Final Water Taxi Expansion Progress Report

June 30, 2022

I. Contents

II. Proviso Text

On November 17, 2020, the King County Council ("Council") unanimously adopted ordinance 19210[1], a final $12.59 billion budget for the 2021-22 biennium, including Section 113, Transit, Proviso P3 and Expenditure Restriction ER2.

PROVISO P3:

Of this appropriation, $1,000,000 shall not be expended or encumbered until the executive transmits a preliminary and a final water taxi expansion progress report detailing progress on route planning and motions that should acknowledge receipt of the preliminary and of the final reports and motions acknowledging the preliminary and final reports are passed by the council. Each motion should reference the subject matter, the proviso's ordinance number, ordinance section and proviso number in both the title and body of the motion.

The preliminary and a final water taxi expansion progress reports shall include a discussion of the progress on the planning activities identified in Expenditure Restriction ER2 of this section, including, but not limited to, shoreside preliminary design, route planning, equipment specification, preliminary capital and operating budgets and other details necessary to prepare for implementation of the routes by the council.

The executive should electronically file the preliminary report and motion required by this proviso no later than November 29, 2021, and the final report and motion required by this proviso no later than June 30, 2022, with the clerk of the council, who shall retain an electronic copy and provide an electronic copy to all councilmembers, the council chief of staff and the lead staff for the mobility and environment committee, or its successor.

ER2 EXPENDITURE RESTRICTION:

Of this appropriation, $500,000 shall be expended or encumbered solely for operational planning for previously studied water taxi expansion routes originating in Kenmore and Shilshole. The planning shall include, but not be limited to, shoreside preliminary design, route planning, equipment specification, preliminary capital and operating budgets and other details necessary to prepare for implementation of the routes by the council.

[1] King County 2021-22 Biennial Budget, Section 113, Transit

III. Executive Summary

This report is provided pursuant to Ordinance 19210, Section 113, Transit, Proviso P3. The Proviso directs the Executive to transmit a report on Water Taxi expansion progress for previously studied Water Taxi expansion routes originating in Kenmore and Ballard. This includes technical analysis and stakeholder engagement around shoreside preliminary design, route planning, equipment specification, preliminary capital and operating budgets, and other details necessary to prepare for implementation of the routes by the Council.

Current Metro policies approved by the King County Council, such as the Service Guidelines, Metro Connects, and the Strategic Plan, guide investment priorities in support of a regional mobility network and to better advance equity and environmental sustainability through Metro's operations and service growth. While the implementation of a Kenmore or Ballard Water Taxi route would advance county goals of providing access to public transportation and help reduce greenhouse gas emissions in the region, this report does not address how implementation of these routes could be prioritized across all King County Metro public transportation services.

The potential expansion route landing sites align with previous planning work. Landing site improvements and multimodal network connections have been identified for the potential expansion routes, with preliminary shoreside design concepts where applicable. The Kenmore route landing sites would be the Lakepointe development site in Kenmore and the University of Washington Waterfront Activity Center (UW WAC) in Seattle. The Ballard route landing sites would be Shilshole Marina in the Ballard neighborhood of Seattle and the Seattle waterfront's Pier 50. Additional engagement with landing site owners will be required.

Lakepointe: The site currently has no in-water or uplands terminal infrastructure and connections to transit would require additional multimodal improvements. Several bus routes could be revised to better serve the landing site if landside improvements are made, which will require a service re-design and incur additional operations costs. The property is slated for redevelopment in which Water Taxi expansion infrastructure and multimodal connections could be integrated.

UW WAC: The landing site would be adjacent to the Sound Transit University of Washington Link light rail station; however, uplands multimodal infrastructure and redevelopment of an existing in-water dock would be needed. The University of Washington (UW) does not support Water Taxi expansion at this location. Without a Water Taxi landing at the UW WAC, a Kenmore expansion route will not be feasible. Other potential Seattle landings such as Leschi and Madison Park are not time competitive, have less favorable ridership projections, and limited multimodal access preventing those landings from being viable on the Seattle side.

Shilshole: The landing site would have existing terminal infrastructure but limited network connectivity, with no transit service reachable within a quarter mile on foot and limited multimodal access. A fixed route Water Taxi shuttle, or other new mobility services, would be needed to connect riders between central Ballard and Golden Gardens Park, which will add additional operational costs.

Pier 50: Pier 50 docking capacity is limited by two King County routes and three Kitsap County routes. The addition of a new route would require additional docking capacity. The landing site would have convenient access to transit and multimodal connections, so no additional network changes would be needed.

Adopted King County policies such as the King County Equity and Social Justice Strategic Plan, King County 2020 Strategic Climate Action Plan, the Service Guidelines, and Metro Connects were used to assess route planning and establish service profiles for both expansion routes. The service profiles were set to meet a minimum of 1-hour frequencies, 12-hour spans of service, and an increase in service during the summer sailing season. Hourly service aligns with guidance for minimum frequency for fixed-route transit options. The Ballard route would operate with one vessel while the Kenmore route would require two vessels to meet the desired 1-hour frequency. As a result of the second vessel, the Kenmore route could operate at greater frequencies, every 40 minutes, which is assumed in the route profiles.

At the time of analysis for this proviso response, electrification of current or future passenger-only ferry (POF) routes was not mandated by existing King County policy, however moving Marine toward zero-emission operations was considered in alignment with King County goals. Preliminary vessel specifications, propulsion technology, and related design requirements were developed. As proposed in previous studies, a vessel size with a passenger load of 150, and a cruising speed of 28 knots was selected to meet estimated demand. Electrical capacity to meet the load requirements of a single run on a fully electric plug-in ferry would not be met within the specified dwell time of the potential ferry service schedules and would require terminal battery storage. However, a plug-in hybrid system could be accommodated without terminal battery storage. A plug-in hybrid diesel-electric ferry technology is deemed most appropriate for the potential Kenmore and Ballard routes at the time of analysis. As battery and hydrogen fuel cell technology evolve, the feasibility of alternative zero-emission propulsion technologies will increase. Metro will continue to consider alternative technologies in fleet choices to align with County policies.

Implementing Water Taxi service requires one-time capital investments and a sustainable funding source to fully support operating, maintenance, and debt service costs to implement routes. Capital investments can be funded through a combination of grants, local revenue sources, and bond issuance. The capital costs vary due to the differing needs at the various landing sites. For the Ballard route, capital costs could be minimal for an initial phase of service given the preferred landing site location's existing infrastructure; permanent service would require additional capital investment at the Pier 50 landing site. Operating costs would be funded through an increase to the existing dedicated POF property tax levy and supplemented with passenger fare revenue.

The POF tax levy funding rates are based on the capital costs being funded by bonds and grants, or solely by bonds for each route. The Kenmore route would begin levy funding two years prior to operations to support the debt service for bonds on capital costs. The Ballard route would begin levy funding when the phase one operations begin.

Expansion Route	Tax Levy Begins	Operations Begin	Tax Rate (Bonds and Grants)	Tax Rate (Bonds Only)
Kenmore	2029	2031	$0.01190	$0.01300
Ballard	2024	2024	$0.00800	$0.00925

For context, the existing Vashon Island and West Seattle ferry service levy rate is $0.0125, effective as of 2017. The maximum authorized ferry property tax levy is $0.075 per $1,000 assessed value. Both expansion routes tax levies would be within the authorized total tax levy.

An Equity Impact Review was conducted for this work. The communities that would be served by expanded Water Taxi service generally have low equity scores, and most have existing transit options available. Therefore, the expansion routes would provide benefit in areas where the population is less diverse and wealthier than county averages.

The Kenmore route currently faces many challenges to implementation, most notably lack of support from UW for the identified landing site and lack of other suitable Seattle-side landing sites. The Ballard route has fewer challenges to implementation and could be implemented in a phased approach. A preliminary phase could be implemented with minimal capital improvements at the landing sites and use a leased vessel during a two-year initial phase. The full implementation could increase capacity at Pier 50, include electrification infrastructure, and procure dedicated vessels for regular service. However, any implementation would require funding and the proper environmental and permitting approvals to be in place.

IV. Background

Department Overview: King County Metro is the Puget Sound region's largest public transportation agency. Metro provides bus, paratransit, vanpool, and water taxi services, and operates Seattle Streetcar, Sound Transit Link light rail, and Sound Transit Express bus service. Metro is committed to providing safe, equitable, and sustainable mobility, and prioritizing service where needs are greatest.

Historical Context: The King County Ferry District (KCFD) was founded in 2008, and year-round passenger-only ferry (POF) service from downtown Seattle to West Seattle and Vashon Island began in 2010. The Marine Division, which currently operates the King County Water Taxi routes, joined the King County Metro Transit Department (Metro) in 2019. As part of the state approved business plan used to form the KCFD, provision of POF service was planned to grow over time. In mid-2009, the KCFD began to study demonstration routes on Puget Sound and Lake Washington, but by late 2009 the KCFD ended the study in response to the economic recession. The Council directed the Marine Division, through a proviso in the 2015-2016 adopted budget, to revisit the 2009 study and expand the analysis to incorporate potential new long-term, passenger-only route service expansion opportunities. That effort resulted in a final report on Ferry Expansion Options for Marine Division, which identified both the Kenmore and Ballard routes as top potential expansions and was approved by Motion 14561 in 2015[2]. Through two provisos in the 2019-2020 adopted budget, Council directed to further planning and implementation work on a Kenmore[3] and Ballard[4] expanded Water Taxi routes. The 2015 study and subsequent 2020 work are the starting points from which this report was developed. Notably, the Puget Sound Regional Council (PSRC) published a ferry study in 2020,[5] identifying opportunity and interest in additional regional ferry service into the downtown Seattle waterfront.

Current Context: A preliminary Water Taxi Expansion Report detailing preliminary assumptions and analysis for this body of work, as directed by Ordinance 19210, Section 113, Transit, Proviso P3 was passed by Council March 1, 2022[6]. The report included route planning and equipment specification work completed at that time. This report builds from the analysis included in that report.

Metro policy, such as the Service Guidelines, Metro Connects, and the Strategic Plan guide investment priorities in support of a regional mobility network and to better advance equity and environmental sustainability through Metro's operations and service growth.

King County Metro Strategic Plan for Public Transportation 2021-2031[7]

Metro's Strategic Plan outlines Metro's goals, the strategies and objectives to achieve them, and measures to determine if the goals are being met. Metro's Strategic Plan updates were approved by the Council in December 2021. This policy lays the groundwork for how Metro approaches decision making and is the driving policy for this work. The Strategic Plan goals are as follows:

- Invest upstream where needs are greatest.
- Address the climate crisis and environmental justice.
- Innovate to improve mobility, equity, and sustainability.

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[2] King County. (2015). Final Report on Ferry Expansion Options for Marine Division
[3] King County. (2020). Implementation of a Kenmore Water Taxi Route Proviso Response
[4] King County. (2020). Implementation of a Ballard-to-downtown Seattle Water Taxi Route Proviso Response
[5] PSRC. (2021). Puget Sound Passenger-Only Ferry Study
[6] King County. (2022). A Preliminary Water Taxi Expansion Progress Report.
[7] King County. (2021). Strategic Plan for Public Transportation 2021-2031

- Keep passengers, employees, and communities safe.
- Support thriving, equitable, transit-oriented communities that foster economic development.
- Improve Access to mobility options.
- Build a skilled, diverse, and well-supported workforce that has opportunities to grow.
- Be responsible stewards of financial resources and investing in line with values and goals.
- Conduct deliberate and transparent community engagement.

King County Metro Service Guidelines 2021 Update[8]

Metro uses service guidelines to evaluate, design, and modify transit services to meet changing needs and to deliver efficient, high-quality service. The service guidelines establish criteria and processes that Metro uses to analyze and plan changes to the transit system. The guidelines help make sure that decision-making and recommendations to policy makers are objective, transparent, and aligned with the region's goals for public transportation.

The 2015 Service Guidelines did not include information on Water Taxi service. Metro's Service Guidelines updates were approved by the Council in December 2021. The 2021 update includes criteria and processes for evaluating, designing, and modifying existing Water Taxi service. The changes approved by the Council are considered in the route planning analysis for this proviso response.

Metro Connects[9]

Metro Connects is Metro's long-range plan and vision for bringing more and better transit service to King County. The plan is guided by Metro's values of safety, excellent customer service, sustainability, equity and social justice, partnerships, and innovation.

The original version of Metro Connects, adopted in 2017, did not address Water Taxi service. Metro Connects was updated by Metro and approved by the Council in 2021. This update includes information on future Water Taxi service. Target service levels established in the update were used to determine potential service levels and spans of service for the Kenmore and Ballard routes.

King County 2020 Strategic Climate Action Plan[10]

King County's Strategic Climate Action Plan (SCAP) is a five-year blueprint for County climate action, integrating climate change into all areas of County operations. This policy helped guide the equipment specifications analysis for this report, including lower emission and zero-emission alternatives. The core sections, reducing greenhouse gas (GHG) emissions, sustainable and resilient frontline communities, and preparing for climate changes, are guided by the following principles:

- Act with urgency and intention.
- Lead with racial justice and equity.
- Respond to community needs and priorities.
- Use and develop best available science.
- Seek systemic solutions.
- Build partnerships.
- Lead through local actions.

[8] King County. (2021). Service Guidelines
[9] King County. (2021). King County Metro Long-Range Plan Metro Connects
[10] King County. (2021). King County 2020 Strategic Climate Action Plan

- Prioritize health and co-benefits.
- Be transparent and accountable.

Transportation is the region's largest source of GHG emissions [11]. The SCAP outlines focus areas to increase regional transit ridership, reduce total vehicle miles, and adopt clean fuels standards to reduce transportation-fuel GHG emissions.

King County Equity and Social Justice Strategic Plan[12]

The King County Equity and Social Justice (ESJ) Strategic Plan is a blueprint for change, mutually created by King County employees and community partners. The shared vision is to create, "[a] King County where all people have equitable opportunity to thrive." The ESJ Strategic Plan directs King County to invest upstream and where needs are greatest to address root causes and be pro-equity. This policy guided the EIR analysis for this report. For Transportation and Mobility, efforts are focused around:

1. Investments in service improvements.
2. Investments in community partnerships.
3. Investments in the places and people with greatest needs.
4. Leveraging the County's role as a major employer.

Regulatory & Environmental Considerations

Waterborne transportation is subject to federal, state, and local environmental regulations. The expansion routes would be subject to environmental review and permitting to ensure the service and how it is operated meets all relevant regulations.

Compliance with the National Environmental Policy Act (NEPA) is required for projects involving major federal actions. The NEPA process requires coordinating with the lead federal agency as soon as possible to determine if the project is to be considered categorically excluded or have an impact. Depending on the determination, the project may need to proceed with an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). Based on the determination, the Marine Division would prepare environmental studies needed to support the review process. This would include consultation with the appropriate agencies, tribes, and the community.

Additional considerations for environmental and permitting needs are addressed for the Kenmore route in Appendix A and the Ballard route in Appendix B. Appendix B provides additional guidance on regulatory and environmental considerations for a phased approach to implementation of a Ballard route, as the minimal capital needs for implementing a phase one of service may result in more streamlined regulatory processes.

Report Methodology: Metro's Marine Division and Mobility Division developed this report. Additionally, Metro retained the services of a passenger ferry consultant, KPFF Consulting Engineers – Marine Transit Consulting Group, and its subconsultants to provide technical support, analysis, and development of technical reports. The scope of work to respond to the Proviso used the findings and recommendations from the 2015 and 2020 studies as a basis for the technical work to understanding implementation of both the Kenmore and Ballard expansion routes.

[11] King County. (2021). King County 2020 Strategic Climate Action Plan. Page 60.
[12] King County. (2016). King County Equity and Social Justice Strategic Plan 2016-2022

V. Report Requirements

This section is organized to align to requirements of Ordinance 19210, Section 113, Transit, Proviso P3. It provides information around the planning for Water Taxi expansion routes originating in Kenmore and Ballard. Specifically, the Proviso requests detail around shoreside preliminary design, route planning, equipment specification, preliminary capital and operating budgets, and other details necessary to prepare for implementation of the routes by the Council. Metro's Marine and Mobility Divisions worked with the consultant and subconsultants to perform technical analysis and develop the following responses to these requirements, discussed in the subsections below. Content of this report references additional details that are included in appendices, or cited from previous reports.

A. Shoreside Preliminary Design

This section details preliminary concepts and assumptions for shoreside design for the new routes as requested in the proviso.

Landing Sites

For the Kenmore route, the assumed landing sites would be the Lakepointe development site in Kenmore and the UW WAC. Figure 1 shows the assumed Kenmore routing and landing sites. For the Ballard route, the assumed landing sites would be Ballard's Shilshole Marina and the existing King County Water Taxi terminal at Pier 50 located on the downtown Seattle waterfront. Figure 2 shows the assumed Ballard routing and landing sites. These landing site assumptions align with the 2020 Proviso response analysis[13] [14].

The Lakepointe development site is the preferred landing site by the City of Kenmore and could also be utilized for vessel maintenance and tie-up, as documented in the 2020 Proviso report[15]. The UW WAC is selected because of its numerous transit connections, particularly Link light rail to downtown Seattle and Northgate, and bus options to many other destinations. Additional landing sites in Kenmore and Seattle were considered and dismissed in previous planning efforts[16]. Pier 50 is selected as it is home to current King County Water Taxi services. Shilshole Bay Marina is operated by the Port of Seattle and provides some existing infrastructure that would allow for easier implementation of a new route. Previous planning efforts considered an additional landing at Pier 86, near Centennial Park and the Expedia campus but was dismissed given the lack of a suitable docking facility[17].

[13] King County. (2020). Implementation of a Kenmore Water Taxi Route Proviso Response. Page 4.
[14] King County. (2020). Implementation of a Ballard-to-downtown Seattle Water Taxi Route Proviso Response. Page 9.
[15] King County. (2020). Implementation of a Kenmore Water Taxi Route Proviso Response. Page 13.
[16] King County. (2020). Implementation of a Kenmore Water Taxi Route Proviso Response. Page 7.
[17] King County. (2020). Implementation of a Ballard-to-downtown Seattle Water Taxi Route Proviso Response. Page 9.

Figure 1: Potential Kenmore routing and landing sites

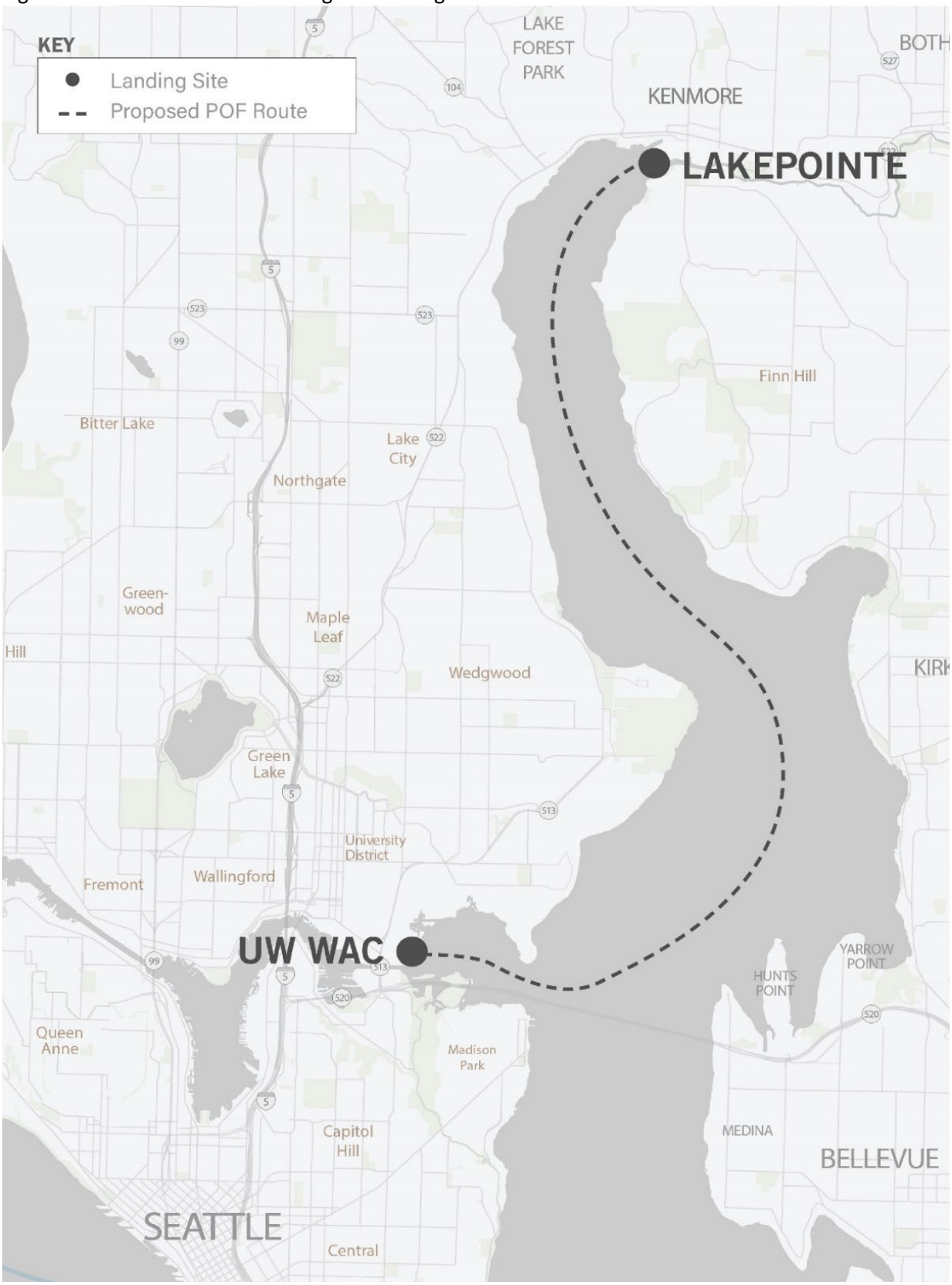
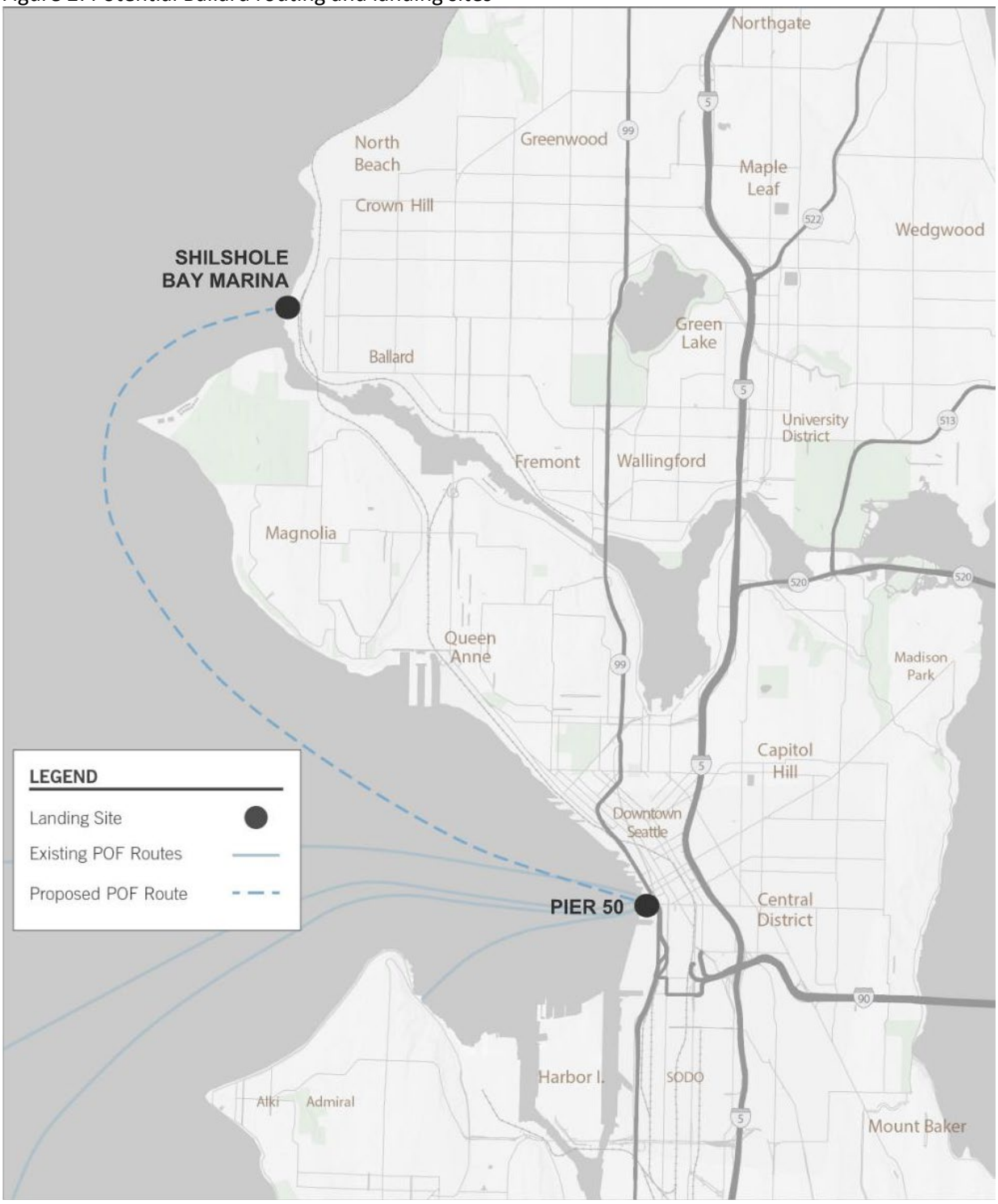


Figure 2: Potential Ballard routing and landing sites



Maintenance Facility Assumptions

For the Ballard route, the existing King County Water Taxi maintenance facility at Pier 48 could be utilized for routine maintenance activities. The continuation of shipyard maintenance activities at the current location were assumed, including the use of vessel drydocks and hull/out-of-water maintenance, with labor, materials, and ancillary costs being estimated. Routine terminal maintenance activities such as minor repairs and cleaning were also assumed.

For the Kenmore route, though similar maintenance activities were also assumed, a new maintenance facility would need to be planned to avoid the inefficiencies of travelling via the Hiram M. Chittenden Locks to and from the existing Pier 48 maintenance barge for routine maintenance. The maintenance location was assumed to be at the new Lakepointe terminal where additional space and capital investment would be dedicated to creating the needed maintenance facility.

Pier 50 Capacity

The current Pier 50 facility supports the existing King County Water Taxi routes to West Seattle and Vashon Island, as well as three Kitsap Transit Fast Ferry routes. With its two operating slips, the facility is currently operating at capacity, particularly during the commute periods when services run more frequently. An additional float would be needed to support any additional service given the five routes that currently operate out of this location, and the current and anticipated ridership demand during peak periods. This report assumes capital costs for an additional new float and additional operating slips at Pier 50.

The limited capacity at the current facility, and the strong desire for additional POF services to the downtown Seattle waterfront, has been a growing matter of interest for many, as outlined in the 2020 PSRC Passenger-Only Ferry Study[18]. Additionally, Kitsap Transit is currently undertaking a siting study to identify a long-term solution to current capacity constraints on their POF services.
The recently completed habitat beach to the south also presents limitations on in-water and over-water expansion at the terminal. Float expansion would need to be designed to avoid the habitat beach's extent and maintain any overwater footprint within the harbor line.

Terminal Improvements

Terminal improvement needs vary by landing site location. In Kenmore, the Lakepointe landing site currently has no in-water or uplands (meaning on land) terminal infrastructure and would require additional improvement to allow transit vehicles to connect to the terminal. At the UW WAC, infrastructure would be required to connect the dock to existing pedestrian, cycle, and transit options, as well as redevelopment of an existing in-water dock. Appendix A includes additional details and shoreside design concepts for the potential Kenmore route. Shilshole and Pier 50 both have existing infrastructure; however, some improvements would be needed due to the expansion of services at those existing facilities. Appendix B includes additional details and shoreside design concepts for the potential Ballard route.

Landing Site Owner Engagement Status

To date, King County has engaged with partner agencies throughout planning studies, inclusive of this proviso response. This section details the status of landing site owner engagement as it pertains to shoreside design and implementation readiness.

[18] PSRC. (2021). Puget Sound Passenger-Only Ferry Study

Lakepointe: The City of Kenmore has continued to express interest in the potential expansion route. The city has helped connect the Marine Division with the Lakepointe property owner, shared the current understanding of the potential redevelopment of the property, and has collaborated with the owner to ensure all parties remained informed.

UW WAC: In previous planning efforts, the UW raised concerns with the Kenmore expansion route landing at the UW WAC location, including potential conflicts between Water Taxi service and the UW rowing teams that practice in the area, as well as other recreational boaters currently using the UW WAC facility. For this proviso effort, Metro reached out to the University Office of Regional & Community Relations to continue discussions about a potential Water Taxi landing at UW WAC. In response, UW expressed its opinion the UW WAC is not an appropriate location for a Water Taxi landing, and it cannot support continued planning efforts for this location. Without a Water Taxi landing at the UW WAC, a Kenmore Water Taxi route will not be feasible, as other Seattle landings such as Leschi and Madison Park are not time competitive and have less favorable ridership projections. Together, these factors suggest that the lack of an identified and supported Seattle-side terminal are major limitations to advancing a route between Kenmore and Seattle currently.

Shilshole: The Port of Seattle has been an active partner in previous and current Water Taxi planning efforts. For this report, Metro conducted a site visit with Port of Seattle representatives where the Port suggested Dock X as the landing location. The Port also suggested A Dock, H Dock, and I Dock as potential landing locations and expressed their interest in Water Taxi service and landing at Shilshole Marina. Locations of existing docks, as well as general Marina information are shown on the Port of Seattle's website[19].

General programming needs and preliminary designs were shared with the Port as part of the Metro's planning for this report. Several of the docks may be feasible to meet Water Taxi and general marina operational needs with minimal capital costs; however, this analysis uses Dock X as the preferred landing location due to its operational advantages and minimal capital improvement needs. Continued discussions regarding use/lease agreement of the facility, and further understanding of parking impacts, restrictions, availability of shoreside infrastructure, and approach are necessary prior to the start of service. This includes ensuring priorities from ongoing analysis and changes in marina operations are considered in any implementation plan.

Pier 50: Pier 50, located on the downtown Seattle waterfront, is owned by King County. However, as the Kitsap Transit Fast Ferries also jointly use the Pier 50 facility, engagement with Kitsap Transit is necessary should there be a desire to utilize Pier 50 for expanded County Water Taxi services. Further engagement on future electrification work will be necessary with partners such as Washington State Ferries, the Port of Seattle, and utility providers.

Electrical Capacity

Electrification of current or future POF routes is not mandated by current King County policy. Because moving Marine toward zero-emission operations will further align with King County goals, it is included in this work. Electrical power and grid capacity infrastructure are limited at and near the terminal locations identified in this report.

[19] http://www.portseattle.org/sites/default/files/2020-08/SBM_Map_Brochure-2020_web-1page.pdf

Specifically, depending on the electrical loads needed for future POF routes and the timing of the route implementation, additional electrical grid infrastructure could be needed at the terminal locations. Early negotiation with the local utilities (Seattle City Light and Puget Sound Energy) is thus required, as the process to expand grid electrical capacity could take up to five years. Additionally, as more industries seek to reduce emissions via electrification, electrical grid capacity could become further constrained. Local utilities are seeking to conduct additional capacity planning and incorporating Water Taxi expansions into these plans could assist future implementation efforts. Electrification improvements at the landing site locations is included in the shoreside design concepts, as well as the capital and operations costing work.

Landing Site Access

The landing sites would be accessed by pedestrian, bicycle, and vehicle traffic by way of personal vehicle, rideshare, or potential fixed-route bus or shuttle drop-off. Access enhancement to accommodate these modes differs by terminal location. Preliminary site layouts include these considerations.

B. Route Planning

This section details methodology, assumptions, and analysis for route planning and network integration for the expansion routes as requested in the Proviso.

Route Planning Methodology & Assumptions

Time Competitiveness and Demand

The 2020 proviso work evaluated time competitiveness and demand for the potential expansion routes. A key principle of this work is that for users to select the Water Taxi as a mode of transit, the ferry must be competitive with other currently available transit options. To determine and assess competitiveness, route profiles were developed to generate feasible travel times for the potential new ferry routes compared to other existing modes for various trip pairs that could be served by Water Taxi. The 2020 proviso work showed that the Kenmore POF route could provide faster travel times than existing transit options during the congested PM peak period for various trip pairs[20]. For Ballard, the 2020 proviso response showed travel times by Water Taxi would be slower than existing transit options for most trip pairs throughout the day[21].

Ridership demand was developed as part of the 2020 proviso effort[22][23]. The ridership estimates established in the 2020 proviso work were used to properly size the potential service vessels and used in the financial analysis, detailed in section V.D of this report. The service schedule, or frequency of sailings, was developed following Metro service policies.

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[20] King County. (2020). Implementation of a Kenmore Water Taxi Route Proviso Response. Appendix A. Attachment A.7.

[21] King County. (2020). Implementation of a Ballard-to-downtown Seattle Water Taxi Route Proviso Response. Appendix A. Attachment A.5.

[22] King County. (2020). Implementation of a Kenmore Water Taxi Route Proviso Response. Appendix A. Attachment A.6.

[23] King County. (2020). Implementation of a Ballard-to-downtown Seattle Water Taxi Route Proviso Response. Appendix A. Attachment A.4.

Frequency of Sailings

Metro Connects specifies that Water Taxi services should run at least every hour, and service for both routes was designed to align with this vision[24]. Hourly service aligns with guidance for other fixed-route transit options and increases opportunities to integrate with Metro's transit network.

For Ballard service, hourly service would be met with one vessel, but more frequent service would not. To minimize cost while maintaining effective service, an hourly service schedule supported by one vessel was assumed.

For Kenmore service, due to the length of the route, hourly service would only be supported by two vessels operating simultaneously. With two vessels, it would be possible to run more frequent service, with sailings departing every 40 minutes. As more frequent service is preferred, particularly for commute periods, all sailings for the Kenmore route were assumed to depart every 40 minutes.

Seasonal Schedules

Current King County Water Taxi routes see an increase in service and demand during the summer season, which is common for many passenger-only ferries (POF) and vehicle ferry operators. To align with this demand pattern, two different service schedules were assumed for each route: one for the lower-demand winter season and one for the higher-demand summer season.

Experience from existing Water Taxi routes and other ferry services indicates that, to be competitive and provide sufficient options for commute riders, three round trips per commute period [6 to 9:00 a.m. for the AM commute, and 3 to 6:00 p.m. for the PM commute] must be provided. As a result, commute-only service is assumed to provide, at minimum, this level of round trips.

Six months of the year were assumed to follow the winter schedule while the remaining six months of the year were assumed to follow the summer schedule. This six-month split aligns with the existing West Seattle Water Taxi schedule.

Service Predictability

Metro Connects outlines that Water Taxi services should have between eight and 18 hours of service a day, while other fixed-route services should have a minimum of 12 hours of service a day. To ensure predictable service that is easy for riders to use, a minimum 12-hour service day would be provided, including on winter Saturdays, running approximately 8:00 a.m. to 8:00 p.m. The 12-hour winter Saturday service day was included regardless of perceived Saturday winter demand to align with key Metro service guidelines and match service levels of other transit service connecting to the Water Taxi terminals.

Level of Service

Following the King County policies and methodologies included in this report, service schedules were developed for each expansion route. Table 1 summarizes the potential Kenmore service schedule and Table 2 summarizes the potential Ballard service schedule. Note: the Kenmore route would require two

[24] King County. (2021). King County Metro Long-Range Plan Metro Connects. Page 14.

operating vessels to meet the service level guidelines. As a result, 40-minute headways are attainable. Appendix A details this work for the Kenmore route and Appendix B for the Ballard route.

Table 1. Kenmore service schedule summary

	Winter	Summer
Vessel Passenger Capacity	150 passengers	150 passengers
Operating Vessels	2 vessels	2 vessels
Backup Vessels	1 vessel	1 vessel
Maximum Service Frequency	40-minute headway	40-minute headway
Commute Service	11 RTs per day: •6 RTs in the AM peak •5 RTs in the PM peak	21 RTs per day Mon-Thurs: •6 RTs in the AM peak •5 RTs in the PM peak •Mid-day service (10 RTs) 26 RTs per day Fridays: •Additional late night Friday service (5RTs)
Saturday Service	•18 RTs per day	•21 RTs per day •Late night service (3 RTs)
Sunday Service	No service	•18 RTs per day
Special Events	10 per year	None; extended service schedule assumed to cover special events

Note: Round Trips are abbreviated as “RTs.”

Table 2. Ballard service schedule summary

	Winter	Summer Peak
Vessel Passenger Capacity	150 passengers	150 passengers
Operating Vessels	1 vessel	1 vessel
Backup Vessels	1 vessel	1 vessel
Maximum Service Frequency	1 hour headway	1 hour headway
Commute Service	6 RTs per day: •3 RTs in the AM peak •3 RTs in the PM peak	14 RTs per day Mon-Thurs: •3 RTs in the AM peak •4 RTs in the PM peak • Midday service (7 RTs) 16 RTs per day Fridays: •Additional late night Friday service (2 RTs)
Saturday Service	•12 RTs per day	•15 RTs per day
Sunday Service	No service	•12 RTs per day
Special Events	None	None

Note: Round Trips are abbreviated as "RTs."

Existing Network

Figures 3 through 6 show the existing network in the vicinity of the potential landing sites. The existing network, including transit, parking, bicycle, and pedestrian infrastructure in the vicinity of the potential landing sites are assessed in Appendix A for the Kenmore route and Appendix B for the Ballard route.

- **Lakepointe**: At the potential Lakepointe landing site, improvements would be needed if transit was to be routed to serve the terminal itself versus serving stops along existing routing. The current land use at the landing site is industrial in nature with limited to no pedestrian or bike infrastructure on the site itself or from the site to SR-522.
- **UW WAC**: The potential UW WAC landing site is within a quarter mile walk to the University of Washington Link light rail station and surrounding transit and multimodal connections.
- **Shilshole**: The Shilshole Marina is isolated from most of Ballard's population, businesses, and services, with constrained access by any mode of travel and no current transit service. Past Metro bus service along Seaview Avenue NW was discontinued due to low ridership.
- **Pier 50**: The Pier 50 landing site is adjacent to robust multimodal and transit connections throughout downtown Seattle.

Figure 3: Existing transit and bicycle connections near the potential Lakepointe landing site

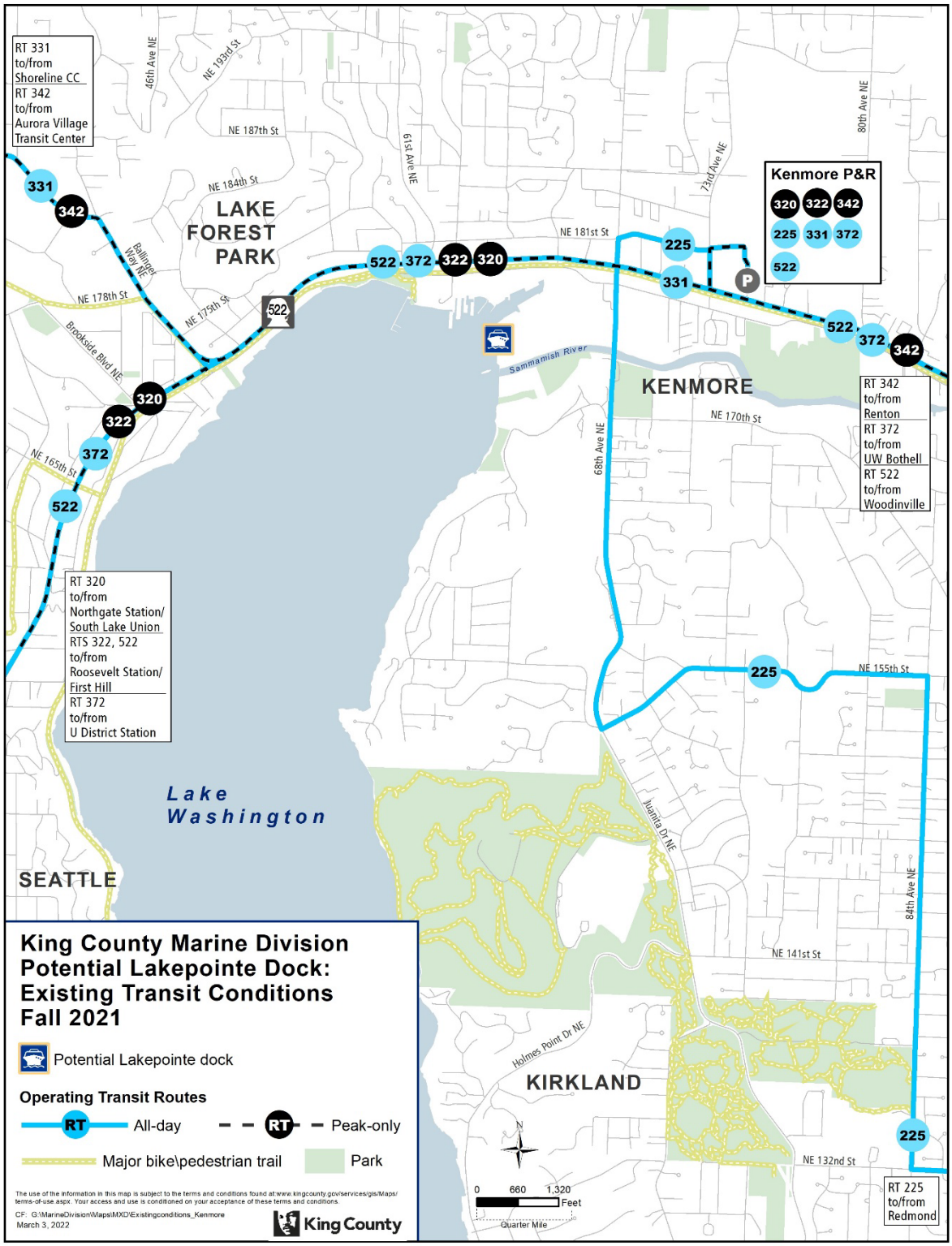

Figure 4: Existing transit and bicycle connections near the potential UW WAC landing site

Figure 5: Existing transit and bicycle connections near the potential Shilshole landing site

Figure 6: Existing transit and bicycle connections near the potential Pier 50 landing site

Potential Network Changes

Metro anticipates changes may be needed to the transit and multimodal network to connect riders to and from the water taxi terminals. This section details those potential changes, additional details are included for the Kenmore route in Appendix A and for the Ballard route in Appendix B.

Potential fixed-route bus changes to connect to Water Taxi

Potential changes to fixed-route services to connect to the Water Taxi are based on the Metro Connects interim network [25], as well as potential changes to area services in conjunction with Sound Transit investments. Using the potential levels of service for the potential routes, Metro developed route proposals and cost estimates for fixed routes. These potential changes may be subject to King County Council approval, except as follows (per King County Code 28.94.020 [26]):

- Any single change or cumulative changes in a service schedule which affect the established weekly service hours for a route by 25 percent or less;
- Any change in route location which does not move the location of any route stop by more than 1/2 mile; and
- Any changes in route numbers.

Kenmore

There is no current or planned fixed-route transit service in the vicinity of the Lakepointe landing site. Metro Connects Route 1215, between Shoreline Community College and Kenmore Park & Ride, and Route 3114, between Redmond and the Kenmore Park & Ride, could be extended from the park and ride terminal to serve the Water Taxi assuming adequate roadway facilities are provided through the terminal site. These Metro Connects routes most closely align with current Route 331 and Route 225 respectively. Cost estimates for the extension are included in the costing section of this report, which includes travel time back to the park & ride to continue to use the facilities at that terminal for route layover. Additional details on the route extensions are included in Appendix A.

Ballard

There is no current or planned fixed-route transit service in the vicinity of the Shilshole landing site. However, as with the West Seattle Water Taxi landing site, which is not proximate to all-day transit service, a fixed-route Water Taxi shuttle would be needed to create a connection for riders. The potential fixed-route shuttle would connect riders from the landing site to central Ballard and the transit options available there. The shuttle would operate to match the seasonal schedule of the Water Taxi. The creation of this route would need to be approved by the Council by ordinance. The costs of the shuttle service are included in the costing analysis of this report. Facilities for layover and operator comfort station access would need to be established at Shilshole Marina, however it is expected these could be accommodated at minimal capital or operating cost. Additional details on the fixed-route shuttle are included in Appendix B.

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[25] Metro Connects envisions integrating its expanded mobility system with regional partners – especially Sound Transit – and delivering more than 70 percent more Metro bus service by 2050. This significant service expansion will occur in two phases: an interim service network targeted for implementation before the Ballard Link expansion, and a 2050 service network that completes the Metro Connects vision.

[26] https://kingcounty.gov/council/legislation/kc_code/38_Title_28.aspx

Potential multimodal improvements to connect to Water Taxi

Considerations for multimodal access at the potential landing sites are included in the shoreside design concepts, however additional considerations for multimodal access outside the terminal improvements are desired.

- **Lakepointe**: Should private redevelopment occur, multimodal access through the new development to the potential landing site should be created and preferably required from the developer. Given current conditions, the immediate area around the potential landing site would require multimodal improvements on-site and to the west and the north, including across SR-522. Since the neighboring businesses are industrial in nature, Metro and partners would need to balance freight, pedestrian, bike safety, and priority in the area.
- **UW WAC**: Pedestrian improvements may be required to provide safe access through existing UW parking lots adjacent to Husky Stadium and areas closer to the UW WAC landing site.
- **Shilshole**: The completion of the Burke Gilman Trail, known as the "Missing Link," is the main planned improvement to bike, walk, and roll access in the area. However, this project has an unclear completion date.
- **Pier 50**: No additional multimodal improvements.

Metro would need to coordinate with the City of Kenmore, the City of Seattle, the Port of Seattle, and the University of Washington on any necessary improvements for multimodal access outside the terminal locations.

C. Equipment Specification

This section details methodology, assumptions, and findings for the propulsion analysis and equipment specifications for the expansion routes as called for by the Proviso. Equipment specification is a foundational assumption for moving forward with service understanding, landing site layouts, and costing of landing site and vessel capital and operating elements. The full propulsion analysis is documented in Appendix C with key elements discussed in this section.

Equipment Specification Methodology & Assumptions

Vessel Emission Profile and Associated Propulsion Systems

Electrification of current or future POF routes is not mandated by existing King County policy, however King County's Strategic Climate Action Plan calls for decreasing greenhouse gases now and into the future[27]. The propulsion alternative(s) selected for the Kenmore and Ballard routes should therefore support these goals as much as possible. To be consistent with Metro's adopted emissions reductions goals, the selection of new vessel propulsion technology is based on its ability to meet and balance the following goals:

- Decrease greenhouse gas emissions.
- Capitalize on current and future marine industry technological developments.
- Reduce and balance the level of risk/uncertainty in design cost and schedule of newly emerging technologies.

[27] King County. (2021). King County 2020 Strategic Climate Action Plan. Page 60.

Propulsion Analysis

As detailed in Appendix C, the propulsion analysis included research, industry engagement, and analysis on a variety of propulsion options. Key industry engagement included local vessel designers, vessel builders, marine battery manufacturers, and local utility companies. This included ABB, All American Marine, Arcadia Alliance, BAE Systems, BMT, Elliot Bay Design Group, Glosten, Green City Ferries, Schneider Electric, Seattle City Light, and Spear Power Systems. Both routes require a cruising speed of 28 knots to meet the potential service schedules and remain time-competitive with other modes. The selected propulsion system alternative would need to provide enough power to travel at this high-speed for a significant portion of each route which ranges from approximately 9 to 10.5 miles in distance. Shoreside infrastructure requirements could also be limiting at the various landing sites, such as limited space at the UW WAC for additional infrastructure. Table 3 shows all analyzed options, from zero-emissions to alternative diesel and gas fuels. For findings and more detail on the technologies behind each propulsion method, please see Appendix C.

Table 3. Alternative propulsion options assessed

Zero-Emissions	Hybrid Propulsion	Alternative Diesel & Gas Fuels
• Nuclear • Hydrogen Fuel Cell • Full Plug-in Electric	• Hybrid Diesel-Electric • Plug-in Hybrid	• Conventional Diesel (ultra-low sulfur diesel) • Biodiesel – B20 Blend • R99/Renewable Diesel • Liquefied Natural Gas (LNG)

Zero emission propulsion options (nuclear, hydrogen fuel cell, and full plug-in electric) offer the greatest emissions reduction opportunity as well as the highest level of uncertainty regarding timeframe, cost, and availability of fuel sources. The uncertainty is mostly associated with the current state of power density, or the size and weight at which power can be stored on a vessel and the power produced from these alternatives. Alternative diesel and other gas fuels, such as biodiesel, R99/Renewable Diesel, and LNG (Liquefied Natural Gas), provide low implementation risk, however they also offer the least amount of emission reduction and limited options to retrofit to other new technologies, if available. Hybrid options could support the desired route profiles with the current state of technology and would have the flexibility to be converted to zero-emissions systems in the future. Table 4 summarizes how each of the propulsion options align with the selection goals.

Table 4. Summary of propulsion option analysis

Propulsion Option	Emissions reduction potential	Potential to capitalize on future technologies	Level of risk/uncertainty in design cost & schedule
Zero-Emissions	Highest	Uncertain	High
Hybrid: Plug-in Hybrid	**Medium** Plug-in hybrid has a higher potential to reduce emissions than diesel-electric based on the ability to reduce emissions through landside charging using clean electricity from the grid.	**High** Diesel components could be removed while electric motors could remain and be powered by emerging technologies, such as improved batteries or hydrogen fuel cells.	**Medium** Technology currently exists that meets the specified route profiles, though it is not widespread.
Alternative Diesel and Gas Fuels	Medium to Low	Limited	Low

The propulsion configuration most appropriate to move forward for costing and operations analysis as part of this technical work on implementation of the Kenmore and/or Ballard routes is a plug-in diesel electric hybrid. This option was selected by Metro for its ability to upgrade to the newest clean propulsion technology as batteries and/or fuel cell technology continue to advance. Though shorter and slower routes could operate with currently available technologies, route lengths, and speeds, result in weights of the batteries and/or fuel cells that are currently infeasible for the potential Ballard and Kenmore routes. With the rapid pace of technological development, a goal that the hybrid system is to be convertible to zero emissions operations within the next ten years. Appendix C contains additional considerations and processes for zero emissions conversion.

Shoreside Infrastructure to Support a Plug-in Hybrid System

The selected plug-in hybrid would only operate on diesel power for the high-speed portion of the route and would use electric power for the low-speed zones (such as east of Webster's Point on Lake Washington, and during all maneuvering to and from each landing). As a result, less electrical power would be needed at the terminal to charge the ferry batteries than if the system were full plug-in electric. The terminal electrical power demands to charge the batteries in this option would be small enough that chargers could be provided at both ends of the route with minimal local infrastructure improvements. Though minimal, this infrastructure would require an uplands area of approximately 85 feet by 39 feet.

However, in the future when converting the hybrid system to an all-electric zero-emissions system, additional space could be required as additional battery storage would likely be needed. Estimates for the current additional space, given existing battery energy density, are provided in Appendix C. Additional grid capacity may also be needed to support a full electric system which would require

additional coordination with local utilities and could take up to five years depending on concurrent projects and on the additional capacity needed.

D. Preliminary Capital and Operating Budgets

This section details methodology, assumptions, and findings for the capital and operational costs as well as financing analysis for the expansion routes as requested in the proviso. This analysis uses the updated assumptions, analysis, and findings from the previously reported sections on shoreside design, route planning, and equipment specifications and all costs have been adjusted for inflation.

Costing and financial forecasting methodology, analysis, and understanding used in previous studies served as a basis in this work. However, the capital and operational costs will differ from previous study findings. Key areas identified in this report that will impact costs relative to previous studies include:

- Service levels for both routes have been updated to align with King County policy to provide additional service relative to previous study assumptions;
- This study assumes two vessels operating instead of one for the Kenmore route;
- Shoreside infrastructure costs will differ to accommodate the plug-in hybrid propulsion technology; and
- Plug-in Hybrid propulsion technology will have differing operational costs.

Capital Costs

Capital costs for the potential expansion routes include costs associated with facilities at the landing site as well as vessel procurement. The information provided in this document includes estimates based on the current understanding of implementation readiness. Additional capital costs may be needed for supporting network improvements such as multimodal connections outside the landing sites. The current expectation for fixed route transit connections is not anticipated to require capital costs for comfort station or layover facilities. However, minimal costs may be associated with establishing or maintaining these facilities in coordination with the Port of Seattle at the Shilshole landing site.

Kenmore

Appendix A details the capital costs assumptions and analysis for the potential Kenmore expansion route, showing approximately $73.8M in total capital costs.

- **Lakepointe landing site — $31.5M**: The site is programmed to include a new service float, a maintenance float/facility, electrification infrastructure, and a parking facility.
- **UW WAC landing site — $11.8M**: The existing float would need to be replaced with a new float to support service.
- **Vessel needs — $30.5M**: Three 150-passenger hybrid-electric vessels are assumed, two vessels would be needed to deliver service, with one backup for service vessels.

Ballard

Appendix B details the capital costs assumptions and analysis for the potential Ballard expansion route, with details for capital costs for a potential phased approach toward permanent service. An initial phase of service could have minimal capital costs at the landing site locations, however permanent service may require capital investment at Pier 50, for a range of approximately $21.5M to $47M in capital costs.

- **Shilshole landing site —$1.2M**: The site has existing infrastructure that can be leveraged for expanded Water Taxi service, with capital costs to improve safety and access at the existing site.
- **Pier 50 landing site — $0 to $25.5M**: The existing pier 50 facility can be leveraged at minimal capital costs for expanded Water Taxi service; however, capacity is limited at this facility. Permanent service may require additional capital costs to expand Pier 50 capacity.
- **Vessel needs — $20.3M**: Two 150-passenger hybrid-electric vessels are assumed, one vessel would be needed to deliver service, with one backup for service vessels.

Operating Costs

Annual operating costs use a cost model that included estimates for labor, maintenance, and energy/fuel costs. This includes the service hours for fixed-route transit and vessel operating hours in the representative service schedule.

- The Kenmore route operating costs is estimated at approximately $11.9M annually or $1,567 per vessel operating hour. Appendix A details the operations costing assumptions and analysis.
    - The annual operating costs for Kenmore include fixed-route transit service revisions to support the Kenmore route estimated at $1.46M annually.
- A phase one of Ballard route operating costs is estimated at approximately $6.6M annually or $1,650 per vessel operating hour. Appendix B details the operating costing assumptions and analysis.
    - The phase one annual operating costs for Ballard include a fixed route shuttle to support the Ballard route estimated at $940,000 annually.
- A permanent Ballard route operating costs is estimated to be approximately $7.1M annually or $1,763 per vessel operating hour.
    - The permanent annual operating costs for Ballard include a fixed route shuttle to support the Ballard route estimated at $1.12M annually.

The permanent Ballard route costs differ from the phase one assumptions as the estimate assumes differing vessel types and the permanent route would begin service seven years after an initial phase route — and accounts for the associated inflation.

Operating Assumptions

The Ballard route is assumed to operate service with one vessel, while Kenmore assumes simultaneous operation of two vessels to support service. Both routes assume the presence of an additional vessel to serve as a back-up for annual US Coast Guard inspections and in case of unplanned maintenance, etc.

Both services assume that 45 minutes of crew costs would be needed both before and after planned vessel operating hours to allow for startup and tie-up time before and after passenger service. Terminal staff hours would be assumed for operations at the Lakepointe facility for the Kenmore route, while existing Pier 50 terminal personnel hours would be assumed sufficient to cover the Ballard route personnel needs.

Three crew members would be assumed necessary to operate each vessel. These members include one captain and two deckhands. An additional staff member (Port Captain) would be assumed for the Ballard route. Regarding maintenance personnel, three full-time dedicated maintenance personnel/employees

(one engineer and two oilers) would be assumed for the Kenmore routes. The Ballard route would be assumed to have only two full-time dedicated maintenance personnel (one engineer and one oiler) as existing Pier 48 maintenance staff could also help support the route.

The potential Ballard first phase route is assumed to be a diesel-powered vessel; permanent service costs are based on a combination of fuel costs and electricity costs for a hybrid vessel.

The associated service hour costs for fixed-route bus service revisions, as detailed earlier in this report, are included in the estimates. Exact routing, layover locations, and site configurations may influence the total service hours needed for the potential fixed-route connections to the Shilshole & Lakepointe landing sites.

Finance Plan

This section provides a high-level overview of the potential ways for funding the implementation of the expansion routes. It is intended to be representative of what is projected to be required to establish secure funding in support of each additional route's service over a 20-year timeline.

The Marine Division's current primary funding source is a dedicated property tax levy that is supported by passenger fares, federal grants, and bond issuance for capital investments. The property tax levy is currently set at a rate to sustain existing operations. Adding new service would require a complete analysis of all funding sources projected into the future which is beyond the scope of this report.

Expanded Water Taxi service requires capital investment and a sustainable funding source to support operating costs. Capital investments can be funded through a combination of grants, local sources, and bonds. The analysis conducted for this report assumes operating costs and debt service would be funded through an increase to the existing dedicated POF property tax levy supplemented with passenger fare revenue. This approach aligns with the existing funding structure for POF operated by King County.

The capital investment and ongoing operating costs for expanded Water Taxi routes are calculated using high level estimates based on the timing of implementation and include an annual inflation rate. These estimates are subject to change based on further implementation planning, partnership agreements, the timing of funds being secured to support the service, as well as inflation or supply chain challenges.

The property tax levy, along with the annual operating costs and debt service for two different funding options, for each route is illustrated in Figures 7 and 8. Figure 7 provides examples for the Kenmore route that show the property tax levy rate that would need to be levied to fund the ongoing operating costs as well as the debt service for two levels of bond funding. The highest bond issuance assumption is $74M with no support from grants or partnerships for capital costs. The second assumption shows bonds at $52M and grants and other support of $22M. The levy rate would be $0.01300 per $1,000 of assessed property valuation for full bonding of capital costs and would be $0.01190 per $1,000 of assessed property valuation for bonding that includes partial funding from grants and other sources. Additional detail can be found in Appendix A.

Figure 7: Kenmore funding options

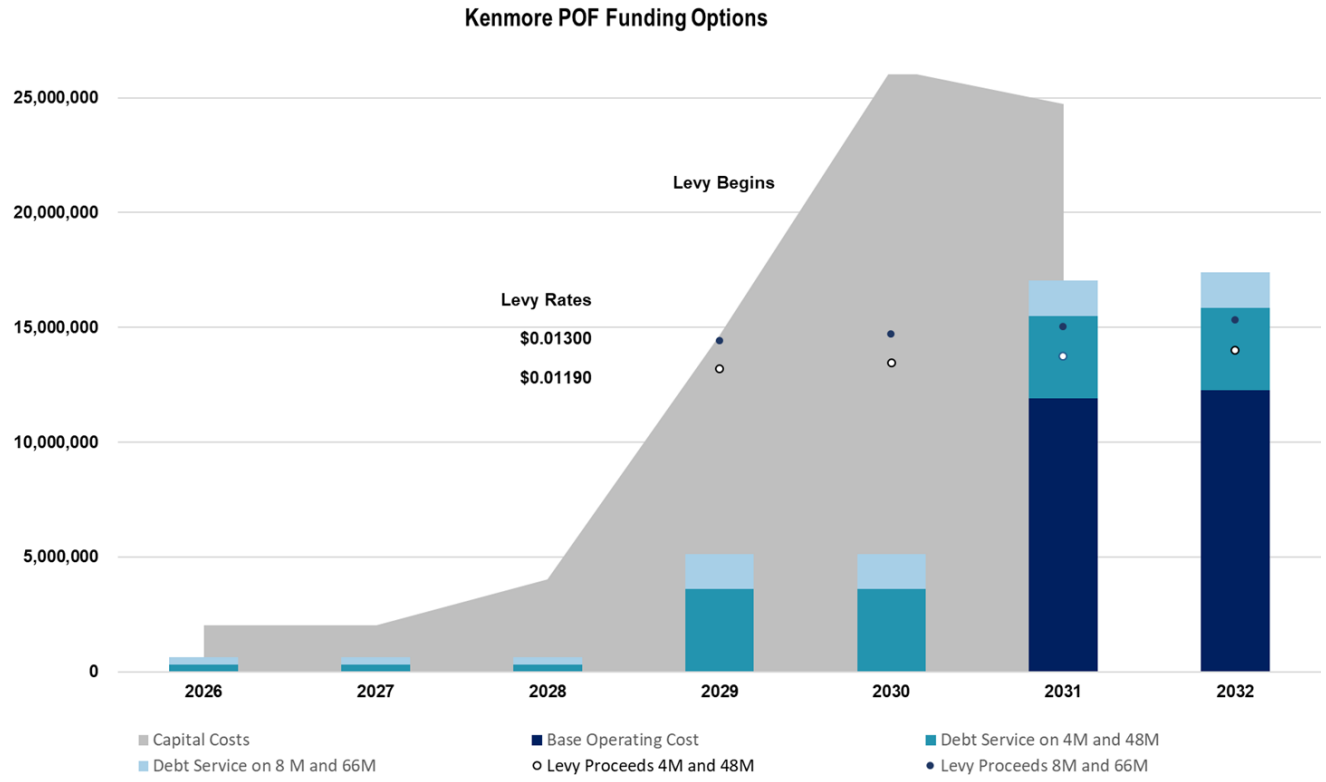
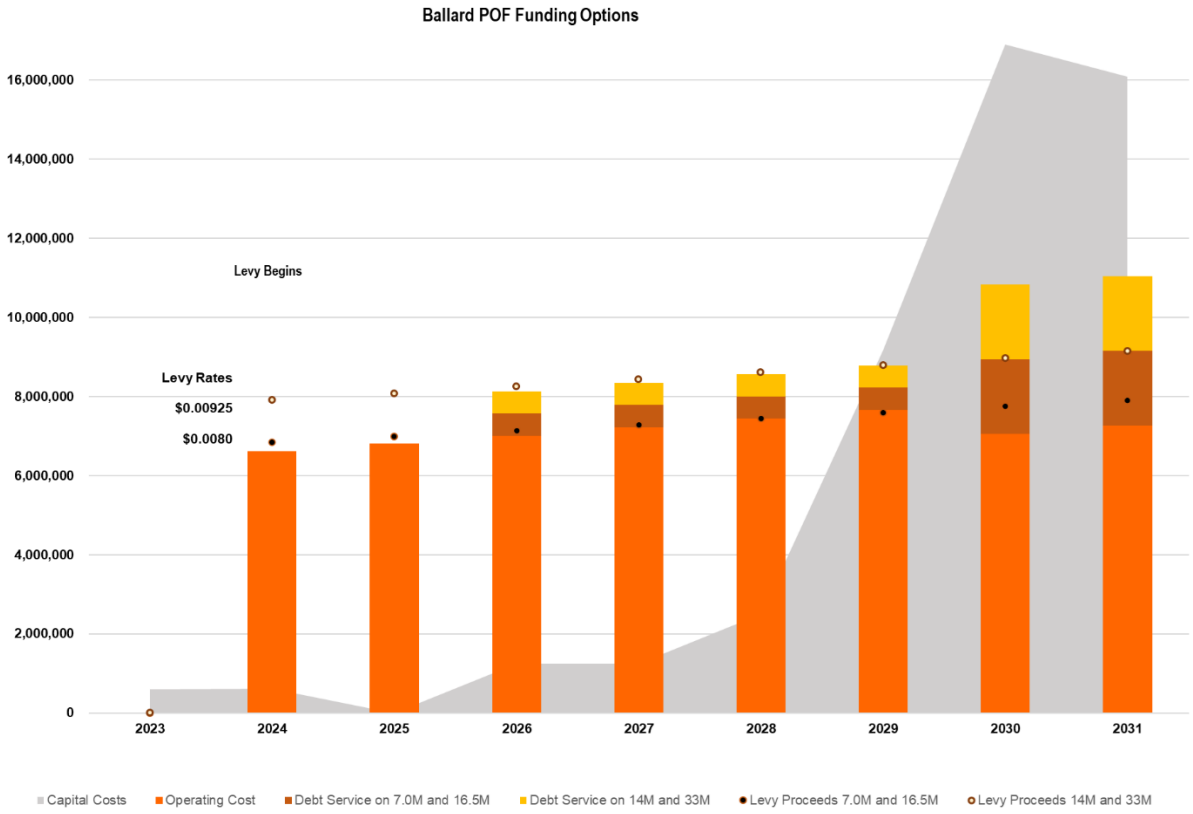


Figure 8 provides examples for the Ballard route, including the phase one service. It shows the property tax levy rate that would need to be levied to fund the ongoing operating costs as well as the debt service for two different levels of bond funding. The highest bond issuance assumption is $47M with no support from grants or partnerships for capital costs. The second assumption shows bonds at $23.5M and grant support of $23.5M. The levy rate would be $0.00925 per $1,000 of assessed property valuation for full bonding of capital costs and would be $0.0080 per $1,000 of assessed property valuation for half bonds and half grants funding the capital costs. Further details can be found in Appendix B.

Figure 8: Ballard funding options



In comparison, the existing levy rate that funds the Vashon Island and West Seattle routes is $0.0125 per $1,000 of assessed property value. The maximum allowable levy rate for this dedicated property tax is $0.075 per $1,000 of assessed property value; therefore, all scenarios for both routes could be funded within the allowable limit.

The Marine Division has a successful history in seeking and receiving grants for capital projects and would seek out as much grant funding as possible to support this expansion. The following grant opportunities are currently available for these capital investments:

- Federal Highway Administration (FHWA) – Ferry Boat Program.
- Federal Transit Administration (FTA) – Passenger Ferry Grant Program – Section 5307.
- Department of Transportation - Rebuilding American Infrastructure with Sustainability and Equity Better Utilizing Investments to Leverage Development (RAISE) Grant.

Additional federal, state, and local programs would be assessed to determine potential applicability for these Water Taxi expansion routes.

E. Additional Considerations to Prepare for Implementation of the Routes

In addition to the key areas addressed through earlier sections, additional considerations to prepare for implementation of the expansion routes are detailed in this section as requested in the proviso.

Equity Impact Review

Metro conducted an equity impact review (EIR) for this work. The EIR is included as Appendix D with key findings reported here. As part of the Mobility Framework adoption, King County Metro has identified a need to invest in service that will positively impact priority populations to address deep and persistent inequities — especially by race and place — that in many cases are getting worse and threaten our collective prosperity. The EIR combines technical analysis and community context to assess how decision making can further King County's equity and social justice goals. The EIR is inclusive of to date planning efforts and their assessment of differing potential landing sites for both expansion routes.

Metro is focused on expanding service where needs are greatest while continuing to meet mobility needs throughout King County. Areas of transit need have been identified through the King County Equity score (1-5) assigned to each census tract. The King County Equity Score combines three demographic characteristics (English proficiency, people of color, and household income) into an equal weighted score. Higher scores indicate less wealthy, more diverse populations. The data that makes up the equity score is from the 2013 – 2017 American Community Survey of the US Census Bureau[28]. These are considered priority populations for King County and are consistent with work done as part of Metro's Strategic Plan. The communities that would be served by expanded Water Taxi service generally have low equity scores, and most have existing transit options available. Therefore, the expansion routes would provide benefit in areas where the population is less diverse and wealthier than county averages, this would conflict with Metro's Strategic Plan goal of investing where needs are greatest[29]

Stakeholder Engagement

The 2020 Proviso work, as well as the 2015 expansion study and 2020 PSRC study, included stakeholder engagement activities. This work included coordinating technical aspects and priorities with landing site property owners and local government agencies, as well as community surveys that showed support for these expansion routes and the potential landing sites. The technical work and analysis included in the previous studies were guided by those efforts[30][31]. Metro conducted further engagement with landing site property owners and partner agencies to advance technical understanding for implementation including the Port of Seattle, the City of Seattle, the City of Kenmore, the University of Washington, and the Lakepointe development site owner. Section V.A of this report details the status of shoreside design engagement with each landing site owner. Additionally, technical coordination around shoreside, propulsion, and vessel technology needs for implementation required engagement with utility providers and other specialized vendors, which is detailed in Appendix C.

Further community engagement in addition to more robust stakeholder engagement with area agencies, tribes, and community groups will be conducted as a part of route implementation. Engagement with partners in planning efforts to date showed support for the routing and landing site

[28] US Census. American Community Survey
[29] King County. (2021). Strategic Plan for Public Transportation 2021-2031. Page 6
[30] King County. (2020). Implementation of a Kenmore Water Taxi Route Proviso Response. Pages 13-17.
[31] King County. (2020). Implementation of a Ballard-to-downtown Seattle Water Taxi Route Proviso Response. Pages 11 – 16.

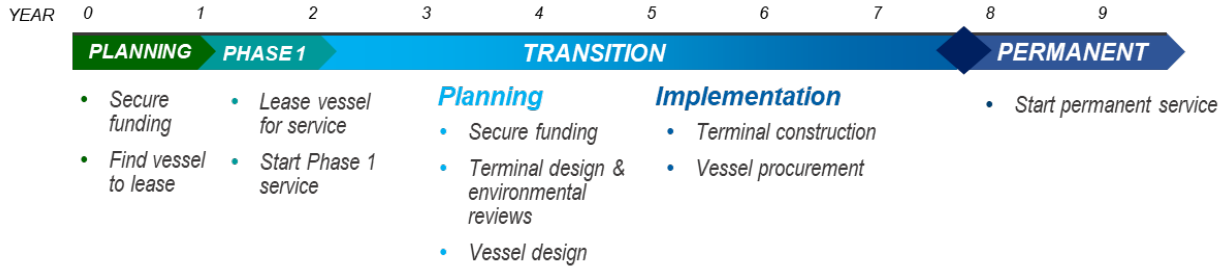
locations for Water Taxi expansion from the Port of Seattle[32] and City of Kenmore[33], however, as discussed in section V.A of this report, the UW does not support service to and from the UW WAC at this time.

Implementation Readiness

The Kenmore route currently faces many challenges to implementation, primarily the lack of a UW support. Without the UW WAC site, no suitable Seattle-side landing site exists. While Appendix A contains additional implementation readiness considerations for the Kenmore route, given the UW's opinion that the UW WAC is not an appropriate location for a Water Taxi landing, and it does not support continued planning, there is currently no clear implementation pathway for a Kenmore route

The Ballard route has fewer challenges to implementation relative to the Kenmore route. Appendix B details the next steps for a phased approach to implementation readiness of the Ballard expansion route. An initial phase route would require minimal capital improvements at the landing sites, and a leased vessel could be used during a two-year period. This strategy would require funding and the proper environmental and permitting approvals to be in place. Figure 9 shows a potential timeline for this phased approach toward permanent service for the Ballard route. Further implementation readiness work cannot move forward without dedicated funding for route implementation in place.

Figure 9: Potential timeline for implementation of a Ballard expansion route



[32] King County. (2020). Implementation of a Ballard-to-downtown Seattle Water Taxi Route Proviso Response. Page 11.

[33] King County. (2020). Implementation of a Kenmore Water Taxi Route Proviso Response. Page 13.

VI. Conclusion/Next Actions

This report provides analysis of planning and implementation of Kenmore and Ballard expansion Water Taxi routes. Key technical components detailed in this report and the Appendices include shoreside preliminary design, route planning, equipment specification, preliminary capital and operating budgets, and other details necessary to prepare for implementation of the routes by the Council.

Without the University of Washington's partnership, the Kenmore expansion route currently has no clear pathway to implementation. Without a landing at the UW WAC, a Kenmore Water Taxi expansion route is not be feasible, as the other Seattle landings previously studied are not time competitive and have less favorable ridership projections (such as Leschi and Madison Park) [34].

Implementation of a Ballard expansion route has a clearer path. This report details how a phased approach to implementation can be achieved should funding be programmed.

Current Metro policies, such as the Service Guidelines, Metro Connects, and the Strategic Plan, guide investment priorities in support of a regional mobility network and to better advance equity and environmental sustainability through Metro's operations and service growth. While the implementation of a Kenmore or Ballard Water Taxi route would advance King County goals of providing access to public transportation and help reduce greenhouse gas emissions in the region, this proviso response does not include how implementation of these routes would be prioritized across all King County Metro public transportation services.

VII. Appendices

Appendix A: Kenmore Water Taxi Implementation
Appendix B: Ballard Water Taxi Implementation
Appendix C: Water Taxi Expansion Propulsion Analysis
Appendix D: Equity Impact Review

[34] King County. (2020). Implementation of a Kenmore Water Taxi Route Proviso Response. Page 7.

Final Water Taxi Expansion Progress Report

Appendix A

Kenmore Water Taxi Implementation

Kenmore Water Taxi Implementation

Landing Sites

- The University of Washington (UW) is not supportive of a landing site at UW WAC
- Lease/use agreement coordination needed with the Lakepointe property owner

Regulatory Approvals

Coordination with federal, state, and local agencies to confirm required approvals and process.

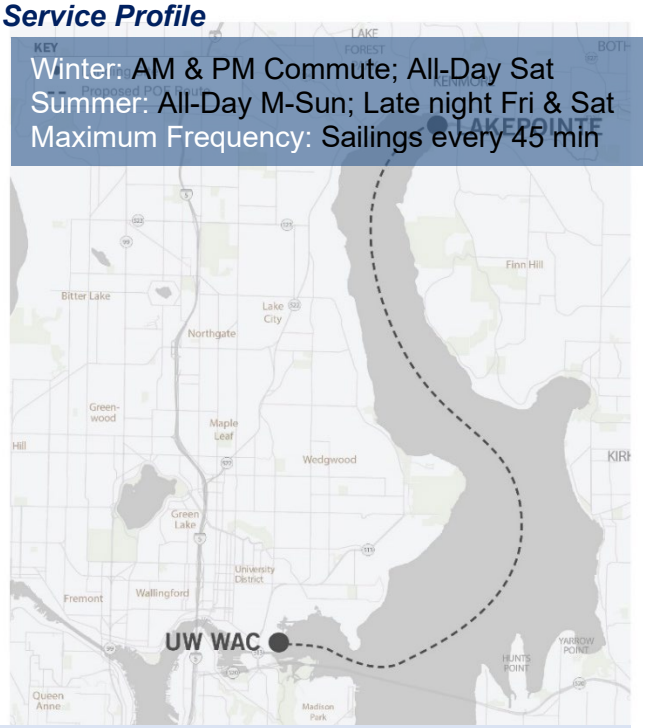
Environmental Studies

The following studies would be needed:

- Analysis of vessel wake, existing wind-wave climate, and sediment transport
- Review of existing shoreline structures to determine tolerance for vessel wake wash
- Biological evaluation

Service Profile

Winter: AM & PM Commute; All-Day Sat
Summer: All-Day M-Sun; Late night Fri & Sat
Maximum Frequency: Sailings every 45 min



Capital Investments

LAKEPOINTE LANDING	Construct improvements including: a new service float, gangway/ramp, utility connections (power, water, and sewer), gravel parking lot, passenger drop-off lane, and electrification infrastructure (capacitors, energy storage system). Plan for potential revisions should property redevelopment occur
MAINTENANCE FACILITY - LAKEPOINTE	Construct a new maintenance float, add a small maintenance shop to the float
UW WAC LANDING	A new service float would be needed, but the UW is currently an unwilling partner
VESSELS	Design and procure three new 150-passenger hybrid-electric vessels

First/Last-Mile Connections

- Fixed route connections via Metro Connects planned routes 1215 and 3114 (existing routes 331 and 225) to serve the Lakepointe landing site entrance at SR 522. Additional funding would be needed to operate at planned fixed-route service levels.
- On-site parking lot for 150 vehicles at the Lakepointe landing site

Expected Timeline

OPERATIONS: [PROGRAMMING ASSUMPTIONS AND COSTS]

To develop operating costs for Kenmore Water Taxi service and determine the extent of capital investment, the team developed a service schedule for Water Taxi service. This included evaluating connecting Metro bus service and identifying where expansion of bus service would be necessary to connect to a Kenmore Water Taxi landing.

The Water Taxi service schedule and the bus service expansion schedules are summarized in the following sections that provide the basis for the operating cost model.

Water Taxi Service Schedule

Due to the length of the route, and to meet service level guidelines (hourly frequency), the Kenmore route would require two operating vessels in both the winter and summer months. With two vessels providing service, sailings could depart as frequently as every 40 minutes.

The lower demand Kenmore winter schedule was designed to primarily serve the weekly commute periods with at least three round trips in the AM peak (6 a.m. –9 a.m.) and three round trips in the PM peak (4 p.m.–7 p.m.). One additional commute round trip before the AM commute period was added to serve school and hospital employees that work in the UW area with early shift start times. This was in response to feedback received in previous engagement efforts for Metro's North Link Connections Mobility Project. The winter schedule would also include Saturday service to help meet the needs of non-traditional workers and potential recreational ridership.

The summer schedule would provide all-day service every day of the week, expanded from the winter schedule to include mid-day and Sundays to meet anticipated recreational ridership demand. Late evening service would be added to the schedule on Friday and Saturday nights to further support recreational and discretionary riders.

Special event service to UW was assumed for ten days out of the year during the winter service schedule for events such as football games. The extended summer service schedule is assumed sufficient to cover service needs for any special events in that season.

Table 1: Kenmore Service Schedule Summary

	Winter	Summer
Vessel Passenger Capacity	150 passengers	150 passengers
Operating Vessels	2 vessels	2 vessels
Backup Vessels	1 vessel	1 vessel
Maximum Service Frequency	40-minute headway	40-minute headway
Commute Service	11 RTs per day: • 6 RTs in the AM peak • 5 RTs in the PM peak	21 RTs per day Mon-Thurs: • 6 RTs in the AM peak • 5 RTs in the PM peak • Mid-day service (10 RTs) 26 RTs per day Fridays: • Additional late night Friday service (5RTs)
Saturday Service	• 18 RTs per day	• 21 RTs per day • Late night service (3 RTs)
Sunday Service	No service	• 18 RTs per day
Special Events	10 per year	None; extended service schedule assumed to cover special events

Note: Round Trips are abbreviated as “RTs.”

Current Network Understanding

Water Taxi service expansion can complement and provide opportunity to revise the current transit and multimodal network.

Lakepointe Landing Site

Kenmore is currently served by local and peak-only Metro services as well as Sound Transit services. Improvements would be needed if transit was to be routed to serve the terminal itself versus serving stops along existing routing. The transit and bicycle network near the potential Lakepointe landing site is shown in Figure 1. Routes, including frequencies and spans, are shown in Table 2.

Table 2: Transit Routes* Near the Potential Lakepointe Landing Site

Route	Connections	Frequency*	Span
225	Kenmore P&R – Kingsgate P&R – Totem Lake TC – Lake Washington Technical Institute – Redmond Technology Station	30 minutes	All Day
320	Kenmore P&R – Lake City – Northgate Station – South Lake Union	Nine AM peak trips, eight PM peak trips	Peak Only
322	Kenmore P&R – Lake City – Roosevelt Station – First Hill	Seven AM peak trips, ten PM peak trips	Peak Only
331	Kenmore P&R – Lake Forest Park – Aurora Village TC – Shoreline CC	20 minutes during the peak, 30 minutes during the day	All Day
342	Aurora Village TC – Lake Forest Park – Kenmore – Bothell – Woodinville – I-405 corridor – Renton TC	Four AM peak trips, four PM peak trips	Peak Only
372	UW Bothell – Bothell P&R – Kenmore P&R – Lake City – UW Seattle – U District Station	5-15 minutes during the peak, 15 minutes during the day	All Day
ST 522	Woodinville P&R – UW Bothell – Kenmore P&R – Lake City – Roosevelt Station	15 minutes during the peak, 20 minutes during the day	All Day

*This represents the routes and frequency of trips for the Fall 2021 service change.

Routes 320 and 322 were implemented as part of the North Link Connections Mobility Project in Fall 2021. Other routes in or connections around Kenmore may also be impacted by the ongoing East Link Connections Mobility Project, including Route 342. Any changes from the East Link project would be implemented in 2024.

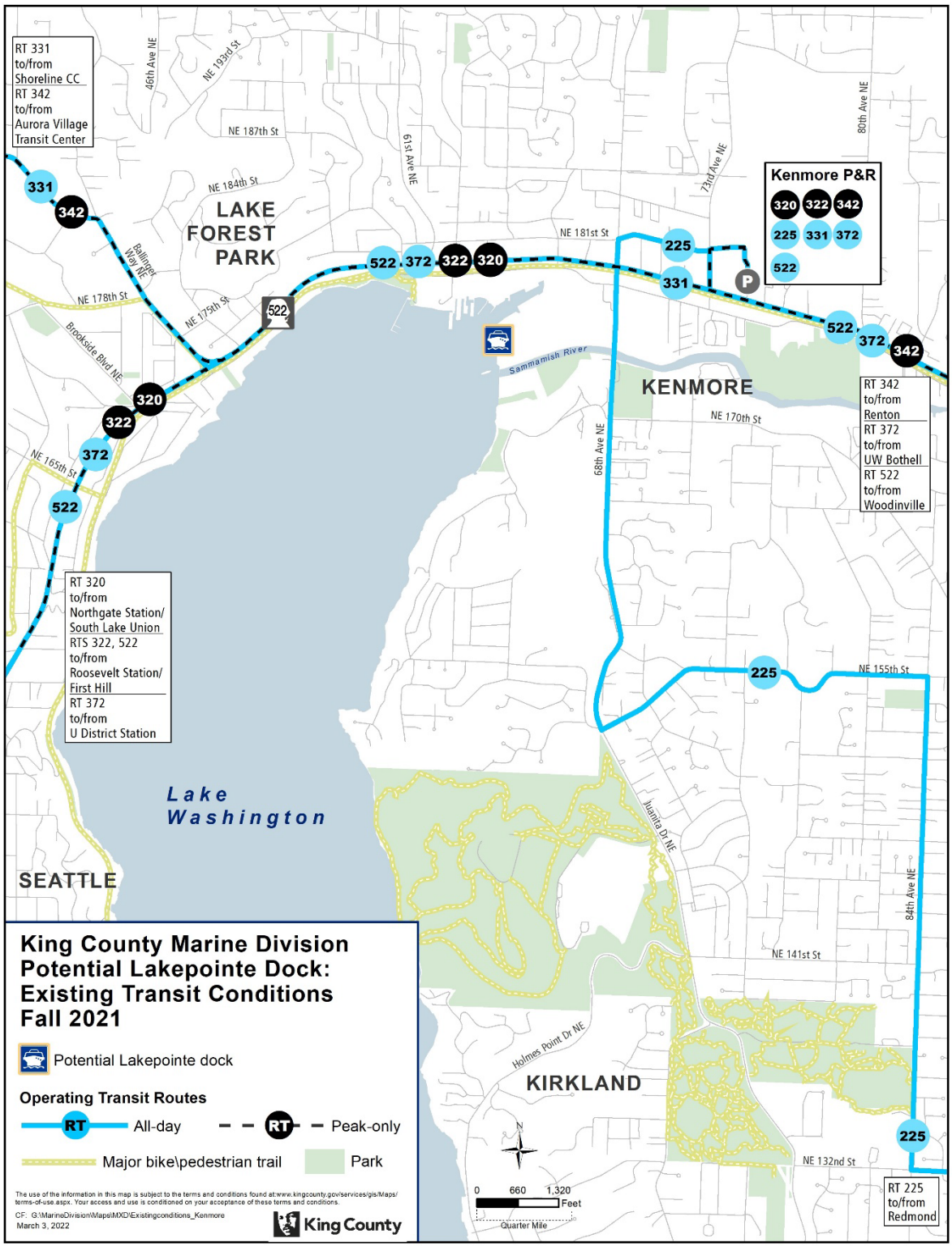


Figure 1: Existing Transit and Bicycle Connections Near the Potential Lakepointe Landing Site

Sound Transit plans to implement Stride BRT along the SR-522 corridor between Bothell and the Shoreline South/148th Link light rail Station after the Lynnwood Link extension is complete. This would replace existing ST Route 522, which operates between Woodinville and Roosevelt Station, connecting to both BRT services on I-405 and Link light rail in Shoreline. Metro's Metro Connects interim network also envisions frequency and span improvements on existing routes, in addition to other network changes. Based on these improvements, the PSRC's Vision 2050 regional planning document identifies Kenmore and Bothell areas as high-capacity transit communities that are considered hubs for employment and population growth.

There are multiple Metro park-and-rides, both Metro owned and leased lots, in the vicinity of the Lakepointe landing site. Table 3 details the permanent Metro park and rides in the area. The future of any existing leased park-and-ride lots are dependent on property owner and Metro needs. The closest permanent park-and-ride, the Kenmore Park-and-Ride, is shown in Figure 1. The figures for 2021 represent the average utilization through the second quarter of the year.

Table 3: Metro Managed Permanent Park and Rides Near the Lakepointe Landing Site

Metro-managed permanent P&R Lot	Owner	Total Spaces	2019 Average Utilization	Q2 2021 Average Utilization	Located within 1/2-mile of potential landing site?
Bothell P&R	KC	220	89%	11%	No
Brickyard Road P&R	WSDOT	443	84%	12%	No
Kenmore P&R*	KC	603	92%	8%	Yes
Woodinville P&R	WSDOT	438	53%	6%	No

*A transit-oriented development is planned next to the existing Kenmore P&R, which would add parking stalls.

The Burke-Gilman Trail follows the Lake Washington shoreline to the west and south of the site as shown in Figure 3. To the east is the Sammamish River Trails along the Sammamish River. Together, the two well-established trails offer extensive paved, flat, separated access for long distances. Both can be considered all ages and abilities facilities.

Access from the north is limited and requires crossing multi-lane, high traffic NE Bothell Way/SR-522. The nearest signalized crossing of SR522 to the site is at 68th Avenue NE. A signal is in place on 68th Avenue NE and NE 175th Street for access from the east.

The Lakepointe landing site is in an industrial area with limited to no pedestrian or bike infrastructure on the site itself or from the site to SR-522. The site is adjacent to the Kenmore Air Harbor, an asphalt manufacturing plant, and a concrete mix plant and landscaping supply company.

To the south toward Kirkland, there is no sidewalk or bike lane on 68th Avenue NE over the bridge crossing the Sammamish River. A sidewalk begins on the west side of 68th Avenue NE south of the bridge. Several other roadways to the southwest have marked bike lanes, though moderate to considerable grades. These facilities are likely to be comfortable only for people confident cycling with traffic. The City of Kenmore has planned improvements to bike and walk infrastructure in 2022 as part of the Walkways and Waterways bond and other future improvements outlined in the Pedestrian and Bicycle Safety Strategy. Neighboring cities,

including Bothell and Kirkland, also have planned improvements to their bike and walk infrastructure.

UW WAC Landing Site

The UW WAC landing site is adjacent to Husky Stadium, within a ¼ mile walk to the University of Washington Link light rail Station and Montlake Boulevard NE and NE Pacific Street with frequent transit service. The transit and bicycle network near the potential landing site at UW WAC is shown in Figure 2. Routes, including frequencies and spans, are shown in Table 4. Only routes that operate along NE Pacific Street and Montlake Boulevard NE are included in the figure and table. There are other routes which operate further from the UW WAC landing site along West Stevens Way NE and NE 45th Street.

Table 4: Transit Routes Near the Potential UW WAC Landing Site (Fall 2021)

Route	Connections	Frequency*	Span
43	University District – Montlake – Capitol Hill – Downtown Seattle	21 AM peak trips (14 northbound, seven southbound), 17 PM peak trips (four northbound, 13 southbound)	Peak Only
44	Ballard – Wallingford – University of Washington Station	10 minutes during the peak, 12 minutes during the day	All Day
48	Mt. Baker TC – Central District – Montlake – University District	12 minutes during the peak, 15 minutes during the day	All Day
65	Jackson Park – Lake City – University District*	15 minutes all day	All Day
73	Jackson Park – Maple Leaf – University of Washington Station	15 minutes during the peak, 30 minutes during the day	All Day
255	Totem Lake TC – Kirkland – University District	6-12 minutes during the peak, 15 minutes during the day	All Day
271	Issaquah – Eastgate – Bellevue College – Bellevue Transit Center – Montlake – University District	10-12 minutes during the peak, 15 minutes during the day	All Day
ST 542	Redmond TC – Evergreen Point – University District	20 minutes during the peak, 30 minutes during the day	All Day

*Route 67 only stops on NE Pacific St/Montlake Blvd NE in the northbound direction.

At the potential UW WAC landing site there is complete sidewalk infrastructure throughout adjacent neighborhoods and a well-established network of separated and marked bike or multiuse trails from all directions to the site, including the Burke-Gilman Trail to the north and west; unpaved trail network northeast of the site through Union Bay Natural Area; and Montlake, Arboretum and Portage Bay neighborhoods. See Figure 4.

Bikes and pedestrians share narrow sidewalks on both sides of Montlake Bridge for riders coming from the south. For connections to Link light rail at the adjacent University of

Washington Station, there are open bike racks and on-demand lockers available. Bikes can also be carried on all Water Taxi vessels, Metro buses, and Link light rail cars.

Figure 2: Existing Transit and Bicycle Connections Near the Potential UW WAC Landing Site

Bus Network Changes

Potential changes to fixed-route Metro bus service were identified to align with new Water Taxi service and were based on the Metro Connects interim network. Connections to and from the Kenmore Park & Ride, SR-522, and the Finn Hill area were prioritized in the proposed changes to ensure riders from different areas would have access opportunities to the Lakepointe landing site, in addition to other Metro or Sound Transit services.

Metro Connects routes 1215, between Shoreline Community College and Kenmore Park & Ride, and 3114, between Redmond and the Kenmore Park & Ride, would be extended from their terminal to serve the Water Taxi as shown in Figure 3. These routes most closely align with existing routes 331 and 225. Cost estimates are based on the route extension matching with the seasonal water taxi service levels, meaning these routes would also extend a number of selected trips to the Lakepointe landing site when the water taxi is operating. Service levels on routes 1215 and 3114 would be higher than the comparable routes in the current network, however, the cost estimates are based on if the Metro Connects network were implemented. The combined frequency of the two routes could be scheduled to provide 30-minute frequency between the landing site and the Kenmore Park-and-Ride. Additional resources would be needed to match planned Metro Connects service levels. The additional operating resources needed for the route extensions to serve the Lakepointe landing site at Metro Connects service levels are shown in Table 5.

The costs shown in Table 5 reflect the full cost to operate service (fully allocated rate) in 2022 which includes operating costs to return to the Park & Ride to continue to use the expected layover and comfort station facilities for these routes.

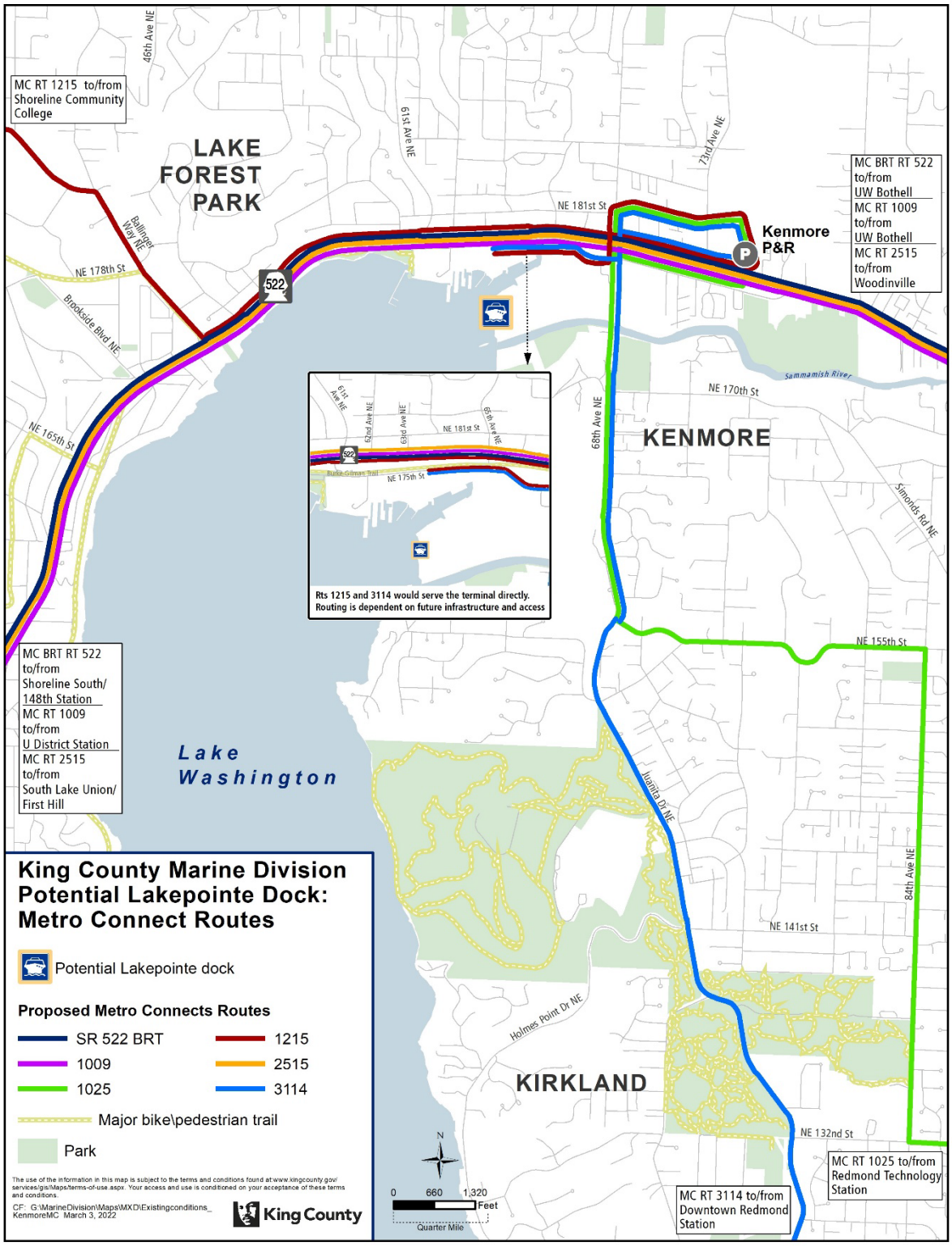


Figure 3: Metro Connects Interim Network and Potential Extension of Metro Connects Routes 1215 and 3114 to Serve the Lakepointe Landing Site

Table 5: Resources to Support Potential Metro Connects Fixed Route Changes at the Lakepointe Landing Site

MC Route	Connections	Frequency		Resources Needed	
		Full Route	To Water Taxi	Annual Hours	2031 Dollars
1215	Shoreline CC - North City - Ballinger Way - Lake Forest Park - Kenmore P&R	15 minutes	30 minutes	1,726	$446,820
3114	Redmond - Education Hill - Totem Lake TC - Juanita - Finn Hill - Kenmore P&R	30 minutes	30 minutes	3,909	$1,012,180
				5,635	*$1,459,000*

Due to the existing proximity of the UW WAC landing site to the UW Link Light Rail Station and multiple frequent transit connections in the Metro Connects interim network, there are no proposed network changes near this terminal.

Bike and Pedestrian Connections

The Lakepointe landing site would require improved bike and pedestrian connections on-site and to the west and the north, including across SR-522. Because the neighboring businesses are industrial in nature, Metro and partners would need to balance freight, pedestrian, and bike safety in the area if implementation occurs without redevelopment of the adjacent land use. No improvements are included in the capital costs at this time however as redevelopment of the area around the terminal progresses, multimodal connections should be included in the redevelopment plans.

Metro would need to coordinate with the City of Kenmore, the City of Seattle, and the UW on any necessary improvements for bike and pedestrian access outside the terminal locations.

Operating Cost Model

Annual operating costs were developed based on the service levels resulting from the representative service schedule and include estimates for vessel and terminal labor, maintenance, and energy/fuel costs. Operating costs for bus network changes are also provided. The following sections outline the assumptions used to develop the operating cost model.

VESSEL LABOR

The service schedule was used to determine overall labor hours required to operate the vessel including crew members and vessel maintenance crew. Key assumptions in calculations include:

- Three crew members included one captain, one senior deckhand, and one purser deckhand to operate each vessel.
- Vessel maintenance crew included two engineers and two oilers to meet maintenance labor requirements.
- Labor hours were based on operating hours plus 45 minutes of startup and tie-up time before and after service

- Labor costs were based on labor rates, benefits, and overhead costs from 2021.

VESSEL MAINTENANCE

Three categories of vessel maintenance activities were assumed for the operating cost estimate: routine/preventative maintenance, annual drydocking, and an estimate of unplanned maintenance. Costs were modeled for maintenance-specific labor costs, costs of materials, and other ancillary costs. Key assumptions used for estimating vessel maintenance costs include:

- Routine (or preventative) maintenance was calculated as a percentage of vessel operating hours and included routine/preventative machinery maintenance along with materials and ancillary costs.
- Annual maintenance costs included an assumed annual cost for vessel drydocks and hull/out-of-water maintenance that accounts for included labor, materials, and ancillary costs.
- Unplanned maintenance costs included unplanned or unexpected machinery failures.

ENERGY COSTS: FUEL, ELECTRICITY

The cost model calculated energy costs as a combination of fuel costs and electricity costs. Electrical power was assumed for when the vessel was at the dock and when traversing the slowdown area near Webster Point. Diesel fuel was assumed to power all other portions of the route.

- Fuel cost per gallon was based on Northlake Marina's 2021 cost of fuel.
- Fuel usage of the hybrid vessel assumed that diesel engines are turned off and unused for maneuvering, slow-down zones, and idling at the dock, when the vessel would be running exclusively on electric batteries. Diesel fuel use was assumed for the high-speed portion of the route.
- Estimates for vessel fuel usage were based on data from All American Marine for a 150-passenger vessel. Two 750-gallon fuel tanks were assumed per vessel.
- Electricity costs were calculated using Puget Sound Energy's fee schedule.

LANDING SITE OPERATIONS AND MAINTENANCE

The following assumptions were used to estimate landing site operations and maintenance costs for new Lakepointe and UW WAC landings.

- Assumed landing site operations costs include routine landing site maintenance, landing site lease, and fare collection (via Ticket Vending Machine).
- One new information agent was assumed to support Kenmore landing site operations part time in the winter and two information agents in the summer season.
- No information agent was assumed for the UW WAC landing.

ADMINISTRATIVE COSTS

The estimate also includes the following administrative and overhead costs associated with new Water Taxi service.

- Additional full time management staff person to support service expansion.
- Liability insurance and miscellaneous administrative costs were calculated as a percentage of total operating costs.

BUS NETWORK CHANGES

Operating cost estimates for bus network changes are based on the bus route extension matching with the seasonal Water Taxi service levels, meaning these routes would also extend to the Lakepointe landing site when the Water Taxi is operating. Service levels on routes 1215 and 3114 are higher than the comparable routes in the current network. However, the modeled

operating cost estimates are based on if a select number of trips on each route are extended to the Lakepointe landing site. The cost model does not reflect additional roadway or stop improvements that may be needed to support these revisions. More detailed evaluation of these potential capital needs would need to be developed if this concept is moved forward into design.

Operating Cost Summary

Based on the assumptions described in the operating cost model section, estimated operating costs for a Kenmore Water Taxi route are **$11.9 million annually** or **$1,567 per vessel operating hour**. These costs are in $2031 dollars and assume that the route begins operating in 2031. Figure 4 depicts the distribution of operating costs by vessel, landing site and administrative costs.

Category	*Cost*
Vessel	$ 6,912,000
Terminal	$ 1,636,000
Network Expansions	$ 1,459,000
Administration/Support	$ 1,895,000
Total	**$ 11,902,000**

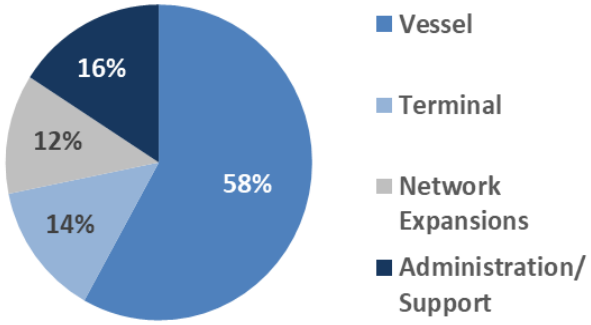


Figure 4: Estimated Operating Costs Distributed by Category

CAPITAL NEEDS

To implement new Water Taxi service, capital investment would be required. Capital needs for Kenmore Water Taxi service fall into four main categories: landings, vessels, electrification infrastructure, and a maintenance location. Additional capital investment beyond these four categories may be needed to support landside transit connections. As part of identifying the capital needs for a Kenmore Water Taxi route, Metro met with property owners and interested parties to receive feedback on a potential ferry landing. The following sections summarize capital needs for each landing site and information received from outreach to date.

Landings

Options for landing locations for this route have been studied extensively by the Marine Division in both the 2015 Expansion Options Report and the 2020 Proviso efforts. The Lakepointe facility was the preferred location for the City of Kenmore and was selected based on the opportunities to construct access improvements, such as passenger and bicycle parking and a shuttle drop-off lane, and sufficient in-water space to support a maintenance facility.

Based on ridership forecasts and transit connectivity findings regarding multiple sites in both the 2015 and 2020 efforts, the UW WAC was identified as the only viable landing site on the Seattle end of the route moved forward to this proviso and considered for Water Taxi service.

This study did not revisit the site selection process. Instead, sites selected in the 2020 Proviso effort were carried forward for this work. Additional information regarding site selection can be

found in the *Report on Implementation of a Kenmore Water Taxi Route* prepared by the Marine Division in response to King County Council Ordinance 18835.

The following sections outline the capital infrastructure needs required at the Lakepointe and the UW WAC sites to support a Kenmore to Seattle Water Taxi route.

LAKEPOINTE

The Lakepointe development site is located along the north shore of Lake Washington where the Sammamish River enters Lake Washington. The property is currently undeveloped and is adjacent to a gravel storage yard and near Kenmore Air. The site has been slated for multi-use development for many years and remains in the feasibility and master planning phase. Should redevelopment plans advance, considerations for this potential expansion route should be included.

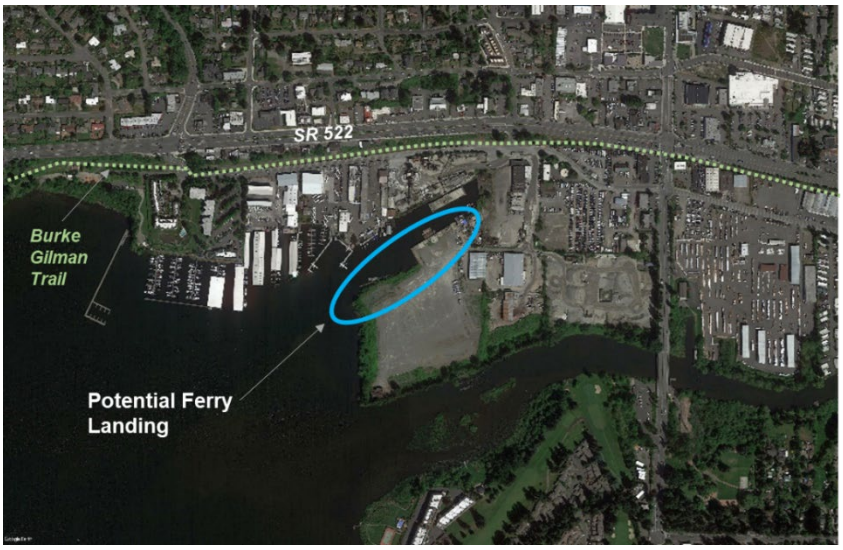


Figure 5: Aerial View of the Lakepointe Property (Google Earth)

Partner Engagement Status

The City of Kenmore has continued to express interest in the potential expansion route. The City has helped connect the Marine Division with the Lakepointe property owner, shared the current understanding of the potential redevelopment of the property, and has collaborated with the owner to ensure all parties remain informed. In February 2022, King County Metro delivered a presentation to the Kenmore City Council providing an update on the status of the current proviso. The Council expressed continued support for the project and the Lakepointe location.

Water Taxi Landing Concept

Designated as the preferred landing site in the previous 2020 proviso, the Lakepointe site was programmed to include a new service float, a maintenance float/facility, and a parking lot. During this proviso effort, the main elements were maintained, with design efforts focusing on adding detail to the layout and identifying new infrastructure to provide the needed electricity to support the hybrid electric service profile. The infrastructure necessary to support ferry service is illustrated in the attached drawing set and includes the following:

$31.5 M
Lakepointe Capital Cost

- In-water and Overwater Infrastructure
  - New service float w/ associated gangway and ramp
  - New maintenance float w/ associated gangway
  - Conex box located on the maintenance float for maintenance shop and equipment storage
  - Conex box located on the maintenance float for crew lockers, break room, and restroom
- Uplands Infrastructure

- Gravel parking lot for up to 150 stalls
- Paved ADA parking stalls
- Passenger drop-off lane
- Bike lockers
- Ticket Vending Machines (TVMs)
- Covered passenger shelter
- Crew parking (12 stalls)
- Improved access road with bike and pedestrian improvements
- Sewer, water, and electrical utility connections

Electrification Improvements

This route would be served by hybrid-electric vessels that would require electrical power to charge their batteries. Vessel charging would occur at the Lakepointe facility for each roundtrip. Charging infrastructure will be sufficient to provide the roundtrip hybrid-electric operations. That equipment includes:

- Shoreside energy storage system (ESS)
- Batteries
- Inverters
- Filters
- Switchboards
- Transformers
- Rapid Charging System (RCS)
- Shore power outlet
- Two outlet feeders
- Autonomous, laser-guided, cable reel system to connect the vessel electrical system to the shore power outlet

Costs

Capital costs for the Lakepointe facility are estimated to be $31.5 million. These costs include electrification and maintenance improvements, along with the full Water Taxi landing concept outlined in this section.

UW WAC

The University of Washington Waterfront Activities Center (UW WAC) is located along Union Bay near UW Stadium and the UW Link Light Rail Station.

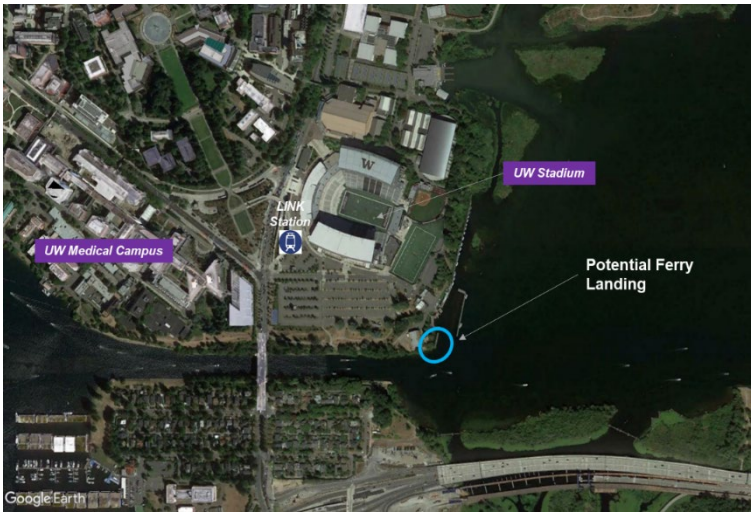


Figure 6: Aerial View of the UW WAC and Surrounding Area (Google Earth)

Partner Engagement Status

In previous proviso efforts, the University of Washington raised concerns with the Kenmore Water Taxi route landing at the UW WAC location including potential conflicts with Water Taxi service and the crew team that practice in the area as well as other recreational boaters currently using the UW WAC facility. Previous provisos acknowledged these concerns, citing that additional

coordination with the University would be needed to address these items. Also mentioned was that the Marine Division uses highly trained and skilled professional mariners, sophisticated radar equipment, and implements operational protocols to minimize the risk of any conflicts between the Water Taxi and other users of the waterway.

For this proviso, Metro reached out to the University Office of Regional & Community Relations to continue discussions about a potential Water Taxi landing at UW WAC. In response, UW expressed that in their opinion the UW WAC is not an appropriate location for a Water Taxi landing, and they cannot support continued planning efforts for this location. Without a Water Taxi landing at the UW WAC, a Kenmore Water Taxi route will not be feasible as other Seattle landings such as Leschi and Madison Park are not time competitive and have less favorable ridership projections.

Water Taxi Landing Concept

If the UW was amenable to a Water Taxi landing at UW WAC, the existing float would need to be replaced with a new float to support service. The new float could be of a similar size and orientation to the current float or could be larger and support docking on both sides. The larger float concept would have a raised gangway to allow canoers and kayakers to travel underneath it, minimizing conflicts with Water Taxi vessels while in the dock. The larger concept was preferred and is depicted in the following figure. Renderings to provide a visual framework are attached.

$11.8 M
UW WAC Capital Cost

Key improvements include:

- In-water and Overwater Infrastructure
  - New service float w/ associated raised gangway and ramp
- Uplands Infrastructure
  - Ticket Vending Machines (TVMs)
  - Covered Passenger Shelter (optional)

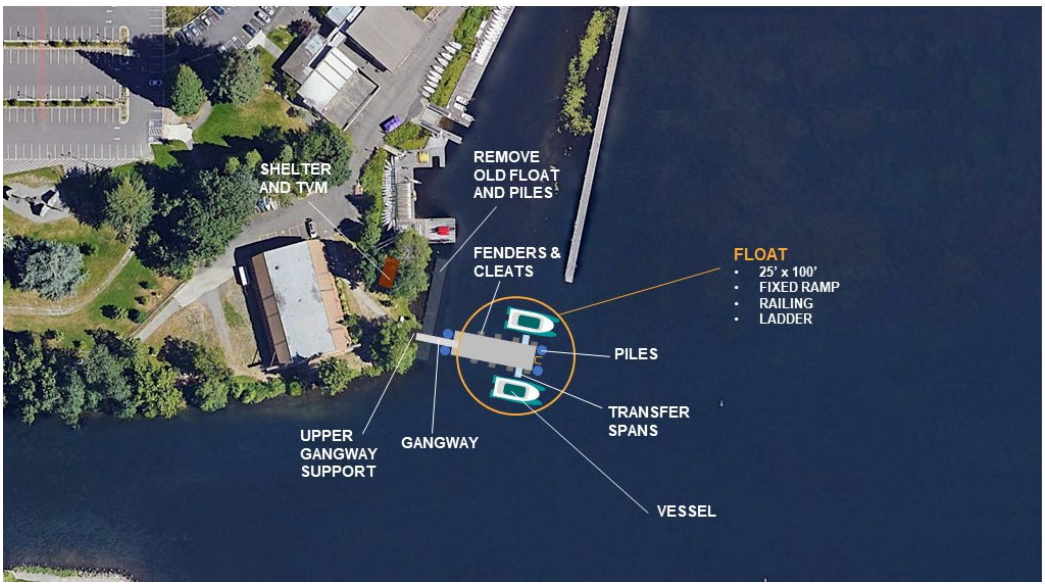


Figure 7: UW WAC Concept From 2020 Proviso

Electrification
Hybrid electric vessel propulsion would serve this route and charging would occur at the Lakepointe site. To minimize physical and visual impact, no vessel charging or electrification infrastructure would be located at the UW WAC landing.

Costs
The costs for the concept prepared for the 2020 Proviso were updated based upon inflation and updated market conditions. Capital costs for the in-water and uplands infrastructure are estimated to be approximately $11.8 million.

Vessels
Three 150-passenger hybrid-electric vessels are assumed for this route. Two vessels would be needed to deliver service, with one backup or reserve vessel. The estimated cost of the three vessels is approximately $30.5 million.

The hybrid-electric vessels would have both diesel engines and electric motors powered by electric batteries and be able to transition to future emissions technologies when they become more readily available.

$30.5 M
Vessel Capital Cost

This propulsion type was selected based on the propulsion analysis conducted in the earlier phases of this work. More information regarding the propulsion analysis is provided in Appendix C.

Outreach to Date
Throughout the course of the propulsion analysis conducted during the interim report, vessel manufacturers and designers were contacted regarding the how various propulsion infrastructures would impact vessel design requirements.

Electrification Improvements
The Water Taxi route would operate with a hybrid electric vessel that requires a shoreside energy storage system (ESS). This ESS would consist of batteries, inverters, filters, switchboards, and transformers. The ESS system was selected because it significantly reduces the utility demand because the shoreside batteries could charge over the approximately 35-minute time between the departure of one vessel and the arrival of the next. By using the ESS, a smaller amount of power would be drawn from the grid over the longer 35-minute charging time as opposed to a higher demand spike over the 7-minute dwell time used for vessel charging.

To meet international shore power standards, the shore power infrastructure would be rated for 11kV and charge the vessel via two parallel feeders from a single shore power outlet. Due to the short dwell time, the shore power outlet would need to be physically connected to the vessel electrical system via an autonomous, laser-guided, cable reel system. Charging of vessel batteries and all charging infrastructure would be located at the Lakepointe facility.

GREENHOUSE GAS IMPACTS
Hybrid operation of this route and the associated decrease in greenhouse gases aligns with King County Metro's climate and sustainability goals. King County's Strategic Climate Action Plan (SCAP) is a five-year blueprint for County climate action, integrating climate change into all areas of County operations. The core sections of the SCAP include reducing greenhouse gas

(GHG) emissions, sustainable and resilient frontline communities, and preparing for climate changes. By operating portions of the route on electric power, the hybrid service would decrease fuel usage and could result in a greenhouse gas emissions savings of approximately 16% per trip. These savings are summarized in the table below.

	Gallons of Fuel	*Emissions per Gallon of Fuel (kg)*	*Emissions Estimate (kg)*
Full Diesel	77.5	10.19	790
Hybrid	64.8	10.19	660
Savings	**12.7 gal**		**129 kg**

When exploring future conversion from hybrid propulsion to future technology, Metro would work to transition to propulsion options that result in zero emissions as soon as it is feasible.

Outreach to Date
The local electrical utilities with jurisdiction Kenmore and Seattle (Puget Sound Energy and Seattle City Light, respectively) were consulted about the current electrical infrastructure near the landing sites, the overall grid system capacity, and their input on supplying power to a hybrid-electric ferry route. Both utility providers indicated willingness to support a Water Taxi route and provided useful feedback on the potential grid improvements needed to support the electricity needs of the hybrid ferry.

Based on the outreach, the Lakepointe site was identified as the best suited for charging infrastructure. A shoreside ESS with landside batteries would be provided. The batteries would trickle charge from the grid when the vessels were not docked and would then rapidly discharge into the vessel batteries during the vessel dwell time. This trickle-charge method would prevent high demand spikes on the PSE grid during the short dwell time window for vessel charging (seven minutes).

Maintenance Location
Routine and preventative maintenance activities are assumed to occur at a new maintenance facility that will be constructed at the Lakepointe landing location. The new facility would include a small maintenance shop, dedicated maintenance float, and crew locker room with crew restrooms.

Outreach to Date
Maintenance improvements were discussed with the City of Kenmore in conjunction with the landing site improvements due to the maintenance facility being co-located with the Water Taxi landing in this instance.

Capital Costs Summary
Capital costs including vessels and landings would be approximately $73.8 million. These costs include landings, vessels, electrification infrastructure, and a maintenance facility and are summarized below.

$31.5M Lakepointe Landing *including electrification & maintenance improvements*	$11.8M UW WAC Landing	$30.5M Vessels	**$73.8M** **TOTAL**

FINANCIAL PLAN

Kenmore to Seattle POF service requires capital investment and a sustainable funding source to support operating costs. Capital investments can be funded through a combination of grants, local sources, and debt service. The Marine Division has been successful in obtaining federal and state grants for their capital investments and will continue to seek all grant funding opportunities.

The capital investment and ongoing operating costs for a new Kenmore POF route have been calculated using high level estimates, based on the timing of implementation and including an annual inflation rate. The estimates are subject to change based on further detailed planning, partnership agreements, and the timing of funds being secured to support the service.

Examples of twenty-year financial plans are provided in Figure 8. The plans list the vessels and terminal capital investments, the operating costs by category and the debt service costs. The revenue is broken down by funding type. The ending fund balance is the difference between the total revenues and total expenses. The first financial plan reflects capital costs being fully bonded at $74 million. The second financial plan shows the capital costs are funded by $52 million in bonds and $22 million in grants/other.

Kenmore Route Financial Plan

(Based on $74M Bonds)

$$ in Millions	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Vessels	$ -	$ -	$ -	$ -	$ 1.45	$ 13.03	$ 15.93	$ -	$ -	$ -
Terminals	$ -	$ 2.02	$ 2.02	$ 4.03	$ 13.22	$ 13.22	$ 8.81	$ -	$ -	$ -
Total Capital	$ -	$ 2.02	$ 2.02	$ 4.03	$ 14.67	$ 26.25	$ 24.74	$ -	$ -	$ -
Vessel Operations	$ -	$ -	$ -	$ -	$ -	$ -	$ 6.91	$ 7.12	$ 7.33	$ 7.55
Terminal Operations	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.64	$ 1.69	$ 1.74	$ 1.79
Bus Network Extensions	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.46	$ 1.50	$ 1.55	$ 1.59
Management/ Administrative Overhead	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.89	$ 1.95	$ 2.01	$ 2.07
Total Operating	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.90	$ 12.26	$ 12.63	$ 13.00
Debt Service ($74M)	$ -	$ 0.64	$ 0.64	$ 0.64	$ 5.13	$ 5.13	$ 5.13	$ 5.13	$ 5.13	$ 5.13
Total Expenses	$ -	$ 2.66	$ 2.66	$ 4.67	$ 19.80	$ 31.38	$ 41.77	$ 17.39	$ 17.76	$ 18.13
Bonds	$ 8.00	$ -	$ -	$ 66.00	$ -	$ -	$ -	$ -	$ -	$ -
Grants/Other	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Property Tax Levy	$ -	$ -	$ -	$ -	$ 14.42	$ 14.71	$ 15.01	$ 15.32	$ 15.63	$ 15.95
Fare Revenue	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.19	$ 1.32	$ 1.46	$ 1.59
Total Revenue	$ 8.00	$ -	$ -	$ 66.00	$ 14.42	$ 14.71	$ 16.20	$ 16.64	$ 17.09	$ 17.54
Fund Balance	$ 8.00	$ 5.34	$ 2.68	$ 64.01	$ 58.63	$ 41.96	$ 16.39	$ 15.64	$ 14.97	$ 14.38

$$ in Millions	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Vessels	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Terminals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Vessel Operations	$ 7.78	$ 8.01	$ 8.25	$ 8.50	$ 8.76	$ 9.02	$ 9.29	$ 9.57	$ 9.86	$ 10.15
Terminal Operations	$ 1.84	$ 1.90	$ 1.95	$ 2.01	$ 2.07	$ 2.13	$ 2.20	$ 2.26	$ 2.33	$ 2.40
Bus Network Extensions	$ 1.64	$ 1.69	$ 1.74	$ 1.79	$ 1.85	$ 1.90	$ 1.96	$ 2.02	$ 2.08	$ 2.14
Management/ Administrative Overhead	$ 2.13	$ 2.20	$ 2.26	$ 2.33	$ 2.40	$ 2.47	$ 2.55	$ 2.62	$ 2.70	$ 2.78
Total Operating	$ 13.39	$ 13.80	$ 14.20	$ 14.63	$ 15.08	$ 15.52	$ 16.00	$ 16.47	$ 16.97	$ 17.47
Debt Service ($74M)	$ 5.13	$ 5.13	$ 5.13	$ 5.13	$ 5.13	$ 5.13	$ 5.13	$ 5.13	$ 5.13	$ 5.13
Total Expenses	$ 18.52	$ 18.93	$ 19.33	$ 19.76	$ 20.21	$ 20.65	$ 21.13	$ 21.60	$ 22.10	$ 22.60
Bonds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Grants/Other	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Property Tax Levy	$ 16.27	$ 16.60	$ 16.94	$ 17.29	$ 17.64	$ 18.00	$ 18.36	$ 18.74	$ 19.12	$ 19.51
Fare Revenue	$ 1.73	$ 1.92	$ 2.05	$ 2.10	$ 2.16	$ 2.22	$ 2.34	$ 2.40	$ 2.46	$ 2.51
Total Revenue	$ 18.00	$ 18.52	$ 18.99	$ 19.39	$ 19.80	$ 20.22	$ 20.70	$ 21.14	$ 21.58	$ 22.02
Fund Balance	$ 13.86	$ 13.45	$ 13.11	$ 12.74	$ 12.33	$ 11.90	$ 11.47	$ 11.01	$ 10.49	$ 9.91

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Kenmore Route Financial Plan

(Based on $52M Bonds)

$$ in Millions	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Vessels	$ -	$ -	$ -	$ -	$ 1.45	$ 13.03	$ 15.93	$ -	$ -	$ -
Terminals	$ -	$ 2.02	$ 2.02	$ 4.03	$ 13.22	$ 13.22	$ 8.81	$ -	$ -	$ -
Total Capital	$ -	$ 2.02	$ 2.02	$ 4.03	$ 14.67	$ 26.25	$ 24.74	$ -	$ -	$ -
Vessel Operations	$ -	$ -	$ -	$ -	$ -	$ -	$ 6.91	$ 7.12	$ 7.33	$ 7.55
Terminal Operations	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.64	$ 1.69	$ 1.74	$ 1.79
Bus Network Extensions	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.46	$ 1.50	$ 1.55	$ 1.59
Management/ Administrative Overhead	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.89	$ 1.95	$ 2.01	$ 2.07
Total Operating	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.90	$ 12.26	$ 12.63	$ 13.00
Debt Service ($52M)	0	0.32	0.32	0.32	3.59	3.59	3.59	3.59	3.59	3.59
Total Expenses	$ -	$ 2.34	$ 2.34	$ 4.35	$ 18.26	$ 29.84	$ 40.23	$ 15.85	$ 16.22	$ 16.59
Bonds	4.00	0.00	0.00	48.00	0.00	0.00	0.00	0.00	0.00	0.00
Grants/Other	4.00	0.00	0.00	18.00	0.00	0.00	0.00	0.00	0.00	0.00
Property Tax Levy	0.00	0.00	0.00	0.00	13.20	13.47	13.74	14.02	14.31	14.60
Fare Revenue	0.00	0.00	0.00	0.00	0.00	0.00	1.19	1.32	1.46	1.59
Total Revenue	8.00	0.00	0.00	66.00	13.20	13.47	14.93	15.34	15.77	16.19
Fund Balance	$ 8.00	$ 5.66	$ 3.32	$ 64.97	$ 59.91	$ 43.54	$ 18.24	$ 17.73	$ 17.28	$ 16.88

$$ in Millions	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Vessels	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Terminals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Vessel Operations	$ 7.78	$ 8.01	$ 8.25	$ 8.50	$ 8.76	$ 9.02	$ 9.29	$ 9.57	$ 9.86	$ 10.15
Terminal Operations	$ 1.84	$ 1.90	$ 1.95	$ 2.01	$ 2.07	$ 2.13	$ 2.20	$ 2.26	$ 2.33	$ 2.40
Bus Network Extensions	$ 1.64	$ 1.69	$ 1.74	$ 1.79	$ 1.85	$ 1.90	$ 1.96	$ 2.02	$ 2.08	$ 2.14
Management/ Administrative Overhead	$ 2.13	$ 2.20	$ 2.26	$ 2.33	$ 2.40	$ 2.47	$ 2.55	$ 2.62	$ 2.70	$ 2.78
Total Operating	$ 13.39	$ 13.80	$ 14.20	$ 14.63	$ 15.08	$ 15.52	$ 16.00	$ 16.47	$ 16.97	$ 17.47
Debt Service ($52M)	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59	3.59
Total Expenses	$ 16.98	$ 17.39	$ 17.79	$ 18.22	$ 18.67	$ 19.11	$ 19.59	$ 20.06	$ 20.56	$ 21.06
Bonds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grants/Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Property Tax Levy	14.89	15.20	15.51	15.82	16.15	16.47	16.81	17.15	17.50	17.86
Fare Revenue	1.73	1.92	2.05	2.10	2.16	2.22	2.34	2.40	2.46	2.51
Total Revenue	16.62	17.12	17.56	17.92	18.31	18.69	19.15	19.55	19.96	20.37
Fund Balance	$ 16.52	$ 16.25	$ 16.02	$ 15.72	$ 15.36	$ 14.94	$ 14.50	$ 13.99	$ 13.39	$ 12.70

Figure 8: Kenmore Financial Plans

Levy Options

This section provides a high-level overview of the potential ways for funding the implementation of the Kenmore POF route. It is intended to be representative of what would be required to establish secure funding supporting the service over a twenty-year timeline.

The Marine Division's current primary funding source is a dedicated property tax levy that is supported by passenger fares, federal grants, and bond issuance for capital investments. The property tax levy is currently set at a rate to sustain existing operations. Adding new service would require a complete analysis of all funding sources projected into the future.

Operating costs for the new service would be funded through an increase to the existing dedicated POF property tax levy supplemented with passenger fare revenue. All options are within the maximum allowable levy rate for ferry service in King County. The tax levy along with the annual operating costs and debt service on two different bond options are illustrated in Figure 9 below.

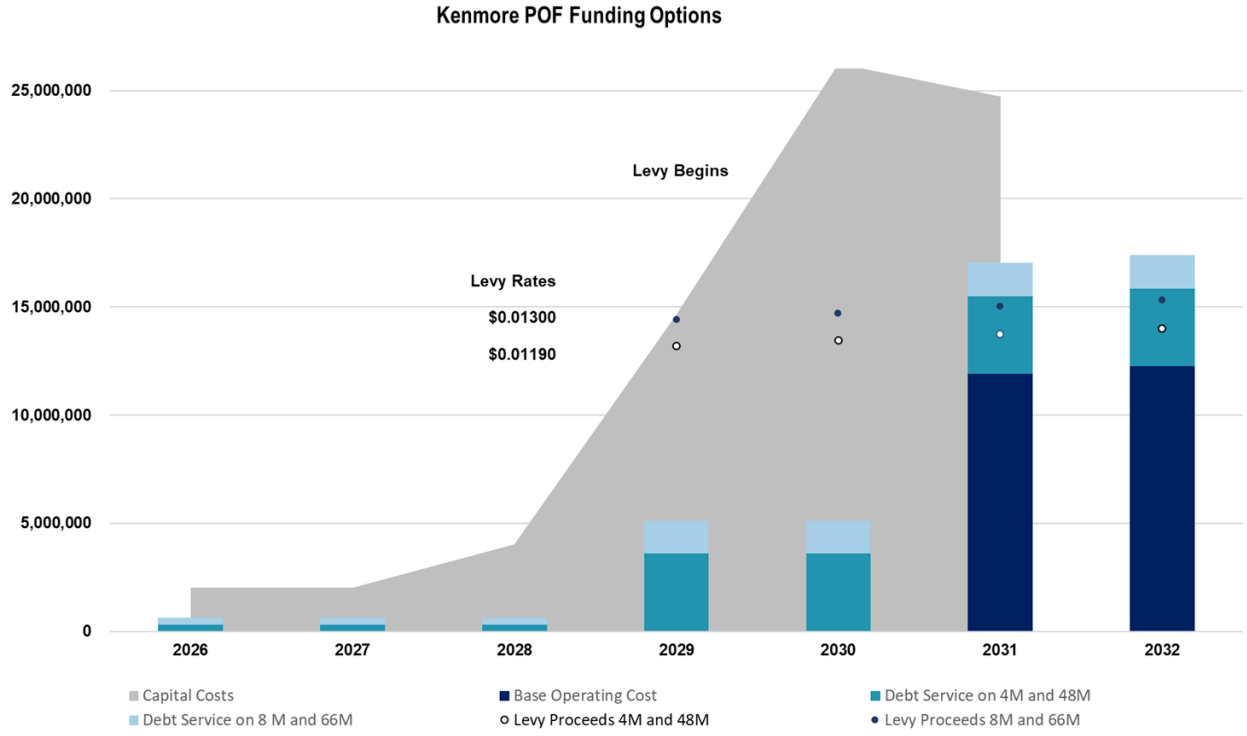


Figure 9: Kenmore Funding Options

Based on current funding assumptions and initial timing of investments, Figure 9 illustrates the total investment outlay over time, using two examples of funding combinations to support the implementation of Kenmore POF service.

Figure 9 provides examples that show the property tax levy rate that would need to be levied in order to fund the ongoing operating costs, as well as the debt service on two levels of bond funding. The highest bond issuance assumption is $74M, with no support from grants or partnerships. The second assumption shows bonds at $52M and grants and other support of $22M. In each of the examples, the levy rate would range between $0.01190 and $0.01300 per $1,000 of assessed property valuation. In comparison, the existing levy rate that funds the Vashon Island and West Seattle routes is $0.0125 per $1,000 of assessed property value.

Potential Grant Funding Options

The Marine Division has a successful history in seeking and receiving grants for many of their past capital projects and would seek out as much grant funding as possible for any new capital projects. The following grant opportunities are available for these capital investments:

- Federal Highway Administration (FHWA) - Ferry Boat Program
- Federal Transit Administration - Passenger Ferry Grant Program Section 5307, and Section 5337
- Department of Transportation - Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant
- Other Federal Transit Administration competitive and earned share grants

ENVIRONMENTAL REVIEW AND APPROVALS

Waterborne transportation is subject to federal, state and local environmental regulations. The Kenmore Water Taxi route would be subject to environmental review to ensure it meets all applicable regulations.

Environmental Review

Compliance with the National Environmental Policy Act (NEPA) is required for projects involving major federal actions. The NEPA process requires coordinating with the lead federal agency as soon as possible to determine if the project is considered to be categorically excluded or have an impact. Depending on the determination, the project may need to proceed with an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). Based on the determination, the Marine Division would prepare environmental studies needed to support the review process.

Metro would consult agencies with jurisdiction, Tribes with Usual and Accustomed treaty rights, and other stakeholders during project development and future operations. This effort would also require continued community engagement and outreach with property owners.

Permits and Approvals

- Federal, state, and local agency permits and approvals would be required for work in and adjacent to the shoreline. Anticipated agencies involved in review include Federal: U.S. Army Corps of Engineers and National Marine Fisheries/U.S. Fish and Wildlife
- State: Washington Department of Fish and Wildlife, Washington State Department of Natural Resources, Washington Department of Archeology and Historic Preservation, Department of Ecology
- Local: City of Seattle (UW WAC landing) and City of Kenmore (Lakepointe Landing)

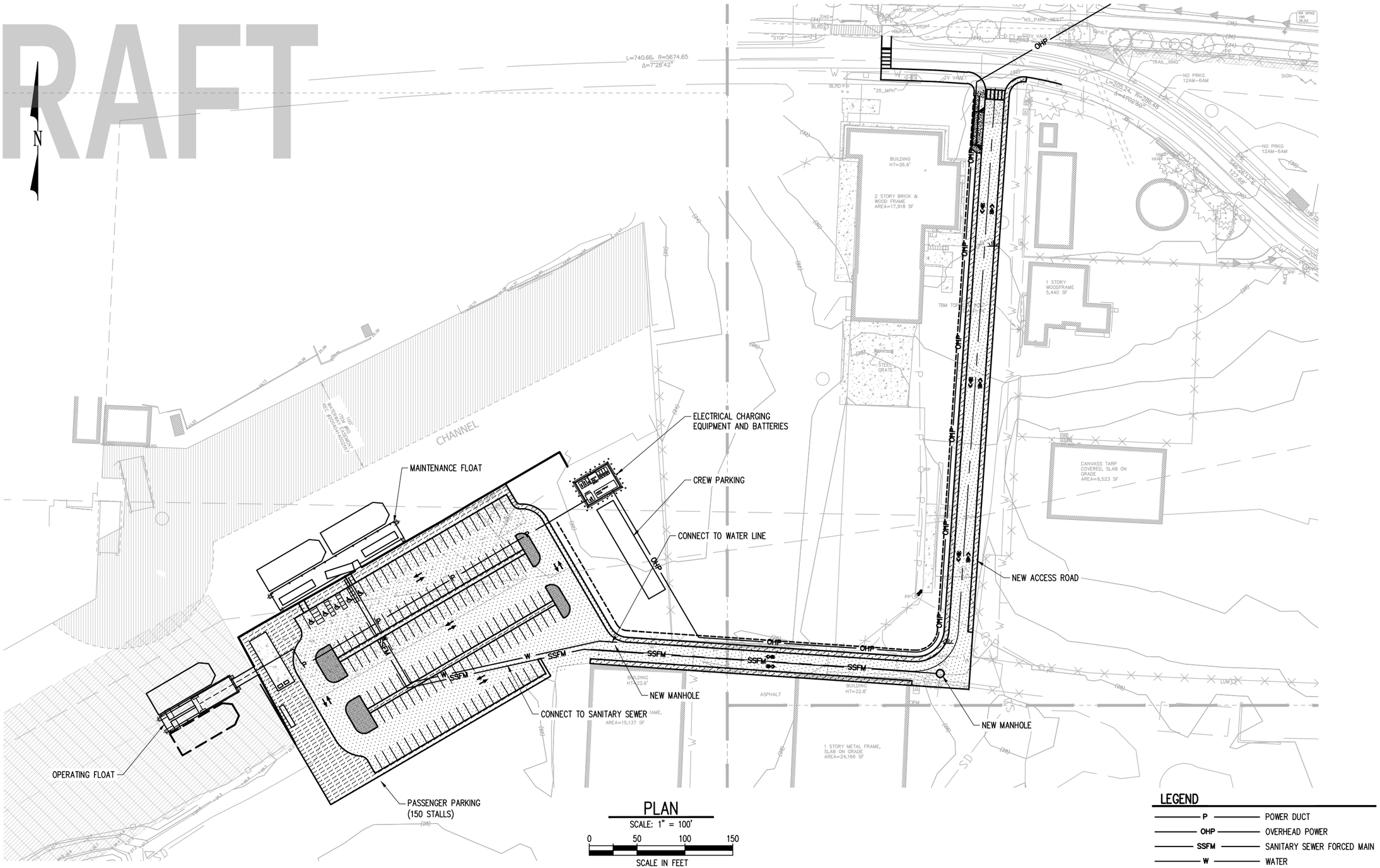
Environmental Studies and Operating Protocols

At the route level, north Lake Washington narrows near Kenmore, which could increase the risk of additional wake impacts along the shoreline. This risk could be mitigated by maintaining a vessel travel path in the middle of the lake, maximizing the distance from each shoreline. The 2020 Proviso recommended the following studies to be conducted during environmental review:

- Conduct a wind-wave and vessel wake energy assessment to quantify existing wave climate, which can generate sediment transport along the shorelines and determine threshold for Lake Washington Water Taxi wake wash criterion.
- Review fixed and floating structures, which extend well beyond the average structure from the shoreline, to determine tolerance for vessel wake wash.
- Review recreational activity on the lake around Kenmore, Magnuson Park, and the UW WAC landing sites to define operation protocols and to minimize impacts to recreation.
- Delineation of Kenmore Air take-off and landing zones.
- Evaluate potential impacts to threatened and endangered fish species at landing sites and stream mouths.

IMPLEMENTATION

The Kenmore route currently faces many challenges to implementation. First and foremost, without UW agreement, a Seattle-side landing is not currently available. As a result, full route or any phased implementation cannot begin until a Seattle-side landing is available.



PLAN
SCALE: 1" = 100'

0 50 100 150
SCALE IN FEET

LEGEND

P	POWER DUCT
OHP	OVERHEAD POWER
SSFM	SANITARY SEWER FORCED MAIN
W	WATER

No.	REVISION	BY	APP'D	DATE

kpff
1601 5th Avenue, Suite 1600
Seattle, WA 98101
206.622.5822
www.kpff.com

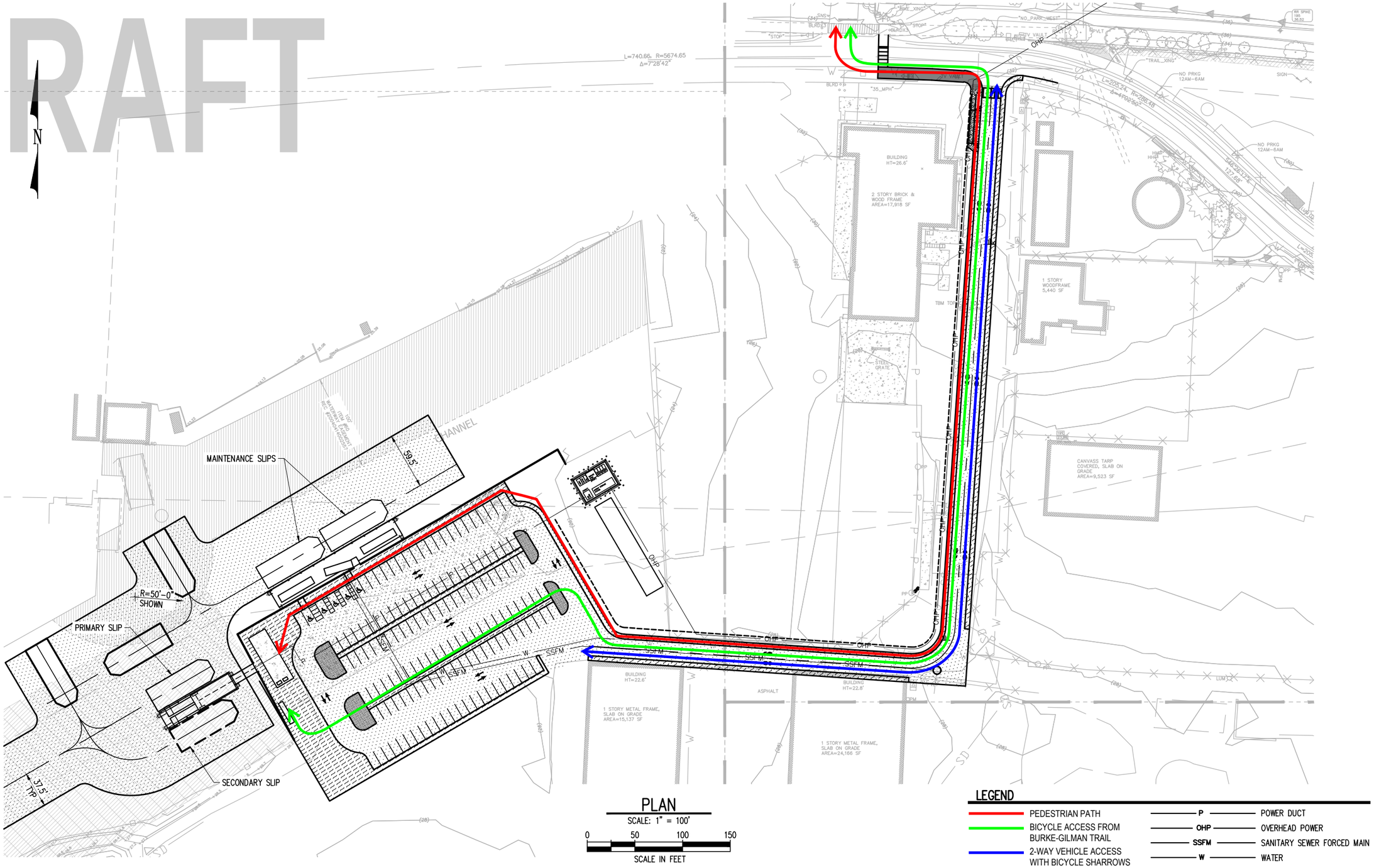
DESIGNED:	PROJECT MANAGER:	SCALE: NTS
DRAWN:	APPROVED:	SITE LOCATION NO:
CHECKED:	IBIS NO: / WORK REQUEST:	ONE INCH AT 11x17: 1" — IF NOT ONE INCH, SCALE ACCORDINGLY
RECOMMENDED:	CONTRACT NO:	

King County Department of Transportation

KING COUNTY DEPARTMENT OF TRANSPORTATION
MARINE DIVISION - KING COUNTY WATER TAXI
KENMORE CONCEPT

SITE AND PROPOSED IMPROVEMENTS PLAN

DATE:	1/7/2022
DRAWING NO:	SP1
SHEET NO:	OF - -



PLAN

SCALE: 1" = 100'

0 50 100 150

SCALE IN FEET

LEGEND

- PEDESTRIAN PATH
- BICYCLE ACCESS FROM BURKE-GILMAN TRAIL
- 2-WAY VEHICLE ACCESS WITH BICYCLE SHARROWS
- P — POWER DUCT
- OHP — OVERHEAD POWER
- SSFM — SANITARY SEWER FORCED MAIN
- W — WATER

No.	REVISION	BY	APP'D	DATE

kpff
1601 5th Avenue, Suite 1600
Seattle, WA 98101
206.622.5822
www.kpff.com

DESIGNED:	PROJECT MANAGER:	SCALE: NTS	
DRAWN:	APPROVED:	SITE LOCATION NO:	
CHECKED:	IBIS NO: / WORK REQUEST:	ONE INCH AT 11x17: 1" IF NOT ONE INCH, SCALE ACCORDINGLY	
RECOMMENDED:	CONTRACT NO:		

King County Department of Transportation

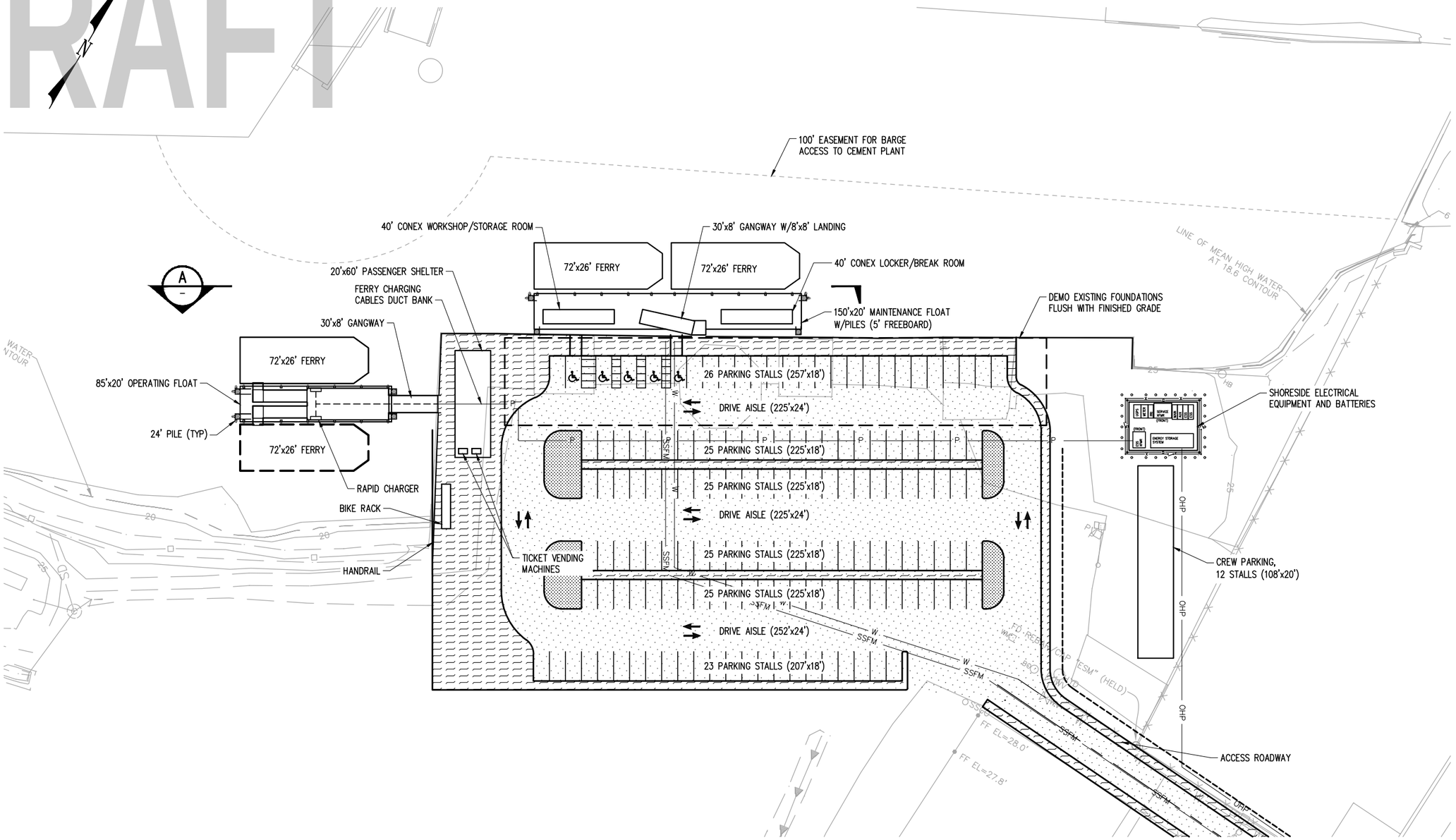
KING COUNTY DEPARTMENT OF TRANSPORTATION
MARINE DIVISION - KING COUNTY WATER TAXI
KENMORE CONCEPT

ACCESS PLAN

DATE: 1/7/2022

DRAWING NO: SP2

SHEET NO: - OF -



PLAN

SCALE: 1" = 60'

0 30 60 90

SCALE IN FEET

No.	REVISION	BY	APP'D	DATE

kpff
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Seattle, WA 98101
206.622.5822
www.kpff.com

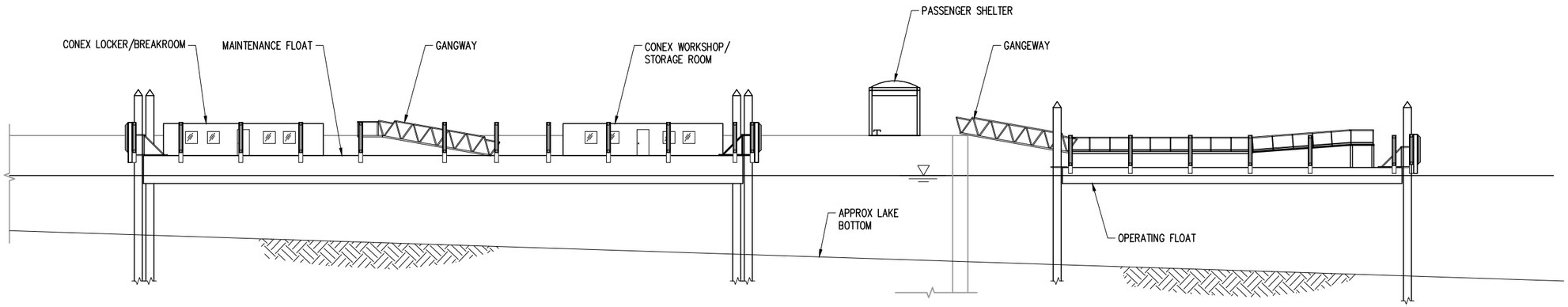
DESIGNED:	PROJECT MANAGER:	SCALE: NTS	DATE: 1/7/2022
DRAWN:	APPROVED:	SITE LOCATION NO:	
CHECKED:	IBIS NO:	ONE INCH AT 11x17 1" IF NOT ONE INCH, SCALE ACCORDINGLY	DRAWING NO: SP3
RECOMMENDED:	CONTRACT NO:	WORK REQUEST:	SHEET NO: - OF -

King County Department of Transportation

KING COUNTY DEPARTMENT OF TRANSPORTATION
MARINE DIVISION - KING COUNTY WATER TAXI
KENMORE CONCEPT

TERMINAL SITE PLAN

NOTES:
1. SEE kpxx FOR ADDITIONAL INFORMATION.



ELEVATION
SCALE: 1" = 30'

No.	REVISION	BY	APP'D	DATE

kpff
1601 5th Avenue, Suite 1600
Seattle, WA 98101
206.622.5822
www.kpff.com

DESIGNED:	PROJECT MANAGER:	SCALE: AS NOTED
DRAWN:	APPROVED:	SITE LOCATION NO:
CHECKED:	IBIS NO:	ONE INCH AT 11x17 1" IF NOT ONE INCH, SCALE ACCORDINGLY
RECOMMENDED:	CONTRACT NO:	WORK REQUEST:

King County
Department of Transportation

KING COUNTY DEPARTMENT OF TRANSPORTATION
MARINE DIVISION - KING COUNTY WATER TAXI
KENMORE CONCEPT

FLOATS ELEVATION

DATE: 1/7/2022
DRAWING NO: SE1
SHEET NO: - OF -

Looking Northwest:

Looking Northeast:

Final Water Taxi Expansion Progress Report

Appendix B

Ballard Water Taxi Implementation

Ballard Water Taxi Implementation *(Phase 1 & transition to permanent service)*

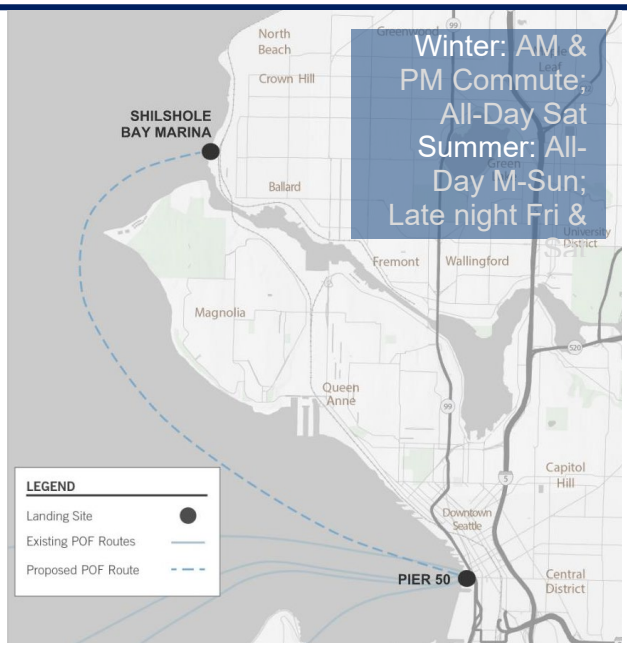
Landing Sites

- Agreements with the Port of Seattle for the Shilshole landing
- Schedule coordination with Kitsap Transit for the Pier 50 landing

Regulatory Approvals

Coordination with federal, state and local agencies to confirm required approvals and process.

Service Profile & Routing shown at right



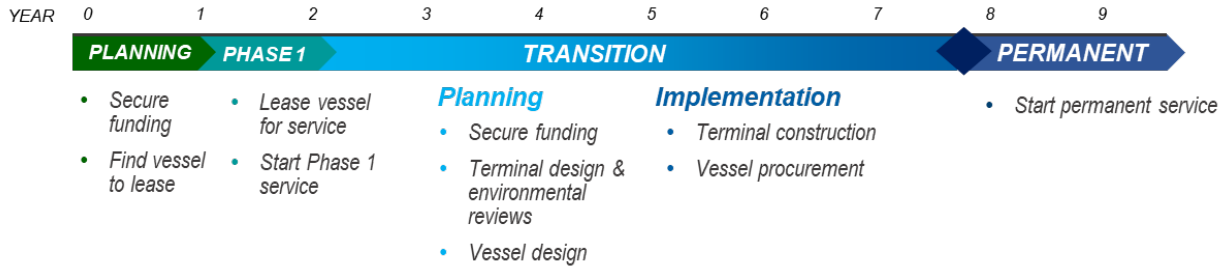
Capital Investments

	Phase 1 Service	*Permanent Service*
SHILSHOLE LANDING	Add a gangway, ramp, and fendering to the existing float; construct ADA path improvements	*No additional improvements required*
PIER 50 LANDING	*No improvements required, use existing Pier 50 float*	Construct a new service float and associated gangways; electrify the facility in collaboration with WSF Colman Dock Electrification project
MAINTENANCE FACILITY	*No improvements required, use existing Pier 48 maintenance barge*	
VESSEL	Lease a 150-passenger vessel	Purchase two new vessels to support low and/or zero-emissions operations depending on available technology

First/Last Mile Connections

- Shuttle running every 30-minutes connecting Shilshole to the surrounding neighborhood
- Bike lockers or other facilities for those travelling from the nearby Burke-Gilman Trail

Expected Timeline



PHASING

Two phases of service were developed for the Ballard route. The first phase includes Phase 1 Service that would act as a proof of concept that could likely be implemented faster than permanent service with existing terminal infrastructure in place at Shilshole Marina and Pier 50.

The second phase of the Ballard service would be permanent Water Taxi service that requires more capital investment to support long-term service operations and growth. Permanent service would take longer to implement due to the higher capital needs. Table 1 outlines the differences between the Phase 1 Service and permanent service.

Table 1: Differences Between Phase 1 Service and Permanent Service

Phase 1 Service	Permanent Service
Shilshole Bay Marina Improvements	Pier 50 Improvements
Use leased boat *Leased boat will likely be diesel due to available options.*	Construct new hybrid vessels

OPERATIONS: PROGRAMMING ASSUMPTIONS AND COSTS

To estimate operating costs for Ballard Water Taxi service, the team developed a representative service schedule for Water Taxi service. The service schedule was assumed both for the Phase 1 Service and permanent service. A schedule was also developed for a complementary shuttle. The following sections summarize the Water Taxi service schedule, shuttle service and operating cost assumptions and estimated annual operating costs for Phase 1 Service and permanent service.

Water Taxi Service Schedule

The potential Ballard winter schedule is designed to primarily serve the commute periods during the week, with at least three round trips in the AM peak (6 a.m.–9 a.m.) and three round trips in the PM peak (4 p.m.–7 p.m.). The Ballard winter schedule would also include Saturday service to help meet the needs of non-traditional workers and potential recreational ridership. The Ballard route could meet an hourly service schedule year-round with one operating vessel.

The summer schedule would provide all-day service every day of the week, expanded from the winter schedule to include mid-day and Sundays to meet anticipated recreational ridership demand. Late evening service would be added to the schedule on Friday and Saturday nights to further support recreational and discretionary riders.

Table 2 summarizes the potential Ballard service schedule for the 6-month winter and 6-month summer service levels. There would be no special event service for the potential Ballard water taxi route.

Table 2: Ballard Service Schedule Summary

	Winter	Summer Peak
Vessel Passenger Capacity	150 passengers	150 passengers
Operating Vessels	1 vessel	1 vessel
Backup Vessels	1 vessel	1 vessel
Maximum Service Frequency	1 hour headway	1 hour headway
Commute Service	6 RTs per day: •3 RTs in the AM peak •3 RTs in the PM peak	14 RTs per day Mon-Thurs: •3 RTs in the AM peak •4 RTs in the PM peak • Midday service (7 RTs) 16 RTs per day Fridays: •Additional late night Friday service (2 RTs)
Saturday Service	•12 RTs per day	•15 RTs per day
Sunday Service	No service	•12 RTs per day
Special Events	None	None

Note: Round Trips are abbreviated as "RTs."

Current Network Understanding

Shilshole Bay Marina is located to the west of downtown Ballard, along Seaview Avenue NW near the Sunset Hill neighborhood. There is no current transit service within ¼ mile walkshed of the potential landing site location. Other parts of Ballard are served by Metro peak-only and all-day routes, including the RapidRide D Line along 15th Avenue NW. Details on frequency and span are shown in Table 3 and transit in the greater Ballard area is shown in Figure 1.

Table 3: Transit Routes Near the Potential Shilshole Landing Site

Route	Connections	Frequency	Span
15X	Blue Ridge – Crown Hill – Downtown Seattle	Six AM peak trips, six PM peak trips	Peak Only
17X	Loyal Heights – Downtown Seattle	Five AM peak trips, five PM peak trips	Peak Only
18X	North Beach – Downtown Seattle	Five AM peak trips, five PM peak trips	Peak Only
29	Ballard – SPU – Queen Anne – Downtown Seattle	Six AM peak trips, six PM peak trips	Peak Only
40	Northgate Station – Crown Hill – Ballard – Fremont – South Lake Union – Downtown Seattle	8 to 10 minutes during the peak, 15 minutes during the day	All Day
44	Ballard – Wallingford – U District Station	10 minutes during the peak, 12 minutes during the day	All Day
45	Loyal Heights – Greenwood – Green Lake – Roosevelt Station – U District Station – UW Campus	10 minutes during the peak, 15 minutes during the day	All Day
D Line	Crown Hill – Ballard – Interbay – Uptown – Downtown Seattle	6-8 minutes during the peak, 10 minutes during the day	All Day

Figure 1: Existing transit and bicycle connections near the potential Shilshole landing site.

Sound Transit plans to extend Link light rail to Ballard as part of the Sound Transit 3 (ST3) regional transit system plan, approved by voters in 2016. Due to funding uncertainties,

implementation is now planned to occur in 2039. The Metro Connects interim network also envisions frequency and span improvements on existing routes, in addition to other network changes that reflect the implementation of Link light rail between Ballard and downtown Seattle.

There are no Metro managed or leased park-and-ride lots in the vicinity of the Shilshole landing site.

Shilshole Marina is isolated from most of Ballard's population, businesses, and services, with constrained access by any mode of travel. At 1.7 miles from central Ballard (NW Market Street and Ballard Avenue NW), walking would take about 35 minutes and biking about 9 minutes. Shilshole Marina's land access is along a single north-south linear roadway, Seaview Avenue NW, running parallel to the shoreline. Seaview Avenue NW has continuous sidewalks and a section of the separated and paved Burke Gilman Trail directly from central Ballard and east.

Parallel to the east side of Seaview Avenue NW are railroad tracks owned by BNSF Railway. The tracks are fully fenced and can be crossed only at very limited locations. On the other side of the tracks is a very steep hillside below neighborhoods that consist of single-family homes. These residential areas are accessible by way of very few streets, trails, and stairways. Thus, access from the neighborhoods uphill to the east is extremely limited and only for people with strong mobility. For those who would walk the trails or stairs, the travel time is at least 30 minutes or longer. The trails have no lights.

The Pier 50 landing site is adjacent to robust multimodal and transit connections throughout downtown Seattle as shown in Figure 2.

Figure 2: Existing Transit and Bicycle Connections Near the Potential Pier 50 Landing Site

Supporting Shuttle Service

There is no current or planned fixed-route transit service on or near Seaview Ave NW. However, as with the West Seattle Water Taxi landing site that is not served by all-day transit service, this analysis assumed a fixed route Water Taxi shuttle to connect passengers to Shilshole Marina from adjacent neighborhoods and provide transfer opportunities to routes 15, 17, 18, 1010, 1012, 1993, and RapidRide D Line in the Metro Connects interim network. The shuttle would operate to match the seasonal schedule of the water taxi, connecting riders from Golden Gardens Park to NW Market St, shown in Figure 3. Additional costs are shown in Table 4.

Table 4: Resources to Support a Potential Ballard Water Taxi Fixed-Route Shuttle

		Frequency	Resources Needed	
Route	Connections	To Water Taxi	Annual Hours	2024 Dollars*
Golden Gardens Shuttle	Golden Gardens - Shilshole Landing Site - Market Street	30 minutes	5,834	$935,000

*Year 1 of Phase 1 Ballard Route is projected to begin in 2024.

The cost estimates shown in Table 4 do not include additional operating costs for potential turnaround loops or capital costs relating to securing layover and comfort station access or vehicle procurement costs.

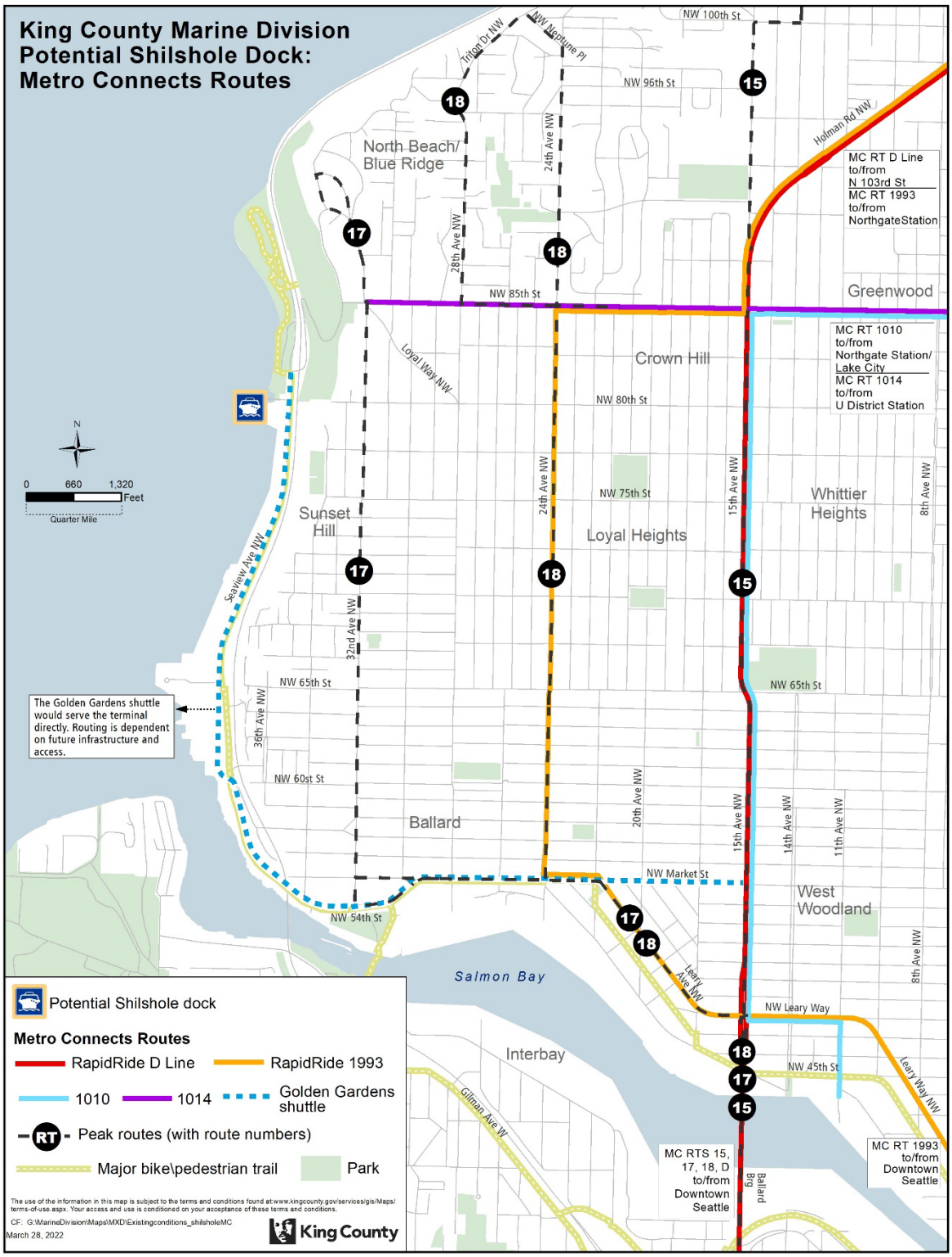


Figure 3: Metro Connects Interim Network and Potential Shuttle Service to Shilshole

Bike and Pedestrian Connections

The completion of the Burke Gilman Trail, known as the "Missing Link," is the primary planned improvement to bike, walk, and roll access at either potential landing site location. However, this project has an unclear completion date. Opportunities for alternative improvements would be limited due to the location and topography of the area. Any other improvements would require consultation with the City of Seattle, as the area around the landing site is not identified as an equity priority area for future Metro investments.

Operating Cost Model

Annual operating costs were developed using a cost model that included estimates for labor, maintenance, and energy/fuel costs. Based on the service hours and vessel operating hours in the representative service schedule, the model estimated costs for both the initial Phase 1 Service and the permanent Ballard Water Taxi service. The following sections outline the assumptions used to develop the operating cost model.

VESSEL LABOR

The service schedule was used to determine overall labor hours, which were then multiplied by the hourly rate for programmed personnel/crew. Key assumptions include:

- Three crew members including one captain, one senior deckhand, and one purser deckhand to operate each vessel.
- Vessel maintenance crew includes one engineer and one oiler to meet maintenance labor requirements.
- Labor hours were based on operating hours plus 45 minutes of startup and tie-up time before and after service
- Labor costs were based on labor rates, benefits and overhead costs from 2021.

VESSEL MAINTENANCE

Three categories of vessel maintenance activities were assumed for the operating cost estimate: routine/preventative maintenance, annual drydocking, and an estimate of unplanned maintenance. Costs were modeled for maintenance-specific labor costs, costs of materials, and other ancillary costs. Key assumptions of the vessel maintenance costs include:

- Routine (or preventative) maintenance was calculated as a percentage of vessel operating hours and included routine/preventative machinery maintenance along with materials and ancillary costs.
- Annual maintenance costs included an assumed annual cost for vessel drydocks and haul/out-of-water maintenance that account for labor, materials, and ancillary costs.
- Unplanned maintenance costs included unplanned or unexpected machinery failures.

ENERGY COSTS: FUEL, ELECTRICITY

The Phase 1 Service was assumed to be a diesel-powered vessel. Permanent service costs were based on a combination of fuel costs and electricity costs for a hybrid vessel. Assumptions for vessel energy costs include:

- Fuel cost per gallon was based on 2021 Harbor Island fuel prices.
- Fuel usage of the hybrid vessel assumed that diesel engines are turned off and unused for maneuvering, slow-down zones, and idling at the dock, when the vessel would be running exclusively on electric batteries. Diesel fuel use was assumed for the high-speed portion of the route.
- Estimates for vessel fuel usage were based on data from All American Marine for 150-passenger vessel. Two 750-gallon fuel tanks were assumed per vessel.

- Electrical power was assumed when the vessel was at the dock and calculated using Seattle City Light's network fee schedule.

TERMINAL OPERATIONS COSTS

Operating costs for a new Shilshole Water Taxi landing and additional operating costs at Pier 50 include:

- Assumed terminal operations costs include routine terminal maintenance, terminal lease, and fare collection (via Ticket Vending Machine).
- No informational agent was assumed for the Shilshole landing.
- One information agent was assumed to support Pier 50 operations.

SHUTTLE OPERATING COSTS

Shuttle costs were based on number of operating hours using an hourly operating cost estimate from other Metro shuttle service.

Operating Cost Summary

Based on operating assumptions outlined in the operating cost model section, annual operating costs were estimated for Phase 1 Service and permanent service and account for inflation.

PHASE 1 SERVICE OPERATING COSTS

Operating costs for a Ballard Phase 1 Service are estimated at approximately **$6.6 million annually** or **$1,650 per vessel operating hour**. Figure 4 depicts the distribution of operating costs for Phase 1 Service by vessel, terminal, and administrative costs.

Category	*Cost*
Vessel	$ 4,357,000
Terminal	$ 200,000
Shuttles	$ 935,000
Administration/Support	$ 1,117,000
Total	**$ 6,609,000**

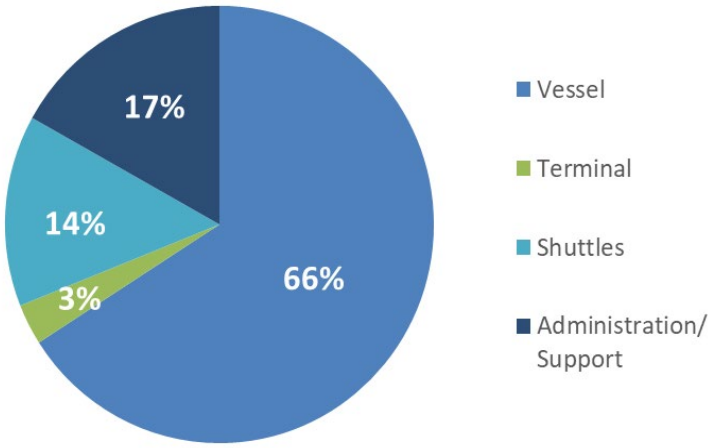


Figure 4: Estimated Operating Costs for Phase 1 Service by Vessel, Terminal, and Administrative Costs

PERMANENT SERVICE

Annual operating costs for permanent Ballard Water Taxi service are estimated to be approximately **$7.1 million annually** or **$1,763 per vessel operating hour**. This estimate accounts for starting service seven years after Phase 1 Service and the associated inflation. Figure 5 depicts the operating cost break down for the permanent service by operating cost category.

Category	*Cost*
Vessel	$ 4,370,000
Terminal	$ 239,000
Shuttles	$ 1,116,000
Administration/Support	$ 1,334,000
Total	**$ 7,059,000**

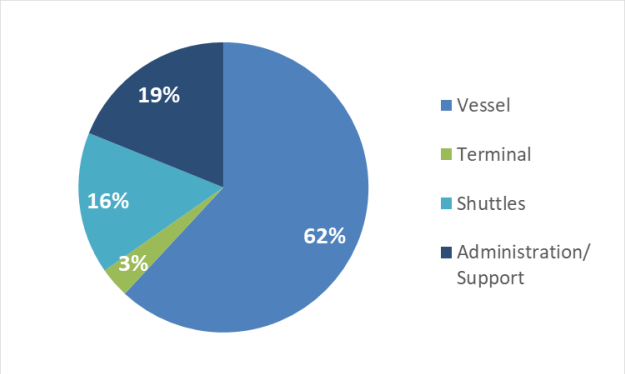


Figure 5: Estimated Operating Costs for Permanent Service by Vessel, Terminal, and Administrative Costs

CAPITAL NEEDS

To implement new Water Taxi service, capital investment would be required. Capital needs for Ballard water taxi service fall into five main categories: terminals, shuttle, vessel(s), electrification infrastructure, and maintenance. As part of identifying the capital needs for a Ballard water taxi route, Metro met with property owners and interested parties to receive feedback on a potential ferry landing. The following sections summarize capital needs for each landing site and information received from outreach to date.

Terminals

SHILSHOLE BAY MARINA

Located in the Sunset Hill neighborhood adjacent to Seaview Avenue NW, Shilshole Bay Marina is owned and operated by the Port of Seattle and provides guest moorage services, a full-service boat yard, and recreational boat launches. In addition, a City of Seattle public boat launch and Golden Gardens Park is located just north of the marina.

Figure 6: Aerial View of Shilshole Bay Marina Dock X (Google Earth)

Partner Engagement Status

The Port of Seattle has been an active partner in previous and

current planning efforts. For this proviso effort, Metro conducted a site visit with Port of Seattle representatives where the Port suggested Dock X as the landing location. The Port also suggested A Dock, H Dock, and I Dock as potential landing locations and expressed their interest in Water Taxi service and landing at Shilshole Marina. General programming needs and preliminary designs were shared with the Port. Several of the docks may be feasible to meet Water Taxi and general marina operational needs with minimal capital costs; however, this analysis uses Dock X as the preferred landing location due to its operational advantages and minimal capital improvement needs. Continued discussions regarding use/lease agreement of the facility, and further understanding of parking impacts, restrictions, availability of shoreside infrastructure, and approach would be necessary prior to the start of service. This will include ensuring priorities from ongoing analysis and changes in marina operations are considered in any implementation plan.

Docks Not Preferred

Dock A was not preferred due to its limited existing infrastructure and the need to construct a float to support permanent service.

Dock H/I were not preferred due to operational challenges and potential travel time concerns. The speed reductions and the increased chance of encountering and navigating around marina traffic will likely result in longer travel times than those from Dock X, and a minimum of one-hour headways may not be possible from Dock H/I. As a result, the need for more expensive two-boat service may be required to meet Metro service guidelines if Dock H/I are selected. Further analysis would need to be conducted to confirm the Dock H/I travel times, though Dock X was ultimately preferred for this analysis due to its operational benefits.

Water Taxi Landing Concept

Based on discussions with the Port, this proviso considers Dock X at the north end of the marina for the Water Taxi landing. Dock X has existing infrastructure including a float and gangway that could be used for Water Taxi service with minimal improvements, and also has operational benefits relative to docks in the central portion of the Marina, as vessel speeds would be reduced within the marina.

The improvements required for Water Taxi service for Dock X are depicted in the attached drawing set and are summarized below:

- In-water and overwater Infrastructure
  - New fendering along existing float
  - Improved cleats for vessel tie up
  - New ramp system for loading/unloading passengers
  - Bull rail along existing float to improve safety and ADA access

The Water Taxi landing concept was designed to allow for a Water Taxi vessel to tie-up on either side of the Dock X float. The vessel would tie-up on the north side of the float during winter months and on the south side of the float in the summer months when there is more recreational use of the float.

Electrification Improvements

Roundtrip charging would be located at Pier 50 for this route. Therefore, no electrification infrastructure would be installed at the Shilshole Marina.

Costs

As needed terminal improvements are more minimal due to the new preferred docking locations, capital costs shown in this proviso are also less than those previously shown in the 2020 proviso response regarding this Water Taxi route. Capital costs for this terminal were assumed to occur prior to Phase 1 Service, with no additional capital costs needed for permanent service.

$1.2M	$0
Phase 1 Service Costs	Permanent Service Costs

PIER 50

The current Pier 50 facility supports the existing King County Water Taxi routes to West Seattle and Vashon Island as well as three Kitsap Transit (KT) Fast Ferry routes. With only two operating slips, the facility is currently near capacity and at capacity during the commute periods when ferry service runs more frequently. An additional float would be needed to support more than five routes operating at this location.

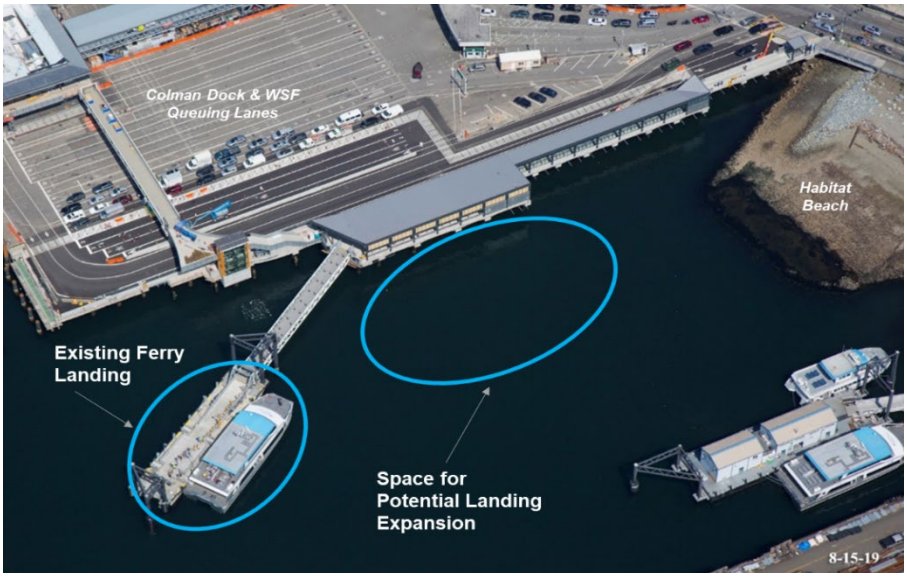


Figure 7: Aerial View of the Pier 50 Facility and Surrounding Area

Facility Constraints

Many recent studies indicate interest in expanding passenger-only ferry service to downtown Seattle. However, as previously mentioned, additional Water Taxi service is limited by the two operating slips at Pier 50. Currently, Kitsap Transit is conducting a Siting Study to identify a long-term solution for expansion of Fast Ferry Service along the Seattle waterfront.

While Pier 50 could accommodate Phase 1 Service to/from Ballard, the limited availability of operating slips would not be sufficient to add a permanent Ballard Water Taxi route. Therefore, this proviso includes a new float at Pier 50 to support permanent Ballard service in conjunction with all existing routes operating from this location.

Partner Engagement Status

Pier 50 is owned by King County. However, as the KT Fast Ferries also jointly use the Pier 50 facility, outreach with KT will be necessary. Further engagement on future electrification work will be necessary with partners such as Washington State Ferries, the Port of Seattle, and utility providers.

Water Taxi Landing Concept

This proviso assumed new in-water and overwater infrastructure at Pier 50 for permanent Ballard Water Taxi service. It would be difficult to increase the size of the existing passenger shelter due to lack of uplands space, and the recently completed habitat beach to the south of

the facility limits in-water and over-water expansion of the walkway and terminal. The assumed capital infrastructure is depicted in the attached drawing set and includes:

- In-water and Overwater Infrastructure
  - New float w/ two slips (bow-loading and side-loading capable at each slip)
  - New passenger ingress-only gangway (See the access diagram on Sheet 2)
  - New passenger egress-only gangway (See the access diagram on Sheet 2)
  - Pile supported platform

Electrification Improvements
To support the charging of the hybrid electric vessel selected for this route and any future electrification efforts, additional shoreside utility and battery infrastructure would be needed. Much of this infrastructure would be built in collaboration with the improvements being made to Colman Dock and at the Pier 48 facility to support the electrification efforts of the Washington State Ferries (WSF) fleet.

Some form of energy storage system would likely be needed along with potential duct bank expansion. The final form of these improvements will vary depending on WSF's needs and the technology available at the time the Pier 50 improvements are constructed, and permanent service begins.

$0	**$25.5M**
Phase 1 Service Costs	**Pier 50 Permanent Service Costs**

Shuttle

The shuttle is not part of Metro's existing service and 10-year fleet plans. However, due to requirement of a single vehicle, it is expected that growth could be easily accommodated if funding for the service were identified in future budgets. Additional implementation work would be needed regarding securing layover and comfort station access in the vicinity of the Shilshole landing site, however the capital costs associated with this are expected to be minimal. Therefore no capital costs are included in this effort regarding the shuttle.

$935K	**$1.12M**
Phase 1 Service Costs	**Pier 50 Permanent Service Costs**

Vessels

The length of the Ballard route and the speed of the proposed vessel meant that the proposed minimum hourly service schedule can be met with one operating vessel. However, two 150 passenger hybrid vessels are assumed for this route. One vessel will be needed for service, while one vessel will be needed as a backup / maintenance spare.

The hybrid electric vessels selected would have both diesel engines and electric motors powered by batteries and will be able to transition to future emission reduction technologies when they become more readily available.

This propulsion type was selected based on the propulsion analysis conducted in the earlier phases of this work. For more information regarding the propulsion analysis, please reference the propulsion analysis appendix associated with this work.

The Ballard route operates on Puget Sound, the same waterway as the other King County Water Taxi routes. Following Ballard route implementation, fleet planning will be considered holistically for all three Puget Sound routes, particularly in relation to back-up vessel coordination, etc.

$0	**$20.3M**
Phase 1 Service Vessel Capital Costs	**Vessel Acquisition Costs**

Electrification Infrastructure

Providing charging infrastructure at the Pier 50 terminal would support Ballard Water Taxi service. It would also allow for electrification of the other King County Water Taxi routes, particularly the West Seattle route that has an operating profile that lends itself to transition to zero-emissions given current technology.

GREENHOUSE GAS IMPACTS

Hybrid operation of this route and the associated decrease in greenhouse gases aligns with King County Metro's climate and sustainability goals. King County's Strategic Climate Action Plan (SCAP) is a five-year blueprint for County climate action, integrating climate change into all areas of County operations. The core sections of the SCAP include reducing greenhouse gas (GHG) emissions, sustainable and resilient frontline communities, and preparing for climate changes. By operating portions of the route on electric power, the hybrid service would decrease fuel usage and could result in a greenhouse gas emissions savings of approximately 8% per trip.

	Gallons of Fuel	*Emissions per Gallon of Fuel (kg)*	*Emissions Estimate (kg)*
Full Diesel	77.0	10.19	784
Hybrid	70.7	10.19	720
Savings	**6.3 gal**		**64 kg**

Alternative fuels for marine propulsion are rapidly changing and the high-speed portion of the route would likely be powered by green technology in the next 5-10 years. When exploring future conversion from hybrid propulsion to future technology, King County Metro is committed to transitioning to propulsion options that result in zero emissions for all operations as soon as is feasible.

Outreach to Date

Seattle City Light indicated they are willing to support a Ballard Water Taxi route and provided feedback on the potential grid improvements needed to support the electricity needs of the hybrid ferry.

Maintenance

Routine and preventative maintenance activities are assumed to occur at the existing Pier 48 maintenance barge.

FINANCIAL PLAN

Ballard to Seattle POF service requires capital investment and a sustainable funding source to support operating costs. Capital investments can be funded through a combination of grants, local sources, and debt service. The Marine Division has been successful in obtaining federal and state grants for their capital investments and will continue to seek all grant funding opportunities.

The capital investment and ongoing operating costs for a new Ballard POF route have been calculated using high level estimates based on the timing of implementation and include an annual inflation rate. The estimates are subject to change based on further detailed planning, partnership agreements, and the timing of funds being secured to support the service.

Examples of twenty-year financial plans are provided in Figure 8. The plans list the vessels and terminal capital investments, the operating costs by category and the debt service costs. The revenue is broken down by funding type. The ending fund balance is the difference between the total revenues and total expenses.

Ballard Route Financial Plan

(Based on $47M Bonds)

$$ in Millions	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Vessels	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.97	$ 8.69	$ 10.62	$ -
Terminals	$ 0.60	$ 0.62	$ -	$ 1.19	$ 1.19	$ 2.37	$ 7.77	$ 7.77	$ 5.18	$ -
Total Capital	$ 0.60	$ 0.62	$ -	$ 1.19	$ 1.19	$ 2.37	$ 8.74	$ 16.46	$ 15.80	$ -
Vessel Operations	$ -	$ 4.36	$ 4.49	$ 4.62	$ 4.76	$ 4.90	$ 5.05	$ 4.37	$ 4.50	$ 4.64
Terminal Operations	$ -	$ 0.20	$ 0.21	$ 0.21	$ 0.22	$ 0.22	$ 0.23	$ 0.24	$ 0.25	$ 0.25
Shuttle Operations	$ -	$ 0.94	$ 0.96	$ 0.99	$ 1.02	$ 1.05	$ 1.08	$ 1.12	$ 1.15	$ 1.18
Management/ Administrative Overhead	$ -	$ 1.12	$ 1.15	$ 1.19	$ 1.22	$ 1.26	$ 1.30	$ 1.33	$ 1.37	$ 1.42
Total Operating	$ -	$ 6.62	$ 6.81	$ 7.01	$ 7.22	$ 7.43	$ 7.66	$ 7.06	$ 7.27	$ 7.49
Debt Service ($47M)	$ -	$ -	$ -	$ 1.12	$ 1.12	$ 1.12	$ 1.12	$ 3.77	$ 3.77	$ 3.77
Total Expenses	$ 0.60	$ 7.24	$ 6.81	$ 9.32	$ 9.53	$ 10.92	$ 17.52	$ 27.29	$ 26.84	$ 11.26
Bonds	$ -	$ -	$ 14.00	$ -	$ -	$ -	$ 33.00	$ -	$ -	$ -
Grants/Other	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Property Tax Levy	$ -	$ 7.90	$ 8.08	$ 8.25	$ 8.43	$ 8.60	$ 8.78	$ 8.96	$ 9.14	$ 9.33
Fare Revenue	$ -	$ 0.91	$ 1.00	$ 1.12	$ 1.21	$ 1.30	$ 1.40	$ 1.48	$ 1.59	$ 1.66
Total Revenue	$ -	$ 8.81	$ 23.08	$ 9.37	$ 9.64	$ 9.90	$ 43.18	$ 10.44	$ 10.73	$ 10.99
Fund Balance	$ (0.60)	$ 0.97	$ 17.24	$ 17.29	$ 17.40	$ 16.38	$ 42.04	$ 25.19	$ 9.08	$ 8.81

$$ in Millions	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Vessels	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Terminals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Vessel Operations	$ 4.78	$ 4.92	$ 5.07	$ 5.22	$ 5.37	$ 5.54	$ 5.70	$ 5.87	$ 6.05	$ 6.23
Terminal Operations	$ 0.26	$ 0.27	$ 0.28	$ 0.28	$ 0.29	$ 0.30	$ 0.31	$ 0.32	$ 0.33	$ 0.34
Shuttle Operations	$ 1.22	$ 1.26	$ 1.29	$ 1.33	$ 1.37	$ 1.41	$ 1.46	$ 1.50	$ 1.55	$ 1.59
Management/ Administrative Overhead	$ 1.46	$ 1.50	$ 1.55	$ 1.59	$ 1.64	$ 1.69	$ 1.74	$ 1.79	$ 1.85	$ 1.90
Total Operating	$ 7.72	$ 7.95	$ 8.19	$ 8.42	$ 8.67	$ 8.94	$ 9.21	$ 9.48	$ 9.78	$ 10.06
Debt Service ($47M)	$ 3.77	$ 3.77	$ 3.77	$ 3.77	$ 3.77	$ 3.77	$ 3.77	$ 3.77	$ 3.77	$ 3.77
Total Expenses	$ 11.49	$ 11.72	$ 11.96	$ 12.19	$ 12.44	$ 12.71	$ 12.98	$ 13.25	$ 13.55	$ 13.83
Bonds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Grants/Other	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Property Tax Levy	$ 9.52	$ 9.72	$ 9.91	$ 10.12	$ 10.33	$ 10.54	$ 10.75	$ 10.97	$ 11.20	$ 11.43
Fare Revenue	$ 1.73	$ 1.80	$ 1.87	$ 1.99	$ 2.06	$ 2.14	$ 2.21	$ 2.28	$ 2.42	$ 2.49
Total Revenue	$ 11.25	$ 11.52	$ 11.78	$ 12.11	$ 12.39	$ 12.68	$ 12.96	$ 13.25	$ 13.62	$ 13.92
Fund Balance	$ 8.57	$ 8.37	$ 8.19	$ 8.11	$ 8.06	$ 8.03	$ 8.01	$ 8.01	$ 8.08	$ 8.17

Ballard Route Financial Plan

(Based on $23.5M Bonds)

$$ in Millions	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Vessels	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.97	$ 8.69	$ 10.62	$ -
Terminals	$ 0.60	$ 0.62	$ -	$ 1.19	$ 1.19	$ 2.37	$ 7.77	$ 7.77	$ 5.18	$ -
Total Capital	$ 0.60	$ 0.62	$ -	$ 1.19	$ 1.19	$ 2.37	$ 8.74	$ 16.46	$ 15.80	$ -
Vessel Operations	$ -	$ 4.36	$ 4.49	$ 4.62	$ 4.76	$ 4.90	$ 5.05	$ 4.37	$ 4.50	$ 4.64
Terminal Operations	$ -	$ 0.20	$ 0.21	$ 0.21	$ 0.22	$ 0.22	$ 0.23	$ 0.24	$ 0.25	$ 0.25
Shuttle Operations	$ -	$ 0.94	$ 0.96	$ 0.99	$ 1.02	$ 1.05	$ 1.08	$ 1.12	$ 1.15	$ 1.18
Management/ Administrative Overhead	$ -	$ 1.12	$ 1.15	$ 1.19	$ 1.22	$ 1.26	$ 1.30	$ 1.33	$ 1.37	$ 1.42
Total Operating	$ -	$ 6.62	$ 6.81	$ 7.01	$ 7.22	$ 7.43	$ 7.66	$ 7.06	$ 7.27	$ 7.49
Debt Service ($23.5M)	$ -	$ -	0	0.56	0.56	0.56	0.56	1.89	1.89	1.89
Total Expenses	$ 0.60	$ 7.24	$ 6.81	$ 8.76	$ 8.97	$ 10.36	$ 16.96	$ 25.41	$ 24.96	$ 9.38
Bonds	$ -	$ -	7.00	0.00	0.00	0.00	16.50	0.00	0.00	0.00
Grants/Other	$ -	$ -	7.00	0.00	0.00	0.00	16.50	0.00	0.00	0.00
Property Tax Levy	$ -	$ 6.84	6.98	7.14	7.29	7.44	7.59	7.75	7.91	8.07
Fare Revenue	$ -	$ 0.91	1.00	1.12	1.21	1.30	1.40	1.48	1.59	1.66
Total Revenue	$ -	$ 7.75	21.98	8.26	8.50	8.74	41.99	9.23	9.50	9.73
Fund Balance	$ (0.60)	$ (0.09)	$ 15.08	$ 14.58	$ 14.11	$ 12.49	$ 37.52	$ 21.34	$ 5.88	$ 6.23

$$ in Millions	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Vessels	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Terminals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Vessel Operations	$ 4.78	$ 4.92	$ 5.07	$ 5.22	$ 5.37	$ 5.54	$ 5.70	$ 5.87	$ 6.05	$ 6.23
Terminal Operations	$ 0.26	$ 0.27	$ 0.28	$ 0.28	$ 0.29	$ 0.30	$ 0.31	$ 0.32	$ 0.33	$ 0.34
Shuttle Operations	$ 1.22	$ 1.26	$ 1.29	$ 1.33	$ 1.37	$ 1.41	$ 1.46	$ 1.50	$ 1.55	$ 1.59
Management/ Administrative Overhead	$ 1.46	$ 1.50	$ 1.55	$ 1.59	$ 1.64	$ 1.69	$ 1.74	$ 1.79	$ 1.85	$ 1.90
Total Operating	$ 7.72	$ 7.95	$ 8.19	$ 8.42	$ 8.67	$ 8.94	$ 9.21	$ 9.48	$ 9.78	$ 10.06
Debt Service ($23.5M)	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89
Total Expenses	$ 9.61	$ 9.84	$ 10.08	$ 10.31	$ 10.56	$ 10.83	$ 11.10	$ 11.37	$ 11.67	$ 11.95
Bonds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grants/Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Property Tax Levy	8.23	8.40	8.58	8.75	8.93	9.11	9.30	9.49	9.68	9.88
Fare Revenue	1.73	1.80	1.87	1.99	2.06	2.14	2.21	2.28	2.42	2.49
Total Revenue	9.96	10.20	10.45	10.74	10.99	11.25	11.51	11.77	12.10	12.37
Fund Balance	$ 6.58	$ 6.94	$ 7.31	$ 7.74	$ 8.17	$ 8.59	$ 9.00	$ 9.40	$ 9.83	$ 10.25

Figure 8: Ballard Route Financial Plans

The first financial plan depicted in Figure 8 reflects capital costs being fully bonded at $47 million. The second financial plan shows the capital costs are funded by $23.5 million in bonds and $23.5 million in grants/other.

Levy Options

This section provides a high-level overview of the potential ways for funding the implementation of the Ballard POF route. It is intended to be representative of what would be required to establish secure funding supporting the service over a twenty-year timeline.

The Marine Division's current primary funding source is a dedicated property tax levy that is supported by passenger fares, federal grants, and bond issuance for capital investments. The property tax levy is currently set at a rate to sustain existing operations. Adding new service would require a complete analysis of all funding sources projected into the future.

Operating costs for the new service would be funded through an increase to the existing dedicated POF property tax levy, supplemented with passenger fare revenue. All options are within the maximum allowable levy rate for ferry service in King County. The tax levy, along with the annual operating costs and debt service on two different bond options, is illustrated below in Figure 9.

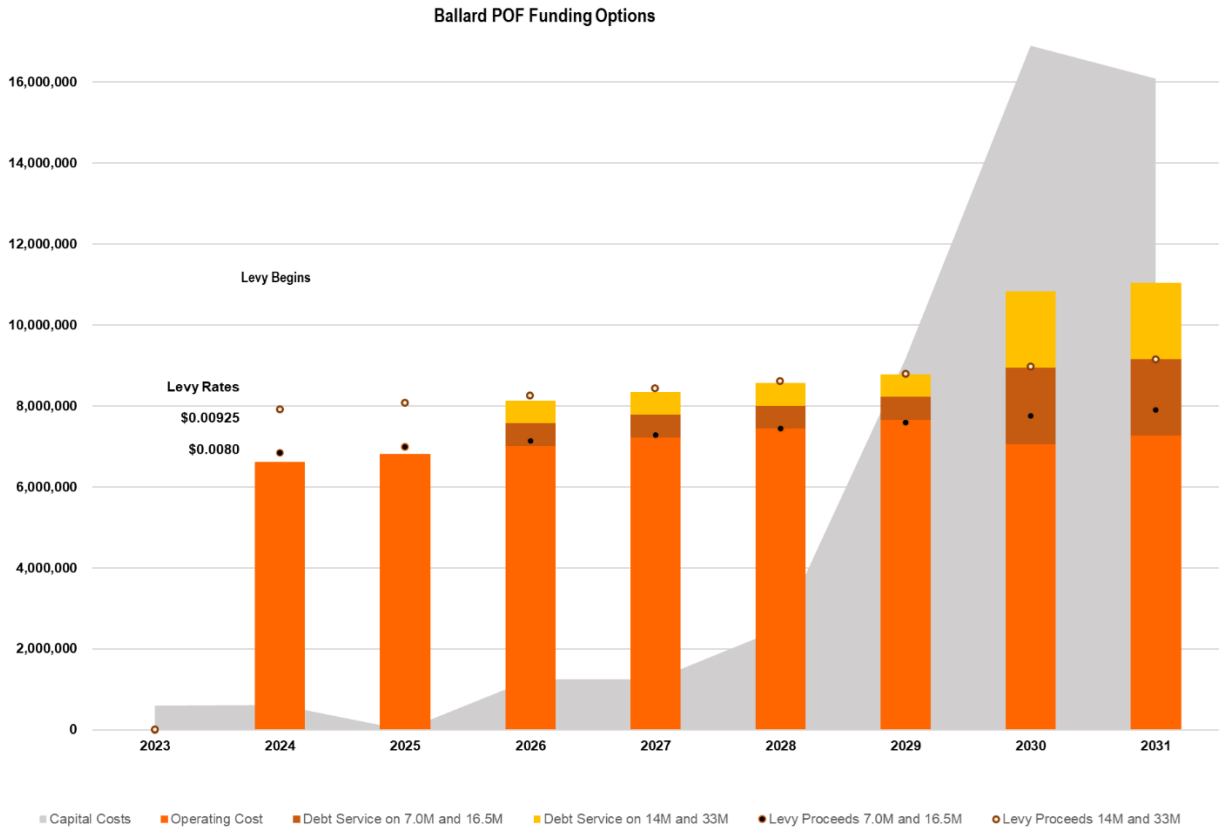


Figure 9: Ballard Funding Options

Based on current funding assumptions and initial timing of investments, Figure 9 illustrates the total investment outlay over time using two examples of funding combinations to support the implementation of Ballard POF service.

The examples in Figure 9 show the property tax levy rate (that would need to be levied in order to fund the ongoing operating costs) as well as the debt service on two levels of bond funding. The highest bond issuance assumption is $47M, with no support from grants or partnerships. The second assumption shows bonds at $23.5M and grants and other support of $23.5M. In each of the examples, the levy rate would range between $0.00800 and $0.00925 per $1,000 of assessed property valuation. In comparison, the existing levy rate that funds the Vashon Island and West Seattle routes is $0.0125 per $1,000 of assessed property value.

Potential Grant Funding Options

The Marine Division has a successful history in seeking and securing grants for many of their past capital projects and would seek out as much grant funding as possible for any new capital projects. The following grant opportunities are available for these capital investments:

- Federal Highway Administration (FHWA) - Ferry Boat Program
- Federal Transit Administration - Passenger Ferry Grant Program Section 5307, and Section 5337
- Department of Transportation - Rebuilding American Infrastructure with Sustainability and Equity Better Utilizing Investments to Leverage Development (RAISE) Grant
- Other Federal Transit Administration competitive and earned shared grants

ENVIRONMENTAL REVIEW AND APPROVALS

Waterborne transportation is subject to federal, state, and local environmental regulations. The Ballard Water Taxi route would be subject to environmental review to ensure it meets all applicable regulations.

Environmental Review

Compliance with the National Environmental Policy Act (NEPA) is required for projects involving major federal actions. The NEPA process requires coordinating with the lead federal agency as soon as possible to determine if the project is considered to be categorically excluded or have an impact. Depending on the determination, the project may need to proceed with an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). Based on the determination, the Marine Division would prepare environmental studies needed to support the review process.

Metro would consult with these agencies with jurisdiction, Tribes with Usual and Accustomed treaty rights, and other stakeholders during project development and future operations. This effort would also require continued community engagement and outreach with property owners.

Permits and Approvals

Federal, state, and local agency permits and approvals would be required for work in and adjacent to the shoreline. Anticipated agencies involved in review include:

SHILSHOLE BAY MARINA

- Federal: U.S. Army Corps of Engineers
- State: Washington Department of Fish and Wildlife
- Local: City of Seattle

PIER 50

- Federal: U.S. Army Corps of Engineers and National Marine Fisheries/U.S. Fish and Wildlife
- State: Washington Department of Fish and Wildlife, Washington State Department of Natural Resources, Washington Department of Archeology and Historic Preservation
- Local: City of Seattle

Environmental Studies and Operating Protocols

To support a Phase 1 Service the Shilshole Bay Marina landing would require overwater infrastructure and would need to meet federal, state, and local environmental regulations prior to starting service.

For permanent service, in-water and uplands infrastructure expansion would be needed at the Pier 50 facility. The following work would further define impacts and any necessary mitigating measures as a part of the environmental review in the design phase of project implementation:

- Preparing a biological evaluation.
- Evaluating potential impacts to threatened and endangered fish species at landing sites.

The Marine Division will consult with Tribes with Usual and Accustomed treaty rights early in the environmental review process.

IMPLEMENTATION

The following sections outline the next steps for implementing Phase 1 Service, permanent service and an estimated schedule for implementation.

Phase 1 Service

Phase 1 Service would require minimal capital improvements at the Shilshole Marina, and landing infrastructure is already in place at Pier 50. Shuttle service would also be provided for the Phase 1 Service.

A diesel-powered vessel would be leased for the Phase 1 Service that would carry approximately 150 passengers and would likely be a diesel vessel. The current back-up vessel for the King County Water Taxi system would serve as a back-up vessel as needed to provide support for the Phase 1 service.

NEXT STEPS

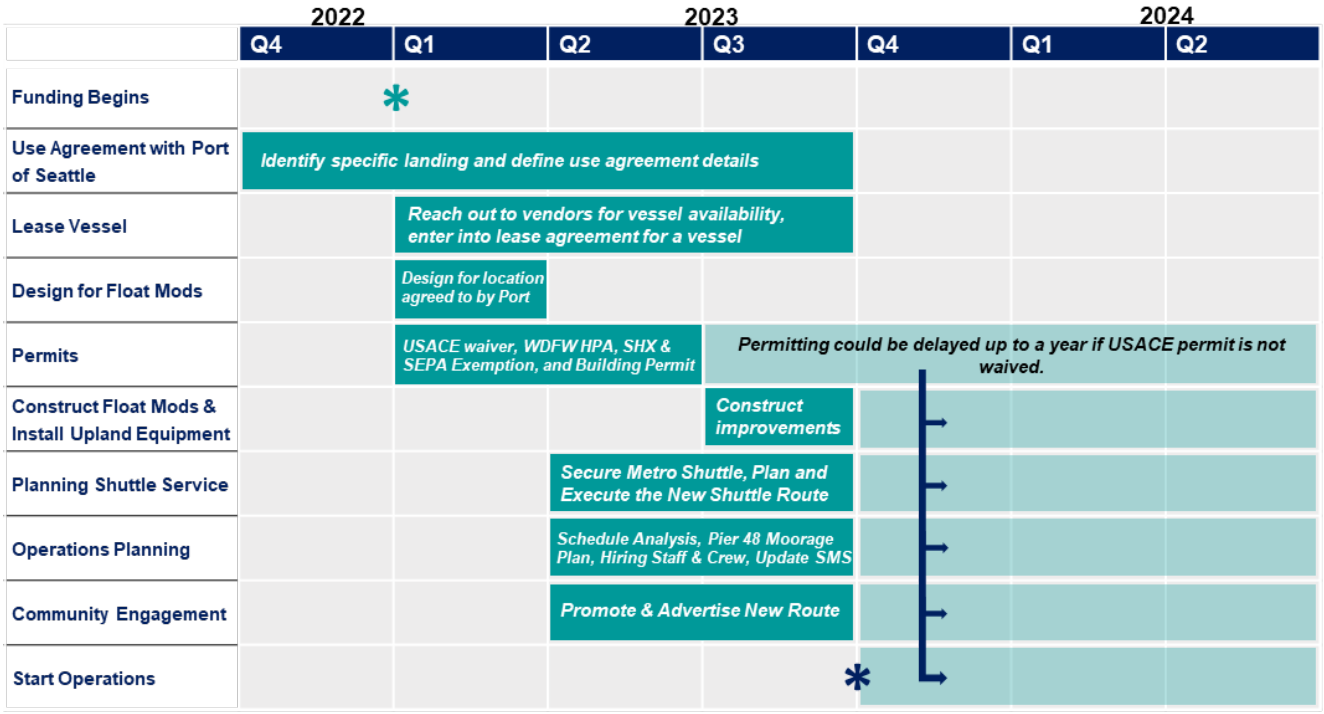
Phase 1 Service

Phase 1 service could begin as early as 2023. Steps that are needed to begin Phase 1 service include:

- Receiving funding through the King County Council.
- Securing a use agreement with the Port of Seattle that would identify the specific improvements at Shilshole Marina.
- Identifying a vessel for lease through contacting potential vendors and entering into a lease agreement.
- Designing float modifications to accommodate passenger-only ferry service at Shilshole Marina.
- Obtaining environmental approvals and construction permits. If the U.S. Army Corps of Engineers (USACE) waives the requirement for authorization, it is anticipated this

process will take about six months to complete. If the USACE requires approval, this could extend service start date by approximately one year.
- Constructing improvements at Shilshole Marina including float modifications and upland improvements like signage and ticket vending machines.
- Planning shuttle service for the new shuttle route.
- Completing operations planning such as completing a schedule analysis, reviewing moorage at Pier 48, hiring staff and crew and updating the Safety Management System (SMS)
- Conducting community engagement to promote and advertise the new route.

Timing of these next steps are shown in the schedule below.



Permanent Service

Pier 50 improvements would be required to support the Ballard service and all five other Water Taxi and Fast Ferry services from the Pier 50 location. These improvements would take years to design, permit, and construct.

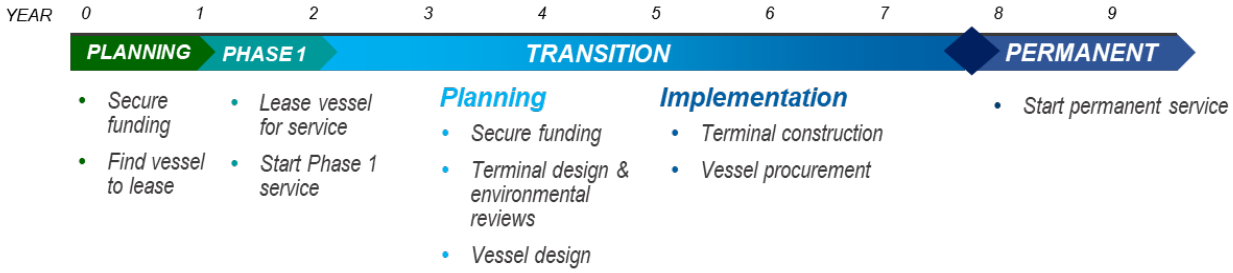
Schedule

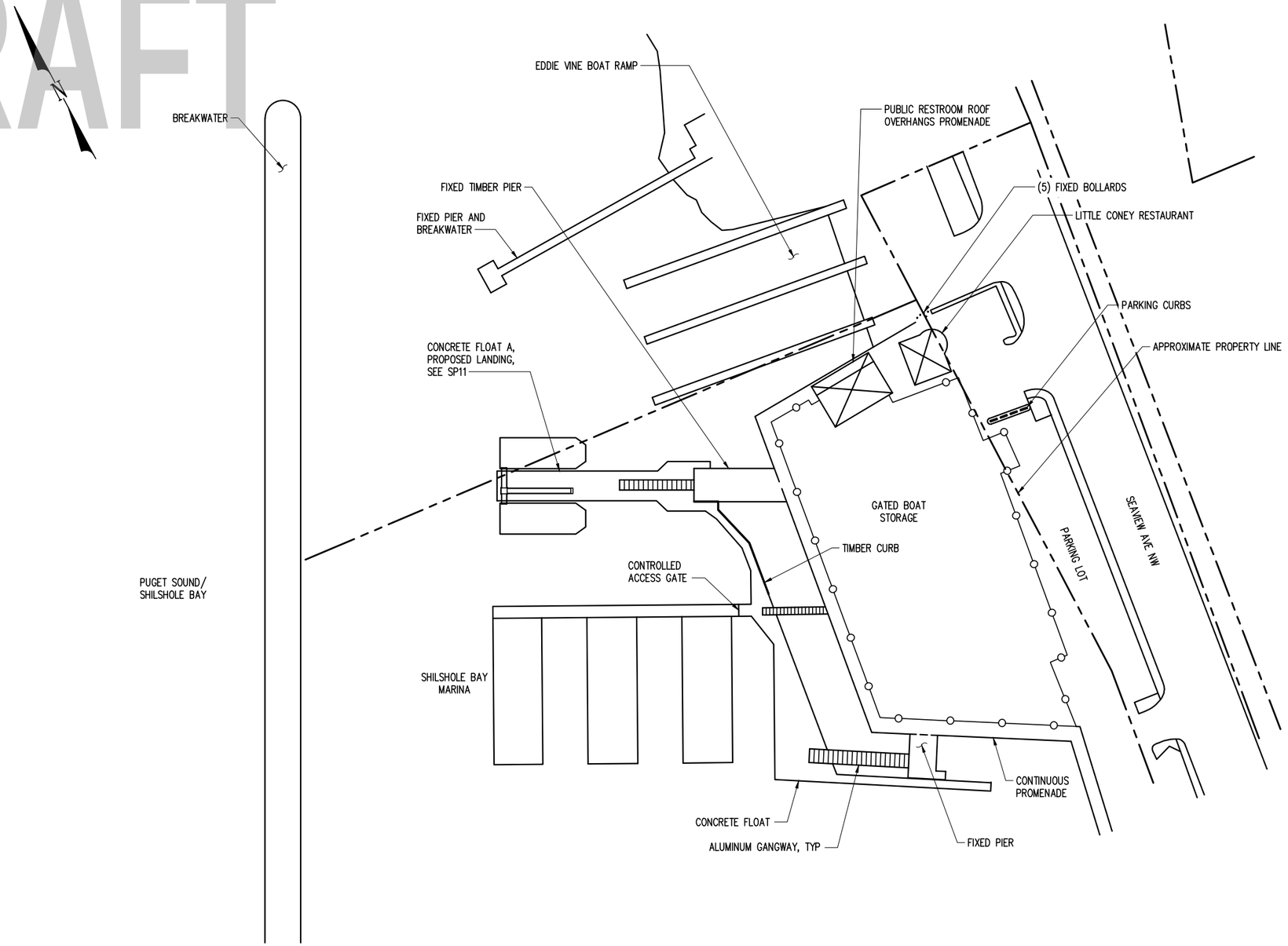
Implementing Phase 1 Service and permanent service would take approximately eight years. The first year would be dedicated to securing funding for service, conducting outreach, making lease arrangements and constructing improvements at Shilshole.

The Phase 1 service would operate for two years and, if approved for permanent service, there would be a transition period to plan and implement permanent service. Key assumptions that went into the development of this schedule included:

- Total environmental and permitting approximately four years.
  - Preliminary environmental work time frame: 6-9 months
  - EIS process: 2 years

  - Federal, state, and local permitting: 18 months
- Pier 50 terminal construction will take approximately one year after regulatory approval
- Vessel procurement and construction will take approximately 2 years and can occur concurrently with terminal improvements





PLAN
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0 50 100 150
SCALE IN FEET

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King County
Department of Transportation

KING COUNTY DEPARTMENT OF TRANSPORTATION
MARINE DIVISION - KING COUNTY WATER TAXI
SHILSHOLE CONCEPT

OVERALL SITE PLAN

DATE: 1/7/2022
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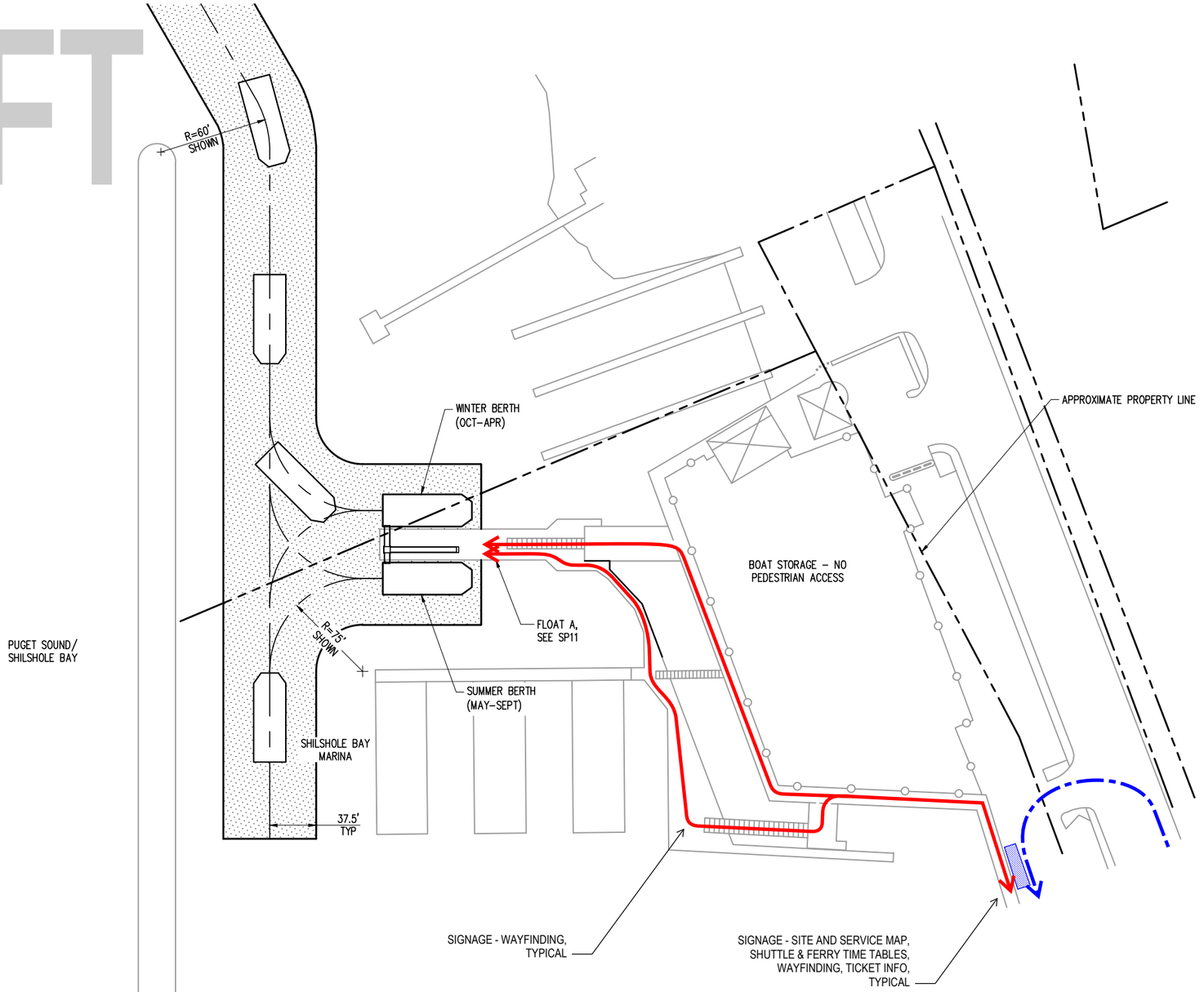
SHEET NO: - OF -



NOTES:
1. SEE SP1 FOR ADDITIONAL INFORMATION.
2. 72'x26' FERRY SHOWN.

SHUTTLE PATH
PEDESTRIAN PATH

PLAN

SCALE: 1" = 100'

0 50 100 150

SCALE IN FEET

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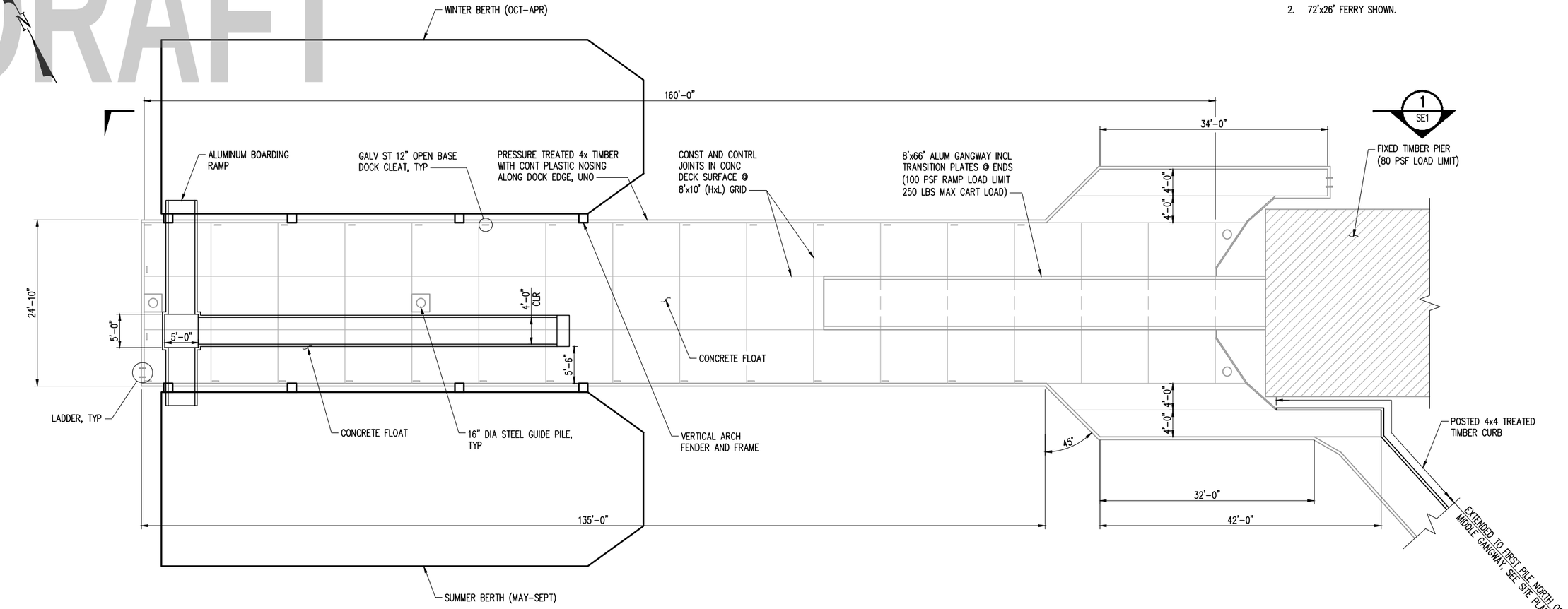
MARINE DIVISION - KING COUNTY WATER TAXI
SHILSHOLE CONCEPT

ACCESS PLAN

NOTES:
1. DIMENSIONS SHOWN ARE APPROXIMATE AND REQUIRE FIELD VERIFICATION.
2. 72'x26' FERRY SHOWN.



PLAN
SCALE: 1/16" = 1'–0"

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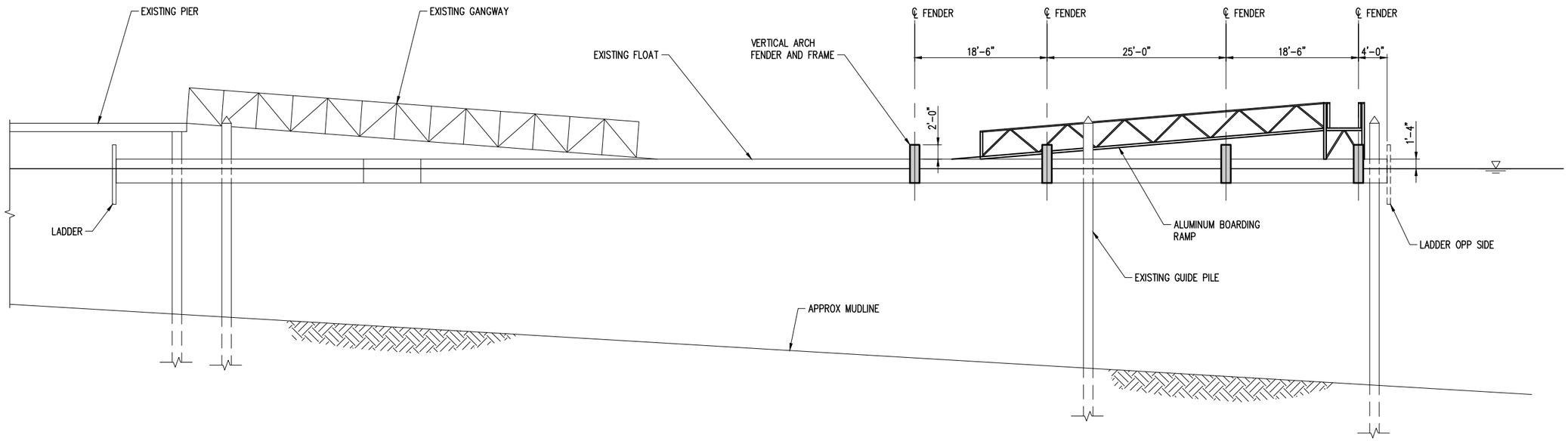
MARINE DIVISION - KING COUNTY WATER TAXI
SHILSHOLE CONCEPT

PROPOSED FLOAT PLAN

DRAFT

NOTES:
1. SEE SP10 FOR ADDITIONAL INFORMATION.



ELEVATION
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MARINE DIVISION - KING COUNTY WATER TAXI
SHILSHOLE CONCEPT

PROPOSED FLOAT ELEVATION

DATE: 1/7/2022
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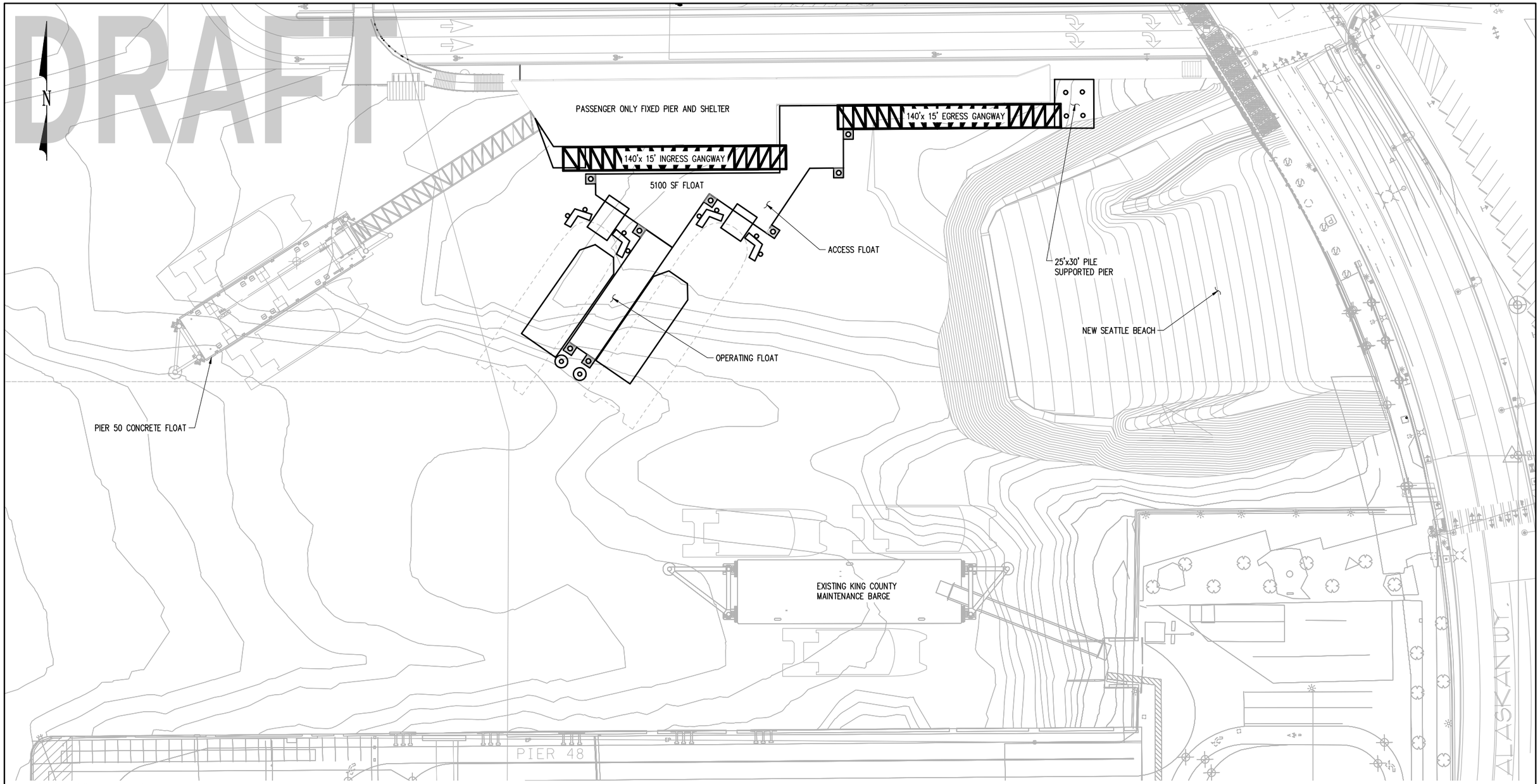
SHEET NO: - OF -

PLOTTED: Feb 11, 2022 - 9:21a PLOTTED BY: RICKT

DRAFT



GENERAL NOTES:

1. NEW OVER WATER COVERAGE 12,540 SF
2. NEW PILE APPROXIMATE
   36"ø (8)
   30"ø (16)

PLAN
SCALE: 1" = 60'

0 30 60 90
SCALE IN FEET

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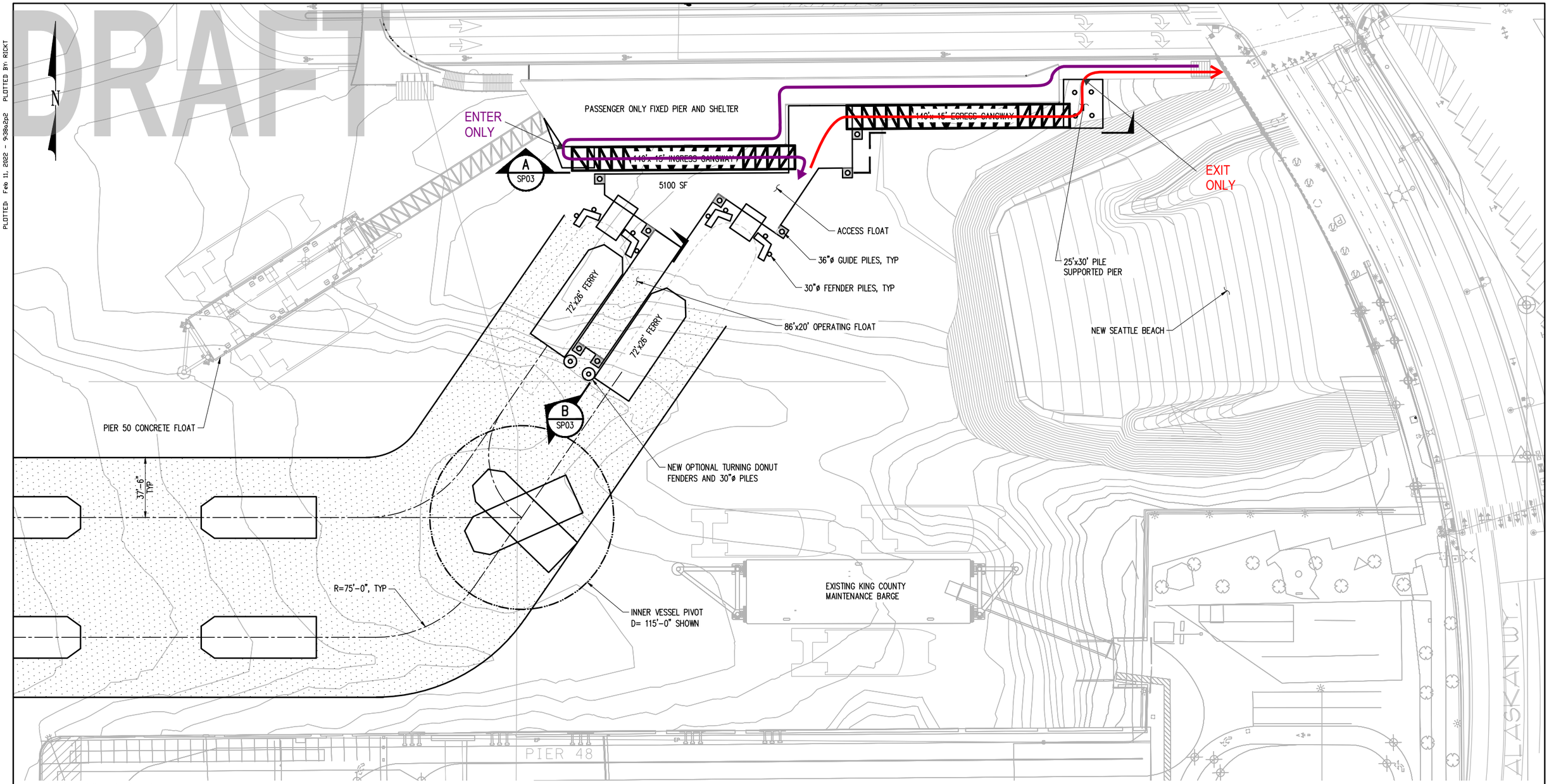
KING COUNTY DEPARTMENT OF TRANSPORTATION
MARINE DIVISION - KING COUNTY WATER TAXI
PIER 50 CONCEPT

SITE AND PROPOSED IMPROVEMENTS PLAN

DATE: 2/11/2022
DRAWING NO: SP1
SHEET NO: - OF -

FILE: V:\1800436 KKC Pier 50\02_Design (v2019)\P50-SP01

PLOTTED: Feb 11, 2022 - 9:38a&2p2 PLOTTED BY: RICKT



GENERAL NOTES:

1. NEW OVER WATER COVERAGE 12,540 SF
2. NEW PILE APPROXIMATE
   36"ø (8)
   30"ø (16)

PEDESTRIAN INGRESS PATH
PEDESTRIAN EGRESS PATH

PLAN
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MARINE DIVISION - KING COUNTY WATER TAXI
PIER 50 CONCEPT

ACCESS AND SITE IMPROVEMENTS PLAN

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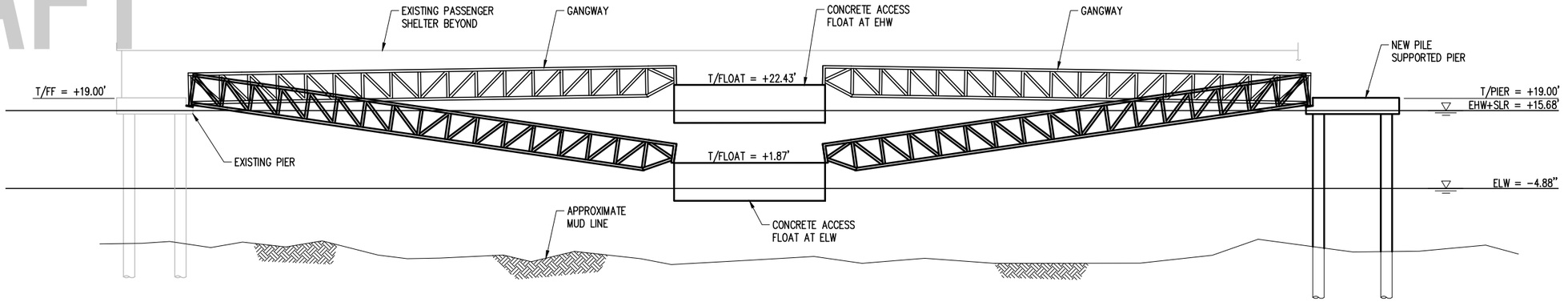

ACCESS FLOAT AND GANGWAYS – ELEVATION (A / SP02)

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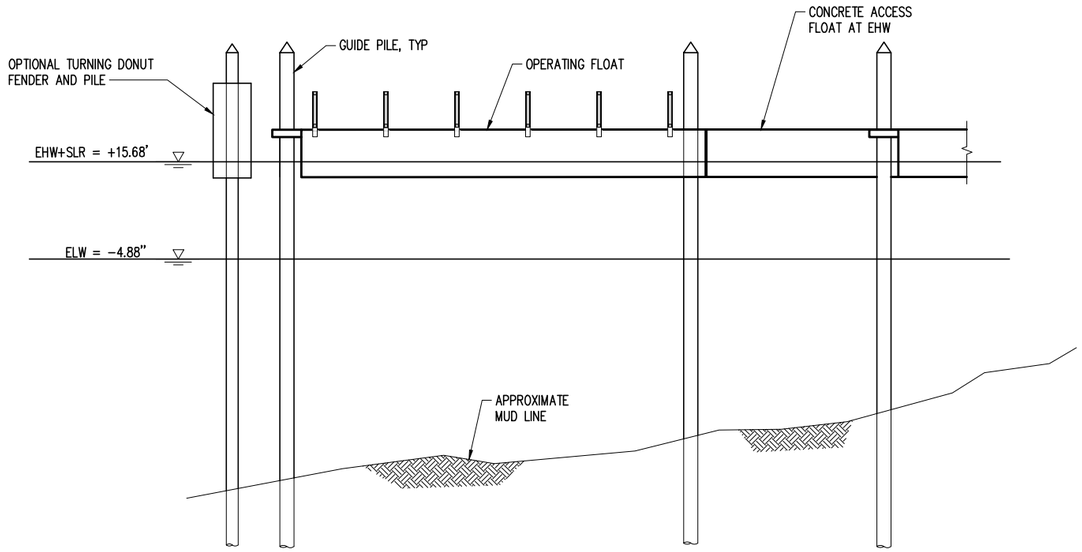

OPERATING FLOAT – ELEVATION (B / SP02)

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KING COUNTY DEPARTMENT OF TRANSPORTATION
MARINE DIVISION - KING COUNTY WATER TAXI
PIER 50 CONCEPT

ELEVATIONS

Final Water Taxi Expansion Progress Report

Appendix C

Propulsion Analysis and Electrification

Propulsion Analysis Introduction and Methodology

To reduce the effects of climate change, ferry services and the transportation industry have been innovating technologically and working toward zero-emissions operations. Traditional passenger-only ferry (POF) vessels are powered by conventional diesel propulsion, or in the case of the current King County Water Taxi vessels, use of a B20 blend of biodiesel and ultra-low sulfur diesel fuel. Diesel fuel releases carbon dioxide, a greenhouse gas that contributes to climate change. At the state and local level there is a focus on establishing goals to decrease greenhouse gas emissions and aligning with these goals is a priority for implementing new King County Water Taxi service.

This alternative propulsion analysis was conducted to understand the propulsion alternatives available, how those alternatives apply to the proposed expansion routes (Kenmore and Ballard), and what level of emission savings could be achieved with the goal of achieving zero-emissions, as much as possible. Consultation with industry leaders provided information to help frame the applicability, timeframe of technology progression, and input as to the power required to meet the service profiles for the Kenmore and Ballard routes. Key industry stakeholders included local vessel designers, vessel builders, marine battery manufacturers, and local utility companies. Consultation with these stakeholders were around the following key topics:

- Current available vessel and propulsion technologies, and associated specifications
- Future technological landscape and timeframe of technological development
- Power requirements and landside infrastructure to support low-emissions propulsion

The following sections of this analysis present the background information and current conditions of POF propulsion technology, a summary of propulsion alternatives considered, the strengths and weaknesses when applying to Water Taxi service, and identification of the preferred propulsion system to be analyzed in the final report.

Industry Stakeholders
ABB
All American Marine
Arcadia Alliance
BAE Systems
BMT
Elliott Bay Design Group
Glosten
Green City Ferries
Schneider Electric
Seattle City Light
Spear Power Systems

Analysis Overview

Multiple propulsion alternatives were evaluated specific to the two routes in review, each with different route profiles and power needs. Table A1 below shows all analyzed options, from zero-emissions to alternative diesel and gas fuels. For findings regarding each of the analyzed options, please see the *Propulsion Alternatives and Vessel Design* section of this Appendix.

Table A1: Alternative Propulsion Options Assessed

Zero-Emissions	Hybrid Propulsion	Alternative Diesel & Gas Fuels
• Nuclear • Hydrogen Fuel Cell • Full Plug-in Electric	• Hybrid Diesel-Electric • Plug-in Hybrid	• Conventional Diesel (ultra-low sulfur diesel) • R99/ Renewable Diesel • Liquefied Natural Gas (LNG)

Of the analyzed alternatives, the plug-in hybrid option was recommended to move forward to the costing analysis. For comparison purposes, a cost baseline will be also provided. This baseline will assume that the new Kenmore and Ballard services will be implemented with the propulsion technology

that is currently used by the rest of the water taxi system, conventional diesel. The cost baseline will be produced for comparative purposes only, with the plug-in hybrid being the propulsion method deemed most promising by the propulsion analysis. The following sections outline how this alternative was selected by first identifying the needs a propulsion system must meet for each route and then discussing how the potential options meet the selection goals.

Background and Current Conditions

Passenger vessels operating at high-speeds (>25 knots) have high energy requirements and the regulatory framework for these alternative propulsion options is not yet clearly defined. The following section provides background on the energy needed to power the proposed water taxi services and an overview of the current regulatory and technological conditions in which the proposed POF routes would operate.

Energy and power needs for high-speed ferries

POF services with smaller vessels that run at high speeds require a large amount of power to operate with a smaller space to accommodate battery storage. Given current technologies, these characteristics are currently challenging to decrease emissions while maintaining higher vessel speeds. The vessel hull resistance of high-speed ferries increases exponentially with the vessel speed. In other words, a ferry operating at 28 knots (the speed proposed for both the Kenmore and Ballard route to meet time competitiveness of other modes) needs between four and eight times as much power as a similar ferry operating at half that speed.

Providing this much power from alternative energy sources can prove difficult as current electric battery and other low emissions technologies have a lower energy density than diesel fuel. In the case of batteries, this means that the number and size of batteries required to store enough energy to operate the vessel at the required speed (energy density), would be too heavy to fit in a standard hull design for a 150-passenger vessel and would require even more energy to push the heavier vessel through the water. Significant hull design changes could mitigate this. These changes may include making the hull larger while carrying fewer passengers, though this mitigation measure would likely be insufficient and would still result in a negative impact of the service profile currently established for these routes. Another option would be to use advanced hull materials, such as carbon fiber, to reduce the weight of the hull. These advanced materials may reduce the hull weight enough to maintain the current service profile but will likely require regulatory approvals with uncertain timelines. This is discussed in more detail in the *Regulatory environment* subsection later in this report. Until the energy density of current battery technology improves, full electrification of a high-speed, smaller vessel may be unattainable.

An alternative energy form, compressed hydrogen, used in fuel cells has an energy density that is higher than current battery technology but still lower than diesel fuel. The hydrogen is stored in a compressed gas form and current regulations would require the storage tanks be located outside the hull for safety.

Like other transit modes, high-speed POF services aim to move people as quickly as possible with just enough time in the dock to unload and load passengers (referred to as dwell time). This ferry service model does not allow for long periods of time at the dock for charging batteries.

Current state of battery technology

With the increasing demand for battery powered automobiles and buses, battery technologies for these land-based modes of transport have been developing in parallel with batteries for marine vessels. While lessons can be learned across platforms, the battery technologies themselves are very different and are not directly interchangeable. For example, marine batteries are under the jurisdiction of the US Coast

Guard (USCG) and must meet a higher level of safety requirements. These safety requirements, particularly related to preventing and suppressing fires if the batteries overheat, can cause marine batteries to be more expensive than their landside counterparts. Marine battery systems can also charge more quickly and supply more power per battery than the batteries currently used in the automobile industry.

Marine battery technology is rapidly developing, but the weight of batteries significantly increases energy consumption. Additionally, current batteries can be limited in how fast they can be charged or discharged. A major focus of marine battery innovation is the development of alternative chemistries that have a greater energy density, allowing future battery banks the ability to store the same amount of energy with less weight. Another focus for marine battery development is the ability to charge and discharge quickly without affecting the service life of the batteries.

Given the larger energy requirements for high-speed ferry routes and the short dwell times available for charging, transferring sufficient energy into the vessel batteries creates a very high demand for a relatively short period of time. In many locations, these high, short-term demands cannot be met if the ferry were to be charged directly from the electrical utility grid. To mitigate this, shoreside batteries can be used to reduce the peak demand on the grid, but the short discharge time is likely to shorten the expected service life for the batteries.

Regulatory environment

Low-emissions ferry technology is a rapidly evolving industry. USCG regulations for electric propulsion technology and hydrogen storage and transfer are in development. As a result, regulations do not currently exist for many technologies, and would require coordination with the USCG through the planning, design, and construction phases of the project. Vessel design alternatives that include lighter materials (such as carbon fiber) and reduce fuel consumption are also under development by the USCG.

Other federal regulations faced by ferry propulsion systems that use diesel engines include all new and re-powered engines being required to mee the EPA's Tier 4 engine standards. Tier 4 engines are accompanied by exhaust treatment systems that result in lower emissions of dangerous air pollutants such as nitrous oxides, sulfur oxides, and particulates. However, Tier 4 engine regulations are not specifically aimed at reducing the greenhouse gas emissions that contribute to climate change. Apart from Tier 4 engine systems, leaner low-sulfur diesel and biodiesel blends are also used by many services to decrease smog and particulates caused by combustion engines that are used in POF operations.

Propulsion Alternatives and Vessel Design

There are a variety of vessel propulsion system options and vessel hull designs that can reduce greenhouse gas emissions. The following sections summarize the vessel propulsion options and vessel design options considered for the potential Kenmore and Ballard Water Taxi routes.

Alternative diesel and gas fuels

Low-emission and renewable fuels are available that can be used with traditional diesel (compression ignition) engines. While these fuels do not necessarily reduce greenhouse gas emissions, they are currently used to reduce the emission of particulates and other air pollutants compared to conventional diesel fuel. A B20 blend ultra-low sulfur bio-diesel fuels are used in the current King County Water Taxi vessels. These alternatives are drop in fuels, do not require any additional shoreside infrastructure, and can be used with existing engines. However, some alternatives, like liquefied natural gas (LNG), require different engines, modifications to an engine's fuel system, and could affect maintenance schedules.

While conventional diesel fuel is currently the least expensive option, it has the highest greenhouse gas emissions. Of the fuel options, R99/Renewable Diesel best meets Metro's emissions goals by providing the greatest reduction in greenhouse gases. Table A2 provides a summary of the strengths and weaknesses of the alternative diesel and gas fuel options.

Table A2: Strengths and Weaknesses of Alternative Diesel and Gas Fuels

Type	Description	Strengths	Weaknesses
Conventional Diesel (B20 ultra-low sulfur bio-diesel)	Use Tier 4 engines and conventional liquid diesel fuel	• Least expensive • Same as existing service • No shoreside infrastructure required; delivered by truck or at commercial fuel pier	• Highest emissions of analyzed options • Subject to fluctuating diesel prices • Future retrofits/technological updates would likely be expensive
R99/ Renewable Diesel[1]	Use Tier 4 engines and renewable diesel	• Significant emissions reduction (60 to 90% cleaner than conventional diesel[1] • Petroleum free • Familiar technological platform • Minimal shoreside infrastructure-possibility of fueling by truck	• More expensive than conventional diesel • Non-zero emissions • Limited maritime experience with R99 - additional maintenance and replacement of filters may be required • Future retrofits/technological updates would likely be expensive
Liquefied Natural Gas (LNG)	Natural gas is held in a liquid state using a cryogenic tank and is used to fuel an engine that is designed to accommodate LNG.	• Decrease in emissions when compared to non-biodiesel options • Multiple current examples in operations • Potential operations and maintenance cost savings due to LNG being cleaner than diesel • Minimal shoreside infrastructure-possibility of fueling by truck	• Diesel engines require modifications to use LNG • Current operations use LNG engines for significantly larger vessels • Non-zero emissions in burning • Emissions are often released during extraction and storage • Fuel must be stored at sub-zero temperatures • Limited opportunity to convert systems and capitalize on emerging technologies • Infrastructure has higher capital costs than diesel • Gas tanks would need to be located above deck due to USCG regulations

Hybrid propulsion options

Hybrid propulsion options strive to maintain the reliability of diesel power while providing opportunities to decrease emissions and transition to more electric propulsion as battery technology continues to

[1] https://frogferry.com/pilot/sustainability/

improve. A variety of hybrid options are currently available and represent the mid-range for vessel costs--they are more expensive than conventional diesel options but less expensive than the zero-emission propulsion options discussed in the following section[2].

The hybrid propulsion options provide redundancy to be able to use both diesel and electric propulsion. The hybrid diesel-electric option is powered by a diesel motor rather than shoreside power like the plug-in hybrid, thus has fewer opportunities to reduce emissions. The plug-in hybrid propulsion is a better option for the Kenmore and Ballard potential water taxi routes based on the ability to reduce emissions through landside charging using clean electricity generated from hydropower. Table A3 provides a summary of the strengths and weaknesses of currently available hybrid propulsion options.

Table A3: Strengths and Weaknesses of Hybrid Propulsion Options

Type	Description	Strengths	Weaknesses
Hybrid Diesel-Electric	Diesel generators are used to generate power for electrical propulsion motors. On-board battery banks are used for power storage. Battery power is generally used during low-speed operations when power requirements are low.	• Higher capital cost than traditional diesel but less than full battery electric • Reduced emissions and noise when operating near terminals and in low-wake zones • Moderate transition to zero-emission technologies developed in the future	• Minimal emissions reduction as the batteries are charged by onboard diesel generators • Added weight of the batteries and other electrical components increase the vessel weight, thereby increasing the power and fuel required to maintain speed unless other weight saving measures are implemented • Batteries (with current technology) require replacement every 5 to 10 years
Plug-in Hybrid	On-board battery banks are used for power storage and power an electric motor for propulsion. Batteries are charged by a landside power source. A diesel engine is also provided, and the vessel switches between power systems based	• Reduced emissions • Redundant systems • Higher capital cost than conventional diesel but less than full battery electric • Limited shore power infrastructure required • Weight of additional propulsion system components could be offset using a carbon fiber hull to improve operating efficiency • Easy transition to zero-emissions technologies developed in the future	• Emission reductions when operating on battery power which is slightly offset due to the weight of the systems • Added weight of the batteries and other electrical components increase the vessel weight, thereby increasing the power and fuel required to maintain speed unless other weight saving measures are implemented • Batteries (with current technology) require replacement every 5 to 10 years

[2] Lummi Island Ferry System Alternative Fuel Analysis

	on route operating needs		

Zero-emissions options

Nuclear, hydrogen fuel cell, and full plug-in electric vessels are on the cutting edge of zero-emissions propulsion technology. Smaller high-speed POF vessels, such as those proposed for the Kenmore and Ballard routes, are an emerging frontier for zero emissions technology. Due to the very large power requirements for these routes, the challenges with energy density that are faced by hydrogen fuel cell propulsion options are similar to those faced by battery technology when attempting to maintain sufficiently fast service speeds while keeping operating costs relatively low.

While nuclear power has zero emissions, there are no ferry vessels that are powered by this technology. There are challenges with safety, the regulatory environment, and nuclear waste disposal.

Hydrogen fuel cells have a lot of potential as a marine power source and demonstration vessels have been built in the U.S. Currently, the size and weight of the fuel cell itself, the need to store hydrogen as a compressed gas, and the relatively low energy density of this fuel limits the applicability of this energy source for high-speed ferries. Another challenge is the availability of hydrogen fuel, which must be delivered by truck from California at this time, thereby offsetting any emission reductions resulting from its use[3].

Each of these challenges is being addressed by emerging technologies, and during the preparation of this report, Washington Maritime Blue[4] submitted a letter of interest in response to the US Department of Energy's Hydrogen Energy Earthshot program outlining the numerous regional initiatives and studies currently underway to develop a sustainable hydrogen-based maritime ecosystem including generators, distributors, end users, and supporting industries. The potential for hydrogen fuel cell ferry service operated by King County Metro was included in the letter. If adequate support can be found for these programs, hydrogen as a clean fuel could be a much more viable option in five to ten years.

Full plug-in electric vessels use battery technology to power the vessels. This technology, while currently employed in the maritime industry, is typically ideal for shorter, slower routes. Currently, the battery power required for full plug-in electric vessels weighs down the vessel that inhibits the necessary higher speeds required for POF operations.

Table A4 summarizes the strengths and weakness of the zero-emission propulsion options that could potentially be used for the proposed Kenmore and Ballard Water Taxi routes.

[3] There is a project underway to build a hydrogen generation plant at the Wells Dam in Eastern Washington using excess hydropower. Once complete, hydrogen will be more readily available in the Puget Sound area.

[4] Washington Maritime Blue is a non-profit, strategic alliance formed to accelerate innovation and sustainability in support of an inclusive blue economy.

Table A4: Strengths and Weaknesses of Zero-emissions Propulsion Options

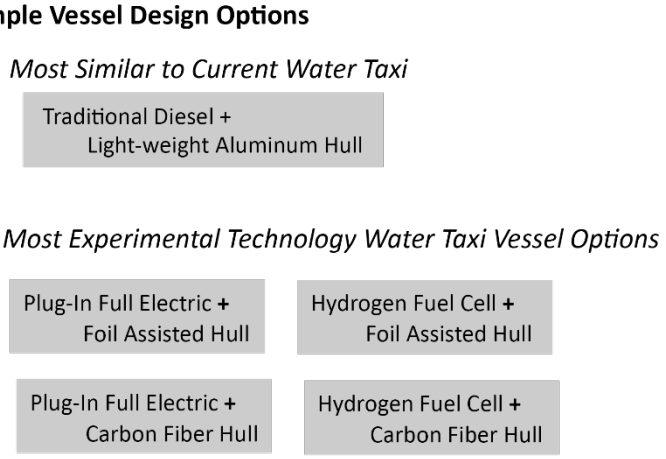
Type	Description	Strengths	Weaknesses
Nuclear	Powered by nuclear fission	• Zero emissions	• Higher safety requirements • No nuclear-powered ferry vessels are currently in operation • Nuclear waste disposal • Significant coordination with the USCG due to limited existing regulations
Hydrogen Fuel Cell	Batteries are used for startup and can be used alongside fuel cell power for faster speeds. Fuel cell-only power can be used. While travelling at slower speeds and idling at the dock, fuel cells can recharge the batteries.	• Zero emissions- provided that the hydrogen is produced w/o emissions as well • Alignment with the DOE's Hydrogen Energy Earthshot initiative • Better suited to the high speeds (and high-power requirements) of the routes in this study • Potential for technological upgrades and increased speed/capacity in the next 5 years • Fewer mechanical parts than a traditional diesel system could lead to decreasing maintenance costs • Minimal shore power infrastructure needed	• Production of hydrogen offsite can be emissions generating • Refueling of current technology could take a couple of hours • Current closest hydrogen production is in California- significant emissions produced in transport of hydrogen fuel • No current vessels of this size and speed have been developed as proof of concept • Hydrogen tanks may need to be located above deck due to safety regulations • Significant coordination with the USCG due to limited existing regulations
Full Plug-in Electric	Electricity is drawn from the power grid or onshore battery reserves into onboard electrical battery storage. Batteries power an electrical propulsion motor.	• Zero emissions- provided that the electricity is also produced w/o emissions • Ideal for shorter/slower routes with lower power demand • Fewer mechanical parts than a traditional diesel system could lead to decreasing maintenance costs	• Weight from batteries needed may necessitate an alternate hull form (foil-assisted hull form, carbon fiber composite hull) which is more expensive and carries a higher design risk • Limited dwell time requires landside battery infrastructure to reduce demand on the power grid • Batteries (with current technology) require replacement every 5 to 10 years • Extensive shore power infrastructure needed • Significant coordination with the USCG due to limited existing regulations

Vessel Design to Reduce Emissions

Vessel design elements like foil-assist hulls or carbon fiber hulls can be used to decrease the weight and energy needs of a vessel and thereby reduce emissions. However, these associated technologies are often expensive and few US shipyards currently have the ability to construct them.

These vessel design options can be used in conjunction with alternative propulsion options. Figure A1 shows how these technologies work with different propulsion options.

Figure A1- Example Vessel Design Options



Foil-Borne and Foil-Assist Hulls

Energy demands can be reduced by developing hull forms with lower resistance. Hydrofoils that either fully or partially support the hull at cruising speed are currently in service, with partially supporting foils more common. Hydrofoils reduce resistance by lifting the hull out of the water, thereby reducing wave-making resistance. While this reduces resistance at medium to high speeds, the foil increases drag and vessel draft at low speeds. For deep water routes with no speed restrictions, such as Ballard to downtown Seattle, foils can work well. On the Kenmore to UW route, the slow zone west of Webster Point and the water depth at the UW WAC present challenges that would require additional study to determine the viability of a foil-supported hull.

Carbon Fiber or Composite Hull Structure

Light-weight hull options such as carbon fiber are being developed to improve the efficiency of conventionally powered ferries and they can also be used to mitigate the weight impacts of electric propulsion batteries and other currently weight-intensive propulsion alternatives.

These materials are strong but are less malleable than traditional metal hulls. While the breaking strength of carbon fiber may be higher than aluminum, if an unusual load is applied, such as hitting a mostly submerged log at high speed, carbon fiber would crack or break where aluminum would bend or dent. This behavior drives the need for material-specific design formulas and safety factors for new USCG regulations currently under development to ensure a carbon fiber or composite hulls are at least as safe as those built from steel or aluminum.

Moreover, manufacturing carbon fiber hulls requires advanced technology and training available at only a few US boatbuilders. Consequently, pursuing a vessel with this technology may limit the location options for vessel construction and/or hull maintenance.

Propulsion Alternative for Costing: Plug-in Hybrid

Based on the reduction in greenhouse gas emissions, the available technology, and ability for future conversion to zero-emission propulsion, the plug-in hybrid propulsion option is recommended for future analysis for the potential Kenmore and Ballard water taxi routes. The following sections provide the goals established for evaluating propulsion alternatives, the route characteristics, and additional detail regarding plug-in hybrid vessel technology.

Propulsion Alternative Evaluation Goals

Each propulsion alternative was evaluated based on the identified goals for selection, which include:

- Decrease greenhouse gas emissions
- Be able to capitalize on future technological developments to further decrease emissions
- Avoid high levels of risk/ uncertainty in design cost & schedule

Evaluation of alternatives relative to these goals helped to identify the options most suitable for the proposed routes and aligned with overall King County Metro goals of reducing greenhouses gases of the overall Metro system.

Route considerations

Taking the identified goals and the knowledge obtained through extensive outreach with industry stakeholders, each route was examined individually to identify its power needs and any route-specific conditions. Both routes require a cruising speed of 28 knots to meet the proposed service schedules and remain time-competitive with other modes. The selected propulsion system alternative would need to provide enough power to travel at this high-speed for a significant portion of each route which ranges from approximately 9 to 10.5 miles in distance.

Kenmore

The proposed Kenmore Water Taxi route, which is approximately ten and a half miles long in one direction and requires a cruising speed of 28 knots to provide a competitive travel time, requires more power compared to other existing Water Taxi routes.

2,900 kW hr	**Sufficient**	**Limited**	**40 min**
Power Need per Round Trip	Kenmore Uplands Space	UW Uplands Space	Time Available to Charge Batteries b/w Sailings

Ballard

As a slightly shorter route of just over nine miles, the Ballard route would require less power overall than the Kenmore route, despite also traveling at the high speed of 28 knots for most of the route length. Additionally, as sailings on this route depart every hour, there is additional time to charge landside batteries, meaning that the overall grid demand would be lower for this route than for the Kenmore route.

With one end of this route landing at Pier 50, adjacent to the planned WSF Colman Dock electrification project, there is opportunity for the Ballard route to partner with other proposed projects along the Seattle Waterfront to more efficiently support improvements to the local power supply. However, it is important to note that transitioning the entire Water Taxi system, including the existing Water Taxi routes to zero emissions operations would result in additional power demands at the Pier 50 terminal.

2,600 kW hr	Sufficient	Sufficient	60 min
Power Need per Round Trip	Ballard Uplands Space	Pier 50 Uplands Space	Time Available to Charge Batteries b/w Sailings

Propulsion Alternative Evaluation

Taking into consideration the selection goals and the route characteristics, each propulsion alternative was then evaluated to identify the options most suitable for the proposed routes.

Zero emission propulsion options (nuclear, hydrogen fuel cell and full plug-in electric) were found to have the highest emissions reduction opportunity and also the highest level of uncertainty as it relates to the timeframe, cost, and availability of fuel sources. This is mostly associated with the current state of power density, or the size and weight at which power can be stored on a vessel and the power produced from these alternatives. Alternative diesel and other gas fuels such as hydrogen were identified to provide low implementation risk, however they also provide the least amount of emission reduction and would be more difficult to retrofit if new technology options become available. Hybrid options can support the desired route profiles with the current state of technology and have the flexibility to be converted to zero-emissions systems in the future. Table A5 below summarizes how each of the propulsion options align with the selection goals. The following sections provide additional detail on how the proposed propulsion options do and do not align with the identified goals.

Table A5: Summary of Propulsion Option Analysis

Propulsion Option	Emissions reduction potential	Potential to capitalize on future technologies	Level of risk/ uncertainty in design cost & schedule
Zero-Emissions	Highest	Uncertain	High Risk
Hybrid	**Medium** Plug-in hybrid has a higher potential to reduce emissions than diesel-electric based on the ability to reduce emissions through landside charging using clean electricity from the grid.	**High** Diesel components could be removed while electric motors could remain and be powered by emerging technologies, such as improved batteries or hydrogen fuel cells.	**Medium Risk** Technology currently exists that meets the specified route profiles, though it is not widespread.
Alternative Diesel and Gas Fuels	Medium to Low	Limited	Low

Decrease Greenhouse Gas Emissions

The first factor considered was how the propulsion alternative(s) selected for the Kenmore and Ballard route would align with Metro's goal to decrease greenhouse gases now and into the future. As a result, the zero-emissions propulsion options of hydrogen fuel cell and full plug-in electric would be the most desired if the systems were light enough to support POF service at the needed cruising speed for the desired vessel size of 150 passengers. However, interviews with industry stakeholders indicated that no POF vessel of the desired size is currently operating with a zero-emissions propulsion system at a 28-knot speed for a route of this length.

Given the energy requirements and dwell times on both routes, full electrification with direct charging of the ferries from the grid is not feasible without significant upgrades to the available electrical utility infrastructure. Using shoreside batteries to limit the peak demand may be possible but only if one-way charging is provided at both ends of both routes. Even with one-way charging available at all landings, a full-electric propulsion system would weigh more than a comparable diesel propulsion system and either a carbon fiber or foil-supported hull would be required to mitigate the added weight. Additionally, space available at the terminal locations was evaluated to determine how much square footage could be devoted for electric battery onshore storage. While most terminals had sufficient space for the footprint for batteries to support a fully-electric service, space available at the UW WAC is currently limited to support the large footprint needed for batteries to support a fully-electric option for this route, given current battery energy density.

Level of risk/uncertainty in design cost & schedule

Although the zero-emissions vessel propulsion options would reduce emissions, pursing a vessel design of zero emissions for the Kenmore and Ballard route profiles at this stage would have two primary risks.

1. A high likelihood of the vessel design requiring alteration to the routes' cruising speed and passenger capacity due to current technology weight limitations. Changing the proposed service speed and capacity would make both routes less desirable for users and/or less time competitive with current travel options, at the expense of route ridership.
2. The uncertainty in the cost and schedule of the vessel design process due to the lack of currently available technology to meet the proposed route specifications. New technology could be developed as a part of this design process that may not require changes to the proposed service profiles, but it is uncertain how long these technologies would take to be developed, how much they would cost to design and manufacture, and how long they might take to be approved by USCG and other relevant regulatory agencies.

Potential to capitalize on future technological developments

Due to the risks outlined above, a zero-emissions propulsion option was not deemed the most feasible option for implementing the Kenmore and Ballard water taxi routes at this time. However, due to the rapid pace of technological development for both hydrogen fuel cells and marine electric batteries, achieving zero-emissions operations by 2030 seems to be a feasible goal, provided that the selected propulsion alternative has a high potential to capitalize on future technological developments that would further decrease operational emissions. Of the remaining propulsion alternatives, a hybrid propulsion system would provide the greatest potential for future emission reductions as it would include both a diesel engine and an electric motor. Provided it is designed with future upgrades in mind, the electric motor can be powered by electricity from hydrogen fuel cells or electric batteries charged from onshore power. The diesel engine and diesel storage tank can be then replaced with additional battery capacity and a more powerful electric motor or hydrogen storage and a more efficient fuel cell.

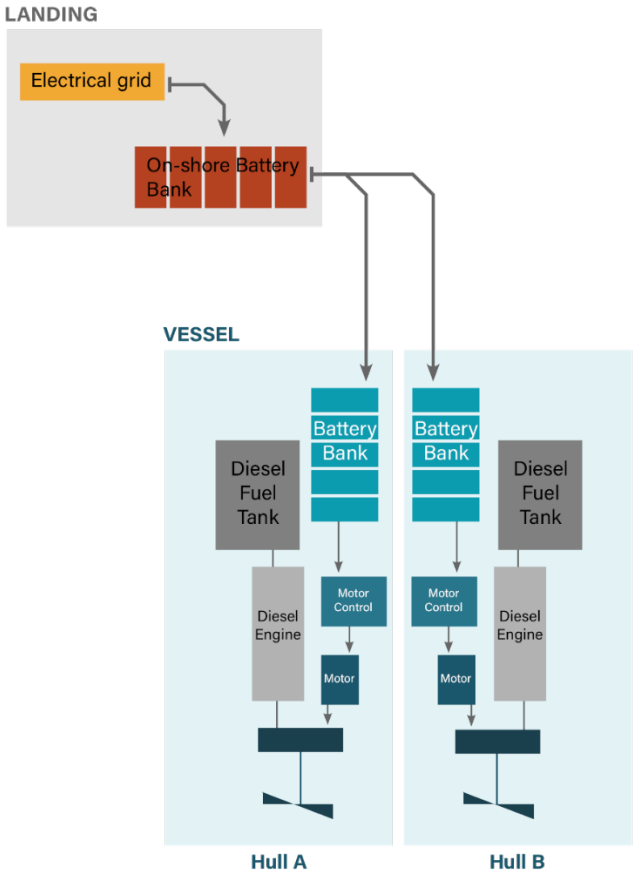
Plug-in Hybrid

Based on this analysis, a plug-in hybrid propulsion vessel would be the most viable for the proposed routes. The vessel would only operate on diesel power for the high-speed portion of the route and would use electric power for the low-speed zone east of Webster's Point (Kenmore/WAC route) and all maneuvering to and from each landing. The shoreside electrical demands to charge the batteries in this option would be small enough that chargers could be provided at both ends of the route with minimal local infrastructure improvements. Although the added weight of batteries and other components would initially limit the net impact on greenhouse gas emissions, the propulsion system could be designed to facilitate the replacement of the diesel engine and fuel tanks with either a high-power

electric or fuel cell propulsion system when one of those technologies is sufficiently mature to be practical and efficient.

Figure A2 illustrates the components of a plug-in diesel-electric hybrid vessel in a 150-passenger catamaran vessel and how the system connects to the electrical grid.

Figure A2: Plug-In Diesel-Electric Hybrid Propulsion System and its Connection to the Grid



This option was selected for its ability to upgrade to the newest clean propulsion technology as batteries and/or fuel cell technology continue to advance. Though shorter and slower routes could operate with currently available technologies, the route lengths and speeds result in weights of the batteries and/or fuel cells that are currently infeasible for the proposed Ballard and Kenmore routes. With the rapid pace of technological development, this hybrid system could be converted to zero-emissions operations within the next ten years. Figure A3 shows how the initial hybrid system could be converted to either full plug-in electric of fuel cell propulsion while keeping the existing hull, low-speed electric motor, reduction gear, shafting, and propeller.

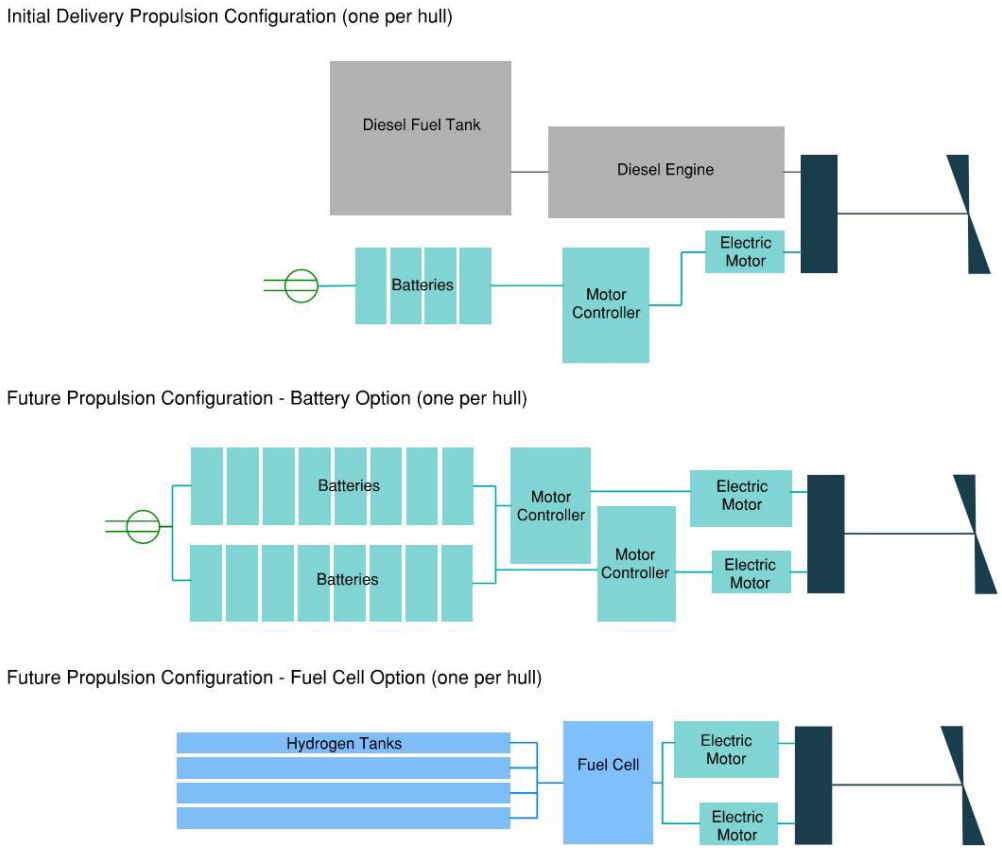


Figure A3- Proposed Hybrid Propulsion Configuration and Potential System Conversion Options

Until the time of system conversion, to decrease emissions as much as possible with the proposed hybrid system, it is recommended that the diesel engine run on R99 that is the lowest emission diesel option currently available. Costing will include the higher cost of this diesel option as opposed to conventional diesel. Emissions savings will be estimated as operational profiles are further defined and will be provided in the final report.

Shoreside infrastructure to support plug-in hybrid

To support a full plug-in electric or a hybrid plug-in electric service with round-trip charging on either route, shoreside electrical infrastructure is required. Compared to the high infrastructure needs of a fully-electric system, a plug-in hybrid requires less infrastructure and would have a much lower demand if charging directly from the grid. For the recommended plug-in hybrid option, the battery Energy Storage Systems (ESS) containers would not be required but a capacitor bank would likely be required to mitigate the upstream impacts of the short-term demand. Switchgear including a primary circuit breaker, utility meter, service transformer, main circuit breaker, auxiliary panel, and distribution / ESS panel would also be required.

The electrical equipment required for a future full plug-in electric service with round trip charging is more extensive and, with current technology, would include the following:

- Three containerized battery energy storage systems (ESS)
- Three ESS transformers

- Switchgear
    - Primary circuit breaker
    - Utility meter
    - Service transformer
    - Main circuit breaker
    - Auxiliary panel
    - Distribution / ESS panel

The shoreside infrastructure also requires an upland area to support these elements. The equipment would require an area of approximately 85 feet by 39 feet, as shown in Figure A4.

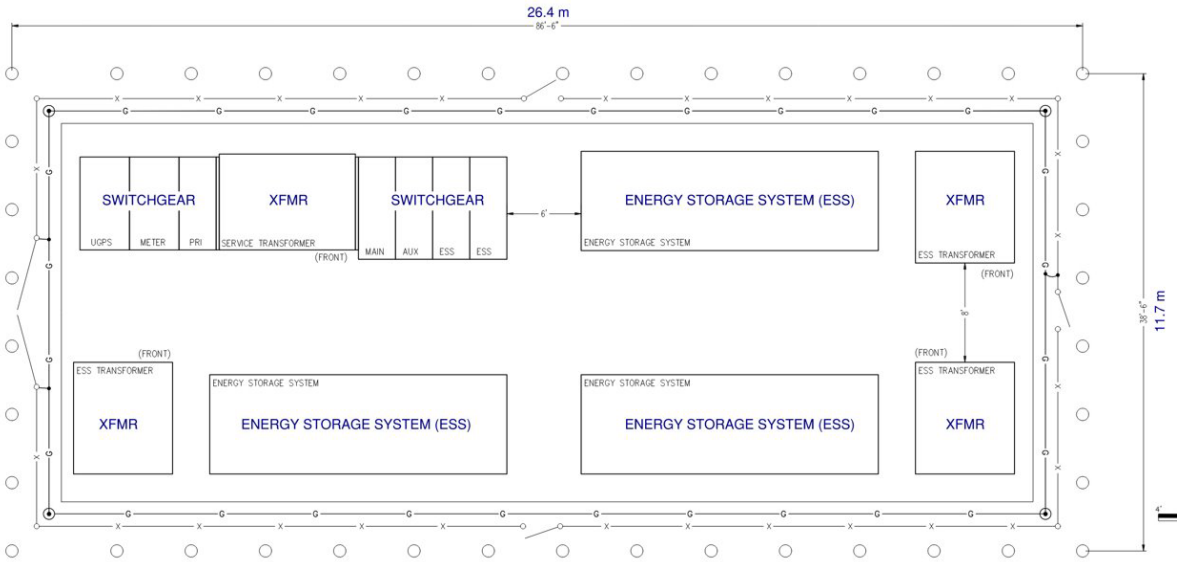


Figure A4: Electrical Equipment at Kenmore or Shilshole for Round-Trip Full-Electric Service

With lower energy requirements, the equipment for one-way charging of a full-electric ferry at these terminals would still require two battery ESS, transformers, and switchgear but it could be configured to occupy a small area of approximately 46 feet by 52 feet, as is shown in Figure A5.

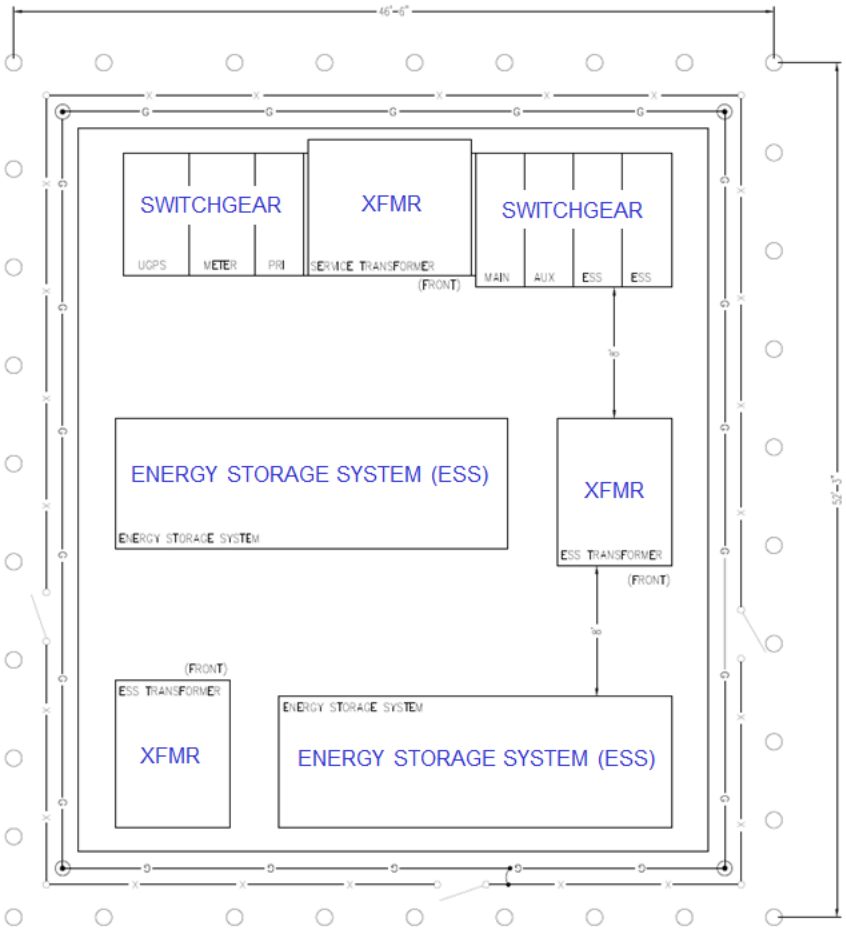


Figure A5: Electrical Equipment at Kenmore or Shilshole for One-Way Full-Electric Service

In future, when converting the hybrid system to an all-electric zero-emissions system, additional space requirements may differ depending upon advancements in battery technology. Based on coordination with the local utilities, additional grid capacity may also be needed to support a full electric system, which would require additional coordination and could take up to 5 years depending on projects going on at the time and on the additional capacity needed.

If in the future, a hydrogen fuel cell system was selected instead, terminal infrastructure needs would be different and could vary depending on the source of the hydrogen. If hydrogen is trucked in, the terminals will need to be reconfigured in a way that allows truck access to the dock, if such access is not currently available. If hydrogen is instead produced on-site, an electrolyzer and associated infrastructure would be needed. Additional details on terminal infrastructure needs would be developed at the time of system conversion.

Final Water Taxi Expansion Progress Report Appendix D: EIR

King County

King County adopted a Strategic Plan for Equity and Social Justice to advance equity and social justice in the community. As new programs or projects are planned, it is expected that an Equity Impact Review (EIR) is conducted as part of the planning, development, and implementation processes. This EIR process merges quantitative data, community engagement, and qualitative findings to inform planning, decision-making, and implementation of actions which affect equity in King County.

The EIR process has five phases. Phase 1 is defining the scope or identifying who will be affected by the program. Phase 2 is assessing equity and community context. Phase 3 is analyzing and decision process development. Phase 4 is implementation with a focus on staying connected with communities and employees. Phase 5 is ongoing learning, with listening, adjusting, and co-learning with communities and employees.

The first three phases of the EIR process are documented here as it relates to the status of planning and implementation readiness for the expansion routes. This work includes analysis through previous planning work including the 2020 studies on these expansion routes. Previous studies included multiple landing sites at the Kenmore and Seattle side for the Kenmore route and an additional potential stop at the Expedia campus for the Ballard route. While this proviso response uses the preferred landing sites of Lakepointe, UW WAC, Shilshole, and Pier 50 for analysis and reporting, this EIR considers all previously considered landing sites for a more robust analysis and reporting of equity impacts for this planning and implementation readiness report.

Phase 1: Define scope of who will be impacted and how

Who is impacted?

King County is striving to invest in areas of greatest need. Areas of need have been identified through the King County Equity score (1-5) assigned to each census tract that measures populations of color, low-income populations, and populations with limited English proficiency. Higher scores represent a more diverse, less wealthy population. These are considered priority populations for King County and are consistent with work done as part of Metro's Mobility Framework. Metro conducted analysis to consider factors such as Community Assets, Family Wage Jobs, Housing Units, total equity scores, as well as percentages of low-income, people of color, and people with limited English proficiency within a one-mile walk shed of the potential landing sites. The community asset database used in this analysis includes the spatial locations of critical community resources including medical facilities, libraries, churches, schools, and community centers. The potential landing sites considered through planning efforts to date are included in the analysis:

- The Kenmore route analysis includes landing sites at the University of Washington Waterfront Activities Center (WAC), Madison Park, and Leschi in Seattle; as well as Lakepointe and Log Boom Park in Kenmore
- The Ballard route analysis includes landing sites at the Pier 50 Terminal (currently serving the West Seattle and Vashon Island routes as well as Kitsap Fast Ferries) in downtown; as well as the Expedia campus in the Interbay community and Shilshole Marina in Ballard.

Figures D1 and D2 show the locations of the potential landing sites and the King County Equity scores for the area census tracts. Tables D1 and D2 show the existing conditions for the area surrounding the proposed landing sites and is used to capture information about jobs, assets, and people that have potential to be served by new service. For comparison, King County has 21.7% low-income, 39% minority, and 10.6% limited English proficiency residents.

For the Kenmore route which considered differing landing sites, both Log Boom Park and Lakepointe are close enough to each other that either site contains similar populations, households, and numbers of jobs. There are significant differences in population for the Seattle landing sites, with the University of Washington having the largest populations served, as well as community assets and jobs.

Table D1. Landing Site Assets and Opportunities

Landing Site	Community Assets[1]	Family Wage Jobs[2]	Housing Units[3]
Lake Wash Log Boom	9	608	1,805
Lakepointe	14	601	3,129
UW WAC	9	18,336	929[4]
Madison Park	4	471	2,365
Leschi	13	1,482	3,916
Pier 50	80	116,222	25,911
Shilshole	1	297	1,417
Expedia	4	2408	1,749

1 – Number of community assets within a 1-mile walk buffer of each landing site location
2 – Number of family wage jobs within a 1-mile walk buffer of each landing site location
3 – Number of housing units within a 1-mile walk buffer of each landing site location
4 – This does not include UW student housing

Table D2. Landing Site Demographics and Equity Scores

Landing Site	KC Equity Score[1]	Total Pop[2]	% LI[3]	% POC[4]	% LEP[5]	Number of Tracts	Number of LI Tracts	Number of Minority Tracts	Number of LEP Tracts
Log Boom	2.0	33,280	14%	24%	6%	6	1	0	0
Lakepointe	2.0	33,280	14%	24%	6%	6	1	0	0
UW WAC	2.2	14,449	31%	31%	3%	3	1	1	0
Madison Park	1.2	15,801	9%	19%	2%	3	0	0	0
Leschi	2.1	21,148	18%	37%	3%	4	1	2	0
Pier 50	3.2	68,761	31%	43%	11%	14	10	8	4
Shilshole	1.7	14,961	13%	15%	1%	2	0	0	0
Expedia	1.8	29,032	15%	28%	3%	5	0	1	0

1 – Average of scores for all census tracts that intersect the one-mile walk buffer around each landing site
2 – Total population of all census tracts that intersect the one-mile walk buffer around each landing site
3 – Combined percent of low-income populations for all census tracts that intersect the one-mile walk buffer around each landing site
4 – Combined percent of persons of color for all census tracts that intersect the one-mile walk buffer around each landing site
5 – Combined percent of limited English proficiency speakers (5 and older) for all census tracts that intersect the one-mile walk buffer around each landing site

Figure D1: Equity Impact Review for Potential Kenmore Passenger-Only Ferry Route

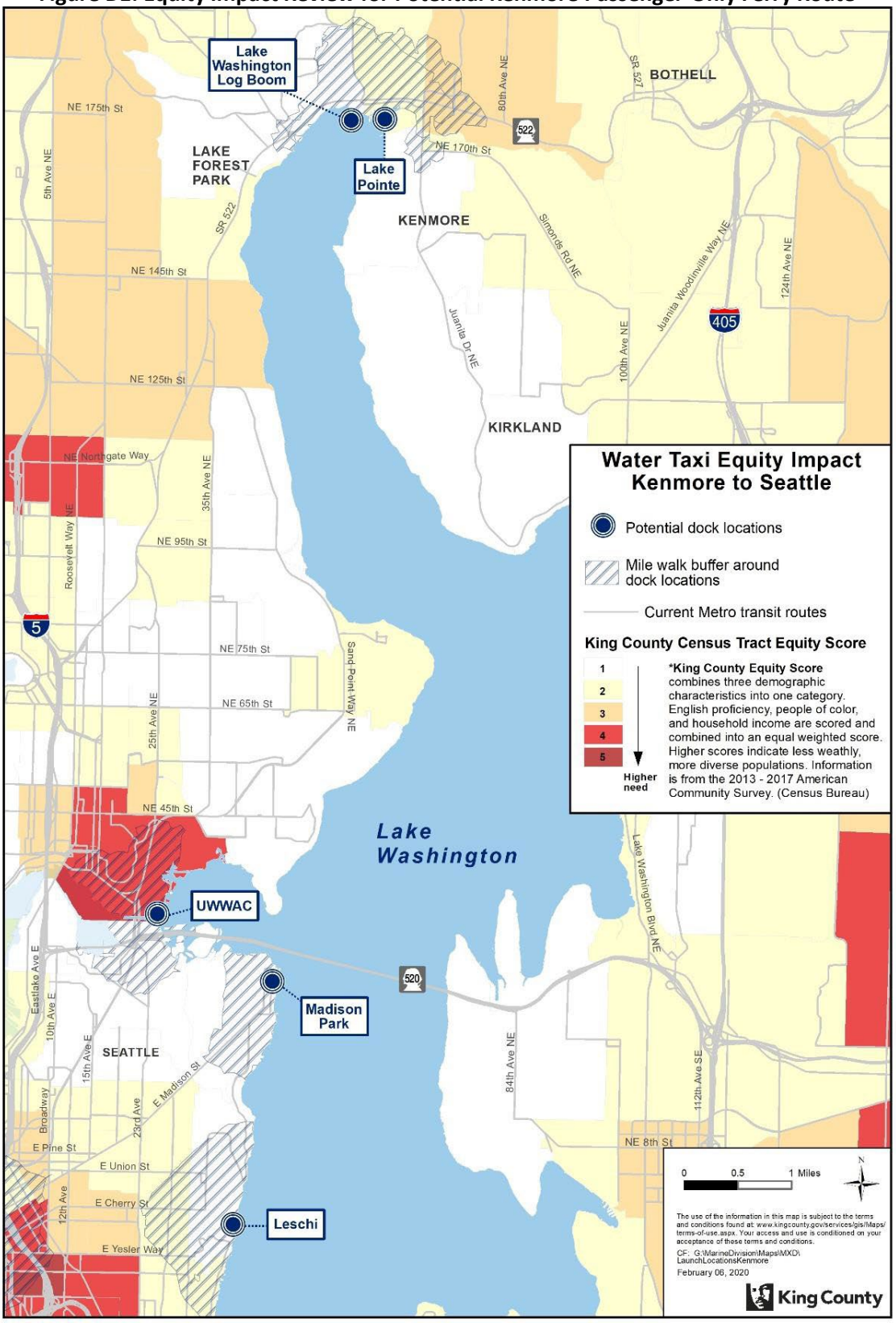
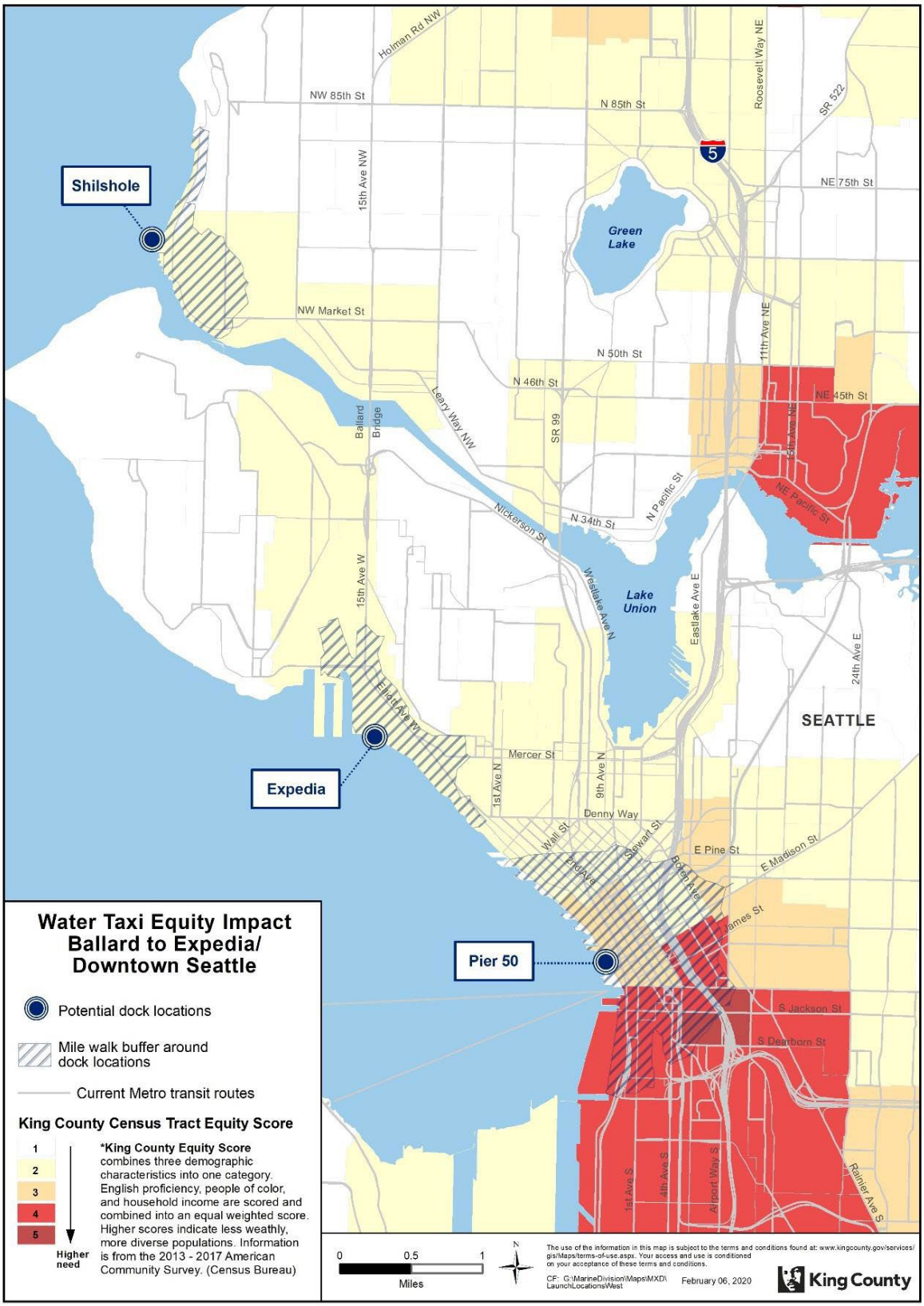


Figure D2: Equity Impact Review for Potential Ballard Passenger-Only Ferry Route



What would the impact be?

This section summarizes the social equity impacts of new passenger-only ferry service for the people and places affected. For this evaluation, social equity impacts are considered changes from the proposed route that make priority populations better or worse off relative to current conditions. This analysis considers planning level assumptions including ridership forecasting for the various landing sites performed in 2020. The main impacts considered in this section include:

- Impacts to ferry riders, such as trip travel time and reliability, trip cost, and amenity value.
- Impacts on communities near the landing sites through changes in access and/or capacity to a location or the desirability of a location.

Impacts to Riders

Based on the proposed service profiles, additional POF would primarily be used for commute trips year-round and leisure/recreational trips in the warmer months and for special events. Impacts that may affect riders include:

- **Trip Travel Time.**
    - Kenmore: Travel times from downtown Seattle or the University of Washington to the Kenmore or Bothell Park and Rides via the UW WAC landing site would be similar or slightly faster than other transit options during the PM commute period (5:00 pm). Compared to driving, travel times would be similar at peak times and 10 to 20 minutes slower at other times. For the other two landing sites (Madison Park and Leschi), travel times during the PM commute period are longer from downtown Seattle and shorter from First Hill via the POF service compared to other transit options.
    - Ballard: Travel times from downtown Seattle to Ballard directly via Shilshole Bay Marina would be longer than other transit options during the PM commute period (5:00 pm). Travel time would be 12 minutes longer if an additional stop was added at the Expedia Campus. Compared to driving, travel times directly from downtown Seattle to Ballard would typically be over 20 minutes more except for periods of heavy traffic congestion when travel time would be similar.
- **Trip Reliability**. POF service would provide reliable travel times because it is not affected by local traffic conditions. Reliability would be particularly valuable during times of high traffic congestion where POF service could be faster than driving as well as other transit options. Further, connections to other separated transit facilities such as Sound Transit Link light-rail at potential landing sites such as the UW WAC and Pier 50 would provide additional reliability for trips.
- **Trip Cost**. Fare for a POF trip ($5.50) would be higher than for a comparable bus trip ($2.75). Trip costs would likely be substantially lower than driving based on parking costs alone. The additional costs for gasoline and mileage would make car trips even more costly.
- **Trip Amenity Value**. POF service offers more amenities than other modes traveling between the potential landing sites, such as restrooms, a seat for every passenger, and space to get up and take in the views. Like the West Seattle route, the amenity value alone may induce new ridership, particularly for discretionary and recreational trips, on weekends and for special events.

Impacts on Community

Impacts (positive or negative) to the broader community near any of the landing site options would likely be minimal. All the landing sites would have some uplands work to accommodate POF service, but

there would be no direct impacts on housing or businesses at any of the potential landing sites. As a result, the impacts on priority populations in those areas would also be minimal. Impacts on the nearby community include:

- **Access**.
    - Kenmore: The addition of POF service between Kenmore and Seattle does not improve access for those traveling between the two locations. There are existing transit options on weekdays and weekends between Kenmore and Seattle. Metro bus route 372 provides direct service from Kenmore to the University of Washington, and Sound Transit Express route 522 provides direct service from Kenmore to downtown Seattle. In addition, a new Sound Transit bus rapid transit route will connect Kenmore to the 145th Street light rail station in Shoreline starting in 2026. All Seattle POF landing site options would provide transfers to downtown Seattle and First Hill.
    - Ballard: The addition of POF service between Shilshole and downtown Seattle would improve access for those living, working, or visiting near Shilshole Marina. The nearest bus route (route 17, which travels along 32nd Avenue NW and travels to downtown Seattle) is over 0.5 miles away with large grade differences. The addition of a stop at the Expedia Campus would not improve access for the site. The site is currently serviced by several bus routes that run along 15th Avenue W, including the RapidRide D line.
- **Capacity**. The addition of POF trips would increase overall transit capacity. Existing transit connections serving these communities do not have overcrowding issues, thus additional transit capacity is not an existing need for either expansion route.
- **Desirability**.
    - Kenmore: There is interest in redeveloping the Lakepointe site with a mixture of uses. The Lakepointe site is currently under private ownership and is used for storage, so there is no potential for the displacement of housing or businesses. There is opportunity for development of affordable housing at this site which could, if built, increase access to this service for disadvantaged populations.
    - Ballard: For the Shilshole landing site, proximity to POF service to downtown Seattle may increase the desirability of some nearby properties, even as an amenity. For the Shilshole landing site, Golden Gardens Park is nearby with a few nearby restaurants, like the existing West Seattle landing site. However, given the limited span of service and longer travel times, the service is unlikely to incentivize land use changes.

Phase 2: Equity and Community Context

Planning efforts for expansion routes included an online survey take by approximate 2,000 respondents (Kenmore) and 4,500 respondents (Ballard). The survey included questions regarding existing travel patterns, dock location preferences, as well as factors that might increase their willingness to shift modes. Demographic information of the participants of the online survey showed a higher proportion of younger people, higher incomes, and higher English proficiency than King County averages. Survey results found that that most people who responded were in favor of Water Taxi service in their community.

The Water Taxi accepts ORCA card use for payment and as such can help facilitate mobility for ORCA LIFT users as well as seniors, students, and holders of Regional Reduced Fare Permits (RRFP). ORCA users can also transfer between different transit providers including the Water Taxi, buses, and Link light rail.

As part of King County's focus on equity and social justice and the Mobility Framework, Metro is focused on expanding service where needs are greatest while continuing to meet mobility needs throughout the County. The communities that would be served by expanded water taxi service generally have low equity scores and most have existing transit options available. Therefore, the expansion routes would provide benefit in areas where the population is less diverse and wealthier than county averages.

Phase 3: Decision Process

Determining resource allocation and actual impacts are subject to funding constraints and budget decisions made by King County Council. King County Metro has identified Equity as a top priority in current and future budget developments. Future Water Taxi routes will need to find an opportunity to serve populations above and beyond those who traditionally have easy access to waterfront amenities. One way to do this is to ensure that Water Taxi service coupled with land-side service connection is time and cost competitive for all potential users and by offering both traditional peak commuting service as well as off-peak service.

This proviso response is intended to provide updated planning and implementation information to King County Council. The EIR is an integral part of the proviso response. Water Taxi service growth will need to be reviewed and planned as part of Metro's overall long-term transportation planning. A further Equity Impact Review would need to be completed in the event funding for new Water Taxi service is identified. As part of the Mobility Framework adoption, King County Metro has identified a need to invest in service that will positively impact priority populations to address deep and persistent inequities–especially by race and place–that in many cases are getting worse and threaten our collective prosperity.