

Attachment 9
Mitigation Plans



Washington State
Department of Transportation

SR 520 Bridge Replacement and HOV Program



I-5 to Medina: Bridge Replacement and HOV Project

Initial Aquatic Mitigation Report I-5 to Medina: Bridge Replacement and HOV Project

Prepared for

Washington State Department of Transportation
Urban Corridors Office

and

Federal Highway Administration

October 2009

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Washington State
Department of Transportation

SR 520 Bridge Replacement and HOV Program



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Initial Aquatic Mitigation Report I-5 to Medina: Bridge Replacement and HOV Project

October 2009

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ACRONYMS

BMP	best management practice
cfs	cubic feet per second
DDD	Dichlorodiphenyldichloroethane
DO	dissolved oxygen
EIS	Environmental Impact Statement
ESA	Endangered Species Act
GIS	geographic information system
HCT	high-capacity transit
HOV	high-occupancy vehicle
HPA	Hydraulic Project Approval
LWD	large woody debris
LWSC	Lake Washington Ship Canal
m	meter
mg/L	milligrams per liter
n.d.	no date
NMFS	National Marine Fisheries Service
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PGIS	pollution-generating impervious surface
RM	River Mile
SPU	Seattle Public Utilities
SR	State Route
TCDD	2,3,7,8-Tetrachlorodibenzodioxin (dioxin)

USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation

1. EXECUTIVE SUMMARY

This document documents the development and results of a screening process for aquatic mitigation opportunities to offset impacts on aquatic species and habitat associated with the construction and operation of the I-5 to Medina: Bridge Replacement and HOV Project. The Washington State Department of Transportation (WSDOT) will replace the existing State Route (SR) 520 bridges, approaches, and portions of the highway leading to the bridges, which will result in additional inwater and overwater structures, and impacts to the aquatic and riparian resources of Lake Washington and the Lake Washington Ship Canal. The goal of the Initial Aquatic Mitigation Plan is to define a mitigation screening framework that will facilitate future efforts to functionally link project impacts to potential mitigation benefits, benefits based on how each impact or mitigation action would affect habitat functions that support key juvenile salmonid life functions of migration, rearing, refugia and feeding.

The screening exercise consisted of a three-part process that pared all the potential parcels within the geographic study area (a large portion of the Lake Washington Basin) down to a list of 30 sites, which offer the best opportunities to achieve the project mitigation goals. The initial screen used straightforward pass/fail criteria to remove both high-risk sites and those sites deemed insufficient in providing substantial functional uplift from a list of thousands of parcels. The remaining 208 candidate sites were then sorted into four functional groups, based on the relationship between basin geography and salmonid life history functions they provide. After sorting, additional evaluation criteria, including an evaluation of existing site condition and potential functional uplift (where information was available) and site consistency with existing restoration plans, were then considered to facilitate advancement of a subset of high value or potential uplift sites (30 sites total) for more detailed analysis in the future. The overall screening and evaluation process reduces the number of potential mitigation sites to a manageable number while still advancing those sites best suited to provide a wide array of aquatic mitigation options that will meet the specific compensatory mitigation needs of the project. The aquatic mitigation team advanced only those individual sites that when combined with other identified sites, could provide the types and quantity of aquatic mitigation to adequately compensate for the project's estimated effects on fish and aquatic habitat. This effort resulted in an interim list of top candidate sites for each of the four functional groups; Lake Washington, Lake Washington Ship Canal, Marine, and Riverine. These sites are not ranked, as the final ranking of sites will require input from resource agencies and further evaluation with more detailed data sources, including field reconnaissance.

Although an exact quantitative accounting of project effects and functional uplift from mitigation opportunities is beyond the scope of this document. As the mitigation planning effort proceeds, future detailed analysis will establish and document a quantitative basis for the appropriateness and sufficiency of the mitigation plan to replace lost or impaired habitat functions resulting from the project. An example of such a quantitative approach might involve the incorporation of salmonid population effects metrics, salmonid habitat metrics, or a combination of these metrics to develop a common denominator for mitigation planning.

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42 The Washington State Department of Transportation (WSDOT) is proposing to construct the I-5 to
43 Medina: Bridge Replacement and HOV Project to replace the existing State Route (SR) 520 bridges,
44 approaches, and portions of the highway leading to the bridges. The study area for this project (see
45 Figure 1) contains important aquatic and riparian resources that are essential to the health and
46 sustainability of the natural ecosystem. Project construction would result in both temporary and
47 permanent effects on these aquatic and fisheries resources. Federal, state, and local regulations, as well
48 as WSDOT policy, require that WSDOT provide mitigation for these effects to aquatic and fisheries
49 resources.

50 The Initial Aquatic Mitigation Report is part of a three-document set that identifies aquatic mitigation
51 appropriate to the project's effects and supports the permitting process. This report, in conjunction with
52 the Initial Wetland Mitigation Report, list potential mitigation opportunities to offset impacts to aquatic
53 resources. The Initial Aquatic Mitigation Report provides preliminary information about mitigation
54 planning concurrently with publication of the I-5 to Medina: Bridge Replacement and HOV Project
55 Environmental Impact Statement (EIS). The report also identifies a pool of pre-qualified candidate
56 mitigation sites from which to develop a specific conceptual mitigation plan as the project elements and
57 effects become more clearly defined.

58 The information in this report presents an early approximation of project effects representing the range
59 of alternatives under consideration. This early approximation provides preliminary guidance about the
60 nature and extent of needed mitigation. This approach accelerates the development of specific mitigation
61 components and may be used to identify and implement early mitigation actions. The remaining two
62 documents in the set (the Conceptual Aquatic Mitigation Plan and the Final Conceptual Aquatic
63 Mitigation Plan) further refine the site selection and develop and refine site-specific aquatic mitigation
64 concepts. These documents also serve as supplements to the permit applications for Sections 401 and
65 404 of the Clean Water Act, the Hydraulic Project Approval (HPA), and local Critical Areas
66 Ordinances.

67 The project team is currently evaluating several design options (for more information on these options,
68 see WSDOT 2009). The extent and magnitude of the project's effects would vary depending upon the
69 alternative chosen. Currently, only the 6-Lane Alternative has been developed sufficiently to quantify
70 effects to aquatic resources. Additional analysis will occur as the mitigation team concludes its process.

71 The following sections of the Initial Aquatic Mitigation Report summarize the proposed project's effects
72 on aquatic and fisheries resources, the mitigation needs, and the preliminary results of screening and
73 selecting candidate mitigation sites to compensate for the project's effects on aquatic and fisheries
74 resources. WSDOT and consultant biologists (the mitigation team) developed a mitigation site selection
75 process to be adapted and applied through collaboration with regulatory agencies. The purposes of the
76 site selection process are the following:

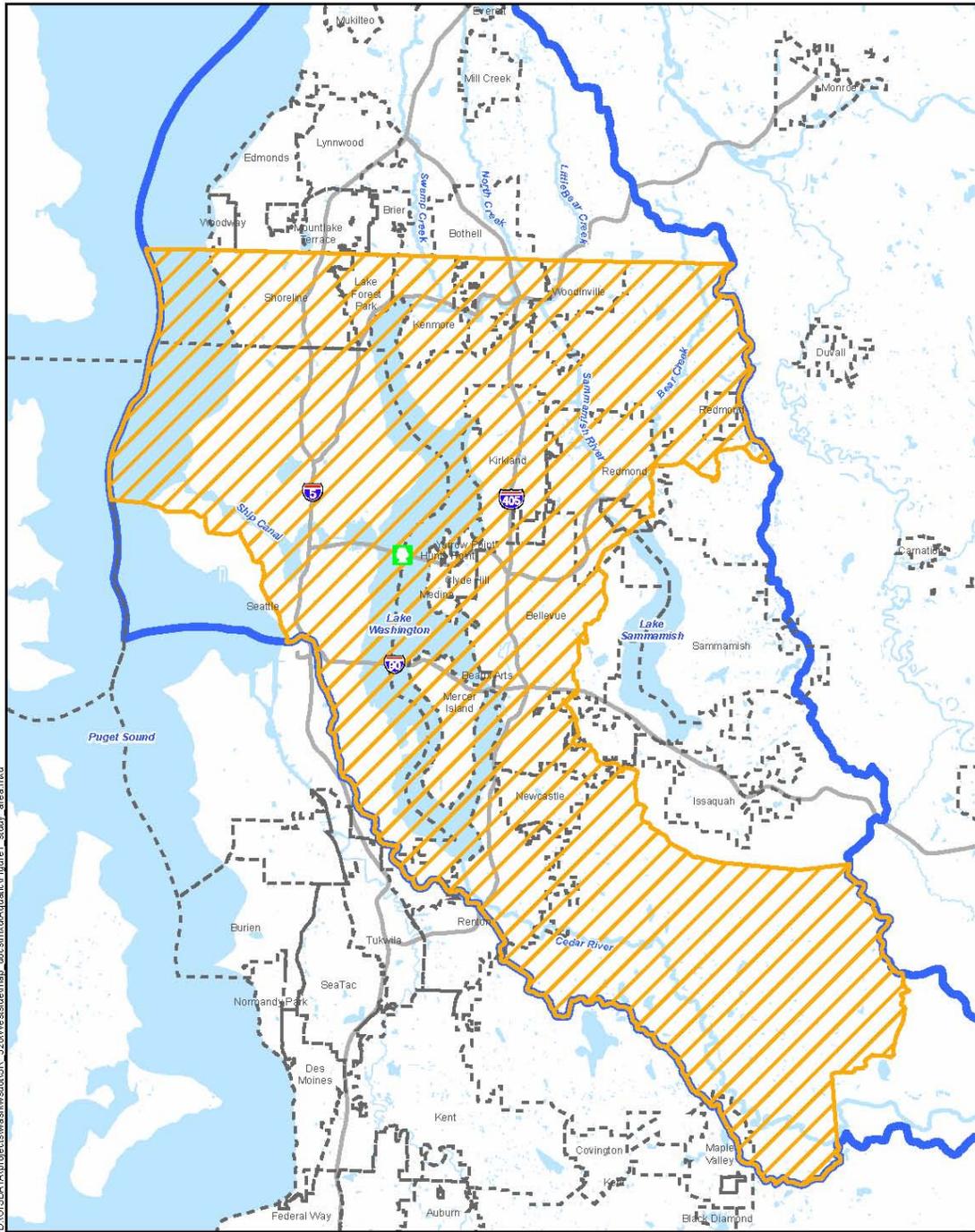
- 77 • Document decisions in the selection process.
- 78 • Quickly eliminate unsuitable or higher-risk sites.

- 79 • Develop a list of suitable sites with lower risk.
- 80 • Identify appropriate and viable site(s) for WSDOT project delivery.
- 81 • Manage the level of effort by following an efficient process.
- 82 • Adapt to changing project and regulatory requirements.

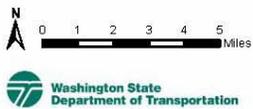
83 The goal of selection process is to develop a list of potential mitigation sites that would compensate for
84 the project's effects on aquatic and fisheries resources. The list is intended to be a living document,
85 growing and changing as the project evolves and more information is collected and analyzed.
86 Ultimately, a short list of the best sites will be provided to WSDOT for potential project implementation
87 and/or site acquisition.

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- | | | | |
|--|--------------------|--|------------|
| | Study Area | | Water Body |
| | Municipal Boundary | | Stream |
| | WRIA 8 Boundary | | Highway |

Figure 1: Study Area

I-5 to Medina: Bridge Replacement and HOV Project

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91

Figure 1. Study Area

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3. PROJECT DESCRIPTION

94 The Interstate 5 (I-5) to Medina: Bridge Replacement and High-Occupancy Vehicle (HOV) Project is
95 part of the State Route (SR) 520 Bridge Replacement and HOV Program (SR 520) Program and
96 encompasses three main geographic areas—Seattle, Lake Washington, and the Eastside. The project
97 area includes the following:

- 98 • Seattle communities: Portage Bay/Roanoke, North Capitol Hill, Montlake, University District,
99 Laurelhurst, and Madison Park
- 100 • Eastside communities: Medina, Hunts Point, Clyde Hill, and Yarrow Point
- 101 • The Lake Washington ecosystem and associated wetlands
- 102 • Usual and accustomed fishing areas of tribal nations that have historically used the area’s aquatic
103 resources and have treaty rights

104 Improvements to the western portion of the SR 520
105 corridor—known as the I-5 to Medina: Bridge Replacement
106 and HOV Project (the *I-5 to Medina Project*)—are being
107 evaluated in a Supplemental Draft EIS (SDEIS). Project limits
108 for this project extend from I-5 in Seattle to 92nd Avenue NE
109 in Yarrow Point, where it transitions into the Medina to SR
110 202: Eastside Transit and HOV Project (the *Medina to SR 202*
111 *Project*). Exhibit 1 shows the project vicinity.

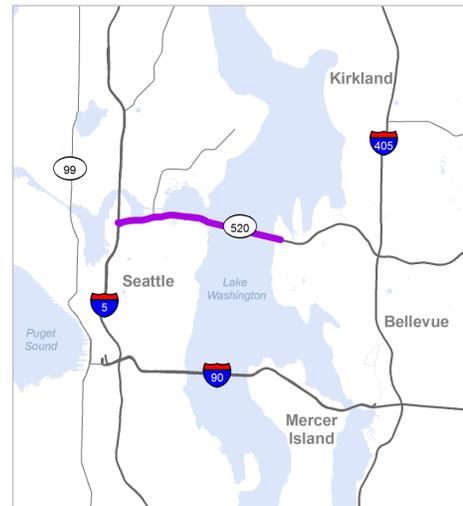


Exhibit 1. Project Vicinity Map

112 For this project, a mediation group convened at the direction
113 of the state legislature after the publication of the Draft EIS in
114 2006 to evaluate the corridor alignment for SR 520 through
115 Seattle. The mediation group identified three 6-lane design
116 options for SR 520 between I-5 and the floating span of the
117 Evergreen Point Bridge; these options were documented in a
118 Project Impact Plan (WSDOT 2008). The SDEIS evaluates the following two alternatives and the three
119 design options:

- 120 • No Build Alternative
- 121 • 6-Lane Alternative
 - 122 – Option A
 - 123 – Option K
 - 124 – Option L

125 The 6-Lane Alternative is summarized below. More detailed information on the three design options is
126 provided in the Description of Alternatives Discipline Report (WSDOT 2009).

127 **3.1 6-LANE ALTERNATIVE**

128 The 6-Lane Alternative would complete the regional HOV connection (3+ HOV occupancy) across SR
129 520. This alternative would include six lanes (two 11-foot-wide outer general-purpose lanes and one
130 12-foot-wide inside HOV lane in each direction), with 4-foot-wide inside and 10-foot-wide outside
131 shoulders (Exhibit 2 depicts a cross section of the 6-Lane Alternative). The proposed width of the
132 roadway would be narrower than the one described in the Draft EIS and reflects public comment from
133 local communities.

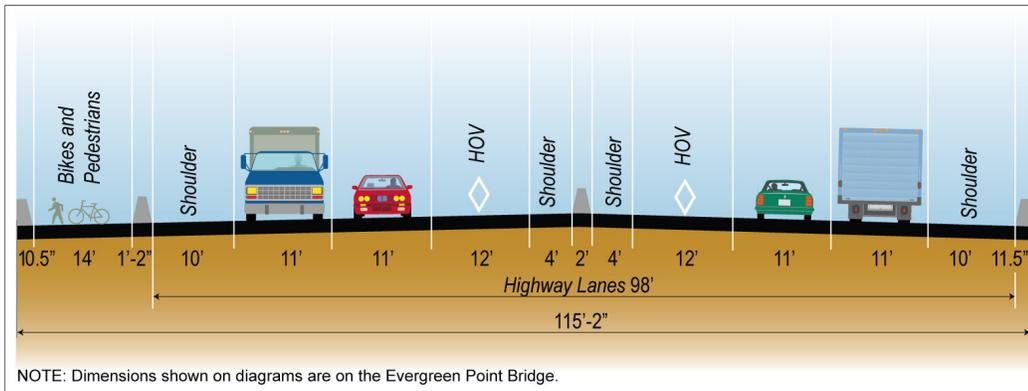


Exhibit 2. 6-Lane Alternative Cross Section

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141 SR 520 would be rebuilt from I-5 to Evergreen Point Road in Medina and restriped and reconfigured
142 from Evergreen Point Road to 92nd Avenue NE in Yarrow Point. A 14-foot-wide bicycle/pedestrian
143 path would be built along the north side of SR 520 through the Montlake area and across the Evergreen
144 Point Bridge, connecting to the regional path on the Eastside. A bridge maintenance facility and dock
145 would be built underneath the east approach to the Evergreen Point Bridge.

146 The sections below describe the design options identified for the 6-Lane Alternative in each of the three
147 geographical areas it would encompass.

148 **3.1.1 Floating Bridge**

149 The floating span would be located approximately 190 feet north of the existing bridge at the west end
150 and 160 feet north at the east end. Rows of three 10-foot-tall concrete columns would support the
151 roadway above the pontoons (see below), and the new span would be approximately 22 feet higher than
152 the existing bridge. A 14-foot-wide bicycle/pedestrian path would be located on the north side of the
153 bridge.

154 A single row of 21 75-foot-wide by 360-foot-long longitudinal pontoons would support the floating
155 bridge. One 240-foot-long by 75-foot-wide cross pontoon at each end of the bridge would be set
156 perpendicularly to the longitudinal pontoons. The longitudinal pontoons would be bolstered by 54

157 smaller supplemental stability pontoons on each side for stability and buoyancy. The longitudinal
158 pontoons would not be sized to carry future high-capacity transit (HCT), but would be equipped with
159 connections for additional supplemental stability pontoons to support HCT in the future. The floating
160 pontoons for the new bridge would be anchored to the lake bottom to hold the bridge in place.

161 Near the east approach bridge, the roadway would be widened to accommodate transit ramps to the
162 Evergreen Point Road transit stop.

163 **3.1.2 Bridge Maintenance Facility**

164 As mentioned above, routine access, maintenance, monitoring, inspections, and emergency response for
165 the floating bridge would be based out of a new bridge maintenance facility located underneath SR 520
166 between the east shore of Lake Washington and Evergreen Point Road in Medina. This bridge
167 maintenance facility would include a working dock, a two-story, 7,200-square-foot maintenance
168 building, and parking.

169 **3.1.3 Eastside Transition Area**

170 The I-5 to Medina project and the Medina to SR 202 project overlap between Evergreen Point Road and
171 92nd Avenue NE in Yarrow Point. Work planned as part of the I-5 to Medina project between Evergreen
172 Point Road and 92nd Avenue NE would include moving the Evergreen Point Road transit stop west to
173 the lid (part of the Medina to SR 202 project) at Evergreen Point Road, adding new lane and ramp
174 striping from the Evergreen Point lid to 92nd Avenue NE, and moving and realigning traffic barriers as a
175 result of the new lane striping. The restriping would transition the I-5 to Medina project improvements
176 into the improvements to be completed as part of the Medina to SR 202 project.

177 **3.1.4 Seattle**

178 **3.1.4.1 Elements Common to the 6-Lane Alternative Options**

179 SR 520 would connect to I-5 in a configuration similar to the way it connects today. Improvements to
180 this interchange would include a new reversible HOV ramp connecting the new SR 520 HOV lanes to
181 existing I-5 reversible express lanes. WSDOT would replace the Portage Bay Bridge and the Evergreen
182 Point Bridge (including the west approach and floating span), as well as the existing local street bridges
183 across SR 520. New stormwater facilities would be constructed for the project to provide stormwater
184 retention and basic treatment, as well as enhanced treatment where feasible. The project would include
185 landscaped lids across SR 520 at I-5, 10th Avenue East and Delmar Drive East, and in the Montlake area
186 to help reconnect the communities on either side of the roadway. The project would also remove the
187 Montlake freeway transit station.

188 The most substantial differences among the three options are the interchange configurations in the
189 Montlake and University of Washington areas.

190 **3.1.5 Options**

191 The most substantial differences among the three options are the interchange configurations in the
192 Montlake and University of Washington areas.

193 ***Option A***

194 Option A would include a new Portage Bay Bridge, which would include a total of seven lanes (four
195 general-purpose lanes, two HOV lanes, and a westbound auxiliary lane). WSDOT would replace the
196 interchange at Montlake Boulevard NE with a new interchange in a similar configuration. The Lake
197 Washington Boulevard ramps and the median freeway transit stop near Montlake Boulevard East would
198 be removed, and a new bascule bridge (i.e., drawbridge) would be added to Montlake Boulevard NE,
199 parallel to the existing Montlake Bridge. SR 520 would maintain a low profile through the Washington
200 Park Arboretum and flatten out east of Foster Island, before rising to the west highrise of the Evergreen
201 Point Bridge. This option would include quieter pavement and might also include noise walls, depending
202 on neighborhood interest.

203 Suboptions for Option A would include adding eastbound and westbound off-ramp to Lake Washington
204 Boulevard, adding an eastbound direct access on-ramp for transit from Montlake Boulevard East, and a
205 constant slope profile from 24th Avenue East to the west highrise, with no Foster Island Land Bridge.

206 ***Option K***

207 Option K would also replace the Portage Bay Bridge, but the new bridge would include four general-
208 purpose lanes and two HOV lanes with no westbound auxiliary lane. In the Montlake area, Option K
209 would remove the existing Montlake Boulevard East interchange and the Lake Washington Boulevard
210 ramps and replace their functions with a depressed, single-point urban interchange (SPUI) at the
211 Montlake shoreline. Two HOV direct-access ramps would service the new interchange, and a tunnel
212 under the Montlake Cut would move traffic from the new interchange north to the intersection of
213 Montlake Boulevard NE and NE Pacific Street. SR 520 would maintain a low profile through Union
214 Bay and would make landfall at Foster Island and remain flat before rising to the west transition span of
215 the Evergreen Point Bridge. A land bridge would be constructed over SR 520 at Foster Island. Citizen
216 recommendations made during the mediation process defined this option to include only quieter
217 pavement for noise mitigation, rather than the sound walls that were included in the 2006 Draft EIS.
218 Because quieter pavement is not recognized by the Federal Highway Administration (FHWA) as an
219 acceptable form of noise mitigation in Washington state, sound walls could be included in Option K.
220 The decision to build sound walls depends on neighborhood interest, the findings of this Noise
221 Discipline Report, and WSDOT's reasonability and feasibility determinations.

222 A suboption for Option K would include constructing an eastbound off-ramp to Montlake Boulevard
223 East configured for right turns only.

224 ***Option L***

225 Under Option L, the Montlake Boulevard East interchange and the Lake Washington Boulevard ramps
226 would be replaced with a new, elevated SPUI at the Montlake shoreline. A bascule bridge would span
227 the east end of the Montlake Cut, from the new interchange to the intersection of Montlake Boulevard
228 NE and NE Pacific Street. This option would also include a ramp connection to Lake Washington
229 Boulevard and two HOV direct-access ramps providing service to and from the new interchange. SR
230 520 would maintain a low, constant slope profile from 24th Avenue East to just west of the west
231 transition span of the floating bridge. Noise mitigation identified for this option would include sound
232 walls as defined in the Draft EIS.

233 Suboptions for Option L would include adding left-turn movement from Lake Washington Boulevard
234 for direct access to SR 520 and adding capacity on northbound Montlake Boulevard NE to NE 45th
235 Street.

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239 The project is located in the Lake Washington watershed, which comprises 13 major drainage sub-
240 basins and numerous smaller drainages, totaling about 656 miles (1,050 kilometers) of streams, two
241 major lakes, and numerous smaller lakes. Lake Washington and its major drainages (Issaquah Creek, the
242 Sammamish River, and the Cedar River) are located in the Cedar-Sammamish Watershed Basin, or
243 Water Resource Inventory Area (WRIA) 8.

244 The majority of the watershed is highly developed, with 63 percent of the watershed fully developed;
245 WRIA 8 has the highest human population of any WRIA in Washington State (NMFS 2008a). Lake
246 Washington is the second largest natural lake in Washington with 80 miles (128 kilometers) of
247 shoreline. The lake is approximately 20 miles long (32 kilometers) with a mean width of approximately
248 1.5 miles (2.4 kilometers), has a circumference of 50 miles (80 kilometers), covers 22,138 surface acres
249 (8,960 hectares), and has a mean depth of approximately 100 feet (30 meters) and a maximum depth of
250 approximately 200 feet (60 meters) (Jones and Stokes 2005).

251 **4.1 LAKE WASHINGTON HYDROLOGY**

252 The Lake Washington watershed has been dramatically altered from its pre-settlement conditions
253 primarily due to urban development and removal of the surrounding forest, as well as the lowering of the
254 lake elevation and rerouting of the outlet through the Ship Canal. As a result, the Cedar River is now the
255 major source of fresh water to Lake Washington, providing about 50 percent (663 cubic feet per second
256 [cfs]) of the mean annual flow entering the lake (NMFS 2008). The Cedar River drainage area is
257 approximately 184 square miles (476 square kilometers), which represents about 30 percent of the Lake
258 Washington watershed area.

259 The Lake Sammamish basin is also a substantial fresh water source, providing about 25 percent (307
260 cfs) of the mean fresh water flow into Lake Washington. The Sammamish sub-basin has a drainage area
261 of about 240 square miles (622 square kilometers) and represents about 40 percent of the Lake
262 Washington basin. Tributaries to the Sammamish River include Swamp, North, Bear, and Little Bear
263 creeks, as well as the surface waters of Lake Sammamish. Hydrology in the Lake Sammamish sub-basin
264 is generally affected by the same factors that affect Lake Washington.

265 The remainder of fresh water flow into Lake Washington originates from a variety of small creeks
266 located primarily along the northern and eastern shores. These smaller tributaries and sub-basins in the
267 Lake Washington system include Thornton, McAleer, Forbes, Juanita, Kelsey, Coal, and May creeks,
268 and Mercer Slough. Within Lake Washington, the natural hydrologic cycle has been altered.
269 Historically, lake elevations peaked in winter and declined in summer. Present operation of the locks
270 produces peak elevations throughout most of the summer.

271 The U.S. Army Corps of Engineers (USACE) is mandated by Congress (Public Law 74-409, August 30,
272 1935) to maintain the level of Lake Washington between 20 and 22 feet (USACE datum) as measured at
273 the locks. USACE operates this facility to systematically manage the water level in Lake Washington
274 over four distinct management periods, using various forecasts of water availability and use. The four
275 management periods are as follows:

- 276 • Spring refill – lake level increases between February 15 and May 1 to 22 feet (USACE datum).
- 277 • Summer conservation – lake level maintained at about 22 feet for as long as possible, with involuntary
278 drawdown typically beginning in late June or early July.
- 279 • Fall drawdown – lake level decreasing to about 20 feet from the onset of the fall rains until
280 December 1.
- 281 • Winter holding – lake level maintained at 20 feet between December 1 and February 15.

282 Operation of the locks and other habitat changes throughout the Lake Washington basin, have
283 substantially altered the frequency and magnitude of flood events in Lake Washington and its tributary
284 rivers and streams. Historically, Lake Washington’s surface elevation was nearly 9 feet (2.7 meters [m])
285 higher than it is today, and the seasonal fluctuations further increased that elevation by an additional 7
286 feet (2.1 m) annually (Williams 2000). In 1903, the average lake elevation was recorded at
287 approximately 32 feet (9.8 m) (USACE datum) (NMFS 2008).

288 **4.2 LAKE WASHINGTON SHORELINE HABITAT**

289 Lowering the lake elevation after completion of the Ship Canal transformed about 1,334 acres (540
290 hectares) of shallow water habitat into upland areas, reducing the lake surface area by 7 percent and
291 decreasing the shoreline length by about 13 percent (10.5 miles or 16.9 kilometers) (Chrzastowski
292 1981). The most extensive changes occurred in the sloughs, tributary delta areas, and shallow portions of
293 the lake. The area of fresh water marshes decreased about 93 percent, from about 1,136 acres (460
294 hectares) to about 74 acres (30 hectares) (Chrzastowski 1981). Essentially all of the existing wetlands
295 and riparian zone habitat developed after the lake elevation was lowered. Currently, this habitat occurs
296 primarily in Union Bay, Portage Bay, Juanita Bay, and Mercer Slough (Dillon et al. 2000).

297 Lake level regulation by USACE has eliminated the seasonal inundation of the shoreline that historically
298 shaped the structure of the riparian vegetation community. This, together with urban development, has
299 replaced much of the hardstem bulrush- and willow-dominated community with developed shorelines
300 and landscaped yards. The current lake level regulation affects the growth of many species of native
301 terrestrial and emergent vegetation. This lake level regulation indirectly buffers the shorelines from
302 potential winter storm wave effects. The loss of natural shoreline has also reduced the historic complex
303 shoreline features such as overhanging and emergent vegetation, woody debris (especially fallen trees
304 with branches and/or rootwads intact), and gravel/cobble beaches. The loss of native shoreline
305 vegetation and wetlands has reduced the input of terrestrial detritus and insects to support the aquatic
306 food web.

307 These natural shoreline features have been largely replaced with armored banks, piers, and floats, and
308 limited riparian vegetation. A survey of 1991 aerial photos estimated that 4 percent of the shallow water
309 habitat within 100 feet (30.5 m) of the shore was covered by residential piers (ignoring coverage by
310 commercial structures and vessels) (USFWS 2008). Later studies report about 2,700 docks in Lake
311 Washington and armoring of approximately 71 percent to 81 percent of the shoreline (Warner and Fresh
312 1999; City of Seattle 2000; Toft 2001).

313 An even greater density of docks and shoreline modifications occur throughout the Ship Canal, Portage
314 Bay, and Lake Union (City of Seattle 1999; Weitkamp and Ruggerone 2000). Areas that have some
315 amount of undeveloped shoreline include Gas Works Park, the area south of SR 520 (in Lake Union and
316 Portage Bay), and a protected cove west of Navy Pier at the south end of Lake Union. Vegetation within
317 these areas is limited, with the area south of SR 520 possessing the highest abundance of natural riparian
318 vegetation, consisting primarily of cattails (*Typha* spp.) and small trees (Weitkamp and Ruggerone
319 2000). The loss of complex habitat features (i.e., woody debris, overhanging riparian and emergent
320 vegetation) and shallow water habitat in Lake Washington has reduced the availability of prey refuge
321 habitat and forage for juvenile salmonids. Dense growths of introduced Eurasian milfoil and other
322 aquatic macrophytes effectively isolate much of the more natural shoreline from the deeper portions of
323 the aquatic habitat.

324 Portage Bay is lined by University of Washington facilities, commercial facilities, and houseboats. The
325 southeastern portion of Portage Bay has an area of fresh water marsh habitat and naturally sloped
326 shoreline, while the remainder of the shoreline is developed, with little natural riparian vegetation. The
327 Montlake Cut is a concrete-banked canal that connects Portage Bay to Union Bay, which extends
328 eastward to Webster Point and the main body of Lake Washington.

329 Prior to construction of the Ship Canal, Union Bay consisted of open water and natural shorelines
330 extending north to 45th Street. The lowered lake levels resulting from the Ship Canal construction
331 produced extensive marsh areas around Union Bay, with substantial portions of this marsh habitat
332 subsequently filled, leaving only the fringe marsh on the southern end (Jones and Jones 1975). The south
333 side of the bay is bordered by the Arboretum, with a network of smaller embayments and canals, and
334 extensive marsh habitats. The north side of Union Bay contains a marshy area owned by the University
335 of Washington; the area was previously filled with landfill material. Numerous private residences with
336 landscaped waterfronts and dock facilities dominate the remainder of the shoreline.

337 Development and urbanization have also altered base flow in many of the tributary systems (Horner and
338 May 1998). Increases in impervious and semi-impervious surfaces add to runoff during storm events and
339 reduce infiltration and groundwater discharge into streams and rivers. A substantial amount of surface
340 water and groundwater is also diverted into the City of Seattle and King County wastewater treatment
341 systems and is eventually discharged to Puget Sound.

342 Although the frequency and magnitude of flooding in the lake and the lower reaches of tributary streams
343 have declined due to the operation of the locks, flooding has generally increased in the upstream reaches
344 of tributary rivers and streams. This change is largely because of the extensive development that has
345 occurred within the basin over the last several decades (Moscrip and Montgomery 1997).

346 No measurable changes in shoreline habitat condition are expected to occur in the near future, although
347 gradual changes (both positive and negative) are likely to occur. Therefore, the existing degraded habitat
348 in the study area and the greater Lake Washington watershed is expected to continue to affect ESA listed
349 Chinook salmon and other salmonid species in the watershed for the foreseeable future.

350 **4.3 LAKE WASHINGTON WATER AND SEDIMENT QUALITY**

351 The water quality and sediment quality in the Lake Washington basin are degraded as a result of a
352 variety of current and historic point and non-point pollution sources.

353 **4.3.1 Pollution**

354 Historically, Lake Washington, Lake Union, and the Ship Canal were the receiving waters for municipal
355 sewage, with numerous shoreline area outfalls that discharged untreated or only partially treated sewage
356 directly into these waterways. Cleanup efforts in the 1960s and 1970s included expanding the area
357 wastewater treatment facilities and eliminating most untreated effluent discharges into Lake
358 Washington. However, some untreated discharges occasionally still enter these waterways through
359 discharge from combined sewer overflows during periods of high precipitation.

360 In addition to point source pollution, a variety of non-point sources continue to contribute to the
361 degradation of water and sediment quality. Non-point sources include stormwater and subsurface runoff
362 containing pollutants from road runoff, failing septic systems, underground petroleum storage tanks,
363 gravel pits/quarries, landfills and solid waste management facilities, sites with improper hazardous waste
364 storage, and commercial and residential sites treated with fertilizers and pesticides.

365 Historical industrial uses in the basin, such as those around Lake Union and southern Lake Washington,
366 Newcastle, Kirkland, and Kenmore, have contaminated sediments with persistent toxins; these toxins
367 include polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and heavy metals
368 (King County 1995). The expanding urbanization in the basin has also increased sediment input into the
369 Lake Washington system water bodies.

370 **4.3.2 Aquatic Vegetation**

371 Along with these physical changes to the basin, substantial biological changes have occurred. Non-
372 native plant species have been introduced into Lake Washington, and years of sewage discharge into the
373 lake increased phosphorus concentration and subsequently led to extensive eutrophication. Blue-green
374 algae dominated the phytoplankton community and suppressed production of zooplankton, reducing the
375 available prey for salmonids and other species. However, water quality improved dramatically in the
376 mid 1960s as sewage was diverted from Lake Washington to Puget Sound, and the dominance by blue-
377 green algae subsided and zooplankton populations rebounded.

378 Despite reversing the eutrophication trend in the lake, the introduction of Eurasian milfoil to Lake
379 Washington in the 1970s caused additional localized aquatic habitat and water quality problems. Milfoil
380 and other aquatic vegetation dominate much of the shallow shoreline habitat of Lake Washington, Lake
381 Sammamish, Lake Union, Portage Bay, and the Ship Canal. Dense communities of aquatic vegetation,
382 or floating mats of detached plants, can adversely affect localized water quality conditions. Dense
383 communities can reduce dissolved oxygen (DO) to below 5 ppm (parts per million), and the
384 decomposition of dead plant material increases the biological oxygen demand, further reducing DO and
385 pH (WDNR 1999). Under extreme conditions, these situations can become anoxic.

386 **4.3.3 Water Quality**

387 In addition to the substantial water column habitat modification caused by aquatic vegetation, excessive
388 accumulation and decomposition of organic material has transformed areas of natural sand or gravel
389 substrate to fine muck and mud. Substantial shoreline areas of Lake Washington, the Ship Canal, and the
390 project action area have soft substrate, with substantial accumulations of organic material from the
391 decomposition of milfoil and other macrophytes. The dense vegetation also reduces the currents and
392 wave energy in these areas, which encourages the accumulation of fine sediment material. As
393 microorganisms in the sediment break down the organic material, they consume much of the oxygen in
394 the lower part of the lake. By the end of summer, concentrations of DO in the hypolimnion can approach
395 0.0 milligrams per liter (mg/L). Despite these effects in some shallow nearshore habitats, mean
396 hypolimnetic DO levels recorded at long-term monitoring sites in the lake between 1993 and 2001
397 ranged from 7.7 to 8.9 milligrams per liter (mg/L) (King County 2003). However, it should be noted that
398 water depths in the hypolimnion extend well below the photic zone, to more than 200 feet. Also, the
399 portions of the hypolimnion closer to the shoreline, which show the lowest DO concentrations, are
400 support outmigrating and rearing juvenile salmonids to a greater degree than do deep water habitats.

401 Salt water intrusion occurs in the Ship Canal above the locks, but very little of the deeper, heavier salt
402 water mixes with the lighter fresh water surface layer. Consequently, this area lacks the diversity of
403 habitats and brackish water refuges characteristic of most other (unaltered) river estuaries. Usually this
404 salt water intrusion extends to the east end of Lake Union but can extend as far as the University Bridge
405 in an extremely dry summer. The extent of this intrusion into the Ship Canal and into Lake Union is
406 primarily controlled by outflow at the locks and the frequency of large and small lock operations.

407 Historical data indicate that reduced water column mixing due to the salt water layer likely produced
408 year-round anaerobic conditions in the deeper areas of Lake Union and the Ship Canal (Shared Strategy
409 2007). The lack of mixing, along with a significant oxygen sediment demand, can reduce dissolved
410 oxygen levels to less than 1 mg/L, and could prevent fish from using the water column below 10-m
411 depth. This condition was likely more severe before about 1966, when a salt water barrier was
412 constructed at the locks, thereby improving water quality conditions upstream. Water quality in Lake
413 Union has also improved since the 1960s, from the reduction in direct discharges of raw sewage and the
414 closing of the gas plant, along with the upland cleanup activities at the gas plant and other industrial
415 sites. However, Lake Union still experiences periods of anaerobic conditions that typically begin in June
416 and can last until October (Shared Strategy 2007).

417 The thermal stratification of Lake Washington and Lake Union can produce surface temperatures in
418 excess of 68° F (20° C) for extended periods during the summer. In addition, there is a long-term trend
419 of increasing summer and early fall water temperatures (Goetz et al. 2006; Newell and Quinn 2005;
420 Quinn et al. 2002; King County 2007). From 1932 to 2000, there was a significant increase in mean
421 August water temperature from about 66° F to 70° F (19° to 21° C) at a depth of 15 feet (Shared
422 Strategy 2007). If this trend continues, surface water temperatures could exceed the lethal threshold for
423 returning adult salmon in some years.

424 Although raw sewage can no longer be discharged directly into the action area waters, untreated,
425 contaminated discharges occasionally enter these waterways during periods of high precipitation

426 through discharge from combined sewer overflows (NMFS 2008b). For example, a recent incident
427 resulted in the accidental discharge of an estimated 6.4 million gallons of sewage into Ravenna Creek,
428 which discharges into Union Bay (King County 2008).

429 The Ship Canal and Lake Union are listed on the Ecology 303(d) list of impaired water bodies for
430 exceeding water quality criteria for total phosphorous, lead, fecal coliform, and aldrin (Ecology 2008).
431 In addition, portions of Lake Washington are listed on the 303(d) list for exceeding water quality criteria
432 for fecal coliform, as well as the tissue quality criteria for 2,3,7,8 TCDD (dioxin), PCBs, total chlordane,
433 4,4' DDD ([metabolite](#) of [DDT](#)) and 4, 4' DDE (breakdown product of DDT) in various fish species
434 (Ecology 2008). Therefore, the overall water quality conditions in the action area are degraded
435 compared to historical conditions.

436 **4.4 FISH AND FISH PREDATORS IN LAKE WASHINGTON AND THE SHIP CANAL**

437 The Lake Washington watershed supports a diverse group of fish species, including several species of
438 native salmon and trout such as Chinook, coho, and sockeye salmon and steelhead trout. Cutthroat trout
439 are also present in many of the tributaries and the lake. Rainbow trout were commonly planted in Lake
440 Washington in the past and are still present in the lake. Several observers have reported sightings of
441 individual bull trout in the watershed, but there is no evidence of a reproductive population occurring
442 within Lake Washington or the lake's tributaries. There is a substantial reproducing population of bull
443 trout in the Chester Morse Reservoir within the upper Cedar River watershed, but this population is
444 isolated from the rest of the watershed by Chester Morse Dam. Some bull trout observed in the Ship
445 Canal and Lake Washington may have been entrained from this upper Cedar River population and
446 moved downstream, thus becoming isolated from their original population. Bull trout produced in other
447 watersheds may occasionally migrate into the Ship Canal and Lake Washington, or prey on juvenile
448 salmon downstream from the Ballard Locks. Fish species in the Ship Canal are the same as those in
449 Lake Washington except that because no deep-water habitat is present, the species that require this
450 habitat type are rarely likely to occur in the Ship Canal. In addition, the shoreline and shallow-water
451 areas of Portage Bay and Union Bay provide habitat primarily for those species that prefer shallow-
452 water habitats with abundant aquatic vegetation. Many introduced species such as carp, smallmouth
453 bass, and yellow perch use the shallow areas within this highly altered habitat.

454 Predation of salmonids by native and non-native predatory fishes is a substantial source of mortality in
455 Lake Washington and the Ship Canal (Fayram and Sibley 2000; Warner and Fresh 1998; Kahler et al.
456 2000). Fayram and Sibley (2000) and Tabor et al. (2004, 2006) demonstrated that bass may be a risk
457 factor for juvenile salmonid survival in Lake Washington. Celedonia et al. (2008a, b) found that larger
458 bass tend to be present near shoreline structures and bridge piers, including areas where young salmon
459 are likely to migrate and rear. Therefore, juvenile Chinook and steelhead may be more vulnerable to
460 predation as they migrate through Lake Washington to marine waters, as well as through the relatively
461 confined Ship Canal. The highly modified habitat throughout the Ship Canal and the locks may also
462 contribute to an increased predation potential by reducing refuge habitat.

463 The primary fresh water predators of salmonids in the lakes and waterways in the Lake Washington
464 basin include native and non-native species. Substantial non-native predator fish include yellow perch
465 (*Perca flavescens*), smallmouth bass (*Micropterus dolomieu*), and largemouth bass (*Micropterus*

466 *salmoides*). Predominant native fish predators include cutthroat trout (*O. clarki clarki*), northern
467 pikeminnow (*Ptychocheilus oregonensis*), and prickly sculpin (*Cottus asper*). However, sampling in
468 February and June of 1995 and 1997 found only 15 juvenile Chinook salmon in the stomachs of 1,875
469 predators (prickly sculpin, smallmouth and largemouth bass, and cutthroat trout) examined, with most of
470 the predation by prickly sculpin (Tabor et al. 2004). These data suggest the predation of less than 10
471 percent of the Chinook salmon entering the lake from the Cedar River.

472 Smallmouth bass overlap with juvenile Chinook salmon in Lake Washington in May and June, when
473 both occur in shoreline areas. However, predation rates are also affected by physical conditions. For
474 example, smallmouth bass do not feed as actively in low water temperatures in areas typically occupied
475 by Chinook, as they do above 68°F (20°C) (Wydoski and Whitney 2003). Chinook also avoid overhead
476 cover, docks and piers, and the coarse substrate habitat areas preferred by smallmouth bass (Tabor et. al
477 2004a; Gayaldo and Nelson 2006; Tabor et al. 2006; Celedonia et al. 2008a, b).

478 Tabor et al. (2006) concluded that under existing conditions, predation by smallmouth and largemouth
479 bass has relatively minor effect on Chinook salmon and other salmonid populations in the Lake
480 Washington system. However, predation appears to be greater in the Ship Canal than in the lake. Tabor
481 et al. (2000) estimated populations of about 3,400 smallmouth and 2,500 largemouth bass in the Ship
482 Canal, with approximately 60 percent of the population occurring at the east end at Portage Bay. They
483 also observed that smallmouth bass consume almost twice as many Chinook salmon smolts per fish as
484 largemouth bass (500 smolts versus 280 smolts, respectively). This consumption occurs primarily during
485 the Chinook salmon outmigration period (mid-May to the end of July) when salmon smolts represented
486 50 percent to 70 percent of the diet of smallmouth bass (Tabor et al. 2000). An additional study
487 estimated the overall consumption of salmonids in the Ship Canal at between 36,000 and 46,000
488 juvenile salmon, corresponding to mortality estimates ranging from 0.5 percent to 0.6 percent (Tabor et
489 al. 2006).

490 While there has been an obvious increase in the number of non-native predators in the lake, changes in
491 the number of native predators have been less apparent. However, there is some anecdotal evidence that
492 the number of cutthroat trout has increased considerably over time (Nowak 2000). In addition,
493 Brocksmith (1999) concluded that the northern pikeminnow population increased by 11 percent to 38
494 percent between 1972 and 1997, as did the number of large northern pikeminnow. The greater number,
495 and the larger size, of these predators suggest an overall increase in predation mortality of anadromous
496 juvenile salmonids. The incidence of fresh water predation by fish in Lake Washington and the Ship
497 Canal may also be increasing due to the increasing water temperatures (Schindler 2000).

498 In addition to fresh water predation, the relatively confined marine habitat area below the locks may also
499 result in additional predation mortality for salmonid smolts. Footen (2000) found that the most abundant
500 predators near the locks were sea-run cutthroat trout (*Salmo clarki clarki*) and staghorn sculpin
501 (*Leptocottus armatus*), while farther away the key predators were staghorn sculpin and resident Chinook
502 salmon (blackmouth). Another important predator in the area was bull trout. Chinook salmon smolts
503 made up 12 percent of the cutthroat trout diet, while 34 percent was other species smolts, mostly chum.
504 Bull trout diet consisted of 27 percent Chinook and 12 percent other salmonids. Fifty percent of the
505 sculpin diet was Chinook salmon, but this estimate was based on only one sample. The primary known
506 avian and mammalian predators on juvenile salmon and steelhead are glaucous-winged gulls (*Larus*

507 *glaucescens* and others), harbor seals (*Phoca vitulina*), and California sea lions (*Zalophus*
508 *californianus*).

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510 **5. POTENTIAL EFFECTS TO AQUATIC RESOURCES AND**
511 **MITIGATION FRAMEWORK**

512 **5.1 POTENTIAL EFFECTS TO AQUATIC RESOURCES**

513 Construction and operation of the project would affect Lake Washington as well as portions of the Lake
514 Washington Ship Canal. These effects would be primarily related to the alteration or displacement of
515 aquatic habitat due to either the placement of project-related structures (piles, columns) or to shading
516 from overwater structures. These changes would affect shoreline/riparian habitat as well as deeper open
517 water habitat.

518 The project has the potential to affect fish and aquatic habitat in Portage Bay, Montlake Cut, Union Bay,
519 Lake Washington, and tributary streams on the east side of Lake Washington. To build the replacement
520 bridges and other project-related facilities, some construction would take place outside of the footprint
521 of the existing infrastructure, but generally within the permanent right of way. To safely construct any of
522 the proposed design options or their suboptions, WSDOT would build construction work bridges along
523 both sides of the existing bridge structures, except where construction activities could be safely
524 conducted from barges or existing roadways. In addition, detour bridges would be constructed in some
525 areas to allow simultaneous vehicular traffic and construction activity in the project corridor. A portion
526 of the work area (which includes the work bridges/detour bridges and proposed finger piers that would
527 extend from the work bridge to the individual support columns) would be located within the footprint of
528 the proposed 6-Lane Alternative. In other cases, the construction limits would extend beyond the area
529 affected by the permanent structure. This would increase the amount of aquatic habitat affected by the
530 structures for a period of time (several years). After construction of SR 520 was complete, some aquatic
531 habitat areas affected by construction, particularly riparian and shoreline habitats, would be restored and
532 replanted with appropriate riparian vegetation.

533 Project effects on aquatic resources in the project area would be both permanent and temporary. For fish
534 resources, the amount of aquatic habitat lost would be primarily due to in-water support structures of the
535 elevated or floating bridge structures. The proposed project would place new structures and/or maintain
536 existing structures within the shoreline and open-water habitats that support various fish species
537 throughout much of the Seattle study area. New structures would be built and existing structures would
538 be removed from these habitat areas in Portage Bay, Union Bay, and open-water areas adjacent to the
539 western shoreline of Lake Washington.

540 Table 1 shows the permanent effect that could result from installing bridge columns. In addition to
541 changes in bridge height, the project could also affect fish resources due to increased shading from the
542 wider overwater bridge structures. For example, under all options, the floating portion of the Evergreen
543 Point Bridge would be equal, at approximately twice the width of the existing bridge. In Portage Bay,
544 the proposed replacement bridge would be approximately 2,690 feet long and have a minimum width of
545 approximately 115 feet; it would be least 40 feet wider than the existing bridge. The new West
546 Approach to the Evergreen Point Bridge would be approximately 57 feet wider than the existing
547 roadway. For Options A and L, the new bascule bridge over the Montlake Cut would be approximately
548 60 feet wide, similar to the existing bridge.

549 While the shaded aquatic habitat would continue to function, the reduced light levels could affect
 550 aquatic plant growth and therefore the quality of the habitat for fish. Most of the proposed bridge
 551 structures would be similar or higher than the existing bridge structures. The higher sections would
 552 somewhat offset the potential effects of the wider structures, while the shading effects would likely be
 553 substantially greater for sections that remain at about the same height as the existing structures. In
 554 addition, the shading could also have a positive effect of fish habitat by decreasing the growth of
 555 invasive milfoil in the shallow nearshore areas. Table 2 lists the amount of overwater structure for each
 556 option, while Table 3 lists temporary effects from overwater shading due to construction of temporary
 557 work and detour bridges.

558 **Table 1. Estimated Number of Concrete Columns and Resulting Permanent Habitat Effect**

Alternative	Portage Bay	West Approach	East Approach	Total
Existing (Baseline) Conditions	119 (1,890 sq/ft)	404 (6,590 sq/ft) ^a	14 (350 sq/ft) ^a	537 (8,830 sq/ft)
Option A	47 (18,020 sq/ft) ^a	187 (5,290 sq/ft)	4 (450 sq/ft)	238 (23,760 sq/ft)
Option A and Suboptions	47 (18,020 sq/ft) ^a	214 (6,050 sq/ft)	4 (450 sq/ft)	265 (24,520 sq/ft)
Option K	42 (17,850 sq/ft) ^a	928 ^b (97,890 sq/ft) ^c	4 (450 sq/ft)	974 (116,190 sq/ft)
Option K and Suboptions	48 (18,160 sq/ft) ^a	928 ^b (97,890 sq/ft) ^c	4 (450 sq/ft)	980 (116,500 sq/ft)
Option L	48 (18,160 sq/ft) ^a	185 (9,150 sq/ft)	4 (450 sq/ft)	237 (27,760 sq/ft)
Option L and Suboptions	48 (18,160 sq/ft) ^a	185 (9,150 sq/ft)	4 (450 sq/ft)	237 (27,760 sq/ft)

^a Area includes footings or shaft caps at the mud line supporting the columns.

^b Columns range from 2 to 7 feet in diameter, while columns for the other options range from 6 to 10 feet.

^c Area includes the entire in-water fill of the submerged roadway entering the single-point urban interchange. .

Table 2. Total Area (acres) of Overwater Structure that Would Cause Shading Effects

Option	Floating Bridge	East Approach Area	Portage Bay Area	West Approach Area	Montlake Area	Total
Existing (Baseline) Conditions	10.8	0.8	3.1	11.1	0.2	26.4
Option A^a	29.5	1.8	3.6	9.6	0.2	44.0 ^b
Suboptions^a	29.5	1.8	3.6	11.2	0.2	45.6 ^b
Option K^a	29.5	1.8	2.1	10.3	0	43.0 ^c
Suboptions^a	29.5	1.8	2.1	10.3	0	43.0 ^c
Option L^a	29.5	1.8	2.3	11.1	1.5	45.5 ^d
Suboptions^a	29.5	1.8	2.3	11.1	1.4	45.4 ^d

^a Acreages represent new overwater structure area where no existing overwater structures occur (does not include areas where new overwater structure overlaps with existing overwater structure).

^b Includes 2.8 acres (6 percent) of additional shading of aquatic bed wetlands within open water.

^c Includes approximately 3.5 acres (7 percent) of additional shading effects on aquatic bed wetlands within open water.

^d Includes approximately 3.8 acres (8 percent) of additional shading effects on aquatic bed wetlands within open water.

Table 3. Approximate Acres of Shading from Temporary Detour and Work Bridge Structures

Location	Portage Bay ^a	West Approach ^a	East Approach ^b	Total
Option A	3.2	8.7	1.5	13.4
Option A and Suboptions	3.2	8.7	1.5	13.4
Option K	3.2	9.1	1.5	10.6
Option K and Suboptions	3.2	9.1	1.5	10.6
Option L	3.2	7.5	1.5	12.2
Option L and Suboptions	3.2	7.5	1.5	12.2

^a Acreages do not include overlap with the proposed permanently shaded bridge structure.

^b Includes 0.8 acre of work bridges and 0.7 acre of falsework.

Shading over shallow nearshore habitats may likely have greater potential effects to aquatic plants and organisms than shading in the deeper open lake environment, due to a reduction in the photosynthetic potential of primary producers that inhabit the littoral zone. Nearshore areas generally provide areas of greater habitat complexity to support a diverse biological community. Therefore, increased shading in these areas would have a greater potential to affect the growth and behavior of a variety of plant and

567 animal species. However, shading would also reduce the densities of invasive aquatic vegetation, which
568 could result in slight improvements to water quality conditions and habitat use.

569 As noted previously, the amount of shading generated from a new overwater structure (e.g., bridge deck)
570 depends both on the width of the structure as well as the height of the structure over the water. For
571 example, in Portage Bay, the proposed bridge height (approximately 48 feet) would likely be sufficiently
572 high to allow natural vegetation to grow underneath, based on the fact that mature trees (40 to 80 feet
573 high) currently grow within the shadow of the existing Portage Bay Bridge. Although the western half of
574 the proposed bridge would be slightly lower than the existing structure, the eastern half of the proposed
575 bridge would be approximately 8 feet higher than the existing bridge and typically between 13 and
576 16 feet above the water. The comparison of bridge heights to existing locations would vary by option
577 and bridge location (Table 4).

578 In addition to permanent impacts from inwater and overwater bridge structures, some design options
579 would also result in impacts to the shoreline of Lake Washington. For example, the Alternative K
580 roadway would be lower than the other options at the eastern shoreline of the Washington Park
581 Arboretum. The roadway would actually be below the high water elevation of the lake and would result
582 in fill of approximately 90,500 square feet (2.1 acres) of shallow-water habitat. This would require some
583 excavation along the Washington Park Arboretum shoreline and the construction of retaining walls
584 extending out into the water.

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Table 4. Approximate Height (feet) from the High Water Level to the Underside of Bridge Structures^a

Location	Existing (Baseline) Conditions	Option A	Option K	Option L
Portage Bay				
West shoreline	50	48	48	48
Mid-point	10	16	16	16
East shoreline	8	13	13	13
Montlake				
Montlake Cut	35-46	35-46	0 ^b	43-57
Union Bay				
West Arboretum shoreline	2.5	17	<0 ^c	8 ^e
West Foster Island shoreline	6	25	<0 ^c	13 ^e
West Approach				
East Foster Island shoreline	4	23	<1	15 ^e
Mid-point ^c	4	8	5	19 ^e
West Highrise	44	50	50	47 ^e
East Approach				
East Highrise	55-64	70	70	70

^a Bridge heights were estimated from elevation information at each bridge pier location, which varies between options.
^b Option K will tunnel under the Montlake Cut.
^c The proposed roadway would occur below the high water elevation in the nearshore area of the Arboretum by several feet.
^d About 1,400 feet east of Foster Island, midway between the island and West Highrise.
^e Suboption A has a similar profile as Option L in this area.

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The project would require substantial in-water pile-driving activities to construct work bridges in shallow water areas that cannot be accessed by barge. The underwater sound levels generated during pile-driving activities could disturb or alter the natural behavior and habitat of fish and other aquatic species and, in some instances, cause injury or mortality. The type and magnitude of effects on fish and other aquatic species depend on a wide range of factors including the type and size (diameter) of pile, type of pile-driving hammer, pile-driving duration, sound attenuation method, size, and number of surface waves, depth of the site, sound minimization best management practices (BMPs) employed, geologic conditions that govern the penetration rate of the pile, and the required penetration depth.

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It is anticipated that at least some of the pile-driving activities can be accomplished using a vibratory hammer to minimize in-water sound levels. However, some impact pile driving (proofing) would be needed to achieve adequate load-bearing capacity for the piles. After the construction is completed, these piles would be removed with a vibratory hammer. Table 5 lists the number of temporary piles that would be required and the corresponding mudline habitat areas temporarily affected.

601 Site-specific evaluations are planned for this project to assess the sound levels generated by pile-driving
 602 in Portage Bay, Union Bay, and Lake Washington and to identify appropriate BMPs to minimize the
 603 potential effects of pile-driving on fish and other aquatic species. Specific in-water construction periods
 604 would also be established through the project permitting process to minimize potential effects of pile-
 605 driving and other in-water construction activities on salmonid species.

606 **Table 5. Estimated Number of Support Piles and Lakebed Occupied**
 607 **for Temporary Detour and Construction Work Bridges**

Alternative	Portage Bay	West Approach	East Approach	Total
Option A	741 (2,330 sq/ft)	1,987 (6,240 sq/ft)	165 ^b (520 sq/ft)	2,893 ^a (9,090 sq/ft)
Option A and Suboptions	741 (2,330 sq/ft)	2,042 (6,410 sq/ft)	165 ^b (520 sq/ft)	2,948 ^a (9,260 sq/ft)
Option K	698 (2,190 sq/ft)	2,797 (8,790 sq/ft)	165 ^b (520 sq/ft)	3,660 ^a (11,500 sq/ft)
Option K and Suboptions	698 (2,190 sq/ft)	2,797 (8,790 sq/ft)	165 ^b (520 sq/ft)	3,660 ^a (11,500 sq/ft)
Option L	704 (2,210 sq/ft)	1,984 (6,230 sq/ft)	165 ^b (520 sq/ft)	2,853 ^a (8,960 sq/ft)
Option L and Suboptions	704 (2,210 sq/ft)	1,984 (6,230 sq/ft)	165 ^b (520 sq/ft)	2,853 ^a (8,960 sq/ft)

^a Area calculations based on 24-inch piles.

^b Includes piles for the work bridges and falsework structures.

608 **5.1.1 Turbidity**

609 In-water construction activities might generate some turbidity plumes from disturbance of the bottom
 610 sediments. Increased turbidity could occur during installation of the work bridge piles, although
 611 turbidity risks are considered more likely to occur during removal of the work bridge support piles.
 612 Turbidity is also a potential concern for the BMPs implemented for other construction concerns. For
 613 example, bubble curtains and cofferdams may disturb sediments and increase turbidity levels, even
 614 though they are intended to minimize construction effects.

615 **5.1.2 Anchoring**

616 Increased turbidity can alter the behavior of aquatic species, impair their ability to capture prey, and in
 617 severe cases cause physical injuries such as gill abrasion in fish. However, the relatively calm, protected,
 618 waters in Portage Bay have very little current, and are unlikely to cause the substantial dispersion of any
 619 suspended sediment that might occur from construction activities, thereby limiting the overall potential
 620 to affect aquatic species or habitat conditions. The substantial anchoring depths (two-thirds of the
 621 anchors will be in water depths of at least 180 feet) would also likely limit potential effects because
 622 fewer species typically occur in the deeper areas of the lake. The implementation of appropriate BMPs
 623 would also likely minimize the potential effects of any turbidity resulting from construction activities.

624 **5.1.3 Water Quality**

625 Other potential short-term construction effects could include spills of hazardous materials (e.g., oil and
626 gasoline), chemical contaminants, or other materials. All pollutants would be handled in a manner that
627 would not contaminate surface water in the study area. No maintenance or fueling of construction
628 equipment, vehicles, or vessels would be allowed within 200 feet of the area waterways to reduce the
629 risk of spills of petroleum and hydraulic fluids in sensitive areas. Materials that modify pH, such as
630 cement, cement grindings, and cement saw cutting, would be managed or isolated to minimize the
631 spread of these materials by surface water runoff or by other means. The contractor would be required to
632 submit a spill prevention and control plan before beginning work.

633 **5.1.4 Stormwater**

634 Stormwater that runs off SR 520 within the study area is currently not treated before it is discharged into
635 Lake Washington, Lake Union, and Portage Bay. Under the proposed options and sub-options, all
636 stormwater from new and replaced impervious surfaces would be treated for water quality before being
637 discharged into these water bodies. In addition, although compliance with water quality regulations in
638 accordance with WSDOT's *Highway Runoff Manual* (WSDOT 2008b) would be met by providing basic
639 stormwater treatment, WSDOT would provide enhanced stormwater treatment at multiple facilities
640 under all options and their sub-options, where feasible and practical. This action would further improve
641 the water quality of stormwater runoff prior to discharge.

642 Under all options, the proposed project would treat 100 percent of runoff from post-project pollution
643 generating impervious surfaces (PGIS). This would reduce the discharge concentrations of total
644 suspended solids, and total and dissolved zinc and copper for all options. More importantly, all proposed
645 project options would reduce the total loading of these substances discharged into the receiving
646 environment (Lake Washington and the Ship Canal), including reductions in both dissolved copper and
647 dissolved zinc loading. In addition, the current floating bridge drainage system is leaching high levels of
648 zinc, but the WSDOT (2005) stormwater monitoring report suggests that dissolved zinc may decrease
649 dramatically in some areas of Lake Washington since the drainage system of the new floating bridge
650 would use materials constructed of alternative materials. Overall, all stormwater discharges would
651 comply with Clean Water Acts standards and would meet state water quality standards for the protection
652 of aquatic life.

653 **5.2 MITIGATION FRAMEWORK**

654 Preliminary effects on aquatic ecological habitat were calculated by overlaying the proposed design onto
655 the project base maps of aquatic features. Physically affected habitat areas were determined as the area
656 of intersection of the two sets. Effects were calculated based on the project action that causes the effect,
657 and were broken down by the type of ecological stressors that the project action will affect. This impact
658 analysis presents only the direct impacts of the various design options and does not take into account the
659 removal of existing bridge or roadway structures that would likely offset some of the construction and
660 operational impacts of the project. For example, while all options include the construction of new
661 bridge columns and decking, the existing bridge columns and decking will also be removed, reducing
662 overall (net) impacts to aquatic resources.

663 The types and magnitude of these effects guided the mitigation team in formulating the types of
664 mitigation activities that would serve to offset the temporary and permanent effects of project
665 construction and operation. Unlike the regulatory process for wetland mitigation, no prescribed
666 mitigation ratios exist for the majority of the effects to aquatic habitat. In addition, many of the potential
667 effects to fish and other aquatic species would be indirect, and resulting from effects to organism
668 behavior patterns or effects to fish predators or prey resources. For example, partial shading effects from
669 the new bridge structures could alter juvenile salmon migration patterns or timing, or influence the
670 distribution of salmonid predators within the study area. These effects could ultimately affect the
671 number of juvenile salmon completing successful outmigration to marine waters.

672 Effects on individual fish, or populations of fish, resulting from habitat alterations are generally
673 mitigated by increasing the quality and quantity of habitat for the species of interest, either at the site of
674 the effect or at an offsite location that would provide similar benefit to the species/populations of
675 interest. Therefore, the team analyzed habitat creation or improvement projects within WRIA 8 to
676 address the project's mitigation needs.

677 The goal of the mitigation screening and ranking process was to select a suite of sites (land parcels)
678 where the restoration combined uplift in aquatic functions and values would be of a sufficient magnitude
679 to offset the project's effects on key salmonid habitat functions. Salmon, in particular Chinook salmon,
680 were chosen as key indicator species because these species are the most studied species in the watershed
681 and the most comprehensive data set linking habitat variables in the watershed was collected for
682 salmonids (City of Seattle 2008; King County 2005). The key salmonid life history functions that would
683 be affected are directly related to the life history phases of the affected fish. These functions are refugia,
684 rearing areas, foraging areas, and migratory corridors that are important for juvenile salmonid survival in
685 littoral, nearshore, or lotic areas of the Lake Washington basin. The mitigation screening approach was
686 designed to link affected habitat features and ecological functions with potential enhancements of such
687 features that support the key life history functions of salmonids in the Lake Washington basin.

688 To screen or sort potential mitigation sites, it is necessary to consider which habitat elements are the
689 most important within WRIA 8, and the relationship between these elements and the key life history
690 functions they support. Project effects can then be calculated based on their influence on these habitat
691 elements, as can the benefit of enhancing these elements with mitigation activities. Since there is
692 currently no prescription for aquatic effects, the mitigation team needs to find a common denominator to
693 quantify the project effects versus project mitigation needs. There needs to be a common currency and
694 link between mitigation actions and project effects, and a possible solution may be to use salmonid
695 population effects metrics combined with salmonid habitat metrics. A key step that will be examined in
696 greater detail in the Conceptual Aquatic Mitigation Plan is the incorporation of salmonid population
697 effects metrics, salmonid habitat metrics, or a combination of these metrics to develop a common
698 denominator for mitigation planning and ultimately documenting the sufficiency and appropriateness of
699 WSDOT's proposed mitigation actions.

700 High quality habitat for juvenile salmonids in Lake Washington and Lake Union is characterized by
701 fine-grained substrates, shallow gradients, overhead cover, unarmored banks, and no barriers to
702 migration (Tabor and Piaskowski 2002; City of Seattle 2001). High quality habitats in Lake Union and
703 the Ship Canal are similar to those in Lake Washington, but include limited barriers to migration (City

704 of Seattle 2001). Favorable habitat in Puget Sound is similar to that in fresh water areas, but also
705 includes eelgrass beds, marine riparian vegetation, and diverse substrate types (City of Seattle 2001).
706 From a landscape ecology perspective, improving the spatial distribution of refuge, cover, and food, as
707 well as connectivity between and among habitats is important in the Cedar/Sammamish rivers, Lake
708 Washington, Lake Union/Ship Canal, and Puget Sound. The individual key juvenile salmonid life
709 history functions (migration, feeding, and rearing/refugia) were used to assess project effects, as well as
710 in screening potential mitigation sites. These functions are discussed below in greater detail.

711 **5.2.1 Rearing and Refugia**

712 Juvenile salmonids require habitat that provides refuge from predatory, physiological, and high-energy
713 challenges. High-quality freshwater refuge habitat, limited in Lake Washington and the Ship Canal
714 (Tabor and Piaskowski 2002; Weitkamp et al. 2000), consists of unarmored, shallow-gradient littoral
715 zone with large woody debris (LWD) and overhanging vegetation (Tabor and Piaskowski 2002). Low-
716 quality refuge habitat is prevalent in most Lake Washington shoreline areas due to shoreline
717 development, lack of LWD, and the proliferation of exotic predatory fish species. Shoreline
718 modifications that preclude shallow water habitat comprise most of the Lake Washington shoreline (Toft
719 2001; Toft et al. 2003a). In Lake Washington, pilings and riprap likely contribute to increased energy
720 expenditure and risk of predation on juvenile salmonids by bass and northern pikeminnow (Celedonia et
721 al. 2008 a, b). Riprap areas have been shown in other lakes to exhibit higher water velocities, depths,
722 and steep slopes compared with unaltered habitats (Garland et al. 2002). Due to littoral zone activities
723 and modifications, including dredging, filling, bulkheading, and construction, very little native
724 vegetation remains on the Lake Washington shoreline (Weitkamp et al. 2000; Toft 2001; Toft et al.
725 2003a).

726 Refuge is limited in the Lake Washington basin near the fresh/salt water transition at the locks due to the
727 limited natural habitat and sharp osmotic gradient. Juvenile salmonids exiting Lake Washington may
728 seek tributary mouths as refuge habitats because overhead vegetative cover and the water from these
729 tributaries provide refuge from higher salinities or temperatures (Seattle Parks and Recreation 2003). In
730 nearshore marine areas and shallow nearshore areas, aquatic and marine riparian vegetation, LWD, and
731 larger substrates are considered high quality refuge habitat (City of Seattle 2001). In Puget Sound, this
732 habitat is limited due to the prevalence of bulkheads and overwater structures, and extensive filling,
733 dredging, and grading in shoreline areas (Weitkamp et al. 2000; City of Seattle 2001).

734 **5.2.2 Foraging**

735 Juvenile salmon require habitat that provides and supports the production of ample prey resources,
736 which includes unaltered shorelines with organic inputs and small substrates. Juvenile Chinook in Lake
737 Washington prey on insects and pelagic invertebrates, namely chironomids and *Daphnia* spp. (Koehler
738 2002). Juvenile salmonids in Puget Sound feed on forage fish larvae and eggs as well as other pelagic,
739 benthic, and epibenthic organisms from nearshore, intertidal, and eelgrass/kelp areas (Simenstad and
740 Cordell 2000). Although existing literature generally concludes that lack prey resources are not a
741 limiting factor for juvenile salmon (Kerwin 2001), inwater construction activities have the potential to
742 temporarily affect foraging behavior, by decreasing primary productivity, or altered feeding behaviors
743 due to changes in water clarity (sedimentation) or inwater noise and disturbance. Because the proposed

744 project has the potential to temporarily affect the foraging ability of juvenile outmigrant salmonids, this
745 life-history element was incorporated into the mitigation framework.

746 **5.2.3 Migration**

747 Lake habitat generally considered favorable for migration includes a gently sloping beach with no
748 overwater structures to restrict light penetration of the water. Juvenile salmonids require habitat with
749 few barriers to their seaward migration. Lake Washington lacks these barriers, but concern exists among
750 biologists that overwater structures such as docks and piers may indirectly act as a barrier to alter
751 migration patterns (Weitkamp et al. 2000). Juvenile salmon readily pass under small docks and narrow
752 structures under which darkness is not complete, but some studies have indicated that under some
753 conditions, large overwater structures with dark shadows can alter migration (Fresh et al. 2001).
754 However, juvenile migration of salmonids is complex and influenced by a variety of factors. In a study
755 of the effects of the existing SR 520 bridge, Celedonia et al. (2008a, pp. 97-98) observed no apparent
756 holding behavior of juvenile Chinook at the existing bridge during year 1 of the study, while in another
757 year minutes to hours of holding was observed for about half the fish (Celedonia et al. 2008a, p. ii).
758 Some juveniles pass directly under the bridge without delay, while others spend up to two hours holding
759 close to the bridge. Overall, these short delays are unlikely to result in detectable changes in survival of
760 Chinook or other juvenile salmon as they migrate through Lake Washington and the Ship Canal.

761 In nearshore areas of the Duwamish estuary and Elliott Bay, several studies have shown that unlike Lake
762 Washington's docks and piers, overwater structures in the Duwamish estuary and in Elliott Bay do not
763 have a detrimental effect on juvenile salmonid migration patterns; however, this has been attributed to
764 the difference in size and construction from similar structures along Lake Washington and Lake Union
765 shorelines (Weitkamp et al. 2000). Some studies have shown that drastic changes in ambient underwater
766 light environments may alter fish migration behavior (Nightingale and Simenstad 2001).

767 The migratory corridor is severely modified at the locks, as the fresh- to salt water transition occurs
768 rather abruptly within the salt wedge and mixing zone near the locks. Options for fish passage include a
769 fish ladder for large fish, a fish slide (primarily for smaller fish), and the water of the locks themselves.
770 However, the locks remain problematic because of the high rate of injury, including scale loss (Seiler
771 1996).

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776 Effects to aquatic and wetland resources generally have different mitigation requirements and needs than
777 do effects to wetland resources. Because the project is adjacent to the entrance of the Lake Washington
778 Ship Canal, the project could affect fish from all naturally spawned anadromous populations located
779 upstream of this location, including important populations of Endangered Species Act (ESA) listed
780 Chinook salmon in the Cedar River and Sammamish River. Likewise, many species of juvenile salmon
781 produced in WRIA 8 use the marine nearshore within and adjacent to Shilshole Bay. Based on the wide
782 variety of interrelated physical, chemical, and biological effects to aquatic species and habitat that could
783 occur from the construction and operation of the project, it is unlikely that all aquatic mitigation needs
784 would be satisfied at a single site or within a single drainage basin. In addition, although achieving
785 onsite aquatic mitigation is a primary goal of this process (such suitable sites would take priority)
786 existing project constraints (the project is located in a heavily developed and near fully built out, urban
787 environment) dictate the need to examine appropriate mitigation opportunities within offsite areas as
788 well, in order to develop a range of sites that will provide the type and quantity of compensatory
789 mitigation required to adequately offset the aquatic impacts of the project.

790 The current approach, described in this document, builds upon past SR 520 mitigation planning efforts.
791 Previous mitigation planning efforts included preparation of an Initial Aquatic Habitat Mitigation Plan
792 (WSDOT 2006), prepared simultaneously with the Draft SR 520 Bridge Replacement and HOV Project
793 Environmental Impact Statement (Draft EIS). The 2006 report identified mitigation measures for
794 potential aquatic habitat effects resulting from construction and operation of the SR 520 project. This
795 version of the Initial Aquatic Habitat Mitigation Plan supersedes that effort, and seeks to assess sites for
796 their suitability to offset the impacts from the current design options. This report incorporates resource
797 agency input on the 2006 mitigation report, as well as feedback on the 2006 DEIS.

798 The following sections summarize the approach and rationale in conducting preliminary screenings and
799 parings of candidate mitigate sites. The result of this process was a compiled list of preliminary
800 candidate aquatic mitigation sites for the project. The general approach included the following elements:
801 (a) reviewing previous project reports and public documents; (b) researching planning documents,
802 databases, and photographs; (c) integrating available geographic information system (GIS) data sources
803 that relate appropriate physical or biological data to specific geographic locations; and (d) stakeholder
804 input.

805 To characterize and evaluate mitigation opportunities for the project, it was necessary to evaluate the
806 potential of individual land parcels to offer mitigation opportunities likely to successfully achieve the
807 project's mitigation goals. The offsite mitigation site selection process was divided into two steps: (1) an
808 initial pass/fail screening for physical constraints and general mitigation suitability, including
809 geographical boundaries; and (2) a more detailed sorting into various functional groups, with additional
810 analysis parameters added for later analysis. These two steps, described in detail below, produced four
811 separate lists of functional mitigation sites, which were then further pared down (see Section 6) to
812 produce several unranked lists of preliminary preferred sites.

813 **6.1 REVIEW OF EXISTING INFORMATION**

814 Prior to conducting the mitigation screening and evaluation, the mitigation team used GIS information to
815 prepare overlay data layers for analyzing and interpreting aerial photographs and for identifying and
816 characterizing potential mitigation sites. Such characteristics included location, proximity, and
817 connectivity to streams or riparian areas, potential wetland areas, and riverine deltas. County assessor
818 tax parcel information was overlain onto an aerial photographic base map to estimate the size of
819 potential mitigation sites.

820 Also, to assist the mitigation team with site selection, the team considered pertinent information on the
821 land use, marine and fresh water shorelines, and rivers and streams within each functional group.
822 Literature and available spatial data, including information on topography, land use, and water bodies,
823 which were considered and utilized during the site selection process, included the following:

- 824 • King County GIS layers including critical areas, parcels, parks, trails, water system-related data, land
825 use, and zoning (data acquired from King County 2008)
- 826 • King County Flood Hazard Management Plan (2006)
- 827 • Chinook Salmon Conservation Plan – WRIA 8 (King County 2005)
- 828 • Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Near Term Action Agenda for Salmon
829 Habitat Conservation (King County 2002)
- 830 • Puget Sound Nearshore Project Priorities (December 2007)
- 831 • Synthesis of Salmon Research and Monitoring – Investigations Conducted in the Western Lake
832 Washington Basin, City of Seattle (December 2008)
- 833 • Seattle’s Urban Blueprint for Habitat Protection and Restoration (City of Seattle 2001)
- 834 • Seattle Shoreline Park Inventory and Habitat Assessment (June 2003)
- 835 • Seattle Shoreline Alternative Mitigation Plan (Preliminary Plan) (May 2006)
- 836 • SR 520 Bridge Replacement and HOV Project Draft EIS, Appendix E (August 18, 2006)
- 837 • SalmonScape interactive Web site (WDFW 2009)

838 **6.2 INITIAL SCREENING (PARE 1)**

839 The mitigation team established initial screening criteria based on the geographical locations of potential
840 mitigation sites and other factors related to the physical constraints of potential sites, such as available
841 area and the current level of onsite development. The initial screening used four parameters to determine
842 suitability of the site: parcel location, parcel classification, parcel size/shoreline length, and preliminary
843 fatal flaw analysis (see Table 6). These parameters are described in detail below.

844 The initial screening, conducted as a GIS exercise, had only two outcomes: pass or fail. The results of
845 the initial screening are presented in Appendix A, which lists all parcels that successfully advanced
846 through the initial screening. In addition to the list of mitigation sites generated by the screening
847 exercise, several local jurisdictions provided WSDOT with lists of potential mitigation sites within their

848 jurisdictions. These sites were added to the initial list and subjected to the same screening process as
 849 other potential sites.

850 If sites were screened out during the initial screening, they were placed on a secondary list for
 851 consideration at a later time, as needed. In most cases, if any of the criteria were not met, the parcel was
 852 not carried forward for further consideration as a potential mitigation opportunity.

853 **Table 6. Site Suitability Criteria**

Parameter	Criteria
Parcel Location	A parcel must border the shoreline of following water bodies in Water Resource Inventory Area (WRIA) 8: <ul style="list-style-type: none"> • Lake Washington • Lake Union and Ship Canal • Marine shoreline of WRIA 8 between West Point and Carkeek Park • Lower Cedar River (River Mile [RM] 0.0 to RM 21.7) • North of Lake Washington tributaries (Swamp, North, and Little Bear Creeks) • Sammamish River and Bear Creek
Parcel Classification	A parcel (privately held or publicly owned) must be classified as vacant or unoccupied by the King County Assessor's Office.
Parcel Size/ Shoreline Length	A parcel must have a minimum shoreline length of 200 feet (or 500 feet for riverine sites) along a water body listed above.
Preliminary Fatal Flaw Analysis	A parcel must not contain onsite hazardous materials or sensitive cultural resources.

854

855 1. **Parcel location** – To successfully pass the initial screening, a parcel needed to border the shoreline
 856 of the specific water bodies listed in Table 6. The purpose of this criterion was to select one or more
 857 migration sites close to where project effects would occur in order to maximize onsite and within-
 858 basin mitigation opportunities. The geographic screening focused mitigation on those sites with the
 859 most potential to provide “in-kind” mitigation similar to the impacted habitat and providing
 860 maximum ecological benefit while meeting the mitigation requirements of the relevant resource
 861 agencies.

862 2. **Parcel classification** – To successfully pass the initial screen, a privately held or publicly owned
 863 parcel needed to be classified as vacant or unoccupied by the King County Assessor's Office (King
 864 County 2009). WSDOT established this criterion because vacant/unoccupied parcels generally offer
 865 better construction and maintenance access while providing fewer barriers to acquisition (e.g., land
 866 owner cooperation and/or parcel cost) compared with occupied parcels. In addition, vacant or

867 unoccupied parcels normally have a higher proportion of the parcel available as aquatic buffer due to
868 the general lack of developed facilities or structures on the parcel.

869 3. **Parcel size/shoreline distance** – To successfully pass the initial screening, an individual parcel
870 needed to have a minimum shoreline length of 200 feet immediately adjacent to a water body listed
871 in Parameter 1 above. This criterion was based on the scale of the preliminary in-water effects and a
872 site size that minimized the total number of sites required, thus establishing a scale of efficiency for
873 mitigation construction, maintenance, and monitoring activities. The WSDOT project team chose
874 200 feet as a sufficient shoreline length to support mitigation activities that would provide
875 substantial increases in the ecological functions associated with salmonid migration and rearing
876 habitat on a suitable scale for acquisition, construction, and operational/monitoring efficiencies.

877 An exception to this criterion was made for parcels adjacent to rivers or streams (riverine parcels).
878 As a general rule, parcel sizes are generally smaller and development densities are higher in urban
879 areas than in less developed suburban or rural areas. Because the large geographic extent of riverine
880 parcels extends relatively far into unincorporated King County (e.g., the Cedar River and North Lake
881 Washington tributaries), many more mitigation opportunities exist, and mitigation site development
882 constraints are often greater for these rural parcels. Accordingly, WSDOT determined that the
883 appropriate minimum size (shoreline length) for potential riverine parcels should be larger to reflect
884 these differences. To successfully pass the initial screening, a riverine parcel needed to have a
885 minimum shoreline length of 500 feet.

886 4. **Preliminary fatal flaw analysis** – A preliminary fatal flaw analysis was conducted for prospective
887 mitigation sites to screen out those sites with conditions that would make successful mitigation
888 construction difficult or impossible within time and budget constraints. For the purposes of the initial
889 screening, the fatal flaw was the likelihood of encountering onsite hazardous materials or sensitive
890 cultural resources.

891 The mitigation team provided a list of prospective parcels to WSDOT, then WSDOT compared the list
892 against existing databases of potential hazardous materials and cultural resources sites. Any prospective
893 mitigation parcel identified as having a high potential of containing hazardous materials or sensitive
894 cultural resources was then screened out from further analysis. An exception to this standard was made
895 for several parcels under these circumstances: although the results of the fatal flaw analysis indicated
896 that hazardous materials could be associated with an individual parcel, the contamination was known to
897 be primarily associated with the upland portions of the parcel, and mitigation activities would
898 concentrate on the shoreline of the parcel. In these few cases (see Appendix A for a complete list of
899 these parcels), the mitigation parcel was advanced through the initial screening.

900 **6.3 MITIGATION SITE SORTING AND CLASSIFICATION**

901 All parcels that passed the initial screening were carried forward to the next step of sorting and
902 classifying the potential sites. The purpose of this secondary screening was to rank and compare
903 potential mitigation sites for their suitability to meet specific mitigation needs of the project. The
904 mitigation team assigned variable scores for the following factors:

- 905 1. Specific geographic area of the parcel
- 906 2. Specific mitigation types/opportunities available on the parcel
- 907 3. Exact length of shoreline available for mitigation
- 908 4. Overlap and concurrency with existing watershed or fish restoration/recovery plans

909 For the purposes of this screening, it was assumed that for a given aquatic species, the function of a
910 discreet unit of aquatic habitat is inherently related to the location of the habitat within the larger
911 watershed. For example, most juvenile salmonids utilize the shorelines of Lake Washington for
912 outmigration and early growth (Kerwin 2001). In Lake Washington, Chinook salmon fry tend to use
913 shallow shoreline areas after lake entry, while older Chinook fingerlings utilize deeper water (Fresh
914 2000; Tabor et al. 2004, 2006). Sockeye fry initially inhabit sandy, littoral habitats but move relatively
915 quickly into deep, limnetic waters, while juvenile steelhead and juvenile coho may be found in both
916 littoral and limnetic areas (R. Tabor *in* City of Seattle 2008). In locations within the project vicinity that
917 provide several different habitat functions, such as nearshore areas of WRIA 8 Puget Sound, Chinook
918 and coho smolts may spend up to several months rearing (feeding and growth) prior to their
919 outmigration to deeper waters of Puget Sound or to the Pacific Ocean (Kerwin 2001; Toft 2001; Toft et
920 al. 2003b; City of Seattle 2008).

921 Because various functional effect types would occur due to the project, and because the ultimate goal of
922 the overall screening process is to be able to compare the suitability of sites to meet the mitigation goals
923 and needs, all sites that passed the initial screening were grouped into one of four categories based on
924 geography, which can be considered to be roughly equivalent to the specific aquatic function(s)
925 provided by the various groups (Figure 2). This allowed comparison of sites that generally provide a
926 similar ecological function and avoided a subjective weighting exercise that would be required to
927 directly compare disparate mitigation sites and types (e.g., comparing sites that provide functions for
928 fresh water outmigration to sites that support marine rearing). In addition, these four areas have varying
929 spatial relationships to the specific construction and operational effects of the project.

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937 The mitigation team conducted a GIS analysis to assign the individual parcels to one of four
938 functional/geographic groups, as follows:

939 **Lake Washington Ship Canal (LWSC)** – Sites located along Ship Canal between the east end of Union
940 Bay and the Ballard Lock that primarily support outmigration of juvenile salmonids, and to a lesser
941 extent, fresh water juvenile rearing.

942 **Lake Washington** – Sites located along the shoreline of Lake Washington that support both fresh water
943 rearing and outmigration of juvenile salmonids.

944 **Riverine** – Sites located along the Cedar River, the Sammamish River (including Bear Creek), and the
945 north Lake Washington tributaries that support spawning, fresh water rearing, and migration of
946 juvenile salmonids.

947 **Marine Shoreline** – Sites located along the marine shoreline of WRIA 8 that support both marine
948 rearing and migration of salmonids.

949 With the exception of prioritizing sites in the LWSC, no overall priority was assigned to the four
950 functional/geographic groups. Because the LWSC has been identified by both the scientific literature
951 (Kerwin 2001; City of Seattle 2008) and numerous regulatory agency staff as a primary limiting factor
952 due to the extensive modification and degradation within this area , and because the effects from project
953 construction and operation would directly affect this area, WSDOT has determined that the LWSC area
954 has the greatest need for project mitigation.

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959 Although the general grouping of mitigation sites by functional/geographic groups as described in
960 Section 5 allowed comparison between related mitigation parcels, further analysis was required to
961 prioritize individual sites within a given group.

962 The mitigation team identified and applied four key parameters to each list of geographic sites to define
963 a group of sites best suited to serve the project's mitigation needs. The comparison of sites using these
964 parameters was based on the characterization of several different elements. For example, the specific
965 ecological setting of parcels within a given functional group may indicate that the parcel is better at
966 supporting some of the key life history functions directly or indirectly affected by project actions
967 compared with a parcel at some other location.

968 Also, the condition of the existing ecological function of each site (if known) can help determine the
969 potential degree and magnitude of functional uplift that could be achieved at a given site. In addition, all
970 other elements being equal, larger mitigation sites offer an opportunity to maximize efficiencies for
971 mitigation construction, maintenance, and monitoring activities, and an overall greater chance of
972 mitigation success; thus, the parcel size and shoreline length are important. Lastly, many mitigation sites
973 or actions that have been previously evaluated and recommended in species recovery or watershed
974 restoration plans, particularly those plans with a watershed or regional focus, are generally assumed to
975 have a better chance of substantially adding to species or watershed recovery.

976 The purpose of the functional group analysis was to generally classify potential mitigation sites within
977 each functional group for their suitability to meet the specific mitigation needs of the project. The
978 following factors were considered in this process:

- 979 1. Specific geographic areas that are known to support key life history functions or stocks of salmonids
980 of concern. eg. South Lake Washington
- 981 2. Status of known habitat factors that determine existing ecological condition of parcels. eg. Degree
982 of shoreline armoring
- 983 3. Available parcel area for mitigation (both exact shoreline length and overall parcel size).
- 984 4. Overlap and concurrency with existing watershed or fish restoration/recovery plans such as the
985 WRIA 8 Chinook Salmon Conservation Plan.

986 Although these factors were considered in the overall process, it is important to recognize that the
987 relative contribution of local geography varies significantly between functional groups. Furthermore, as
988 a practical matter, the availability of relevant GIS data pertaining to ecological condition varies by
989 geographic area. Therefore, the number of the metrics used to conduct gross-level sorting of sites within
990 functional groups varied among the groups. In some cases (LWSC Functional Group) all four of the
991 metrics were available and suitable for evaluation purposes, so all were used. The end result of the
992 process was a shorter list of appropriate mitigation sites that were judged to have the greatest suitability

993 to achieve the mitigation goals. For each of the four functional groups, the evaluation criteria/factors
994 considered are described in detail below.

995 **7.1 LAKE WASHINGTON SHIP CANAL FUNCTIONAL GROUP**

996 To provide an estimate of the amount of mitigation opportunity that exists within each site, the
997 mitigation team used the estimated shoreline length of each parcel within the LWSC Functional Group
998 to compare the parcels. For each parcel, the estimated linear feet of shoreline length was calculated
999 using GIS. This information was generated using King County’s GIS shoreline database as part of the
1000 initial screening. A higher priority was assigned to those parcels that have a longer shoreline, and thus
1001 greater potential mitigation opportunity.

1002 Next, the parcels were reviewed for concurrency with watershed and species recovery plans, such as the
1003 WRIA 8 Chinook Recovery Plan (King County 2005), that identify site-specific projects that would
1004 benefit the overall health and viability of a particular species or watershed. Specific project mitigation
1005 opportunities that overlap with such recovery plans have a higher priority because they meet both the
1006 compensatory project mitigation requirements and support pre-identified wider-scale species or
1007 watershed recovery efforts. Plans and programs specific to WRIA 8 and the study area were reviewed.
1008 Where these projects overlapped with individual parcels that passed the initial screening, the parcels
1009 were identified as higher priority. Only projects that had not been completed or funded were included.
1010 The evaluation criteria for recovery plan consistency were applied as follows:

1011 **Higher Priority (A)** – Parcels where published recovery plans identified site-specific habitat
1012 enhancement/shoreline projects.

1013 **Lower Priority (B)** – Parcels where published recovery plans did not identify site-specific habitat
1014 enhancement/shoreline projects.

1015 In addition to the information on parcel size and concurrency with existing restoration plans, the existing
1016 ecological condition of parcels in the LWSC was used for purposes of parcel comparison. This
1017 information is GIS-based and is derived from two primary GIS data sets. Detailed information on
1018 hardened structures was based on a GIS dataset titled “Inventory and Mapping of City of Seattle
1019 Shorelines along Lake Washington, the Ship Canal, and Shilshole Bay”, created by Toft et al. (2003).
1020 This detailed dataset provides specific information on the location and distribution of docks, riprap,
1021 bulkheads, and unconfined shoreline reaches for the entirety of the geographic distribution of sites
1022 within this group.

1023 To supplement these data, a dataset prepared by Washington State Department of Natural Resources
1024 (WDNR) was utilized. This dataset provides overwater structure locations for the length of the Lake
1025 Washington shoreline; however, it does not provide detail on other hardened structure types (riprap,
1026 bulkheads, etc.) as does the Toft et al. (2003) dataset. Using a combination of two GIS layers, the
1027 individual parcels were classified into three categories according to the amount of potential functional
1028 uplift that could be achieved based on existing site conditions. The classifications were applied as
1029 follows:

1030 **Higher Priority (A)** – Sites where the LWSC shoreline has hardened via retained structures such as
1031 docks, bulkheads, riprap banks, etc. These sites offer two linked mitigation opportunities: removal of
1032 the retained structures and restoration of the shoreline (e.g., regrading, placement of suitable
1033 substrate, enhancement or creation of riparian vegetation).

1034 **Medium Priority (B)** – Sites where the LWSC shoreline is unretained (not confined by structures such
1035 as docks, bulkheads, riprap banks, etc.), but where shoreline enhancement or restoration is feasible
1036 due to the presence of degraded existing conditions, including the presence of landscaping.
1037 Mitigation activities would focus on installing natural vegetation, and may also involve some
1038 shoreline regrading or placement of beach substrate.

1039 **Lower Priority (C)** – Sites where the LWSC shoreline is composed of unretained vegetated or beach
1040 habitat. At these locations, shoreline enhancement or restoration would likely not provide large
1041 increases in the ecological functions at the site.

1042 Multiple parcels had a mix of retained and unretained features. Therefore, to aid in classification and
1043 subsequent site evaluation, WSDOT used the shoreline inventory data (Toft et al. 2003a) to estimate the
1044 amount (linear feet) of each shoreline subtype present along the shoreline of each parcel. Because the
1045 shoreline inventory data were not as precise or accurate as the King County shoreline database, there
1046 were discrepancies in the total parcel shoreline lengths between these two datasets. Therefore, for each
1047 parcel where the data were available, the relative percentage of each of the six shoreline types from Toft
1048 et al. (2003a) (Appendix B) was applied to the overall calculated shoreline length from the King County
1049 shoreline dataset to calculate the length of each shoreline type. The six shoreline types were: Rip-rap,
1050 Bulkhead (vertical), Bulkhead (sloping), Beach, Natural Vegetation, and Landscaped. These data are
1051 presented in Appendix B.

1052 Lastly, the fourth comparison of parcels within the LWSC Functional Group was based on the parcel's
1053 exact location in relation to the proposed project's construction and operational effects. Resource
1054 agencies have indicated a preference to conduct on-site mitigation, defined as mitigation activities
1055 conducted as physically close to the corresponding effects as feasible and practicable. Because a portion
1056 of the LWSC Functional Group geographic area is located immediately within or adjacent to the area the
1057 project would affect, this evaluation criterion accounts for the benefits of conducting compensatory
1058 mitigation near the affected area. This classification criterion was applied as follows:

1059 **Higher Priority (A)** – Sites located within or immediately adjacent (within 1/2-mile) of the SR 520
1060 project corridor.

1061 **Lower Priority (B)** – Sites located more than 1/2-mile from the SR 520 project corridor.

1062 **7.2 LAKE WASHINGTON FUNCTIONAL GROUP**

1063 For the Lake Washington Functional Group, the amount of mitigation opportunity existing at each
1064 parcel was evaluated by using shoreline length, as described above. In addition, the parcels within Lake
1065 Washington were reviewed for concurrency with watershed and species recovery plans, in a similar
1066 manner as discussed above for the LWSC Functional Group. The classifications areas are as follows:

1067 **Higher Priority (A)** – Parcels where published recovery plans identify site-specific habitat
1068 enhancement/shoreline projects.

1069 **Lower Priority (B)** – Parcels where published recovery plans did not identify site-specific habitat
1070 enhancement/shoreline projects.

1071 Detailed information on hardened structures in Lake Washington was based on the same two GIS
1072 datasets used for the LWSC Functional Group. The classifications for the Lake Washington Functional
1073 Group are as follows:

1074 **Higher Priority (A)** – Sites where the Lake Washington shoreline has hardened via retained structures
1075 such as docks, bulkheads, riprap banks, etc. These sites offer two linked mitigation opportunities: (1)
1076 removal of the retained structures, and (2) restoration of the shoreline (e.g., regrading, placement of
1077 suitable substrate, and enhancement or creation of riparian vegetation).

1078 **Medium Priority (B)** – Sites where the Lake Washington shoreline is unretained (not confined by
1079 structures such as docks, bulkheads, riprap banks, etc.) but where shoreline enhancement or
1080 restoration is feasible due to the presence of degraded existing conditions, including the presence of
1081 landscaping. Mitigation activities would focus on installing natural vegetation, and may also involve
1082 some shoreline regrading or placement of beach substrate.

1083 **Lower Priority (C)** – Sites where the Lake Washington shoreline is composed of unretained vegetated
1084 or beach habitat. At these locations, shoreline enhancement or restoration would likely not provide
1085 large increases in the ecological functions at the site.

1086 In addition to information on parcel size, concurrency with existing restoration plans, and information
1087 on the existing ecological condition of parcels along Lake Washington, specific geographic areas within
1088 Lake Washington were used to aid in the analysis. The analysis of Lake Washington parcel geographic
1089 location takes into account both the distance of the parcel from SR 520 and the parcel's location relative
1090 to specific locations in the lake that support ecological functions important for juvenile salmonids. This
1091 analysis prioritizes several specific areas that are known to support key life history functions or stocks of
1092 salmonids of concern within the lake. The parcels along Lake Washington were assigned one of three
1093 priorities, based on their geographic location.

1094 **Higher Priority** – Sites located along the southwest and southeast shores of Lake Washington, between
1095 the south end of Mercer Island and the mouth of the Cedar River *or* sites located within or
1096 immediately adjacent (within 1/2-mile) of the SR 520 project corridor *or* sites located along the
1097 shore of Lake Washington within or adjacent (within 300 feet) to the mouth of a stream/river.
1098 Mitigation activities would include enhancement of the stream/lake interface zone (delta), which has
1099 been shown to provide key rearing and feeding opportunities for juvenile salmonids.

1100 **Medium Priority** – Sites located along the north and northwest shore of Lake Washington, between a
1101 line extending west from Arrowhead Point and the mouth of the Sammamish River.

1102 **Lower Priority** – All other sites within Lake Washington

1103 **7.3 RIVERINE FUNCTIONAL GROUP**

1104 Within the Riverine Functional Group, prioritization of specific geographic areas based on fish life
1105 histories is not as straightforward as for the previous functional groups due to the numerous salmonid
1106 life history stages supported by riverine habitat. In addition, no complete GIS-based shoreline inventory
1107 or habitat data for riverine environments are readily available, making a straightforward analysis of the
1108 existing ecological condition of individual parcels impossible. Because of the limitations in using those
1109 evaluation factors, the analysis of the Riverine Functional Group compares sites based solely on the
1110 other two evaluation factors, i.e., parcel size (exact shoreline length) and concurrency with existing
1111 restoration plans.

1112 The parcels in the Riverine Functional Group were evaluated for the amount of mitigation opportunity
1113 existing at each parcel and for concurrency with watershed and species recovery plans, in a manner
1114 similar to that discussed above for other functional groups. The classification areas for recovery plan
1115 comparison are as follows:

1116 **Higher Priority (A)** – Parcels where published recovery plans identify site-specific habitat
1117 enhancement/shoreline projects.

1118 **Lower Priority (B)** – Parcels where published recovery plans do not identify site-specific habitat
1119 enhancement/shoreline projects.

1120 **7.4 MARINE SHORELINE FUNCTIONAL GROUP**

1121 As with the riverine sites, prioritization of specific geographic areas within the Marine Shoreline
1122 Functional Group, based on fish life histories, is not straightforward. However, unlike the riverine sites,
1123 a GIS-based shoreline inventory data is available for the Marine Shoreline Functional Group. The data
1124 from the Toft et al. 2003a shoreline survey, discussed above, extend to much of the shoreline area
1125 covered by this functional group. The parcels were evaluated for the amount of mitigation opportunity
1126 existing at each parcel and for concurrency with watershed and species recovery plans, in a manner
1127 similar to that discussed above for other functional groups. The classification areas for comparison of
1128 identified actions in recovery plans are as follows:

1129 **Higher Priority (A)** – Parcels where published recovery plans identify site-specific habitat
1130 enhancement/shoreline projects.

1131 **Lower Priority (B)** – Parcels where published recovery plans do not identify site-specific habitat
1132 enhancement/shoreline projects.

1133 Detailed information on shoreline habitat in marine areas was based on the same two GIS datasets
1134 discussed for the Lake Washington Functional Group and the LWSC Functional Group. The
1135 classification areas are as follows:

1136 **Higher Priority (A)** – Sites where the Marine shoreline has hardened via retained structures such as
1137 docks, bulkheads, riprap banks, etc. These sites offer two linked mitigation opportunities:

1138 (1) removal of the retained structures, and (2) restoration of the shoreline (e.g., regrading, placement
1139 of suitable substrate, and enhancement or creation of riparian vegetation).

1140 **Medium Priority (B)** – Sites where the Marine shoreline is unretained (not confined by structures such
1141 as docks, bulkheads, riprap banks, etc.) but where shoreline enhancement or restoration is feasible
1142 due to the presence of degraded existing conditions, including the presence of landscaping.
1143 Mitigation activities would focus on installing natural vegetation, and may also involve some
1144 shoreline regrading or placement of beach substrate.

1145 **Lower Priority (C)** – Sites where the Marine shoreline is composed of unretained vegetated or beach
1146 habitat. At these locations, shoreline enhancement or restoration would likely not provide large
1147 increases in the ecological functions at the site.

1148 **7.5 FUNCTIONAL GROUP CLASSIFICATION AND RANKING (PARE 2)**

1149 To identify candidate mitigation sites for the project, the mitigation team used a hierarchical selection
1150 process based on the four functional groups in the project area. For each of the functional groups, the
1151 metrics discussed above were used as a gross-level screening to narrow the number of potential sites for
1152 each group. This second paring was semi-quantitative, as it is based both on numeric and non-numeric
1153 criteria, although numerical screening criteria were not used to order the individual sites. Rather, the
1154 short list of suitable sites was developed using a holistic watershed approach and applying best
1155 professional judgment from a number of technical specialists on the SR 520 project team.

1156 Potential projects were defined as involving physical restoration, enhancement, or rehabilitation at
1157 specifically identified geographic sites within the four functional areas. In addition to lists of projects
1158 within each unique functional group, an additional list of mitigation opportunities was formulated. This
1159 latter group includes mitigation opportunities that are more programmatic in their nature, potentially
1160 including such activities as WSDOT funding of incentive programs and/or public education and
1161 outreach programs. Because these type of non-physical habitat restoration projects are currently not
1162 specifically defined, and do not contain a geographic element, they were not suited to the initial
1163 screening and evaluation discussed above.

1164 **7.6 LOCAL AGENCY INPUT**

1165 The mitigation team also incorporated sites provided by representatives from the City of Seattle Parks
1166 Department, Seattle Public Utilities, University of Washington, King County Water and Land Resources
1167 Division, and WRIA 8. Additional sites were added by biologists on the mitigation team with extensive
1168 experience in the project area through the SR 520 Bridge Replacement and HOV Project and other local
1169 projects.

1170

1171

8. FUNCTIONAL GROUP SITE CLASSIFICATION RESULTS

1172 The mitigation team screened an initial list of potential aquatic mitigation sites that would compensate
1173 for the project's effects. This entire list (see Appendix B) of 208 candidate sites that passed the initial
1174 screening, broken down by functional group, will be maintained to provide flexibility moving forward
1175 with the screening process (additional sites can be added to the final list or moved up for consideration
1176 and more detailed analysis based on additional information or stakeholder input). The WSDOT
1177 mitigation team analyzed all sites on the list and generally prioritized the sites to generate a shorter list
1178 of sites that would offer the best mitigation opportunities (defined as the potential to achieve the
1179 project's mitigation goals with a relatively high chance of success) based on the criteria presented in
1180 Section 6. There were a total of 30 specific sites advanced for further consideration in the mitigation
1181 screening process, as well as several programmatic actions that could help meet the mitigation goals.
1182 These sites, all of which would support site-specific physical habitat improvement projects, are
1183 presented by functional group in Table 7, shown in Figures 3-1 through 3-4, and summarized as follows:

1184 The Ship Canal Functional Group list includes seven potential mitigation sites located from Union Bay
1185 downstream to the Hiram Chittenden Locks.

1186 The Lake Washington Functional Group list includes 12 potential mitigation sites located on the shores
1187 of Lake Washington, based on preliminary screening criteria.

1188 The Marine Functional Group list includes four potential mitigation sites located in the marine
1189 environment downstream of the Hiram Chittenden Locks, based on preliminary screening criteria.

1190 The Riverine Functional Group list includes seven potential mitigation sites, located on the Cedar River
1191 and its tributaries and the Sammamish River and its tributaries, based on preliminary screening
1192 criteria.
1193

Table 7. Mitigation Sites Advanced for Further Screening

Functional Group	Site Name	Parcel Number(s)
Ship Canal	University of Washington	1625049001
	Arboretum	4114600275, 4116100010, 2125049044
	Montlake Park	6788202280
	Hiram Chittendon Locks (upstream of locks)	1125039012, 0467000800
	Lake Union Vacant Industrial	088801605, 4088801610, 4088801615, 4088801620
	Aurora Bridge North	4088804415
	NOAA Montlake Lab	8805900001
Lake Washington	Seward Park	2324049007
	Magnuson Park	0225049061, 0225049001, 0225049062
	Gene Coulon Park	3344500775, 0523059010, 0523059003
	Newcastle Beach Park	1724059004, 1724059038
	Luther Burbank Park	0124049002, 0624059014, 0724059054
	WDNR Parcel	0723059105
	Beer Sheva Park	3524049013, 3524049102
	Pritchard Island Beach Park	6896300010
	Martha Washington Park	1102001300
	Rainier Beach Park	7129304755
	Meydenbauer Park	4389201295 (additional parcels to be acquired)
	Madrona Park	4114600995
Marine	Carkeek Park	2626039001
	Commodore Park – Wolf Creek	1025039047
	Hiram Chittendon Locks (downstream of locks)	1025039051
	Shilshole Marina	468000050

Functional Group	Site Name	Parcel Number(s)
Riverine	Lions Property	3323069074
	Rainbow Bend	7120400045 (5 parcels)
	Black River Pump Station	3779200090
	North Creek 228th Ave	27052900301300, 2705200302100
	Bear Creek	1125059098, 1225059261, 7202410180, 7202410190, 7202410260
	Squak Creek	1126049100, 1126049126, 1126049142
	Swamp Creek	4156700004, 4156700010, 4156700015, 4164100171, 9406500630

1195

1196 Detailed aerial photographs of each selected parcel are presented in Appendix D. These figures show the
1197 mitigation parcel with adjacent parcels and briefly summarize the baseline environmental conditions in
1198 relation to aquatic habitat, as well as the possible mitigation opportunities available at the site. In
1199 addition, the assumed direct benefit to fish resources is indicated, based on the life history phase(s) that
1200 the project would benefit. Six of these sites are also included in the wetland mitigation initial plan.
1201 These sites are as follows: University of Washington (2 sties in Wetland Plan), Montake Park,
1202 Arboretum (3 sites in Wetland Plan), Magnuson Park, Seward Park and Beer Sheva Park.

1203 As discussed in Section 6.5, other non-project specific mitigation opportunities exist within WRIA 8.
1204 These programmatic opportunities include activities involving incentive achievement-oriented programs
1205 (e.g., indirect funding of habitat or water quality improvement projects or public outreach/educational
1206 activities). Various non-project specific mitigation opportunities were reviewed by the WSDOT
1207 mitigation team and the top such opportunities advanced for future consideration (Table 8).
1208

1209

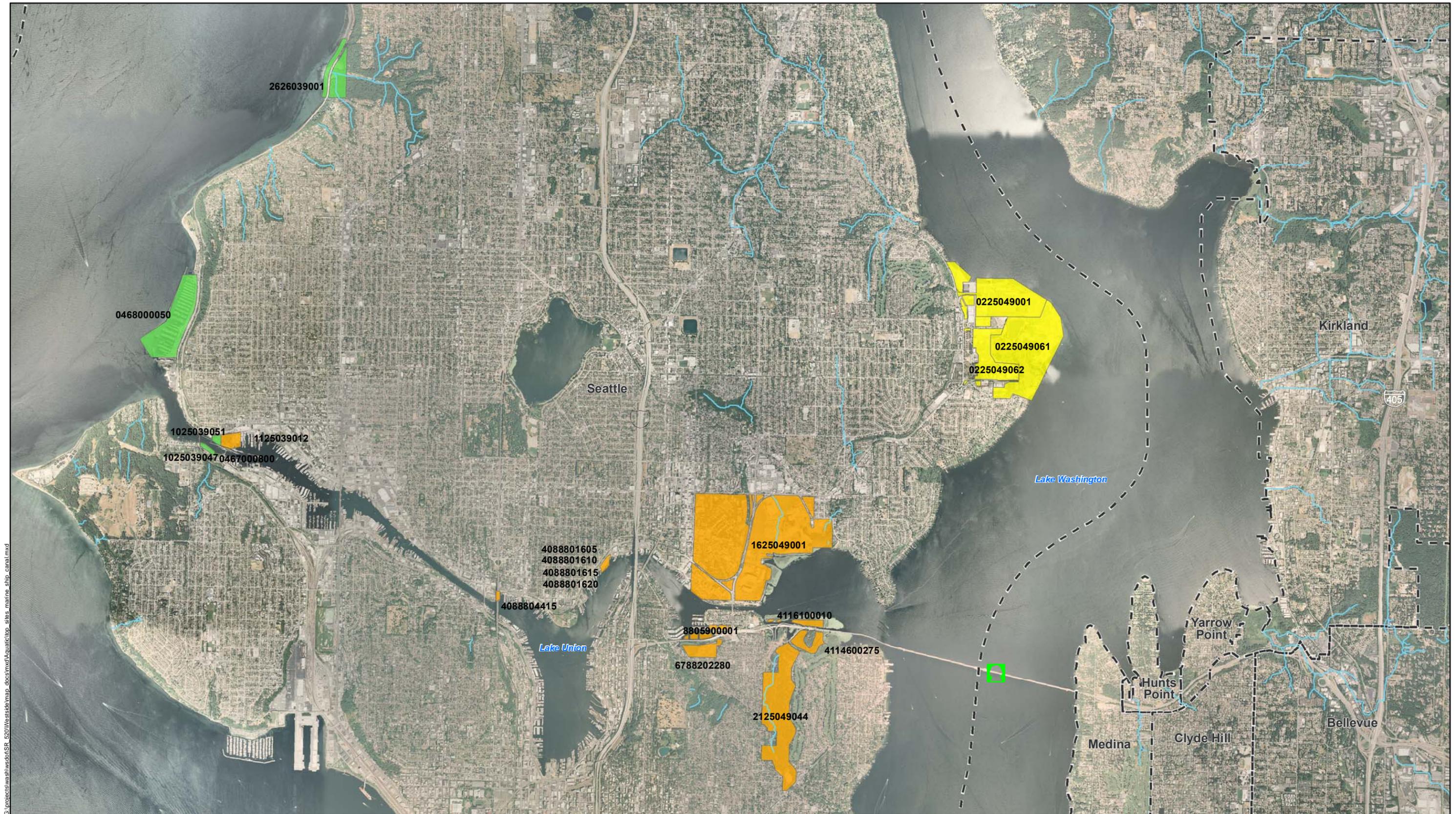
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Table 8. Programmatic Mitigation Activities Advanced for Further Screening

General Description	Examples	Primary Salmonid Life History Functions Addressed	Geographic Focus
Habitat-based incentive programs aimed at creating or restoring habitat functions that support salmonids on private property	Bulkhead/dock modification/removal, shoreline riparian planting, in-water debris removal, invasive species control	Migration refugia and rearing	Water bodies within WRIA 8, with emphasis on Lake Washington and the LWSC
Habitat-based incentive programs aimed at minimizing effects from shoreline development or redevelopment activities on private property	Fish-friendly dock installations or retrofits, marina retrofits, redevelopment planning assistance, shoreline buffer preservation, Green Shorelines, programmatic hydraulic project approvals (HPAs)	Migration refugia and rearing	Water bodies within WRIA 8, with emphasis on Lake Washington and the LWSC
Public education and outreach programs supporting minimization of shoreline and water quality effects and encouraging habitat restoration actions and activities	Environmental and outdoor education centers, Green Shorelines Programs, watershed stewards, displays at Issaquah Salmon Days or other community events	All	Water bodies within WRIA 8, with emphasis on Lake Washington and the LWSC
Funding of ecological studies within WRIA 8 to better understand salmonid life histories; physical, biological, and chemical aquatic habitat needs; habitat limiting factors; and mitigation success	Salmonid research and studies on habitat utilization, predators, water temperature effects, flushing flows studies, migration routes and timing, spawning success, hatchery influences, mitigation effectiveness, etc.	All	Water bodies within WRIA 8, with emphasis on Lake Washington and the LWSC
Improve water quality within WRIA 8 water bodies by reducing pollutant inputs into the system	Remove combined sewer overflows and illicit outfalls, reduce nutrient/pollutant input from lawns, improve/retrofit existing stormwater facilities	All	Water bodies within WRIA 8, with emphasis on Lake Washington and the LWSC



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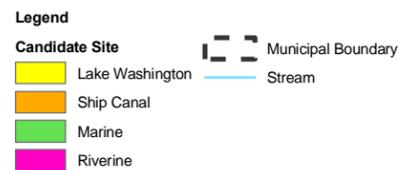
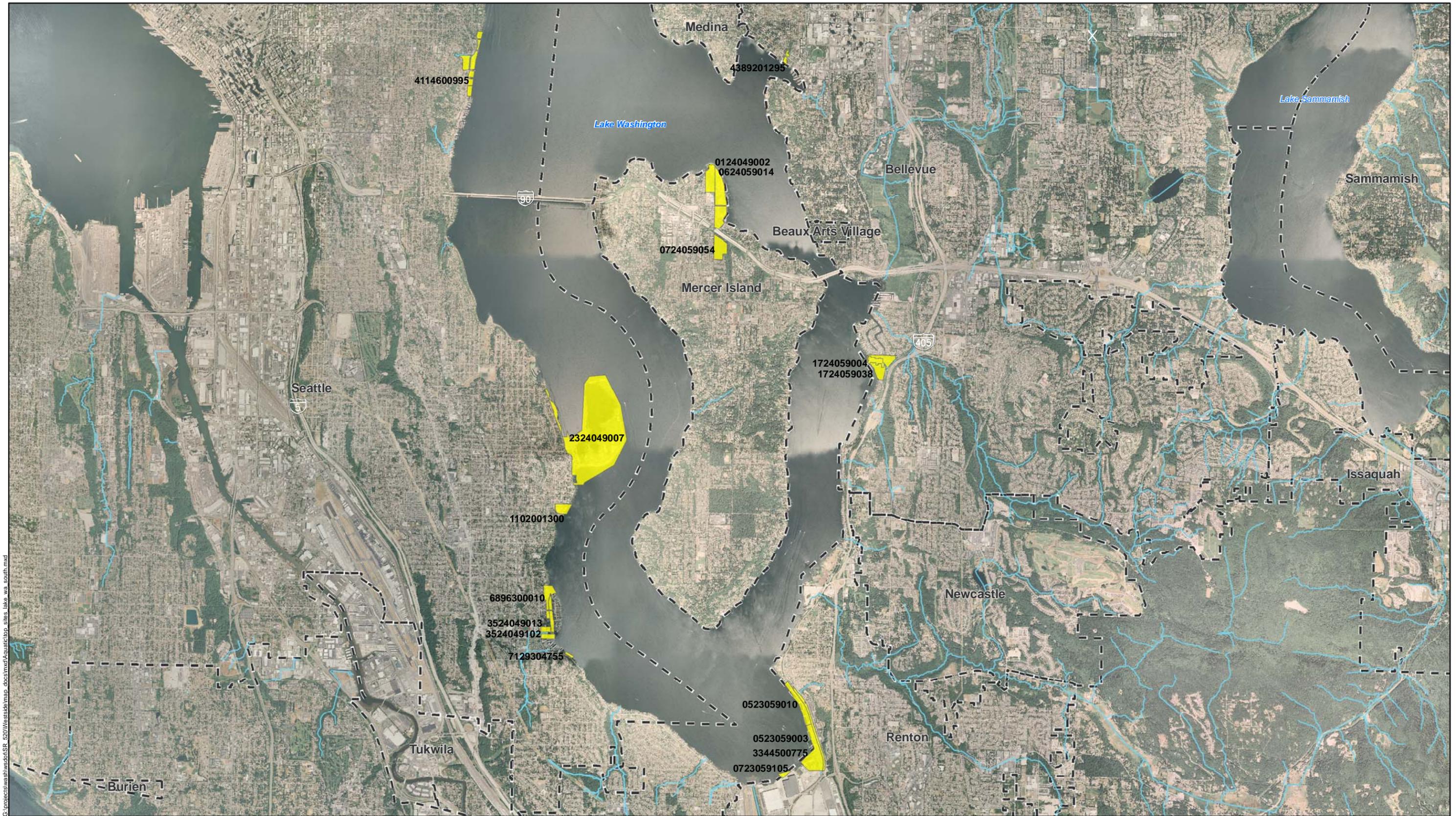


Figure 3-1: Lake Wahington, Ship Canal, and Marine Potential Candidate Sites

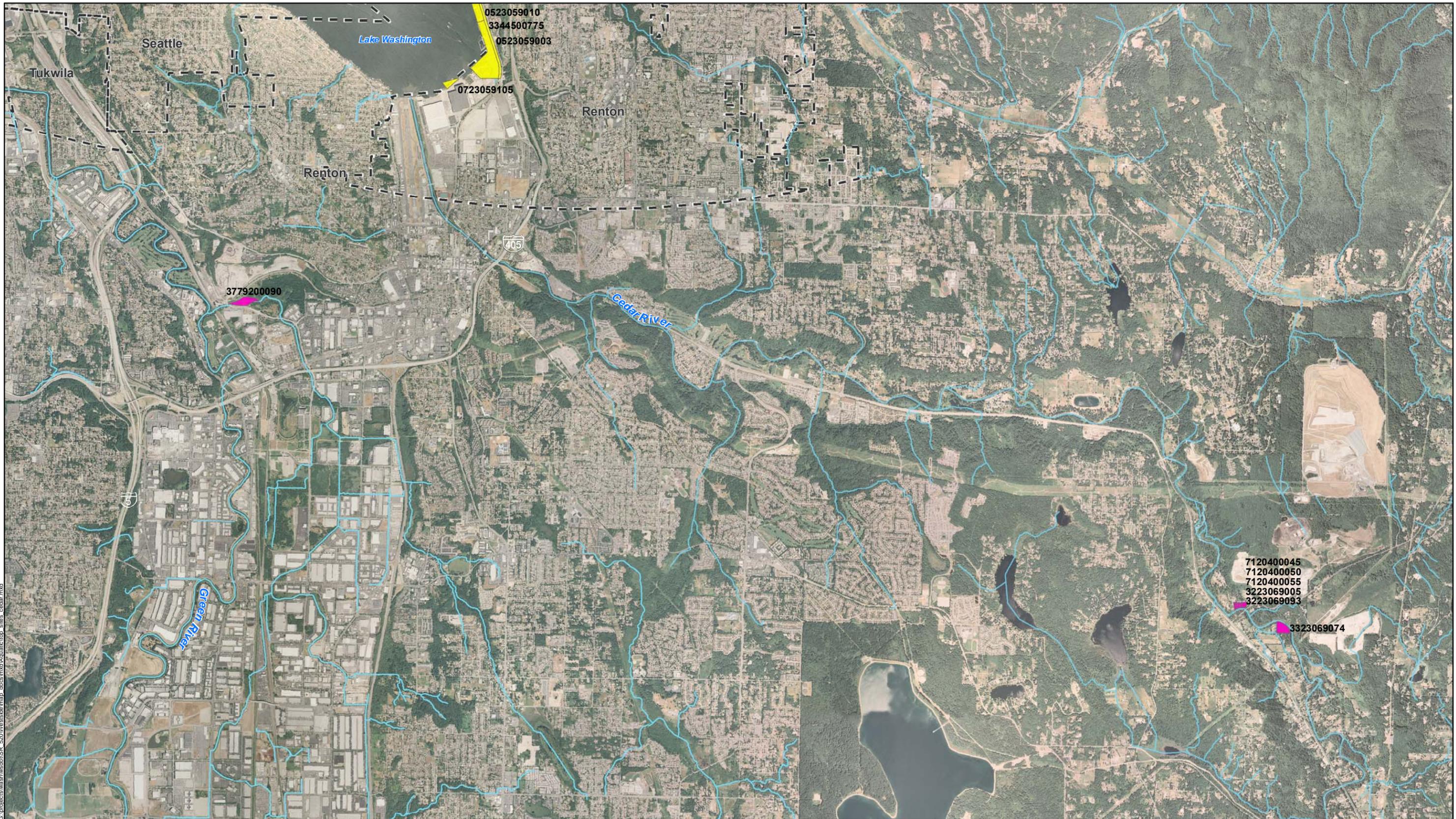


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- Legend**
- Candidate Site
 - Lake Washington
 - Ship Canal
 - Marine
 - Riverine
 - Municipal Boundary
 - Stream

Figure 3-2: South Lake Washington Potential Candidate Sites

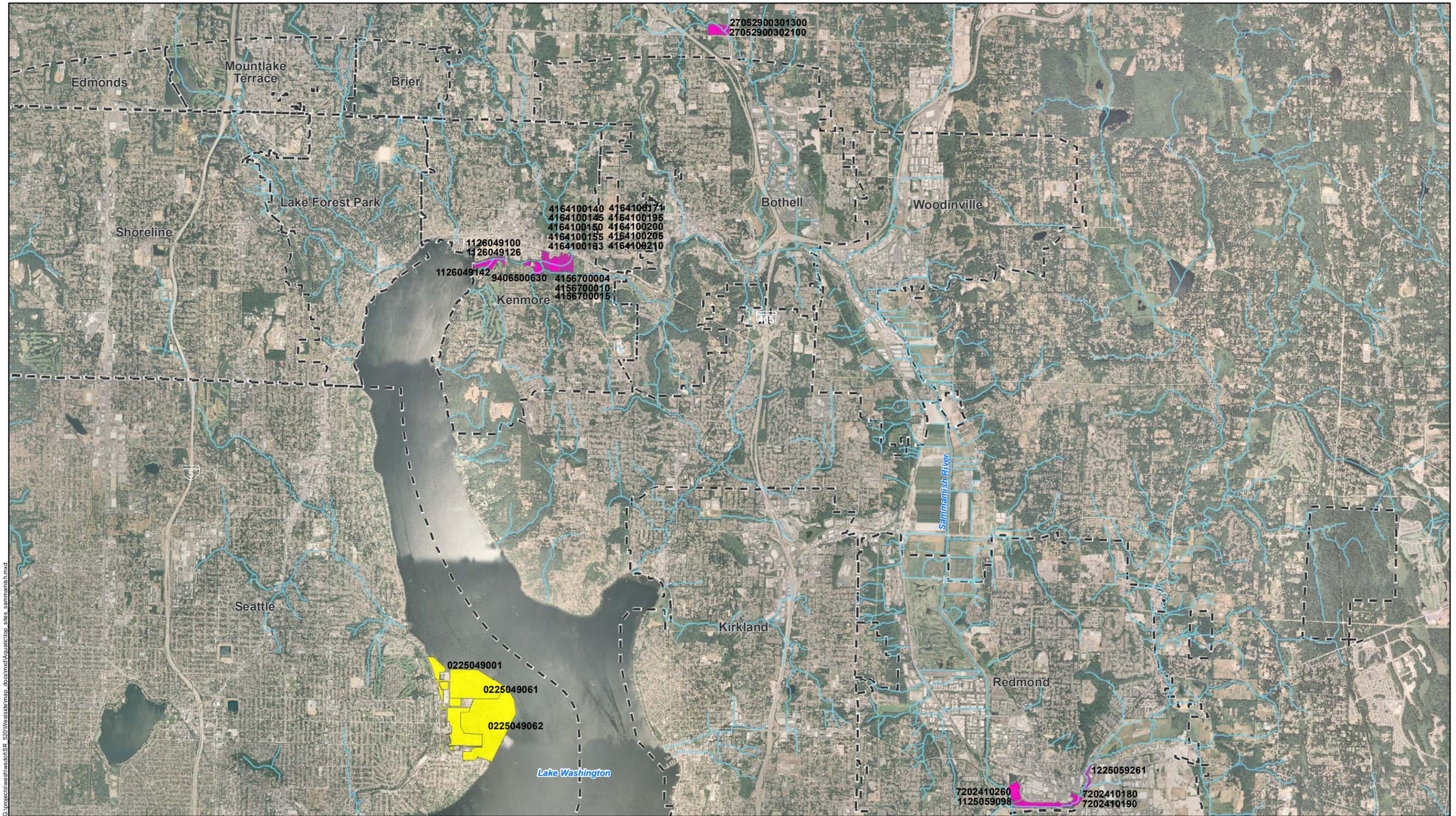


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- Legend**
- | | |
|--|--|
| Candidate Site | Municipal Boundary |
| Lake Washington | Stream |
| Ship Canal | |
| Marine | |
| Riverine | |

Figure 3-3: Cedar River Potential Candidate Sites



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- Legend**
- Candidate Site**
 - Lake Washington
 - Ship Canal
 - Marine
 - Riverine
 - Municipal Boundary
 - Stream



Figure 3-4: Sammamish River and Tributaries Potential Candidate Sites

1243 **8.1 COMPENSATION FOR PROJECT IMPACTS**

1244 The combination of defined mitigation projects in a variety of aquatic shoreline locations in the Lake
1245 Washington basin that support multiple salmonid life history functions and wider-spread programmatic
1246 mitigation activities should provide adequate functional uplift to offset project effects. As discussed in
1247 Section 4, no prescribed aquatic habitat mitigation ratios exist for the majority of the project effect types.
1248 Therefore, this mitigation approach relies on the inherent relationship between the status of fish
1249 populations and the quality and quantity of fish habitat these populations utilize. Specifically, the
1250 mitigation screening utilized existing information on those ecological functions most important to
1251 juvenile salmonids in the SR 520 study area to assess potential effects and to target these functions for
1252 improvement by specific mitigation actions and activities.

1253 Although an exact accounting of project effects to functional uplift from mitigation opportunities is
1254 beyond the scope of this document, the overall approach is suited to assessing effects and mitigation
1255 benefits based on how each project or mitigation action would affect habitat functions that support
1256 juvenile salmonid migration, rearing, refugia and feeding. Some of the potential restoration activities,
1257 such as increasing the amount of native overhanging vegetation at the shoreline, would address juvenile
1258 foraging by increasing detritus delivery to the substrate, thus increasing invertebrate production in the
1259 water as well as providing surface feeding opportunities to juvenile salmonids from insects that drop
1260 into littoral and nearshore shoreline waters. Also, the addition of overhanging vegetation would provide
1261 refuge from predators and provide localized areas of favorable light and temperature conditions. By
1262 removing bulkheads, riprap, and debris armoring, water depths and velocities would be decreased at the
1263 water's edge, providing safe refugia for juvenile salmonids in the restored habitat. Restoration of the
1264 selected site shorelines would establish a substantial length of high-quality edge habitat in the Lake
1265 Washington basin, which is important to juvenile salmon migration, and would provide increased
1266 connectivity from the Cedar and Sammamish rivers to Shilshole Bay (City of Seattle 2008; Seattle Parks
1267 and Recreation 2003).

1268 As the mitigation planning effort proceeds, future analysis will establish and document a quantitative
1269 basis for the appropriateness and sufficiency of the mitigation plan to replace lost or impaired habitat
1270 functions resulting from the project. An example of such a quantitative approach might involve the
1271 incorporation of salmonid population effects metrics, salmonid habitat metrics, or a combination of
1272 these metrics to develop a common denominator for mitigation planning. A key step that will be
1273 examined in greater detail in the conceptual aquatic mitigation plan will be to document the sufficiency
1274 and appropriateness of WSDOT's proposed mitigation actions.

1275 In addition, this approach allows the overlay of a broader landscape ecology perspective, which is
1276 important for prioritizing habitat restoration opportunities (Simenstad and Cordell 2000). For this initial
1277 screening effort, the broader perspective was useful for fitting existing conditions and potential habitat
1278 restoration opportunities into the overall habitat setting that littoral, riverine, and nearshore zones
1279 provide. Landscape perspective considerations included mitigation site locations in relation to known
1280 use areas (e.g., Cedar River), migration corridors, and locations relative to known rearing areas/tributary
1281 streams.

1282 The methods and initial results from this planning and screening framework will be shared with resource
1283 agencies, stakeholders, and the Tribes as part of early agency coordination. Initial work completed to
1284 this point is intended to document the planning and screening framework to date. However, no firm
1285 decisions have been made regarding mitigation sites at this time. As a result of coordination with
1286 resource agencies and the Tribes, the mitigation team may modify this process, and potentially add or
1287 delete candidate sites.

1288

1289

9. SUMMARY AND NEXT STEPS

1290 The screening exercise consisted of a three-part process that pared all the potential parcels within the
1291 geographic study area down to a list of 30 sites, which represent the best potential sites to achieve the
1292 project mitigation goals.

1293 9.1 INITIAL SCREEN

1294 During the initial screen, the mitigation team evaluated all sites (parcels) within the defined mitigation
1295 area. This list of several thousand parcels was narrowed down to 208 candidate sites, based on the
1296 parcel's ability to successfully pass through a set of four initial screening criteria (see Section 6 for
1297 criteria). All sites that failed the initial screening were removed from the list, and the remaining
1298 candidate sites continued to the site sorting and classification criteria. Because the overall list of all
1299 parcels undergoing the initial screen includes all parcels adjacent to the LWSC, Lake Washington, and
1300 the majority of parcels bordering the Cedar River, the Sammamish River, and the WRIA 8 shoreline, the
1301 list of screened parcels is too large to include in this report.

1302 9.2 MITIGATION SITE SORTING AND CLASSIFICATION

1303 The mitigation team sorted and classified all 208 candidate sites based on four functional groups that
1304 relate to the geography of the sites and the geographical relationship to key salmonid life history phases.
1305 Once the sites were sorted into their respective functional groups, a specific criterion was applied to
1306 each functional group (see Section 6 for criteria). These criteria were applied to allow more specific
1307 evaluation of site suitability in meeting the mitigation needs of the project. This classification was semi-
1308 quantitative, and rigid numerical screening criteria were not used to order the individual sites. Site
1309 descriptions of all of the sites sorted and classified in this step are provided in the Pare 1 List (Appendix
1310 A).

1311 9.3 ADVANCEMENT OF TOP SITES FOR FURTHER SCREENING

1312 The final step in the process was a gross ranking of all sites within each of the four functional groups
1313 (208 sites) to select the sites most amenable to mitigation activities that would meet defined functional
1314 goals, while providing efficiency of site design and construction. In addition, paring down the candidate
1315 list allowed WSDOT to arrive at a number of "good" sites small enough to facilitate more detailed site-
1316 specific investigations in the future. This paring utilized a holistic watershed approach, based on the
1317 classification factors, pertinent literature and data, local knowledge, and best professional judgment
1318 from a number of technical specialists on the SR 520 project team. A total of 30 preferred sites remained
1319 on the list after this step. Of these, 7 were located in the LWSC Functional Group, 12 were within the
1320 Lake Washington Functional Group, 7 within the Riverine Functional Group, and 4 within the Marine
1321 Functional Group (see Table 7). The geographic locations of these sites are displayed in Figures 3-1
1322 through 3-4. Detailed site maps and description of baseline conditions and mitigation opportunities are
1323 presented in Appendix D.

1324 **9.4 ADVANCEMENT OF PROGRAMMATIC MITIGATION OPTIONS**

1325 An additional group of potential mitigation actions was also advanced for further consideration,
1326 involving mitigation opportunities that are more programmatic in nature, potentially including such
1327 activities as WSDOT funding of incentive programs and/or public education and outreach programs.
1328 Because these type of non-physical habitat restoration projects are currently not specifically defined, and
1329 do not contain a geographic element, they were not suited to the initial screening and evaluation, as
1330 previously mentioned. Although the programmatic mitigation programs and activities considered are an
1331 alternative or supplemental path to achieving aquatic mitigation, they would still require approval from
1332 the relevant regulatory agencies and local jurisdictions prior to implementation.

1333 These programs and activities could supplement the specific, defined aquatic habitat restoration or
1334 creation projects advanced by producing habitat benefits across a larger landscape and/or modifying
1335 activities or behaviors that could degrade habitats in the futures. In addition, these actions may facilitate
1336 restoration enhancements in areas not otherwise available. By providing incentives, a number of these
1337 programmatic projects can compete for these incentives rather than relying on a specific physical
1338 mitigation site where negotiations may become complicated and/or the mitigation potential may be
1339 limited by that site's specific features (e.g., unsuccessful purchase negotiations for the specific
1340 mitigation sites advanced as described above).

1341 **9.5 NEXT STEPS**

1342 This planning and screening framework, the advanced programmatic activities and the interim list of top
1343 candidate sites for each functional group will be shared with resource agencies, stakeholders, and the
1344 Tribes as part of early agency coordination. It is important to note that this list is designed to evolve
1345 based on more detailed site analysis and further agency input, and no firm decisions have been made
1346 regarding mitigation sites at this time. The mitigation team may modify this process and potentially
1347 identify additional viable candidate sites as a result of coordination with resource agencies and the
1348 Tribes.

1349 Also, because the project design effort is ongoing, the quantification and classification of project effects
1350 is also ongoing. The classification and characterization of project effects in relation to functional effects
1351 on aquatic habitats and species are currently evolving, and the final accounting of all project effects will
1352 aid the mitigation team in better defining the specific mitigation needs of the project. Changes and
1353 refinements in project design elements also have the potential to alter the list of top candidate sites.

1354 Once a final draft list of top candidate sites has been finalized, additional analysis, including data
1355 analysis and site visits, will be required to better classify the potential of each parcel to have a
1356 reasonable probability of mitigation success. Further information to be analyzed includes data on site
1357 layout and condition (exact amount of the site available to mitigation activities), the landscape and local
1358 setting (amount/type of environmental degradation of adjacent parcels), and specific access and
1359 maintenance considerations. In addition, an evaluation of existing aquatic habitat on the site will be
1360 conducted to better evaluate the quality and quantity of functional uplift available onsite, as related to
1361 the project effects. Each site will be evaluated regarding its potential to provide the functions to support
1362 increased salmonid migration, feeding, and rearing/refugia functions.

1363 The final screening/ranking will occur at a later date, and may include additional criteria, pending
1364 review by the project team and additional guidance provided by regulatory agencies. The ultimate goal
1365 of the aquatic mitigation screening process is to assign a relative ranking to the short list of the
1366 mitigation sites within each functional group. This will then allow the mitigation team to select a
1367 complementary group of mitigation projects/actions that will fully compensate for all project effects.

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