Fish Passage Criteria, Stream/Estuary/Tidal

The following summarizes the fish passage criteria required by ODFW, NOAA, and WDFW (for reference due to the same salmonid species). The rationale for where the original culvert invert and tidal slough design came from based on these requirements is presented (*blue italics*).

ODFW

Oregon Department of Fish and Wildlife Oregon Administrative Rules (Division 412) describes state fish passage regulations (dated January 9, 2006 and filed in Oregon State Archives most recently June 13, 2008) - (http://arcweb.sos.state.or.us/rules/OARS_600/OAR_635/635_412.html). Within Division 412, OAR 635-412-0035 (4) and (5) specify fish passage criteria for **estuaries**, **floodplains** and **wetlands**. Each section from the rules is presented below, with notes.

(4) Requirements for fish passage at artificial obstructions in estuaries, and above which a stream is present, are:

Historic channels and sloughs exist behind the culvert – they are fed by intermittent and perennial springs and seeps coming from the bluffs, by ground water, and by surface water from the Willamette River. The 1852 GLO map shows an outflow channel from a pond in much the same location as existing. The original Oaks Bottom Management Plan (Houck 1988) indicated that the area is fed by springs/seeps and Willamette River flow. Due to the overall silting in and filling in of the site and transitions to willow dominated habitat, the water control structure was installed to allow greater flooding of the wetland and return the site to more of an open water/emergent wetland. Because of the long-term historical presence of channels and sloughs at Oaks Bottom, OAR 635-412-0035 (4) should be considered.

(a) Fish passage shall be provided at all current and historic channels; *1852 GLO map shows pond and outlet channel in similar location to the existing condition – there is both a historic and current channel at the culvert*

(b) Fish passage structures shall meet the criteria of OAR 635-412-0035(2) or (3), except fish passage structures shall be sized according to the cumulative flows or active channel widths, respectively, of all streams entering the estuary above the artificial obstruction; *Proposed culvert width of 12 feet accommodates the active channel width of the slough.*

(c) Tide gates and associated fish passage structures shall be a minimum of 4 feet wide and shall meet the requirements of OAR 635-412-0035(2) within the design streamflow range and for an average of at least 51% of tidal cycles, excluding periods when the channel is not passable under natural conditions. *Proposed culvert width is greater than 4 feet wide. Design stream flow ranges are described below (see OAR 635-412-0005) for definitions:*

> Design stream flow range is defined as "flows within a stream, bracketed by the Low Fish Passage Design Flow and the High Fish Passage Design Flow, for which a fishway shall provide fish passage.

High fish passage design flow means the daily average stream discharge that is exceeded 5% of the time during the period when the Department determines that native migratory fish require fish passage.

Low fish passage design flow means the mean daily average stream discharge that is exceeded 95% of the time, excluding days with no flow, during the period when the Department determines that native migratory fish require fish passage.

If the above design stream flow ranges are met, then requirements to meet "at least 51% of tidal cycles" will be met. Need clarification from ODFW on what the 51% of tidal cycles means. Does it mean 51% of complete tidal cycles (high to low tides) or 51% or greater of mean tidal elevation?

Regarding "rearing season", the season of interest for juvenile salmonid rearing and refuge is winter and spring through their outmigration as smolts into the Columbia. Originally suggested mid-Oct thru mid-July to encompass the complete season from onset of rains through outmigration. However, it would likely make sense for this season to be changed to November 1 thru June 30 to generally encompass when flows increase on the Willamette through the peak of the outmigration. Note, the definition of rearing season excludes the summer and early fall months when the channel would not be accessible under natural condition – there is no expectation (or desire) to have the channel accessible during the summer when water temperatures are high and predators are present.

Regarding high fish passage design flow, we started with the not to be exceeded more than 5% design flow (in this case "stream discharge" is interpreted as water surface elevation, or inundation frequency) at high-tide – this has been the reference for other projects in the City, including Ramsey I, Ramsey II, and Powers Marine. The high flow design is primarily directed at ensuring velocities do not exceed swimming ability of target species at the higher flows. Sizing of culvert has been selected to ensure velocities are generally less than 2 feet/second even at high flows.

Regarding low fish passage design, this is interpreted as 95% frequency at low tide during the rearing season. However, recognizing the depths of excavation that could require and concerns raised by project team representatives beginning in spring 2007, we suggested lowering the design criteria to a 75% inundation frequency during the rearing season, believing this was a reasonable design criteria, given the desire to protect the wetlands from drainage while still providing frequent fish access. Merri Martz, Cindy Studebaker and Scott Clement met in summer 2007 to confirm this approach; we agreed this was a reasonable decision given the desire to avoid and minimize impacts to the wetlands, while also recognizing the desire to provide functional rearing habitat to juvenile salmon. The 75% frequency for average daily low tides is approximately 5.7 feet in elevation (current culvert invert is at approx 7.2 feet). Also, recognizing that just because the water touches the invert at 5.7 feet, does not mean that fish can access so some additional depth of elevation is necessary to allow fish to swim into and out of the culvert and proposed tidal sloughs.

(5) Requirements for fish passage at artificial obstructions in estuaries, floodplains, and wetlands, and above which <u>no stream is present</u>, are:
Although historic channel sloughs exists behind the culvert, one could debate whether a "slough" would be considered in the same context as a "stream", hence it is prudent to consider design criteria outlined in this section as well.

(a) Downstream Fish Passage:

(A) Downstream fish passage shall be provided after inflow which may contain native migratory fish; *Replacement of the culvert and removal of the water control structure will reduce stranding that may occur under existing conditions where fish could be trapped in the reservoir, behind the WCS or in the north ponds without a surface water outlet.*

(B) Downstream fish passage shall be provided until water has drained from the estuary, floodplain, or wetland, or through the period determined by the Department which shall be based on one, or a combination of, the following: *Did not think it would be reasonable to provide downstream fish passage until the wetlands are completely drained, which does not generally occur anyway (always some residual water in reservoir, etc.… Reviewed the below factors in considering design criteria.*

(i) A specific date; *As with all or most other recent projects in the Lower Willamette River for City of Portland, recommended design ("rearing") window is from mid-Oct thru mid-July. This is based on the presence of juvenile salmonids reported in the Willamette Fish Study and other field data indicating that juvenile salmonids reside in the lower River through the summer. Summer months have never been included in the consideration due to high water temperatures, predators, etc. This has been the working design assumption until recently. The suggestion that revising the rearing season window to November 1 thru June 30 to better match ODFW in-water work window, and to better match flow conditions in the lower Willamette River has been incorporated.*

(ii) Water temperature, as measured at a location or locations determined by the Department; *As described at the end of this memo based on a literature review, considerations for water temperature are: Preferred - between 12 and 14 ℃, Lower lethal temperature is 0.8 ℃ and upper lethal temperature is 26 ℃. Temperature gages have been installed in Oaks Bottom are we will be getting the data as the summer progresses. We have yet to further investigate how the proposed grading plan and water depths might affect water temperature in the slough and wetlands, and what those effects on fish behavior and productivity might be.*

(iii) Ground surface elevation; *driven by minimum water depth (see below)*

(iv) Water surface elevation; *Recommend a minimum 18-inch water depth at the culvert to allow fish passage into Oaks Bottom and provide functional rearing habitat moving upstream from the culvert back into the historic channel sloughs.*

The recommended rearing depth was selected based on a literature review of preferred/suitable habitat for juvenile salmon (fry, subyearling and yearling) in low-land riverine systems in the PNW. Depth considerations include predator avoidance, cover, velocity, likelihood of vegetation and invertebrate food source. Note, the deepest water depths will be at the culvert - water depth will get shallower from culvert moving upstream into the channels/sloughs.

(v) Some other reasonable measure. *– Recommend that inundation frequency is the most reasonable measure, based on mean water surface elevation (e.g, takes into account daily tidal fluctuations) during the rearing season, targeting the 75th percentile for accessibility.*

(C) Egress delays may be approved by the Department based on expected inflow frequency if there is suitable habitat and as long as passage is provided by the time the conditions in OAR 635-412-0035(5)(a)(B) occur; *Suitable rearing habitat is expected to be present thru the rearing season - Positive drainage (at least 0.5% slope) will be provided from the upstream end of excavation out through the culvert.*

(D) A minimum egress flow of 0.25 cubic feet per second (cfs) at one point of egress shall be provided; *Have not included this criterion to-date. Tidal fluctuations would likely be far in excess of 0.25 cfs. Outflow from springs/reservoir is generally expected to be 0.25 cfs or more.*

(E) Egress flow of 0.5 cfs per 10 surface acres, for at least the first 100 surface acres of impounded water, shall be provided; *Have not considered this criterion to-datel; would likely result in a criterion of 0.5 cfs since no more than 10 acres will be impounded. Tidal fluctuations would likely be far in excess of 0.5 cfs. Outflow from springs/reservoir may not meet 0.5 cfs.*

(F) All plunging egress flows shall meet the requirements of OAR 635-412-0035(2)(l)(B); *Do not anticipate plunging egress at any point.*

(G) If egress flow is provided by a pump, it shall be appropriately screened; *Do not anticipate using a pump to provide egress.*

(H) The minimum water depth and width through or across the point of egress shall be 4 inches; *This criteria will be met with the proposed 18 inches at the culvert. Need to clarify with ODFW if this criterion should be considered in the context of the north channel – If it would apply throughout the length of the channel, excavation depth will likely deepen towards the northern pond.*

(I) The ground surface above the artificial obstruction shall be sloped toward the point(s) of egress to eliminate isolated pools; *Project will provide 0.5% positive drainage in channel sloughs and wetland ponds considered "rearing habitat". Note, excavation was originally proposed to connect up both the south and the north circular ponds ("duck donuts"); however the Project Team concluded that the north area was unique and*

should be protected. In fall 2007 the channel to the north pond was removed from the excavation plan and only proposed as a grubbing through the reed canary grass root mat. This area will provide high flow refugia to juvenile salmon during higher Willamette River flows (above elevation 12.7) – Because this area would only be used during flood flows, positive drainage and excavation is not suggested.

(J) An uninterrupted, open connection with a minimum water depth of 4 inches shall be present from the point of egress to the downstream waters of this state, unless another connection is provided as per OAR 635-412-0035(2)(l)(A). *This minimum water depth has not been considered in the context of upper channel – If we choose to design to this criteria, excavation depth will likely deepen towards the northern pond.*

(b) Upstream Fish Passage: a fishway or road-stream crossing structure with or without a tide gate shall be provided during the period determined by the Department if there is current or historic native migratory fish spawning or rearing habitat within the estuary, floodplain, or wetland area impounded by the artificial obstruction. *Note, historic is defined as pre-1859 (see OAR 635-412-0005). We know this area was historically connected to the Willamette River per 1852 GLO map, and that juvenile salmon would very likely have used this off-channel habitat to rear. We know that channel sloughs and floodplain wetland habitat comprised this area. The existing culvert does not provide suitable access to the artificially impounded area. Providing upstream fish passage (in the context of estuaries, floodplains and wetlands) is required by state law. I believe we can do this if the downstream fish passage criteria (described above) are met.*

Although site conditions at Oaks Bottom may not precisely fit either one of these sections (e.g, is a slough a "stream" as the OARs are written?) it is clear what the intent of the state law suggests - If an area was historically (or is currently) accessible to native fish, then passage is required.

NOAA

For fish passage in culverts in streams must have minimum 6 inches depth for juveniles and maximum 1 fps velocity at:

Low flow design is the mean daily average streamflow exceeded 95% of the time during migration season

High flow design is mean daily average streamflow exceeded 5% of the time during fish passage season

For tide gates and structures in estuaries they are still developing guidance.

WDFW

For fish passage in culverts in streams must have minimum 10 inches of depth and maximum 3 fps velocity (assume a culvert with natural substrate will pass juvenile fish if designed per adult trout criteria) at:

Low flow design is the 2-year 7-day average low flow

High flow design is mean daily flow

For fish passage in tidal zones/estuaries should meet depth and velocity criteria 90% of the time during migration period (or period of interest), or develop specific criteria for project to be approved by WDFW.

Fish Habitat/Use Preferences

- Preferred water depth for rearing juveniles ~1.5 feet in shallow shorelines, off-channel areas and other slow velocity habitats for winter rearing
- Chinook fry and juveniles prefer heavily vegetation side-channels, blind sloughs, tidal sloughs with mudflats or marshes, inundated floodplains, backwaters, and shallow shorelines
- Coho will utilize backwaters, sloughs, side-channels and channel margins for winter rearing and refuge
- Water temps between 12 and 14 °C preferred; lower lethal temp is 0.8 °C and upper lethal temp is 26 °C.