques. The location of each sample would be identified using a Global Positioning System (GPS) and may be 1 to 2 feet off the potential center line of the trench due to GPS inaccuracies.

The sediment samples would then be logged and composited into two samples. Each composite sample would be from three cores and would be composited in a sequential manner (e.g., Cores 1, 2, 3, and Cores 4, 5, 6). The two samples would be submitted for laboratory analysis of both physical and chemical properties. A list of the proposed analytical tests and detection levels is included in Appendix C. The analytical testing would exclude the listed site-specific chemicals on the third page of Appendix C and dioxin/furans. Some or all of these analyses may be required if in-water sediment disposal approval is ultimately sought. Samples for dioxin/furans would be collected, submitted to the testing lab, and frozen for later analysis. A monthly laboratory storage charge would be incurred after four months of hold; the cost estimate assumes that the samples would be held for one year, the maximum hold time for dioxin/furans, and that dioxin/furan analysis is not included.

Once the laboratory results have been received, data validation of the analysis results would be undertaken, and the detected values compared against the Sediment Management Standards (SMS) screening levels. The tabulated set of results compared against the SMS screening levels would be provided.

The rough-order-of-magnitude cost based on 2024 rates to organize the work, contract with the various entities, undertake sediment sampling, laboratory analysis, validate the results, and generate a results table is shown in Exhibit 6-3. The cost estimate does not include discussions with and submissions to regulators. This type of work should be exempt from an HPA, SEPA, and a shoreline permit. However, the latter would require application to the City for a written shoreline exemption. Sampling would also require a Corps approval, including ESA consultation, and DNR authorization. The sediment sampling might qualify for streamlined ESA approval using a programmatic that could reduce the level of documentation and the turnaround time from approximately six to 12 months to approximately two months.

Exhibit 6-3: Estimated Costs for Preliminary Sediment Sampling

Task Description	Labor	Expenses
Field plans, and preparation	$12,000	$100
Sediment sampling and analysis	$12,000	$28,400
Verification of data and tabulation and consultation	$7,400	$100
Permitting	$20,000 (if it qualifies for ESA programmatic)	
TOTAL	**$62,000**	**$28,600**

6.4 Bathymetry

The Makai feasibility study (2024) includes a recommendation for a high-resolution bathymetric survey with a spatial resolution of less than 3 feet where the pipeline would be trenched, and a resolution of less than 1 foot where the pipeline, intake, or discharge diffuser would be installed directly on the bed of the lake or Ship Canal. KPFF provided a rough-order-of-magnitude cost estimate as shown in Exhibit 6-4.

Exhibit 6-4: Estimated Costs for Bathymetric Survey

Task Description	Cost
Bathymetric survey	\$20,000 - \$25,000
Survey control	\$5,000
TOTAL	**\$25,000 - \$30,000**

7 CLOSURE

The findings and conclusions documented in this report have been prepared for specific application to this project and have been developed in a manner consistent with that level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area, and in accordance with the terms and conditions set forth in our agreement. This assessment is based on several factors and may include (but not be limited to) reviewing public documents; reviewing available topographic and bathymetric maps, aerial photos, and water quality data; reviewing readily available published information about surface and subsurface conditions; and interviewing agency representatives with respect to regulatory and permit-related topics. No new data collection, sampling, or quantitative laboratory testing was performed.

The conclusions presented in this report are professional opinions based on interpretation of information currently available to us and are made within the operational scope, budget, and schedule constraints of this project. The ultimate decision making authority rests with the jurisdictional agency charged with administering the applicable law or regulations. Shannon & Wilson cannot guarantee that any agency will issue an approval or permit. No warranty, express or implied, is made. Site conditions, both surface and subsurface, may be affected as a result of natural processes or human influence. This report does not provide sufficient information for construction-related activities.

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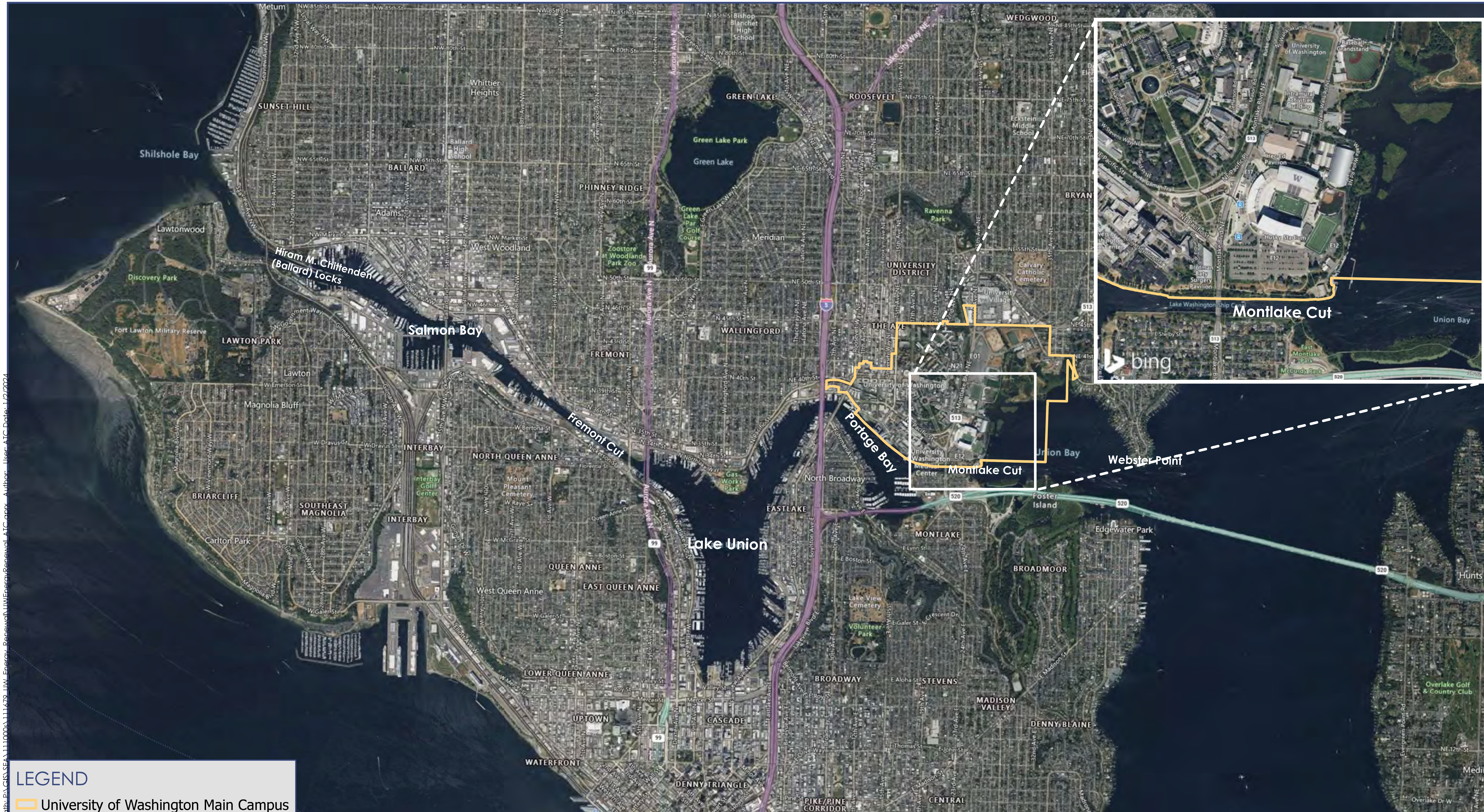

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March 2025

Vicinity Map

Figure 1

APPENDIX A: ENVIRONMENTAL PERMIT/APPROVAL ELEMENTS

Appendix A

Environmental Permit/Approval Elements

CONTENTS

Table A-1: Environmental Permit/Approval Matrix

Agency	Contact	Environmental Permit/Approval	Trigger	Required Environmental Applications and Supporting Documents/Studies
U.S. Army Corps of Engineers (Corps)	Jacalen Printz Jacalen.M.Printz@usace.army.mil (206) 764-6901 Shane Shelburn shane.m.shelburne@usace.army.mil (206) 316-3156	Clean Water Act (CWA) Section 404 and/or Rivers and Harbors Act Section 10	▪ 404: discharge of fill material into waters of the U.S. ▪ 10: work in or over a navigable waterway	▪ Joint Aquatic Resources Permit Application (JARPA) ▪ Aquatic areas delineation report ▪ Mitigation report/plan if needed
	National Marine Fisheries Service: Donald Hubner donald.hubner@noaa.gov (206) 526-4359 U.S. Fish and Wildlife Service: Ryan McReynolds ryan_mcreynolds@fws.gov (360) 753-6047	Section 7 Endangered Species Act (ESA) consultation (resulting in either concurrence or Biological Opinions from U.S. Fish and Wildlife Service and National Marine Fisheries Service) and Essential Fish Habitat (EFH) consultation under Magnuson-Stevens Fishery Conservation and Management Act	Work with potential to affect federally listed fish or wildlife	Biological Assessment, including EFH analysis
	Lance Lundquist lance.a.lundquist@usace.army.mil (206) 764-6909	Section 106 of the National Historic Preservation Act (NHPA) consultation	Work with potential to affect historic properties	Cultural resources/historic properties report
	Dana Dysart dana.m.dysart@usace.army.mil (206) 316-3970	Section 408 review/permission	Alteration/work in a federal project	▪ JARPA, including design drawings that show the bounds of the federal project ▪ Hydrologic and hydraulic study
	Joy Dunay Joy.M.Dunay@usace.army.mil (206) 764-6083	Dredge Management Materials Office (DMMO)	Dredging, particularly if it includes in-water disposal	▪ JARPA ▪ Sediment Sampling and Analysis Plan ▪ Bathymetry and geotechnical information ▪ Post sediment sampling report

Agency	Contact	Environmental Permit/Approval	Trigger	Required Environmental Applications and Supporting Documents/Studies
U.S. Coast Guard	Carl Smith Carl.F.Smith@uscg.mil (206) 220-7277	Bridge Permit under either the Rivers and Harbors Act Section 9 or General Bridge Act of 1946	Attachment of intake or discharge lines to SR 520 bridge or if a new line is over a navigable water	▪ Project initiation request ▪ Navigation impact report ▪ Bridge Permit application ▪ NEPA support ▪ BA ▪ Cultural resources/historic properties survey
Washington State Department of Ecology (Ecology)	Loree' Randall loree.randall@ecy.wa.gov (360) 485-2796	401 Water Quality Certification	Required if the project includes discharge of fill under Section 404 of the Clean Water Act or more than a *de minimis* discharge under Section 10 of the Rivers and Harbors Act	▪ Pre-filing Meeting Request ▪ Request for CWA Section 401 Water Quality Certification form ▪ JARPA ▪ Aquatic areas delineation report ▪ Mitigation report/plan if needed ▪ Possible Water Quality Monitoring and Protection Plan
	Loree' Randall loree.randall@ecy.wa.gov (360) 485-2796	Coastal Zone Management (CZM) Consistency	Federal action in a coastal county	▪ Form: Certification of Consistency with the Washington State Coastal Zone Management Program for Activities Requiring a Federal License or Permit ▪ Proof of receipt of all required permits and approvals
	Jeanne Tran jeanne.tran@ecy.wa.gov (425) 531-8311 Rachel McCrea rmcc461@ecy.wa.gov (206) 594-0146	National Pollutant Discharge Elimination System (NPDES) Individual Discharge Permit	Required for discharge of "wastewater" into state or federal waters	▪ Form 1 NPDES ▪ Form 2-C Supplemental Cooling Water Intake Structure ▪ Form 2E Facilities Which Discharge Only Nonprocess Wastewater ▪ Other information required under 40 Code of Federal Regulations 122.21(r) ▪ For discharge into temperature-impaired Ship Canal, extensive additional studies and modeling would be required to support total maximum daily load (TMDL) and rule-making

Agency	Contact	Environmental Permit/Approval	Trigger	Required Environmental Applications and Supporting Documents/Studies
	Stacey Britton stacey.britton@ecy.wa.gov (360) 764-3727	NPDES Construction Stormwater General Permit	Required if project disturbs 1 acre or more of land	▪ Notice of Intent ▪ Public notice ▪ Stormwater Pollution Prevention Plan ▪ Completed State Environmental Policy Act (SEPA)
	Rebekah Padgett rebekah.padgett@ecy.wa.gov (425) 365-6571	Shoreline Variance/CUP Reviewer	Requirement by the City for CUP or Shoreline Variance	Documents prepared for the City shoreline permits will be transmitted by the City to Ecology
	Doug Wood doug.wood@ecy.wa.gov (206) 594-0196 Kasey Cykler kign461@ecy.wa.gov (360) 603-1037	Water right	New withdrawal from Lake Washington	▪ Water Right Pre-Application Consultation Form ▪ Application for a New Water Right Permit form ▪ Supporting environmental and hydrologic information ▪ Completed SEPA
Washington State Department of Natural Resources	Trina Contreras trina.contreras@dnr.wa.gov (206) 764-6909	Aquatic Use Authorization / Aquatic Lands Lease	Activity that takes place on state-owned aquatic lands	▪ JARPA ▪ Attachment E to JARPA ▪ Surveys or a legal description of the property
University of Washington	Julie Blakeslee jblakesl@uw.edu (206) 543-5200	SEPA review	Agency decision or project with potential impacts on the environment	Environmental Impact Statement
Washington Department of Fish and Wildlife (WDFW)	Laura Arber Laura.Arber@dfw.wa.gov (425) 379-2306	Hydraulic Project Approval (HPA)	Work that uses, diverts, obstructs, or changes the natural flow or bed of state waters	▪ Aquatic Protection Permitting System online application ▪ SEPA determination
	Jesse Schultz Jesse.Schultz@dfw.wa.gov (360) 480-2105	Aquatic Invasive Species Permit	Activities that include possession, transportation, and introduction of the snail to a different location	▪ Under investigation

Agency	Contact	Environmental Permit/Approval	Trigger	Required Environmental Applications and Supporting Documents/Studies
City of Seattle (City)	Ben Perkowski Ben.Perkowski@seattle.gov (206) 684-0347	Shoreline Permits (Shoreline Substantial Development Permit, Shoreline Special Use Approval, and a Shoreline Conditional Use Permit, possibly a Shoreline Variance and Environmentally Critical Areas Exception depending on location and design)	Activity that meets the definition of "development" in shoreline jurisdiction.	▪ Master Use Permit Application, and supplemental shoreline permit application(s) ▪ Analysis of Shoreline Master Program (SMP) and environmentally critical areas (ECA) review criteria consistency ▪ Supporting studies necessary to address SMP and ECA compliance and review criteria (suite of studies depends on location and design)
	As assigned by Seattle Department of Construction & Inspections at time of application	Other City construction-related permits (depending on location and design)	tbd	tbd

Table A-2: Environmental Permit/Approval Schedule

	Months																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
FEDERAL																											
Corps Section 404/10 Permit, including ESA/106/NEPA	actual timeline can vary significantly depending on ESA and NWP vs. Individual Permit																										
Corps Section 408 Review/Permission																											
STATE																											
Ecology 401 Water Quality Certification	varies based on specific Corps authorization																										
Ecology CZM Consistency																			varies based on specific Corps authorization								
Ecology NPDES Individual Discharge Permit	[up to 15 years for discharge into temperature-impaired Ship Canal]																										
Ecology NPDES Construction Stormwater General Permit																					apply >60 days before start of construction if permit is required						
Ecology Water Right																											
DNR Aquatic Use Authorization/Lease										DNR cannot begin final management review until all permits have been received																	
UW SEPA: Final EIS/FONSI																											
WDFW HPA																											
CITY																											
City Shoreline Permits and Critical Areas Review																											
Other City Permits																											

NOTES:

* Month 1 is that point at which a preferred alternative and 30% plans are available.

** Permit timelines can vary significantly from what is shown depending on project design, agency staff availability, specific authorization types, and other factors.

*** Timeframes shown do not indicate level of effort, which may be high at the beginning and end, and in a monitoring state in the middle (or variations thereof).

Table A-3: Environmental Permit Contacts – Communication Log Through March 5, 2025

Agency	Contact	Environmental Permit/Approval	Communication History	Key Notes
U.S. Army Corps of Engineers (Corps)	Jacalen Printz Jacalen.M.Printz@usace.army.mil (206) 764-6901 Shane Shelburn shane.m.shelburne@usace.army.mil (206) 316-3156	Clean Water Act (CWA) Section 404 and/or Rivers and Harbors Act Section 10	▪ 12.10.23: email correspondence ▪ 12.13.23: Teams call with Jacalen Printz and Shane Shelburn, jointly with Dana Dysart (Corps) + Dave Woodson (UW) + Amy Summe (Shannon & Wilson [S&W]) ▪ 5.24: email correspondence	12.13.23 call ▪ A little early to talk specifics about Corps permits. ▪ Make sure that the Biological Assessment addresses all of the potential benefits ▪ Suggests discussion with the U.S. Fish and Wildlife Service and National Marine Fisheries Service 5.24 emails ▪ Correspondence regarding applicability of in-water work window to pipe installation below lake bed. For work at depth (in the case of direct pipe method), in-water work window likely not applied – but would apply to pipe daylighting at intake location and the work to construct the intake. Other trenchless installation or installation close to lake bed might also require in-water work window.
	National Marine Fisheries Service (NMFS): Donald Hubner donald.hubner@noaa.gov (206) 526-4359	Section 7 Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultation	▪ 12.10.23: email correspondence ▪ 12.14.23: email correspondence ▪ 2.9.24: Teams call with Don Hubner + Dave Woodson (UW) + Amy Summe (S&W)	2.9.24 call ▪ For any discharge into the Ship Canal, would there be any backflow issues (e.g., related to flow, salinity, temperature, etc.) given the volume of the discharge that could have adverse effects on the aquatic environment? ▪ If other entities pursue a similar approach, at what point would the total volume of water withdrawn from Lake Washington have adverse effects on the lake's characteristics and ecology? ▪ Would there be benefits, such as added flexibility, to having two intake locations at different depths with different temperature profiles? ▪ Address entrainment and impingement at the intake. ▪ Avoid creating predator habitat (e.g., installations in the shallow nearshore environment that provide cover for bass). ▪ Provide a realistic assessment of any measurable benefits on salmon and recognize the climate benefits of reducing fossil fuel use. ▪ Consider what appropriate modeling should be conducted in advance to support the design and BA, and what long-term monitoring of performance should be undertaken. ▪ Written feedback will be provided this month. 6.12.24 call ▪ Concerns about the potential for trenching activity in Union Bay to have adverse effects on juvenile salmon rearing and outmigration and adult salmon immigration due to unavoidable overlap. ▪ Concerned about the potential for bay sediments to be mobilized/suspended and then transported into the Ship Canal – turbidity, contamination, dissolved oxygen, and pH.
	U.S. Fish and Wildlife Service (USFWS): Ryan McReynolds ryan_mcreynolds@fws.gov (360) 753-6047 Molly Good molly_good@fws.gov	ESA consultation	▪ 12.10.23: email correspondence with Amy Summe (S&W) ▪ 12.11.23: email response from Ryan McReynolds ▪ 12.11.23: email from Molly Good, check back in January 2024 ▪ 1.22.24: email correspondence with Ryan McReynolds	Email from Ryan McReynolds 12.11.23: ▪ Usual considerations would be relevant; e.g., location/placement of the intake(s), screening of the intake(s), location/placement of the return-discharge(s), etc. Expects input from WDFW and NMFS would address USWS' concerns ▪ Interested in more discussion after new year Email from Ryan McReynolds 1.22.24: ▪ Scheduling remains challenging.
	Lance Lundquist lance.a.lundquist@usace.army.mil (206) 764-6909	Section 106 of the National Historic Preservation Act (NHPA) consultation	12.29.23: voicemail (VM) and email correspondence	
	Dana Dysart dana.m.dysart@usace.army.mil (206) 316-3970	Section 408 review/permission (for the new discharge pipe, share map)	12.13.23: Teams call with Dana + Dave Woodson (UW) and Amy Summe (S&W) Late 2023/early 2024: additional email exchanges with Dana and other Corps staff relating to and including provision of data 5.29.24: call with Amy Summe (S&W) 5.30.24: email with Amy Summe (S&W)	12.13.23 call ▪ Corps will share their CAD/GIS boundary layers (3-dimensional, coordination required if project goes over/under/through). ▪ Important not to disturb the prism (can't make narrower or shallower). ▪ Need H&H analysis to describe impact of water discharge. ▪ Corps happy to work with team to discuss/evaluate alternatives. 5.29.24 call ▪ Corps is allowed to excavate to the previously authorized depth (30 feet) with a 4-foot margin

Agency	Contact	Environmental Permit/Approval	Communication History	Key Notes
				▪ In recent smaller pipe that went under Ship Canal in Fremont Cut, Corps required pipe placement about 12-15 feet below the federal channel boundary. 5.30.24 email ▪ Confirmed top surface of the 30-foot navigation boundary depth is at 16.75 NAVD88 (low lake) ▪ Can trench through channel, but depth needs to be more than 34 feet below low lake surface – more encourage to minimize risks of vessels damaging the pipe ▪ Likely to require pipe be covered ▪ Past dredging of the channel more than 15 years ago – not certain
	Joy Dunay Joy.M.Dunay@usace.army.mil (206) 764-6083	Dredge Management Materials Office (DMMO) (if there's any dredging)	5.29.24: phone call with Amy Summe (S&W)	5.29.24 call ▪ Where material is going can influence DMMP involvement – might be led by the Washington State Department of Ecology (Ecology). There is a lot of contamination in intake area, but not designated as a cleanup site. There will be a lot of scrutiny of work in that area in general. If not using open water disposal – then may be using MTCA to handle. Need to be farther along in design to get better answers. ▪ Pretty straight forward if trenching – need 30% design with figures/cross-sections/depth. Then could talk specifics of what is required –e.g., # of samples, what testing for. There would be links to other agency permits/requirements. ▪ Not predetermined that couldn't do in-water disposal – would need to test. Maybe peat would be something you can't do in-water disposal (e.g., if there are WQ concerns/fish life related perhaps to oxygen or pH). Elliott Bay Disposal – closest area. ▪ 3 week reviews likely of Sampling and Analysis Plan drafts. ▪ Still need to get 404/10 approvals for sampling – bit of a gray area. Some applicants get them and some don't. DMMP doesn't regulate that. Those take a long time. (start 404 ahead if timing is an issue) ▪ Timing: no requirement to sample right after getting permit, maybe within a year or longer if not depositional area. Once you sample, need "recency" if approved for in-water disposal (3 years) – not as big a deal for upland disposal, could get extensions. If planning to cover excavated area, then only need to sample the material you're dredging, and if planning to dispose upland – might not need to go through DMMP.
	Kyle Comanor kyle.comanor@usace.army.mil	Senior Water Manager (not a permit/approval)	6.6.24: Teams call with Amy Summe and Ryan Rohlfing (S&W)	6.6.24 call ▪ Corps does not monitor flows through the lake system explicitly – they monitor inflow at Cedar River and then outflow at locks, can use data to estimate flows through the canal ▪ A 50 cubic feet per second (cfs) discharge by UW should not cause any backflow issues and no change in direction of flow ▪ Consider multiple discharge points ▪ He heard from Eric Warner (Muckleshoot Indian Tribe) that discharge at bottom of canal is preferred 7.30.24 email ▪ Confirmed that Corps considers "everything upstream of the locks one body of water… it's a single system with multiple components. Moving water around upstream of the Locks won't change the volume of water we're holding back."
U.S. Coast Guard	Carl Smith Carl.F.Smith@uscg.mil (206) 220-7277	Bridge Permit under either the Rivers and Harbors Act Section 9 or General Bridge Act of 1946	12.29.23: email and VM correspondence	
Washington State Department of Ecology (Ecology)	Loree' Randall loree.randall@ecy.wa.gov (360) 485-2796	401 Water Quality Certification	No contact necessary at this time.	
	Loree' Randall loree.randall@ecy.wa.gov (360) 485-2796	Coastal Zone Management (CZM) Consistency	No contact necessary at this time.	
	Tricia Miller tricia.miller@ecy.wa.gov (206) 594-0167 Jeanne Tran jeanne.tran@ecy.wa.gov (425) 531-8311 Laura Fricke laura.fricke@ecy.wa.gov (425) 507-5644	National Pollutant Discharge Elimination System (NPDES) Individual Discharge Permit	11.30, 12.5, 12.7.23: VM left for Tricia Miller 12.5.23: VM left for Laura Fricke 12.7.23: Received VM from Jeanne Tran. Called back. 12.19.23: call with Jeanne Tran + Meg Strong (S&W).	12.7.23: Received VM from Jeanne Tran. Called back. ▪ Have we started water rights conversation, as critical. ▪ If discharging to Montlake Cut and discharge temps are less than the cut, then won't need a mixing zone. 12.19.23: call with Jeanne Tran. ▪ Jeanne to be our NPDES Ecology contact. ▪ Jeanne to research if new discharge permit will be allowed for Lake WA. Will report back.

Agency	Contact	Environmental Permit/Approval	Communication History	Key Notes
			1.2.24: call with Jeanne Tran and Meg Strong (S&W). 5.22.24: call with Jeanne Tran and Meg Strong/Amy Summe (S&W).	▪ Temperature of discharge is the primary issue. 1.2.24: Call with Jeanne Tran. ▪ Jeanne communicated that a new NPDES permit will be allowed for non-contact cooling water according to the watershed lead. The section lead needs to agree regarding a new NPDES permit, and has not been briefed yet. Therefore, this information may change. It might take some months to hear back from the section lead. 5.22.24: Call with Jeanne Tran ▪ Likes intake location – cold and deep. ▪ Initial concerns about discharge options 1 and 2 in Montlake Cut/Canal related to present lack of information about outfall structure design. Where? Shallow? Deep? Diffusion? Consider multiple/split discharges – perhaps both vertical and horizontal dispersion given the volume of water that is being used by the system. Consider scour at the entry point. Jeanne also suggested that the discharge be split between two points rather one point. ▪ Key assumption is that we would not add anything to the water (scale or corrosion inhibitor). If so - straight forward cooling water discharge. Temp only concern – must meet WQ standards. ▪ She said *not* impossible to have surface discharge – oxygenation would be a benefit, but concern w/ scour. ▪ Recommends multi-agency meeting – not opposed to joining a pre-application meeting w/ water rights staff. ▪ Consider any conflicts with municipal CSO/outfalls and other permitters or permittees for this area ▪ Depending on location – might need to apply antidegradation measures to meet background. ▪ Portage Bay – stagnant water, how would we introduce flow? ▪ Temp and flow is main concern – monitoring will be required. Advanced modeling: depending on how discharge, don't necessarily see the need for hydraulic model. Model is used when seeking mixing zone – and this type of project would not get a mixing zone and would not need mixing zone if meeting standards. Monitoring pH and DO not likely required. 5.22.24: follow-up email to Jeanne Tran ▪ Provided S&W February 2024 report and links to LLTK resources about the Ship Canal temperature investigations
	Rachel McCrea, Cleo Neculae, Monika Kannadaguli, Matthew Evinger, Joe Burcar, Thomas Buroker, Kalman Bugica, Austin Schmalz, Jay Cook, Kasey Cykler, Jeanne Tran, Rebekah Padgett	Multi-department meeting to discuss water right, NPDES, and shoreline approvals	10.4.24: Multi-department Ecology meeting + UW, AEI, and S&W	
	Rachel McCrea, Cleo Neculae, Jay Cook, Kasey Cykler, Jeanne Tran, Rebekah Padgett	Multi-department meeting to discuss NPDES process	2.11.25: Multi-department meeting + UW, AEI, and S&W	
	Stacey Britton stacey.britton@ecy.wa.gov (360) 764-3727	NPDES Construction Stormwater General Permit	No contact necessary at this time.	
	Rebekah Padgett rebekah.padgett@ecy.wa.gov (425) 365-6571	Shoreline Variance/CUP	Included in 10.4.24 and 2.11.25 Ecology multi-department meetings	
	Doug Wood doug.wood@ecy.wa.gov 425.577.0173	Water right application	12.18.23: Teams call with Michael Fink + Victoria Buker and Dave Woodson (UW), Geoff McMahon (AEI), + Amy Summe (S&W) 5.6.24: Call with Doug Wood + Jim Bailey (S&W) 7.19.24: Team pre-application consultation with Doug Wood, Jay Cook, Kasey Cykler, Michele Curtis (Ecology water rights staff), and Jeanne Tran (Ecology NPDES staff) + UW, AEI, and S&W	5.6.24: Conversation with Doug Wood ▪ Had a general discussion with Northwest Regional Office staff that would be responsible for reviewing a future water right application. In particular we talked about the cost reimbursement program and the pre-application meeting. The preapplication meeting should provide a good indication if Ecology has any concerns about granting a new water right. 7.19.24: Pre-Application Consultation Call ▪ Lake Washington is closed to consumptive uses, and Ecology considers Lake Washington a separate waterbody from the canal which makes transfer of water from body of lake into the canal a consumptive use. ▪ Ecology open to technical arguments that Lake Washington and the Ship Canal are a single system – Corps management of the system as a single pool could help ▪ If can show the use is non-consumptive and demonstrate environmental benefit, then project could be eligible for priority processing. In addition to possible fish migration benefits, could describe climate benefit ▪ Discussed different pathways of priority processing and cost-reimbursement program – timelines. Complexity of this project may take two years

Agency	Contact	Environmental Permit/Approval	Communication History	Key Notes
				▪ Multi-department meeting of Ecology water right, water quality, and shoreline leads recommended
Washington State Department of Natural Resources (DNR)	Trina Contreras trina.contreras@dnr.wa.gov (206) 764-6909 Andrew Taylor Andrew.Taylor@dnr.wa.gov Jessica Olmstead Jessica.Olmstead@dnr.wa.gov (253) 740-0602	Aquatic Use Authorization / Aquatic Lands Lease	▪ 12.10.23: email correspondence ▪ 12.15.23: Teams call with Trina Contreras and DNR habitat specialist (Andrew Taylor) ▪ 1.3.24: email correspondence with Trina ▪ 4.2 and 4.4.24: email correspondence with Trina	12.15.23: Conversation with Trina Contreras and Andrew Taylor ▪ Require an "outfall authorization" ▪ Consider easement (non-exclusive) vs. lease (exclusive) ▪ Cost based on market value of adjacent land use, could be "spendy." Speculated about potentials for negotiating cost based on salmon habitat and other green energy benefits – could negotiate if there is wiggle room in the Washington Administrative Code (WAC). Also – consider whether could be appropriate to call this a conservation easement? ▪ Would like to set up a larger meeting with policy folks early next year to explore April 2024 ▪ Provided DNR with the February 2024 report per information request to support DNR organizing a policy-level discussion with other DNR staff and UW 11.1.24: Call with Jessica Olmstead, Andrew Taylor, Rachel Skubel ▪ This represents a new project type for DNR ▪ Still unclear if project would require lease or easement; DNR would determine best fit ▪ Recommends providing 30% plans to DNR before starting other regulatory approval pursuits; DNR requires all regulatory approvals in hand before issuing lease or easement ▪ Interested in results of any modeling to demonstrate effects of discharge on temperature ▪ DNR interested in being included in any future pre-submittals or pre-application meetings with other regulators ▪ Would review project through lens of fish habitat (impacts to, improvements of)
University of Washington	Julie Blakeslee jblakesl@uw.edu (206) 543-5200	State Environmental Policy Act (SEPA) review	12.29.23: Teams call with Julie Blakeslee + Victoria Buker (UW)	▪ Anticipate preparation of a focused environmental impact statement ▪ Hold formal scoping initiation until a project description is available with sufficient detail to gather meaningful input and inform alternatives/impacts ▪ Recognize that studies prepared in preparation for permitting may be schedule drivers
Washington Department of Fish and Wildlife (WDFW)	Laura Arber Laura.Arber@dfw.wa.gov (425) 379-2306 Joseph Short joseph.short@dfw.wa.gov (425) 775-1311	Hydraulic Project Approval (HPA)	▪ 12.10.23: email correspondence with Laura ▪ 12.12.23: Teams call with Laura Arber + Marilyn Ostergren (UW) ▪ 12.19.23: email from Joseph Short ▪ 1.3.24: email correspondence with Laura Arber ▪ 2.9/2.12.24: email correspondence with Laura Arber	12.12.23: Conversation with Laura Arber ▪ Lots of questions at this point about design/construction methods ▪ Encourage avoidance of the Lake WA nearshore ▪ Number of scenarios where mitigation would be required ▪ The Montlake Cut sediments are "flocculent" – careful where/how discharge to avoid disturbance which would create turbid plume that would settle very slowly ▪ Connected me with a biologist who has shared some info about fish use at depth 12.19.23: Email from Jeff Short ▪ Provided list of fish that may be found in area of potential intake, provided 2006 UW fish study regarding pelagic fish in Lake Washington 1.3.24: Email from Laura Arber Screening: Confirmed that *NOAA Fisheries West Coast Region Anadromous Salmonid Passage Design Manual* provides appropriate screening guidance. Should also coordinate with WDFW screening biologists Danny Didricksen (Daniel.Didricksen@dfw.wa.gov) and Kayla Rademacher (Kayla.Rademacher@dfw.wa.gov) Consider the following: ▪ Returned water needs to be cool/cold with higher dissolved oxygen than what was removed. ▪ Create multiple release locations (prefer 4 – 5) to add cooler water in various areas instead of just one location. ▪ Install roughened rock "rapids" at each site to aerate the water and increase the dissolved oxygen before returning it to the Ship Canal ▪ Surround the rock "rapids" with riparian vegetation to cover and provide sufficient shade to keep the air and water cool before returning it the Ship Canal – WDFW prefer it not be placed in a pipe (culvert) as this would interfere with overall air mixing. – Rapids need to be constructed with larger rocks and drops to prevent fish from going up them. Please coordinate the WDFW Habitat Biologist as you create these features. Email exchange with Laura Arber 2.9/2.12.24:

Agency	Contact	Environmental Permit/Approval	Communication History	Key Notes
				▪ Continued discussion regarding the relative temperature and dissolved oxygen of the discharge water compared to the source and receiving waters; appropriate standard. Concern if any discharge temperature/oxygen conditions were to be no better than receiving waters during times when the receiving water is impaired; should strive for cooler water with higher dissolved oxygen levels. Email exchange with Laura Arber 5.24.24 ▪ Confirmed work window October 1-April 15 ▪ Window *may* only apply to pipe daylighting and intake install if the intake is tunneled ▪ Dredging not preferred method – direct pipe preferred for less harm to aquatic habitat/fish. But dredging is "worth considering and discussing" ▪ "water temperature and dissolved oxygen (DO) that directly benefit fish life are primary concerns for WDFW. Since this is a listed waterbody, temperatures better than background aren't sufficient and will need to be coordinated with Ecology"
City of Seattle (City)	Ben Perkowski Ben.Perkowski@seattle.gov (206) 684-0347	Master Use Permit (Shorelines and Environmentally Critical Areas)	▪ 12.10.23: email correspondence ▪ 12.14.23: Teams call with Ben Perkowski ▪ 1.19/2.1/2.13.24: email correspondence with Ben Perkowski ▪ 2.13.24: email correspondence with Ben Perkowski ▪ 4.30.24: email correspondence with Ben Perkowski	Conversation with Ben Perkowski 12.14.23: ▪ SEPA: is UW anticipating EIS or checklist? ▪ Shoreline permits: Conditional Use Permit and Special Use Permit for Utility Lines, City will check into whether they think proposal is a Utility Service Use, which is prohibited in CP environment. [Ben will explore this internally and confirm with Ecology if necessary] ▪ "Heat exchanger" means a device that uses water to cool a structure and discharges warm water into a water body. These are prohibited in Lake Washington/Ship Canal/Lake Union [Ben will explore this internally and confirm with Ecology if necessary] ▪ Recommends inter-agency meeting down the line to discuss mitigation (if any) Follow-up email correspondence with Ben Perkowski 12.14.23: ▪ Ben confirmed that the City would consider the intake and discharge pipes to be permitted as utility lines and not a utility service. ▪ Raised the question of how the heater exchanger SMP code prohibitions related to discharge of "warm water" back into the waterbodies. Suggested a formal code interpretation. Follow-up email correspondence with Ben Perkowski 2.13.24: ▪ Follow-up email discussion regarding interpretation of warm water and other problematic definitions Follow-up email correspondence with Ben Perkowski 4.30.24: ▪ Provided an emailed memo with some analysis of the issue and request for interpretation ▪ Ben responded that interpretation request needs to be submitted through formal process Follow-up email correspondence with Ben Perkowski 11.18.2024: ▪ UW submitted a Shannon & Wilson memo with analysis of the issue and a draft Director's Rule text for City review and consideration.
	As assigned by SDCI at time of application	Other City construction-related permits (depending on location and design)	No contact necessary at this time.	

Agency	Contact	Environmental Permit/Approval	Communication History	Key Notes
Other Key Stakeholders				
Tribal Coordination/ Consultation	Eric Warner Eric.Warner@muckleshoot.nsn.us		▪ 12.14.23: Teams call with Eric Warner + UW, AEI, and S&W ▪ 9.19.24: Teams call with Eric Warner + UW, AEI, and S&W	6.24.24: Conversation with Eric Warner ▪ Preference for water discharge and diffusion near the bottom of the canal, rather than the surface ▪ Potential for a portion of the cool-water discharge (possibly 2 to 3 cfs) to be used in a reactivated rearing pond ▪ Interest in UW coordination with LLTK/WRIA 8 efforts ▪ Concern about the possible effects of discharges west of the Montlake Cut interfering with flows and juvenile salmon movement ▪ Ensuring intake is appropriately screened and that dissolved oxygen levels in the discharge water are suitable 9.19.24: Conversation with Eric Warner ▪ Eric supported the consideration of the lake and Ship Canal as a single waterbody ▪ Continued concerns about effects of discharge in the Cut reducing velocity that would attract juveniles to the Lake WA outlet ▪ Concern about possibility of trenching-related turbidity during intake line installation entering the deeper water of the Corps-dredged canal east of the Montlake Cut, which may be occupied by salmon. ▪ Interested in potential benefits of UW project on the Tribe's rearing pond project as a source of cold water; Eric will connect with Tribe water rights staff
Water Resource Inventory Area (WRIA) 8 Salmon Recovery Council	Jason Mulvihille-Kuntz Jason.Mulvihill-Kuntz@kingcounty.gov (206) 477-4780 Mary Ramirez mramirez@kingcounty.gov (206) 477-1506		▪ 5.24.24: Teams call with Jason Mulvihille-Kuntz and Mary Ramirez (WRIA 8), Lucas Hall (LLTK), Eric Moe (Djoule) + UW, AEI, and S&W ▪ 3.5.25: Teams call with Jason Mulvihille-Kuntz and Mary Ramirez (WRIA 8), Lucas Hall (LLTK), Eric Moe (Djoule), Thomas Mathis (DSI) + UW and S&W	5.24.24: Conversation with WRIA 8/LLTK ▪ Primarily a high-level discussion of the work that WRIA 8/LLTK is doing, along with the work that Djoule is doing with Seattle Pacific University, and an introduction of the UW project ▪ Interest in additional discussion to see if there may be co-benefits to information/effort sharing 3.5.25: Conversation with WRIA 8/LLTK ▪ Following debrief of Ecology meeting held on 2.11.25, WRIA 8/LLTK expressed interest in advocating to Ecology, in partnership with UW and possibly others, for cold-water discharge to Ship Canal. ▪ Interested in understanding whether additional legal opinion might reach different conclusion; UW may consult counsel ▪ WRIA 8 is exploring whether there are benefits to fish, which species and what life history stages, of pockets of cold water refuge
Seattle Pacific University (SPU)	Eric Moe (consultant to SPU)		▪ 5.24.24: Teams call with Jason Mulvihille-Kuntz and Mary Ramirez (WRIA 8), Lucas Hall (LLTK), Eric Moe (Djoule) + UW, AEI, and S&W ▪ 3.5.25: Teams call with Jason Mulvihille-Kuntz and Mary Ramirez (WRIA 8), Lucas Hall (LLTK), Eric Moe (Djoule), Thomas Mathis (DSI) + UW and S&W	See above.
Long Live the Kings (LLTK)	Lucas Hall lhall@lltk.org (206) 382-9555 x30		▪ 5.24.24: Teams call with Jason Mulvihille-Kuntz and Mary Ramirez (WRIA 8), Lucas Hall (LLTK), Eric Moe (Djoule) + UW, AEI, and S&W ▪ 3.5.25: Teams call with Jason Mulvihille-Kuntz and Mary Ramirez (WRIA 8), Lucas Hall (LLTK), Eric Moe (Djoule), Thomas Mathis (DSI) + UW and S&W	See above.

APPENDIX B: WATER QUALITY SAMPLING RESULTS

Appendix B

Water Quality Sampling Results

CONTENTS

1. Water Quality Test Results from Potential Intake Location: December 6, 2024
2. Water Quality Test Results from Potential Intake and Preferred Discharge Location: January 10, 2025

Alliance
TECHNICAL GROUP

3600 Fremont Ave N
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Shannon & Wilson
Clare McKenna
400 N 34th Street, Suite 100
Seattle, WA 98103

RE: UW Energy Renewal Program, 111679-P2-6
Work Order Number: 2412122

December 13, 2024

Attention Clare McKenna:

Fremont Analytical, Inc, an Alliance Technical Group company, received 1 sample(s) on 12/6/2024 for the analyses presented in the following report.

Biochemical Oxygen Demand by SM 5210B
Diesel and Heavy Oil by NWTPH-Dx
Dissolved Metals by EPA 200.8
PCBs by EPA Method 8082A

All analyses were performed according to our accredited Quality Assurance program. Please contact the laboratory if you should have any questions about the results.

Alliance Technical Group is committed to accuracy, speed, and customer service. Thank you for choosing Alliance Technical Group's Seattle laboratory team for your analytical needs. We appreciate this opportunity to serve you!

Sincerely,

Kelley Lovejoy

Kelley Lovejoy
Project Manager

CC:
Amy Summe

DoD-ELAP Accreditation #79636 by PJLA, ISO/IEC 17025:2017 and QSM 5.4 for Environmental Testing
ORELAP Certification: WA 100009 (NELAP Recognized) for Environmental Testing
Washington State Department of Ecology Accredited for Environmental Testing, Lab ID C910

Original

CLIENT:	Shannon & Wilson
Project:	UW Energy Renewal Program
Work Order:	2412122

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
2412122-001	Intake: 84	12/06/2024 11:30 AM	12/06/2024 3:01 PM

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

Case Narrative

WO#: **2412122**

Date: **12/13/2024**

CLIENT: Shannon & Wilson

Project: UW Energy Renewal Program

I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Prep Comments for METHOD (PREP-PCB-W), SAMPLE (2412122-001A) required Acid Cleanup Procedure (Using Method No 3665A).
Prep Comments for METHOD (PREP-PCB-W), SAMPLE (2412122-001A) required Florisil Cleanup Procedure (Using Method No 3620C).

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
DUP - Sample Duplicate
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MCL - Maximum Contaminant Level
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
REP - Sample Replicate
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **2412122**
Date Reported: **12/13/2024**

Client: Shannon & Wilson   **Collection Date:** 12/6/2024 11:30:00 AM
Project: UW Energy Renewal Program
Lab ID: 2412122-001   **Matrix:** Water
Client Sample ID: **Intake: 84**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Biochemical Oxygen Demand by SM 5210B				Batch ID: R96300		Analyst: BB
Biochemical Oxygen Demand	ND	2.00		mg/L	1	12/6/2024 5:30:00 PM
PCBs by EPA Method 8082A				Batch ID: 46097		Analyst: CO
Aroclor 1016	ND	0.0189		µg/L	1	12/12/2024 1:15:15 PM
Aroclor 1221	ND	0.0189		µg/L	1	12/12/2024 1:15:15 PM
Aroclor 1232	ND	0.0189		µg/L	1	12/12/2024 1:15:15 PM
Aroclor 1242	ND	0.0189		µg/L	1	12/12/2024 1:15:15 PM
Aroclor 1248	ND	0.0189		µg/L	1	12/12/2024 1:15:15 PM
Aroclor 1254	ND	0.0189		µg/L	1	12/12/2024 1:15:15 PM
Aroclor 1260	ND	0.0189		µg/L	1	12/12/2024 1:15:15 PM
Aroclor 1262	ND	0.0189		µg/L	1	12/12/2024 1:15:15 PM
Aroclor 1268	ND	0.0189		µg/L	1	12/12/2024 1:15:15 PM
Total PCBs	ND	0.0189		µg/L	1	12/12/2024 1:15:15 PM
Surr: Decachlorobiphenyl	54.7	9.13 - 160		%Rec	1	12/12/2024 1:15:15 PM
Surr: Tetrachloro-m-xylene	82.4	20 - 116		%Rec	1	12/12/2024 1:15:15 PM
Diesel and Heavy Oil by NWTPH-Dx				Batch ID: 46132		Analyst: AP
Diesel Range Organics	ND	95.0		µg/L	1	12/13/2024 12:45:43 PM
Heavy Oil	ND	142		µg/L	1	12/13/2024 12:45:43 PM
Total Petroleum Hydrocarbons	ND	237		µg/L	1	12/13/2024 12:45:43 PM
Surr: 2-Fluorobiphenyl	73.4	50 - 150		%Rec	1	12/13/2024 12:45:43 PM
Surr: o-Terphenyl	76.4	50 - 150		%Rec	1	12/13/2024 12:45:43 PM
Dissolved Metals by EPA 200.8				Batch ID: 46081		Analyst: ME
Arsenic	0.658	0.500		µg/L	1	12/10/2024 3:03:00 PM
Copper	ND	2.00		µg/L	1	12/10/2024 3:03:00 PM
Lead	ND	0.300		µg/L	1	12/10/2024 3:03:00 PM
Zinc	ND	2.50		µg/L	1	12/10/2024 3:03:00 PM

Work Order: 2412122
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT

Biochemical Oxygen Demand by SM 5210B

Sample ID: **MB-96300** SampType: **MBLK** Units: **mg/L** Prep Date: **12/6/2024** RunNo: **96300**
Client ID: **MBLKW** Batch ID: **R96300** Analysis Date: **12/6/2024** SeqNo: **2009197**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Biochemical Oxygen Demand	ND	2.00									

Sample ID: **LCS-96300** SampType: **LCS** Units: **mg/L** Prep Date: **12/6/2024** RunNo: **96300**
Client ID: **LCSW** Batch ID: **R96300** Analysis Date: **12/6/2024** SeqNo: **2009198**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Biochemical Oxygen Demand	189	2.00	198.0	0	95.6	84.6	115.4				

Sample ID: **2412106-001ADUP** SampType: **DUP** Units: **mg/L** Prep Date: **12/6/2024** RunNo: **96300**
Client ID: **BATCH** Batch ID: **R96300** Analysis Date: **12/6/2024** SeqNo: **2009201**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Biochemical Oxygen Demand	102	2.00						100.8	1.57	20	

Work Order: 2412122
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT

Dissolved Metals by EPA 200.8

Sample ID: **MB-46081** SampType: **MBLK** Units: **µg/L** Prep Date: **12/9/2024** RunNo: **96234**
Client ID: **MBLKW** Batch ID: **46081** Analysis Date: **12/10/2024** SeqNo: **2007821**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	ND	0.500									
Copper	ND	2.00									
Lead	ND	0.300									
Zinc	ND	2.50									

Sample ID: **LCS-46081** SampType: **LCS** Units: **µg/L** Prep Date: **12/9/2024** RunNo: **96234**
Client ID: **LCSW** Batch ID: **46081** Analysis Date: **12/10/2024** SeqNo: **2007822**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	92.1	0.500	100.0	0	92.1	85	115				
Copper	97.1	2.00	100.0	0	97.1	85	115				
Lead	44.5	0.300	50.00	0	89.0	85	115				
Zinc	95.1	2.50	100.0	0	95.1	85	115				

Sample ID: **2412043-001CDUP** SampType: **DUP** Units: **µg/L** Prep Date: **12/9/2024** RunNo: **96234**
Client ID: **BATCH** Batch ID: **46081** Analysis Date: **12/10/2024** SeqNo: **2007824**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	1.06	0.500						1.108	3.96	30	
Copper	ND	2.00						0		30	
Lead	ND	0.300						0		30	
Zinc	ND	2.50						0		30	

Sample ID: **2412043-001CMS** SampType: **MS** Units: **µg/L** Prep Date: **12/9/2024** RunNo: **96234**
Client ID: **BATCH** Batch ID: **46081** Analysis Date: **12/10/2024** SeqNo: **2007825**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	95.1	0.500	100.0	1.108	94.0	70	130				
Copper	92.9	2.00	100.0	0	92.9	70	130				
Lead	43.1	0.300	50.00	0	86.2	70	130				

Date: *12/13/2024*

Work Order: 2412122
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT

Dissolved Metals by EPA 200.8

Sample ID: **2412043-001CMS** SampType: **MS** Units: **µg/L** Prep Date: **12/9/2024** RunNo: **96234**
Client ID: **BATCH** Batch ID: **46081** Analysis Date: **12/10/2024** SeqNo: **2007825**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Zinc	92.5	2.50	100.0	1.431	91.1	70	130				

Sample ID: **2412043-001CMSD** SampType: **MSD** Units: **µg/L** Prep Date: **12/9/2024** RunNo: **96234**
Client ID: **BATCH** Batch ID: **46081** Analysis Date: **12/10/2024** SeqNo: **2007826**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	95.4	0.500	100.0	1.108	94.3	70	130	95.12	0.275	30	
Copper	93.6	2.00	100.0	0	93.6	70	130	92.86	0.772	30	
Lead	43.0	0.300	50.00	0	85.9	70	130	43.10	0.311	30	
Zinc	92.1	2.50	100.0	1.431	90.7	70	130	92.51	0.455	30	

Date: *12/13/2024*

Work Order: 2412122
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT

Diesel and Heavy Oil by NWTPH-Dx

Sample ID: **MB-46132** SampType: **MBLK** Units: **µg/L** Prep Date: **12/12/2024** RunNo: **96321**
Client ID: **MBLKW** Batch ID: **46132** Analysis Date: **12/13/2024** SeqNo: **2009723**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel Range Organics	ND	99.0									
Heavy Oil	ND	149									
Total Petroleum Hydrocarbons	ND	248									
Surr: 2-Fluorobiphenyl	16.9		24.75		68.2	50	150				
Surr: o-Terphenyl	18.3		24.75		74.1	50	150				

Sample ID: **LCS-46132** SampType: **LCS** Units: **µg/L** Prep Date: **12/12/2024** RunNo: **96321**
Client ID: **LCSW** Batch ID: **46132** Analysis Date: **12/13/2024** SeqNo: **2009724**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Petroleum Hydrocarbons	878	243	1,216	0	72.2	42.5	123				
Surr: 2-Fluorobiphenyl	17.7		24.32		72.6	50	150				
Surr: o-Terphenyl	19.7		24.32		81.1	50	150				

Sample ID: **LCSD-46132** SampType: **LCSD** Units: **µg/L** Prep Date: **12/12/2024** RunNo: **96321**
Client ID: **LCSW02** Batch ID: **46132** Analysis Date: **12/13/2024** SeqNo: **2009725**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Petroleum Hydrocarbons	891	246	1,232	0	72.3	42.5	123	877.8	1.49	30	
Surr: 2-Fluorobiphenyl	18.8		24.64		76.4	50	150		0		
Surr: o-Terphenyl	20.0		24.64		81.0	50	150		0		

Work Order: 2412122
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT
PCBs by EPA Method 8082A

Sample ID: **MB-46097** SampType: **MBLK** Units: **µg/L** Prep Date: **12/10/2024** RunNo: **96253**
Client ID: **MBLKW** Batch ID: **46097** Analysis Date: **12/11/2024** SeqNo: **2008226**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aroclor 1016	ND	0.0200									
Aroclor 1221	ND	0.0200									
Aroclor 1232	ND	0.0200									
Aroclor 1242	ND	0.0200									
Aroclor 1248	ND	0.0200									
Aroclor 1254	ND	0.0200									
Aroclor 1260	ND	0.0200									
Aroclor 1262	ND	0.0200									
Aroclor 1268	ND	0.0200									
Total PCBs	ND	0.0200									
Surr: Decachlorobiphenyl	241		500.0		48.2	9.13	160				
Surr: Tetrachloro-m-xylene	411		500.0		82.2	20	116				

Sample ID: **LCS-46097** SampType: **LCS** Units: **µg/L** Prep Date: **12/10/2024** RunNo: **96253**
Client ID: **LCSW** Batch ID: **46097** Analysis Date: **12/11/2024** SeqNo: **2008227**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aroclor 1016	1.89	0.0200	2.500	0	75.5	38.1	130				
Aroclor 1260	1.86	0.0200	2.500	0	74.3	29.2	150				
Surr: Decachlorobiphenyl	282		500.0		56.5	9.13	160				
Surr: Tetrachloro-m-xylene	381		500.0		76.2	20	116				

Sample ID: **LCSD-46097** SampType: **LCSD** Units: **µg/L** Prep Date: **12/10/2024** RunNo: **96253**
Client ID: **LCSW02** Batch ID: **46097** Analysis Date: **12/11/2024** SeqNo: **2008228**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aroclor 1016	2.18	0.0200	2.500	0	87.3	38.1	130	1.888	14.4	20	
Aroclor 1260	2.16	0.0200	2.500	0	86.2	29.2	150	1.856	14.9	20	
Surr: Decachlorobiphenyl	310		500.0		62.0	9.13	160		0		
Surr: Tetrachloro-m-xylene	398		500.0		79.5	20	116		0		

Alliance TECHNICAL GROUP

Sample Log-In Check List

Client Name:	SW	Work Order Number:	2412122
Logged by:	Clare Griggs	Date Received:	12/6/2024 3:01:00 PM

Chain of Custody

	Question	Yes	No	Not Present / NA
1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

	Question	Yes	No	Not Present / NA
3.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Present ☑
4.	Was an attempt made to cool the samples?	Yes ☑	No ☐	NA ☐
5.	Were all items received at a temperature of >2°C to 6°C *	Yes ☑	No ☐	NA ☐
6.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
7.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
8.	Are samples properly preserved?	Yes ☑	No ☐	
9.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
10.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
11.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
12.	Does paperwork match bottle labels?	Yes ☑	No ☐	
13.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
14.	Is it clear what analyses were requested?	Yes ☑	No ☐	
15.	Were all hold times (except field parameters, pH e.g.) able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

	Question	Yes	No	NA
16.	Was client notified of all discrepancies with this order?	Yes ☑	No ☐	NA ☐

Person Notified:	Clare McKenna	Date:	12/6/2024
By Whom:	Clare Griggs	Via:	☑ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:	Confirming metals method.		
Client Instructions:	6020		

17. Additional remarks:

NA

Run dissolved metals by 200.8 per DR. -KL 12/9/24

Item Information

Item #	Temp ºC
Sample	3.5

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Original

Fremont Analytical
An Alliance Technical Group Company

3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790

Chain of Custody Record & Laboratory Services Agreement

Date: 12/6/24	Page: 1 of: 1
Laboratory Project No (internal): 2412122	
Project Name: UW Energy Renewal Program	Special Remarks:
Client: Shannon + Wilson	Project No: 111679-P2-6
Address: 400 N 34th St Suite 100	Collected by: CRM
City, State, Zip: Seattle WA 98103	Location: Intake
Telephone: 206-632-8020	Report To (PM): Amy Summe
Email(s): Clare.McKenna@shanwil.com Amy.Summe@shanwil.com	Disposal: Samples will be disposed in 30 days unless otherwise requested. ☐ Retain volume (specify above) ☐ Return to client

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCs (EPA 8260 / 624)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)	TPH (DRO + RRO)	BOD			Comments
1	Intake: 84	12/6/24	11:30	W	4								X	X	D			X	X			
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

Turn-around Time:
☒ Standard ☐ Next Day
☐ 3 Day ☐ Same Day
☐ 2 Day ____ (specify)

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished (Signature)	Print Name	Date/Time	Received (Signature)	Print Name	Date/Time
x Clare McKenna	Clare McKenna	15:01	x [signature]	Briana Ballard	12/6 3:01PM
x			x		

COC 1.3 - 11.06.20

www.fremontanalytical.com

3600 Fremont Ave N
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Shannon & Wilson
Amy Summe
400 N 34th Street, Suite 100
Seattle, WA 98103

RE: UW Energy Renewal Program, 111679-P2-6
Work Order Number: 2501201

January 17, 2025

Attention Amy Summe:

Fremont Analytical, Inc, an Alliance Technical Group company, received 2 sample(s) on 1/10/2025 for the analyses presented in the following report.

Biochemical Oxygen Demand by SM 5210B
Diesel and Heavy Oil by NWTPH-Dx
Dissolved Metals by EPA 200.8
PCBs by EPA Method 8082A

All analyses were performed according to our accredited Quality Assurance program. Please contact the laboratory if you should have any questions about the results.

Alliance Technical Group is committed to accuracy, speed, and customer service. Thank you for choosing Alliance Technical Group's Seattle laboratory team for your analytical needs. We appreciate this opportunity to serve you!

Sincerely,

Lyann Rivera
Project Manager

CC:
Clare McKenna

DoD-ELAP Accreditation #79636 by PJLA, ISO/IEC 17025:2017 and QSM 5.4 for Environmental Testing
ORELAP Certification: WA 100009 (NELAP Recognized) for Environmental Testing
Washington State Department of Ecology Accredited for Environmental Testing, Lab ID C910

Original

Date: *01/17/2025*

CLIENT:	Shannon & Wilson
Project:	UW Energy Renewal Program
Work Order:	2501201

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
2501201-001	Discharge: 20	01/10/2025 11:23 AM	01/10/2025 2:41 PM
2501201-002	Intake: 96	01/10/2025 12:18 PM	01/10/2025 2:41 PM

Note: If no "Time Collected" is supplied, a default of 12:00AM is assigned

Case Narrative

WO#: **2501201**
Date: **1/17/2025**

CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

Matrix Spike (MS) and MS Duplicate (MSD) samples are tested from an analytical batch of "like" matrix to check for possible matrix effect. The MS and MSD will provide site specific matrix data only for those samples which are spiked by the laboratory. The sample chosen for spike purposes may or may not have been a sample submitted in this sample delivery group. The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples and the MS/MSD to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.
Prep Comments for METHOD (PREP-PCB-W), SAMPLE (2501201-001A) required Acid Cleanup Procedure (Using Method No 3665A).
Prep Comments for METHOD (PREP-PCB-W), SAMPLE (2501201-002A) required Acid Cleanup Procedure (Using Method No 3665A).
Prep Comments for METHOD (PREP-PCB-W), SAMPLE (2501201-002A) required Florisil Cleanup Procedure (Using Method No 3620C).
Prep Comments for METHOD (PREP-PCB-W), SAMPLE (2501201-001A) required Florisil Cleanup Procedure (Using Method No 3620C).

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
DUP - Sample Duplicate
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MCL - Maximum Contaminant Level
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
REP - Sample Replicate
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Alliance TECHNICAL GROUP

Analytical Report

Work Order: **2501201**
Date Reported: **1/17/2025**

Client: Shannon & Wilson
Project: UW Energy Renewal Program
Lab ID: 2501201-001
Client Sample ID: Discharge: 20
Collection Date: 1/10/2025 11:23:00 AM
Matrix: Water

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Biochemical Oxygen Demand by SM 5210B				Batch ID: R96975		Analyst: JH
Biochemical Oxygen Demand	ND	2.00		mg/L	1	1/10/2025 4:35:00 PM
PCBs by EPA Method 8082A				Batch ID: 46444		Analyst: CO
Aroclor 1016	ND	0.0190		µg/L	1	1/16/2025 1:17:18 PM
Aroclor 1221	ND	0.0190		µg/L	1	1/16/2025 1:17:18 PM
Aroclor 1232	ND	0.0190		µg/L	1	1/16/2025 1:17:18 PM
Aroclor 1242	ND	0.0190		µg/L	1	1/16/2025 1:17:18 PM
Aroclor 1248	ND	0.0190		µg/L	1	1/16/2025 1:17:18 PM
Aroclor 1254	ND	0.0190		µg/L	1	1/16/2025 1:17:18 PM
Aroclor 1260	ND	0.0190		µg/L	1	1/16/2025 1:17:18 PM
Aroclor 1262	ND	0.0190		µg/L	1	1/16/2025 1:17:18 PM
Aroclor 1268	ND	0.0190		µg/L	1	1/16/2025 1:17:18 PM
Total PCBs	ND	0.0190		µg/L	1	1/16/2025 1:17:18 PM
Surr: Decachlorobiphenyl	52.8	5.42 - 149		%Rec	1	1/16/2025 1:17:18 PM
Surr: Tetrachloro-m-xylene	85.2	20.8 - 127		%Rec	1	1/16/2025 1:17:18 PM
Diesel and Heavy Oil by NWTPH-Dx				Batch ID: 46437		Analyst: AP
Diesel Range Organics	ND	96.2		µg/L	1	1/14/2025 7:07:54 PM
Heavy Oil	ND	144		µg/L	1	1/14/2025 7:07:54 PM
Total Petroleum Hydrocarbons	ND	241		µg/L	1	1/14/2025 7:07:54 PM
Surr: 2-Fluorobiphenyl	60.9	50 - 150		%Rec	1	1/14/2025 7:07:54 PM
Surr: o-Terphenyl	73.3	50 - 150		%Rec	1	1/14/2025 7:07:54 PM
Dissolved Metals by EPA 200.8				Batch ID: 46431		Analyst: ME
Arsenic	0.653	0.500		µg/L	1	1/13/2025 5:19:00 PM
Copper	ND	2.00		µg/L	1	1/13/2025 5:19:00 PM
Lead	ND	0.300		µg/L	1	1/13/2025 5:19:00 PM
Zinc	ND	2.50		µg/L	1	1/13/2025 5:19:00 PM

Analytical Report

Work Order: **2501201**
Date Reported: **1/17/2025**

Client: Shannon & Wilson | **Collection Date:** 1/10/2025 12:18:00 PM
Project: UW Energy Renewal Program
Lab ID: 2501201-002 | **Matrix:** Water
Client Sample ID: Intake: 96

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Biochemical Oxygen Demand by SM 5210B				Batch ID: R96975		Analyst: JH
Biochemical Oxygen Demand	ND	2.00		mg/L	1	1/10/2025 4:35:00 PM
PCBs by EPA Method 8082A				Batch ID: 46444		Analyst: CO
Aroclor 1016	ND	0.0190		µg/L	1	1/16/2025 1:26:57 PM
Aroclor 1221	ND	0.0190		µg/L	1	1/16/2025 1:26:57 PM
Aroclor 1232	ND	0.0190		µg/L	1	1/16/2025 1:26:57 PM
Aroclor 1242	ND	0.0190		µg/L	1	1/16/2025 1:26:57 PM
Aroclor 1248	ND	0.0190		µg/L	1	1/16/2025 1:26:57 PM
Aroclor 1254	ND	0.0190		µg/L	1	1/16/2025 1:26:57 PM
Aroclor 1260	ND	0.0190		µg/L	1	1/16/2025 1:26:57 PM
Aroclor 1262	ND	0.0190		µg/L	1	1/16/2025 1:26:57 PM
Aroclor 1268	ND	0.0190		µg/L	1	1/16/2025 1:26:57 PM
Total PCBs	ND	0.0190		µg/L	1	1/16/2025 1:26:57 PM
Surr: Decachlorobiphenyl	52.2	5.42 - 149		%Rec	1	1/16/2025 1:26:57 PM
Surr: Tetrachloro-m-xylene	69.8	20.8 - 127		%Rec	1	1/16/2025 1:26:57 PM
Diesel and Heavy Oil by NWTPH-Dx				Batch ID: 46437		Analyst: AP
Diesel Range Organics	ND	95.7		µg/L	1	1/14/2025 7:19:44 PM
Heavy Oil	ND	144		µg/L	1	1/14/2025 7:19:44 PM
Total Petroleum Hydrocarbons	ND	239		µg/L	1	1/14/2025 7:19:44 PM
Surr: 2-Fluorobiphenyl	64.3	50 - 150		%Rec	1	1/14/2025 7:19:44 PM
Surr: o-Terphenyl	68.8	50 - 150		%Rec	1	1/14/2025 7:19:44 PM
Dissolved Metals by EPA 200.8				Batch ID: 46431		Analyst: ME
Arsenic	0.619	0.500		µg/L	1	1/13/2025 5:30:00 PM
Copper	ND	2.00		µg/L	1	1/13/2025 5:30:00 PM
Lead	ND	0.300		µg/L	1	1/13/2025 5:30:00 PM
Zinc	ND	2.50		µg/L	1	1/13/2025 5:30:00 PM

Work Order: 2501201
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT

Biochemical Oxygen Demand by SM 5210B

Sample ID: **MB-96975** SampType: **MBLK** Units: **mg/L** Prep Date: **1/10/2025** RunNo: **96975**
Client ID: **MBLKW** Batch ID: **R96975** Analysis Date: **1/10/2025** SeqNo: **2021892**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Biochemical Oxygen Demand	ND	2.00									

Sample ID: **LCS-96975** SampType: **LCS** Units: **mg/L** Prep Date: **1/10/2025** RunNo: **96975**
Client ID: **LCSW** Batch ID: **R96975** Analysis Date: **1/10/2025** SeqNo: **2021893**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Biochemical Oxygen Demand	168	2.00	198.0	0	84.6	84.6	115.4				

Sample ID: **2501201-001D DUP** SampType: **DUP** Units: **mg/L** Prep Date: **1/10/2025** RunNo: **96975**
Client ID: **Discharge: 20** Batch ID: **R96975** Analysis Date: **1/10/2025** SeqNo: **2021895**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Biochemical Oxygen Demand	ND	2.00						0		20	

ALLIANCE TECHNICAL GROUP

Work Order: 2501201
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT

Dissolved Metals by EPA 200.8

Sample ID: **MB-46431** SampType: **MBLK** Units: **µg/L** Prep Date: **1/13/2025** RunNo: **96936**
Client ID: **MBLKW** Batch ID: **46431** Analysis Date: **1/13/2025** SeqNo: **2021274**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	ND	0.500									
Copper	ND	2.00									
Lead	ND	0.300									
Zinc	ND	2.50									

Sample ID: **LCS-46431** SampType: **LCS** Units: **µg/L** Prep Date: **1/13/2025** RunNo: **96936**
Client ID: **LCSW** Batch ID: **46431** Analysis Date: **1/13/2025** SeqNo: **2021275**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	101	0.500	100.0	0	101	85	115				
Copper	105	2.00	100.0	0	105	85	115				
Lead	46.6	0.300	50.00	0	93.2	85	115				
Zinc	101	2.50	100.0	0	101	85	115				

Sample ID: **2501201-001BDUP** SampType: **DUP** Units: **µg/L** Prep Date: **1/13/2025** RunNo: **96936**
Client ID: **Discharge: 20** Batch ID: **46431** Analysis Date: **1/13/2025** SeqNo: **2021277**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	0.611	0.500						0.6530	6.65	30	
Copper	ND	2.00						0		30	
Lead	ND	0.300						0		30	
Zinc	ND	2.50						0		30	

Sample ID: **2501201-001BMS** SampType: **MS** Units: **µg/L** Prep Date: **1/13/2025** RunNo: **96936**
Client ID: **Discharge: 20** Batch ID: **46431** Analysis Date: **1/13/2025** SeqNo: **2021278**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	106	0.500	100.0	0.6530	106	70	130				
Copper	111	2.00	100.0	0	111	70	130				
Lead	48.9	0.300	50.00	0	97.8	70	130				

Work Order: 2501201
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT

Dissolved Metals by EPA 200.8

Sample ID: **2501201-001BMS** SampType: **MS** Units: **µg/L** Prep Date: **1/13/2025** RunNo: **96936**
Client ID: **Discharge: 20** Batch ID: **46431** Analysis Date: **1/13/2025** SeqNo: **2021278**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Zinc	107	2.50	100.0	0	107	70	130				

Sample ID: **2501201-001BMSD** SampType: **MSD** Units: **µg/L** Prep Date: **1/13/2025** RunNo: **96936**
Client ID: **Discharge: 20** Batch ID: **46431** Analysis Date: **1/13/2025** SeqNo: **2021279**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	106	0.500	100.0	0.6530	105	70	130	106.2	0.216	30	
Copper	108	2.00	100.0	0	108	70	130	110.7	2.33	30	
Lead	48.4	0.300	50.00	0	96.8	70	130	48.89	0.995	30	
Zinc	107	2.50	100.0	0	107	70	130	106.6	0.0563	30	

Alliance TECHNICAL GROUP

Work Order: 2501201
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT

Diesel and Heavy Oil by NWTPH-Dx

Sample ID: **MB-46437** SampType: **MBLK** Units: **µg/L** Prep Date: **1/13/2025** RunNo: **96972**
Client ID: **MBLKW** Batch ID: **46437** Analysis Date: **1/14/2025** SeqNo: **2021754**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel Range Organics	ND	100									
Heavy Oil	ND	150									
Total Petroleum Hydrocarbons	ND	250									
Surr: 2-Fluorobiphenyl	19.0		25.00		75.8	50	150				
Surr: o-Terphenyl	20.2		25.00		80.9	50	150				

Sample ID: **LCS-46437** SampType: **LCS** Units: **µg/L** Prep Date: **1/13/2025** RunNo: **96972**
Client ID: **LCSW** Batch ID: **46437** Analysis Date: **1/14/2025** SeqNo: **2021755**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Petroleum Hydrocarbons	855	250	1,250	0	68.4	47.5	118				
Surr: 2-Fluorobiphenyl	17.5		25.00		70.1	50	150				
Surr: o-Terphenyl	19.0		25.00		76.2	50	150				

Sample ID: **2501208-001BDUP** SampType: **DUP** Units: **µg/L** Prep Date: **1/13/2025** RunNo: **96972**
Client ID: **BATCH** Batch ID: **46437** Analysis Date: **1/14/2025** SeqNo: **2021765**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel Range Organics	ND	96.7						0		30	
Heavy Oil	ND	145						0		30	
Total Petroleum Hydrocarbons	ND	242						0		30	
Surr: 2-Fluorobiphenyl	18.9		24.18		78.3	50	150		0		
Surr: o-Terphenyl	19.5		24.18		80.7	50	150		0		

Sample ID: **2501208-003BDUP** SampType: **DUP** Units: **µg/L** Prep Date: **1/13/2025** RunNo: **96972**
Client ID: **BATCH** Batch ID: **46437** Analysis Date: **1/14/2025** SeqNo: **2021767**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel Range Organics	ND	95.4						0		30	
Heavy Oil	ND	143						0		30	

Work Order: 2501201
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT
Diesel and Heavy Oil by NWTPH-Dx

Sample ID: **2501208-003BDUP**	SampType: **DUP**	Units: **µg/L**	Prep Date: **1/13/2025**	RunNo: **96972**
Client ID: **BATCH**	Batch ID: **46437**		Analysis Date: **1/14/2025**	SeqNo: **2021767**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Petroleum Hydrocarbons	ND	238						0		30	
Surr: 2-Fluorobiphenyl	16.1		23.84		67.6	50	150		0		
Surr: o-Terphenyl	16.7		23.84		70.0	50	150		0		

Date: *1/17/2025*

Work Order: 2501201
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT

PCBs by EPA Method 8082A

Sample ID: **2501196-001DDUP** SampType: **DUP** Units: **µg/L** Prep Date: **1/14/2025** RunNo: **97008**
Client ID: **BATCH** Batch ID: **46444** Analysis Date: **1/16/2025** SeqNo: **2022609**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aroclor 1016	ND	0.0189						0		30	
Aroclor 1221	ND	0.0189						0		30	
Aroclor 1232	ND	0.0189						0		30	
Aroclor 1242	ND	0.0189						0		30	
Aroclor 1248	ND	0.0189						0		30	
Aroclor 1254	ND	0.0189						0		30	
Aroclor 1260	ND	0.0189						0		30	
Aroclor 1262	ND	0.0189						0		30	
Aroclor 1268	ND	0.0189						0		30	
Total PCBs	ND	0.0189						0		30	
Surr: Decachlorobiphenyl	199		471.8		42.2	5.42	149		0		
Surr: Tetrachloro-m-xylene	318		471.8		67.5	20.8	127		0		

Sample ID: **MB-46444** SampType: **MBLK** Units: **µg/L** Prep Date: **1/14/2025** RunNo: **97008**
Client ID: **MBLKW** Batch ID: **46444** Analysis Date: **1/16/2025** SeqNo: **2022612**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aroclor 1016	ND	0.0200									
Aroclor 1221	ND	0.0200									
Aroclor 1232	ND	0.0200									
Aroclor 1242	ND	0.0200									
Aroclor 1248	ND	0.0200									
Aroclor 1254	ND	0.0200									
Aroclor 1260	ND	0.0200									
Aroclor 1262	ND	0.0200									
Aroclor 1268	ND	0.0200									
Total PCBs	ND	0.0200									
Surr: Decachlorobiphenyl	261		500.0		52.3	9.13	160				
Surr: Tetrachloro-m-xylene	355		500.0		71.0	20	116				

Work Order: 2501201
CLIENT: Shannon & Wilson
Project: UW Energy Renewal Program

QC SUMMARY REPORT

PCBs by EPA Method 8082A

Sample ID: **LCS-46444** SampType: **LCS** Units: **µg/L** Prep Date: **1/14/2025** RunNo: **97008**
Client ID: **LCSW** Batch ID: **46444** Analysis Date: **1/16/2025** SeqNo: **2022613**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aroclor 1016	1.85	0.0200	2.500	0	73.9	15.3	141				
Aroclor 1260	1.81	0.0200	2.500	0	72.6	17.2	146				
Surr: Decachlorobiphenyl	265		500.0		53.0	5.42	149				
Surr: Tetrachloro-m-xylene	352		500.0		70.5	20.8	127				

Alliance TECHNICAL GROUP

Sample Log-In Check List

Client Name:	SW	Work Order Number:	2501201
Logged by:	Clare Griggs	Date Received:	1/10/2025 2:41:00 PM

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Present ☑
4.	Was an attempt made to cool the samples?	Yes ☑	No ☐	NA ☐
5.	Were all items received at a temperature of >2°C to 6°C *	Yes ☑	No ☐	NA ☐
6.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
7.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
8.	Are samples properly preserved?	Yes ☑	No ☐	
9.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
10.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
11.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
12.	Does paperwork match bottle labels?	Yes ☑	No ☐	
13.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
14.	Is it clear what analyses were requested?	Yes ☑	No ☐	
15.	Were all hold times (except field parameters, pH e.g.) able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

16.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: Date:

By Whom: Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding:

Client Instructions:

17. Additional remarks:

Item Information

Item #	Temp ºC
Sample	3.9

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical

An Alliance Technical Group Company

3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790

Chain of Custody Record & Laboratory Services Agreement

Date: 1/10/25 Page: 1 of: 1

Laboratory Project No (internal): 2501201

Project Name: UW Energy Renewal Program

Special Remarks:

Client: Shannon + Wilson

Project No: 111679 - P2-6

Address: 400 N 34th St Suite 100

Collected by: CRM

City, State, Zip: Seattle WA 98103

Location: Lake WA

Telephone: 206-632-8020

Report To (PM): Amy Summe

Disposal: Samples will be disposed in 30 days unless otherwise requested.
☐ Retain volume (specify above) ☐ Return to client

Email(s): Clare.McKenna@shanwil.com Amy.Summe@shanwil.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCs (EPA 8260 / 624)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)	TPH (DRO + RRO)	BOD			Comments
1	Discharge : 20	1/10/25	11:23	W	4								X	X	D			X	X			
2	Intake : 96	1/10/25	12:18	W	4								X	X	D			X	X			
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

Turn-around Time:
☒ Standard ☐ Next Day
☐ 3 Day ☐ Same Day
☐ 2 Day ______ (specify)

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished (Signature)	Print Name	Date/Time	Received (Signature)	Print Name	Date/Time
x Clare McKenna	Clare McKenna	1/10/25 14:35	x [signature]	Payton Cleven	1/10/25 2:41PM
x			x		

APPENDIX C: SEDIMENT SAMPLE ANALYTICAL TESTS

Appendix C

Sediment Sample Analytical Tests

Table 5-1. Recommended sediment analytical methods and sample quantitation limits.

Parameter (unit)	Sample Preparation Method	Sample Analysis Method	Sample Quantitation Limit (MRL)[1]
CONVENTIONAL PARAMETERS			
Total Solids $^{M/F}$ (%)	—	PSEP 1986 or SM 2540G	0.1
Total Volatile Solids$^{M/F}$ (%)	—	PSEP 1986 SM 2540G	0.1
Total Organic Carbon $^{M/F}$ (%)	PSEP 1997 and Bragdon-Cook 1993	SM 5310B or EPA 9060A	0.1
Total Sulfides $^{M/F}$ (mg/kg)	—	PSEP 1986/Plumb 1981	1.0
Ammonia $^{M/F}$ (mg/kg)	—	Plumb 1981	0.1
Grain Size $^{M/F}$ (%)	—	PSEP 1986 or ASTM D-422 mod	1.0
STANDARD CHEMICALS OF CONCERN			
Metals (mg/kg)			
Antimony ^{M}	EPA 3050B	EPA 6010D/6020B	0.5
Arsenic $^{M/F}$	EPA 3050B	EPA 6010D/6020B	5
Cadmium $^{M/F}$	EPA 3050B	EPA 6010D/6020B	0.5
Chromium $^{M/F}$	EPA 3050B	EPA 6010D/6020B	5
Copper $^{M/F}$	EPA 3050B	EPA 6010D/6020B	5
Lead $^{M/F}$	EPA 3050B	EPA 6010D/6020B	5
Mercury $^{M/F}$	EPA 7471B	EPA 7471B	0.05
Nickel ^{F}	EPA 3050B	EPA 6010D/6020B	5
Selenium ^{F}	EPA 3050B	EPA 6010D/6020B	1
Silver $^{M/F}$	EPA 3050B	EPA 6010D/6020B	0.5
Zinc $^{M/F}$	EPA 3050B	EPA 6010D/6020B	5
Polynuclear Aromatic Hydrocarbons (µg/kg)			
Low molecular weight PAHs			
Naphthalene $^{M/F}$	EPA 3550C-mod[3]	EPA 8270D	20
Acenaphthylene $^{M/F}$	EPA 3550C-mod[3]	EPA 8270D	20
Acenaphthene $^{M/F}$	EPA 3550C-mod[3]	EPA 8270D	20
Fluorene $^{M/F}$	EPA 3550C-mod[3]	EPA 8270D	20
Phenanthrene $^{M/F}$	EPA 3550C-mod[3]	EPA 8270D	20
Anthracene $^{M/F}$	EPA 3550C-mod[3]	EPA 8270D	20
2-Methylnaphthalene $^{M/F}$	EPA 3550C-mod[3]	EPA 8270D	20

Table 5-1. Recommended sediment analytical methods and sample quantitation limits.

Parameter (unit)	Sample Preparation Method	Sample Analysis Method	Sample Quantitation Limit (MRL) [1]
High-molecular weight PAHs			
Fluoranthene [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Pyrene [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Benzo(a)anthracene [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Chrysene [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Benzofluoranthenes [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Benzo(a)pyrene [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Indeno(1,2,3-c,d)pyrene [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Dibenzo(a,h)anthracene [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Benzo(g,h,i)perylene [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Chlorinated Hydrocarbons (µg/kg)			
1,4-Dichlorobenzene [M]	EPA 3550C-mod[3]	EPA 8270D	20
1,2-Dichlorobenzene [M]	EPA 3550C-mod[3]	EPA 8270D	20
1,2,4-Trichlorobenzene [M]	EPA 3550C-mod[3]	EPA 8270D	20
Hexachlorobenzene [M]	EPA 3550C-mod[3]/3540C	EPA 8270D/8081B	10
Phthalates (µg/kg)			
Dimethyl phthalate [M]	EPA 3550C-mod[3]	EPA 8270D	20
Diethyl phthalate [M]	EPA 3550C-mod[3]	EPA 8270D	20
Di-n-butyl phthalate [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Butyl benzyl phthalate [M]	EPA 3550C-mod[3]	EPA 8270D	20
Bis(2-ethylhexyl)phthalate [M/F]	EPA 3550C-mod[3]	EPA 8270D	100
Di-n-octyl phthalate [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Phenols (µg/kg)			
Phenol [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
2-Methylphenol [M]	EPA 3550C-mod[3]	EPA 8270D	20
4-Methylphenol [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
2,4-Dimethylphenol [M]	EPA 3550C-mod[3]	EPA 8270D	20
Pentachlorophenol [M/F]	EPA 3550C-mod[3]	EPA 8270D	100
Miscellaneous Extractable Organic Compounds (µg/kg)			
Benzyl alcohol [M]	EPA 3550C-mod[3]	EPA 8270D	50
Benzoic acid [M/F]	EPA 3550C-mod[3]	EPA 8270D	100
Carbazole [F]	EPA 3550C-mod[3]	EPA 8270D	500
Dibenzofuran [M/F]	EPA 3550C-mod[3]	EPA 8270D	20
Hexachlorobutadiene [M]	EPA 3550C-mod[3]	EPA 8270D	10
N-Nitrosodiphenylamine [M]	EPA 3550C-mod[3]	EPA 8270D	20

Table 5-1. Recommended sediment analytical methods and sample quantitation limits.

Parameter (unit)	Sample Preparation Method	Sample Analysis Method	Sample Quantitation Limit (MRL) [1]
Pesticides (µg/kg)			
DDE (p,p'-, o,p'-) $^{M/F}$	EPA 3540C	EPA 8081B	2
DDD (p,p'-, o,p'-) $^{M/F}$	EPA 3540C	EPA 8081B	2
DDT (p,p'-, o,p'-) $^{M/F}$	EPA 3540C	EPA 8081B	2
Aldrin ^{M}	EPA 3540C	EPA 8081B	2
Chlordane compounds ^{M} (cis-chlordane, trans-chlordane, cis-nonachlor, trans-nonachlor, and oxychlordane)	EPA 3540C	EPA 8081B	2
Dieldrin $^{M/F}$	EPA 3540C	EPA 8081B	2[2]
Heptachlor ^{M}	EPA 3540C	EPA 8081B	2[2]
Endrin ketone ^{F}	EPA 3540C	EPA 8081B	2
beta-Hexachlorocyclohexane ^{F}	EPA 3540C	EPA 8081B	2
Polychlorinated Biphenyls (µg/kg)			
Total Aroclors $^{M/F}$ (1016, 1221, 1232, 1242, 1248, 1254, and 1260) [4]	EPA 3540C	EPA 8082A	10
SITE-SPECIFIC CHEMICALS OF CONCERN			
Butyltins			
Tributyltin, porewater (µg/L) ^{M}	Krone 1989/DMMP 1998/ EPA 8270-SIM	Krone 1989/EPA 8270-SIM	0.03
Mono- ^{F}, di- ^{F}, tri- $^{M/F}$, and tetra- ^{F} butyltin (µg/kg)	Krone 1989/ EPA 8270-SIM	Krone 1989/EPA 8270-SIM	5
Total Petroleum Hydrocarbons (mg/kg)			
TPH-diesel ^{F}	NWTPH-Dx/EPA 3630C/3665A	NWTPH-Dx	25
TPH-residual ^{F}	NWTPH-Dx/EPA 3630C/3665A	NWTPH-Dx	50
Dioxins/ Furans (ng/kg)			
2,3,7,8-TCDD $^{M/F}$	EPA 8290A/1613B	EPA 8290A/ 1613B	1
Dioxins/furans (other) $^{M/F}$	EPA 8290A/1613B	EPA 8290A/ 1613B	1–10

Note: ^{M} = marine screening only; ^{F} = freshwater screening only; $^{M/F}$ = both marine and freshwater

[1] MRLs are based on dry sample weight assuming no interferences; site-specific method modifications may be required to achieve these MRLs in some cases.

[2] The standard method MRL is above the screening levels. For these CoCs, labs should ensure that MDLs are below the screening levels and report MDL for nondetects.

[3] EPA Method 3550C is modified to add matrix spikes before the dehydration step, not after.

[4] See section 6.1.2 for rules for PCB summation.