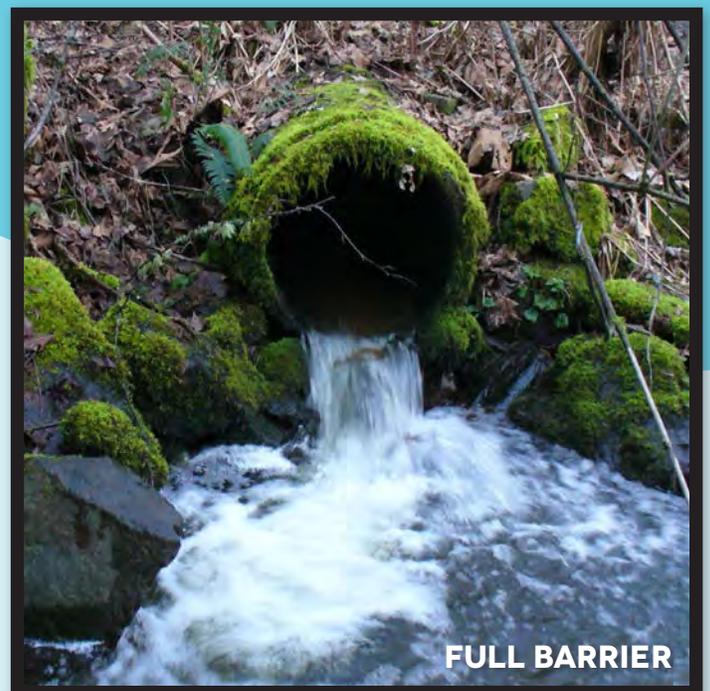


Appendix E

Culvert Assessment Memorandum

Preliminary Assessments: Fish Passage at City of Kirkland Road and Trail Stream Culverts



Prepared August 2014 by:



PRELIMINARY ASSESSMENTS

Fish Passage at City of Kirkland Road and Trail Stream Culverts

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August 2014

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120612

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Cite this document as:
The Watershed Company. August 2014.
Fish Passage at City of Kirkland Road and Trail Stream
Culverts - Preliminary Assessments.

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Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual	

FISH PASSAGE AT CITY OF KIRKLAND ROAD AND TRAIL STREAM CULVERTS

BACKGROUND

In conjunction with preparation of the 2014 update of its Surface Water Master Plan, the City of Kirkland has sought to identify and prioritize those trail and road crossing of streams within its jurisdiction most in need of upgrading in order to improve fish passage in a cost-effective manner. Several of the crossing upgrades perceived to provide the most benefit to fish were taken to the conceptual design level and included in a listing of recommended Capital Improvement Projects (CIPs) in the updated Plan. A number of such culvert crossings of streams within the City had been evaluated by previous efforts, including the 2005 update of the Master Plan and project-related engineering review. However, it was thought that a number of additional road and trail crossings of streams should be evaluated before conducting prioritization and selection of recommended culvert replacement CIPs to be included in the current Master Plan update.

Selection of Additional Culverts for Evaluation

Identification of additional culvert crossings in need of evaluation were made from the following sources:

1. Culverted crossings of streams for which information was limited in the recently-annexed area in the northern part of the City.
2. Previously-identified, but to-date not implemented, CIPs.
3. Culverted stream crossings of the Cross Kirkland Corridor (CKC) Trail, which is in the process of being converted to a trail from a former railroad grade.
4. Additional stream crossings in need of evaluation as identified through a City-wide evaluation and mapping effort as described below:

City-wide, culvert crossings of streams were selected and evaluated for fish passage which are located along streams classified as “fish bearing” or Type F according to the Forest Practices Act stream typing protocol, WAC 222-16-013. A

review of Washington State Department of Natural Resources (DNR) mapping as an overlay to City of Kirkland mapping was used as a first cut or first level screening to identify these Type F-mapped stream segments as presumed fish-bearing streams. Culverts along stream segments not mapped as Type-F streams, but known or suspected to have fish presence based on local knowledge and studies, were also included as candidates for inclusion in the culvert analysis. An initial, broader list, was refined in consultation with City staff and other Master Plan team members to arrive at a final list of culverts for which additional field information was needed with respect to evaluation for fish passage.

Culvert location maps showing the culverts identified from all of these sources and evaluated in this report are provided as Attachment A.

Field Methods and Data

Each culvert identified for evaluation was visited and photographed, with additional information collected on a separate checklist (Attachment B). Information collected for each culvert includes stream or basin name, cross street, type and diameter, length estimate, visual slope estimate, fish use status if known, any substrate through the culvert, description of any outfall plunges, upstream and downstream channel width, and, finally, a qualitative fish passability assessment based on the gathered information.

On the checklist form, fish passability is rated on a scale of 1 through 4, as follows:

1. Fully passable. May have relatively minor shortcomings with respect to current design standards, but is fully passable to fish based on observed width, flow depth, slope, substrate and roughness, (lack of) internal or outfall plunges, and anticipated velocities. Current design standards are provided in the Washington Department of Fish and Wildlife's 2013 *Water Crossing Design Guidelines* (Barnard et. al., 2013). Little or no improvement in upstream habitat accessibility for fish would result from culvert replacement.
2. Hindrance to passage. Most fish can pass upstream most of the time based on slope and velocity etc., but the culvert has moderate to significant deviations from current design standards. If located along a fish-bearing stream segment, such culverts should eventually be replaced and brought up to standard, but are not denying habitat access to a significant degree in the meantime.
3. Partial barrier. Some fish may be able to pass at some flows, but the culvert could result in significant prevention of or disruption in upstream fish movements. Velocities or plunges may be too high for juveniles at all

or most flows, and may be too high for adults at only moderately elevated flows. Upgrading or replacement would result in significantly improved habitat access for fish.

4. Full or nearly full barrier. The present condition and configuration of the culvert allows for little or no upstream fish passage, generally due to high velocities and/or plunges.

Completed checklist forms and accompanying photographs for each of the culverts evaluated throughout the City are provided following the report text in Attachment B. Note that information regarding some of the culverts to be evaluated and ranked came from sources outside of and preceding this study, and so checklist forms for these culverts were not prepared and are not included. Examples are Yarrow Creek culverts at NE 48th Place, just east of 116th Ave NE and 116th Ave NE just north of NE 41st Street (where Yarrow creek crosses under 116th Ave NE). These are the only two Yarrow Creek culverts within City of Kirkland right of way and are presumed to be barriers to upstream passage, pending confirmation. Their priority for upgrading is lowered due to very limited headwater habitat upstream and a number of additional barriers downstream.

Also included in Attachment A is City-wide mapping showing the location of each culvert by basin within the City as well as its fish passability rating. Several comprehensive spreadsheets summarizing the information about each of the listed culverts have also been prepared and are also provided following the report text in Attachment C. These include 1) a version with culverts organized geographically, by basin, to assist in locating each culvert on the accompanying maps, 2) a version sorted by priority for upgrade, as described below, and 3) an abbreviated version showing only those culverted stream crossings along the Cross Kirkland Corridor Trail, under development.

Prioritization

The information collected during these evaluations, along with subsequent analysis, was used to prioritize culverts for upgrade or replacement based on improved fish passage and habitat access. A column on each of the attached spreadsheets provides a priority rating on a scale of 1 through 4. The Priority 1, or highest, rated culverts for replacement are also shown on the attached map.

Priority ratings for each culvert evaluated were made taking the following factors into consideration:

- Whether or not the stream segment including the culvert crossing location is known to be fish-bearing (and with what confidence or to what extent). If not presently fish-bearing, does it represent potential fish

habitat or is it inherently unsuitable in some way (too small, too steep, seasonal upstream of a natural barrier, etc.)?

- Accessibility from downstream. Are there existing barriers downstream of the culvert that would prevent fish from reaching it? Are they natural or man-made? Would replacement of this culvert need to be combined with another, downstream culvert replacement or another project to be effective?
- How much potential habitat upstream (and of what quality) would be made accessible by upgrading or replacing this culvert.
- Cost feasibility. Would available funds be better spent first on other projects that would result in more and/or better habitat being made more accessible for the amount of money spent?

Priority for culvert upgrade, typically replacement, was assigned on a scale of 1 through 4, generally as follows:

1. a) Located on a fish-bearing or potentially fish-bearing stream segment, b) Rated as a full (4) or partial (3) barrier, c) Independently restores access to a high or moderate amount of good-quality habitat, and d) Can be accomplished at a relatively low to moderate cost.
2. Same as #1 rating except must be implemented in conjunction with one or more other projects to be effective, restores access to only a fairly limited amount of habitat, is comparatively expensive, and/or is infeasible for some other reason.
3. Would be rated #1 or #2, except is only rated as a hindrance (2) to upstream migration. As noted above, such culverts should eventually be replaced and brought up to standard, but such replacement is not urgent and the culvert is not precluding access significantly in the meantime.
4. These are culvert crossings located either along non-fish-bearing stream segments with little or no habitat potential *or* which are already fully passable (1). These are rated as having a low priority for replacement.

Culverts are listed in descending order of their priority rating for upgrade, usually replacement, on an accompanying spreadsheet. Of these, several have been developed as concept designs and are included as recommended CIPs in the 2014 update of the City's Surface Water Master Plan.

Approximate Priority Index values were also estimated for each of the culverts according to Washington Department of Fish and Wildlife methodology (WDFW, 2009), see Attachment D. These values are based on some very

approximate estimates of the habitat areas that would be made accessible by anticipated culvert improvements; detailed stream surveys were beyond the scope of this study. These rough Priority Index values are listed in a column on each of the attached spreadsheets in Attachment C for comparison with the scale 1 through 4 rankings as described above. These two methods are generally in agreement, but with the discrepancies noted appearing to be primarily due to anticipation of high costs or other feasibility issues associated with some of the potential culvert replacement projects. The Priority Index can accommodate costs to a limited degree, however this is not generally taken into account until an actual cost estimate is made. Cutthroat trout and coho salmon are the most prevalent salmonid fish species using Kirkland streams. In application of the Index, credit was typically given for improvements in access for either resident or sea-run cutthroat, where applicable, but not both.

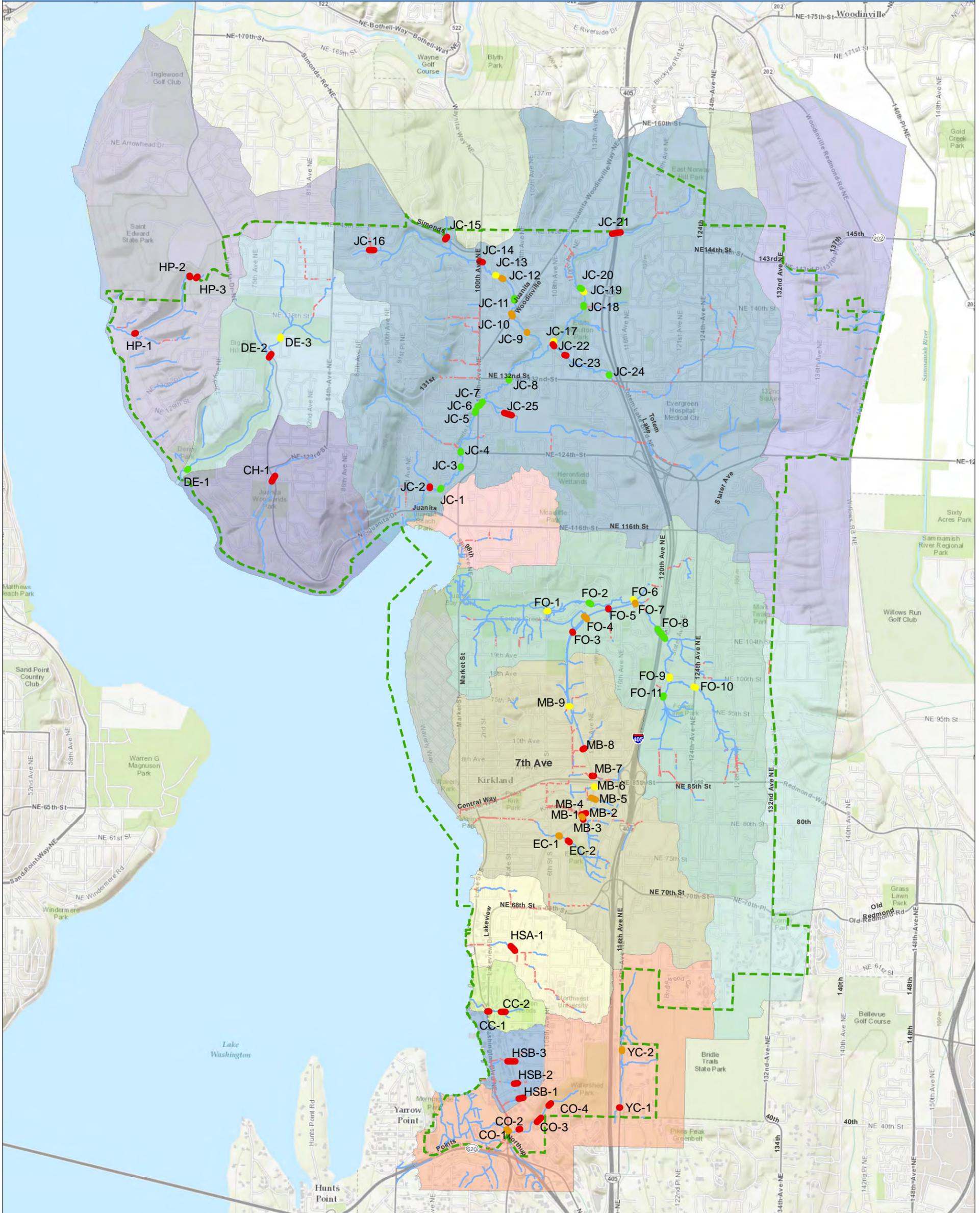
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ATTACHMENT A

Culvert Location Maps

KIRKLAND FISH PASSAGE BARRIER ANALYSIS



Barrier Status

- █ 1 = Passable
- █ 2 = Hindrance
- █ 3 = Partial Barrier
- █ 4 = Full Barrier

City Limit

- - - City Limit
- ~ Streams
- ~ Open
- - - Pipe

Drainage Basins

- █ Carillon Creek
- █ Champagne Creek
- █ Denny Creek
- █ Forbes Creek
- █ Holmes Point
- █ Houghton Slope A
- █ Houghton Slope B
- █ Juanita Creek
- █ Kingsgate Slope
- █ Kirkland Slope
- █ Lower Sammamish River Valley
- █ Moss Bay
- █ South Juanita Slope
- █ To Redmond
- █ Yarrow Creek

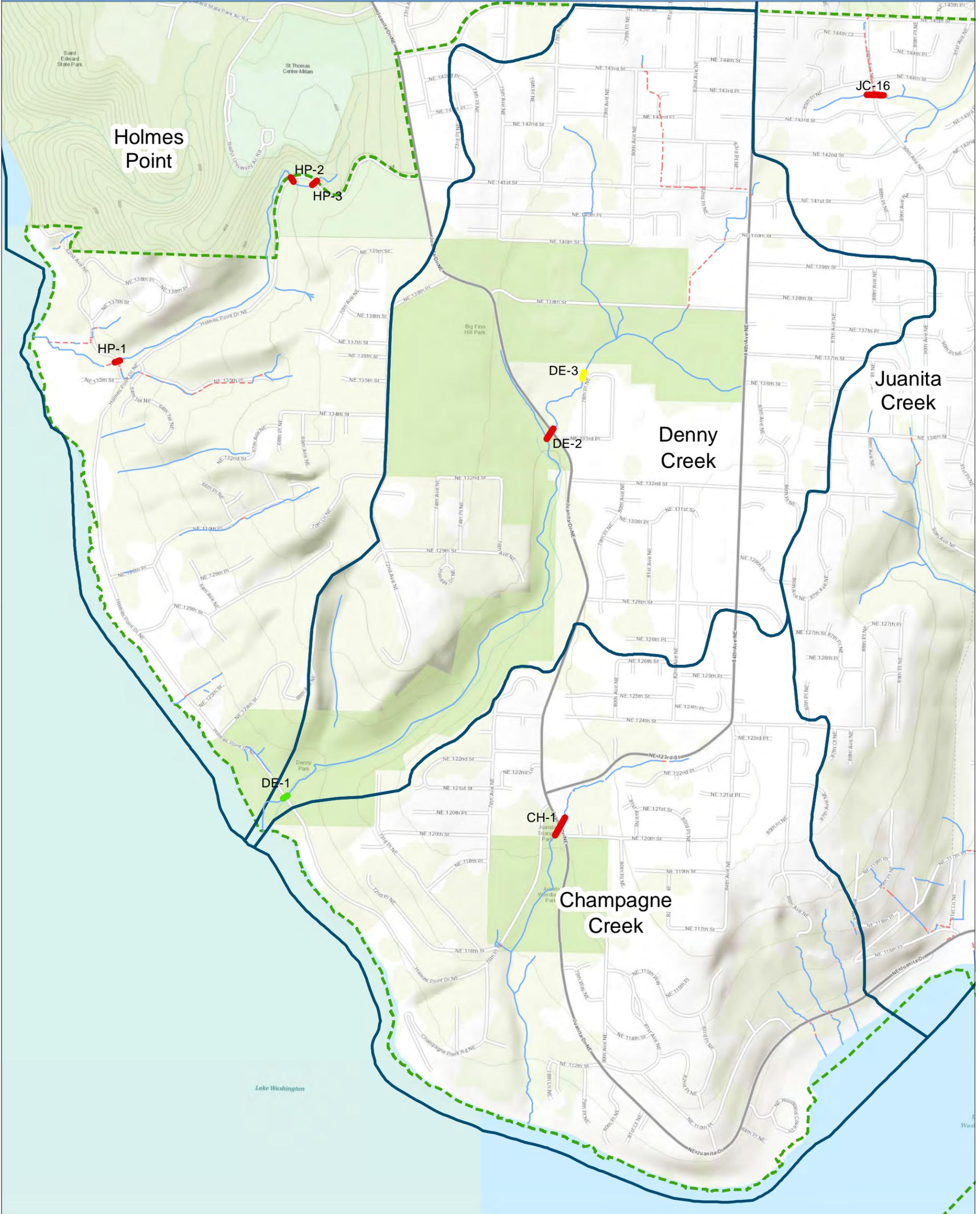


0 2,500 5,000 Feet

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Data source:
City of Kirkland, The Watershed Company.
Basemap:
Esri World Topographic Map, Esri World Street Map

KIRKLAND FISH PASSAGE BARRIER ANALYSIS



- Barrier Status**
- █ 1 = Passable
 - █ 2 = Hindrance
 - █ 3 = Partial Barrier
 - █ 4 = Full Barrier
- City Limit** - - -
- Drainage Basins**
- Streams**
- ~ Open
 - - - Pipe

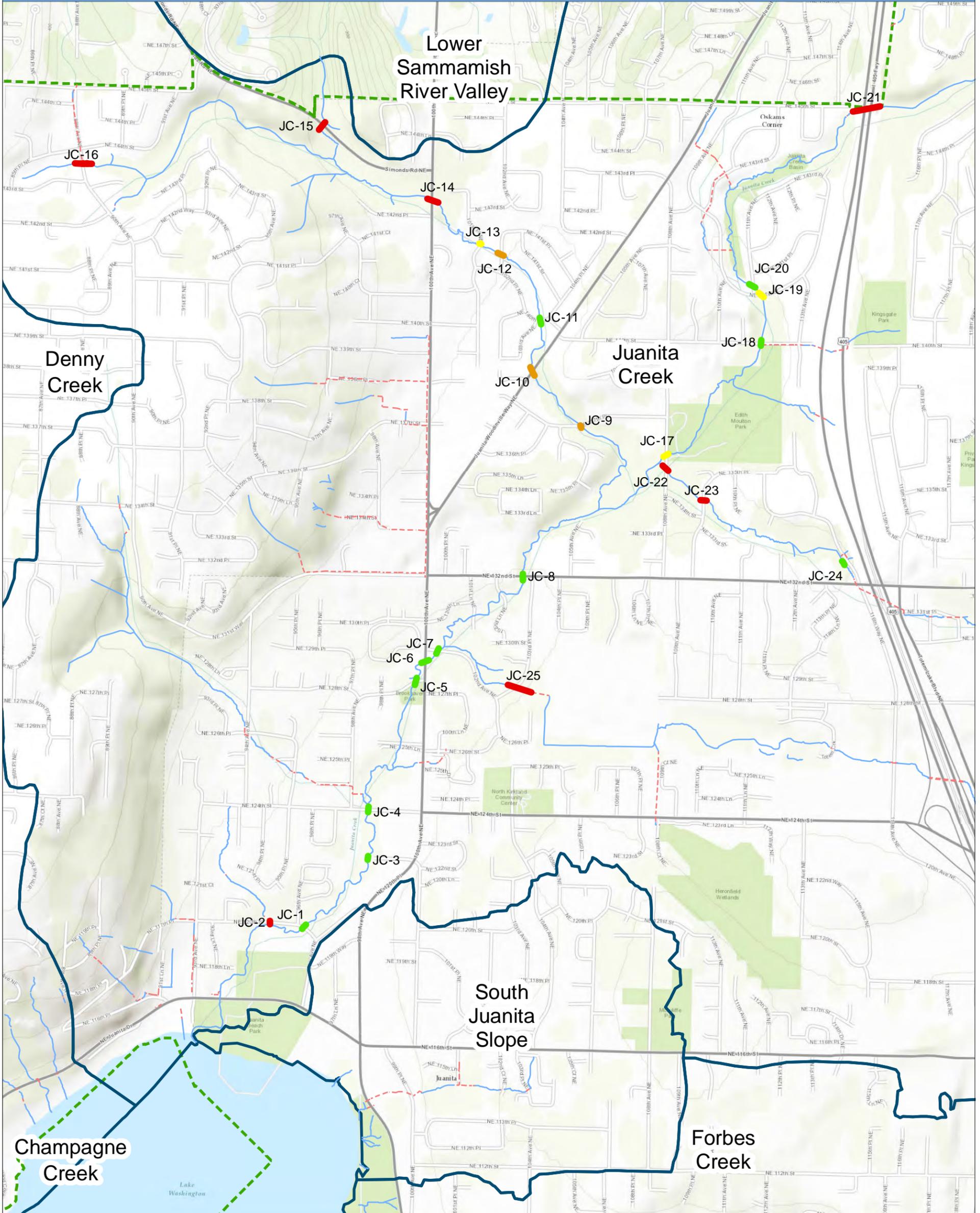


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Data source:
City of Kirkland, The Watershed Company.
Basemap:
Esri World Topographic Map, Esri World Street Map



KIRKLAND FISH PASSAGE BARRIER ANALYSIS



- Barrier Status**
- 1 = Passable
 - 2 = Hindrance
 - 3 = Partial Barrier
 - 4 = Full Barrier
- City Limit** - - -
- Drainage Basins**
- Streams**
- ~ Open
 - - - Pipe

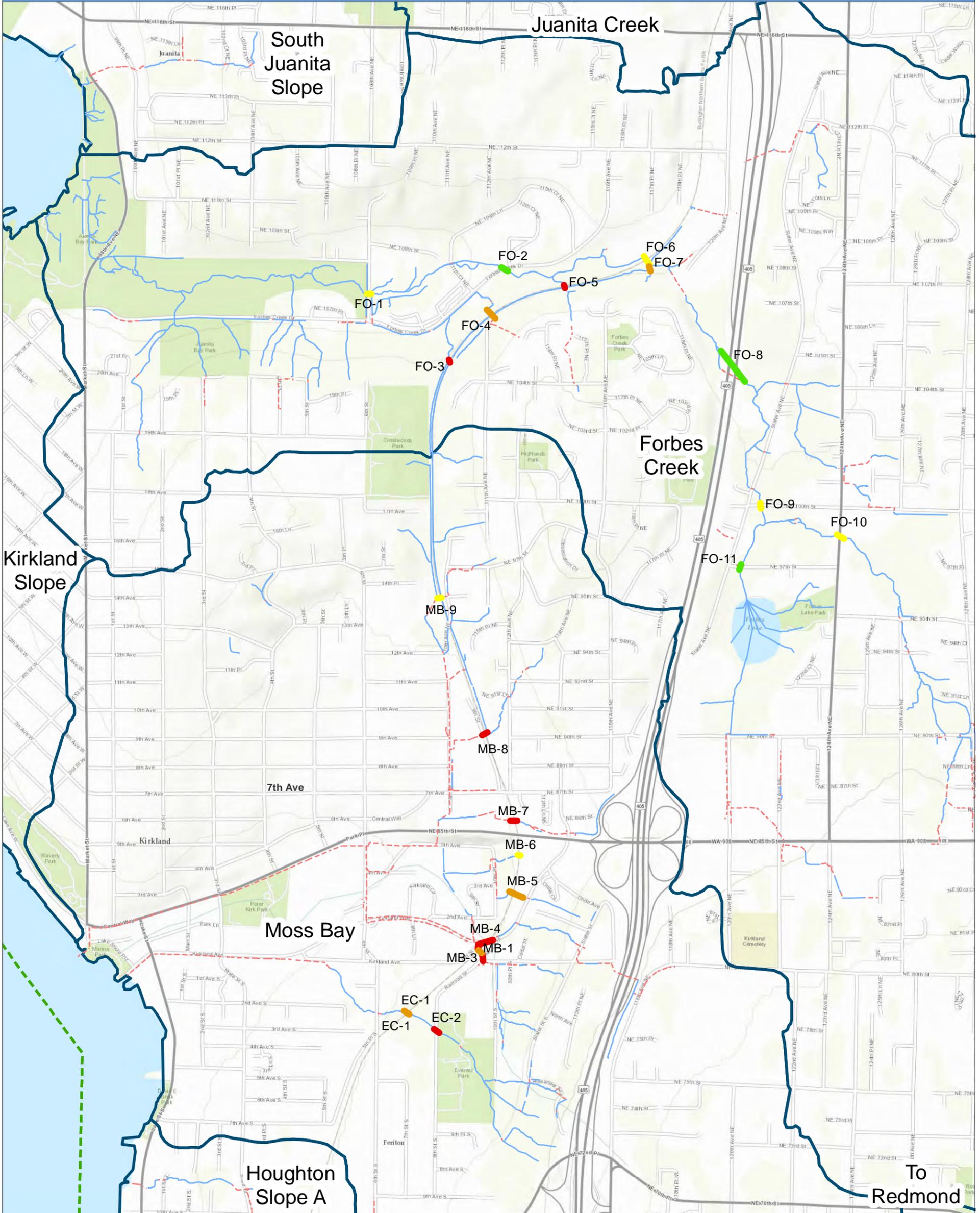


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Data source:
City of Kirkland, The Watershed Company.
Basemap:
Esri World Topographic Map, Esri World Street Map



KIRKLAND FISH PASSAGE BARRIER ANALYSIS



- Barrier Status**
- █ 1 = Passable
 - █ 2 = Hindrance
 - █ 3 = Partial Barrier
 - █ 4 = Full Barrier
- City Limit**
- City Limit
- Drainage Basins**
- Drainage Basins
- Streams**
- ~ Open
 - Pipe

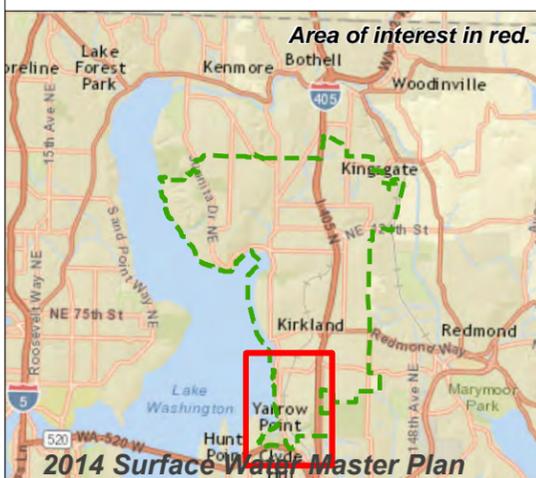
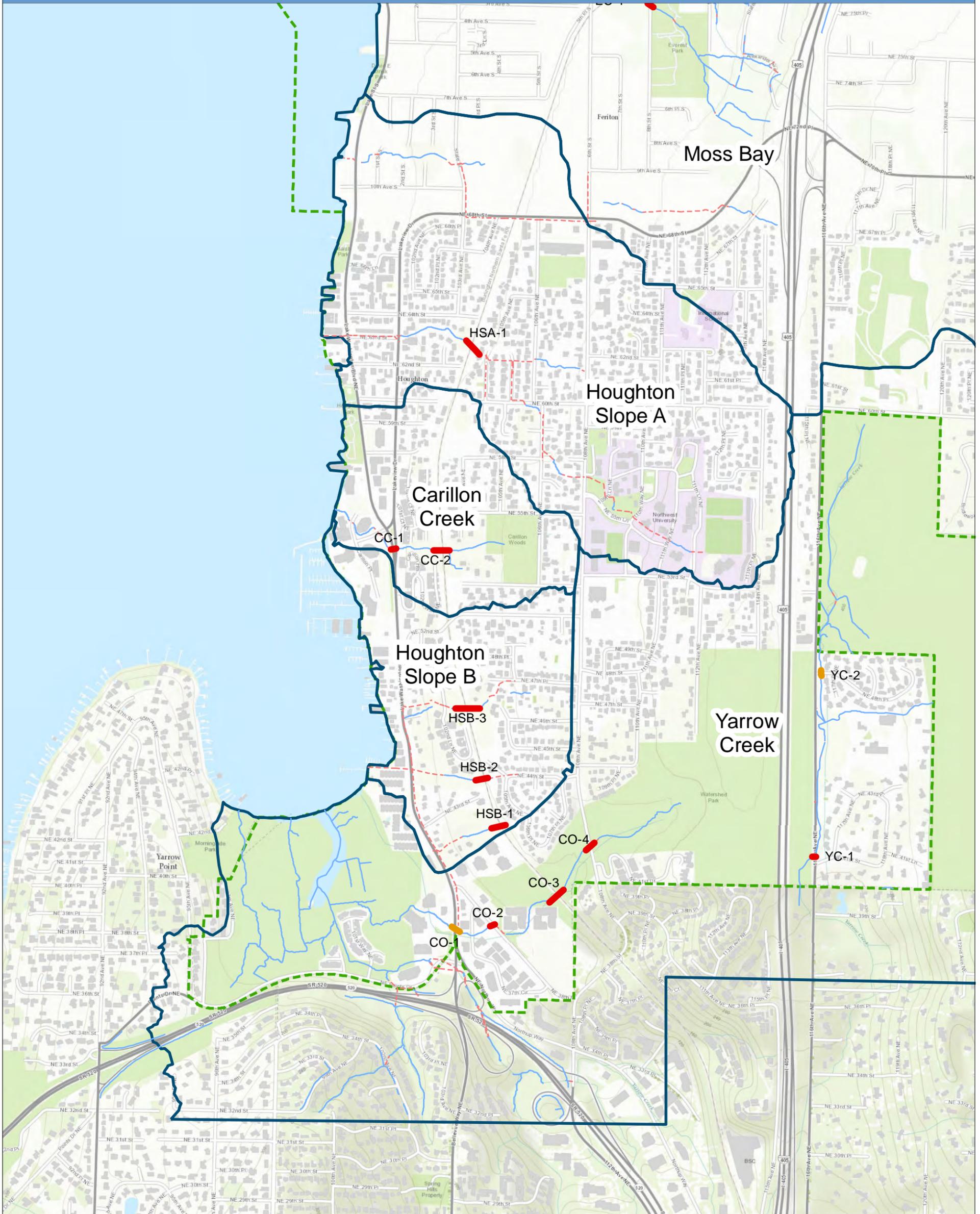


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Data source:
City of Kirkland, The Watershed Company.
Basemap:
Esri World Topographic Map, Esri World Street Map



KIRKLAND FISH PASSAGE BARRIER ANALYSIS



- Barrier Status**
- █ 1 = Passable
 - █ 2 = Hindrance
 - █ 3 = Partial Barrier
 - █ 4 = Full Barrier
- City Limit**
- Drainage Basins**
- Streams**
- ~ Open
 - Pipe



Original Scale=1:250,000 @ 11x17 layout. Please scale accordingly.

Data source:
City of Kirkland, The Watershed Company.
Basemap:
Esri World Topographic Map, Esri World Street Map



ATTACHMENT B

Culvert Assessment Checklists

Checklists for Fish Passage Evaluation of Kirkland Culverts

List of Culverts Assessed

Culvert ID

HP-1 (2).....	1
HP-2 (3).....	3
HP-3 (4).....	5
DE-1 (5).....	7
DE-2 (6).....	9
DE-3 (A).....	11
CH-1 (7).....	13
JC-8 (16).....	15
JC-9 (e).....	17
JC-10 (17).....	19
JC-11 (18).....	21
JC-12 (19).....	23
JC-13 (20).....	25
JC-14 (21).....	27
JC-15 (22).....	29
JC-16 (c).....	31
JC-17 (f).....	33
JC-18 (D).....	35
JC-19 (23).....	37
JC-20 (24).....	39
JC-21 (26).....	41
JC-22 (g).....	43
JC-23 (h).....	45
JC-24 (i).....	47
FO-1 (SD 0049).....	49
FO-2 (jj).....	51
FO-3 (CKC - #4).....	53
FO-4 (CKC - #3).....	55
FO-5 (CKC - #2).....	57
FO-6 (CKC - #1 (=SD 0054 (A - TRACKS))).....	59
FO-7 (CKC - #1 (=SD 0054 (B - SPUR))).....	61
FO-9 (mm).....	63
FO-10 (nn).....	65
FO-11 (oo).....	67
MB-1 (CKC - #19).....	69
MB-2 (CKC - #20).....	71
MB-3 (CKC - #18).....	73
MB-4 (CKC - #10).....	75
MB-5 (CKC - #9).....	77
MB-6 (CKC - #8).....	79
MB-7 (CKC - #7).....	81
MB-8 (CKC - #6).....	83
MB-9 (CKC - #5).....	85

Checklist for Fish Passage Evaluation of Kirkland Culverts

EC-1 (CKC - #11).....87
EC-2 (SD-0061)89
HSA-1 (CKC - #12)91
CC-1 (y).....93
CC-2 (z, CKC #13).....95
HSB-1 (CKC - #16)97
HSB-2 (CKC - #15)99
HSB-3 (CKC - #14)101
CO-3 (CKC - #17).....102

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HP-1 (2)**

Culvert ID:
HP-1 (2)

Stream: Holmes Pt.

Cross Street: 62nd Avenue NE

Type, Dia: 36 in, 131 ft., concrete AND 36 in, 61 ft., CAP

Length if known 61 ft
or estimate:

Fish use of Stream Segment: Unknown, no fish found in 1998 study.
Y/N/Unk./Presumed

Slope through Culvert: Moderate, estimated at 2-3%, but may be additional plunges inside

Substrate/roughness w/in culvert? About 6" of gravel at the upstream end and 12" at the downstream end.

Plunge at outfall: No plunge and no pool at the outfall
Y/N, ht., pool?

Est. OHW width: Upstream – 5-6' Downstream – 12 feet or wider but artificial due to filled in pool behind dam

Passage Assessment – Passable, Full/Partial Barrier: Presumed to be a full barrier due to length, overall high slope, and interior plunge that is audible from the upstream end

Photos: Inlet 17, 18 Outlet 19, 20

Notes: Very long. Likely a junction (manhole with plunge?) and turn with a pipe type change along the way. Piped beneath a residential yard. Possible fix at the time of dam removal.

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HP-1 (2)**



Figure 1. Culvert HP-1 Inlet at 62nd Ave, 3-8-13



Figure 2. Culvert HP-1 Outlet at 62nd Ave, 3-8-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HP-2 (3)**

Culvert ID:
HP-2 (3)

Stream: Holmes Pt.

Cross Street: Holmes Pt. Drive

Type, Dia: 18 in RCP

Length if known 55 ft
or estimate:

Fish use of Stream Segment: Unknown, no fish found in 1998 study.
Y/N/Unk./Presumed

Slope through Culvert: Steep, estimated at 6-8%.

Substrate/roughness w/in culvert? None.

Plunge at outfall: Nearly 2-foot plunge at the outfall into a 1-foot (max.) pool.
Y/N, ht., pool?

Est. OHW width: Upstream – 5' Downstream – 5'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Full barrier due both to plunge at the outfall plus being smooth and steep inside to create a velocity barrier

Photos: Inlet 24-26 Outlet 21-23

Notes: A lot of work would need to be done downstream to make fish passage here relevant. For cutthroat; unlikely that coho would commonly come this far even with all intervening barriers fixed.

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HP-2 (3)**



Figure 3. Culvert HP-2 Inlet at Holmes Point Drive, 3-8-13



Figure 4. Culvert HP-2 Outlet at Holmes Point Drive, 3-8-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HP-3 (4)**

Culvert ID:
HP-3 (4)

Stream: Holmes Pt.

Cross Street: Holmes Pt. Drive

Type, Dia: 18 in RCP

Length if known 71 ft.
or estimate:

Fish use of Stream Segment: Likely No.
Y/N/Unk./Presumed

Slope through Culvert: Steep, estimated at 6%.

Substrate/roughness w/in culvert? None, smooth pipe.

Plunge at outfall: Yes, plunge height 15-18" into 6" pool.
Y/N, ht., pool?

Est. OHW width: Upstream – 5', downstream – 3'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Full barrier due to plunge and velocity due to steepness

Photos: Inlet 29-31 Outlet 27, 28

Notes: Providing passage is a low priority. Stream is likely too small here for other than occasional use by juvenile cutthroat – if they have access.

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HP-3 (4)**



Figure 5. Culvert HP-3 Inlet at Holmes Point Drive, 3-8-13



Figure 6. Culvert HP-3 Outlet at Holmes Point Drive, 3-8-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
DE-1 (5)**

Culvert ID:
DE-1 (5)

Stream: Denny Creek

Cross Street: Holmes Pt. Drive

Type, Dia: 120 – inch (10-foot-wide by 4 ½ foot high concrete box culvert.)

Length if known 55 ft.
or estimate:

Fish use of Stream Segment: Yes, cutthroat and coho from 1998 study.
Y/N/Unk./Presumed

Slope through Culvert: About 3% but rough, with gravel and boulders.

Substrate/roughness w/in culvert? Yes, rounded gravel, cobbles, and boulders.

Plunge at outfall: No, but there is a series of log weirs leading up to the outlet of the culvert.
Y/N, ht., pool?

Est. OHW width: Upstream – 12' Downstream – 16'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Fully Passable.

Photos: Inlet 44, 45 Outlet 42, 43

Notes: This culvert is fully passable in its present condition as of 3/13. Look at whether Denny Creek report has already evaluated this culvert.

Meets WDFW Culvert Design Manual Criteria? Perhaps technically does still not meet width criteria. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
DE-1 (5)**



Figure 7. Culvert DE-1 Inlet at Holmes Point Drive, 3-8-13



Figure 8. Culvert DE-1 Outlet at Holmes Point Drive, 3-8-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
DE-2 (6)**

Culvert ID:
DE-2 (6)

Stream: Denny Creek

Cross Street: Juanita Drive

Type, Dia: 24 in Concrete

Length if known 138 ft.
or estimate:

Fish use of Stream Segment: Unknown, no fish found in 1998 study.
Y/N/Unk./Presumed

Slope through Culvert: Estimated at 3-4%

Substrate/roughness w/in culvert? None

Plunge at outfall: Yes, the plunge height is about 1 foot into a large 2-foot-deep scour pool.
Y/N, ht., pool?

Est. OHW width: Upstream – 9' Downstream 9'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Presumed full barrier due to long length and high slope with correspondingly high velocities.

Photos: Inlet 40, 41 Outlet 38, 39

Notes: This culvert is a relatively high priority for providing fish passage due to the size of the stream and the lack of barriers below. Neighborhood wants pedestrian underpass combined with fish passage improvements at this location.

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
DE-2 (6)**



Figure 9. Culvert DE-2 Inlet at Juanita Drive, 3-8-13



Figure 10. Culvert DE-2 Outlet at Juanita Drive, 3-8-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
DE-3 (A)**

Culvert ID:
DE-3 (A)

Stream: Denny Creek

Cross Street: 13433 78th PI NE

Type, Dia: Twin corrugated pipes 24" high by 36" wide (aluminum?)

Length if known 76 ft
or estimate:

Fish use of Stream Segment: Unknown, no fish found in 1998 study.
Y/N/Unk./Presumed

Slope through Culvert: Low, 1 or 2%.

Substrate/roughness w/in culvert? None.

Plunge at outfall: Yes, 8-10" plunges at outfall into 3' pool.
Y/N, ht., pool?

Est. OHW width: Upstream – 6' Downstream – 9'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Partial barrier. Moderate-sized trout could jump into and swim through these culverts.

Photos: Inlet 35-37 Outlet 32-34

Notes: Under driveway serving 2 houses. In open space area in front of home.

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
DE-3 (A)**



Figure 11. Culvert DE-3 Inlet at 78th Place NE, 3-8-13



Figure 12. Culvert DE-3 Outlet at 78th Place NE, 3-8-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
CH-1 (7)**

Culvert ID:
CH-1 (7)

Stream: Champagne Creek

Cross Street: Juanita Drive

Type, Dia: 18 in. concrete

Length if known 226 ft.
or estimate:

Fish use of Stream Segment: Y/N/Unk./Presumed - Unknown or not expected this segment but cutthroat use documented farther downstream

Slope through Culvert: Steep, estimated at 6-8%

Substrate/roughness w/in culvert? None.

Plunge at outfall - Y/N, ht., pool? Yes, 2-foot-high plunge onto steep cobbles and hard soil, then finally there is pool about 4 feet vertically below the outfall.

Est. OHW width: Upstream – 6' Downstream – 8'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Full barrier due to plunge at outfall and velocity due to slope and smooth pipe.

Photos: Inlet 67, 68 Outlet 61-66

Notes: There is not significant habitat available upstream so this is not a high priority.

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
CH-1 (7)**



Figure 13. Culvert CH-1 Inlet at Juanita Drive, 2-8-13



Figure 14. Culvert CH-1 Outlet at Juanita Drive, 2-8-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-8 (16)**

Culvert ID:
JC-8 (16)

Stream: Juanita Creek - east trib

Cross Street: NE 132nd Street

Type, Dia: 14-foot bolted structural aluminum plate CAP or arch. 14 feet at channel bottom

**Length if known 73 ft.
or estimate:**

Fish use of Stream Segment: Presumed
Y/N/Unk./Presumed

Slope through Culvert: Moderate, 2-3%

Substrate/roughness w/in culvert? Yes, large gravel streambed is continuous through culvert

Plunge at outfall: No plunge, no pool. A pool begins 18-20 feet downstream.
Y/N, ht., pool?

Est. OHW width: Upstream – 13' Downstream – 16'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Passable.

Photos: Inlet 6-9 Outlet 1-5

Notes: Check whether this was evaluated in 2005 SW Master Plan - if not, evaluate.

Meets WDFW Culvert Design Manual Criteria? Somewhat less than design standards for width. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-8 (16)**



Figure 15. Culvert JC-8 Inlet, 3-26-13



Figure 16. Culvert JC-8 Outlet, 3-26-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-9 (e)**

**Culvert ID:
JC-9 (e)**

Stream: Juanita NW tributary

Cross Street: Ne 137th Pl.

Type, Dia: 36 in. concrete

**Length if known \pm 80 ft
or estimate:**

**Fish use of Stream Segment: yes
Y/N/Unk./Presumed**

Slope through Culvert: 2-3%

Substrate/roughness w/in culvert? None, concrete bottom.

Plunge at outfall: No plunge.
Y/N, ht., pool?

Est. OHW width: Upstream 9', downstream 11'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 3 – Partial barrier. Long, somewhat steep slope, no substrate, but no plunge at outfall

Photos: Inlet 6-9 Outlet None, too many blackberries.

Meets WDFW Culvert Design Manual Criteria? No (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-9 (e)**



Figure 17. Culvert JC-9 Juanita NW Tributary Inlet at NE 137th Place

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-10 (17)**

Culvert ID:
JC-10 (17)

Stream: Juanita Creek- NW/east trib

Cross Street: Juanita Woodinville Way

Type, Dia: 36 in. concrete

Length if known 108 ft.
or estimate:

Fish use of Stream Segment: Yes, cutthroat and coho from 1998 study.
Y/N/Unk./Presumed

Slope through Culvert: Backwatered about half way through, then estimated at 3-4% un
upper half.

Substrate/roughness w/in culvert? None.

Plunge at outfall: No plunge at outfall, culvert is backwatered about 15" deep.
Y/N, ht., pool?

Est. OHW width: Upstream 6-7' Downstream 8-9'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Partial Barrier. Fish can swim easily
through the lower part of the pipe at most flows, then need to pass through a short, low-depth,
high-velocity section at the upper end.

Photos: Inlet 6-9 Outlet 1-5

Notes: A very large scour pool has formed at the outlet. 18' wide, 22' long, and 3' deep. This
indicates high velocities and energy during storm events. (Check whether King County has any
data on this pipe?)

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW
width +2 for stream simulation. (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-10 (17)**



Figure 18. Culvert JC-10 Inlet at Juanita Woodinville Way, 3-11-13



Figure 19. Culvert JC-10 Outlet at Juanita Woodinville Way, 3-11-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-11 (18)**

Culvert ID:
JC-11 (18)

Stream: Juanita Creek - NW/east trib

Cross Street: NE 140th Place

Type, Dia: 48 in concrete

Length if known 78 ft
or estimate:

Fish use of Stream Segment: Presumed yes.
Y/N/Unk./Presumed

Slope through Culvert: None, near-zero, backwatered from both ends.

Substrate/roughness w/in culvert? Culvert is about half full of sandy sediment.

Plunge at outfall: Y/N, ht., pool? No plunge at outfall. Culvert is countersunk. Water surface is 1-foot below top of 4-foot culvert.

Est. OHW width: Upstream – 7' Downstream – 10'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Fully passable. Culvert is countersunk with a near-zero gradient.

Photos: Inlet 15, 16 **Outlet** 10-14

Notes: Substrate is mostly sand at culvert outlet, becoming small, sandy gravel farther downstream. Check whether King County has any data on this pipe?

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-11 (18)**



Figure 20. Culvert JC-11 Inlet at NE 140th Place, 3-11-13



Figure 21. Culvert JC-11 Outlet at NE 140th Place, 3-11-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-12 (19)**

Culvert ID:
JC-12 (19)

Stream: Juanita Creek - NW/east trib

Cross Street: 102nd Ave NE

Type, Dia: 3-foot by 4-foot CMP, arch on top, flat on bottom

Length if known 73 ft
or estimate:

Fish use of Stream Segment: Presumed
Y/N/Unk./Presumed

Slope through Culvert: Estimated 4%

Substrate/roughness w/in culvert? None at downstream end, slight amount at upstream end.

Plunge at outfall: No plunge, no pool. Water exits culvert shallowly and swiftly onto rubble
Y/N, ht., pool? substrate – 1-foot chunks of angular rock and concrete.

Est. OHW width: Upstream 7-8' Downstream 6'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Partial barrier. No plunge at outfall, but flows are shallow, swift, and moderately steep.

Photos: Inlet 20, 21 Outlet 17-19

Notes: Check whether King County has any data on this pipe?

Meets WDFW Culvert Design Manual Criteria? No. Fails depth, slope, and substrate requirements. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-12 (19)**



Figure 22. Culvert JC-12 Inlet at 102nd Avenue NE, 3-11-13



Figure 23. Culvert JC-12 Outlet at 102nd Avenue NE, 3-11-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-13 (20)**

Culvert ID:
JC-13 (20)

Stream: Juanita Creek - NW/east trib

Cross Street: 101st Pl. NE

Type, Dia: 4-foot wide by 3-foot high CMP

Length if known (Not known.)
or estimate:

Fish use of Stream Segment: presumed.
Y/N/Unk./Presumed

Slope through Culvert: Estimated at 2%.

Substrate/roughness w/in culvert? Yes, small, sandy gravel along bottom.

Plunge at outfall: No plunge, no pool.
Y/N, ht., pool?

Est. OHW width: Upstream 6' Downstream 6'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: mostly passable. Migration hindrance; long length, width does not meet design standards.

Photos: Inlet 25-27 Outlet 22-24

Notes: Not up to WDFW design standards and not ideal for passage, yet this culvert is probably not significantly limiting fish use of the tributary.

Meets WDFW Culvert Design Manual Criteria? No, too narrow. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-13 (20)**



Figure 24. Culvert JC-13 Inlet at 101st Place NE, 3-11-13



Figure 25. Culvert JC-13 Outlet at 101st Place NE, 3-11-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-14 (21)**

Culvert ID:
JC-14 (21)

Stream: Juanita Creek- NW/east trib

Cross Street: 100th Ave NE

Type, Dia: 42 in concrete at inlet, 4-foot by 4-foot concrete box culvert at outlet

Length if known 125ft
or estimate:

Fish use of Stream Segment: Cutthroat from 1998 study.
Y/N/Unk./Presumed

Slope through Culvert: Steep at upstream end.

Substrate/roughness w/in culvert? No substrate present in the culvert at either end

Plunge at outfall: Yes, a 2 ½ foot plunge at the outfall into a deep plunge pool.
Y/N, ht., pool?

Est. OHW width: Upstream 6' Downstream 8-9'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Full barrier due to inlet plunge onto steep, smooth concrete for approx. 40 feet. Also due to 2 ½ foot plunge at outfall.

Photos: Inlet 1-6 Outlet 7-9

Notes: This is an in-stream detention structure. Grated inlet then very smooth and steep for about 40 feet, then another plunge into control structure or stilling basin. May be lower gradient internally, but there is also a 2 ½ foot plunge at the outfall. Check whether King County has any data on this pipe?

Meets WDFW Culvert Design Manual Criteria? No. 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-14 (21)**



Figure 26. Culvert JC-14 Inlet at 100th Avenue NE, 3-12-13



Figure 27. Culvert JC-14 Outlet at 100th Avenue NE, 3-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-15 (22)**

Culvert ID:
JC-15 (22)

Stream:

Cross Street: Simonds Road

Type, Dia: 24-inch concrete (not found)

Length if known 96 feet
or estimate:

Fish use of Stream Segment: Presumed no.
Y/N/Unk./Presumed

Slope through Culvert:

Substrate/roughness w/in culvert?

Plunge at outfall:
Y/N, ht., pool?

Est. OHW width:
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier:

Photos: Inlet 11 Outlet 10 (storm drain outlet, not stream)

Notes: This is more of a wetland/swale. Not particularly fish habitat and passage is doubtful.

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-15 (22)**



Figure 28. Culvert JC-15 Inlet at Simonds Road, 3-12-13



Figure 29. Culvert JC-15 Outlet at Simonds Road, 3-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-16 (c)**

Culvert ID:
JC-16 (c)

Stream: Juanita Creek - NW/east trib

Cross Street: 88th Ave NE between. NE 143rd and NE 144th Sts

Type, Dia: 36 in CMP.

Length if known 194 ft.
or estimate:

Fish use of Stream Segment: Unknown
Y/N/Unk./Presumed

Slope through Culvert: Low at outlet, but steeper at inlet.

Substrate/roughness w/in culvert? Quarry spalls in pipe at inlet. Little/none at outlet

Plunge at outfall: Y/N, ht., pool? No plunge at outfall. Culvert is backwatered with a 15-inch pool.

Est. OHW width: Upstream – 7' Downstream 10-12'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Likely full or at least partial barrier. Steeper at inlet, unknown slope throughout.

Photos: Inlet 19-21 **Outlet** 12-18

Notes: Quarry spall heaven! Huge amounts of quarry spalls – fairly old – were placed at this culvert outlet. Also quarry spalls and a lot of accumulated debris at the inlet. Check whether King County has any data on this pipe?

Meets WDFW Culvert Design Manual Criteria? No, does not meet width requirements. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-16 (c)**



Figure 30. Culvert JC-16 Inlet at 88th Avenue NE, 3-12-13



Figure 31. Culvert JC-16 outlet at 88th Avenue NE, 3-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-17 (f)**

Culvert ID:
JC-17 (f)

Stream: Juanita Creek

Cross Street: 108th Ave. NE

Type, Dia: 48-inch CMP

Length if known 65 ft.
or estimate:

Fish use of Stream Segment: yes
Y/N/Unk./Presumed

Slope through Culvert: <1%

Substrate/roughness w/in culvert? Very little, only a trace of sand at the outlet.

Plunge at outfall: No plunge. A pool at the outlet partially in the culvert is 1 foot deep.
Y/N, ht., pool?

Est. OHW width: upstream 11', downstream 13'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 2 – generally passable but does not meet current design standards.

Photos: Inlet 14-15 Outlet 10-13

Notes: Generally passable, no plunge at the outfall, backwatered nearly all the way through.

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-17 (f)**



Figure 32. Culvert JC-17 Inlet at 108th Avenue NE, 9-12-13



Figure 33. Culvert JC-17 Outlet at 108th Avenue NE, 9-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-18 (D)**

Culvert ID:
JC-18 (D)

Stream: Juanita

Cross Street: 11019 NE 140th St.

Type, Dia: 12-foot-wide by 6-foot-high concrete box culvert.

Length if known 62'
or estimate:

Fish use of Stream Segment: Yes
Y/N/Unk./Presumed

Slope through Culvert: About 3 feet of fall through culvert which includes 3 fish ladder steps

Substrate/roughness w/in culvert? Yes, includes gravel and some boulders.

Plunge at outfall: Y/N, ht., pool? Yes, a 6-inch plunge into a deep pool. Two additional plunges just shy of a foot each inside the culvert.

Est. OHW width: Upstream 10' Downstream 16'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Mostly passable. Juveniles may not be able to pass weirs at all flows.

Photos: Inlet 27, 28 Outlet 22-26, 29-31

Notes: Very substantial concrete box culvert which includes a fish ladder within it.

Meets WDFW Culvert Design Manual Criteria? May be slightly below width requirements. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-18 (D)**



Figure 34. Culvert JC-18 Inlet at NE 140th Street, 3-12-13



Figure 35. Culvert JC-18 Outlet at NE 140th Street, 3-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-19 (23)**

Culvert ID:
JC-19 (23)

Stream: Juanita Creek- NE/east trib

Cross Street: NE 141st Street

Type, Dia: 48in CMP

Length if known 69 ft.
or estimate:

Fish use of Stream Segment: Yes
Y/N/Unk./Presumed

Slope through Culvert: Moderate, estimated at 2%.

Substrate/roughness w/in culvert? None.

Plunge at outfall: Y/N, ht., pool? No plunge at outfall, but 1-foot plunge over boulder cascade about 8 feet downstream *then* a 1-foot deep pool.

Est. OHW width: Upstream 6' Downstream 8'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Hindrance or partial barrier; may restrict upstream of juveniles at some flows.

Photos: Inlet 36-39 **Outlet** 32-35

Notes: Neighbor on the east side of the outlet reports that adult salmon were somewhat common a number of years ago, but not in recent years.

Meets WDFW Culvert Design Manual Criteria? No, too narrow and maybe velocity and depth issues at some flows as well. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-19 (23)**



Figure 36. Culvert JC-19 Inlet at NE141st Street, 3-12-13



Figure 37. Culvert JC-19 Outlet NE 141st Street, 3-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-20 (24)**

Culvert ID:
JC-20 (24)

Stream: Juanita Creek- NE/east trib

Cross Street: 111th Ave NE

Type, Dia: 60-inch CMP

Length if known 77 ft.
or estimate:

Fish use of Stream Segment: Presumed
Y/N/Unk./Presumed

Slope through Culvert: Fairly low-gradient.

Substrate/roughness w/in culvert? Up to one foot depth of sand and angular rock at the outfall.

Plunge at outfall: Y/N, ht., pool? No plunge; an 18-inch-deep pool backwaters the culvert at the outlet.

Est. OHW width: Upstream 8' Downstream 8'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Not a barrier – passage conditions are fairly good.

Photos: Inlet 42-44 **Outlet** 40, 41

Notes: CIP to fix headwall on this culvert underway

Meets WDFW Culvert Design Manual Criteria? No, too narrow. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-20 (24)**



Figure 38. Culvert JC-20 Inlet at 111th Avenue NE, 3-12-13



Figure 39. Culvert JC-20 Outlet at 111th Avenue NE, 3-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-21 (26)**

Culvert ID:
JC-21 (26)

Stream: Juanita Creek - NE/east trib

Cross Street: I-405

Type, Dia: 48-inch CMP with tar

Length if known 309 feet
or estimate:

Fish use of Stream Segment: Presumed use at downstream end.
Y/N/Unk./Presumed

Slope through Culvert: Steep, estimated at 3-4%

Substrate/roughness w/in culvert? None

Plunge at outfall: Y/N, ht., pool? 3-foot plunge onto boulders, then glide area

Est. OHW width: Downstream 11-12' u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Full barrier due to high plunge onto rock at the outlet. Also very long and steep, likely resulting in a velocity barrier.

Photos: Inlet _____ Outlet 50-57

Notes: Did not visit inlet. Outlet information is sufficient to conclude that this culvert is a full barrier to upstream fish passage.

Meets WDFW Culvert Design Manual Criteria? No! (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation. Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-21 (26)**



Figure 40. Culvert JC-21 Outlet at I-405, 3-12-13



Figure 41. Culvert JC-21 Outlet at I-405, 3-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-22 (g)**

Culvert ID:
JC-22 (g)

Stream: Juanita Creek, east tributary

Cross Street: 108th Avenue NE

Type, Dia: Concrete, 1 @24", 1 @ 18"

Length if known 85 ft.
or estimate:

Fish use of Stream Segment: Yes below culverts. Unknown above culverts
Y/N/Unk./Presumed

Slope through Culvert: Steep, perhaps 6%

Substrate/roughness w/in culvert? None, bare pipe.

Plunge at outfall: Yes, about 1 foot. First onto concrete then into a pool about 2 feet deep
Y/N, ht., pool?

Est. OHW width: Upstream 13', downstream 11'
u/s, d/s

Passage Assessment - Passable, Full/Partial Barrier: 4 – full barrier due to slope and velocity, plunges at outfalls

Photos: Inlet 25-27 Outlet 21-24

Notes: Could rate fairly high for replacement if the upstream pond outlet at 109th Ave. NE could be replaced as well.

Meets WDFW Culvert Design Manual Criteria? Meets no standards for fish passage. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-22 (g)**



Figure 42. Culvert JC-22 Inlet at 108th Avenue NE, 9-12-13



Figure 43. Culvert JC-22 Outlet at 108th Avenue NE, 9-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-23 (h)**

Culvert ID:
JC-23 (h)

Stream: Juanita Creek, east tributary.

Cross Street: 109th Avenue NE

Type, Dia:

Length if known 80-90 ft.
or estimate:

Fish use of Stream Segment: Unknown
Y/N/Unk./Presumed

Slope through Culvert:

Substrate/roughness w/in culvert?

Plunge at outfall: Yes
Y/N, ht., pool?

Est. OHW width:
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 - full Barrier, Weaver's pond is upstream

Photos: Inlet 28-30 Outlet 31-34

Notes: Road embankment (109th Ave. NE) forms high dam – about 15 feet high. Lots of bullfrogs. There is a trash rack at the pond outlet. Culvert outlet is on a rip-rapped slope and is not passable

Meets WDFW Culvert Design Manual Criteria? Does not meet width standards (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-23 (h)**



Figure 44. Culvert JC-23 Inlet at 109th Avenue NE, 9-12-13



Figure 45. Culvert JC-23 Outlet at 109th Avenue NE, 9-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-24 (i)**

Culvert ID:
JC-24 (i)

Stream: Juanita Creek, east tributary

Cross Street: Apartment driveway culvert off of 114th Pl. NE

Type, Dia: 6-foot Dia: CMP (or slightly larger*)

Length if known 35 ft.
or estimate:

Fish use of Stream Segment: Unknown
Y/N/Unk./Presumed

Slope through Culvert: Flat – backwatered clear through

Substrate/roughness w/in culvert? Streambed substrate with cobbles, gravel, sand, boulders

Plunge at outfall: no
Y/N, ht., pool?

Est. OHW width: upstream 9', downstream 10'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 1 – fully passable

Photos: Inlet 38-39 Outlet 35-37

Notes: *Culvert is countersunk such that the full diameter could not be measured.

Meets WDFW Culvert Design Manual Criteria? Is fully passable though it does not meet width standards (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
JC-24 (i)**



Figure 46. Culvert JC-24 Inlet at 114th Place NE apartment driveway, 9-12-13



Figure 47. Culvert JC-24 Outlet at 114th Place NE apartment driveway, 9-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-1 (SD 0049)**

Culvert ID:
FO-1 (SD 0049)

Stream: Forbes

Cross Street: 108th Ave NE

Type, Dia: Dual 48" squashed CMPs plus dual 36" CMPs.

Length if known 35-40'
or estimate:

Fish use of Stream Segment: Yes.
Y/N/Unk./Presumed

Slope through Culvert: Flat

Substrate/roughness w/in culvert? Sand and silt

Plunge at outfall: None
Y/N, ht., pool?

Est. OHW width: upstream 10', downstream 12'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 2 - Hindrance Most fish can pass most of the time.

Photos: Inlet 1-4 Outlet 5-6

Notes:

There are catch basins, 1 each about 40-50 feet each side of the crossing. The road should drain unless they are clogged. The culverts were not clogged with sediment at the time of a site visit on 6/27/13 and, given the low gradient, were not a barrier to fish migration.

Meets WDFW Culvert Design Manual Criteria? No, does not meet stream simulation width requirements - 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-1 (SD 0049)**



Figure 48. Culvert FO-1 Inlet at 108th Avenue NE, 6-27-13



Figure 49. Culvert FO-1 Outlet at 108th Avenue NE, 6-27-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-2 (jj)**

Culvert ID:
FO-2 (jj)

Stream: Forbes Creek

Cross Street: Forbes Creek Drive

Type, Dia: Bolted CMP arch. 11.5 feet wide at substrate by 3.5 feet high at downstream.
Upstream end is 13 feet wide by 7 feet high.

Length if known 110 ft
or estimate:

Fish use of Stream Segment: yes
Y/N/Unk./Presumed

Slope through Culvert: 2-3%

Substrate/roughness w/in culvert? Streambed gravel and cobble.

Plunge at outfall: None
Y/N, ht., pool?

Est. OHW width: upstream – 12', downstream – 18' (but artificial channel)
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 1 – not a barrier. Meets stream simulation in principle.

Photos: Inlet 28-32 Outlet 18-22 Concrete weir below outlet 23-27

Notes: The concrete weir below the outlet is not and should not be a barrier unless it becomes clogged with debris. May need maintenance from time to time.

Meets WDFW Culvert Design Manual Criteria? May be slightly under width, but meets Stream simulation in principle. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-2 (jj)**



Figure 50. Culvert FO-2 Inlet at Forbes Creek Drive, 9-13-13



Figure 51. Culvert FO-2 Outlet at Forbes Creek Drive, 9-13-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-3 (CKC - #4)**

Culvert ID:
FO-3 (CKC - #4)

Stream: Drainage to Forbes.

Cross Street: CKC near dead end of 111th Ave NE

Type, Dia: 24-inch concrete

Length if known 35 feet
or estimate:

Fish use of Stream Segment: unknown/unlikely, but fairly good flow of about 0.1 cfs on 10-
Y/N/Unk./Presumed 18-13

Slope through Culvert: $\pm 2\%$

Substrate/roughness w/in culvert? None.

Plunge at outfall: yes, 4-foot plunge into 1-foot-deep pool
Y/N, ht., pool?

Est. OHW width: upstream – 4.5 feet, downstream 4 feet
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 - Full barrier due to plunge at outfall

Photos: Inlet 26-29 Outlet 18-25

Notes: Fairly good flow for previously dry weather – incised channel downstream.

Meets WDFW Culvert Design Manual Criteria? No. 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-3 (CKC - #4)**



Figure 52. Culvert FO-3 Inlet near dead end of 111th Avenue NE (CKC), 10-18-13



Figure 53. Culvert FO-3 Outlet near dead end of 111th Avenue NE (CKC), 10-18-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-4 (CKC - #3)**

Culvert ID:

FO-4 (CKC - #3)

Stream: Drainage to Forbes

Cross Street: CKC near dead end of 111th Ave NE

Type, Dia: 24 inch concrete

Length if known 40 ft -
or estimate:

Fish use of Stream Segment: No
Y/N/Unk./Presumed

Slope through Culvert: $\pm 6\%$

Substrate/roughness w/in culvert? None.

Plunge at outfall: No plunge – partially clogged with leaves and debris – no pool, no flow
Y/N, ht., pool?

Est. OHW width: Upstream – 5 feet (swales along corridor). Downstream - N/A (no channel)
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 3 - mostly a barrier. Steep, lack of flow. Not expected to be a fish-bearing stream.

Photos: Inlet 12-16 Outlet 17

Notes: Culvert dry this date. Drainage is too small and dry to be fish habitat. Appears to be an ephemeral stream with flow only in response to wet weather.

Meets WDFW Culvert Design Manual Criteria? No. 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-4 (CKC - #3)**



Figure 54. Culvert FO-4 Inlet near dead end of 111th Avenue NE (CKC), 10-18-13



Figure 55. Culvert FO-4 Outlet near dead end of 111th Avenue NE (CKC), 10-18-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-5 (CKC - #2)**

Culvert ID:

FO-5 (CKC - #2)

Stream: Drainage tributary to Forbes Creek

Cross Street: Cross Kirkland Corridor – near Forbes Creek Drive

Type, Dia: 36in CMP

Length if known 46 ft.

or estimate:

Fish use of Stream Segment: No

Y/N/Unk./Presumed

Slope through Culvert: Steep; around 10%

Substrate/roughness w/in culvert? None

Plunge at outfall: Yes, plunge is about 6 feet high, minimal pool 4-6 inches deep.

Y/N, ht., pool?

Est. OHW width: Downstream – 6 feet, Upstream – 5 feet (swales along corridor)

u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 - Not passable, absolute barrier.

Photos: Inlet 7-11 Outlet 1-7

Notes: Trickle of flow on 10/18/13. Incised channel about 5 feet deep extends downstream. This drainage is judged to be too small and steep to be fish habitat and so is a low priority for replacement on that basis, though erosion at the outfall could stand to be addressed. (Assessment does not include parallel access road upstream.)

Meets WDFW Culvert Design Manual Criteria? 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment). (No, does not meet criteria.)

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-5 (CKC - #2)**



Figure 56. Culvert FO-5 Inlet near Forbes Creek Drive (CKC), 10-18-13



Figure 57. Culvert FO-5 Outlet near Forbes Creek Drive (CKC), 10-18-13

Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-6 (CKC - #1 (=SD 0054 (A - TRACKS)))

Culvert ID:

FO-6 (CKC - #1 (=SD 0054 (A - TRACKS)))

Stream: Forbes

Cross Street: 117th PI NE, 116th Ave. NE

Type, Dia: 4' concrete

Length if known 85 ft
or estimate:

Fish use of Stream Segment: yes
Y/N/Unk./Presumed

Slope through Culvert: est. 2%

Substrate/roughness w/in culvert? None – smooth pipe with bare bottom

Plunge at outfall: No Plunge, 15" pool
Y/N, ht., pool?

Est. OHW width: Upstream 15', downstream 14'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 2 – hindrance or partial barrier

Photos: Inlet 13-16 Outlet 17, 18

Notes: The culvert is backwatered more than half the way through then steeper at the upstream end. Rates between a hindrance and partial barrier. Most fish could pass most of the time. Note that there is only up to 200 feet upstream of the RR and spur to an absolute barrier. Little benefit unless upstream passage barriers are corrected as well.

Meets WDFW Culvert Design Manual Criteria? No, does not meet 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-6 (CKC - #1 (=SD 0054 (A - TRACKS)))**



Figure 58. Culvert FO-6 Inlet at 117th Place NE and 116th Avenue NE, 6-28-13



Figure 59. Culvert FO-6 Outlet at 117th Place NE and 116th Avenue NE, 6-28-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-7 (CKC - #1 (=SD 0054 (B - SPUR)))**

Culvert ID:

FO-7 (CKC - #1 (=SD 0054 (B - SPUR)))

Stream: Forbes

Cross Street: 117th PI NE, 116th Ave. NE

Type, Dia: 4' concrete

Length if known 60 ft
or estimate:

Fish use of Stream Segment: yes
Y/N/Unk./Presumed

Slope through Culvert: est. 5-7%

Substrate/roughness w/in culvert? None – smooth pipe with bare bottom

Plunge at outfall: Yes. About 15" high boulder cascade plunge into small 12" pool at outfall.
Y/N, ht., pool? Also, 18" high woody debris jam at inlet.

Est. OHW width: Upstream 24', downstream 15'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 3 - mostly a barrier though some fish may be able to pass at some times/flows. Not fully passable.

Photos: Inlet 21-25 Outlet 19, 20

Notes: A substantial barrier is formed by 18" high woody debris jam blocking the inlet of a fairly steep culvert along with 15" cascades at the outlet. Daylighting the spur (only) would still allow the main RR grade to be used as a trail, however an absolute, incontrovertible barrier is present about 200 feet farther upstream.

Meets WDFW Culvert Design Manual Criteria? No, does not meet 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-7 (CKC - #1 (=SD 0054 (B - SPUR)))**



Figure 60. Culvert FO-7 Inlet at 117th Place NE and 116th Avenue NE, 6-28-13



Figure 61. Culvert FO-7 Outlet at 117th Place NE and 116th Avenue NE, 6-28-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-9 (mm)**

Culvert ID:
FO-9 (mm)

Stream: Forbes Creek

Cross Street: NE 100th St.

Type, Dia: 36-inch concrete

**Length if known \pm 50ft
or estimate:**

Fish use of Stream Segment: Some cutthroat documented above I-90
Y/N/Unk./Presumed

Slope through Culvert: Flat, near-zero.

Substrate/roughness w/in culvert? Little/none.

Plunge at outfall: No plunge, glide or shallow pool up to 1' in depth.
Y/N, ht., pool?

Est. OHW width: Upstream – 10', downstream – 9'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 2 - passable but pipe is narrow and no substrate. Not stream-like within the pipe.

Photos: Inlet 18-20 Outlet 13-17

Notes:

Meets WDFW Culvert Design Manual Criteria? No (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-9 (mm)**



Figure 62. Culvert FO-9 Inlet at NE 100th Street, 9-17-13



Figure 63. Culvert FO-9 Outlet at NE 100th Street, 9-17-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-10 (nn)**

Culvert ID:
FO-10 (nn)

Stream: Forbes Creek (trib.)

Cross Street: 124th Ave NE

Type, Dia: 24-inch CMP

Length if known 80 ft.
or estimate:

Fish use of Stream Segment: Cutthroat found just downstream in 1998
Y/N/Unk./Presumed

Slope through Culvert: Flat

Substrate/roughness w/in culvert? (Not observable, the culvert is submerged.)

Plunge at outfall: No, the top of the culvert is submerged by about 8 inches.
Y/N, ht., pool?

Est. OHW width: Downstream – 8'. Upstream is an extensive wetland area – OHW is **very** wide.
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 2 – Passable but far short of design standards.

Photos: Inlet 5 Outlet 1-4

Notes: Submerged culvert drains extensive wetlands east of 124th.

Meets WDFW Culvert Design Manual Criteria? No. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-10 (nn)**



Figure 64. Culvert FO-10 Inlet at 124th Avenue NE, 9-17-13



Figure 65. Culvert FO-10 Outlet at 124th Avenue NE, 9-17-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-11 (oo)**

Culvert ID:
FO-11 (oo)

Stream: Forbes Creek

Cross Street: NE 97th Street

Type, Dia: 40' wide by 30" high "squashed" CMP

Length if known \pm 50 ft.
or estimate:

Fish use of Stream Segment: unknown
Y/N/Unk./Presumed

Slope through Culvert: Flat, near-zero.

Substrate/roughness w/in culvert? A few inches of sand and small gravel.

Plunge at outfall: None.
Y/N, ht., pool?

Est. OHW width: Upstream – 6', downstream – 8'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: Not a barrier unless when clogged with trash at the upper end.

Photos: Inlet 9-12 Outlet 6-8

Notes: Trash rack and cage at the upstream end and then an additional 4 feet of 24-inch Dia: concrete pipe. Not a barrier unless clogged with trash. Channel upstream and downstream appears to have been dredged historically.

Meets WDFW Culvert Design Manual Criteria? Does not meet with standards, but does have some substrate. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
FO-11 (oo)**



Figure 66. Culvert FO-11 Inlet at NE 97th Street, 9-17-13



Figure 67. Culvert FO-12 Outlet at NE 97th Street, 9-17-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-1 (CKC - #19)**

Culvert ID:

MB-1 (CKC - #19)

Stream: Moss Bay drainages (mostly piped to mouth)

Cross Street: CKC

Type, Dia: 24-inch Concrete

Length if known (Piped downstream)
or estimate:

Fish use of Stream Segment:

Y/N/Unk./Presumed

Slope through Culvert: Appears fairly steep at inlet - \pm 6%.

Substrate/roughness w/in culvert? None at inlet

Plunge at outfall: (N/A?)

Y/N, ht., pool?

Est. OHW width: Upstream – 6 feet

u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 – Appears impassable due to slopes and depths.

Photos: Inlet 14-17 Outlet _____

Notes: Weird thumping and banging noises from within the culvert. This culvert is entirely downstream of the CKC and so does not cross it.

Meets WDFW Culvert Design Manual Criteria? (NO) 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-1 (CKC - #19)**



Figure 68. Culvert MB-1 Inlet in CKC, 10-25-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-2 (CKC - #20)**

Culvert ID:

MB-2 (CKC - #20)

Stream: Moss Bay drainages (mostly piped to mouth)

Cross Street: CKC at Railroad Ave

Type, Dia: 24-inch RCP

Length if known Long. 179 feet?
or estimate:

Fish use of Stream Segment:

Y/N/Unk./Presumed

Slope through Culvert: Moderate - +2%

Substrate/roughness w/in culvert? None at inlet, outlet is backwatered.

Plunge at outfall: No, culvert is backwatered – overhanging soil and roots hide the outfall.
Y/N, ht., pool?

Est. OHW width: Upstream 6 feet, Downstream – 6 feet.
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 3 – very long with moderate slope; some fish could get through

Photos: Inlet 18-22 Outlet 14-17 (same as #19 inlet)

Notes: Very long, 24-inch concrete pipe under the CKC. Not fully impassable, but adjacent piped stream sections could be impassable. #18, the 30-inch concrete culvert under Railroad Avenue immediately upstream is likely impassable based on sounds indicating a significant plunge within.

Meets WDFW Culvert Design Manual Criteria? (No). 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-2 (CKC - #20)**



Figure 69. Culvert MB-2 Inlet at Railroad Avenue (CKC), 10-25-13



Figure 70. Culvert MB-2 Outlet at Railroad Avenue (CKC), 10-25-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-3 (CKC - #18)**

Culvert ID:

MB-3 (CKC - #18)

Stream: Moss Bay drainages (mostly piped to mouth)

Cross Street: CKC

Type, Dia: 30-inch CAP

**Length if known
or estimate:**

Fish use of Stream Segment:

Y/N/Unk./Presumed

Slope through Culvert:

Substrate/roughness w/in culvert?

Plunge at outfall:

Y/N, ht., pool?

Est. OHW width:

u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier:

Photos: Inlet _____ Outlet _____

Notes: Is this the 30-inch under Railroad Avenue? (Only #20 crosses under CKC. #19 is downstream, #18 upstream.)

Meets WDFW Culvert Design Manual Criteria? 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-3 (CKC - #18)**



Figure 71. Culvert MB-3 Outlet at Cross Kirkland Corridor, 10-25-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-4 (CKC - #10)**

Culvert ID:

MB-4 (CKC - #10)

Stream: Moss Bay drainages (mostly piped to mouth)

Cross Street: Near Kirkland Way

Type, Dia: 30-inch RCP

**Length if known
or estimate:**

Fish use of Stream Segment: (Culvert plugged)
Y/N/Unk./Presumed

Slope through Culvert: (N/A?)

Substrate/roughness w/in culvert? (N/A?)

Plunge at outfall: (N/A?)
Y/N, ht., pool?

Est. OHW width: Upstream along Kirkland way – 3-foot ditch/swale
u/s, d/s Downstream - (N/A?)

Passage Assessment – Passable, Full/Partial Barrier: (N/A). No flow, no channel at outfall.

Photos: Inlet 8-9 Outlet 10-13

Notes: Found 24-inch concrete inlet as the ditch/swale along Kirkland Way. Then “DRAIN” manhole along CKC. Found 30-inch CMP “outfall” on west side of CKC fully filled with concrete!

Meets WDFW Culvert Design Manual Criteria? (N/A?) 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-4 (CKC - #10)**



Figure 72. Culvert MB-4 Inlet near Kirkland Way, 10-25-13



Figure 73. Culvert MB-4 Outlet near Kirkland Way, 10-25-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-5 (CKC - #9)**

Culvert ID:
MB-5 (CKC - #9)

Stream: Moss Bay drainages (mostly piped to mouth)

Cross Street: Kirkland Way

Type, Dia: Unable to confirm because the outlet is submerged (36-inch RCP from list)

**Length if known \pm 45 feet across CKC (but continues under building)
or estimate:**

Fish use of Stream Segment: presumed no
Y/N/Unk./Presumed

Slope through Culvert: Appears fairly flat due to backwatering at outfall

Substrate/roughness w/in culvert? Unable to determine because culvert is backwatered.

Plunge at outfall: No, culvert is backwatered.
Y/N, ht., pool?

Est. OHW width: downstream – 4.5 feet Upstream n/a (no culvert inlet along CKC)
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 3 - Not a full barrier due to outfall conditions, but upstream unknown.

Photos: Inlet 7 Outlet 1-6

Notes: There is no culvert inlet along CKC. Unable to verify culvert size and type because the outlet is submerged.

Meets WDFW Culvert Design Manual Criteria? (No) 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-5 (CKC - #9)**



Figure 74. Culvert MB-5 No Inlet at Kirkland Way, 10-25-13



Figure 75. Culvert MB-5 Outlet at Kirkland Way, 10-25-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-6 (CKC - #8)**

Culvert ID:

MB-6 (CKC - #8)

Stream: Moss Bay drainages (mostly piped to mouth)

Cross Street: CKC - South of NE 85th Street

Type, Dia: 24-inch concrete

Length if known 35 ft. (to manhole)
or estimate:

Fish use of Stream Segment: Presumed not
Y/N/Unk./Presumed

Slope through Culvert: Low, $\pm 2\%$ to manhole across CKC.

Substrate/roughness w/in culvert? 1-2 inches of sand at the outlet.

Plunge at outfall: No plunge, no pool
Y/N, ht., pool?

Est. OHW width: Downstream – 3.5 feet, upstream – n/a
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 2 – The culvert itself is not a barrier to the manhole on the east side.

Photos: Inlet 31 Outlet 27-30

Notes: Manhole/no inlet next to storage building. Minimal trickle of flow present 10/23.

Meets WDFW Culvert Design Manual Criteria? (No) 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-6 (CKC - #8)**



Figure 76. Culvert MB-6 Inlet south of NE 85th Street (CKC), 10-23-13



Figure 77. Culvert MB-6 Outlet south of NE 85th Street (CKC), 10-23-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-7 (CKC - #7)**

Culvert ID:
MB-7 (CKC - #7)

Stream: Moss Bay drainages (mostly piped to mouth)

Cross Street: CKC - North of 85th

Type, Dia: North CKC swale inlet 18-inch CMP, South CKC swale inlet 12-inch plastic, found inlet to 24-inch CMP upslope

**Length if known
or estimate:**

Fish use of Stream Segment: Presumed no
Y/N/Unk./Presumed

Slope through Culvert: \pm 6% based on inlet, sounds of plunges within

Substrate/roughness w/in culvert? None

Plunge at outfall: (Outfall not found across 3 businesses downstream)
Y/N, ht., pool?

Est. OHW width: Upstream – 6 feet
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 - Full barrier

Photos: Inlet 21-26 Outlet _____

Notes:

Pipes enter from both north and south along the CKC, but a stream/drainage culvert inlet was also found beyond the blackberries upstream. A 24-inch CMP with a trickle of flow on 10/23/13

Meets WDFW Culvert Design Manual Criteria? (No) 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-7 (CKC - #7)**



Figure 78. Culvert MB-7 Inlet north of 85th (CKC), 10-23-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-8 (CKC - #6)**

Culvert ID:
MB-8 (CKC - #6)

Stream: Moss Bay drainage (mostly piped to mouth)

Cross Street: 9th Ave, 9th Street

Type, Dia: 3-foot diameter concrete

**Length if known (not known)
or estimate:**

Fish use of Stream Segment: presumed no
Y/N/Unk./Presumed

Slope through Culvert: moderately steep - \pm 5-6%

Substrate/roughness w/in culvert? None, smooth

Plunge at outfall: (outfall not found)
Y/N, ht., pool?

Est. OHW width: upstream 4 feet
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 - Full barrier due to slope and length

Photos: Inlet 16-20 Outlet _____

Notes: Trickle of flow. Steep upstream. Doubtful that there is too much habitat to open up – upstream.

Meets WDFW Culvert Design Manual Criteria? (No.) 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-8 (CKC - #6)**



Figure 79. Culvert MB-8 Inlet at 9th Avenue and 9th Street, 10-22-13



Figure 80. Culvert MB-8 Inlet at 9th Avenue and 9th Street, 10-22-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-9 (CKC - #5)**

Culvert ID:
MB-9 (CKC - #5)

Stream: Moss Bay (mostly piped to mouth)

Cross Street: NE 96th Street

Type, Dia: 24-inch concrete

Length if known 40 feet
or estimate:

Fish use of Stream Segment: not known
Y/N/Unk./Presumed

Slope through Culvert: Flat or nearly flat. 1-foot deep at outfall, and backwatered clear through

Substrate/roughness w/in culvert? Some organic silts, leaves, etc.

Plunge at outfall: No plunge – culvert is half-full backwatered at outfall
Y/N, ht., pool?

Est. OHW width: upstream – 5 feet (railroad swale northward. Downstream 6 feet.
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 2 - Passable, but would not meet design standards

Photos: Inlet 13-15 Outlet 9-12

Notes: This culvert would be readily passable by any, say, resident cutthroat that may inhabit the stream now or going forward, however stream is almost entirely piped downstream.

Meets WDFW Culvert Design Manual Criteria? No. 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
MB-9 (CKC - #5)**



Figure 81. Culvert MB-9 Inlet at NE 96th Street, 10-22-13



Figure 82. Culvert MB-9 Outlet at NE 96th Street, 10-22-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
EC-1 (CKC - #11)**

Culvert ID:
EC-1 (CKC - #11)

Stream: Everest Creek

Cross Street: Between 6th Street S. and Railroad Ave.

Type, Dia: 18-inch CMP

**Length if known \pm 24 feet
or estimate:**

Fish use of Stream Segment: Unknown or not documented, but Everest has good year-around
Y/N/Unk./Presumed flow and could probably support resident trout, if introduced.

Slope through Culvert: Moderate, 3-4%

Substrate/roughness w/in culvert? None.

Plunge at outfall: Yes, 6-inch plunge into 18-inch pool.
Y/N, ht., pool?

Est. OHW width: Upstream – 6 feet. Downstream – 7 feet.
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 3 – some fish could get though due to
the short length and pool at the outfall

Photos: Inlet 31-35 Outlet 23-30

Notes: Would rank this culvert quite high for replacement:

- 1) It is a problem
- 2) The stream has good year-around flows and could support fish if re-introduced
- 3) The culvert is short and near the surface – so should be relatively low-cost and so
good value.

Another culvert is just upstream that should also be included in the project. Cascades farther
upstream.

Meets WDFW Culvert Design Manual Criteria? (No) 1.25 OHW width for no slope, 1.2 OHW
width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
EC-1 (CKC - #11)**



Figure 83. Culvert EC-1 Inlet between 6th Street S and Railroad Avenue, 10-25-13



Figure 84. Culvert EC-1 Outlet between 6th Street S and Railroad Avenue, 10-25-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
EC-2 (SD-0061)**

Culvert ID:
EC-2 (SD-0061)

Stream: Everest Creek

Cross Street: Dead end of 10th Street S.

Type, Dia: 2@ 30" concrete

Length if known 12 ft
or estimate:

Fish use of Stream Segment: unk.
Y/N/Unk./Presumed

Slope through Culvert: est. 6%

Substrate/roughness w/in culvert? None

Plunge at outfall: Yes, 12" into pool.
Y/N, ht., pool?

Est. OHW width: Downstream 10'
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 - Full barrier

Photos: Inlet 55-56 Outlet 52-54

Notes: Not known if fish are present and would benefit directly. Support project to address channel incision and riparian revegetation.

Meets WDFW Culvert Design Manual Criteria? No, does not meet 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
EC-2 (SD-0061)**



Figure 85. Culvert EC-2 Inlet at dead end of 10th Street S, 6-28-13



Figure 86. Culvert EC-2 Outlet at dead end of 10th Street S, 6-28-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HSA-1 (CKC - #12)**

Culvert ID:
HSA-1 (CKC - #12)

Stream: Houghton Slope

Cross Street: Between 62nd and 64th Streets

Type, Dia: 4-foot-diameter concrete

Length if known not known – see Kirkland streams map, piped for some distance upstream.
or estimate:

Fish use of Stream Segment: not known, but good flows and habitat below culvert.
Y/N/Unk./Presumed

Slope through Culvert: very steep - \pm 8-10%

Substrate/roughness w/in culvert? None – smooth with high velocities.

Plunge at outfall: Yes. 5-6 foot boulder cascade plunge, then large pool about 3-1/2 feet deep
Y/N, ht., pool? with wood and boulders. This pool absorbs a lot of energy

Est. OHW width: Downstream – 13 feet, Upstream not found
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 – full, absolute barrier due to 1) 6-foot cascade plunge at outfall, 2) very long and very steep within.

Photos: Inlet 12 Outlet 1-11

Notes: Good flow on 11/8/13. Bank instability on right side. Lots of boulder armoring. Wood in pool below culvert. Fish use unknown, but possible habitat for isolated trout. Culvert inlet(s) not found – mapped as piped for some distance upstream

Meets WDFW Culvert Design Manual Criteria? (No) 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HSA-1 (CKC - #12)**



Figure 87. Culvert HSA-1 Inlet between 62nd and 64th Streets, 11-8-13



Figure 88. Culvert HSA-1 Outlet between 62nd and 64th Streets, 11-8-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
CC-1 (y)**

Culvert ID:
CC-1 (y)

Stream: Carillon Creek

Cross Street: Lake Washington Boulevard

Type, Dia: (not observable)

Length if known 80+ ft.
or estimate:

Fish use of Stream Segment: Unknown (downstream culvert is a barrier. Resident fish?
Y/N/Unk./Presumed Constant flow of cold water.

Slope through Culvert: Not directly observable, but appears steep.

Substrate/roughness w/in culvert? (not observed)

Plunge at outfall: Yes, 9-12" over rock weir into shallow (1') pool.
Y/N, ht., pool?

Est. OHW width: downstream – 12-14 feet, upstream 3.5 feet.
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 – Full Barrier. Internal makeup of culvert is unknown, but a high plunge of perhaps 6-8 feet occurs at the inlet.

Photos: Inlet 65-72 **Outlet** 60-64

Notes: The outlet is a contrived concrete box structure 3' high by 6.5' wide by 10' long. Water upwells from a submerged culvert somewhere within. The inlet is a 4' wide by 1.5' high barred "pillbox" with a \pm 8' plunge immediately below.

Meets WDFW Culvert Design Manual Criteria? Would not meet (any?) fish passage design standards. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
CC-1 (y)**



Figure 89. Culvert CC-1 Inlet at Lake Washington Boulevard, 9-12-13



Figure 90. Culvert CC-1 Outlet at Lake Washington Boulevard, 9-12-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
CC-2 (z, CKC #13)**

Culvert ID:
CC-2 (z, CKC #13)

Stream: Carillon Creek

Cross Street: Cross-Kirkland Corridor

Type, Dia: 24 in. concrete

Length if known (not estimated)
or estimate:

Fish use of Stream Segment: unknown
Y/N/Unk./Presumed

Slope through Culvert: steep, perhaps around 6%

Substrate/roughness w/in culvert? None – smooth concrete pipe

Plunge at outfall: No plunge at outlet and no pool. Water is discharged at a high velocity.
Y/N, ht., pool? However, there is a 1-foot plunge at the inlet.

Est. OHW width: upstream 7-8', downstream 8-16' (typ. 11')
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 – Full barrier due to length, slope, lack of substrate, small dia., and high velocity.

Photos: Inlet 5-8 Outlet 1-4

Notes: This is a very steep culvert along a very steep stream segment. Very high fill embankment – expensive to replace at Cross-Kirkland Corridor. Fish presence not known but doubtful due to downstream barriers and overall steepness of the channel.

Meets WDFW Culvert Design Manual Criteria? Would not meet (any?) fish passage design standards. (1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
CC-2 (z, CKC #13)**



Figure 91. Culvert CC-2 Inlet at Cross Kirkland Corridor, 9-13-13



Figure 92. Culvert CC-2 Outlet at Cross Kirkland Corridor, 9-13-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HSB-1 (CKC - #16)**

Culvert ID:

HSB-1 (CKC - #16)

Stream:

Cross Street: NE 43rd Street.

Type, Dia: 24-inch Concrete

**Length if known
or estimate:**

Fish use of Stream Segment: None
Y/N/Unk./Presumed

Slope through Culvert: 4 – 6%

Substrate/roughness w/in culvert? None

Plunge at outfall: 6-inch plunge, no pool.
Y/N, ht., pool?

Est. OHW width: Upstream 4 feet, Downstream 3 feet.
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 – full barrier due to length, slope, lack of flow. This is an ephemeral drainage. Dry this date – 11/8/13.

Photos: Inlet 27-28 Outlet 30-35

Notes: Dry this date, 11/8/13

Meets WDFW Culvert Design Manual Criteria? (No) 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HSB-1 (CKC - #16)**



Figure 93. Culvert HSB-1 Inlet at NE 43rd Street 11-8-13,



Figure 94. Culvert HSB-1 Outlet at NE 43rd Street, 11-8-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HSB-2 (CKC - #15)**

Culvert ID:
HSB-2 (CKC - #15)

Stream: Houghton Slope B

Cross Street: NE 44th Street

Type, Dia: 24-inch Concrete

**Length if known
or estimate:**

Fish use of Stream Segment: Fish use very unlikely
Y/N/Unk./Presumed

Slope through Culvert: Moderate, 4 – 6%

Substrate/roughness w/in culvert? None.

Plunge at outfall: Yes, 4 – foot plunge, no pool whatsoever. Trickle of flow on 11/8/13.
Y/N, ht., pool?

Est. OHW width: Upstream – 4 feet, Downstream – 6 feet.
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 – Absolute barrier. High plunges at both inlet and outlet, steep in between.

Photos: Inlet 13 Outlet 16-26

Notes: Inlet – trickle of flow on 11/8/13 plunges vertically 4-6 feet in blackberries; inlet not definable. Outlet pipe section has fallen off (see photos). Fish use of stream unlikely (regardless of culvert) due to channel steepness and low flows.

Meets WDFW Culvert Design Manual Criteria? (No) 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HSB-2 (CKC - #15)**



Figure 95. Culvert HSB-2 Inlet at NE 44th Street, 11-8-13



Figure 96. Culvert HSB-2 Outlet at NE 44th Street, 11-8-13

**Checklist for Fish Passage Evaluation of Kirkland Culverts
HSB-3 (CKC - #14)**

Culvert ID:

HSB-3 (CKC - #14)

Stream:

Cross Street: Between 46th Street and 47th Place

Type, Dia:

**Length if known
or estimate:**

Fish use of Stream Segment:

Y/N/Unk./Presumed

Slope through Culvert:

Substrate/roughness w/in culvert?

Plunge at outfall:

Y/N, ht., pool?

Est. OHW width:

u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 – full barrier due to slopes.

Photos: Inlet _____ Outlet _____

Notes: Inlet along E side of CKC not found. Outlet is in a fenced, gated private development and not accessible. Need access. Still, likely a full barrier.

Meets WDFW Culvert Design Manual Criteria? 1.25 OHW width for no slope, 1.2 OHW width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
CO-3 (CKC - #17)**

Culvert ID:
CO-3 (CKC - #17)

Stream: Cochran Springs Creek

Cross Street: NE 38th Place.

Type, Dia: 3-foot diameter steel (observed at inlet)

**Length if known
or estimate:**

Fish use of Stream Segment: Upstream – unknown. Downstream used extensively by
Y/N/Unk./Presumed cutthroat.

Slope through Culvert: Steep, 6 – 8%

Substrate/roughness w/in culvert? None

Plunge at outfall: Yes, 2-foot vertical plunge, but high velocities put flow horizontally against
Y/N, ht., pool? large boulders. About a 12-18 inch pool. Strong flows, approx 2 cfs on 11/8/13.

Est. OHW width: Upstream 8 feet, Downstream 5-6 feet.
u/s, d/s

Passage Assessment – Passable, Full/Partial Barrier: 4 – full barrier due to length, slope,
plunge at outlet, high velocity.

Photos: Inlet 41-46 Outlet 36-39

Notes: Flow perhaps 2 cfs on 11/8/13. The CKC prism above the culvert is high and massive.
Expensive to replace, however the flows are here to support fish. High cutthroat usage
documented downstream to Lake Washington.

Meets WDFW Culvert Design Manual Criteria? (No) 1.25 OHW width for no slope, 1.2 OHW
width +2 for stream simulation (Hydraulic Option not amenable to field assessment).

**Checklist for Fish Passage Evaluation of Kirkland Culverts
CO-3 (CKC - #17)**



Figure 97. Culvert CO-3 Inlet at NE 38th Place, 11-8-13



Figure 98. Culvert CO-3 Outlet at NE 38th Place, 11-8-13

ATTACHMENT C

Culvert Rankings

Culverts evaluated for fish passage for Kirkland's 2014 update of its Surface Water Master Plan - by Basin

Fish Passage Scoring: 1 - Passable ; 2 - Hindrance to passage; 3 - Partial Barrier; 4 - Full or nearly Full Barrier

Number*	Stream	Culverts	Approximate Location	Fish Passable?	Comments	Benefits and Feasibility; (Other Barriers and Upstream Habitat)	Priority Rating	Priority Index
Holmes Point Creek								
HP-1 (2)	Holmes Pt.	36 in, 131 ft., concrete AND 36 in, 61 ft., CAP	62nd Avenue NE	4 - Full Barrier due to length, overall high slope, and interior plunge that is audible from the upstream end.	Should be done in conjunction with downstream dam removal.	Holmes Point Creek has good perennial flows and could likely support resident cutthroat and limited anadromous fish use. Significant habitat exists upstream, however a filled-in earthen dam exists just downstream of this culvert, which is also a full barrier. Benefits of removing the culvert would not accrue without also removing the dam.	2	0.0
HP-2 (3)	Holmes Pt.	18 in, 55 ft., RCP	Holmes Pt. Drive	4 - Full Barrier due both to plunge at the outfall plus being smooth and steep inside to create a velocity barrier.	Too high up in the basin for much fish use even if downstream barriers were removed. Possible minor potential use by cutthroat, but not coho.	Steep, very near headwaters, type N per DNR mapping, fish use or habitat near culvert doubtful. Two full barriers are present downstream. Little or no habitat present upstream. Replacement not justifiable based on fish use or habitat.	4	0.0
HP-3 (4)	Holmes Pt.	18 in, 71 ft., RCP	Holmes Pt. Drive	4 - Full Barrier due to plunge and velocity due to steepness	Also note that pipe crossing Holmes Pt Drive and pipe on SE side of Holmes Pt Drive are a barrier to stream near 13808 Homes Pt Drive	Steep, very near headwaters, type N per DNR mapping, fish use or habitat near culvert doubtful. Two full barriers are present downstream. Little or no habitat present upstream. Replacement not justifiable based on fish use or habitat.	4	0.0
Denny Creek								
DE-1 (5)	Denny Creek	10-foot-wide by 4 ½ foot high concrete box culvert, 55 ft.	Holmes Pt. Drive	1 - Fully Passable.	Denny Creek report may have already evaluated this culvert.	N/A - culvert is already fully passable.	4	0.0
DE-2 (6)	Denny Creek	24 in, 138 ft., Concrete	Juanita Drive	4 - Presumed full barrier due to long length and high slope with correspondingly high velocities.	Neighborhood wants pedestrian underpass combined with fish passage improvements at this location.	This culvert is on a significant, fish-bearing stream with no downstream barriers. A moderate amount of habitat would be made accessible to migratory, anadromous fish upstream. High priority within the City for replacement. Moderately high cost. Has a high degree of community support; costs would increase if a requested pedestrian underpass were included.	1	9.2
DE-3 (A)	Denny Creek	76 ft. twin corrugated pipes 24" high by 36" wide	13433 78th PI NE	2 - Hindrance. Moderate-sized trout could jump into and swim through these culverts.	In open space area in front of home	No fish found in 1998 study, but habitat appears suitable, type F per DNR mapping. Culvert downstream at Juanita Drive is a barrier and would need to be upgraded to allow anadromous access. Some habitat available upstream in low-gradient tributaries and beaver pond habitat. Though relatively low cost, there would be limited benefits to replacing this culvert because it is already largely passable, a downstream barrier is present, and quantity of potential habitat farther upstream is limited.	3	2.3
Champagne Creek								
CH-1 (7)	Champagne Creek	18 in., 226 ft., concrete	Juanita Drive	4 - Full barrier due to plunge at outfall and velocity due to slope and smooth pipe.	Little potential habitat available upstream.	Fish use not expected this far upstream, but cutthroat use documented farther downstream. Downstream incised channel likely includes barriers. There is not significant habitat available upstream so this is not a high priority.	4	2.6
Juanita Creek								
JC-1 (8)	Juanita Creek- east trib	64ft, concrete, unknown dia	NE 120th Street	1 - Passable.	Replaced with fish-passable box culvert in 1999	N/A - culvert is already fully passable.	4	0.0
JC-2 (9)	Juanita Creek-- west trib	18 in., 97 ft., CAP, AND 37 ft. 24" aluminum	NE 120th Street	4 - Obvious barrier, not fully evaluated	pretty obviously a barrier - probably don't need to evaluate, just note as a barrier	Smaller tributary, providing passage may benefit cutthroat.	2 (tentative)	2.6
JC-3 (11)	Juanita Creek - east trib	252 in, 40 ft., RCP	NE 122nd Street	1 - Passable.	City constructed fish passable box culvert in about 2003	N/A - culvert is already fully passable.	4	0.0
JC-4 (12)	Juanita Creek - east trib	252 in, 62 ft., RCP	NE 124th Street	1 - Passable.	City constructed fish passable box culvert in about 2003	N/A - culvert is already fully passable.	4	0.0
JC-5 (b, 13)	Juanita Creek - east trib	82 ft., concrete, unknown dia	NE 128th Street	1 - Passable.	Evaluated in 2005 SW Master Plan	N/A - culvert is already fully passable.	4	0.0
JC-6 (14)	Juanita Creek - east trib	88 ft., concrete, unknown dia	100th Avenue NE	1 - Passable.	Evaluated in 2005 SW Master Plan	N/A - culvert is already fully passable.	4	0.0
JC-7 (15)	Juanita Creek - east trib	144 in., 66 ft., GSST	NE 129th Street	1 - Passable.	Evaluated in 2005 SW Master Plan	N/A - culvert is already fully passable.	4	0.0
JC-8 (16)	Juanita Creek - east trib	14-foot wide by 73 ft. long, CAP	NE 132nd Street	1 - Passable.		N/A - culvert is already fully passable.	4	0.0
JC-9 (e)	Juanita Creek (NW trib.)	36 in. concrete	NE 137th PI	3 - Partial barrier. Long, somewhat steep slope, no substrate, but no plunge at outfall		This partial-barrier culvert is on a significant, fish-bearing stream with no full barriers downstream. A moderate to high amount of habitat would be made more accessible to migratory, anadromous fish upstream. High priority within the City for replacement. Moderate cost.	1	9.5
JC-10 (17)	Juanita Creek- NW/east trib	36 in, 108 ft., concrete	Juanita Woodinville Way	3 - Partial Barrier. Fish can swim easily through the lower part of the pipe at most flows, then need to pass through a short, low-depth, high-velocity section at the upper end.	King County may have data on this pipe.	This culvert is on a significant, fish-bearing stream with no full barriers downstream. A moderate amount of habitat would be made more accessible to migratory, anadromous fish upstream. Relatively high priority within the City for replacement. Moderately high cost.	1	8.8
JC-11 (18)	Juanita Creek- NW/east trib	48 in, 78 ft., concrete	NE 140th Place	1 - Fully passable. Culvert is countersunk with a near-zero gradient.	King County may have data on this pipe.	N/A - culvert is already fully passable.	4	0.0
JC-12 (19)	Juanita Creek- NW/east trib	3-foot by 4-foot CMP, 73 ft.,	102nd Ave NE	3 - Partial barrier. No plunge at outfall, but flows are shallow, swift, and moderately steep.	King County may have data on this pipe.	This culvert is on a significant, fish-bearing stream with no full barriers downstream. A moderate amount of habitat would be made more accessible to migratory, anadromous fish upstream. Relatively high priority within the City for replacement.	1	6.7
JC-13 (20)	Juanita Creek- NW/east trib	4-foot wide by 3-foot high CMP	101st Place NE	2 - Migration hindrance; mostly passable. Long length, width does not meet design standards.		This culvert is on a significant, fish-bearing stream with no full barriers downstream. A moderate amount of habitat would be made more accessible to migratory, anadromous fish upstream. However, since this culvert is already mostly passable, it is of lower priority for replacement than some of the other crossings of the Juanita Creek- NW/east trib .	3	4.8
JC-14 (21)	Juanita Creek- NW/east trib	42 in, 125ft, concrete	100th Ave NE	4 - Full barrier due to inlet plunge onto steep, smooth concrete for approx. 40 feet. Also due to 2 ½ foot plunge at outfall.	King County may have data on this pipe.	This culvert is on a significant, fish-bearing stream with no full barriers downstream. A moderate amount of habitat would be made accessible to migratory, anadromous fish upstream. Relatively high priority within the City for replacement. However, high expense and design complicated considerably by the presence of an in-stream detention facility extending upstream.	2 (note: previously rated high priority, but lowered to p2 due to high cost, location high in the watershed.)	8.8
JC-15 (22)	Juanita Creek- NW/east trib	24 in, 96 ft., Concrete	Simonds Rd. NE	N/A	No significant habitat upstream. It appears to be an intermittent stream.	Low priority because this tributary is not expected to be fish-bearing. A full barrier exists downstream at the 100th Ave NE crossing. Little or no potential fish habitat is present upstream. High expense due to high road fill embankment at Simonds Rd. NE	4	0.0
JC-16 (C)	Juanita Creek - NW/east trib	36 in, 194 ft., Concrete	88th Ave NE between NE 143rd and NE 144th Streets	4 - Likely full or at least partial barrier. Steeper at inlet, unknown slope throughout.	King County May have data on this pipe.	Very near headwaters, type N per DNR mapping, fish use or habitat near culvert doubtful. Full barrier is present downstream at 100th Ave. Little or no habitat present upstream. Replacement not justifiable based on fish use or habitat.	4	0.0
JC-17 (f)	Juanita Creek (main)	48-inch CMP	108th Avenue NE	2 - generally passable but does not meet current design standards.	Generally passable, no plunge at the outfall, backwatered nearly all the way through.	This culvert is on Juanita Creek, a significant, fish-bearing stream, with no full barriers downstream. A significant amount of habitat would be made somewhat more accessible to migratory, anadromous fish upstream. However, since this culvert is already mostly passable, it is of lower priority for replacement than some of the other crossings in the Juanita Creek basin.	3	9.1
JC-18 (D)	Juanita Creek - NE/east trib	120 in, 62 ft., concrete	11019 NE 140th St	1 - Mostly passable. Juveniles may not be able to pass weirs at all flows.	Baffles installed - may be part of Windsor Vista restoration.	N/A - culvert is already passable.	4	0.0

Number*	Stream	Culverts	Approximate Location	Fish Passable?	Comments	Benefits and Feasibility; (Other Barriers and Upstream Habitat)	Priority Rating	Priority Index
JC-19 (23)	Juanita Creek-NE/east trib	48in, 69 ft., CMP	NE 141st Street	2 - Hindrance or partial barrier; may restrict upstream movement of juveniles at some flows.	No plunge at outfall, but 1-foot plunge over boulder cascade about 8 feet downstream then a 1-foot deep pool. Neighbor on the east side of the outlet reports that adult salmon were somewhat common a number of years ago.	This culvert is on Juanita Creek, a significant, fish-bearing stream in the City with no full barriers downstream. A moderate amount of habitat would be made somewhat more accessible to migratory, anadromous fish upstream, although not a full barrier now. Full barrier upstream at I-405. Moderately high priority within the City for replacement on a proactive basis. Moderately high cost.	3	7.3
JC-20 (24)	Juanita Creek-NE/east trib	60-inch CMP, 77 ft.	111th Ave NE	1 - Not a barrier - passage conditions are fairly good.	CIP to fix headwall on this culvert underway	N/A - culvert is already fully passable.	4	0.0
JC-21 (26)	Juanita Creek-NE/east trib	48-inch CMP with tar	I-405	4 - Full barrier due to high plunge onto rock at the outlet. Also very long and steep, likely resulting in a velocity barrier.	I-405 probably evaluated this as part of Nickel Project.	This culvert is on Juanita Creek, a significant, fish-bearing stream in the City with partial barriers downstream. The crossing is high in the basin, near the headwaters, and a moderate amount of habitat would be made more accessible to migratory, anadromous fish upstream. Priority for replacement is moderately high, but would be a WSDOT project along I-405. Likely very high cost.	2 (Limited habitat upstream, expensive)	7.8
JC-22 (g)	Juanita Creek (east trib)	Concrete, 1 @24", 1 @ 18"	108th Avenue NE	4 - full barrier due to slope and velocity, plunges at outfalls	Below I-405.	This culvert is a full barrier near the mouth of the Juanita east trib. There are no full barriers downstream but a number of full barriers occur upstream, limiting the amount of habitat that would be made accessible if this culvert were to be upgraded. It could rate fairly high for replacement if the upstream pond outlet at 109th Ave. NE could be replaced as well, possibly with additional improvements extending farther upstream. Moderate costs.	2	7.0
JC-23 (h)	Juanita Creek (east trib)		109 th Avenue NE	4 - full Barrier, Weaver's pond is upstream		Full barrier with other full barriers both upstream and downstream. Stream is potentially fish-bearing. High costs, wetland impacts and other habitat loss associated with draining pond.	2	3.4
JC-24 (i)	Juanita Creek (east trib)	6-foot dia. CMP (or slightly larger*)	Apartment driveway culvert off of 114th Pl. NE	1 - fully passable	To complete series below I-405. *Culvert is countersunk such that the full diameter could not be measured.	N/A - culvert is already passable.	4	0.0
JC - 25 (c)	Juanita Creek (Totem Lake Trib)			4 - Full barrier due to length and slope		Lower section of this tributary is fish-bearing, with no full barriers extending downstream. Fairly extensive low-gradient habitat upstream. Expensive to replace with other constraints of space and slope.	2	11.1
Forbes Creek								
FO-1 (SD-0049)	Forbes	Dual 48" squashed CMPs plus dual 36" CMPs	108th Ave NE, between Forbes Creek Drive and NE 108th Street at Forbes Creek	2 - Hindrance; Most fish could get through on most flows.	108th Avenue NE is elevated above Forbes Creek and the adjacent wetlands. Curbs on both sides of the road appear at times to prevent street runoff from draining to the stream resulting in standing water on the road during storm events. However, there are catch basins, 1 each about 40-50 feet each side of the crossing, so the road should drain unless they are clogged. The culverts were not clogged with sediment at the time of a site visit on 6/27/13 and, given the low gradient, were not a barrier to fish migration.	This culvert is on Forbes Creek, a significant, fish-bearing stream, and with no barriers downstream. A significant amount of habitat would be made slightly more accessible to migratory, anadromous fish upstream. Low to medium priority within the City for replacement on a proactive basis since it is largely passable at present. Moderate cost.	3	8.3
FO-2 (jj)	Forbes Creek	Bolted CMP arch. 11.5 feet wide at substrate by 3.5 feet high at downstream. Upstream end is 13 feet wide by 7 feet high.	Forbes Creek Drive	1 - Fully Passable, not a barrier. Meets stream simulation in principle.	Not identified in the 2005 Master Plan. The concrete weir below the outlet is not and should not be a barrier unless it becomes clogged with debris. May need maintenance from time to time.	N/A - culvert is already passable.	4	0.0
FO-3 (CKC-4)	Drainage tributary to Forbes Creek	24-inch concrete	CKC near dead end of 111th Ave NE	4 - Full barrier due to plunge at outfall. 4-foot plunge into 1-foot-deep pool	Fairly good flow for previously dry weather - incised channel downstream. Fairly good flow of about 0.1 cfs on 10-18-13	Small stream, but may be perennial. Downstream passage unknown may need additional investigation, may be too steep. Little habitat upstream due to headwater reach. Moderate cost. Expected to be low priority.	4	0.0
FO-4 (CKC-3)	Drainage tributary to Forbes Creek	24 inch concrete	CKC near dead end of 111th Ave NE	3 - mostly a barrier. Steep, lack of flow. Not expected to be a fish-bearing stream.	Culvert dry this date. Drainage is too small and dry to be fish habitat. Appears to be an ephemeral stream with flow only in response to wet weather. No plunge - partially clogged with leaves and debris - no pool, no flow.	Not a fish-bearing stream due to low flows, steepness downstream (natural barrier), and likely seasonal flows. Little or no fish habitat upstream. Very low priority. Costs moderate.	4	0.0
FO-5 (CKC-2)	Drainage tributary to Forbes Creek	36 in. CMP	Cross Kirkland Corridor - near Forbes Creek Drive	4 - Not passable, absolute barrier.	A plunge at the outfall is about 6 feet high. Trickle of flow on 10/18/13. Incised channel about 5 feet deep extends downstream. This drainage is judged to be too small and steep to be fish habitat and so is a low priority for replacement on that basis, though erosion at the outfall could stand to be addressed. (Assessment does not include parallel access road upstream.)	Not a fish-bearing stream due to low flows, steepness downstream (natural barrier), and likely seasonal flows. Little or no fish habitat upstream. Very low priority. Costs moderate.	4	0.0
FO-6 (CKC-1) (SD-0054A, tracks)	Forbes	4' concrete	Forbes Creek crossing under the Eastside Rail Corridor behind the business located at 10830 117th Ave NE	2 - hindrance or partial barrier	The culvert is backwatered more than half the way through then steeper at the upstream end. Rates between a hindrance and partial barrier. Most fish could pass most of the time. Note that there is only up to 200 feet upstream of the RR and spur to an absolute barrier. Little benefit unless upstream passage barriers are corrected as well.	This culvert is on Forbes Creek, a significant, fish-bearing stream, and with no full barriers downstream. However, there is only approx. 200 feet of upstream channel before an absolute barrier. Not a full barrier now. Limited benefit to improvement unless upstream passage barriers are corrected as well, including the spur crossing just upstream as well as a hanging culvert plunging onto a rip-rapped slope. Medium priority within the City for replacement on a proactive basis since it is largely passable at present. Moderate cost.	3	4.8
FO-7 (CKC-1) (SD-0054B, spur)	Forbes	4' concrete	Forbes Creek crossing under the Eastside Rail Corridor behind the business located at 10830 117th Ave NE	3 - mostly a barrier though some fish may be able to pass at some times/flows. Not fully passable.	A substantial barrier is formed by 18" high woody debris jam blocking the inlet of a fairly steep culvert along with 15" cascades at the outlet. Daylighting the spur (only) would still allow the main RR grade to be used as a trail, however an absolute, incontrovertible barrier is present about 200 feet farther upstream.	Similar to the trail/RR crossing immediately downstream. This culvert is on Forbes Creek, a significant, fish-bearing stream, and with no full barriers downstream. However, there is only approx. 200 feet of upstream channel before an absolute barrier. This spur crossing is more of a barrier than the primary trail/RR crossing just downstream. Again, limited benefit to improvement unless upstream passage barriers are corrected as well. Medium priority within the City for replacement on a proactive basis. Moderate cost.	2	5.7

Number*	Stream	Culverts	Approximate Location	Fish Passable?	Comments	Benefits and Feasibility; (Other Barriers and Upstream Habitat)	Priority Rating	Priority Index
FO-8				Passable culvert installed with the I-405 Nickel Project			4	0.0
FO-9 (mm)	Forbes Creek	36-inch concrete	NE 100th Street	2 - passable but pipe is narrow and no substrate. Not stream-like within the pipe.	Not identified as a barrier in the 2005 Master Plan.	This segment of Forbes Creek in the upper watershed is used by resident cutthroat. Full anadromous barriers occur downstream. Limited additional habitat upstream. Since this culvert is mostly passable at present and limited habitat occurs upstream, it's improvement for fish passage or habitat purposes should take a fairly low priority.	3	2.3
FO-10 (nn)	Forbes Creek	24-inch CMP	124th Ave NE	2 - Passable but falls short of design standards.	Not identified as a barrier in the 2005 Master Plan. Cage put on inlet to prevent clogging is likely a barrier. Little/no upstream habitat. Submerged culvert drains extensive wetlands east of 124th	This segment of Forbes Creek in the upper watershed is used by resident cutthroat. Full anadromous barriers occur downstream. Limited additional habitat upstream. Since this culvert is mostly passable at present and limited habitat occurs upstream, it's improvement for fish passage or habitat purposes should take a fairly low priority.	3	1.6
FO-11 (oo)	Forbes Creek	40' wide by 30" high "squashed" CMP	NE 97th St	1 - Not a barrier unless when clogged with trash at the upper end.	Not identified as a barrier in the 2005 Master Plan. Trash rack and cage at the upstream end and then an additional 4 feet of 24-inch dia. concrete pipe. Not a barrier unless clogged with trash. Channel upstream and downstream appears to have been dredged historically. LOTS of beaver activity in this area...	N/A - culvert is already passable.	4	0.0
Moss Bay Drainages								
MB-1 (CKC-19)	Moss Bay drainages (mostly piped to mouth)	24-inch Concrete	CKC at Kirkland Way and Railroad Avenue	4 - Appears impassable due to slopes and depths.	Weird thumping and banging noises from within the culvert. This culvert is entirely downstream of the CKC and so does not cross it.	This Moss Bay Drainage tributary is likely not accessible to migratory fish due to long, continually piped sections downstream with possible included plunges and/or velocity barriers. No resident fish detected in 1998. However, the stream appears to have good year-around flows. Very limited lengths of non-piped channel upstream. Moderate costs, low priority.	4	0.0
MB-2 (CKC-20)	Moss Bay drainages (mostly piped to mouth)	24-inch Concrete	Kirkland Way	3 - very long with moderate slope; some fish could get through	Very long, 24-inch concrete pipe under the CKC. Not fully impassable, but adjacent piped stream sections could be impassable. #18, the 30-inch concrete culvert under Railroad Avenue immediately upstream is likely impassable based on sounds indicating a significant plunge within.	This Moss Bay Drainage tributary is likely not accessible to migratory fish due to long, continually piped sections downstream with possible included plunges and/or velocity barriers. No resident fish detected in 1998. However, the stream appears to have good year-around flows. Very limited lengths of non-piped channel upstream. Moderate costs, low priority.	4	0.0
MB-3 (CKC-18)	Moss Bay drainages (mostly piped to mouth)	30-inch CAP	Railroad Avenue	4 - the 30-inch concrete culvert under Railroad Avenue is likely impassable based on sounds indicating a significant plunge within.	This is likely the 30-inch under Railroad Avenue. (Only #20 crosses under CKC. #19 is downstream, #18 upstream.)	Culverts 18-20 are all adjoining on the same stream and rate similarly. This Moss Bay Drainage tributary is likely not accessible to migratory fish due to long, continually piped sections downstream with possible included plunges and/or velocity barriers. No resident fish detected in 1998. However, the stream appears to have good year-around flows. Very limited lengths of non-piped channel upstream. Moderate costs, low priority.	4	0.0
MB-4 (CKC-10)	Moss Bay drainages (mostly piped to mouth)	30-inch RCP	Near Kirkland Way	4 (or N/A?). No flow, no channel at plugged outfall, though flow apparently piped farther downslope in another pipe.	Found 24-inch concrete inlet as the ditch/swale along Kirkland Way. Then "DRAIN" manhole along CKC. Found 30-inch CMP "outfall" on west side of CKC fully filled with concrete! Flow apparently piped farther downslope in another pipe.	Similar to other small CKC drainages, stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Limited or no habitat upstream. Very low priority. Could be high cost due to convoluted nature of crossing.	4	0.0
MB-5 (CKC-9)	Moss Bay drainages (mostly piped to mouth)	Unable to confirm because the outlet is submerged (36-inch RCP from list)	Kirkland Way	3 - Not a full barrier due to outfall conditions, but upstream unknown.	There is no culvert inlet along CKC. Unable to verify culvert size and type because the outlet is submerged. Slope appears fairly flat due to backwatering at outfall.	Similar to other small CKC drainages, stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Limited or no habitat upstream. Since there is a lack of habitat upstream, this culvert's improvement for fish passage or habitat purposes should be given a very low priority. Moderate cost.	4	0.0
MB-6 (CKC-8)	Moss Bay drainages (mostly piped to mouth)	24-inch concrete	CKC - South of 85th	2 - The culvert itself is not a barrier to the manhole on the east side	Manhole with no inlet next to storage building on upstream side. Minimal trickle of flow present 10/23.	The culvert is already passable, though it would not meet current standards for width etc. Very low priority since it is already passable and no habitat would be made accessible upstream.	4	0.0
MB-7 (CKC-7)	Moss Bay drainages (mostly piped to mouth)	North CKC swale inlet 18-inch CMP, South CKC swale inlet 12-inch plastic, found inlet to 24-inch CMP upslope	CKC - North of 85th	4 - Full barrier	Pipes enter from both north and south along the CKC, but a stream/drainage culvert inlet was also found beyond the blackberries upstream. A 24-inch CMP with a trickle of flow on 10/23/13. Outlet not found. Slope 6% based on inlet, sounds of plunges within.	Stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Limited or no habitat upstream. Since there is a lack of habitat upstream, this culvert's improvement for fish passage or habitat purposes should take a fairly low priority. Moderate cost.	4	0.0
MB-8 (CKC-6)	Moss Bay drainage (mostly piped to mouth)	3-foot diameter concrete	9th Ave, 9th Street	4 - Full barrier due to slope and length	Trickle of flow. Steep upstream. Doubtful that there is too much habitat to open up - upstream. Outlet not found. Moderately steep + 5-6%	Stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, the creek may have year-around flow. Limited or no habitat upstream. Since there is a lack of habitat upstream, this culvert's improvement for fish passage or habitat purposes should take a fairly low priority. Moderate cost.	4	0.0
MB-9 (CKC-5)	Moss Bay (mostly piped to mouth)	24-inch concrete	NE 96th Street	2 - Passable, but would not meet design standards	This culvert would be readily passable by any, say, resident cutthroat that may inhabit the stream now or going forward, however stream is almost entirely piped downstream. No plunge - culvert is half-full backwatered at outfall	Fish use was not detected by electrofishing in 1998. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, the creek may have year-around flow. Limited length of channel and habitat upstream. Since this culvert is mostly passable at present and limited habitat occurs upstream, it's improvement for fish passage or habitat purposes should take a fairly low priority. Moderate cost.	3	1.7
Everest Creek								
EC-1 (CKC-11)	Everest Creek	18-inch CMP	CKC Between 6th Street S. and Railroad Ave.	3 - some fish could get though due to the short length and pool at the outfall.		Everest Creek is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, would rank this culvert fairly high for replacement in spite of moderate PI: 1) It is a problem 2) The stream has good year-around flows and could support fish if re-introduced 3) The culvert is short and near the surface - so should be relatively low-cost and so a good value. Fair amount of habitat available upstream through Everest Park. Another culvert is just upstream that should also be included in the project. Cascades farther upstream. Everest has good year-around flow and could probably support resident trout, if introduced.	1	2.7

Number*	Stream	Culverts	Approximate Location	Fish Passable?	Comments	Benefits and Feasibility; (Other Barriers and Upstream Habitat)	Priority Rating	Priority Index
EC-2 (SD-0061)	Everest	2@ 30" concrete	Everest Park, adjacent to 10th Street South	4 - Full barrier.	Not known if fish are present and would benefit directly. Support project to address channel incision and riparian revegetation.	Fish use of Everest Creek was not detected by electrofishing in 1998. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, the creek has strong, year-around groundwater-fed flows and so it seems it could support some resident trout should they be re-introduced. DNR mapping shows it as a fish-bearing stream, although their mapping is based primarily on slope and basin size and so is subject to verification. Limited length of channel upstream to the vicinity of I-405. If corrected, culvert removal or upgrade would allow any resident fish present or introduced to move around more freely. Relatively low cost.	2	2.4
Houghton Slope A								
HSA-1 (CKC-12)	Houghton Slope A	4-foot-diameter concrete	Between 62nd and 64th Streets	4 - full, absolute barrier due to 1) 6-foot cascade plunge at outfall, 2) very long and very steep within, 3) piped for some distance upstream of CKC.	Good flow on 11/8/13. Bank instability on right side. Lots of boulder armoring. Wood in pool below culvert. Fish use unknown, but possible habitat for isolated trout. Culvert inlet(s) not found – mapped as piped for some distance upstream. 5-6 foot boulder cascade plunge, then large pool about 3-1/2 feet deep with wood and boulders. This pool absorbs a lot of energy.	Houghton Slope A Creek. No fish found in 1998 study, but appears to have good flows. Not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Possible habitat for a present or future isolated trout population. Extensively piped upstream, so little habitat would be made available without including upstream sections as well. Channel is very steep. Low priority due to barrier(s) downstream and questionable fish presence or fish habitat due to steepness of channel. Very expensive to replace due to high fill of the CKC and extensive piped sections extending upstream.	2	2.3
Carillon Creek								
CC-1 (y)	Carillon Creek	(not observable)	Lake Washington Boulevard NE	4 - Full Barrier. Internal makeup of culvert is unknown, but a high plunge of perhaps 6-8 feet occurs at the inlet.	The outlet is a contrived concrete box structure 3' high by 6.5' wide by 10' long. Water upwells from a submerged culvert somewhere within. The inlet is a 4' wide by 1.5' high barred "pillbox" with a + 8' plunge immediately below.	Low priority in near term due to full barrier downstream and lack of habitat due to steep channel profile upstream. Cost of crossing arterial expected to be high.	4	1.9
CC-2 (z, CKC - 13)	Carillon Creek	24 in. concrete	Cross Kirkland Corridor	4 - Full barrier due to length, slope, lack of substrate, small dia., and high velocity.	This is a very steep culvert along a very steep stream segment. Very high fill embankment – expensive to replace at Cross-Kirkland Corridor. Fish presence not known but doubtful due to downstream barriers and overall steepness of the channel.	Also low priority due to full barrier(s) downstream and doubtful fish presence or fish habitat due to steepness of channel. High costs due to high fill embankment at Cross-Kirkland Corridor.	4	2.4
Houghton Slope B								
HSB-1 (CKC-16)	Houghton Slope B	24-inch Concrete	NE 43rd Street	4 - full barrier due to length, slope, lack of flow. This is an ephemeral drainage. Dry 11/8/13		Not a fish-bearing stream due to low, ephemeral flows, steepness downstream (natural barrier). Little or no fish habitat upstream. Very low priority. Costs moderately high due to CKC embankment.	4	0.0
HSB-2 (CKC-15)	Houghton Slope B	24-inch Concrete	NE 44th Street	4 - Absolute barrier. High plunges at both inlet and outlet, steep in between. No pool at outlet	Inlet – trickle of flow on 11/8/13 plunges vertically 4-6 feet in blackberries; inlet not definable. Outlet pipe section has fallen off (see photos). Fish use of stream unlikely (regardless of culvert) due to channel steepness and low flows.	Not a fish-bearing stream due to low flows, steepness downstream (natural barrier), and likely seasonal flows. Little or no fish habitat upstream. Very low priority. Costs moderate.	4	0.0
HSB-3 (CKC-14)	Houghton Slope B		Between 46th Street and 47 th Place	4 - Likely a full barrier	Inlet along E side of CKC not found. Outlet is in a fenced, gated private development and not accessible. Need access. Still, likely a full barrier.	Incomplete information, but not likely a fish-bearing stream. Extensively piped both upstream and downstream. Cost of replacement likely high due to high depth of embankment fill.	4	0.0
Cochran Springs Creek								
CO-1 (aa)	Cochran Springs Creek		Lake Washington Boulevard	3 - Partial Barrier	To be addressed with CIP SCD-0048 set to construct in 2015	Located along a fish-bearing segment with no barriers downstream.	1	6.7
CO-2 (cc)	Cochran Springs Creek		NE 38th Pl	4 - Total barrier due to drop at exit, bends within pipe		Along a fish-bearing segment, but partial barrier downstream and a full barrier a short distance upstream	2	2.3
CO-3 (CKC - 17)	Cochran Springs Creek	3-foot diameter steel (observed at inlet)	Cross Kirkland Corridor	4 - full barrier due to length, slope, plunge at outlet, high velocity.	2-foot vertical plunge, but high velocities put flow horizontally against large boulders. About a 12-18 inch pool. Strong flows, approx 2 cfs on 11/8/13. The CKC prism above the culvert is high and massive. Expensive to replace, however the flows are here to support fish. High cutthroat usage documented downstream to Lake Washington.	Per Appendix F of the 2005 Surface Water Master Plan, there is a complete fish block just downstream at the culvert under NE 38th Place. Cochran Spring Creek has good, year-around flows and is used by cutthroat downstream but is rated type N per DNR mapping upstream. A fairly short distance upstream to the spring source of flow, so the amount of habitat made available would be limited. Very costly to replace this culvert due to a very high fill embankment at the CKC.	2	2.2
CO-4	Cochran Springs Creek			4 - drop at exit.	Not evaluated but presumed barrier due to drop at exit.	Good stream-fed flows, but steep channel near headwaters and barriers downstream and with little length of habitat upstream	2	2.4
Yarrow Creek								
YC-1	Yarrow Creek		116 th Ave NE just north of NE 41 st Street	4 - verified, drop at outfall	Not fully evaluated but confirmed barrier due to steep gradient and plunge at outfall.	Reduced priority for replacement due to far upstream headwater location with limited potential habitat farther upstream.	2	3.3
YC-2	Yarrow Creek		NE 48 th Place, just east of 116 th Ave NE	3 - no plunge at outfall, but undersized and moderate gradient	Not evaluated but confirmed at likely partial barrier.	Reduced priority for replacement due to far upstream headwater location with little potential habitat farther upstream.	2	2.2

Culverts evaluated for fish passage for Kirkland's 2014 update of its Surface Water Master Plan - by Priority Index within Priority Rating

Fish Passage Scoring: 1 - Passable ; 2 - Hindrance to passage; 3 - Partial Barrier; 4 - Full or nearly Full Barrier

Number*	Stream	Culverts	Approximate Location	Fish Passable?	Comments	Benefits and Feasibility; (Other Barriers and Upstream Habitat)	Priority Rating	Priority Index
JC-9 (e)	Juanita Creek (NW trib.)	36 in. concrete	NE 137th Pl	3 - Partial barrier. Long, somewhat steep slope, no substrate, but no plunge at outfall		This partial-barrier culvert is on a significant, fish-bearing stream with no full barriers downstream. A moderate to high amount of habitat would be made more accessible to migratory, anadromous fish upstream. High priority within the City for replacement. Moderate cost.	1	9.5
DE-2 (6)	Denny Creek	24 in, 138 ft., Concrete	Juanita Drive	4 - Presumed full barrier due to long length and high slope with correspondingly high velocities.	Neighborhood wants pedestrian underpass combined with fish passage improvements at this location.	This culvert is on a significant, fish-bearing stream with no downstream barriers. A moderate amount of habitat would be made accessible to migratory, anadromous fish upstream. High priority within the City for replacement. Moderately high cost. Has a high degree of community support; costs would increase if a requested pedestrian underpass were included.	1	9.2
JC-10 (17)	Juanita Creek-NW/east trib	36 in, 108 ft., concrete	Juanita Woodinville Way	3 - Partial Barrier. Fish can swim easily through the lower part of the pipe at most flows, then need to pass through a short, low-depth, high-velocity section at the upper end.	King County may have data on this pipe.	This culvert is on a significant, fish-bearing stream with no full barriers downstream. A moderate amount of habitat would be made more accessible to migratory, anadromous fish upstream. Relatively high priority within the City for replacement. Moderately high cost.	1	8.8
JC-12 (19)	Juanita Creek-NW/east trib	3-foot by 4-foot CMP, 73 ft.,	102nd Ave NE	3 - Partial barrier. No plunge at outfall, but flows are shallow, swift, and moderately steep.	King County may have data on this pipe.	This culvert is on a significant, fish-bearing stream with no full barriers downstream. A moderate amount of habitat would be made more accessible to migratory, anadromous fish upstream. Relatively high priority within the City for replacement.	1	6.7
CO-1 (aa)	Cochran Springs Creek		Lake Washington Boulevard	3 - Partial Barrier	To be addressed with CIP SCD-0048 set to construct in 2015	Located along a fish-bearing segment with no barriers downstream.	1	6.7
EC-1 (CKC-11)	Everest Creek	18-inch CMP	CKC Between 6th Street S. and Railroad Ave.	3 - some fish could get through due to the short length and pool at the outfall.		Everest Creek is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, would rank this culvert fairly high for replacement in spite of moderate PI: 1) It is a problem 2) The stream has good year-around flows and could support fish if re-introduced 3) The culvert is short and near the surface – so should be relatively low-cost and so a good value. Fair amount of habitat available upstream through Everest Park. Another culvert is just upstream that should also be included in the project. Cascades farther upstream. Everest has good year-around flow and could probably support resident trout, if introduced.	1	2.7
JC - 25 (c)	Juanita Creek (Totem Lake Trib)			4 - Full barrier due to length and slope		Lower section of this tributary is fish-bearing, with no full barriers extending downstream. Fairly extensive low-gradient habitat upstream. Expensive to replace with other constraints of space and slope.	2	11.1
JC-14 (21)	Juanita Creek-NW/east trib	42 in, 125ft, concrete	100th Ave NE	4 - Full barrier due to inlet plunge onto steep, smooth concrete for approx. 40 feet. Also due to 2 ½ foot plunge at outfall.	King County may have data on this pipe.	This culvert is on a significant, fish-bearing stream with no full barriers downstream. A moderate amount of habitat would be made accessible to migratory, anadromous fish upstream. Relatively high priority within the City for replacement. However, high expense and design complicated considerably by the presence of an in-stream detention facility extending upstream.	2	8.8
JC-21 (26)	Juanita Creek-NE/east trib	48-inch CMP with tar	I-405	4 - Full barrier due to high plunge onto rock at the outlet. Also very long and steep, likely resulting in a velocity barrier.	I-405 probably evaluated this as part of Nickel Project.	This culvert is on Juanita Creek, a significant, fish-bearing stream in the City with partial barriers downstream. The crossing is high in the basin, near the headwaters, and a moderate amount of habitat would be made more accessible to migratory, anadromous fish upstream. Priority for replacement is moderately high, but would be a WSDOT project along I-405. Likely very high cost.	2	7.8
JC-22 (g)	Juanita Creek (east trib)	Concrete, 1 @24", 1 @ 18"	108th Avenue NE	4 - full barrier due to slope and velocity, plunges at outfalls	Below I-405.	This culvert is a full barrier near the mouth of the Juanita east trib. There are no full barriers downstream but a number of full barriers occur upstream, limiting the amount of habitat that would be made accessible if this culvert were to be upgraded. It could rate fairly high for replacement if the upstream pond outlet at 109th Ave. NE could be replaced as well, possibly with additional improvements extending farther upstream. Moderate costs.	2	7.0
FO-7 (CKC-1) (SD-0054B, spur)	Forbes	4' concrete	Forbes Creek crossing under the Eastside Rail Corridor behind the business located at 10830 117th Ave NE	3 - mostly a barrier though some fish may be able to pass at some times/flows. Not fully passable.	A substantial barrier is formed by 18" high woody debris jam blocking the inlet of a fairly steep culvert along with 15" cascades at the outlet. Daylighting the spur (only) would still allow the main RR grade to be used as a trail, however an absolute, incontrovertible barrier is present about 200 feet farther upstream.	Similar to the trail/RR crossing immediately downstream. This culvert is on Forbes Creek, a significant, fish-bearing stream, and with no full barriers downstream. However, there is only approx. 200 feet of upstream channel before an absolute barrier. This spur crossing is more of a barrier than the primary trail/RR crossing just downstream. Again, limited benefit to improvement unless upstream passage barriers are corrected as well. Medium priority within the City for replacement on a proactive basis. Moderate cost.	2	5.7
JC-23 (h)	Juanita Creek (east trib)		109th Avenue NE	4 - full Barrier, Weaver's pond is upstream		Full barrier with other full barriers both upstream and downstream. Stream is potentially fish-bearing. High costs, wetland impacts and other habitat loss associated with draining pond.	2	3.4
YC-1	Yarrow Creek		116th Ave NE just north of NE 41st Street	4 - verified, drop at outfall	Not fully evaluated but confirmed barrier due to steep gradient and plunge at outfall.	Reduced priority for replacement due to far upstream headwater location with limited potential habitat farther upstream.	2	3.3
JC-2 (9)	Juanita Creek--west trib	18 in., 97 ft., CAP, AND 37 ft. 24" aluminum	NE 120th Street	4 - Obvious barrier, not fully evaluated	pretty obviously a barrier - probably don't need to evaluate, just note as a barrier	Smaller tributary, providing passage may benefit cutthroat.	2	2.6
EC-2 (SD-0061)	Everest	2@ 30" concrete	Everest Park, adjacent to 10th Street South	4 - Full barrier.	Not known if fish are present and would benefit directly. Support project to address channel incision and riparian revegetation.	Fish use of Everest Creek was not detected by electrofishing in 1998. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, the creek has strong, year-around groundwater-fed flows and so it seems it could support some resident trout should they be re-introduced. DNR mapping shows it as a fish-bearing stream, although their mapping is based primarily on slope and basin size and so is subject to verification. Limited length of channel upstream to the vicinity of I-405. If corrected, culvert removal or upgrade would allow any resident fish present or introduced to move around more freely. Relatively low cost.	2	2.4
CO-4	Cochran Springs Creek			4 - drop at exit.	Not evaluated but presumed barrier due to drop at exit.	Good stream-fed flows, but steep channel near headwaters and barriers downstream and with little length of habitat upstream	2	2.4
CO-2 (cc)	Cochran Springs Creek		NE 38th Pl	4 - Total barrier due to drop at exit, bends within pipe		Along a fish-bearing segment, but partial barrier downstream and a full barrier a short distance upstream	2	2.3

Number*	Stream	Culverts	Approximate Location	Fish Passable?	Comments	Benefits and Feasibility; (Other Barriers and Upstream Habitat)	Priority Rating	Priority Index
HSA-1 (CKC-12)	Houghton Slope A	4-foot-diameter concrete	Between 62nd and 64th Streets	4 - full, absolute barrier due to 1) 6-foot cascade plunge at outfall, 2) very long and very steep within, 3) piped for some distance upstream of CKC.	Good flow on 11/8/13. Bank instability on right side. Lots of boulder armoring. Wood in pool below culvert. Fish use unknown, but possible habitat for isolated trout. Culvert inlet(s) not found – mapped as piped for some distance upstream. 5-6 foot boulder cascade plunge, then large pool about 3-1/2 feet deep with wood and boulders. This pool absorbs a lot of energy.	Houghton Slope A Creek. No fish found in 1998 study, but appears to have good flows. Not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Possible habitat for a present or future isolated trout population. Extensively piped upstream, so little habitat would be made available without including upstream sections as well. Channel is very steep. Low priority due to barrier(s) downstream and questionable fish presence or fish habitat due to steepness of channel. Very expensive to replace due to high fill of the CKC and extensive piped sections extending upstream.	2	2.3
YC-2	Yarrow Creek		NE 48 th Place, just east of 116 th Ave NE	3 - no plunge at outfall, but undersized and moderate gradient	Not evaluated but confirmed at likely partial barrier.	Reduced priority for replacement due to far upstream headwater location with little potential habitat farther upstream.	2	2.2
CO-3 (CKC - 17)	Cochran Springs Creek	3-foot diameter steel (observed at inlet)	Cross Kirkland Corridor	4 - full barrier due to length, slope, plunge at outlet, high velocity.	2-foot vertical plunge, but high velocities put flow horizontally against large boulders. About a 12-18 inch pool. Strong flows, approx 2 cfs on 11/8/13. The CKC prism above the culvert is high and massive. Expensive to replace, however the flows are here to support fish. High cutthroat usage documented downstream to Lake Washington.	Per Appendix F of the 2005 Surface Water Master Plan, there is a complete fish block just downstream at the culvert under NE 38th Place. Cochran Spring Creek has good, year-around flows and is used by cutthroat downstream but is rated type N per DNR mapping upstream. A fairly short distance upstream to the spring source of flow, so the amount of habitat made available would be limited. Very costly to replace this culvert due to a very high fill embankment at the CKC.	2	2.2
HP-1 (2)	Holmes Pt.	36 in, 131 ft., concrete AND 36 in, 61 ft., CAP	62nd Avenue NE	4 - Full Barrier due to length, overall high slope, and interior plunge that is audible form the upstream end.	Should be done in conjunction with downstream dam removal.	Holmes Point Creek has good perennial flows and could likely support resident cutthroat and limited anadromous fish use. Significant habitat exists upstream, however a filled-in earthen dam exists just downstream of this culvert, which is also a full barrier. Benefits of removing the culvert would not accrue without also removing the dam.	2	0.0
JC-17 (f)	Juanita Creek (main)	48-inch CMP	108th Avenue NE	2 - generally passable but does not meet current design standards.	Generally passable, no plunge at the outfall, backwatered nearly all the way through.	This culvert is on Juanita Creek, a significant, fish-bearing stream, with no full barriers downstream. A significant amount of habitat would be made somewhat more accessible to migratory, anadromous fish upstream. However, since this culvert is already mostly passable, it is of lower priority for replacement than some of the other crossings in the Juanita Creek basin.	3	9.1
FO-1 (SD-0049)	Forbes	Dual 48" squashed CMPs plus dual 36" CMPs	108th Ave NE, between Forbes Creek Drive and NE 108th Street at Forbes Creek	2 - Hindrance; Most fish could get through on most flows.	108th Avenue NE is elevated above Forbes Creek and the adjacent wetlands. Curbs on both sides of the road appear at times to prevent street runoff from draining to the stream resulting in standing water on the road during storm events. However, there are catch basins, 1 each about 40-50 feet each side of the crossing, so the road should drain unless they are clogged. The culverts were not clogged with sediment at the time of a site visit on 6/27/13 and, given the low gradient, were not a barrier to fish migration.	This culvert is on Forbes Creek, a significant, fish-bearing stream, and with no barriers downstream. A significant amount of habitat would be made slightly more accessible to migratory, anadromous fish upstream. Low to medium priority within the City for replacement on a proactive basis since it is largely passable at present. Moderate cost.	3	8.3
JC-19 (23)	Juanita Creek- NE/east trib	48in, 69 ft., CMP	NE 141st Street	2 - Hindrance or partial barrier; may restrict upstream movement of juveniles at some flows.	No plunge at outfall, but 1-foot plunge over boulder cascade about 8 feet downstream then a 1-foot deep pool. Neighbor on the east side of the outlet reports that adult salmon were somewhat common a number of years ago.	This culvert is on Juanita Creek, a significant, fish-bearing stream in the City with no full barriers downstream. A moderate amount of habitat would be made somewhat more accessible to migratory, anadromous fish upstream, although not a full barrier now. Full barrier upstream at I-405. Moderately high priority within the City for replacement on a proactive basis. Moderately high cost.	3	7.3
JC-13 (20)	Juanita Creek- NW/east trib	4-foot wide by 3-foot high CMP	101st Place NE	2 - Migration hindrance; mostly passable. Long length, width does not meet design standards.		This culvert is on a significant, fish-bearing stream with no full barriers downstream. A moderate amount of habitat would be made more accessible to migratory, anadromous fish upstream. However, since this culvert is already mostly passable, it is of lower priority for replacement than some of the other crossings of the Juanita Creek- NW/east trib.	3	4.8
FO-6 (CKC-1) (SD-0054A, tracks)	Forbes	4' concrete	Forbes Creek crossing under the Eastside Rail Corridor behind the business located at 10830 117th Ave NE	2 - hindrance or partial barrier	The culvert is backwatered more than half the way through then steeper at the upstream end. Rates between a hindrance and partial barrier. Most fish could pass most of the time. Note that there is only up to 200 feet upstream of the RR and spur to an absolute barrier. Little benefit unless upstream passage barriers are corrected as well.	This culvert is on Forbes Creek, a significant, fish-bearing stream, and with no full barriers downstream. However, there is only approx. 200 feet of upstream channel before an absolute barrier. Not a full barrier now. Limited benefit to improvement unless upstream passage barriers are corrected as well, including the spur crossing just upstream as well as a hanging culvert plunging onto a rip-rapped slope. Medium priority within the City for replacement on a proactive basis since it is largely passable at present. Moderate cost.	3	4.8
DE-3 (A)	Denny Creek	76 ft. twin corrugated pipes 24" high by 36" wide	13433 78th PI NE	2 - Hindrance. Moderate-sized trout could jump into and swim through these culverts.	In open space area in front of home	No fish found in 1998 study, but habitat appears suitable, type F per DNR mapping. Culvert downstream at Juanita Drive is a barrier and would need to be upgraded to allow anadromous access. Some habitat available upstream in low-gradient tributaries and beaver pond habitat. Though relatively low cost, there would be limited benefits to replacing this culvert because it is already largely passable, a downstream barrier is present, and quantity of potential habitat farther upstream is limited.	3	2.3
FO-9 (mm)	Forbes Creek	36-inch concrete	NE 100th Street	2 - passable but pipe is narrow and no substrate. Not stream-like within the pipe.	Not identified as a barrier in the 2005 Master Plan.	This segment of Forbes Creek in the upper watershed is used by resident cutthroat. Full anadromous barriers occur downstream. Limited additional habitat upstream. Since this culvert is mostly passable at present and limited habitat occurs upstream, it's improvement for fish passage or habitat purposes should take a fairly low priority.	3	2.3
MB-9 (CKC-5)	Moss Bay (mostly piped to mouth)	24-inch concrete	NE 96th Street	2 - Passable, but would not meet design standards	This culvert would be readily passable by any, say, resident cutthroat that may inhabit the stream now or going forward, however stream is almost entirely piped downstream. No plunge – culvert is half-full backwatered at outfall	Fish use was not detected by electrofishing in 1998. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, the creek may have year-around flow. Limited length of channel and habitat upstream. Since this culvert is mostly passable at present and limited habitat occurs upstream, it's improvement for fish passage or habitat purposes should take a fairly low priority. Moderate cost.	3	1.7

Number*	Stream	Culverts	Approximate Location	Fish Passable?	Comments	Benefits and Feasibility; (Other Barriers and Upstream Habitat)	Priority Rating	Priority Index
FO-10 (nn)	Forbes Creek	24-inch CMP	124th Ave NE	2 - Passable but falls short of design standards.	Not identified as a barrier in the 2005 Master Plan. Cage put on inlet to prevent clogging is likely a barrier. Little/no upstream habitat. Submerged culvert drains extensive wetlands east of 124th	This segment of Forbes Creek in the upper watershed is used by resident cutthroat. Full anadromous barriers occur downstream. Limited additional habitat upstream. Since this culvert is mostly passable at present and limited habitat occurs upstream, it's improvement for fish passage or habitat purposes should take a fairly low priority.	3	1.6
CH-1 (7)	Champagne Creek	18 in., 226 ft., concrete	Juanita Drive	4 - Full barrier due to plunge at outfall and velocity due to slope and smooth pipe.	Little potential habitat available upstream.	Fish use not expected this far upstream, but cutthroat use documented farther downstream. Downstream incised channel likely includes barriers. There is not significant habitat available upstream so this is not a high priority.	4	2.6
CC-2 (z, CKC - 13)	Carillon Creek	24 in. concrete	Cross Kirkland Corridor	4 - Full barrier due to length, slope, lack of substrate, small dia., and high velocity.	This is a very steep culvert along a very steep stream segment. Very high fill embankment – expensive to replace at Cross-Kirkland Corridor. Fish presence not known but doubtful due to downstream barriers and overall steepness of the channel.	Also low priority due to full barrier(s) downstream and doubtful fish presence or fish habitat due to steepness of channel. High costs due to high fill embankment at Cross-Kirkland Corridor.	4	2.4
CC-1 (y)	Carillon Creek	(not observable)	Lake Washington Boulevard NE	4 - Full Barrier. Internal makeup of culvert is unknown, but a high plunge of perhaps 6-8 feet occurs at the inlet.	The outlet is a contrived concrete box structure 3' high by 6.5' wide by 10' long. Water upwells from a submerged culvert somewhere within. The inlet is a 4' wide by 1.5' high barred "pillbox" with a + 8' plunge immediately below.	Low priority in near term due to full barrier downstream and lack of habitat due to steep channel profile upstream. Cost of crossing arterial expected to be high.	4	1.9
HP-2 (3)	Holmes Pt.	18 in, 55 ft., RCP	Holmes Pt. Drive	4 - Full Barrier due both to plunge at the outfall plus being smooth and steep inside to create a velocity barrier.	Too high up in the basin for much fish use even if downstream barriers were removed. Possible minor potential use by cutthroat, but not coho.	Steep, very near headwaters, type N per DNR mapping, fish use or habitat near culvert doubtful. Two full barriers are present downstream. Little or no habitat present upstream. Replacement not justifiable based on fish use or habitat.	4	0.0
HP-3 (4)	Holmes Pt.	18 in, 71 ft., RCP	Holmes Pt. Drive	4 - Full Barrier due to plunge and velocity due to steepness	Also note that pipe crossing Holmes Pt Drive and pipe on SE side of Holmes Pt Drive are a barrier to stream near 13808 Homes Pt Drive	Steep, very near headwaters, type N per DNR mapping, fish use or habitat near culvert doubtful. Two full barriers are present downstream. Little or no habitat present upstream. Replacement not justifiable based on fish use or habitat.	4	0.0
DE-1 (5)	Denny Creek	10-foot-wide by 4 ½ foot high concrete box culvert, 55 ft.	Holmes Pt. Drive	1 - Fully Passable.	Denny Creek report may have already evaluated this culvert.	N/A - culvert is already fully passable.	4	0.0
JC-1 (8)	Juanita Creek - east trib	64ft, concrete, unknown dia	NE 120th Street	1 - Passable.	Replaced with fish-passable box culvert in 1999	N/A - culvert is already fully passable.	4	0.0
JC-3 (11)	Juanita Creek - east trib	252 in, 40 ft., RCP	NE 122nd Street	1 - Passable.	City constructed fish passable box culvert in about 2003	N/A - culvert is already fully passable.	4	0.0
JC-4 (12)	Juanita Creek - east trib	252 in, 62 ft., RCP	NE 124th Street	1 - Passable.	City constructed fish passable box culvert in about 2003	N/A - culvert is already fully passable.	4	0.0
JC-5 (b, 13)	Juanita Creek - east trib	82 ft., concrete, unknown dia	NE 128th Street	1 - Passable.	Evaluated in 2005 SW Master Plan	N/A - culvert is already fully passable.	4	0.0
JC-6 (14)	Juanita Creek - east trib	88 ft., concrete, unknown dia	100th Avenue NE	1 - Passable.	Evaluated in 2005 SW Master Plan	N/A - culvert is already fully passable.	4	0.0
JC-7 (15)	Juanita Creek - east trib	144 in., 66 ft., GSST	NE 129th Street	1 - Passable.	Evaluated in 2005 SW Master Plan	N/A - culvert is already fully passable.	4	0.0
JC-8 (16)	Juanita Creek - east trib	14-foot wide by 73 ft. long, CAP	NE 132nd Street	1 - Passable.		N/A - culvert is already fully passable.	4	0.0
JC-11 (18)	Juanita Creek - NW/east trib	48 in, 78 ft., concrete	NE 140th Place	1 - Fully passable. Culvert is countersunk with a near-zero gradient.	King County may have data on this pipe.	N/A - culvert is already fully passable.	4	0.0
JC-15 (22)	Juanita Creek - NW/east trib	24 in, 96 ft., Concrete	Simonds Rd. NE	N/A	No significant habitat upstream. It appears to be an intermittent stream.	Low priority because this tributary is not expected to be fish-bearing. A full barrier exists downstream at the 100th Ave NE crossing. Little or no potential fish habitat is present upstream. High expense due to high road fill embankment at Simonds Rd. NE	4	0.0
JC-16 (C)	Juanita Creek - NW/east trib	36 in, 194 ft., Concrete	88th Ave NE between NE 143rd and NE 144th Streets	4 - Likely full or at least partial barrier. Steeper at inlet, unknown slope throughout.	King County May have data on this pipe.	Very near headwaters, type N per DNR mapping, fish use or habitat near culvert doubtful. Full barrier is present downstream at 100th Ave. Little or no habitat present upstream. Replacement not justifiable based on fish use or habitat.	4	0.0
JC-18 (D)	Juanita Creek - NE/east trib	120 in, 62 ft., concrete	11019 NE 140th St	1 - Mostly passable. Juveniles may not be able to pass weirs at all flows.	Baffles installed - may be part of Windsor Vista restoration.	N/A - culvert is already passable.	4	0.0
JC-20 (24)	Juanita Creek - NE/east trib	60-inch CMP, 77 ft.	111th Ave NE	1 - Not a barrier - passage conditions are fairly good.	CIP to fix headwall on this culvert underway	N/A - culvert is already fully passable.	4	0.0
JC-24 (i)	Juanita Creek (east trib)	6-foot dia. CMP (or slightly larger*)	Apartment driveway culvert off of 114th Pl. NE	1 - fully passable	To complete series below I-405. *Culvert is countersunk such that the full diameter could not be measured.	N/A - culvert is already passable.	4	0.0
FO-2 (jj)	Forbes Creek	Bolted CMP arch. 11.5 feet wide at substrate by 3.5 feet high at downstream. Upstream end is 13 feet wide by 7 feet high.	Forbes Creek Drive	1 - Fully Passable, not a barrier. Meets stream simulation in principle.	Not identified in the 2005 Master Plan. The concrete weir below the outlet is not and should not be a barrier unless it becomes clogged with debris. May need maintenance from time to time.	N/A - culvert is already passable.	4	0.0
FO-3 (CKC-4)	Drainage tributary to Forbes Creek	24-inch concrete	CKC near dead end of 111th Ave NE	4 - Full barrier due to plunge at outfall. 4-foot plunge into 1-foot-deep pool	Fairly good flow for previously dry weather – incised channel downstream. Fairly good flow of about 0.1 cfs on 10-18-13	Small stream, but may be perennial. Downstream passage unknown may need additional investigation, may be too steep. Little habitat upstream due to headwater reach. Moderate cost. Expected to be low priority.	4	0.0
FO-4 (CKC-3)	Drainage tributary to Forbes Creek	24 inch concrete	CKC near dead end of 111th Ave NE	3 - mostly a barrier. Steep, lack of flow. Not expected to be a fish-bearing stream.	Culvert dry this date. Drainage is too small and dry to be fish habitat. Appears to be an ephemeral stream with flow only in response to wet weather. No plunge – partially clogged with leaves and debris – no pool, no flow.	Not a fish-bearing stream due to low flows, steepness downstream (natural barrier), and likely seasonal flows. Little or no fish habitat upstream. Very low priority. Costs moderate.	4	0.0
FO-5 (CKC-2)	Drainage tributary to Forbes Creek	36 in. CMP	Cross Kirkland Corridor – near Forbes Creek Drive	4 - Not passable, absolute barrier.	A plunge at the outfall is about 6 feet high. Trickle of flow on 10/18/13. Incised channel about 5 feet deep extends downstream. This drainage is judged to be too small and steep to be fish habitat and so is a low priority for replacement on that basis, though erosion at the outfall could stand to be addressed. (Assessment does not include parallel access road upstream.)	Not a fish-bearing stream due to low flows, steepness downstream (natural barrier), and likely seasonal flows. Little or no fish habitat upstream. Very low priority. Costs moderate.	4	0.0

Number*	Stream	Culverts	Approximate Location	Fish Passable?	Comments	Benefits and Feasibility; (Other Barriers and Upstream Habitat)	Priority Rating	Priority Index
FO-8				Passable culvert installed with the I-405 Nickel Project			4	0.0
FO-11 (oo)	Forbes Creek	40' wide by 30" high "squashed" CMP	NE 97th St	1 - Not a barrier unless when clogged with trash at the upper end.	Not identified as a barrier in the 2005 Master Plan. Trash rack and cage at the upstream end and then an additional 4 feet of 24-inch dia. concrete pipe. Not a barrier unless clogged with trash. Channel upstream and downstream appears to have been dredged historically. LOTS of beaver activity in this area...	N/A - culvert is already passable.	4	0.0
MB-1 (CKC-19)	Moss Bay drainages (mostly piped to mouth)	24-inch Concrete	CKC at Kirkland Way and Railroad Avenue	4 - Appears impassable due to slopes and depths.	Weird thumping and banging noises from within the culvert. This culvert is entirely downstream of the CKC and so does not cross it.	This Moss Bay Drainage tributary is likely not accessible to migratory fish due to long, continually piped sections downstream with possible included plunges and/or velocity barriers. No resident fish detected in 1998. However, the stream appears to have good year-around flows. Very limited lengths of non-piped channel upstream. Moderate costs, low priority.	4	0.0
MB-2 (CKC-20)	Moss Bay drainages (mostly piped to mouth)	24-inch Concrete	Kirkland Way	3 - very long with moderate slope; some fish could get through	Very long, 24-inch concrete pipe under the CKC. Not fully impassable, but adjacent piped stream sections could be impassable. #18, the 30-inch concrete culvert under Railroad Avenue immediately upstream is likely impassable based on sounds indicating a significant plunge within.	This Moss Bay Drainage tributary is likely not accessible to migratory fish due to long, continually piped sections downstream with possible included plunges and/or velocity barriers. No resident fish detected in 1998. However, the stream appears to have good year-around flows. Very limited lengths of non-piped channel upstream. Moderate costs, low priority.	4	0.0
MB-3 (CKC-18)	Moss Bay drainages (mostly piped to mouth)	30-inch CAP	Railroad Avenue	4 - the 30-inch concrete culvert under Railroad Avenue is likely impassable based on sounds indicating a significant plunge within.	This is likely the 30-inch under Railroad Avenue. (Only #20 crosses under CKC. #19 is downstream, #18 upstream.)	Culverts 18-20 are all adjoining on the same stream and rate similarly. This Moss Bay Drainage tributary is likely not accessible to migratory fish due to long, continually piped sections downstream with possible included plunges and/or velocity barriers. No resident fish detected in 1998. However, the stream appears to have good year-around flows. Very limited lengths of non-piped channel upstream. Moderate costs, low priority.	4	0.0
MB-4 (CKC-10)	Moss Bay drainages (mostly piped to mouth)	30-inch RCP	Near Kirkland Way	4 (or N/A?). No flow, no channel at plugged outfall, though flow apparently piped farther downslope in another pipe.	Found 24-inch concrete inlet as the ditch/swale along Kirkland Way. Then "DRAIN" manhole along CKC. Found 30-inch CMP "outfall" on west side of CKC fully filled with concrete! Flow apparently piped farther downslope in another pipe.	Similar to other small CKC drainages, stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Limited or no habitat upstream. Very low priority. Could be high cost due to convoluted nature of crossing.	4	0.0
MB-5 (CKC-9)	Moss Bay drainages (mostly piped to mouth)	Unable to confirm because the outlet is submerged (36-inch RCP from list)	Kirkland Way	3 - Not a full barrier due to outfall conditions, but upstream unknown.	There is no culvert inlet along CKC. Unable to verify culvert size and type because the outlet is submerged. Slope appears fairly flat due to backwatering at outfall.	Similar to other small CKC drainages, stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Limited or no habitat upstream. Since there is a lack of habitat upstream, this culvert's improvement for fish passage or habitat purposes should be given a very low priority. Moderate cost.	4	0.0
MB-6 (CKC-8)	Moss Bay drainages (mostly piped to mouth)	24-inch concrete	CKC - South of 85th	2 - The culvert itself is not a barrier to the manhole on the east side	Manhole with no inlet next to storage building on upstream side. Minimal trickle of flow present 10/23.	The culvert is already passable, though it would not meet current standards for width etc. Very low priority since it is already passable and no habitat would be made accessible upstream.	4	0.0
MB-7 (CKC-7)	Moss Bay drainages (mostly piped to mouth)	North CKC swale inlet 18-inch CMP, South CKC swale inlet 12-inch plastic, found inlet to 24-inch CMP upslope	CKC - North of 85th	4 - Full barrier	Pipes enter from both north and south along the CKC, but a stream/drainage culvert inlet was also found beyond the blackberries upstream. A 24-inch CMP with a trickle of flow on 10/23/13. Outlet not found. Slope 6% based on inlet, sounds of plunges within.	Stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Limited or no habitat upstream. Since there is a lack of habitat upstream, this culvert's improvement for fish passage or habitat purposes should take a fairly low priority. Moderate cost.	4	0.0
MB-8 (CKC-6)	Moss Bay drainage (mostly piped to mouth))	3-foot diameter concrete	9th Ave, 9th Street	4 - Full barrier due to slope and length	Trickle of flow. Steep upstream. Doubtful that there is too much habitat to open up - upstream. Outlet not found. Moderately steep + 5-6%	Stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, the creek may have year-around flow. Limited or no habitat upstream. Since there is a lack of habitat upstream, this culvert's improvement for fish passage or habitat purposes should take a fairly low priority. Moderate cost.	4	0.0
HSB-1 (CKC-16)	Houghton Slope B	24-inch Concrete	NE 43rd Street	4 - full barrier due to length, slope, lack of flow. This is an ephemeral drainage. Dry 11/8/13		Not a fish-bearing stream due to low, ephemeral flows, steepness downstream (natural barrier). Little or no fish habitat upstream. Very low priority. Costs moderately high due to CKC embankment.	4	0.0
HSB-2 (CKC-15)	Houghton Slope B	24-inch Concrete	NE 44th Street	4 - Absolute barrier. High plunges at both inlet and outlet, steep in between. No pool at outlet	Inlet - trickle of flow on 11/8/13 plunges vertically 4-6 feet in blackberries; inlet not definable. Outlet pipe section has fallen off (see photos). Fish use of stream unlikely (regardless of culvert) due to channel steepness and low flows.	Not a fish-bearing stream due to low flows, steepness downstream (natural barrier), and likely seasonal flows. Little or no fish habitat upstream. Very low priority. Costs moderate.	4	0.0
HSB-3 (CKC-14)	Houghton Slope B		Between 46th Street and 47 th Place	4 - Likely a full barrier	Inlet along E side of CKC not found. Outlet is in a fenced, gated private development and not accessible. Need access. Still, likely a full barrier.	Incomplete information, but not likely a fish-bearing stream. Extensively piped both upstream and downstream. Cost of replacement likely high due to high depth of embankment fill.	4	0.0

Cross Kirkland Corridor Culverts evaluated for fish passage - with Kirkland's 2014 update of its Surface Water Master Plan

Fish Passage Scoring: 1 - Passable ; 2 - Hindrance to passage; 3 - Partial Barrier; 4 - Full or nearly Full Barrier

Number*	Stream	Culverts	Approximate Location	Fish Passable?	Comments	Benefits and Feasibility; (Other Barriers and Upstream Habitat)	Priority Rating	Priority Index
Forbes Creek								
CKC-1A (FO-6, SD-0054A, tracks)	Forbes	4' concrete	Forbes Creek crossing under the Eastside Rail Corridor behind the business located at 10830 117th Ave NE	2 - hindrance or partial barrier	The culvert is backwatered more than half the way through then steeper at the upstream end. Rates between a hindrance and partial barrier. Most fish could pass most of the time. Note that there is only up to 200 feet upstream of the RR and spur to an absolute barrier. Little benefit unless upstream passage barriers are corrected as well.	This culvert is on Forbes Creek, a significant, fish-bearing stream, and with no full barriers downstream. However, there is only approx. 200 feet of upstream channel before an absolute barrier. Not a full barrier now. Limited benefit to improvement unless upstream passage barriers are corrected as well, including the spur crossing just upstream as well as a hanging culvert plunging onto a rip-rapped slope. Medium priority within the City for replacement on a proactive basis since it is largely passable at present. Moderate cost.	3	4.8
CKC-1B (FO-7, SD-0054B, spur)	Forbes	4' concrete	Forbes Creek crossing under the Eastside Rail Corridor behind the business located at 10830 117th Ave NE	3 - mostly a barrier though some fish may be able to pass at some times/flows. Not fully passable.	A substantial barrier is formed by 18" high woody debris jam blocking the inlet of a fairly steep culvert along with 15" cascades at the outlet. Daylighting the spur (only) would still allow the main RR grade to be used as a trail, however an absolute, incontrovertible barrier is present about 200 feet farther upstream.	Similar to the trail/RR crossing immediately downstream. This culvert is on Forbes Creek, a significant, fish-bearing stream, and with no full barriers downstream. However, there is only approx. 200 feet of upstream channel before an absolute barrier. This spur crossing is more of a barrier than the primary trail/RR crossing just downstream. Again, limited benefit to improvement unless upstream passage barriers are corrected as well. Medium priority within the City for replacement on a proactive basis. Moderate cost.	2	5.7
CKC-2 (FO-5)	Drainage tributary to Forbes Creek	36 in. CMP	Cross Kirkland Corridor – near Forbes Creek Drive	4 - Not passable, absolute barrier.	A plunge at the outfall is about 6 feet high. Trickle of flow on 10/18/13. Incised channel about 5 feet deep extends downstream. This drainage is judged to be too small and steep to be fish habitat and so is a low priority for replacement on that basis, though erosion at the outfall could stand to be addressed. (Assessment does not include parallel access road upstream.)	Not a fish-bearing stream due to low flows, steepness downstream (natural barrier), and likely seasonal flows. Little or no fish habitat upstream. Very low priority. Costs moderate.	4	0
CKC-3 (FO-4)	Drainage tributary to Forbes Creek	24 inch concrete	CKC near dead end of 111th Ave NE	3 - mostly a barrier. Steep, lack of flow. Not expected to be a fish-bearing stream.	Culvert dry this date. Drainage is too small and dry to be fish habitat. Appears to be an ephemeral stream with flow only in response to wet weather. No plunge – partially clogged with leaves and debris – no pool, no flow	Not a fish-bearing stream due to low flows, steepness downstream (natural barrier), and likely seasonal flows. Little or no fish habitat upstream. Very low priority. Costs moderate.	4	0
CKC-4 (FO-3)	Drainage tributary to Forbes Creek	24-inch concrete	CKC near dead end of 111th Ave NE	4 - Full barrier due to plunge at outfall. 4-foot plunge into 1-foot-deep pool	Fairly good flow for previously dry weather – incised channel downstream. Fairly good flow of about 0.1 cfs on 10-18-13	Small stream, but may be perennial. Downstream passage unknown may need additional investigation, may be too steep. Little habitat upstream due to headwater reach. Moderate cost. Expected to be low priority.	4 (if nonfish) 2 (if fish)	0
Moss Bay Drainages								
CKC-5 (MB-9)	Moss Bay (mostly piped to mouth)	24-inch concrete	NE 96th Street	2 - Passable, but would not meet design standards	This culvert would be readily passable by any, say, resident cutthroat that may inhabit the stream now or going forward, however stream is almost entirely piped downstream. No plunge – culvert is half-full backwatered at outfall	Fish use was not detected by electrofishing in 1998. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, the creek may have year-around flow. Limited length of channel and habitat upstream. Since this culvert is mostly passable at present and limited habitat occurs upstream, it's improvement for fish passage or habitat purposes should take a fairly low priority. Moderate cost.	3	1.7
CKC-6 (MB-8)	Moss Bay drainage (mostly piped to mouth)	3-foot diameter concrete	9th Ave, 9th Street	4 - Full barrier due to slope and length	Trickle of flow. Steep upstream. Doubtful that there is too much habitat to open up – upstream. Outlet not found. Moderately steep - + 5-6%	Stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, the creek may have year-around flow. Limited or no habitat upstream. Since there is a lack of habitat upstream, this culvert's improvement for fish passage or habitat purposes should take a fairly low priority. Moderate cost.	4	0
CKC-7 (MB-7)	Moss Bay drainages (mostly piped to mouth)	North CKC swale inlet 18-inch CMP, South CKC swale inlet 12-inch plastic, found inlet to 24-inch CMP upslope	CKC - North of 85th	4 - Full barrier	Pipes enter from both north and south along the CKC, but a stream/drainage culvert inlet was also found beyond the blackberries upstream. A 24-inch CMP with a trickle of flow on 10/23/13. Outlet not found. Slope 6% based on inlet, sounds of plunges within.	Same as above. Stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Limited or no habitat upstream. Since there is a lack of habitat upstream, this culvert's improvement for fish passage or habitat purposes should take a fairly low priority. Moderate cost.	4	0
CKC-8 (MB-6)	Moss Bay drainages (mostly piped to mouth)	24-inch concrete	CKC - South of 85th	2 - The culvert itself is not a barrier to the manhole on the east side	Manhole with no inlet next to storage building on upstream side. Minimal trickle of flow present 10/23.	The culvert is already passable, though it would not meet current standards for width etc. Very low priority since it is already passable and no habitat would be made accessible upstream.	4	0
CKC-9 (MB-5)	Moss Bay drainages (mostly piped to mouth)	Unable to confirm because the outlet is submerged (36-inch RCP from list)	Kirkland Way	3 - Not a full barrier due to outfall conditions, but upstream unknown.	There is no culvert inlet along CKC. Unable to verify culvert size and type because the outlet is submerged. Slope appears fairly flat due to backwatering at outfall.	Similar to other small CKC drainages, stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Limited or no habitat upstream. Since there is a lack of habitat upstream, this culvert's improvement for fish passage or habitat purposes should be given a very low priority. Moderate cost.	4	0
CKC-10 (MB-4)	Moss Bay drainages (mostly piped to mouth)	30-inch RCP	Near Kirkland Way	4 (or N/A)? No flow, no channel at plugged outfall, though flow apparently piped farther downslope in another pipe.	Found 24-inch concrete inlet as the ditch/swale along Kirkland Way. Then "DRAIN" manhole along CKC. Found 30-inch CMP "outfall" on west side of CKC fully filled with concrete! Flow apparently piped farther downslope in another pipe.	Similar to other small CKC drainages, stream is likely too small to be fish-bearing. It is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Limited or no habitat upstream. Very low priority. Could be high cost due to convoluted nature of crossing.	4	0
CKC-18 (MB-3)	Moss Bay drainages (mostly piped to mouth)	30-inch CAP	Railroad Avenue	4 - the 30-inch concrete culvert under Railroad Avenue is likely impassable based on sounds indicating a significant plunge within.	This is likely the 30-inch under Railroad Avenue. (Only #20 crosses under CKC. #19 is downstream, #18 upstream.)	Culverts 18-20 are all adjoining on the same stream and rate similarly. This Moss Bay Drainage tributary is likely not accessible to migratory fish due to long, continually piped sections downstream with possible included plunges and/or velocity barriers. No resident fish detected in 1998. However, the stream appears to have good year-around flows. Very limited lengths of non-piped channel upstream. Moderate costs, low priority.	4	0
CKC-19 (MB-1)	Moss Bay drainages (mostly piped to mouth)	24-inch Concrete	CKC at Kirkland Way and Railroad Avenue	4 - Appears impassable due to slopes and depths.	Weird thumping and banging noises from within the culvert. This culvert is entirely downstream of the CKC and so does not cross it.	This Moss Bay Drainage tributary is likely not accessible to migratory fish due to long, continually piped sections downstream with possible included plunges and/or velocity barriers. No resident fish detected in 1998. However, the stream appears to have good year-around flows. Very limited lengths of non-piped channel upstream. Moderate costs, low priority.	4	0
CKC-20 (MB-2)	Moss Bay drainages (mostly piped to mouth)	24-inch Concrete	Kirkland Way	3 - very long with moderate slope; some fish could get through	Very long, 24-inch concrete pipe under the CKC. Not fully impassable, but adjacent piped stream sections could be impassable. #18, the 30-inch concrete culvert under Railroad Avenue immediately upstream is likely impassable based on sounds indicating a significant plunge within.	This Moss Bay Drainage tributary is likely not accessible to migratory fish due to long, continually piped sections downstream with possible included plunges and/or velocity barriers. No resident fish detected in 1998. However, the stream appears to have good year-around flows. Very limited lengths of non-piped channel upstream. Moderate costs, low priority.	4	0

Number*	Stream	Culverts	Approximate Location	Fish Passable?	Comments	Benefits and Feasibility; (Other Barriers and Upstream Habitat)	Priority Rating	Priority Index
Everest Creek								
EC-1 (CKC-11)	Everest Creek	18-inch CMP	CKC Between 6th Street S. and Railroad Ave.	3 - some fish could get through due to the short length and pool at the outfall.		Everest Creek is likely not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. However, would rank this culvert quite high for replacement: 1) It is a problem 2) The stream has good year-around flows and could support fish if re-introduced 3) The culvert is short and near the surface – so should be relatively low-cost and so a good value. Fair amount of habitat available upstream through Everest Park. Another culvert is just upstream that should also be included in the project. Cascades farther upstream. Everest has good year-around flow and could probably support resident trout, if introduced.	1	2.7
Houghton Slope A								
CKC-12 (HSA-1)	Houghton Slope A	4-foot-diameter concrete	Between 62nd and 64th Streets	4 - full, absolute barrier due to 1) 6-foot cascade plunge at outfall, 2) very long and very steep within, 3) piped for some distance upstream of CKC.	Good flow on 11/8/13. Bank instability on right side. Lots of boulder armoring. Wood in pool below culvert. Fish use unknown, but possible habitat for isolated trout. Culvert inlet(s) not found – mapped as piped for some distance upstream. 5-6 foot boulder cascade plunge, then large pool about 3-1/2 feet deep with wood and boulders. This pool absorbs a lot of energy.	Houghton Slope A Creek. No fish found in 1998 study, but appears to have good flows. not accessible to migratory fish due to long piped sections downstream with possible included plunges and/or velocity barriers. Possible habitat for a present or future isolated trout population. Extensively piped upstream, so little habitat would be made available without including upstream sections as well. Channel is very steep. Low priority due to barrier(s) downstream and questionable fish presence or fish habitat due to steepness of channel. Very expensive to replace due to high fill of the CKC and extensive piped sections extending upstream.	2	1.7
Carillon Creek								
CKC - 13 (CC-2, z)	Carillon Creek	24 in. concrete	Cross Kirkland Corridor	4 - Full barrier due to length, slope, lack of substrate, small dia., and high velocity.	This is a very steep culvert along a very steep stream segment. Very high fill embankment – expensive to replace at Cross-Kirkland Corridor. Fish presence not known but doubtful due to downstream barriers and overall steepness of the channel.	Also low priority due to full barrier(s) downstream and doubtful fish presence or fish habitat due to steepness of channel. High costs due to high fill embankment at Cross-Kirkland Corridor.	4	2.4
Houghton Slope B								
CKC-14 (HSB-3)	Houghton Slope B		Between 46th Street and 47 th Place	4 - Likely a full barrier	Inlet along E side of CKC not found. Outlet is in a fenced, gated private development and not accessible. Need access. Still, likely a full barrier.	Incomplete information, but not likely a fish-bearing stream. Extensively piped both upstream and downstream. Cost of replacement likely high due to high depth of embankment fill.	4	0
CKC-15 (HSB-2)	Houghton Slope B	24-inch Concrete	NE 44th Street	4 - Absolute barrier. High plunges at both inlet and outlet, steep in between. No pool at outlet	Inlet – trickle of flow on 11/8/13 plunges vertically 4-6 feet in blackberries; inlet not definable. Outlet pipe section has fallen off (see photos). Fish use of stream unlikely (regardless of culvert) due to channel steepness and low flows.	Not a fish-bearing stream due to low flows, steepness downstream (natural barrier), and likely seasonal flows. Little or no fish habitat upstream. Very low priority. Costs moderate.	4	0
CKC-16 (HSB-1)	Houghton Slope B	24-inch Concrete	NE 43rd Street	4 - full barrier due to length, slope, lack of flow. This is an ephemeral drainage. Dry 11/8/13		Not a fish-bearing stream due to low, ephemeral flows, steepness downstream (natural barrier). Little or no fish habitat upstream. Very low priority. Costs moderately high due to CKC embankment.	4	0
Cochran Springs Creek								
CKC - 17 (CO-3)	Cochran Springs Creek	3-foot diameter steel (observed at inlet)	Cross Kirkland Corridor	4 - full barrier due to length, slope, plunge at outlet, high velocity.	2-foot vertical plunge, but high velocities put flow horizontally against large boulders. About a 12-18 inch pool. Strong flows, approx 2 cfs on 11/8/13. The CKC prism above the culvert is high and massive. Expensive to replace, however the flows are here to support fish. High cutthroat usage documented downstream to Lake Washington.	Per Appendix F of the 2005 Surface Water Master Plan, there is a complete fish block just downstream at the culvert under NE 38th Place. Cochran Spring Creek has good, year-around flows and is used by cutthroat downstream but is rated type N per DNR mapping upstream. A fairly short distance upstream to the spring source of flow, so the amount of habitat made available would be limited. Very costly to replace this culvert due to a very high fill embankment at the CKC.	2	2.2

Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual

Fish Passage Priority Index

The variability in costs, amounts of habitat gain, and species utilizing potential project sites throughout Washington State can make the characterization and prioritization of corrections to fish passage barriers complex. The WDFW Fish Passage Inventory process uses a Priority Index model to consolidate several factors that affect a fish passage project's feasibility (expected passage improvement, production potential of the blocked stream, fish stock health, etc.) into a manageable framework for developing prioritized lists of projects. The result is a numeric indicator giving each project's relative priority that includes production benefits to both anadromous and resident salmonid species adjusted for sympatric species interactions (species complexes). The Priority Index (PI) for each barrier is calculated as follows:

$$PI = \sum_{\text{all species}} \sqrt[4]{[(BPH) \times MDC]}$$

PI = Fish Passage Priority Index

- Relative project benefit considering cost.
- The PI is actually the sum (Σ all species) of individual PI values, one of which is calculated for each species present in a stream (e.g., PI Coho is added to PI chum to obtain PI all species).
- The quadratic root in the equation is used because it provides a more manageable number and represents a geometric mean of factors used.

B = Proportion of passage improvement

- Proportion of fish run expected to gain access due to the project; gives greater weight to projects providing a greater margin of improvement in passage.
- Derived from passability estimate:

0% passable = 1.00

33% passable = 0.67

67% passable = 0.33

- Refer to Table 3.3 in Chapter 3 for a discussion of judging percent passability.

P = Annual adult equivalent production potential per m²

- Estimated number of adult salmonids that can potentially be produced by each m² of habitat annually.
- The values (adults/m²) are species specific; Chinook salmon = 0.016, chum salmon = 1.25, Coho salmon = 0.05, pink salmon = 1.25, sockeye/kokanee salmon = 3.00, steelhead = 0.0021, bull trout/Dolly Varden = 0.0007, searun cutthroat trout = 0.037, resident cutthroat/rainbow trout = 0.04.

H = Habitat gain in m²

- Measured/calculated from a habitat survey (described in Chapter 8); gives greater weight to projects that will make greater amounts of habitat available.
- Spawning area values used for species complexes normally limited by spawning habitat
- (sockeye, chum, and pink salmon) and rearing area values used for species complexes
- normally limited by rearing habitat (Coho salmon, searun cutthroat, Chinook salmon, and steelhead), (resident cutthroat/rainbow trout and bull trout/Dolly Varden).
- When more than one species within a species complex is present, H is modified to reflect sympatric interactions among species with similar freshwater life histories. The result is a reduction of single species' habitat area values when competing species coexist.

M = Mobility Modifier

- Accounts for benefits to each fish stock for increased mobility (access to habitat being evaluated); gives greater weight to projects that increase productivity of species that are highly mobile and subject to geographically diverse recreational and commercial fisheries by providing access to habitat currently limiting productivity. 2 = Highly mobile stock subject to geographically diverse recreational and commercial fisheries (anadromous species). 1 = Moderately mobile stock subject to local recreational fisheries (resident species).

D = Species Condition Modifier

- Representation of status of species present; gives greater weight to less healthy species as listed in the Washington State Salmonid Stock

Inventory (SaSI) report (WDFW 2003). In the absence of a SSASI assignment, stock condition should be estimated using the best available information.

3 = Condition of species considered critical.

2 = Condition of species considered depressed or stock of concern.

1 = species not meeting the conditions for 2 or 3.

C = Cost Modifier

- Representation of projected cost of project; gives greater weight to less costly projects.
 - 3 = incremental funds needed \$100,000.
 - 2 = incremental funds needed between >\$100,000 and \$500,000.
 - 1 = incremental funds needed >\$500,000.
- All barriers receive a cost modifier value of 2 until engineering evaluations are completed