4 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

4.1 Introduction
This chapter discusses the affected environment and potential environmental consequences, or impacts, of the alternatives being considered. Impacts include: direct or primary effects, which are caused by the project and occur at the same time and place; indirect or secondary effects, which are caused by the project and are later in time or farther removed in distance but are still reasonably foreseeable; and cumulative effects, which result when the proposed action’s incremental impacts are added to the impacts of other past, present, and reasonably foreseeable future actions, regardless of the agency or person who undertakes them. Cumulative effects can result from individually minor, but collectively major actions that take place over time.
4.2 Geology and Soils

4.2.1 Affected Environment

Information for this section is from the Earth Resources Environmental Impacts Technical Report (MWH 2006c). Two reconnaissance-level field inspections were performed in October and November 2005.

4.2.1.1 General

The project area is located at the boundary between the eastern Coast Range and western Willamette Valley. Henry Hagg Lake and Scoggins Dam are located in the lower Scoggins Creek Valley in the western part of the Tualatin Valley region of the Willamette Valley. The RWP would be located in the lowlands of the Tualatin Valley from the Tualatin River to the uplands of the Scoggins Creek Valley. The Willamette Pipeline would be located in the Tualatin Valley lowlands from the Willamette River, crossing the Tualatin River, to Beaverton south of Hall Creek. Terrain is gently sloping in the lowlands and valley floors and gently rolling to moderately steep-sloped in the vicinity of Henry Hagg Lake and Scoggins Dam. Elevations in the project area are approximately 170 to 200 feet on the valley floor and between 1,000 and 2,000 feet in the uplands. The Scoggins Creek valley is bounded by moderately steep hills and rock outcrops are common along its northern valley slopes. The Tualatin Valley consists of shallow rolling hills and flat agricultural lowlands (MSA 2004).

4.2.1.2 Soil Types

Soils within the project area originate from the weathering of marine sedimentary rocks and volcanic rocks of the Coast Range, and from erosion and redistribution of residual soils as alluvium. Soil profiles generally consist of a thin layer of topsoil (surface soil with a relatively high organic content from plant growth and decay) overlying a thick layer of residual soils (soils resulting from the in-place weathering of bedrock). Topsoil is typically composed of organic silt with variable amounts of fine sand. The underlying soils are formed from weathering and subsequent mixing of the marine sediments with the volcanic rock and weathered volcanic soils. Most soils are typically fine-grained (fine sands, silt, and clay).

The table in Appendix D identifies soils that that are most prevalent around Henry Hagg Lake, and that are in the vicinity of the RWP and Willamette Pipeline alignments. Melbourne silty clay loam is the most common soil type and is present all around the reservoir at slopes varying from gentle (2 to 7 percent slopes) to very steep (30 to 60 percent slopes). Laurelwood silt loam is common on the right bank area near Scoggins Dam. The remaining soil types are relatively minor components of the soils surrounding the lake and are present primarily in tributary drainages (NRCS 1982).

The McBee and Wapato units are the predominant soil types within the area that would be traversed by the RWP. Soils along the propose pipeline route along the valley floor include primarily deep silt loam and silty clay loam with relatively gentle slopes (0 to 12 percent). Steeper slopes (12 to 45 percent) are present in the adjacent uplands and in surface drainage channels traversing the lowlands. Minor soils along the RWP route include Aloha silt loam, Chehalem silty clay loam, Cove silty clay loam, Huberly silt loam, and Melbourne silty clay loam (NRCS 2005).
The Willamette Pipeline would traverse small amounts of 29 soil types. Aloha silt loam and Woodburn silt loam are present more than other types. Soils primarily are silt loams with gentle slopes (0 to 12 percent); few have slopes above 12 percent.

4.2.1.3 Sedimentation
Sediments originate primarily from erosion and transportation within the tributary stream drainages and are transported into the lake via the streams. Sediments also are eroded along the reservoir rim due to wave action and reservoir filling and drawdown, but sediment from reservoir rim erosion has been a relatively small component of sediments accumulated in the lake; there is no evidence of substantial quantities of sediments being flushed into the lake as a result of a landslide or major flood event. Most of the reservoir rim erosion probably occurred during the first few filling seasons and is believed to be relatively stable now. Total sediment accumulation in the reservoir is estimated at about 500 acre-feet (Reclamation 2001b), less than 1 percent of the active storage of the reservoir (53,323 acre-feet), with much of the accumulation occurring in the dead storage area. Reclamation estimates show about half of the sediment deposited in the reservoir occupies active storage. Thus, the average rate of sedimentation occupying active storage is estimated at 9.6 to 10 acre-feet per year. (Reclamation 2001b). The source materials for these sediments are primarily fine-grained, and consequently the sediments deposited are mostly fine sands, silt, and clay, or mixtures of these.

4.2.1.4 Seismic Hazards
According to the Seismic Zone Map of Oregon (Oregon Structural Specialty Code 1998), the project area and much of western Oregon is located in seismic zone 3. This corresponds to an intensity VIII earthquake of the Modified Mercalli (MM) Scale; a earthquake this size can produce considerable damage. There are three northwest trending faults in the project vicinity: the Gales Creek fault, the Newberg fault, and the Mount Angel fault. An evaluation was conducted by Reclamation (2006b) to estimate potential seismic ground motions at Scoggins Dam. On the basis of this evaluation, Reclamation determined that Scoggins Dam has a high probability of experiencing high levels of ground shaking. Additional evaluation is underway to better evaluate potential seismic impacts on Scoggins Dam.

4.2.1.5 Mineral and Energy Resources
There are no known coal, petroleum, or natural gas deposits, ore bodies, or other mineral or energy resources identified within the project area. There are two active quarries and one inactive quarry in the Henry Hagg Lake area and immediate vicinity. Another active quarry is adjacent to the Willamette Pipeline corridor.

A small sandstone and gravel pit, the Scott Quarry, is located near Scoggins Creek in the northwest quarter of Section 12 of Township 1 South, Range 4 West. The Scott Quarry is an active, family-owned quarry approximately ¾-acre in size that supplies gravel for road construction and maintenance, primarily for logging roads (Scott 2005).

A rock materials survey conducted in Washington County in 1978 (Gray et al. 1978) identified one other active quarry within the project area. A stone quarry operated by ODOT is in the northwest quarter of
Section 27 of Township 1 South, Range 4 West. This quarry is reported to have an excavated area of about two acres and a past production of 50,000 cubic yards. The rock type in the quarry is listed as being tuff (heat-consolidated volcanic fragments) silty sandstone, and is currently used exclusively by ODOT as a source for crushed rock in highway construction.

Another quarry within the project area, also in the northwest quarter of Section 27 of Township 1 South, Range 4 West, includes a pit used for crushed rock by the owner, Stimson Lumber (BLM 2000). Stimson uses rock crushed from its quarry for fill. This quarry has not been used since about 1996, and because the material requires crushing and processing for use it is not considered optimal for road construction.

Washington County and Reclamation have an agreement allowing the County to dispose of soil and rock generated from road maintenance activities at a site within the project area (Reclamation License Agreement No. 1-07-10-L1580). The site is not far from the entrance to Scoggins Valley Park on Scoggins Valley Road and is in the northwest quarter of Section 21, Township 21 South, Range 4 West, Willamette Meridian.

A commercial quarry, owned and operated by Morse Bros., is on the north side of SW Tonquin Road south of Tualatin and adjacent to the Willamette Pipeline corridor. The quarry is in the southwest quarter of Section 34, Township 2 South, Range 1 West, and in the northwest quarter of Section 3, Township 3 south, Range 1 West. The quarry provides sand and gravel. A Morse Bros. ready mix and asphalt facility is on the south side of Tonquin Road, across from the quarry.

4.2.1.6 Slope Stability
Slopes around Henry Hagg Lake and in the study area are generally stable and at low to moderate risk of large landslides. Eleven major landslide locations have been identified. These are believed to be thousands of years old and apparently occurred at about the same time, suggesting that they were triggered by a catastrophic event such as a large earthquake or a major flood event. These landslides show no evidence of recent movement. Landslides that have occurred recently have been small and are associated with saturation of soils at road cuts and/or removal of slope toe base (Reclamation 2001a), indicating that the method of road construction created conditions favorable for slope failure in highly susceptible soils, primarily the Melbourne silty clay loam soils, on moderate to steep slopes. No substantial landslides have occurred into the lake or its tributaries since its construction.

4.2.2 Environmental Impacts

4.2.2.1 Alternative 1 – No Action

4.2.2.1.1 Potential Impacts (direct, indirect)
Slope Stability
No impacts would occur.

Sedimentation
No impacts would occur. Sedimentation would continue to occur at approximately 9.6 to 10 acre-feet per year.
Seismic Hazards
Reclamation is evaluating seismic hazards at Scoggins Dam and would likely modify the dam to meet current safety of dams or other seismic standards.

Mineral and Energy Resources
Gravel and rock would be used, as needed, for maintenance of the perimeter road and other facilities in Scoggins Valley Park, as well as for construction of potential safety improvements to Scoggins Dam. No direct impacts to quarries in the project area would occur.

4.2.2.1.2 Cumulative Impacts
Rock and gravel used for maintenance, combined with that used for other development and maintenance associated with additional growth in the area, would reduce the quantity of mineral resources in the region.

4.2.2.2 Alternative 2 – 40-Foot Dam Raise

4.2.2.2.1 Potential Impacts (direct, indirect)
Slope Stability - Construction Impacts
Approximately 7 percent of the soils through which the RWP would pass are identified as having severe erosion potential. Also, most of the soils are at risk for lateral spreading and failure if saturated because of high groundwater and/or high precipitation. The alignment would include approximately 650 linear feet of trenching near a hillside on the south side of Scoggins Valley that presents some risk of hillside slope failure if the trench failed or incurred lateral spreading during construction.

However, modern construction practices would reduce the risk of erosion, landslide potential and excavation failure. RWP construction methods would include trench shoring, trench boxes, limits on length and duration of open trenches, shoring and/or sloping of excavations, erosion and sedimentation best management practices, adequate dewatering to minimize trench wall and floor saturation, and other industry standard practices. Implementing such methods would prevent slope and trench wall failures, lateral spreading in trenches and cuts, erosion of disturbed surfaces, and similar problems. The RWP corridor would be revegetated after construction in a manner consistent with existing vegetation. Therefore, no permanent impacts would occur during construction along the RWP alignment.

Impacts to the borrow areas and road construction areas can be controlled by following best management practices. Industry construction and safety standards would be followed, and impacts would be short-term.

Slope Stability - Operating Impacts
Saturation of soils above the reservoir water level, with the resulting pore pressure differentials and reduction in soil strength, is the primary cause of slope instability and failure at Henry Hagg Lake. Associated with this condition is saturation of road cuts and existing road fills (due to precipitation infiltration), which may be excessively steep for stable conditions when saturated.

Alternative 2 would increase the total length of shoreline in contact with soils having moderate or severe erosion potential by 42 percent and 76 percent, respectively. Also, it would increase the relative
percentage of shoreline in contact with soils with severe erosion potential (by 5 percent). However, since the landslides around Henry Hagg Lake have resulted from saturated soils (from precipitation and shallow groundwater) and low soil strength, not erosion, the increase in exposure to wave erosion is not expected to increase the risk of landslides.

Soils surrounding the reservoir are primarily of low to moderate risk of slope failure. Although site-specific geotechnical investigations are limited, a general evaluation of soil types around the reservoir and perimeter road have been performed by looking at typical soil engineering characteristics associated with slope stability. The evaluation indicates that some soils on moderate to steep slopes around the perimeter of the reservoir are at moderate to high risk of slope failure under saturated or near-saturated conditions, particularly where slope failure has occurred previously. Most slope failures that have occurred near the reservoir since construction of Scoggins Dam and perimeter road and the subsequent filling of the reservoir have occurred in Melbourne silty clay loam soils, on moderate (greater than 12 percent) to steep (greater than 20 percent) slopes, under wet or saturated conditions. However, it is known that landslides have occurred in the past prior to construction of the reservoir. Slope failures since construction of the reservoir generally do not appear to be associated with the reservoir but sometimes may be partly associated with the perimeter road, where stormwater runoff infiltrates into soils along the upslope side of the road and contributes to wetting of the underlying and downslope soils.

Short-term, minor impacts may occur on newly-submerged slopes adjacent to the reservoir during the first few years after the dam raise because of saturation of normally unsaturated soil and weathered rock with moderate to severe erosion potential and/or moderate to high risk of slope failure, because of wave action on soil and weathered rock not currently exposed to high-energy forces from water, because of increased pore pressures in soils during reservoir drawdown, and because all of these factors would be increased by a longer shoreline. However, after the new shoreline has been established for three to five years, slopes are expected to be relatively stable (similar to current conditions) because current and anticipated future reservoir operations generally avoid rapid water level drawdown, which can cause excessive hydrostatic pressures above the water line, and because recreationists are required to limit boat speeds and associated wakes. Therefore, no long-term impacts would occur as a result of the higher reservoir level.

Landslide and other earth movement problems pertaining to the reservoir perimeter road have occurred in the past. Under Alternative 2, the road length would increase, as would the length of road constructed on soils with potential stability problems (including, as noted previously, Melbourne silty clay loam on moderate to steep slopes). Because observed landslide activities affecting the existing perimeter road have frequently occurred in locations overlying older landslide material, it is likely that an increase from the existing length of the road that is constructed in landslide materials would result in a corresponding increase in the risk of landslides affecting the perimeter road. Taken together, these changes probably would result in an increased potential for erosion and landslides resulting in road damage. Best engineering and management practices, including but not limited to those identified
hereafter, would minimize potential slope stability problems, reducing the potential for significant impacts to occur.

Disturbed soils along the RWP alignment would be compacted, stabilized, and revegetated consistent with existing conditions and land uses. Therefore, no operational impacts would occur along the RWP alignment.

Landslide and other soil stability problems would be controlled by engineering practices. Road alignment modifications, appropriate upslope drainage and runoff control, dam construction, and pipeline construction would follow all applicable regulations and best management practices to control erosion, stormwater runoff, and slope stability on road cuts, fills, and foundations, including (but not limited to) shallower slopes on cuts and fills and capture and diversion of runoff away from roads, cut slopes and fills. Some engineered stabilization of slopes, including armoring, may be required at selected higher-risk locations to mitigate beach wave erosion.

**Sedimentation - Construction Impacts**

No impacts would occur during construction if best management practices are implemented during construction to prevent excessive sediment releases from the borrow areas, RWP trench excavations, and road construction areas.

**Sedimentation - Operating Impacts**

The change in the rate of sediment accumulation would result in a loss of about 12 acre-feet of reservoir storage volume per year on average, which is about 2 percent of active storage, from sedimentation over a 100-year period.

Estimates of sedimentation based on existing reservoir rim wave cuts are, at best, semi-quantitative. The heights of cuts used for estimating the volume of sediments removed from the shoreline are an approximation based on several random field observations and are believed to be conservatively high. Although most of the sediments deposited in Henry Hagg Lake originate from tributary streams, these sediment sources would not be appreciably affected by project actions. Therefore the evaluation of new sediment sources is limited to the sediments that would be added by increased bank erosion as a result of Alternative 2 actions. A volume of soil estimated to be eroded from the shoreline was determined by assigning a thickness of soil to areas of inundation based on erosion hazard potential (0.25 feet for soils with slight erosion potential, 0.5 feet for soils with moderate erosion potential, and 2 feet for soils with severe erosion potential). Soil erosion thicknesses were assigned based on observations of wave cut heights on shorelines, which in most locations, was less than 2 feet.

The total volume of sediment eroded and removed from shoreline slopes during the first two to five years after completion of the dam raise is estimated to be approximately 335 acre-feet. After this initial period of increased sedimentation, the contribution of sediments from bank erosion is expected to be much less than the contribution from sediment load in the tributary streams, consistent with No Action conditions. The average sediment load deposited in Henry Hagg Lake under Alternative 2 would be 3.4 acre-feet per year above the No Action level over a 100-year period. Using the assumption that about 50 percent of this sediment accumulation would occupy active reservoir storage, the reservoir capacity
would be reduced by about 1.7 acre-feet per year compared to No Action conditions. The projected average annual sediment inflow from drainage would be approximately 19.2 to 20 acre-feet per year. Assuming about half of this (10 acre-feet per year under No Action) is deposited in active storage, the total annual volume of reservoir removed from storage under Alternative 2 would be about 12 acre-feet per year.

**Seismic Hazards - Construction Impacts**

Construction activities would not compromise the integrity of the dam and would not contribute to the probability of dam failure in the event of an earthquake. Liquefaction of wet or saturated cut slopes and excavation walls (such as trenches), resulting in slope failures, could occur during a moderate to severe seismic event. However, failure would be unlikely since standard construction safety and best management practices such as shoring and dewatering would be implemented during construction. Therefore no impacts are expected.

**Seismic Hazards - Operating Impacts**

Recent seismic hazard probability analyses do not include evaluation of probability of failure for the existing Scoggins Dam or for a raised dam. Therefore evaluation of impacts associated with seismic hazards is limited to qualitative observations.

There is a fairly high probability that the effects of a major earthquake in some parts of the Cascadia Subduction Zone or the Gales Creek fault system could cause substantial damage to structures in the vicinity of Henry Hagg Lake and the RWP, particularly to older structures that are not constructed to meet modern seismic design standards. However, the risk that the dam would be damaged by deformation from seismic activity is uncertain at the time of preparation of this document. Reclamation is conducting additional evaluation. Because the dam would be raised with a resulting greater area of inundation in the event of failure, the dam would be conservatively designed and constructed to offset the risk of failure. No impacts would occur if adequate measures are taken to reduce risk of failure.

Damage to the RWP could occur in the event of a major seismic event. Preliminary geotechnical evaluations (MSA 2006) have included recommendations for RWP construction that would minimize damage to the pipeline during a major seismic event, including lap-welded slip joints, construction of a retaining wall or buttress at a location near the toe of a hillside, and use of controlled low strength backfill material as pipe bedding near the toe of the hillside. A more comprehensive geotechnical evaluation would be conducted as part of a detailed design of the RWP; this would include recommendations to minimize damage from a seismic event. Movement along the Gales Creek Fault in reaches that may be crossed by the RWP, movement of earth material around the RWP, or liquefaction of supporting material under and around the RWP, could damage the RWP even if design and construction include measures to minimize seismic damage. RWP rupture would result in property damage; however, it is unlikely that a rupture would pose a substantial risk to human health and safety because of the low population density in the area.

**Mineral and Energy Resources - Construction Impacts**

4.2-7
Construction of the dam, modifications to the perimeter road, and construction of the RWP would not block access to or use of the Scott Quarry. Road construction activities may temporarily reduce or block use of the perimeter road, but because the road completely traverses the lake, access to the quarry would be accessible by using the perimeter road from the other direction, with an increased travel time of less than five minutes. Because the quarry is only used periodically, the likelihood that the quarry would be needed during a road construction block is low. No significant impacts would occur.

Construction activities would not impede access to either of the quarries located on Scoggins Valley Road southeast of the dam. No impacts to these quarries would occur.

Dam construction would require approximately 100,000 cubic yards of rock material, and road relocation construction would require approximately 35,000 cubic yards of rock material (Reclamation 2006b). Sand and rock would also be needed for construction of replacement recreation facilities and the RWP.

**Mineral and Energy Resources - Operating Impacts**

The Scott Quarry would be partially inundated at high water by the rise in lake water level. When the lake water level is not at high water, parts of the quarry may still be partially submerged by high groundwater. Sediment accumulation would occur in the quarry when it is submerged, requiring removal to access quarry material. When not flooded, the quarry may be too close to the lake to be operated because of water quality concerns. These factors would limit or eliminate commercial use of the quarry.

A loss of pit-run material from the quarry would affect local forest road construction and maintenance, primarily associated with logging roads in the privately-owned logging areas in the vicinity. No publicly-available pit-run facilities are located in Scoggins Valley, although pit-run for road construction and maintenance could be obtained from other sources in the Tualatin Valley within a reasonable haul distance. This could result in increased costs for the local timber industry, particularly on small timber companies common to this area, because of the probable increase in costs associated with construction and maintenance of logging roads.

There would be no long-term impacts to the two quarries on Scoggins Valley Road, southeast of the dam. The license agreement between Reclamation and Washington County would be affected – the disposal area specified in the agreement (Reclamation License Agreement No. 1-07-10-L1580) would be converted to elk habitat mitigation area (see Section 4.8.3).

**4.2.2.2 Cumulative Impacts**

Rock and gravel used for project construction and maintenance, combined with that used for other development and maintenance associated with additional growth in the area, would reduce the quantity of mineral resources in the region.

**4.2.2.3 Alternative 3 – Multiple Source Option**

**4.2.2.3.1 Potential Impacts (direct, indirect)**
**Slope Stability - Construction Impacts**
The potential construction impacts of the RWP would be the same as for Alternative 2. However, implementation of the RWP construction methods described under Alternative 2 would prevent slope and trench wall failures, lateral spreading in trenches and cuts, erosion of disturbed surfaces, and similar problems. The RWP corridor would be revegetated after construction in a manner consistent with existing vegetation. Therefore, no impacts would occur during construction along the RWP alignment.

Impacts to the borrow areas and road construction areas would be controlled by following best management practices.

Four of the soil types through which the Willamette Pipeline would pass are identified as having severe erosion potential (Aloha silt loam, Amity silt loam, Quatama loam, and Woodburn silt loam). The types of construction impacts associated with the Willamette Pipeline would be the same as those described for the RWP under Alternative 2. Construction methods similar to those that would be used for the RWP would be used for the Willamette Pipeline. Implementation of those construction methods, as well as revegetating disturbed soils after construction, would prevent impacts.

Sites for the water tanks associated with the Willamette Pipeline have not been selected. The water tanks would be designed and constructed to avoid slope failure. No impacts would occur from construction if standard industry practices and best management practices are followed.

**Slope Stability - Operating Impacts**
The impacts associated with the increase in shoreline, newly submerged slopes, disturbed soils along the RWP, and the road realignment would be similar to Alternative 2. Under Alternative 3, the total length of shoreline in contact with soils having moderate or severe erosion potential would increase (by 37 percent and 62 percent, respectively), as well as the relative percentage of shoreline in contact with soils with severe erosion potential (by 7 percent). However, since the landslides around Henry Hagg Lake have resulted from saturated soils (from precipitation and shallow groundwater) and low soil strength, not erosion, the increase in exposure of soils to wave erosion would not likely increase the risk of landslides.

Disturbed soils along the RWP and Willamette Pipeline alignments would be compacted, stabilized, and revegetated consistent with existing conditions and land uses. Therefore, no operational impacts would occur along the pipeline alignments. As described for Alternative 2, there would be an increased risk of landslides affecting the perimeter road, but landslides and other soil stability problems would be controlled by engineering practices.

**Sedimentation - Construction Impacts**
Best management practices would be implemented to prevent excessive sediment releases from the borrow area, RWP and Willamette Pipeline trench excavations, and road construction areas. Therefore, no impacts would occur during construction.

**Sedimentation - Operating Impacts**
The total annual volume of reservoir removed from storage under Alternative 3 due to sedimentation would be about 11 acre-feet per year on average, which is slightly less than Alternative 2 (12 acre-feet per year) and slightly more than Alternative 1 (9.6 to 10 acre-feet per year).

**Seismic Hazards - Construction Impacts**
The likelihood that construction activities for Alternative 3 would increase the likelihood or degree of damage from seismic activities is the same as for Alternative 2. No impacts are expected.

**Seismic Hazards - Operating Impacts**
The likelihood that operations of Alternative 3 would increase the probability or degree of damage from seismic activities is the same as for Alternative 2. Scoggins Dam would be designed and constructed to minimize the risk of failure from a seismic event, and no impacts are expected.

As described under Alternative 2, the RWP could be damaged if a major seismic event were to occur. However, the RWP would be designed to minimize damage, and damage to the RWP is unlikely to cause significant risk to human health or safety because of the low population density in the area.

The Willamette Pipeline would be designed to meet seismic standards, would have corrosion protection, and is expected to last for at least 100 years. Water flow in the pipeline would be monitored to detect a leak. If the pipeline were to be damaged, water flow would be shut off near the leak until repairs could be made. Water tanks associated with the Willamette Pipeline would be designed to meet seismic standards.

**Mineral and Energy Resources - Construction Impacts**
The types of impacts associated with construction of the components of Alternative 3 would be the same as for Alternative 2. Dam construction would require approximately 70,000 cubic yards of rock material, and road relocation construction would require approximately 35,000 cubic yards of rock material (Reclamation 2006b). Sand and rock would also be needed for construction of replacement recreation facilities, the RWP, and the Willamette Pipeline and associated water tanks.

A Morse Bros. commercial quarry is located on both sides of SW Tonquin Road along the Willamette Pipeline corridor. During construction, access to the Morse Bros. operation would be maintained, and no negative impacts are expected.

**Mineral and Energy Resources - Operating Impacts**
Impacts associated with operation of the reservoir under the Alternative 3 would be similar to Alternative 2. Although the high pool elevation would cause the lake water to inundate only a small part of the Scott Quarry, primarily as a result of rising groundwater, much of the quarry would be flooded during part or most of the year. Sediment accumulation in the quarry also would limit or prevent access to quarry materials during the rest of the year or may render part of the quarry material unsuitable for its intended use. Furthermore, operations probably would not be allowed immediately adjacent to the lake because of concerns about water quality. It is likely that the quarry would be unusable as a result of Alternative 3. As described under Alternative 2 impacts, loss of the Scott Quarry could increase costs for the local timber industry, but there are other sources of pit-run within a reasonable distance. The socio-
The economics section (Section 4.15) describes both the impact to the business and to the local timber industry.

Two quarries located southeast of the dam near Scoggins Valley Road would be unaffected by operations under Alternative 3. No impacts would occur. The license agreement between Reclamation and Washington County would be affected because the disposal site specified in the agreement would be converted for use as elk habitat mitigation (see Section 4.8.3).

The Willamette Pipeline and associated water tanks would have no long-term effect on the Morse Bros. quarry. No impacts would occur.

4.2.2.3.2 Cumulative Impacts
Cumulative impacts would be the same as for Alternative 2.

4.2.3 Mitigation Measures

4.2.3.1 Alternative 1
No mitigation would be necessary for Alternative 1.

4.2.3.2 Alternatives 2 and 3

4.2.3.2.1 Slope Stability
Mitigation of erosion and slope stability concerns would be achieved by maintaining conservative slopes on cuts and fills for roads and in borrow areas that would not result in slope slippage, rotation, failure, or excessive erosion. The appropriate slopes would depend on the individual soil types, loads, vegetation, and other conditions. A geotechnical engineer would need to determine the appropriate slopes for a given soil and location.

Slope stabilization practices, such as terracing, armoring, drainage trenches, key trenches, erosion control matting, runoff diversion and control, revegetation, and other engineered measures would be used to reduce erosion, control drainage of soils, and stabilize slopes and disturbed areas. Such measures would be selected and designed based on site-specific conditions and would be prepared with the assistance of a geotechnical engineer, landscape architect, or other slope stabilization professional to determine the most appropriate methods and designs for slope stability for a given location and soil conditions.

Mitigation of shoreline erosion from wave action probably would require cost-prohibitive and environmentally undesirable measures, such as placement of large quantities of riprap, construction of seawalls, retaining walls, or wave energy dissipation structures offshore. Because it is anticipated that the lake shoreline will stabilize after an initial period of dynamic adjustment (expected to be three to five years), no engineered mitigation measures are recommended. Current required practices that are designed to limit wakes from recreational boating would continue.

4.2.3.2.2 Sedimentation
No mitigation is proposed.
4.2.3.2.3  **Seismic Hazards**
Mitigation would not be necessary if conservative design and construction practices are followed.

4.2.3.2.4  **Mineral and Energy Resources**
A new site would be designated within Scoggins Valley Park for disposal of soil and rock generated from County road maintenance activities. The license agreement between Reclamation and Washington County (Reclamation License Agreement No. 1-07-10-L1580) would be revised or replaced, accordingly.
4.2 GEOLGY AND SOILS ........................................................................ 4.2-1
4.2.1 Affected Environment ...................................................... 4.2-1
4.2.2 Environmental Impacts .................................................... 4.2-3
4.2.3 Mitigation Measures ....................................................... 4.2-11
4.3 Water Quality

This section describes the water quality modeling methodology, assumptions, and effects on water quality in Henry Hagg Lake, Scoggins Creek, and the mainstem Tualatin River, for Alternative 2. The discussion for Alternative 3 includes the Willamette River and stream crossings of the Willamette Pipeline. Much of this section is based on the Water Quality Technical Report prepared for the TBWSP (CH2M Hill 2006).

4.3.1 Affected Environment

The primary study area for the water quality evaluation is the Tualatin River Basin. ODEQ has identified beneficial uses in the Tualatin River subbasin to include fisheries, aquatic life, drinking water, recreation, and irrigation (ODEQ 2003). The water quality results presented in this section do not encompass the entire Tualatin River Basin, but focus on Henry Hagg Lake, Scoggins Creek, and the mainstem Tualatin River, which are the waterbodies that would be most affected by the TBWSP. The following sections describe applicable water quality standards and existing water quality conditions within those three bodies of water. Streams associated with the Willamette pipeline are also discussed.

4.3.1.1 Henry Hagg Lake

The applicable temperature standard for Henry Hagg Lake for trout rearing and migration is a 7-day-average maximum of 18.0 °C (64.4 °F). When Natural Thermal Potential (NTP) temperatures exceed this numeric criterion, then the NTP temperature(s) become the applicable standard. The applicable DO criterion is an absolute minimum 8.0 milligrams per liter (mg/L). Where conditions of barometric pressure, altitude and temperature preclude attainment of the 8.0 mg/L, dissolved oxygen may not be less than 90 percent of saturation. At the discretion of the ODEQ, dissolved oxygen may not fall below 8.0 mg/L as a 30-day mean minimum, 6.5 mg/L as a 7-day minimum mean, and may not fall below 6.0 mg/L as an absolute minimum. Oregon has also adopted special provisions for reservoirs and managed lakes. The Environmental Quality Commission adopted the following rule on May 20, 2004, and this rule became effective for State purposes on filing with the Secretary of State [OAR 340-041-0061(15)]:

- "(15) Reservoirs or managed lakes are deemed in compliance with water quality criteria for temperature, pH, or dissolved oxygen (DO) if all of the following circumstances exist.
- The water body has thermally stratified naturally or because of the presence of an impoundment.
- The water body has three observable layers, defined as the epilimnion, metalimnion, and hypolimnion.
- A layer exists in the reservoir or managed lake in which temperature, pH, and DO criteria are all met, and the layer is sufficient to support beneficial uses.
- All practicable measures have been taken by the entities responsible for management of the reservoir or managed lake to maximize the layers meeting the temperature, pH, and DO criteria.
- One of the following conditions is met:
  - The streams or river segments immediately downstream of the water body meet applicable criteria for temperature, pH, and DO.
All practicable measures have been taken to maximize downstream water quality potential and fish passage. If the applicable criteria are not met in the stream or river segment immediately upstream of the water body, then no further measurable downstream degradation of water quality has taken place because of stratification of the reservoir or managed lake.”

In addition, ODEQ regulations establish an “action level” of 15 micrograms per liter (µg/L) chlorophyll a that is applicable to reservoirs and rivers. This is not a formal numeric criterion for which an exceedance indicates a standards violation, however, exceedances do invoke the requirement that ODEQ undertake a study to determine if designated beneficial uses are impaired. If impairment is identified in the study, ODEQ then is to establish a control strategy where technically and economically practicable (ODEQ 2001).

Henry Hagg Lake has not been deemed water quality impaired by ODEQ nor placed on the 303(d) list, and thus there have been no TMDLs and none is proposed specific to the lake itself. Water quality in Henry Hagg Lake has been documented with extensive field monitoring from 2000 to 2003 and simulated with a model by the USGS (Sullivan and Rounds 2005). The monitoring data and model showed that Henry Hagg Lake exhibits several annual limnological cycles.

As the lake surface warms through the springtime, a thermocline develops in the lake each year by early summer. This thermal gradient isolates cold and dense water near the reservoir bottom. As the summer progresses, DO in this lower layer of water (the hypolimnion), is consumed, typically leading to anoxia by late September. At the onset of anoxia, ammonia concentrations begin to increase in the hypolimnion. As surface water temperatures cool in the fall, the temperature stratification eventually is eliminated and the lake mixes and re-oxygenates, generally in mid-November (lake turnover). Moderate algal blooms (approximately 20 micrograms per liter [µg/L] chlorophyll a), including a blue-green algal bloom in August, typically occur every year in Henry Hagg Lake. The seasonal water temperature pattern of outflows from Henry Hagg Lake is characteristically different than that of the water that flows into the lake, and the outflows occasionally exceed the downstream water temperature standard. Water with low DO concentrations also is predicted to be released in the fall, but efficient aeration of that water by turbulence at the base of the dam prevents violations of the DO criteria downstream in Scoggins Creek (Sullivan and Rounds 2005).

4.3.1.2 Scoggins Creek
The portion of Scoggins Creek below the dam is designated spawning habitat for coho salmon and winter steelhead (ODEQ 2003), and is also recognized by ODFW as spawning and rearing habitat for Pacific lamprey, cutthroat trout, and several other native fish species, as well (ODEQ 2003). Based on these beneficial uses, the DO water quality criterion for salmonid spawning from October 15 through May 15 is 11.0 mg/L. However, if the minimum intergravel DO is 8.0 mg/L, then the DO criterion is 9.0 mg/L. Where conditions of barometric pressure, altitude and temperature preclude attainment of the 11.0 mg/L or 9.0 mg/L criteria, DO may not be less than 95 percent of saturation. The remainder of the year, DO may not be less than 8.0 mg/L as an absolute minimum. At the discretion of the ODEQ, DO may
not fall below 8.0 mg/L as a 30-day mean minimum, 6.5 mg/L as a 7-day minimum mean, and may not fall below 6.0 mg/L as an absolute minimum.

Scoggins Creek is one of 22 streams in the Tualatin Subbasin that was placed on the 303(d) list for DO (ODEQ 1998). The tributary stream segments placed on the this 303(d) list were all listed because of violations of the cool-water DO criteria, with the exception of Scoggins Creek, which was listed for violations of the salmonid spawning criteria. Since development and implementation of the Tualatin Subbasin “total maximum daily loads” (TMDL) (ODEQ 2001), Scoggins Creek was assigned the requirement that there be no measurable decrease in DO below natural conditions and hence removed from the 303(d) list (ODEQ 2007).

Water temperatures in Scoggins Creek downstream of the dam are influenced by the presence of Henry Hagg Lake. The temperature maximum in Scoggins Creek upstream of the reservoir, for example, typically occurs in late July. Below the dam, the peak temperature in Scoggins Creek usually occurs in late September (Sullivan and Rounds 2006). This shift in the peak temperature occurs because Henry Hagg Lake releases relatively cold water from near the bottom of the lake in the spring and summer then finally releases some of its stored summer heat in the fall as the lake is drawn down.

Based on the stream’s designated use for spawning habitat for salmon and steelhead, the 7-day-average maximum temperature may not exceed 13.0 °C (55.4 °F) from October 15 through May 15. The remainder of the year, the 7-day-average maximum temperature may not exceed 18.0 °C (64.4 °F). When Natural Thermal Potential (NTP) temperatures exceed this numeric criterion, then the NTP temperature(s) become the applicable criteria. The designated fishery uses and associated numeric and narrative criteria; for Scoggins Creek, the mainstem Tualatin River, and streams associated with the Willamette Pipeline; were adopted by the State of Oregon in December 2003, and were developed in cooperation with ODFW (ODEQ, 2003). The use categories and criteria are consistent with water temperature criteria guidance published by USEPA Region 10 which was developed in collaboration with ODEQ, ODFW, USFWS, NOAA Fisheries, and others (USEPA, 2003). As required by the Clean Water Act, USEPA must review and approve or disapprove state water quality standards. USEPA Region 10, in consultation with USFWS and NOAA Fisheries, approved the ODEQ temperature standards in March 2004 (DEQ 2010).

4.3.1.3 Tualatin River Mainstem
Streamflow in western Oregon reflects the seasonal variation in precipitation. Most of the precipitation in the Tualatin River Basin falls as rain during the November through April wet season. During the low-flow summer period, the river’s flow is augmented from stored water in Barney Reservoir and Henry Hagg Lake.

Beneficial uses in the Tualatin River Subbasin include fisheries, aquatic life, drinking water, recreation, and irrigation (ODEQ 2003). The applicable temperature standard for the designated salmon and trout rearing and migration in the mainstem Tualatin River is a 7-day-average maximum of 18.0 °C (64.4 °F). When Natural Thermal Potential (NTP) temperatures exceed this numeric criterion, then the NTP temperature(s) become the applicable standard. The applicable DO criteria for the mainstem Tualatin
River downstream of Gaston were established by ODEQ in the 2001 TMDL as 6.5 mg/L as a 30-day mean minimum, 5.0 mg/L as a 7-day minimum mean, and 4.0 mg/L as an absolute minimum.

Water quality in the Tualatin River varies seasonally. Most water quality concerns for the Tualatin River mainstem are manifested during the warm and relatively dry summer, and also in the fall if the flows remain low. The warm summers often cause the river’s temperature to exceed State requirements for migration of fish such as salmon and steelhead. In the reservoir-like reach of the river, from RM 3.4 to RM 30, long travel times, when combined with available nutrients (phosphorus and nitrogen) and sunny summer weather, produce blooms of phytoplankton. Such blooms at times have exceeded ODEQ’s action level for chlorophyll, but also provide substantial DO via algal production during long summer daylight hours. However, the long travel times in this reach of the river also provide time for organic sediments on the bottom of the river to exert a demand on DO in the water column; this is “sediment oxygen demand” (SOD). Algal settling and decay contribute to SOD. In the fall, when algal productivity is inhibited by shorter days, the SOD can lead to substantial DO sags in this reach.

Consequently, algae, pH and DO concentrations have been of concern historically and led ODEQ to list the Tualatin River as an impaired water body in the 1980s and 1990s. Specifically, the Tualatin River Subbasin had stream segments listed on the 1998 303(d) list for many parameters; these include temperature, bacteria, DO, chlorophyll a, toxics (arsenic, iron and manganese), biological criteria, and pH. Since development and ongoing implementation of TMDLs, all of those parameters applicable to the mainstem river have been removed from the most recent 303(d) list (ODEQ 2007). In 2004, the mainstem Tualatin River was listed as water-quality-limited for levels of iron and manganese (ODEQ 2007). The Water Quality Technical Report (CH2M Hill 2006) provides a more detailed description of the TMDLs for the Tualatin Subbasin, the water quality improvements that have been made since their implementation, and the effort to revise the temperature TMDLs for the tributaries and mainstem.

4.3.1.4 Streams Associated with the Willamette Pipeline
The Willamette Pipeline (Alternative 3) would withdraw water from the Middle Willamette Subbasin Water Quality area. The Willamette River is water quality limited in this reach. ODEQ has established TMDLs for temperature, bacteria, and mercury. Additional parameters have been added to the 303(d) list; these include PCBs, Aldrin, Dieldrin, DDT, iron, copper, zinc, and lead. These pollutants are to be addressed in later TMDLs (ODEQ 2006).

The Willamette Pipeline (Alternative 3) would cross the Tualatin River, local streams, and drainages that carry seasonal waters. Named streams that would be crossed by the Willamette Pipeline include Coffee Lake Creek, Rock Creek, Cedar Creek, Chicken Creek, and Summer Creek. Cedar Creek, Chicken Creek, Rock Creek, and Summer Creek were previously listed on the 303(d) list, but all now have approved TMDLs and have been de-listed (ODEQ 2007). Coffee Lake Creek does not appear on the 303(d) list (ODEQ 2007). Water quality limitations of the Tualatin River are described above.

4.3.2 Environmental Impacts
Computerized water quality modeling provided quantitative results that were used to evaluate the effects of the project alternatives on Henry Hagg Lake, Scoggins Creek and the Tualatin River. Where
modeling was not available, a semi-quantitative assessment was conducted using insights from previous modeling and/or monitoring information.

The water quality parameters that have been of most interest historically in the Tualatin River Basin have included phosphorus, algae, DO, ammonia and temperature. Consequently, these parameters are addressed in detail in this section. Other parameters, such as pH, turbidity, bacteria, organic matter, and total dissolved solids, are not addressed as rigorously; however, qualitative discussion about how each alternative would likely affect these parameters on a relative basis is provided.

Finally, total dissolved gas (TDG) concentrations in streams and rivers downstream of dams can be of concern in some situations under certain structural, operational and environmental conditions. Although an increase in dam height might be expected to increase TDG concentrations, it is extremely difficult to predict TDG concentrations downstream of any particular dam because of site-specific and complex interrelations between the structural, operational and environmental conditions. For example, an increase in dam height alone would not necessarily lead to increased TDS if flows spilled over the dam are either reduced at times (as is predicted by the hydrologic modeling (Montgomery Watson Harza, 2006) or if releases are made through a different outlet type, elevation or location. In this case, the outlet type and location have not yet been determined. In addition, even if a predictive method were available, it would have to be corroborated with actual field data for existing conditions. Then, the magnitude of any effect would have assessed based on existing or baseline conditions. The authors of this Draft PR/EIS are unaware of any available TDG data for either Scoggins Creek or the mainstem Tualatin River with which a site-specific evaluation could be made. As a result, TDG is not further discussed in this Draft PR/EIS. If TDG is a concern that needs to be further assessed as the TBWSP progresses, then initial efforts to address this should focus on collecting TDG data in Scoggins Creek under existing conditions and operations.

Potential project-related water quality effects were assessed using models of Henry Hagg Lake and the Tualatin River that were developed by the USGS (Sullivan and Rounds 2005; USGS 2005). The latest models for the Tualatin River Basin are a USGS-modified version of CE-QUAL-W2 version 3.12, a two-dimensional, laterally averaged model originally developed by the Corps and more recently updated by the Corps and Portland State University (Cole and Wells 2002). This model simulates hydrodynamics, water temperature, and water quality. The model was calibrated for years 2000-2003. Years 2001 and 2002 were used for the analyses in this Draft PR/EIS the year 2002 is considered typical, whereas 2001 was an extremely dry year, the second lowest for the period of record from 1928 to 2001 (this is the period of record analyzed in the Surface Water Hydrology Technical Report). For more information about methods of analysis, refer to the Water Quality Technical Report (CH2M Hill 2006).

Monitoring data and model results for the Tualatin River at Shamberg Bridge/Elsner Road (RM 16.22) and Stafford Bridge (RM 5.38) have been historically used by USGS and ODEQ to assess the lower reach
of the river, in which potential impacts on DO and algae would most likely occur\(^1\). For this Draft PR/EIS, model results are also presented at a location near Forest Grove (approximate RM 55) to characterize the upper river; the location is approximately 5 miles downstream of Scoggins Creek.

The water quality analyses assume that both Alternative 2 and Alternative 3 would include \textit{multi-level intake} capabilities for selective withdrawal as part of the modification of Scoggins Dam. While such a structure is proposed, it may or may not be implemented. A multi-level intake would substantially enhance the ability of Scoggins Creek to meet the existing numeric water temperature criteria and/or the natural thermal potential (NTP) criteria, and would reduce \textit{hypoxia} in the lake. The NTP of Scoggins Creek has recently been evaluated pursuant to the new temperature standards in Oregon as part of the ongoing revision of the temperature TMDL (CH2M HILL, 2008). This if further discussed for each alternative below.

\textbf{4.3.2.1 Alternative 1 – No Action}

Alternative 1, or the No Action Alternative, assumes that only existing water facilities would be in place and represents what the conditions may look like in the basin without construction of new water conveyance and storage features. The existing features of the Tualatin Project would continue to store and release water to meet the contracted water demands. Thus, a substantial difference in reservoir, Scoggins Creek or Tualatin River mainstem water quality conditions would not be expected between existing conditions and Alternative 1.

\textit{4.3.2.1.1 Potential Impacts (direct, indirect)}

\textit{Henry Hagg Lake Water Surface Elevation}

Model results indicate water surface levels in Henry Hagg Lake generally increase in the winter as a result of rainfall accumulation and low water demand. Water surface elevation typically reach a maximum in late May and decrease through the summer and fall when water demand is higher. The reservoir reached a minimum water surface elevation in these model runs (2001 and 2002) between mid-November and mid-December (see Figure 4.3-1). Conditions in 2001 were representative of a very dry year, reflected in the much lower water surface elevations in 2001, while 2002 represents more typical conditions.

\footnote{This is because the lower reach of the river functions somewhat like a reservoir as a result of the backwater effects from Oswego Dam (CH2M Hill 2006).}
Henry Hagg Lake Temperature
The annual average whole-lake temperature is approximately 10.9 °C under both 2001 and 2002 conditions. The modeled maximum lake water temperature is 26.8 °C under 2002 conditions and 27.0 °C under 2001 conditions. The reservoir typically becomes stratified during the summer, and reservoir drawdown leads to increasing temperature at the elevation of the dam outlet in the fall (Sullivan and Rounds 2005).

Henry Hagg Lake Dissolved Oxygen
The whole-lake annual average DO under 2001 conditions is 9.2 mg/L, and under 2002 conditions is 9.5 mg/L. Different water levels in the reservoir affect the timing and extent of anoxia in the reservoir’s hypolimnion. There is an average of 85 days in 2001 and 64 days in 2002 for which DO concentrations are less than 1 mg/L somewhere in the reservoir. Reservoir turnover causes the end of anoxic conditions. The turnover date was calculated by USGS on the basis of a breakdown in the DO gradient. Turnover occurs on day 329 (November 25) under 2002 conditions. The turnover date under 2001 conditions is almost two weeks earlier, on day 317, which had the lowest level ever recorded in Henry Hagg Lake (Sullivan and Rounds 2005).

Henry Hagg Lake Ammonia
Ammonia concentrations are low throughout much of the reservoir for Alternative 1. Under 2001 conditions, the whole-lake annual average ammonia concentration are 12.6 µg/L. Under 2002 conditions, the whole-lake annual average ammonia concentration is 12.9 µg/L.

Higher concentrations of ammonia can accumulate in an anoxic hypolimnion (Sullivan and Rounds 2005). This could be of concern if high concentrations were to occur and be released into Scoggins Creek. This is because ammonia can be toxic to aquatic life and also exerts an oxygen demand.
ammonia concentrations do not extend vertically high enough in the lake to be drawn into the existing outlet to Scoggins Creek. However, ammonia concentrations are well below toxicity thresholds.

**Henry Hagg Lake Chlorophyll a and Orthophosphate**
Under 2001 conditions, the whole-lake annual average chlorophyll a concentration is 0.96 µg/L. Under 2002 conditions, the whole-lake annual average chlorophyll a concentration is 1.25 µg/L. Further, the average whole-lake orthophosphate concentrations under 2001 conditions (4.7 µg/L) are lower than 2002 conditions (5.1 µg/L) (Sullivan and Rounds 2005).

The model shows that there is an early season (March/April) bloom of algae in both years, followed by a blue-green algae bloom in August/September. The blue-green algae bloom under 2001 conditions lasts for 43 days while the bloom in 2002 lasts for 66 days. None of these blooms extend deep enough into the water column to be drawn into the outlet to Scoggins Creek.

**Scoggins Creek Temperature**
Henry Hagg Lake Model output indicated that under 2001 conditions, water released from the dam is above the Scoggins Creek temperature standard for 111 days, and under 2002 conditions, 60 days were above the temperature standard.

**Scoggins Creek Dissolved Oxygen**
Although DO levels in Henry Hagg Lake at the intake can be low at times (that is, at or below 4 mg/L from July or August to mid-November as a result of stratification in Henry Hagg Lake, the DO in releases to Scoggins Creek are of minor importance because of the aeration that occurs at the dam outlet caused by efficient turbulence-induced entrainment of air. This results in DO concentrations near or above saturation in Scoggins Creek just downstream of the outlet (Sullivan and Rounds 2005).

**Scoggins Creek Ammonia**
Under 2002 conditions, Scoggins Creek has an annual average ammonia concentration of 10.7 µg/L. Under 2001 conditions, Scoggins Creek has an annual average ammonia concentration of 12.2 µg/L. These levels are much lower than those that would cause any aquatic toxicity or DO sags.

**Scoggins Creek Chlorophyll a and Orthophosphate**
Chlorophyll a and phosphate concentrations released from Henry Hagg Lake are very low (that is, less than about 1 µg/L) and are not a water quality issue in Scoggins Creek.

**Tualatin River Mainstem Temperature**
Temperature conditions in the river are anticipated to be in compliance with standards in the future as a result of ongoing and future programs associated with implementing the TMDLs. One element of that process is that Clean Water Services’ excess effluent heat loads from the two large wastewater treatment plants (Rock Creek and Durham) to the river must be offset by temperature credits under the watershed permit provisions. This cooling can be accomplished primarily by augmentation flows from Henry Hagg Lake and/or riparian shading enhancements. Under Alternative 1, increased augmentation beyond current storage would not be available to assist in offsetting population growth-related increases in effluent flows and thermal loads under future conditions. Therefore, increases in excess
effluent heat loads beyond those currently discharged would have to be offset by riparian shading enhancements or water reuse.

**Tualatin River Mainstem Dissolved Oxygen and Ammonia**

DO conditions in the river are anticipated to be in compliance with standards in the future as a result of ongoing and future programs associated with implementing the TMDLs. Clean Water Services’ oxygen-demanding loads to the river, because of ammonia and CBOD in treatment plant effluents, can be assimilated to a greater extent as a result of augmentation flows from Henry Hagg Lake. Under Alternative 1, increased augmentation beyond current storage would not be available.

**Tualatin River Mainstem Chlorophyll a and Orthophosphate**

Under current conditions, the existing river flows and effluent flows in the summer allow algae blooms to form in the lower river during summer and fall. These blooms occasionally exceed ODEQ’s action level of 15 µg/L, even though the TMDL target for phosphorus in the lower river is currently being met. TMDL-derived effluent limits for phosphorus for the Rock Creek and Durham wastewater treatment facilities (10 to 11 µg/L) are set at the target in-river concentrations.

4.3.2.1.2 **Cumulative Impacts**

Implementation of the Clean Water Services program activities, described in Section 1.6.2, would help diminish some of the effects of the No Action Alternative. The incentive programs for farmers (see Section 1.6.2.3), Storm Water Management Plan, Healthy Streams Plan, Reclaimed Water Master Plan, and facilities plans would all contribute to improved water quality in the Tualatin River over existing conditions. However, additional water demands that would occur under Alternative 1 would reduce the amount of water available for Clean Water Services to implement other programs, such as the Revised Temperature Management Plan, and could affect Clean Water Services’ ability to meet the requirements of the watershed-based NPDES permit.

4.3.2.2 **Alternative 2 – Scoggins Dam 40-Foot Raise**

4.3.2.2.1 **Potential Impacts (direct, indirect)**

Water quality impacts would result primarily from hydrological changes of the project. See Section 3.6 (Hydrologic Changes).

**Henry Hagg Lake Water Surface Elevation**

In the Alternative 2 simulation based on 2001 conditions, inflows and pump-back would be insufficient to reach the target maximum water surface elevation because of drought conditions that year, although storage would be improved compared to Alternative 1. In the Alternative 2 simulation based on 2002 conditions (a normal hydrologic year), inflows and pump-back would be sufficient to meet the target maximum elevation. In both years, the water surface elevation would reach a maximum in May, and decrease through the summer and fall as downstream users call for water releases. The reservoir would reach a minimum water surface elevation between mid-November and mid-December.

**Henry Hagg Lake Temperature**
Under 2001 conditions, the model predicted average whole-lake temperature would be 10.0 °C for Alternative 2, a cooler average whole-lake temperature than Alternative 1 (10.9 °C). Under 2002 conditions, the average whole-lake temperature would be 9.0 °C for Alternative 2, a cooler average whole-lake temperature than Alternative 1 (10.9°C). Longer periods of thermal stratification and a shallower thermocline would also result under this alternative relative to Alternative 1.

**Henry Hagg Lake Dissolved Oxygen**

Alternative 2 under both 2001 and 2002 conditions would result in higher whole-lake DO when compared to Alternative 1. Selective withdrawal was incorporated in the Alternative 2 runs to allow the modeled releases under 2002 conditions to meet a downstream temperature target. Results indicate that selective withdrawal would affect the extent of in-lake hypoxia. Specifically, Alternative 2 would result in fewer days with low (less than 1 mg/L) DO in the lake (53 days for 2001 and 11 days for 2002), compared to Alternative 1 (85 days for 2001 and 64 days for 2002). This suggests that the spatial and temporal extent of hypolimnetic hypoxia in Henry Hagg Lake may be controlled and minimized through utilization of selective withdrawal.

Turnover would occur on average on day 329 (November 25) under 2002 conditions (the same day as for Alternative 1) and day 324 (November 18) under 2001 conditions (later than day 317 under Alternative 1).

One potential impact on DO that was not specifically assessed with the CE-QUAL-W2 model was how organic detritus (e.g., forest litter, shrubs and grasses) in the newly inundated areas of the lake might affect DO in relation to sediment oxygen demand (SOD). This detritus would be expected to decay over time in the bottom sediments and contribute to SOD during periods of lake stratification. Although a rigorous quantitative assessment of this potential impact is not possible with currently available data, the impact would be expected to be relatively minor compared to other existing sources of organic material that contribute to SOD for all three alternatives. Much larger contributing sources of organic detritus include: 1) organic detritus that washes to the lake from the upstream watershed, especially during the high flow season and spring runoff periods (much of this detritus would be expected to settle to the reservoir bottom) and 2) algae that bloom each year in the upper layers of the lake during spring through summer and also settle to the lake bottom. Furthermore, these more influential sources have been contributing detritus to the lake bottom year after year since the dam was constructed, and do not fully decay in a single stratification period, thus accumulating over time in the lake. Finally, the detritus attributable to new inundation will be located in the shallower areas around the periphery of lake. These areas generally will not be deep enough to be located in anoxic or hypoxic areas of the hypolimnion, and therefore are less likely to contribute to SOD or nutrient release.

**Henry Hagg Lake Ammonia**

Under Alternative 2, there is reduced hypolimnetic ammonia in Henry Hagg Lake under relative to Alternative 1. Elevated ammonia concentrations would not extend vertically high enough in the lake to be drawn into the outlet to Scoggins Creek. Ammonia concentrations would be well below toxicity thresholds.
**Henry Hagg Lake Chlorophyll a and Orthophosphate**

Under both 2001 and 2002 conditions, the average whole-lake chlorophyll a concentrations would be lower for Alternative 2 compared to Alternative 1 (0.76 µg/L in 2001 and 0.98 µg/L in 2002). Also, the number of days with blue-green algae blooms would be substantially reduced under Alternative 2; there would be no days with such blooms for 2001 and one-third as many days for 2002.

A sensitivity analysis of the Henry Hagg Lake model (Sullivan and Rounds 2005) showed that blue-green algae were temperature sensitive, preferring relatively warm water. Therefore, the analysis concluded that it is possible that the overall cooler lake temperatures would cause a decrease in blue-green growth (Sullivan and Rounds 2005). Dilution of the chlorophyll in a larger lake also could contribute to the decrease in chlorophyll relative to Alternative 1, but the expanded lake would have a larger surface area and, therefore, could capture more light energy for photosynthesis, which may offset this effect somewhat.

The model predicts slightly higher peak algae concentrations during the spring bloom relative to Alternative 1. None of these blooms would extend deep enough into the water column to be drawn into the outlet to Scoggins Creek.

Under 2001 conditions, the average whole-lake orthophosphate would be about the same for Alternative 2 compared to Alternative 1. Alternative 2 under 2002 conditions would have higher average whole-lake orthophosphate concentrations (9.2 µg/L), compared to the Alternative 1 (5.1 µg/L). Algae use orthophosphate for growth, so the higher orthophosphate concentrations are probably directly related to the lower algal concentrations in Alternative 2 relative to Alternative 1.

**Scoggins Creek Temperature**

The average annual temperature for the Henry Hagg Lake releases for Alternative 2 would be 13.2 °C under 2001 conditions and 12.0 °C under 2002 conditions (Table 4.3-1). These average temperatures would be higher than Alternative 1 (11.8 °C in 2001 and 9.1 °C in 2002). The releases would be warmer in early spring; but substantially lower in temperature during late summer and fall.

| Table 4.3-1. Average Annual Temperature of the Henry Hagg Lake Outflow |
|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 | 2001 Alt. 1    | 2001 Alt. 2    | 2002 Alt. 1    | 2002 Alt. 2    |
| Average Temperature (°C) | 11.8          | 13.2          | 9.1           | 12.0           |
| Days Above Temperature Standard (degree days) | 111         | 0.5               | 61           | 0.0            |

In this section, one “degree day” represents 1 °C above the standard for a period of one day; the analysis does not use the 7-day temperature standard and thus is not a critical analysis of compliance with standards.

As depicted in Figure 4.3-2 and Figure 4.3-3, model runs for Alternative 2, however, assumed that a multi-level intake would be included with dam modification. The ability to selectively withdraw water from different levels in the lake would enhance compliance with temperature standards in Scoggins Creek, which is a substantial improvement relative to Alternative 1 conditions. Thus, the average increase in annual temperature at the existing outlet is insignificant because the number of days in which the temperature standard would be exceeded under Alternative 2 is 0.5 under 2001 conditions.
and zero under 2002 conditions, significantly fewer days than under Alternative 1. As such, implementation of Alternative 2 would improve compliance with the temperature criteria applicable to Scoggins Creek, although the water would be warmer for May through July under 2001 conditions. Again 2001 was an extremely dry year. In the more typical year (2002 conditions), temperature criteria compliance also would be enhanced with Alternative 2, although releases would be warmer from April through September.

Figure 4.3-2. Tualatin River Model Time Series for 2001; 7-Day average of daily maximum; Scoggins Creek downstream of Scoggins Dam

Figure 4.3-4 shows actual measured temperature data for Scoggins Creek upstream and downstream of Henry Hagg Lake. The upstream data are more indicative of the natural temperature regime for Scoggins Creek, and show that Alternative 2, with selective withdrawal capability, would provide an average temperature regime in Scoggins Creek downstream of Henry Hagg Lake that closely mimics the temperature regime just upstream of the reservoir. The measured downstream data show similar patterns as model results for the Alternative 1. Recent evaluations and discussions with DEQ indicate that the temperatures upstream of Henry Hagg Lake are appropriate for defining the NTP temperatures applicable to Scoggins Creek downstream of the dam (CH2M HILL, 2008). Because these NTP temperatures are actually lower than the numeric criteria, the numeric criteria are the applicable criteria for Scoggins Creek downstream of the dam.
Figure 4.3-3. Tualatin River Model Time Series for 2002; 7-Day average of daily maximum; Scoggins Creek downstream of Scoggins Dam
Figure 4.3-4. Measured 7-Day Average of Daily Maximum Temperature for 2001-2002; Scoggins Creek Upstream and Downstream of Henry Hagg Lake

Using the Upper Tualatin River Model to model water temperatures in Scoggins Creek at its mouth under 2001 and 2002 conditions, it appears Alternative 2 would provide an improvement in temperature at the mouth of the creek, although there is a small amount of warming that would occur between the dam and the mouth (CH2M Hill 2006).

**Scoggins Creek Dissolved Oxygen**

Under 2001 conditions, average annual DO in releases from the lake would be 7.4 mg/L, slightly lower than Alternative 1 (7.9 mg/L) (Table 4.3-2). Average DO for Alternative 2 would be 8.3 mg/L in 2002, lower than Alternative 1 (8.8 mg/L). Minimum DO would be lower under both 2001 and 2002 conditions relative to Alternative 1.

Table 4.3-2. Dissolved Oxygen in the Henry Hagg Lake Outlet

<table>
<thead>
<tr>
<th></th>
<th>2001 Alt. 1</th>
<th>2001 Alt. 2</th>
<th>2002 Alt. 1</th>
<th>2002 Alt. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Annual DO (mg/L)</td>
<td>7.9</td>
<td>7.4</td>
<td>8.8</td>
<td>8.3</td>
</tr>
<tr>
<td>Minimum DO (mg/L)</td>
<td>5.1</td>
<td>1.1</td>
<td>4.2</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Although DO would be low at times in the releases from the dam, it would not adversely affect downstream DO because of aeration at the outlet caused by turbulence. This turbulence causes DO just downstream of the outlet to be near or above saturation values (Sullivan and Rounds 2005). At saturation, even in a very dry year like 2001, the DO concentrations in the creek just below the dam would meet DO criteria.

As shown in Figure 4.3-4, water temperatures upstream of Henry Hagg Lake generally are warmer in spring and summer and cooler in fall than water released from the dam. As a result, saturation DO concentrations under more natural conditions would generally be somewhat lower in the spring and summer and higher in the fall.

In dry year (2001) conditions, DO concentrations at the mouth of Scoggins Creek would be slightly lower than at the dam because of the slight warming that occurs in this reach, but DO levels in the fall would be higher for Alternative 2 than for Alternative 1, and would generally be in compliance with the 95 percent saturation criterion.

Under typical hydrologic (2002) conditions, the results are similar to those for 2001 in that Alternative 2 would improve DO concentrations during the fall when the Alternative 1 would not meet the absolute numeric criteria. Note again that the percent saturation criterion would usually be met during this time period.

**Scoggins Creek Ammonia**

Compared to Alternative 1 under 2002 conditions, which had an average ammonia concentration of 10.7 µg/L, Alternative 2 under 2002 conditions (at the outlet) would result in higher average ammonia
concentrations (13.3 µg/L). Similarly, Alternative 2 under 2001 conditions (at the outlet) would result in essentially the same average ammonia concentrations (12.6 µg/L) as Alternative 1 under 2001 conditions, which would have an average ammonia concentration of 12.4 µg/L. These are very low concentrations in relation to ammonia toxicity, and the minor differences would not lead to differences in DO. Moreover, hypolimnetic ammonia would not be released to Scoggins Creek under 2001 or 2002 conditions for Alternative 2.

Scoggins Creek Chlorophyll a and Orthophosphate
Model run results at the Henry Hagg Lake outflow in Scoggins Creek (Table 4.3-3) indicate that, compared to Alternative 1 under 2001 conditions, Alternative 2 under 2001 conditions would result in lower average chlorophyll a concentrations. However, under 2002 conditions, chlorophyll a concentrations would be higher under Alternative 2 than Alternative 1. Alternative 2 under 2002 conditions would also have higher orthophosphate concentrations than Alternative 1 under both 2001 and 2002 conditions. Given the very short residence times in Scoggins Creek, these slight increases in algae and phosphorus would not adversely impact Scoggins Creek.

Table 4.3-3. Average Annual Chlorophyll a and Orthophosphate in Henry Hagg Lake Outflow

<table>
<thead>
<tr>
<th></th>
<th>2001 Alt. 1</th>
<th>2001 Alt. 2</th>
<th>2002 Alt. 1</th>
<th>2002 Alt. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorophyll a</td>
<td>0.82</td>
<td>0.51</td>
<td>0.64</td>
<td>0.75</td>
</tr>
<tr>
<td>Orthophosphate</td>
<td>5.1</td>
<td>5.4</td>
<td>6.3</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Tualatin River Mainstem Temperature
The ongoing temperature TMDL update for the Tualatin River has demonstrated that the NTP temperature conditions for the mainstem exceed the numeric criteria, and therefore the NTP criteria are the applicable criteria, superceding the numeric criterion of 18.0 ºC (CH2M HILL, 2008). For example, the temperatures for the mainstem at Forest Grove are as high as 22 ºC for 2002 NTP conditions. Alternative 1 temperatures at Forest Grove would be well below NTP temperatures for most of 2002, except for early fall when they would be exceeded at times. Alternative 2 temperatures would meet NTP criteria in 2002. Note that air and stream and river temperatures were substantially warmer in 2002 than 2001.

At Elsner and Stafford, the ongoing update to the temperature TMDL has also determined that NTP temperatures are substantially warmer than the numeric criterion of 18.0 ºC (CH2M HILL, 2008). For example, for July through August under 2002 conditions, the NTP temperatures at Elsner and Stafford range from 20 to 23 ºC, and are closely approximated by current river temperatures at Elsner, while current temperatures only slightly exceed NTP temperatures at Stafford. There is minimal difference in river temperatures between Alternatives 1 and 2 at Elsner and Stafford.

Dissolved Oxygen
DO values predicted by the Tualatin River Models at Forest Grove under 2001 conditions would be in compliance with DO criteria for Alternatives 1 and 2, although DO concentrations would be lower with Alternative 2 through August, then higher with Alternative 2 for September to late October, and then
slightly lower for the remainder of the fall (Figure 4.3-5). These minor shifts in DO at Forest Grove are primarily attributable to the shifts in temperature.

DO values predicted by the Tualatin River Models at Forest Grove under 2002 conditions would be in compliance with DO criteria for Alternatives 1 and 2, although DO concentrations would be lower with Alternative 1 through much of the summer, but higher with Alternative 2 from late summer through the end of the fall period (Figure 4.3-6). Again, these shifts are primarily related to the shifts in temperature.

Figure 4.3-5. Tualatin River Model time series for May-November 2001; Dissolved Oxygen, 7-Day average of daily minimum; downstream of Forest Grove
Figure 4.3-6. Tualatin River Model time series for May-November 2002; Dissolved Oxygen, 7-Day average of daily minimum; downstream of Forest Grove
For 2001 conditions at Elsner, DO concentrations would be lower in June and July, but higher from August through mid-November for Alternative 2 compared to Alternative 1 (Figure 4.3-7). For the June to July period, DO and algae concentrations follow very closely (as algae increase DO also increases), and both of these vary closely (but inversely) with river flow. This is because reduced algal populations in the lower river would lead to less oxygen production. During this very low flow year condition, there would still be enough travel time in this lower reach for SOD to reduce DO. This relationship is not as pronounced in the August through fall period. Note that the 30-day criterion is not met most of the late summer and fall under Alternative 1 and most of the summer and early fall under Alternative 2; this is reflective of such a long averaging period (this is a backward-looking rolling average) and temporal shift in DO changes between the two alternatives.

A similar pattern would occur at Stafford under 2001 conditions, although the period of lower DO under Alternative 2 would extend from June through September, with higher DO for October to mid-November (Figure 4.3-8). At Stafford, note that the 30-day criterion is met most of the summer and fall under Alternative 1 and is not met most of the summer and early fall under Alternative 2 even though the instantaneous and 7-day criteria are usually met; this is reflective of such a long averaging period and substantial reductions in DO for Alternative 2 at Stafford.

However, even the limited additional water available for delivery under Alternative 2 in such a dry year would improve DO concentrations at Elsner by more than 2 mg/L in the late summer and fall period. A similar improvement would be seen at Stafford, but only in the fall. The improvements at these locations represent a substantial improvement over Alternative 1 for this time period in which the river
historically has been most susceptible to low DO periods, eliminating a number of time intervals in which criteria would not have been met under Alternative 1.

Figure 4.3-8. Tualatin River Model Time Series for May-November 2001; Dissolved Oxygen, 7-Day average of daily minimum; Stafford

For the more typical year (2002 conditions) at Elsner, DO concentrations would be lower from mid-June through July, but higher from August through mid-November for Alternative 2 compared to Alternative 1 (Figure 4.3-9). For the June to July period, DO and algae concentrations follow very closely (as algae increase DO also increases), and both of these vary closely (but inversely) with river flow, as stated previously. During this more typical flow year condition, the reduction is DO in relation to higher river flow is not as pronounced as the very dry year. This relationship is even less pronounced in the August through fall period. Note that the 30-day criterion is not met some of the late summer and early fall at Elsner under Alternative 1 and early summer under Alternative 2; this is reflective of such a long averaging period and temporal shift in DO changes between the two alternatives.
A similar pattern would occur at Stafford under 2002 conditions, although the period of lower DO under Alternative 2 would extend from May through July, with higher DO for August to mid-November (Figure 4.3-10). At Stafford, note that the 30-day criterion is met most of the summer and fall under Alternative 1 and is not met in the early summer under Alternative 2 even though the instantaneous and 7-day criteria are usually met; this is reflective of such a long averaging period and substantial reductions in DO for Alternative 2 at Stafford.

The greater amount of additional water available for delivery under Alternative 2 in a typical year would improve DO concentrations at Elsner by several mg/L in the late summer and fall period. A similar improvement would be seen at Stafford. The improvements at these locations represent a substantial improvement over Alternative 1 for this time period in which the river historically has been most susceptible to low DO periods.
The difference in ammonia concentrations in water released from Henry Hagg Lake in Alternative 2 compared to Alternative 1 would be very small (only 0.0002 mg/L for 2001 and 0.026 mg/L for 2002) (CH2M Hill 2006). These very slight differences (not measurable in the field) would not lead to significant or measurable increases in DO in the mainstem. For example, 1 mg/L of ammonia, theoretically, could exert a maximum of 4.3 mg/L of oxygen demand, thus the increase in 2002 conditions would only depress DO by 0.01 mg/L. The actual impact in the river would be even smaller because the river would dilute the concentration released from the dam. Moreover, elevated hypolimnetic ammonia would not be released to Scoggins Creek, and hence not to the Tualatin River, under 2001 conditions for Alternative 2.

Under Alternative 2, the concentrations of ammonia in the effluent from the wastewater treatment facilities would be lower than Alternative 1 for the May through mid-November time period. This is because the NPDES permit contains mass limits for ammonia and, at the buildout flows for Alternative 2, the effluent concentrations would have to be lower than for Alternative 1 in order to meet these mass limits.

**Tualatin River Mainstem Chlorophyll a and Orthophosphate**

For the dry year condition year (2001), the USGS Tualatin River models predict elevated algae concentrations (measured as chlorophyll a) at Elsner and Stafford using actual river and effluent flows for that year (see Figure 4.3-11). The predicted values generally are well in excess of ODEQ’s action level of 15 µg/L. Although the model generally predicted higher algae at Elsner and Stafford in 2001 compared to actual conditions, the actual chlorophyll values measured that summer and fall also often
exceeded the action level. For these same dry year conditions, but with buildout effluent flows and increased augmentation flows associated with Alternative 2, the model predicts much lower algae levels at Elsner for the entire summer and early fall and for much of this same period at Stafford. This is because the much higher effluent flows assumed for buildout and increased augmentation flows would substantially reduce the travel times in the lower reservoir reach and thus in turn reduce the concentrations of algal biomass that can grow in the system. Note that the higher natural flows associated with storms also lead to steep reductions in algae concentrations.

Figure 4.3-11. Tualatin River Model Time Series for August through November; Chlorophyll a (microgram/L) at Stafford and Elsner

The model indicates that, by implementing Alternative 2, the chlorophyll a concentration would generally exceed 15 µg/L less frequently than under Alternative 1. Again, the action level is not a formal water quality standard, and it is recognized that some water bodies will exceed this level at times under the best attainable conditions. Given that the Tualatin River is currently meeting the TMDL targets for phosphorus, occasional exceedances of the action level do not necessarily imply impairment.

**Tualatin River Mainstem Other Parameters**

The primary mechanism affecting pH in the mainstem river is algal activity (the wastewater treatment facility discharges have neutral pH), which is only pronounced in the lower portion of the mainstem. During periods of peak algal production, there will generally be a related increase in pH. Thus, pH responses will be proportional to the differences in algal activity between the alternatives. Currently, pH conditions in the Tualatin River rarely, if ever, exceed the upper end of the allowable pH range (6.5-8.5). Because algae concentrations would decrease in the lower river under both Action Alternatives, it would
be anticipated that peak pH values also would decrease somewhat, but not to the extent that they would fall below the lower end of the allowable range.

Turbidity is affected not only by algal activity, but also by suspended solids in the wastewater treatment facility effluents and potential bank erosion and bottom sediment re-suspension during high flow periods. Wastewater treatment facility effluents have low suspended solids concentrations (less than 5 to 10 mg/L), and would be lower for the Action Alternatives than Alternative 1 (because it was assumed that existing mass limits for total suspended solids in the permit would have to be met at the higher buildout flows, thus forcing lower concentrations). Hence turbidity values would be lower in relation to the wastewater treatment facilities. There would be lower algal activity for Alternatives 2 and 3 in the lower river, and thus lower turbidity. Bank and bottom erosion would only vary between the alternatives if high river flows are made substantially higher as a result of the Action Alternatives relative to Alternative 1. According to the hydrologic modeling, the general effect of the Action Alternatives during high flow months in wet and normal years would be reduced flows due to additional reservoir capacity and lower spills. The increases in flows during dry months and years would be substantial percentage-wise, but on an absolute basis are not likely to significantly increase bank or bottom scour. For example, river flow at Farmington in September of a dry year would increase 76 to 77 percent for the Action Alternatives relative to Alternative 1, with the absolute increase being about 150 cfs (from about 190 to 340 cfs) (MWH 2006d). To put this increase and absolute flow value in perspective, the peak flows on a monthly average basis for the Tualatin River at Farmington range from 5,500 to 8,500 cfs for the rainy season months of January through March (MWH 2006d).

Bacteria levels also would not vary significantly between the alternatives. The wastewater treatment facilities disinfect the effluents and have to meet bacteria criteria at end-of-pipe, and thus the assumption of buildout flows associated with the Action Alternatives would not cause higher bacteria levels in the river. The dam raise, pump-back, and future water uses, and related changes in river hydrology, also would not be expected to affect bacteria levels except that increased flows during summer and fall low flow conditions would further dilute background bacteria levels in the river to some extent.

The organic matter concentrations in wastewater treatment facility effluents would be lower under the Action Alternatives than the Alternative 1 (because it was assumed that existing mass limits for total suspended solids and CBOD in the permit would have to be met at the higher buildout flows, thus forcing lower concentrations). The organic matter content in the river is also primarily affected by algal activity in the lower river, and the algal activity under the Action Alternatives would be lower than Alternative 1, and thus the organic matter would also be lower.

The effects of dissolved solids in relation to aquatic life and drinking uses are dependent on the various many types of particles that are in solution. In that sense, the dissolved solids parameter itself is not the most instructive. For this reason, the chloride concentration is often used as a better indicator of potential effects. Background chloride concentrations in the mainstem are generally around 5 mg/L. The average chloride concentration in the wastewater treatment facility effluents is about 50 mg/L, thus the increase in effluent discharges assumed for buildout conditions under Alternatives 2 and 3 would lead to
an increase in chloride concentrations in the lower river. This would not, however, lead to significant adverse effects on aquatic life or drinking water suitability. This is because the Oregon aquatic life criteria are 230 mg/L to protect against chronic effects and 860 mg/L to protect against acute effects. Similarly, the Oregon secondary contaminant criterion for drinking water supplies for chloride is 250 mg/L. Thus, the concentrations in the river under Alternatives 2 and 3 would not even come close to these criteria levels. In addition, the increased flows in the lower river during summer and fall associated with Clean Water Services’ augmentation water under the Action Alternatives would further dilute the wastewater treatment facility discharges.

**Construction Impacts**

Short-term impacts to water quality would occur during construction of Scoggins Dam and would result primarily from stormwater runoff carrying soil and pollutants into Scoggins Creek and Henry Hagg Lake. Best management practices would be implemented during construction to minimize runoff and impacts to water quality. Erosion and sediment control plans would be developed and implemented, and vehicles would be maintained and refueled away from water bodies.

Water quality impacts would occur during construction of the RWP, which includes eight waterway crossings. Trenchless construction methods (e.g. micro-tunneling) would be used for the Tualatin River crossing and may be used for other crossings. (See Section 3.3.4.7.) Trenchless stream crossings would be unlikely to adversely affect water quality. However, frac-out may occur when boring under a stream or wetland.

To minimize the likelihood of frac-out, geotechnical studies will be performed to test substrates at each potential tunnel location for their ability to withstand tunnel construction activities. Tunnel depths will be adjusted according to the results of these geotechnical studies so that tunneling only occurs in substrates that are highly unlikely to result in frac-out. To protect water quality from construction impacts, tunnel entry and exit holes and containment pits would be placed out of the riparian area – at least 150 feet back from the streambank. Additionally, as discussed in subsequent sections, a Horizontal Directional Drill Contingency Plan will be completed to outline contingency measures for containment and cleanup in the event of a frac-out. Geotechnical information associated with other pipeline efforts will be reviewed in preparing the contingency plan.

Trenching may be used for crossing Scoggins Creek and an unnamed tributary to the Tualatin River. Trenched crossings would disturb soils in and adjacent to streams and may result in temporary impacts to water quality (turbidity and sedimentation). As described in Section 3.3.4.7, methods to minimize water quality impacts would be implemented during construction.

Trenched crossings may also affect native fish, including ESA listed winter steelhead juveniles. Therefore, all BMPs associated with open water trenching will adhere to a Temporary Water Management Plan to reduce the impacts to aquatic resources and fish.

**4.3.2.2 Cumulative Impacts**

Implementation of the Clean Water Services program activities, described in Section 1.6.2, would add to the beneficial water quality effects of Alternative 2. Clean Water Services would be better able to
implement the Revised Temperature Management Plan, meet the requirements of the watershed-based NPDES permit, and meet flow targets at Farmington (Table 2-2). Cumulatively, the programs would benefit water quality in the Tualatin River Basin. Program activities described in Section 1.6.2 would not likely affect water quality in Henry Hagg Lake.

Development of the Wapato Unit of the Tualatin River National Wildlife Refuge would also benefit water quality in the Tualatin River. The refuge would protect and enhance wetlands in the area, which, in turn, would improve water quality.

Future development in the Tualatin Basin would likely have negative impacts on water quality from stormwater runoff and increased wastewater discharges. Such impacts would partially offset the benefits achieved by Alternative 2. However, the negative impacts of existing and future development would be lessened by the region’s TMDLs, which consider the effects of stormwater runoff and which have been developed to protect the region’s water quality and beneficial uses.

4.3.2.3 Alternative 3 – Multiple Source Option

4.3.2.3.1 Potential Impacts (direct, indirect)
Water quality impacts would result primarily from hydrological changes of the project. See Section 3.6 (Hydrologic Changes).

Henry Hagg Lake Water Surface Elevation
For Alternative 3, under the 2001 drought conditions, natural inflows and pump-back would be insufficient to reach the target maximum because of drought conditions that year. For Alternative 3, under 2002 conditions (a normal hydrologic year), inflows would be sufficient to meet the target maximum elevation. The water surface elevation would reach a maximum in May, and decrease through the summer and fall as downstream users call for water releases. The lake would reach a minimum water surface elevation between mid-November and mid-December.

Henry Hagg Lake Temperature
Under 2001 conditions for Alternative 3, the average whole-lake temperature would be 10.1 °C, a cooler average whole-lake temperature than Alternative 1 and slightly warmer than Alternative 2. Similarly, under 2002 conditions, the average whole-lake temperature would be 9.6 °C, cooler than Alternative 1 but warmer than Alternative 2. Longer periods of thermal stratification and a shallower thermocline would also result under this alternative relative to Alternative 1 and would be comparable to Alternative 2.

Henry Hagg Lake Dissolved Oxygen
Under both 2001 and 2002 conditions, Alternative 3 would result in higher whole-lake DO than Alternative 1. Further, this alternative would result in fewer days with low (less than 1 mg/L) DO in the lake (53 days under 2001 conditions and 32 days under 2002 conditions), compared to Alternative 1 (85 days under 2001 conditions and 64 days under 2002 conditions). The number of days with anoxic conditions would be the same for Alternative 3 compared to Alternative 2 under 2001 conditions, but there would be one-third fewer days for Alternative 2 compared to Alternative 3.
Selective withdrawal was incorporated into Alternative 3 to allow releases to meet downstream temperature criteria. As with Alternative 2, these results indicate that selective withdrawal would affect the extent of in-lake hypoxia. Turnover would occur on day 325 (November 21) under 2002 conditions — earlier than Alternative 1 (day 329). Turnover would occur on day 323 (November 19) under 2001 conditions—later than Alternative 1 (day 317). Turnover would occur at about the same time for Alternative 3 compared to Alternative 2. There would be reduced spatial and temporal extent of hypolimnetic hypoxia in Henry Hagg Lake under this alternative relative to Alternative 1.

The effect of organic detritus from the newly inundated areas of the lake on SOD would be minimal for this alternative for the same reasons as discussed under Alternative 2. In addition, the inundation area would be smaller for Alternative 3 than Alternative 2, and thus the mass of detritus available would be even smaller.

**Henry Hagg Lake Ammonia**
There would be reduced hypolimnetic ammonia in Henry Hagg Lake under this alternative relative to Alternative 1, but Alternative 3 would have higher ammonia values than Alternative 2, especially for 2002 conditions. Elevated ammonia concentrations would not extend vertically high enough in the lake to be drawn into the outlet to Scoggins Creek for any of the alternatives or years, and concentrations would be well below toxicity thresholds.

**Henry Hagg Lake Chlorophyll a and Orthophosphate**
For 2001 conditions, Alternative 3 would have the same annual whole-lake average chlorophyll a concentration as Alternative 2, both of which would be lower than Alternative 1. For 2002 conditions, Alternative 3 will have higher average whole-lake chlorophyll a than Alternatives 1 and 2.

Under 2001 conditions, Alternatives 2 and 3 would have no blue-green algae blooms (compared to 43 days for Alternative 1). Under 2002 conditions, the number of days of blue-green algae blooms (1.4 days) would be significantly fewer for Alternative 3 compared to Alternative 1 (66 days) and Alternative 2 (23 days).

Annual whole-lake orthophosphate concentrations would be about the same for all alternatives for 2001 conditions. Under 2002 conditions, Alternative 3 conditions would have higher average whole-lake orthophosphate concentrations (6.4 µg/L), compared to Alternative 1 (5.1 µg/L) but lower than Alternative 2.

**Scoggins Creek Temperature**
The average temperature for the Henry Hagg Lake outflow for Alternative 3 would be 13.2 °C under 2001 conditions and 12.2 °C under 2002 conditions (Table 4.3-4). These average temperatures would be higher than the Alternative 1 scenarios (11.8 °C in 2001 and 9.1 °C in 2002) which could possibly be a result of the lower flows associated with Alternative 3. The average increase in annual temperature would be insignificant because the amount of days in which the temperature standard is exceeded is less than 1 under 2001 conditions and zero under 2002 conditions—significantly fewer days than the Alternative 1 scenarios. As such, implementation of Alternative 3 would improve the temperature of outlet water at Scoggins Dam. These beneficial effects are very comparable to those that would occur...
with Alternative 2. As with Alternative 2, this improvement would be associated with the use of selective withdrawal of water from the lake.

Table 4.3-4. Average Annual Temperature of the Henry Hagg Lake Outflow

<table>
<thead>
<tr>
<th></th>
<th>2001 Alt. 1</th>
<th>2001 Alt. 3</th>
<th>2002 Alt. 1</th>
<th>2002 Alt. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Temperature (°C)</td>
<td>11.8</td>
<td>13.2</td>
<td>9.1</td>
<td>12.2</td>
</tr>
<tr>
<td>Days Above Temperature Standard (degree days)</td>
<td>111</td>
<td>0.5</td>
<td>61</td>
<td>0.0</td>
</tr>
</tbody>
</table>

1 In this report, one “degree day” represents 1 °C above the standard for a period of one day, the analysis does not use the 7-day temperature standard and thus is not a critical analysis of compliance with standards.

Scoggins Creek Dissolved Oxygen

Under 2001 conditions, average DO would be 7.4 mg/L, also lower than Alternative 1 (7.9 mg/L) (Table 4.3-5). Average DO for Alternative 3 would be 8.2 mg/L under 2002 conditions—lower than Alternative 1 (8.8 mg/L). Minimum DO would be lower in both scenarios.

Although DO is low at times in releases, it would not adversely affect downstream DO in Scoggins Creek because of aeration at the outlet due to turbulence. The overall effects of Alternative 3 would be very comparable to Alternative 2.

Table 4.3-5. Dissolved Oxygen in the Henry Hagg Lake Outlet

<table>
<thead>
<tr>
<th></th>
<th>2001 Alt. 1</th>
<th>2001 Alt. 3</th>
<th>2002 Alt. 1</th>
<th>2002 Alt. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Annual DO (mg/L)</td>
<td>7.9</td>
<td>7.4</td>
<td>8.8</td>
<td>8.2</td>
</tr>
<tr>
<td>Minimum DO (mg/L)</td>
<td>5.1</td>
<td>1.1</td>
<td>4.2</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Scoggins Creek Ammonia

Compared to Alternative 1 under 2002 conditions (an average ammonia concentration of 10.7 µg/L), Alternative 3 would result in higher average ammonia concentrations (12.6 µg/L). Under 2001 conditions, Alternative 3 would result in essentially the same average ammonia concentrations (12.6 µg/L) as Alternative 1—an average ammonia concentration of 12.4 µg/L.

Scoggins Creek Chlorophyll a and Orthophosphate

Model run results at the Henry Hagg Lake outflow in Scoggins Creek (Table 4.3-6) indicate that Alternative 3, under 2001 conditions, would result in lower average chlorophyll a concentrations than Alternative 1 under 2001 conditions. However, for Alternative 3 under 2002 conditions, chlorophyll a concentrations were higher than for Alternative 1 under 2002 conditions. These results were the same as for Alternative 2.

Alternative 3 under 2002 conditions also had higher orthophosphate concentrations than Alternative 1 under the 2002 conditions, as did the Alternative 3 under 2001 conditions.

Table 4.3-6. Average Annual Chlorophyll a and Orthophosphate in the Henry Hagg Lake Outflow

<table>
<thead>
<tr>
<th></th>
<th>2001 Alt. 1</th>
<th>2001 Alt. 3</th>
<th>2002 Alt. 1</th>
<th>2002 Alt. 3</th>
</tr>
</thead>
</table>
### Tualatin River Mainstem Temperature
The effects of Alternative 3 on mainstem temperature would be comparable to the effects of Alternative 2. The temperature conditions would likely be slightly colder than Alternative 2 because river flows would be slightly higher with Alternative 3 on an annual basis. During the critical months, however, the flows would be similar to Alternative 2, thus the temperature effects would also be similar.

### Tualatin River Mainstem Dissolved Oxygen
Similar to temperature, the effects of Alternative 3 on mainstem DO would be comparable to the effects of Alternative 2. The Alternative 3 DO concentrations would likely be slightly lower on an annual basis than Alternative 2 in the lower river because river flows would be slightly higher with Alternative 3 (there would be a greater algae washout with higher flows), but the difference would likely be minor. During the critical months, however, the flows would be similar to those described for Alternative 2; therefore, the DO levels would also be similar.

### Tualatin River Mainstem Ammonia
The difference in ammonia concentrations in water released from Henry Hagg Lake between Alternative 3 and Alternative 1 would be very small (only 0.0002 mg/L for 2001 and 0.0019 mg/L for 2002). These very slight differences (not measurable in the field) would not lead to significant or measurable increases in DO in the mainstem river. For example, 1 mg/L of ammonia could exert a maximum of 4.3 mg/L of oxygen demand, thus the increase in 2002 conditions would only depress DO by only 0.008 mg/L. The actual impact in the river would be even smaller because the river would dilute the concentration released from the dam. Moreover, elevated hypolimnetic ammonia would not be released to Scoggins Creek, and subsequently not to the Tualatin River, under 2001 conditions for Alternative 3.

Similar to Alternative 2, the concentrations of ammonia in the effluent from the wastewater treatment facilities would be lower than Alternative 1 for the May through mid-November time period. This is because the NPDES permit contains mass limits for ammonia, and at the buildout flows for Alternatives 2 and 3 the effluent concentrations would have to be lower than for Alternative 1 in order to meet these mass limits.

### Tualatin River Mainstem Chlorophyll a
Similar to temperature and DO, the effects of Alternative 3 on mainstem algae would be comparable to the effects of Alternative 2. On an annual basis, the Alternative 3 chlorophyll a concentrations would likely be slightly lower than Alternative 2 in the lower river because river flows are slightly higher with Alternative 3 (there would be a slightly greater algae washout with higher flows), but the difference would likely be minor. During the critical months, however, the flows would be the same for Alternatives 2 and 3, thus the algae should also be the same for these months.

### Tualatin River Mainstem Other Parameters

<table>
<thead>
<tr>
<th>Chlorophyll a (µg/L)</th>
<th>0.82</th>
<th>0.53</th>
<th>0.64</th>
<th>0.70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ortho-P (µg/L)</td>
<td>5.1</td>
<td>5.4</td>
<td>6.3</td>
<td>7.1</td>
</tr>
</tbody>
</table>

4.3-28
Refer to the discussion of other water quality parameters for the Tualatin River Mainstem under Alternative 2. Impacts would be the same for both Action Alternatives.

**Streams Associated with the Willamette Pipeline**
The Willamette Pipeline and associated facilities would have no long-term negative effects on water quality. Willamette River withdrawals are limited as a condition of the water right permit (Permit S-49240). The Final Order Incorporating Settlement Agreement for the permit (OWRD 2007) includes a stipulation that the total amount of water that can be legally diverted must be reduced if specified minimum flows for fish would not be met. The minimum fish flows were developed by ODFW.

Water withdrawn from the Willamette River would be treated at the Willamette River Water Treatment Plant and would meet or exceed applicable drinking water standards. The treatment plant would be expanded to accommodate the additional water withdrawn from the river.

**Construction Impacts**
Short-term impacts to water quality would occur during construction of Scoggins Dam and would result primarily from stormwater runoff carrying soil and pollutants into Scoggins Creek and Henry Hagg Lake. Best management practices would be implemented during construction to minimize runoff and impacts to water quality. Erosion and sediment control plans would be developed and implemented, and vehicles would be maintained and refueled away from water bodies.

Water quality impacts would occur during construction of the RWP and Willamette Pipeline. Eight waterway crossings would occur for RWP construction. The Willamette pipeline alignment would cross 18 streams (including the Tualatin River) and a number of potentially jurisdictional ditches. Most of the ditches are tributaries to streams that have been altered by agricultural or residential development. Trenchless construction methods (e.g. boring) would be used for most of the stream crossings, including the Tualatin River. (See Section 3.3.4.7.) Trenchless stream crossings would be unlikely to adversely affect water quality. However, frac-out may occur when boring under a stream or wetland.

To minimize the likelihood of frac-out, geotechnical studies will be performed to test substrates at each potential tunnel location for their ability to withstand tunnel construction activities. Tunnel depths will be adjusted according to the results of these geotechnical studies so that tunneling only occurs in substrates that are highly unlikely to result in frac-out. Additionally, as discussed in subsequent sections, a Horizontal Directional Drill Contingency Plan will be completed to outline contingency measures for containment and cleanup in the event of a frac-out. Geotechnical information associated with other pipeline efforts will be reviewed in preparing the contingency plan.

To protect water quality from construction impacts, tunnel entry and exit holes and containment pits would be placed out of the riparian area – at least 150 feet back from the streambank. For the Tualatin River crossing (Alternative 3), the tunnel would be at least 80 feet below the riverbed, which geotechnical studies show to be well within a layer of clay soils that would be unlikely to fracture during tunneling. The tunnel entry and exit holes would be set back at least 200 feet from the riverbank (Carollo 2007).
Trenching may be used for some of the minor waterway crossings. Trenched crossings would disturb soils in and adjacent to streams and may result in temporary impacts to water quality (turbidity and sedimentation). As described in Section 3.3.4.7, methods to minimize water quality impacts would be implemented during construction.

Trenched crossings may also affect native fish, including ESA listed winter steelhead juveniles. Therefore, all BMPs associated with open water trenching will adhere to a Temporary Water Management Plan to reduce the impacts to aquatic resources and fish. In addition, areas disturbed during construction would be replanted with native riparian vegetation upon completion of construction.

4.3.2.3.2 Cumulative Impacts
Cumulative impacts would be essentially the same as described for Alternative 2.

4.3.2.4 Summary of Water Quality Impacts
Table 4.3-7, Table 4.3-8, and Table 4.3-9 provide a summary of the water quality impacts to Henry Hagg Lake, Scoggins Creek (represented by Henry Hagg Lake outfall) and the mainstem Tualatin River.
Table 4.3-7. Summary of Henry Hagg Lake Model Results

<table>
<thead>
<tr>
<th>Model Run</th>
<th>Annual whole lake average temp. (ºC)</th>
<th>Annual whole lake average DO (mg/L)</th>
<th>Days with anoxic conditions somewhere</th>
<th>Annual whole lake average Ortho-P (µg/L)</th>
<th>Annual whole lake average Chlor a (µg/L)</th>
<th>Thermo-cline Duration (days)</th>
<th>Turnover Day (Julian day)</th>
<th>Days with Blue-Green Bloom</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001 Alt 1</td>
<td>11.0</td>
<td>9.2</td>
<td>85</td>
<td>4.7</td>
<td>0.96</td>
<td>189</td>
<td>317</td>
<td>43</td>
</tr>
<tr>
<td>2001 Alt 2</td>
<td>10.0</td>
<td>9.6</td>
<td>52</td>
<td>5.2</td>
<td>0.76</td>
<td>191</td>
<td>324</td>
<td>0</td>
</tr>
<tr>
<td>2001 Alt 3</td>
<td>10.1</td>
<td>9.6</td>
<td>53</td>
<td>5.2</td>
<td>0.77</td>
<td>191</td>
<td>323</td>
<td>0</td>
</tr>
<tr>
<td>2002 Alt 1</td>
<td>10.9</td>
<td>9.5</td>
<td>64</td>
<td>5.1</td>
<td>1.25</td>
<td>180</td>
<td>329</td>
<td>66</td>
</tr>
<tr>
<td>2002 Alt 2</td>
<td>9.0</td>
<td>10.0</td>
<td>11</td>
<td>9.2</td>
<td>0.98</td>
<td>188</td>
<td>329</td>
<td>23</td>
</tr>
<tr>
<td>2002 Alt 3</td>
<td>9.63</td>
<td>9.9</td>
<td>32</td>
<td>6.4</td>
<td>1.3</td>
<td>192</td>
<td>325</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Source: CH2M Hill 2006

Table 4.3-8. Summary of Henry Hagg Lake Outfall Model Data for Three Alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Annual average outlet Temperature (ºC)</th>
<th>Annual average outlet DO (mg/L)</th>
<th>Minimum outlet DO (mg/L)</th>
<th>Day of minimum DO</th>
<th>Annual average outlet Ammonia (µg/L)</th>
<th>Annual average outlet Ortho P (µg/L)</th>
<th>Annual average outlet Chlor A (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt. 1</td>
<td>11.8</td>
<td>7.9</td>
<td>5.1</td>
<td>248</td>
<td>12.4</td>
<td>5.1</td>
<td>0.82</td>
</tr>
<tr>
<td>Alt. 2</td>
<td>13.2</td>
<td>7.4</td>
<td>1.1</td>
<td>291</td>
<td>12.6</td>
<td>5.4</td>
<td>0.51</td>
</tr>
<tr>
<td>Alt. 3</td>
<td>13.2</td>
<td>7.4</td>
<td>1.1</td>
<td>291</td>
<td>12.6</td>
<td>5.4</td>
<td>0.53</td>
</tr>
<tr>
<td>2002 Alt 1</td>
<td>9.1</td>
<td>8.8</td>
<td>4.2</td>
<td>263</td>
<td>10.7</td>
<td>6.3</td>
<td>0.64</td>
</tr>
<tr>
<td>2002 Alt 2</td>
<td>12.0</td>
<td>8.3</td>
<td>3.5</td>
<td>311</td>
<td>13.3</td>
<td>9.5</td>
<td>0.75</td>
</tr>
<tr>
<td>2002 Alt 3</td>
<td>12.2</td>
<td>8.2</td>
<td>2.9</td>
<td>301</td>
<td>12.6</td>
<td>7.1</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Source: CH2M Hill 2006

Note: Releases from Henry Hagg Lake are aerated to saturation values by turbulence at the existing outlet structure, thus the DO values in this table would not be representative of values in Scoggins Creek if the outlet remains the same or the releases are similarly aerated by other means.

Table 4.3-9. Summary of Water Quality Effects for Mainstem Tualatin River During the Critical Period (August through Mid-November)

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Mainstem River Location</th>
<th>Temperature</th>
<th>Dissolved Oxygen</th>
<th>Ammonia</th>
<th>Algae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt. 1</td>
<td>Forest Grove (RM 55)</td>
<td>NTP criteria not always met in fall 2002 NTP criteria closely mimic current temperatures Criteria slightly lower than current temperatures in 2002</td>
<td>DO criteria met at all times DO criteria not met at all times DO criteria not met at all times</td>
<td>Effects not measurable WWTFs at permitted levels WWTFs at permitted levels WWTFs at permitted levels</td>
<td>Algae levels not measurable Action level usually met Action level often exceeded</td>
</tr>
<tr>
<td></td>
<td>Elsner (RM 16.2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stafford (RM 5.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alt. 2</td>
<td>Forest Grove (RM 55)</td>
<td>Warmer in summer and cooler in fall than Alt 1; NTP criteria generally met in summer and fall</td>
<td>DO higher August to mid-November than Alt 1 for 2001, DO lower in August and higher September to mid-November than Alt 1 for 2002, DO criteria met at all times</td>
<td>Effects not measurable WWTFs at permitted levels WWTFs at permitted levels WWTFs at permitted levels</td>
<td>Algae levels not measurable</td>
</tr>
<tr>
<td>Alternative</td>
<td>Mainstem River Location</td>
<td>Temperature</td>
<td>Dissolved Oxygen</td>
<td>Ammonia</td>
<td>Algae</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------</td>
<td>-------------</td>
<td>------------------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>Elsner (RM 16.2)</td>
<td>Slightly warmer than Alt 1</td>
<td>DO higher August to mid-November than Alt 1 for 2001 and 2002</td>
<td>WWTFs lower to meet mass limits</td>
<td>Algae levels lower than Alt 1, Action level met more often</td>
<td></td>
</tr>
<tr>
<td>Stafford (RM 5.5)</td>
<td>Slightly warmer than Alt 1</td>
<td>DO lower in August to September and higher October to mid-November than Alt 1 for 2001, DO higher August to mid-November than Alt 1 for 2002</td>
<td>WWTFs lower to meet mass limits</td>
<td>Algae levels generally lower than Alt 1, Action level met more often</td>
<td></td>
</tr>
<tr>
<td>Alt. 3</td>
<td>Forest Grove (RM 55)</td>
<td>Same as Alt 2</td>
<td>Same as Alt 2</td>
<td>Effects not measurable WWTFs lower to meet mass limits</td>
<td>Algae levels not measurable Same as Alt 2</td>
</tr>
<tr>
<td></td>
<td>Elsner (RM 16.2)</td>
<td>Same as Alt 2</td>
<td>Same as Alt 2</td>
<td>WWTFs lower to meet mass limits</td>
<td>Same as Alt 2</td>
</tr>
<tr>
<td></td>
<td>Stafford (RM 5.5)</td>
<td>Same as Alt 2</td>
<td>Same as Alt 2</td>
<td>WWTFs lower to meet mass limits</td>
<td>Same as Alt 2</td>
</tr>
</tbody>
</table>

Source: CH2M Hill 2006
WWTF = wastewater treatment facility
Note: The ongoing temperature TMDL revision process is defining what the natural thermal potential (NTP) is during these naturally warmer periods (CH2M HILL, 2008).

4.3.3 Mitigation Measures

4.3.3.1 Alternative 1

There are no water-quality-related mitigation measures suggested under the No Action Alternative.

4.3.3.2 Alternatives 2 and 3

The proposed outlet configuration at Scoggins Dam will be similar to the existing configuration in order to fully aerate water released to Scoggins Creek. Also, the Clean Water Services allocation for flow augmentation delivered to the river near Spring Hill Pumping Plant via the new RWP will be fully aerated — the design of facilities to connect the RWP to Henry Hagg Lake will address this need.
4.3 WATER QUALITY ................................................................. 4.3-1
4.3.1 Affected Environment............................................... 4.3-1
4.3.2 Environmental Impacts............................................. 4.3-4
4.3.3 Mitigation Measures................................................ 4.3-32

Table 4.3-1. Average Annual Temperature of the Henry Hagg Lake Outflow .... 4.3-11
Table 4.3-2. Dissolved Oxygen in the Henry Hagg Lake Outlet.................... 4.3-14
Table 4.3-3. Average Annual Chlorophyll a and Orthophosphate in Henry Hagg Lake Outflow ... 4.3-15
Table 4.3-4. Average Annual Temperature of the Henry Hagg Lake Outflow .... 4.3-27
Table 4.3-5. Dissolved Oxygen in the Henry Hagg Lake Outlet............... 4.3-27
Table 4.3-6. Average Annual Chlorophyll a and Orthophosphate in the Henry Hagg Lake Outflow ... 4.3-27
Table 4.3-7. Summary of Henry Hagg Lake Model Results ........................... 4.3-31
Table 4.3-8. Summary of Henry Hagg Lake Outfall Model Data for Three Alternatives 4.3-31
Table 4.3-9. Summary of Water Quality Effects for Mainstem Tualatin River During the Critical Period (August through Mid-November) .................... 4.3-31

Figure 4.3-1. Water Surface Elevations in Henry Hagg Lake with 2001 and 2002 Conditions .......................................................................................................................... 4.3-7
Figure 4.3-2. Tualatin River Model Time Series for 2001; 7-Day average of daily maximum; Scoggins Creek downstream of Scoggins Dam .......... 4.3-12
Figure 4.3-3. Tualatin River Model Time Series for 2002; 7-Day average of daily maximum; Scoggins Creek downstream of Scoggins Dam .......... 4.3-13
Figure 4.3-4. Measured 7-Day Average of Daily Maximum Temperature for 2001-2002; Scoggins Creek Upstream and Downstream of Henry Hagg Lake... 4.3-14
Figure 4.3-5. Tualatin River Model time series for May-November 2001; Dissolved Oxygen, 7-Day average of daily minimum; downstream of Forest Grove...... 4.3-16
Figure 4.3-6. Tualatin River Model time series for May-November 2002; Dissolved Oxygen, 7-Day average of daily minimum; downstream of Forest Grove...... 4.3-17
Figure 4.3-7. Tualatin River Model time series for May-November 2001; Dissolved Oxygen, 7-Day average of daily minimum; Elsner .................................................. 4.3-18
Figure 4.3-8. Tualatin River Model Time Series for May-November 2001; Dissolved Oxygen, 7-Day average of daily minimum; Stafford ........................................ 4.3-19
Figure 4.3-9. Tualatin River Model Time Series for May-November 2002; Dissolved Oxygen; Elsner ................................................................. 4.3-20
Figure 4.3-10. Tualatin River Model Time Series for May-November 2002; Dissolved Oxygen; Stafford ................................................................. 4.3-21
Figure 4.3-11. Tualatin River Model Time Series for August through November; Chlorophyll a (microgram/L) at Stafford and Elsner ................................................. 4.3-22

4.3-33
4.4 Water Rights

This section addresses the water rights issues and impacts associated with the implementation of the Project Alternatives, including the details of obtaining the necessary water rights (new applications, transfers and intergovernmental agreements).

Water rights information in this section is adapted from the WSFS. Hydrology information is summarized from the Surface Water Hydrology Technical Report prepared for the project (MWH 2006d), which documents the hydrologic modeling methodology, assumptions, and effects of the alternatives on surface water hydrology in Henry Hagg Lake, Scoggins Creek, and the Tualatin River.

4.4.1 Affected Environment

Under Oregon law, a water right permit must be obtained from the OWRD in order to appropriate and use surface water. The appropriation and use are subject to the principle of “prior appropriation.” Holders of existing water right permits have priority over applicants for new permits. New permits are only issued to the extent that water is available in adequate quantities to first satisfy existing permits.

Henry Hagg Lake is under the control of Reclamation. The reservoir is filled from Scoggins Creek under a 60,000 acre-feet storage permit issued to Reclamation.

All of the Partners participating in the TBWSP hold existing water rights, including surface water, groundwater, and storage. The proposed Action Alternatives would supplement those existing water rights to allow each of the Partners to meet future water needs. Many of the municipal partners have interagency agreements allowing them to share existing and future water rights to balance short-term, individual needs.

The JWC holds a municipal surface water right permit for 75 cfs on Scoggins Creek, with the point of diversion located at Scoggins Dam. This water right is junior to the existing storage permit for Henry Hagg Lake held by Reclamation, and it would be senior to any new water right issued for increasing the storage. The construction for this water right has not been completed, as the conveyance piping from the point of diversion at the dam to the JWC Fern Hill Water Treatment Plant, located near to the Spring Hill Pumping Plant on the Tualatin River, was started with the original dam construction but was not completed.

Three of the project Partners (Cities of Hillsboro, Forest Grove, and Beaverton) hold a total of 110 cfs in municipal surface water rights with an authorized point of diversion from the Tualatin River at the Spring Hill Pumping Plant intake. Final proof surveys and claims of beneficial use have been submitted to OWRD, and final certificates are expected to be issued soon. The current average amount diverted for municipal use during winter months, when water is available in the river, is approximately 35 to 40 cfs.

For the intake at the Willamette River Water Treatment Plant in Wilsonville, TVWD has had a permit (number S-49240) to withdraw up to 202 cfs from the Willamette River for M&I use. OWRD recently approved a permit extension to October 1, 2047 (OWRD 2007). In addition, the permit was assigned
from TVWD to the Willamette River Water Coalition, which includes TVWD and the cities of Tigard, Tualatin, Sherwood, and Gladstone (Heidgerken 2007).

### 4.4.2 Environmental Impacts

#### 4.4.2.1 Alternative 1 – No Action

**4.4.2.1.1 Potential Impacts (direct, indirect)**

Under the No Action Alternative, Scoggins Dam would not be raised, water storage would not be increased, and the proposed water pipelines would not be constructed; however, the demand for a future water supply will continue to increase. Even with water conservation measures, the Tualatin Basin would experience water shortages.

Under the No Action Alternative, the water rights associated with storage in Henry Hagg Lake and the surrounding surface waters would not change and no new water rights would be pursued. There would be no impacts to existing water rights as a result of the No Action Alternative, assuming a continued adherence to the prior appropriations provisions of state water law. However, it is uncertain as to how future water demands would be met under the No Action Alternative. Additional water appropriations would have to be achieved, probably from outside the Tualatin Basin.

Indirect effects under the No Action Alternative could include increased water right appropriations of other existing water utilities in the greater Portland metropolitan area, if some of the project Partners determined it necessary and possible to contract more water from outside sources.

**4.4.2.1.2 Cumulative Impacts**

The No Action Alternative would not result in any changes to existing water rights. Because the No Action Alternative would likely result in future water shortages in the Basin, future water right actions would likely be required that could have a cumulative impact on other river basins from which the water would be transferred (Willamette or Columbia river). Such impacts cannot be identified at this time.

#### 4.4.2.2 Alternative 2 – Scoggins Dam 40-Foot Raise

**4.4.2.2.1 Potential Impacts (direct, indirect)**

The stored water that is now being released into Scoggins Creek and the Tualatin River specifically for flow augmentation purposes would continue unchanged in either quantity or timing. Due to the use of the RWP for conveyance to the Spring Hill Pumping Plant, flow in Scoggins Creek below Scoggins Dam would be reduced by 38 percent. Sufficient flow would be left in Scoggins Creek during RWP operations to meet Scoggins Creek instream water rights. However, the magnitude of change in the downstream average annual flow would be greatly reduced once Scoggins Creek flows into the Tualatin River because of the larger flow in the Tualatin. The reduction in average annual flow volume in the Tualatin River at Dilley would be 12 percent, and effects would be attenuated downstream. Instream and existing water withdrawal rights in the Tualatin would still be met.

*New Water Right Permits*
Two new water right permits from OWRD would be required for the storage and use of surface water under Alternative 2: a storage permit and a secondary surface water permit. Preliminary storage water permit applications were submitted to OWRD in December 2006; initial review was completed in July 2007. These water right permits and subsequent evaluation processes would conform with current OWRD policy.

The storage permit would authorize the appropriation of surface water for filling the expanded reservoir an additional 60,000 acre-feet. This permit would identify the source of water for the proposed use, the allowable amount of water to be stored, the intended use of the impounded water, and the schedule for beginning and completing construction and water use. Current OWRD policy requires that water be available from the proposed surface water source for filling the reservoir at least 50 percent of the time after deducting all previously issued surface water and instream water right permits at or upstream of the proposed point of appropriation from the surface water source. The sources of water for the storage permits would be Scoggins Creek and the Tualatin River at the Spring Hill Pumping Plant intake (Tualatin withdrawals would be limited to high-flow periods), which provide an adequate water supply available to meet the 50-percent availability policy. The storage permit application requests that 10 years be allowed to begin construction of the expanded reservoir.

A secondary surface water permit would authorize use of the stored water. This permit identifies the amount of water that could be used from storage, the approved types of use, the approved period of use, and the locations where the water could be used. For the secondary surface water permit, OWRD requires that the water be used beneficially and without waste. For the majority of the project Partners, the type of use listed in the water right applications is “municipal,” which is defined by OWRD as the “delivery and use of water through the water service system of a municipal corporation for all water uses usual and ordinary to such systems.” A municipal needs form would be submitted to OWRD listing all existing water rights and existing water use for each municipal partner, and quantifying the need for the requested water.

Under Alternative 2 approximately 15,200 acre-feet from the proposed additional storage would be used for release and use for instream flow restoration in the Tualatin River Basin for restoration and water quality improvements. This is identified as several use types in the water rights applications — “pollution abatement, water quality control, aquatic life, wetlands enhancement.” Describing the proposed use as “multiple purpose” provides the opportunity to share the stored water between the Partners and uses. The application seeks flexibility for determining exact locations for flow restoration to meet the evolving needs of tributaries for water quality and habitat enhancements.

Coordination with Existing Water Rights

Existing Storage Right for Henry Hagg Lake
The reservoir is filled from Scoggins Creek under a storage permit for 60,000 acre-feet. Currently, during dry years, the reservoir does not fill completely. Under Alternative 2, the RWP would be constructed to transfer water between Henry Hagg Lake and the Spring Hill Pumping Plant intake on the Tualatin River, in part to assist in filling the existing reservoir. Using Tualatin River water as an additional source of
supply for the reservoir (pump-back) would require a transfer application to be filed. The transfer application process would include a public interest review, and the transfer would only be issued contingent on the change in use not harming other existing water right permit holders and the transfer not harming the public interest.

**Joint Water Commission Water Right on Scoggins Creek**
As stated previously, the JWC holds a 75-cfs municipal surface water right (Permit No. 50879) on Scoggins Creek, with the point of diversion located at Scoggins Dam. The RWP would allow full development of JWC’s municipal surface water right in addition to transporting stored water from Henry Hagg Lake directly to the Fern Hill Water Treatment Plant during the summer.

The JWC municipal surface water right is junior to the existing storage right; therefore, when it is developed it would only be usable after Henry Hagg Lake has filled each year, or if Reclamation is releasing water from the lake in the winter for flood control. However, the JWC permit would have priority over a new storage permit for the raised dam.

Voluntary subordination of the whole or portion of the existing JWC permit to the new storage permit would provide sufficient “available water” to meet OWRD water availability criteria.

**Municipal Surface Water Rights on Tualatin River**
Three of the project Partners (JWC members) hold a total of 110 cfs in municipal surface water rights with an authorized point of diversion from the Tualatin River at the Spring Hill intake. Those permits would continue to be used to supply the JWC members with surface water when water is available in the river, while the new storage permit would authorize additional appropriation of water from the Spring Hill Pumping Plant intake to fill the expanded reservoir, using the proposed RWP for pump-back. The new storage permit would not interfere in any way with the ability of the existing permits to supply surface water to the JWC when available.

4.4.2.2 **Cumulative Impacts**
The additional water rights required for Alternative 2 must meet OWRD rules regarding no harm to existing water right permittees and that the purposes meet the beneficial use standard. The applications would also be evaluated for any potential harm to water quality, sensitive species and other environmental concerns. There are no other known pending or anticipated projects that, combined with this alternative, would have cumulative impacts in addition to the impacts described above.

4.4.2.3 **Alternative 3 – Multiple Source Option**
4.4.2.3.1 **Potential Impacts (direct, indirect)**
With regard to Henry Hagg Lake, the Tualatin River, and Scoggins Creek surface waters, the implementation of Alternative 3 would require the same new water rights permits and coordination with existing water rights as Alternative 2. The following summarizes the water-right-related differences between the two alternatives:
- Alternative 3 would require a new storage permit for 31,000 acre-feet (compared to the 60,000 acre-feet required under Alternative 2) for storage in Henry Hagg Lake.
- Under Alternative 3, up to 40,000 acre-feet of river water would be withdrawn from the Tualatin River and pumped back through the RWP to Henry Hagg Lake from December through April (compared to 60,000 acre-feet proposed under Alternative 2).
- Flow in Scoggins Creek just below Scoggins Dam would be reduced by 31 percent (compared to 38 percent in Alternative 2). Similar to Alternative 2, the magnitude of change in average annual flow would be greatly reduced once Scoggins Creek flows into the Tualatin River. Existing water rights in Scoggins and the Tualatin are not expected to be affected.
- The Willamette Pipeline would utilize the existing Willamette River Water Coalition water right. Additional surface water rights would not be needed.

4.4.2.3.2 Cumulative Impacts
The OWRD availability analysis takes into consideration future potential water needs and related rights. For water rights purposes, new water rights would not be issued if potential cumulative impacts are identified.

4.4.3 Mitigation Measures
There would be no mitigation provided for any of the alternatives because no negative impacts to water right holders are expected.
4.4 Water Rights ................................................................. 4.4-1

4.4.1 Affected Environment .............................................. 4.4-1
4.4.2 Environmental Impacts ............................................ 4.4-2
4.4.3 Mitigation Measures ............................................... 4.4-5
4.5  Groundwater

4.5.1  Affected Environment

Information for this section is summarized from Human Environment Environmental Impacts Technical Report (MWH 2007). The Columbia River Basalt Aquifer is a dominant geologic and hydrogeologic feature and the aquifer is the primary source of groundwater in the central and eastern Tualatin Basin (including the Willamette Pipeline and the eastern end of the RWP alignment proposed under both Action Alternatives). Groundwater in the western edge of the Tualatin Basin and around most of Henry Hagg Lake generally occurs in sand and gravel units and in fractured zones of bedrock, typically in claystone or sandstone, according to well and borehole reports (well logs) on file with OWRD (OWRD 2005). Some wells north and west of Henry Hagg Lake also apparently penetrate into the Siletz and Tillamook volcanic systems. Yields are typically low, ranging from 0 to 20 gallons per minute (gpm) in most wells and often less than 5 gpm, although a few wells with higher yields are reported. In some lowland areas, perched water tables occur in the shallow subsurface under unconfined conditions with static water levels near the surface. Groundwater in water-bearing fractures in bedrock usually is confined, with static water levels typically 5 to 50 feet below ground surface. Water-bearing zones are often only a few feet thick.

Groundwater is present at or near the surface in the valley floor immediately downstream of the dam embankment toe, and several springs were present prior to construction of the original dam. Dewatering and draining of groundwater posed challenges to construction of the existing dam (Reclamation 2001a). The water table is generally deeper in the valley floor east of the dam and in the Tualatin Valley, with the shallow water table typically greater than about 15 feet (OWRD 2005).

Well logs provide only general information on well locations and production potential, and existing information filed with the OWRD is not always accurate or up-to-date. Well locations were estimated based on well log information but the exact location is limited to the level of precision provided on the well log, typically identified by township, range, section and, sometimes, quarter-quarter section. Field observations are primarily qualitative. No attempt was made to physically locate wells, almost all of which are on private property. It is not possible to say with certainty that there are no wells in the RWP alignment area. However, the well construction logs do not identify any wells that would be within 100 feet of the centerline alignment of the RWP. Groundwater wells in the study area are used primarily for domestic use and irrigation of lawns and pasture. Yields are generally insufficient for industrial or larger agricultural requirements. Residences near Henry Hagg Lake rely on private wells for providing drinking water.

The OWRD on-line database of well construction reports (well logs) identifies 77 water-supply wells within the Public Land Survey sections that border on Henry Hagg Lake. An additional 17 well logs are documented for sections that do not currently border on Henry Hagg Lake but would border on the lake if the water rises to the elevations under either a 40-foot dam raise or a 25-foot dam raise.
Washington County Parks operates two wells in Scoggins Valley Park that are subject to Groundwater Under the Direct Influence (GWUDI) requirements, which are set forth in OAR 333-061-0032. The requirements “apply to all public water systems supplied by a surface water source or a groundwater under the direct influence of surface water. . . .” (OAR 333-061-0032(1)(a)). Water from GWUDI wells must be treated to meet criteria set forth in the regulations. Water from both of the wells, which approximately 350 feet deep and 150 feet deep, is treated at a treatment plant near Sain Creek and distributed to bathrooms and other facilities at Area C and the Sain Creek Picnic Area. The water is regularly tested for compliance with applicable requirements.

Most of the shallow subsurface soils and bedrock near the proposed RWP alignment consist of silt, clay, and siltstone or claystone. Groundwater movement through this material is slow, and well yields are typically less than about five gpm. Groundwater from wells is designated for domestic uses and occasionally for secondary applications such as irrigation; however, at very low flow rates, irrigation would only be viable for small areas such as lawns and pastures.

The OWRD on-line data-base of well logs identified 37 water-supply wells within Public Land Survey sections that border on the proposed RWP alignment. This includes six of the 77 wells that are in Public Land Survey sections that border on Henry Hagg Lake; these six wells are north of Stimson Mill and just west of Scoggins Dam. Because of the uncertainties associated with locating wells based on the Public Land Survey (the most precise locator is within a 40-acre quarter-quarter section, and often no more precise than the 640-acre section in which a well is located), the exact location of wells usually cannot be determined. However, based on probable well location indicators, such as proximity to roads and buildings, most of the 37 wells do not appear to be close to the proposed RWP alignment. It appears that three wells are within 1,000 feet of the proposed RWP alignment. Two of these wells are within the lower Scoggins Valley, west of the junction of Scoggins Valley Road and Old Highway 47. The third well is near the JWC Fern Hill Water Treatment Plant. It is unlikely that any of these wells would be within the trench excavation area of the RWP alignment. Wells in the general vicinity typically are domestic wells that produce no more than a few gpm from silt, clay, or fractured claystone from waterbearing zones at depths of 60 feet to several hundred feet. Three monitoring wells installed by JWC near the proposed RWP alignment in the Tualatin Valley indicate that shallow groundwater occurs in silt, clay, and claystone at depths of 15 feet or more.

OWRD also maintains a database of water rights, which includes only permitted wells. According to the water rights database, there are twelve permitted wells within 100 feet of the centerline of the Willamette Pipeline. Four of those are issued to individuals, six are issued to the City of Wilsonville, and two are issued to the City of Tigard. The well locations were estimated using project mapping and the OWRD interactive water right maps which the OWRD created by graphically interpreting paper records; therefore, permitted well locations are approximate. There may be additional wells within 100 feet of the centerline of the Willamette Pipeline corridor, however, because the well log database does not provide specific location information, the number could not be estimated. Prior to final design and construction of the pipeline, the project alignment would be surveyed, which would include accurate location and recording of wells.
4.5.2 Environmental Impacts

4.5.2.1 Alternative 1 – No Action

4.5.2.1.1 Potential Impacts (direct, indirect)
As a result of population growth and regional development, groundwater demand in the Tualatin Valley probably would reach or exceed the capacity of the local and regional aquifers. This probably would not affect well water users adjacent to Henry Hagg Lake but may adversely affect some groundwater users in the Tualatin Valley near the RWP alignment. In addition, there may be possible declines in well production due to well interference and a declining water table. These groundwater supplies probably could not be replaced—a potentially significant impact. The increased demand and declines in production would not be caused by operation of Scoggins Dam or Henry Hagg Lake.

4.5.2.1.2 Cumulative Impacts
The potential impacts described above address the cumulative impacts of development and the No Action Alternative.

4.5.2.2 Alternative 2 – Scoggins Dam 40-Foot Raise

4.5.2.2.1 Potential Impacts (direct, indirect)

Construction Impacts
Construction activities are not anticipated to affect wells or groundwater quality. No wells would be destroyed, damaged, or otherwise affected by construction of the dam or RWP. As noted, the construction logs do not identify any wells that would be within 100 feet of the centerline alignment of the RWP, therefore no impacts would be anticipated to occur to the nearby wells. RWP construction would include flow barriers to prevent excessive groundwater channeling in the pipeline bedding after backfilling. Dewatering during RWP construction will be in-trench and will not result in enough drawdown of the water table to affect wells. No impacts would occur to groundwater supply.

Operating Impacts
Only a qualitative evaluation of change in groundwater level is possible because conditions and data are inadequate for a quantitative analysis. The qualitative evaluation was accomplished by estimating changes in groundwater level associated with changes in lake level, and by assuming that a change in reservoir level would result in a corresponding, if less substantial, change in groundwater level. A rise in reservoir level, sustained over a period of days or weeks, would result in a rise in groundwater level that would be equal to or less than the change in lake level. Similarly, a fall in lake water level of some duration would cause a fall in groundwater level that would be equal to or less than the change in lake level.

Driller reports indicate that 5 to 14 wells would either be inundated or would be within 500 feet of the reservoir at full pool under Alternative 2. Because of the uncertainties associated with locating wells based on well driller reports, the exact number of affected wells has not been determined, nor can the number of wells affected be differentiated between inundated wells and wells that would be within 500 feet of the reservoir at full pool. The two wells in Scoggins Valley Park would be inundated. Either new
wells would need to be drilled or another potable water source provided. The remaining affected wells would be individual domestic wells, most of which probably would not be inundated but would be within 500 feet of the reservoir at full pool.

Individual, domestic (non-public) wells are not directly subject to GWUDI requirements, but surface water influence on well water may result in degradation of water quality with unhealthy levels of bacteria, aesthetic problems, and negative consequences for property values. All of the domestic wells near the reservoir are of relatively low yield, consistent with the majority of wells in the vicinity. It is probable that replacement wells could be constructed that would provide similar water quantity and quality.

Rising groundwater levels associated with Alternative 2 probably would raise the water levels in wells close to the reservoir, up to a maximum of 40 feet but probably somewhat less. This would be a beneficial impact because it would reduce the pumping costs and possibly increase well yields.

As stated previously, the construction logs do not identify any wells that would be within 100 feet of the centerline alignment of the RWP. Wells beyond 100 feet of the centerline of the RWP are not likely to be damaged or destroyed as a result of pipeline installation; therefore no impacts would be anticipated to occur to nearby wells.

4.5.2.2.2 Cumulative Impacts
Alternative 2 would not contribute to negative cumulative effects on groundwater.

4.5.2.3 Alternative 3 – Multiple Source Option

4.5.2.3.1 Potential Impacts (direct, indirect)

Construction Impacts
Construction activities are not anticipated to affect wells, groundwater quality, or groundwater supply. As for the RWP construction, Willamette Pipeline construction would include flow barriers to prevent excessive groundwater channeling in the pipeline bedding after backfilling, and dewatering during Willamette Pipeline construction would be in-trench and would not result in enough drawdown of the water table to affect wells. Water tank construction would not impact groundwater.

Operating Impacts
Impacts would be similar to the impacts associated with Alternative 2, although the number of wells inundated by higher reservoir levels or within 500 feet of the lake may be fewer. This cannot be quantified from the data reviewed for this report. The two potable water wells in Scoggins Valley Park would probably be inundated, so a replacement water source would need to be provided. Domestic wells may be inundated or their water quality negatively affected by higher reservoir levels. Groundwater levels would likely rise near Henry Hagg Lake, resulting in a beneficial impact to well water levels, although the amount of rise in groundwater levels would be less than for Alternative 2, up to a maximum of 25 feet and probably less.
No impacts associated with operation of the RWP or Willamette Pipeline would occur. The water tanks would be concrete with on-site overflow, retention basins, and stormwater management systems, so they would not impact groundwater.

4.5.2.3.2 Cumulative Impacts
Alternative 3 would not contribute to negative cumulative effects on groundwater.

4.5.3 Mitigation Measures

4.5.3.1 Alternative 1
No mitigation is proposed.

4.5.3.2 Alternatives 2 and 3
Wells inundated by rising lake water levels would need to be replaced with new wells drilled further from the reservoir to replace lost water supplies. Domestic wells not inundated but within 500 feet of the reservoir should be tested to determine whether they are subject to surface water influence and, therefore, subject to potential degradation of water quality with unhealthy levels of bacteria. Tests would include microscopic particulate analysis, coliform bacteria tests, and basic quality parameters for comparison with other well water. Properties with wells determined to be negatively affected would receive compensation for either treatment or replacement at a more suitable location.
4.5 GROUNDWATER ........................................................................... 4.5-1

4.5.1 Affected Environment ...................................................... 4.5-1
4.5.2 Environmental Impacts .................................................... 4.5-3
4.5.3 Mitigation Measures ........................................................ 4.5-5
4.6 Wetlands

Federal, state, and local governmental regulations control activities in and near wetlands and other water bodies within the state of Oregon. Wetlands are also a priority habitat identified in the Oregon Conservation Strategy. The intent of this section is to provide a planning level understanding of the wetlands resources potentially affected by the TBWSP. This section provides:

- Qualitative and quantitative descriptions of wetlands that occur within the vicinity of each alternative (qualitative descriptions for the Henry Hagg Lake areas are based on Cowardin and hydrogeomorphic (HGM) classes; only Cowardin classes are discussed for the RWP and Willamette Pipeline).
- Estimates of wetland losses for each alternative.
- Potential mitigation requirements, locations, and strategies for the Action Alternatives.

A wetland delineation was prepared for the RWP corridor (CH2M Hill 2005a) and for the study area around Henry Hagg Lake (DEA 2010); however, a wetland delineation was not completed for the Willamette Pipeline corridor. Wetland functional assessments have not yet been completed for any of the project study areas; however, the Oregon Rapid Wetlands Assessment Protocol (ORWAP) will be used to assess function and values of wetlands that may be impacted. To develop an understanding of the nature of existing wetlands and potential impacts associated with each project alternative, previous documents related to wetlands in the vicinity of Henry Hagg Lake, the RWP, and the Willamette Pipeline corridor were reviewed (CH2M Hill 2003 and 2005a, Reclamation 2004b, URS 2003, Adolfson 2006b, and DEA 2007b). Available aerial photographs were examined. The Washington County Soil Survey (NRCS 1982), National Wetland Inventory (NWI) maps (Metro 1998), and Local Wetland Inventories (LWIs) were also consulted.

Reconnaissance-level field visits were made to the project sites to verify the validity of existing documents. During the field reconnaissance, scientists used the methods defined in *Corps of Engineers Wetlands Delineation Manual* (Corps 1987) to determine the presence of wetlands. The methods in the Corps manual are based on three criteria of jurisdictional wetlands: 1) hydrophytic vegetation; 2) hydric soil; and 3) wetland hydrology. The information that was available for each of the project area components (Henry Hagg Lake, RWP, and Willamette Pipeline) varied; therefore, different approaches were used to describe the existing environment and impacts. These approaches are described in the Affected Environment section for each project area component.

The previous wetland studies, combined with the aerial photographs and other information, provide a disclosure of impacts that is sufficient to enable comparison of the relative impacts of each of the alternatives. The previous work is not adequate for Federal 404 and State Removal-Fill permitting requirements.

Wetland boundaries are subject to verification and approval by both the Oregon Department of State Lands (ODSL) and the Corps. Before any work is started, wetland delineations will need to be approved by these agencies.

4.6-1
4.6.1 Affected Environment
The study area for Alternative 2 (Figure 3-2) includes the vicinity of Henry Hagg Lake, the RWP corridor, and potential wetland mitigation areas. The study area surrounding the lake consists of all areas of potential impact, including the proposed full pool elevation of the 40-foot dam raise, and associated features such as the relocated perimeter road and recreation areas, borrow areas, staging areas, and the proposed dam structure. The RWP study area was identified in by CH2M Hill (2005a) as 6.6 miles long and 200 feet wide.

The study area for Alternative 3 (Figure 3-5) is the Henry Hagg Lake vicinity (including all features identified above), the RWP corridor, the Willamette Pipeline corridor, and potential wetland mitigation areas. The Willamette Pipeline corridor was identified in the TVWD Water Supply Improvements Program (Carollo and MSA 2006) as Alignment E; the study area for the Willamette Pipeline is approximately 22 miles long and 200 feet wide.

4.6.1.1 Henry Hagg Lake and Vicinity
For the Henry Hagg Lake study area, a wetland delineation was conducted by David Evans and Associates, Inc. (DEA), with field work occurring in Spring of 2009. All potentially jurisdictional wetlands were mapped and classified by both Cowardin and Hydrogeomorphic (HGM) classification systems. The 2009 field work was supported by earlier wetland reconnaissance work conducted by DEA in 2005, which utilized aerial photography along with field reconnaissance visits. Other supporting work was also utilized as described below.

The preliminary wetland analysis in the Henry Hagg Lake Resource Management Plan (Reclamation 2004a) was compared to site conditions in numerous representative locations observed during the 2005 and 2009 site visits by DEA. NRCS (formerly Soil Conservation Service) soil survey maps combined with aerial photography and 2-foot topographic contours provided by Clean Water Services and Metro’s Regional Land Information System (RLIS) stream data were utilized within the park area to determine likely areas for ponding or for other indicators of potential wetland presence. Soil pits were dug in numerous areas to determine whether soil conditions were similar to those mapped.

Wetland delineation results are shown on Figure 4.6-1 (Cowardin classifications) and Figure 4.6-2 (HGM – hydrogeomorphic classifications); each figure comprises three sheets.

Figure 4.6-1. Reservoir Wetland Impacts Based on Cowardin Classifications (File Name: Fig 4.6-1 WtldImpacts Cowardin Sht1.pdf, Fig 4.6-1 WtldImpacts Cowardin Sht2.pdf and Fig 4.6-1 WtldImpacts Cowardin Sht3.pdf)

Figure 4.6-2. Reservoir Wetland Impacts Based on HGM Classifications (File Name: Fig 4.6-2 WtldImpacts HGM Sht3.pdf, Fig 4.6-2 WtldImpacts HGM Sht3.pdf, and Fig 4.6-2 WtldImpacts HGM Sht3.pdf)

The Soil Survey of Washington County (NRCS 1982) indicates that two soil series dominate the study area around the reservoir: Melbourne (silty clay loam, Series 31) and Laurelwood (silt loam, Series 28). Both these series are well-drained, as are the majority of other soils in the area. As mapped, most soils within the area were found to be well-drained during site visits.
The wetland delineation confirmed earlier reconnaissance efforts showing that wetlands tend to occur in the following settings: narrow bands of weedy emergent vegetation in places at the edge of the reservoir, occasional narrow bands of scrub-shrub or forested wetlands along creeks, and scattered patches of emergent slope wetlands often occurring lower down on hill slopes. A considerably large proportion of wetlands within the Hagg Lake study area occurs at the outlets of Tanner, Sain, and Scoggins creeks.

In most areas moderate slopes lead from the reservoir edge at full pool, and the creeks leading into the reservoir flow through narrow, relatively steep drainages. In a few areas, level ground can be found adjacent to the reservoir, particularly at Tanner Creek and north of the Sain Creek cove. In these areas wetland vegetation lies within a wider band adjacent to water features.

4.6.1.1.1 Cowardin Classification
The wetland types, according to Cowardin classifications (FWS 1979), that lie within the study area include: palustrine emergent, palustrine scrub-shrub, palustrine forested, and lacustrine littoral emergent. The majority of wetlands in the study area are covered by herbaceous vegetation. Of the remaining wetland area, vegetative cover is composed of slightly less forest than shrub. No vegetated shallows were identified during the site visits or in recent studies by others. It appears that the soil types, degree of inundation, and drawdown patterns within the reservoir below full pool do not encourage the formation of these wetlands.

**Palustrine Emergent**
Within the reservoir study area, the palustrine emergent wetland areas were dominated by herbaceous vegetation, most commonly non-native reed canarygrass (*Phalaris arundinacea*). In less disturbed forested settings, emergent species were dominated by native species such as skunk cabbage (*Lysichiton americanus*), lady fern (*Athyrium filix-femina*), and stinging nettle (*Urtica dioica*). The emergent wetlands were generally located within the lacustrine fringe areas, riverine wetlands, and depressional wetland areas.

**Palustrine Scrub-Shrub**
Palustrine scrub-shrub wetlands in the reservoir study area are generally located within the riverine wetlands along the drainages. There is a large area of scrub-shrub wetland where Scoggins Creek enters the reservoir. In this shallow water area, a wetland complex dominated by native willows (*Salix spp.*) has developed and is partly inundated when the reservoir is at full pool. Scrub-shrub wetlands were also identified along natural shallow drainage swales, and, in some wetlands, formed where existing roadcuts intersect the ground water table. Willow and Nootka rose (*Rosa nutkana*, native) were typically found in these settings.

**Palustrine Forested**
Palustrine forested areas were generally located along drainages and depressional areas, and are dominated mainly by red alder (*Alnus rubra*, native), with an understory of salmonberry (*Rubus spectabilis*, native), twinberry (*Lonicera involucrata*, native), and herbaceous species such as piggyback
plant (Tolmeia menziesii, native), water-parsley (*Oenanthe sarmentosa*, native), and creeping buttercup (*Ranunculus repens*, non-native).

**Lacustrine Littoral Emergent**
The lacustrine littoral community was found along the lake margins from the ordinary high pool elevation extending downward roughly six feet deep. Reed canarygrass was the sole species dominant in this community. These wetlands have formed from inundation caused by construction of Scoggins Dam.

4.6.1.1.2 **HGM Classification**
The wetland types, according to HGM classifications (Adamus and Field 2001), that lie within the reservoir study area include: *lacustrine fringe, slope, depressional/flat, riverine flow-through, riverine impounding*, and other waters. The most common type of wetlands within the study area was riverine flow-through; the least common type was riverine impounding.

**Lacustrine Fringe**
The majority of lacustrine fringe wetlands were dominated by a monoculture of reed canarygrass. Forest and scrub-shrub vegetation is fairly uncommon in this zone. This may be due to the large seasonal drawdowns, which cause repeated disturbance to the vegetation. Forested and scrub-shrub, lacustrine fringe wetlands are limited to the confluence zones of some creeks where they meet the reservoir such as the confluence of Scoggins creek with the reservoir. Lacustrine fringe wetlands have formed from inundation caused by construction of Scoggins Dam.

**Slope**
Slope wetlands were mainly on the northeast portion of the reservoir. Herbaceous vegetation, dominated by reed canarygrass and meadow foxtail (*Alopecurus pratensis*, non-native), occurred in most of these areas. Although the vegetation was weedy and mixed with upland plants, hydric soil indicators and primary wetland hydrology indicators were present within 10 inches of the soil surface.

**Depressional/Flat**
The depressional/flat wetlands in the study area were vegetated with a mixture of species communities. Most depressional areas were dominated by herbaceous vegetation that included cattail (*Typha latifolia*, native), reed canarygrass and tall mannagrass (*Glyceria elata*, native). Other sites were forested with Oregon ash (*Fraxinus latifolia*, native) and western red cedar (*Thuja plicata*, native).

**Riverine**
Riverine wetlands were located along creek flood plains where overbank flow occurs at least once every two years. Overbank flooding is typically quite shallow (i.e., less than 6 inches), except where heavy beaver activity occurs and causes considerable overbank flooding such as in lower portions of Tanner Creek. In forested areas vegetation is typically dominated by mature second growth red alder. Native willows, rose, and other shrubs dominate the shrub layer. The herbaceous layer is dominated by natives, although non-natives may also be present as subdominant species. Areas of scrub-shrub plant communities are typically dominated by native willows, with a herbaceous layer dominated by a mix of native and non-native graminoids, such as small-fruited bulrush (*Scirpus microcarpus*, native) and reed canarygrass, respectively.
A small amount of riverine impounding wetlands were identified in the study area. These were found entirely within wetland ditches, which were uncommon due to the well-drained nature of the soil and well-maintained ditch and culvert system around the reservoir. Of the numerous ditches, only a few were found to be jurisdictional based, due to bed and bank characteristics.

**Other Waters**
The reservoir currently covers approximately 1,117 acres at full pool, which represents open water habitat. Other State and Federal waters within the study area include perennial, intermittent, and ephemeral drainages.

### 4.6.1.2 Tualatin River National Wildlife Refuge and Wapato Lake Unit

As the project alternatives were being developed, FWS requested that the Draft PR/EIS evaluate potential impacts to the Tualatin River National Wildlife Refuge and the proposed Wapato Lake Unit refuge addition. The Wapato Lake Unit is described in Section 1.6.3 and shown on the frontispiece and Figure 3-2. The Wapato Lake Unit has been approved, and the land acquisition process has begun. The Wapato Lake Unit boundaries shown on figures in the Draft PR/EIS represent the proposed land area—not land currently under Federal ownership and FWS management.

The northern portion of the Wapato Lake Unit encompasses areas downstream of the confluence of Scoggins Creek and the Tualatin River. The Wapato Lake area was converted to agricultural use in the 1930s and ditches, dikes and drain tiles were used to drain most of its wetland areas. Current crops include winter wheat, corn, pasture crops and berries. In spite of the agricultural conversion, remnants of riparian forest and emergent wetlands still exist, supporting a diverse association of flora and fauna. When flooded in winter, the Wapato Lake wetland complex supports large numbers of waterfowl (FWS 2007a). Numerous species of shorebirds and marsh birds forage and rest in the area during spring and fall migrations, neotropical landbirds breed in the area, and a variety of wildlife uses the wetland habitats throughout the year (FWS 2007a).

The 1,358-acre Tualatin River National Wildlife Refuge is located along the Tualatin River, immediately north of Sherwood and 10 miles southwest of Portland, as shown on the frontispiece and Figure 3-2. Many species utilize water and wetland habitats within the refuge, which the FWS continues to enhance and restore. Wetlands along the Tualatin are dependent upon seasonal flooding to remain viable.

### 4.6.1.3 Raw-Water Pipeline

The study area of the RWP included all areas of impact due to pipeline installation including construction, sidecasting, and equipment access (140-foot corridor). The RWP was delineated by CH2M Hill (2005a) using the Wetlands Manual (Corps 1987); therefore, a high level of detail is available regarding both existing conditions and impact areas. Figure 4.6-3 shows the RWP waterway crossings and delineated wetlands within the 140-foot corridor.

For a more detailed description of the type of wetland data collected along the RWP study area, refer to the Wetlands Technical Report prepared for the project (DEA 2006b).
The soil survey (NRCS 1982) indicates that two hydric soils are mapped in the RWP study corridor: Wapato sandy loam and Cove clay. These mapped hydric soils occur primarily adjacent to Scoggins Creek, O'Neil Creek, and the Tualatin River.

The RWP study corridor contains primarily palustrine emergent wetlands within the floodplain of Scoggins Creek and the Tualatin River. Nearly all wetlands fall within agricultural fields, and are slope or depressional wetlands. Plant communities are agricultural and disturbed annually for crop production. Drain tiles, irrigation, and other hydrologic manipulations are common on these lands.

A small portion of palustrine forested or scrub-shrub wetlands lie within or adjacent to the riparian area of the Tualatin River and its tributaries. Jurisdictional waters (i.e., those subject to state or federal removal and fill regulations) crossed by the pipeline include seven waterways, including Scoggins Creek (two crossings), one unnamed tributary to Scoggins Creek (ditched), four unnamed tributaries to the Tualatin River, and the Tualatin River (CH2M Hill 2005a).

**4.6.1.4 Willamette Pipeline**

The wetlands and streams discussed in this section and shown on Figure 4.6-4 are those that have been estimated to be within or close enough to the pipeline alignment that they may be directly impacted by construction. The study area for the Willamette Pipeline is approximately 22 miles long and 200 feet wide.

Information in this section is summarized from technical memoranda that describe field reconnaissance and literature research conducted for the Willamette Pipeline corridor and potential water tank sites (Adolfson 2006b, DEA 2007b). Adolfson reviewed recent aerial photographs, NWI maps, and LWIs, and conducted field reconnaissance surveys on September 22 and 28, 2006. DEA reviewed information compiled by Adolfson before conducting a site visit on May 18, 2007, to gather additional information and map general wetland boundaries along the Willamette Pipeline alignment. Wetland boundaries were not delineated.

The Willamette Pipeline alignment crosses 18 streams (including the Tualatin River) and a number of ditches. All of the crossings would occur along roads. The waterway and wetland crossings are shown on Figure 4.6-4 (three sheets). The ditches are along roadsides or are tributaries to streams that have been altered by agricultural or residential development. Many of the ditches likely would not be considered jurisdictional by ODSL but may be considered jurisdictional by the Corps; this would be determined later through wetland delineation and permitting activities if Alternative 3 is selected.

The Tualatin River flows from west to east near the halfway point of the Willamette Pipeline corridor. The pipeline crossing would be along SW Roy Rogers Road Bridge. Riparian forest is present on both sides of the river at this location; the forested corridor varies from about 50 to 100 feet wide along each
Trees are primarily mature Oregon ash and Douglas fir. Other named streams crossed by the pipeline alignment are: Coffee Lake Creek, Rock Creek, Cedar Creek, Chicken Creek, and Summer Creek.

Floodplain wetland areas are present throughout the Tualatin River Basin and adjacent to many of the riparian corridors. Often these wetlands are in poorly drained bottomlands and in tributary floodplains. Most of the wetlands identified within the Willamette Pipeline corridor are located within floodplains for streams traversed by the proposed alignment. These wetlands provide water storage and water quality treatment functions as stormwater runoff flows from roads and other paved surfaces into streams. Although these wetlands still support native trees and shrubs, most are ecologically degraded due to their proximity to developed areas and previous disturbance, with simplified habitat structure and high cover by non-native, invasive plant species. Wetlands within the study corridor are either palustrine emergent, palustrine scrub-shrub, or palustrine forested. The largest floodplain-associated wetland identified within the corridor occurs within the Rock Creek floodplain. Floodplain wetlands are also associated with Coffee Lake Creek, Chicken Creek, Summer Creek, and their tributaries, as well as several unnamed tributaries to Fanno Creek and other unnamed drainages in the study corridor.

Between SW Wilsonville Road and SW Grahams Ferry Road, the alignment crosses the Graham Oaks Natural Area, which is a protected area owned by Metro. The entire area has been in agricultural use for many years. During the May 2007 site visit, it was noted that a portion of this wetland appears to have been planted with toad rush, perhaps by Metro for purposes of wetland restoration. Other vegetation in this area of the pipeline corridor included willow weed, barnyard grass, and a few patches of reed canarygrass.

One wetland with moderately complex habitat structure and a diverse array of native plants is present near SW Hall Boulevard. This palustrine forested wetland, which encompasses a small pond, is dominated by Oregon ash and supports much Himalayan blackberry. Some weeping willow, western crabapple, and black cottonwood are also present. Water drains through a large, grated culvert at the northeastern end of the wetland that leads under Hall Boulevard and probably to a tributary of Fanno Creek.

The sites being considered for the TVWD water tank(s) contain small wetland areas. One of the areas is a riparian forest surrounding a small stream. Another possible wetland is in a swale near a gravel road (Adolfson 2006b).

**4.6.1.5 Proposed Wetland Mitigation Areas**

**4.6.2 Environmental Impacts**

Wetland impacts around Henry Hagg Lake were calculated by overlaying the proposed project alternatives on the mapped wetlands using a geographic information system (GIS).

Wetland impacts associated with the RWP were identified by assuming a 140-foot-wide construction corridor for the pipeline and measuring the length of wetlands along the pipeline route identified in the delineation. This is a conservative assumption because much of the pipeline can be constructed in a narrower corridor.
4.6.2.1 **Alternative 1 – No Action**

4.6.2.1.1 **Potential Impacts (direct, indirect)**
Under Alternative 1, operations at Scoggins Dam would continue essentially the same way as today. There would be no new direct or indirect impacts to wetlands with this alternative.

4.6.2.1.2 **Cumulative Impacts**
Alternative 1 would have no wetland impacts and, therefore, could not add to wetland impacts associated with other actions.

4.6.2.2 **Alternative 2 – Scoggins Dam 40-Foot Raise**

4.6.2.2.1 **Potential Impacts (direct, indirect)**

**Henry Hagg Lake**

**Operational and Maintenance Impacts (Long Term)**
Approximately 57.36 acres of wetland impacts would result from raising the dam 40 feet, constructing new segments of a perimeter road, and development of recreation areas. In addition, 5.61 acres (8.94 stream miles) of potentially jurisdictional waters (drainages) would be inundated. (Figures 4.6-1 and 4.6-2). The open water area of the lake at high pool would be expanded to roughly XXXX acres, which would be a net gain in open water acreage of approximately XXXX acres relative to existing conditions. Table 4.6-1 lists the permanent impacts that would occur from the 40-foot dam raise including inundation, road relocation, borrow area impacts, and development of recreation areas. Road impacts are based on a 100-foot wide construction corridor. The impacts of other waters (streams and drainages) are based on linear distance multiplied by an estimated average stream width of four feet. The greatest impacts would occur to palustrine emergent wetlands (Cowardin) and riverine flow-through wetlands (HGM). The majority of these wetlands are dominated by reed canarygrass and occupy a narrow bench just upslope of the normal full pool level.

Of the 57.36 acres of wetlands and 5.61 acres of drainages that would be impacted by the project, the majority of wetlands are covered by herbaceous vegetation (39.51 acres). Of the remaining wetland area, vegetative cover is composed of 3.94 acres of forest and 13.91 acres of shrub habitat.

Impacts resulting from maintenance activities (e.g. mowing, infrastructure repairs, etc.) to wetlands surrounding Hagg Lake are not anticipated.

**Table 4.6-1. Wetland Impacts at Henry Hagg Lake, Scoggins Dam 40-Foot Raise**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Impact (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cowardin</strong></td>
<td></td>
</tr>
<tr>
<td>Lacustrine Littoral</td>
<td></td>
</tr>
<tr>
<td>Emergent</td>
<td>22.96</td>
</tr>
<tr>
<td>Palustrine Emergent</td>
<td>16.55</td>
</tr>
<tr>
<td>Palustrine Scrub-Shrub</td>
<td>13.91</td>
</tr>
<tr>
<td>Palustrine Forested</td>
<td>3.94</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>57.36</strong></td>
</tr>
<tr>
<td><strong>HGM</strong></td>
<td></td>
</tr>
<tr>
<td>Lacustrine Fringe</td>
<td>39.43</td>
</tr>
</tbody>
</table>

4.6-8
<table>
<thead>
<tr>
<th>Classification</th>
<th>Impact (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope</td>
<td>12.65</td>
</tr>
<tr>
<td>Depressional</td>
<td>1.11</td>
</tr>
<tr>
<td>Riverine Flow-Through</td>
<td>4.13</td>
</tr>
<tr>
<td>Riverine Impounding</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>57.36</strong></td>
</tr>
<tr>
<td>Other Waters</td>
<td></td>
</tr>
<tr>
<td>Perennial Streams</td>
<td>1.78 (2.83 miles)</td>
</tr>
<tr>
<td>Intermittent Streams</td>
<td>3.66 (5.77 miles)</td>
</tr>
<tr>
<td>Ephemeral Streams</td>
<td>0.17 (0.34 miles)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5.61 (8.94 miles)</strong></td>
</tr>
</tbody>
</table>

Note: RWP impacts not included, but provided in following discussion
Not all streams are fish bearing.

Just as the current high pool resulted in a considerable acreage of wetland formation around the lake (i.e. lacustrine littoral emergent Cowardin class and lacustrine fringe HGM class), wetlands would also be expected to form around the perimeter of the new high pool caused by the dam raise. Raising of Scoggins Dam will result in a high pool with a much greater perimeter than current conditions (XXXX feet perimeter for current high pool versus XXXX feet perimeter for proposed high pool). Increased perimeter is a factor that would lead to the potential for an increase in wetland acreage forming around the lake. However, as high pool moves further up the mountain slopes, there is the potential for encountering a greater proportion of steeper slopes relative to current conditions. Steeper slopes are less conducive to forming wide bands of wetlands. Modeling was conducted to estimate the quantity of new wetlands that could potentially form around the proposed increased pool elevations. Modeling incorporated elements of lake shoreline perimeter, slope/elevation data, proposed water management regime, and current wetland formation characteristics around the lake. This modeling projects that approximately XXXX acres of new wetland could potentially form around the lake. These wetlands would predominantly be emergent wetlands; although, willow dominated scrub-shrub wetlands could potentially be established in some areas.

**Construction Impacts (short term)**
Temporary impacts from construction activities will be relatively minor compared to permanent operational impacts. Downstream of the dam, it is assumed that staging areas would be returned to better than original wetland condition following construction. In places, the construction footprint could extend outside the area of permanent impact. For instance, vegetation within wetlands disturbed by temporary access roads may be temporarily disturbed, but would be restored following construction. Temporary impacts are estimated to account for less than 5 percent of the overall impacts shown in the table above.

**Raw Water Pipeline**

**Operational and Maintenance Impacts (long term)**
Approximately 60 feet of the RWP corridor will need to be maintained as permanent easement for maintenance purposes. The vegetation in this area will allow for maintenance activities and will not be allowed to transition to scrub-shrub or forested wetlands.
Mowing of the corridor is anticipated to occur approximately XX times per year. Forested and scrub-shrub wetlands within the maintenance corridor would not be impacted in terms of lost acreage; however, wetland function, particularly habitat functions, would be reduced or altered. Approximately XX and XX acres of forested and scrub-shrub wetlands respectively would be affected, resulting in their conversion to emergent wetlands.

**Construction Impacts (short term)**

Preliminary pipeline routing alignment alternatives were designed to minimize wetland impacts. Most impacts associated with the RWP would occur during construction and would be temporary in nature.

RWP construction would include eight crossings of jurisdictional waterways: Scoggins Creek (two crossings), one unnamed tributary to Scoggins Creek (ditched), four unnamed tributaries to the Tualatin River, and the Tualatin River. The Tualatin River and upper Scoggins Creek crossings would be trenchless, thereby avoiding impacts. Other creek crossings may be trenchless or open-cut. As described in Section 3.3.4.7, open-cut crossings would be done in a way to minimize impacts. While best management practices would be used, trenching may result in the loss of some native riparian vegetation, since crossings would take place within weedy areas (i.e. areas dominated by non-native species).

Assuming disturbance throughout the 140-foot-wide construction corridor, approximately 4 acres of scrub/shrub wetlands, 5 acres of un-inventoried wetlands, and 121 acres of emergent wetlands could be temporarily disturbed during installation of the pipeline. Impact areas are shown on Figure 4-5 and summarized in Table 4.6-2. No forested wetlands would be impacted during the installation of the RWP. Since it is assumed that access roads and staging areas would be removed and restored following construction, no long-term impacts are anticipated, other than those associated with the vaults or other structures required for maintenance purposes. These permanent structures within wetlands would result in a very small permanent footprint relative to the size of the pipeline.

### Table 4.6-2. Wetland Impacts at Raw Water Pipeline, Scoggins Dam 40-Foot Raise

<table>
<thead>
<tr>
<th>Classification</th>
<th>Impact (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowardin Palustrine Emergent</td>
<td>121</td>
</tr>
<tr>
<td>Cowardin Palustrine Scrub-Shrub</td>
<td>4</td>
</tr>
<tr>
<td>Uninventoried</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>130</strong></td>
</tr>
</tbody>
</table>

**Tualatin River National Wildlife Refuge and Wapato Lake Unit**

To evaluate the potential effects of the dam raise on wetlands in the Tualatin River National Wildlife Refuge and Wapato Lake Unit, Pacific Water Resources Inc. used a one-dimensional HEC-RAS (“Hydrologic Engineering Center River Analysis System”) model to model the effects of the flow diversion (from the RWP) at Scoggins Dam and other hydrologic changes resulting from the Tualatin Basin Water Supply Project. Pacific Water Resources evaluated two reaches of the Tualatin River. The Wapato Lake Unit reach extends from immediately downstream of the Scoggins Creek confluence (RM 60.0) to the Gales Creek confluence (RM 56.8). The Tualatin River National Wildlife Refuge reach extends
from just past the Chicken Creek confluence (RM 15.5) to just upstream of the Elsner Road/Shamberg Bridge (RM 16.2).

Table 4.6-3 summarizes the results of the modeling as it relates to the changes in water surface elevations at various flood stages as a result of the implementation of Alternative 2. Results for Alternative 3 are shown for comparison.

### Table 4.6-3. Changes to Water Surface Elevation Adjacent to Tualatin River National Wildlife Refuge and Wapato Lake Unit, Action Alternatives

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Water Surface Delta (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wapato Lake Unit:</td>
<td></td>
</tr>
<tr>
<td>Alternative 2</td>
<td>-0.67</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>-0.39</td>
</tr>
<tr>
<td>Tualatin River National Wildlife Refuge:</td>
<td></td>
</tr>
<tr>
<td>Alternative 2</td>
<td>-0.47 to -0.21</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>-0.16 to -0.07</td>
</tr>
</tbody>
</table>


Figure 4.6-5 and Figure 4.6-6 show representative cross-sections, prepared by Pacific Water Resources, for the river reaches adjacent to the Wapato Lake Unit and Tualatin River National Wildlife Refuge, respectively; profiles for both Action Alternatives are shown for comparison. Only the 1.1- and 2-year profiles are shown because they show the largest relative impact from the Action Alternatives (Pacific Water Resources 2006).

In the figures below, the black line represents an exaggerated profile of the river channel and adjacent floodplain. The horizontal colored lines represent the water surface elevation at the 1.1- and 2-year flood events. For each flood event profile, the top line represents current (year 2000) conditions, the middle line represents conditions under Alternative 3, and the bottom line (lowest water level) represents Alternative 2 conditions.

As visible in these figures, the changes in water surface elevations would have little effect on the frequency and magnitude of the overbank flows on the Tualatin River in the vicinity of the Wapato Lake Unit of the Tualatin River National Wildlife Refuge, as well as in the main refuge. At the main refuge, the difference in water levels would be nearly unchanged. The profiles show that, at the two cross-sections represented in Figure 4.6-5 and Figure 4.6-6, water would not overtop the bank in the 1.1-year flood event but that flooding would still occur, under either Action Alternative, in the 2-year flood event. Flooding would occur in years with more precipitation. Also, the Wapato Lake Unit may experience most of its flooding through perched groundwater and precipitation, versus river flooding. Finally, implementation of either Action Alternative would not preclude releasing stored water at Scoggins Dam to flood portions of the refuge, if needed.
Figure 4.6-5. Flood Elevations at Tualatin River Cross-Section near Wapato Lake Unit, Existing Condition and Action Alternatives
Figure 4.6-6. Flood Elevations at Tualatin River Cross-Section near Tualatin River National Wildlife Refuge, Existing Condition and Action Alternatives
4.6.2.2 Cumulative Impacts
Alternative 2 would contribute to wetland impacts in the region that would be associated with future development and urban expansion. These would include both short-term impacts from construction disturbance and long-term effects. The impacts could be partially offset by development of the Wapato Unit of the Tualatin River National Wildlife Refuge, which would protect and enhance wetlands in the area.

4.6.2.3 Alternative 3 - Multiple Source Option

4.6.2.3.1 Potential Impacts (direct, indirect)

Henry Hagg Lake
Operational and Maintenance Impacts (long term)
Approximately 24 acres of wetland impacts would result from raising the dam 25 feet and constructing new segments of a perimeter road. In addition, 3.4 acres (7.0 stream miles) of jurisdictional waters (drainages) would be inundated, for a total of 27.4 acres of impact (Figure 4.6-3 and Figure 4.6-4). These totals include a 10 percent contingency for potential errors in estimates of wetland impact to account for limitations in the data on existing wetlands and potential impacts.

Table 4.6-4 shows the permanent impacts that would occur at Henry Hagg Lake as a result of Alternative 3 (25-foot dam raise) including inundation, road relocation, and borrow area impacts. Road impacts are based on a 100-foot-wide construction corridor. Other waters (streams and drainages) impacts are based on linear distance times an estimated average stream width of four feet. Similar to Alternative 2, the greatest impacts would occur to palustrine emergent wetlands (Cowardin) and riverine flow-through wetlands (HGM).

<table>
<thead>
<tr>
<th>Wetland Classification</th>
<th>Impact (Acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowardin</td>
<td></td>
</tr>
<tr>
<td>Palustrine Emergent</td>
<td>16</td>
</tr>
<tr>
<td>Palustrine Scrub-Shrub</td>
<td>6</td>
</tr>
<tr>
<td>Palustrine Forested</td>
<td>2</td>
</tr>
<tr>
<td>Other Waters</td>
<td>3.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27.4</strong></td>
</tr>
<tr>
<td>HGM</td>
<td></td>
</tr>
<tr>
<td>Lacustrine Fringe</td>
<td>12</td>
</tr>
<tr>
<td>Slope</td>
<td>2</td>
</tr>
<tr>
<td>Depressional</td>
<td>1</td>
</tr>
<tr>
<td>Riverine Flow-Through</td>
<td>9</td>
</tr>
<tr>
<td>Riverine Impounding</td>
<td>0.06</td>
</tr>
<tr>
<td>Other Waters</td>
<td>3.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27.46</strong></td>
</tr>
</tbody>
</table>

Source: DEA 2006b
Note: RWP impacts not included.
**Construction Impacts (short term)**
Temporary impacts from construction activities will be relatively minor compared to permanent operational impacts. Downstream of the dam, it is assumed that staging areas would be returned to better than original wetland condition following construction. In places, the construction footprint could extend outside the area of permanent impact. For instance, vegetation within wetlands disturbed by temporary access roads may be temporarily disturbed, but would be restored following construction. Although the extent of temporary impacts is currently difficult to estimate, it is assumed that they would make up less than 5 percent of the overall impacts shown in the table above.

**Raw Water Pipeline**

**Operational and Maintenance Impacts (long term)**
Approximately 60 feet of the RWP corridor will need to be maintained as permanent easement for maintenance purposes. The vegetation in this area will allow for maintenance activities and will not be allowed to transition to scrub-shrub or forested wetlands.

**Construction Impacts (short term)**
Preliminary pipeline routing alignment alternatives were designed to minimize wetland impacts. Most impacts associated with the RWP would occur during construction and would be temporary in nature. The impacts to wetlands within the RWP corridor would be similar to those identified for Alternative 2. However, it is likely that construction impacts would be somewhat less for Alternative 3 because the diameter of the pipeline (72 inches) would be less than with Alternative 2 (96 inches).

RWP construction would include eight crossings of jurisdictional waterways: Scoggins Creek (two crossings), one unnamed tributary to Scoggins Creek (ditched), four unnamed tributaries to the Tualatin River, and the Tualatin River. The Tualatin River and upper Scoggins Creek crossings would be trenchless, thereby avoiding impacts. Other creek crossings may be trenchless or open-cut. As described in Section 3.3.4.7, open-cut crossings would be done in a way to minimize impacts. While best management practices would be used, trenching may result in the loss of some native riparian vegetation, since crossings would take place within weedy areas.

Assuming disturbance throughout the 140-foot-wide construction corridor, approximately 4 acres of scrub/shrub wetlands, 5 acres of un-inventoried wetlands, and 121 acres of emergent wetlands could be temporarily disturbed during installation of the pipeline. Impact areas are shown on Figure 4.6-3 and summarized in Table 4.6-2. No forested wetlands would be impacted during the installation of the RWP. Since it is assumed that access roads and staging areas would be removed and restored following construction, no long-term impacts are anticipated, other than those associated with the vaults or other structures required for maintenance purposes. These permanent structures within wetlands would result in a very small permanent footprint relative to the size of the pipeline.

**Tualatin River National Wildlife Refuge and Wapato Lake Unit**
Impacts of Alternative 3 are presented in Table 4.6-3, Figure 4.6-5 and Figure 4.6-6, above (under Alternative 2). Based upon the HEC-RAS modeling and the channel profiles (Pacific Water Resources 2006), the changes in water surface elevations would not substantively affect the frequency and
magnitude of the overbank flows on the Tualatin River in the vicinity of the Tualatin River National Wildlife Refuge and Wapato Lake Unit. Alternative 3 would have less of an effect on flood levels and overbank flows than Alternative 2.

Since it is assumed that construction techniques could be applied in order to avoid them, it is not anticipated that any temporary or permanent impacts to wetlands within the Wapato Lake Unit would be necessary as a result of construction. Techniques such as laying the pipe in the roadway or roadway shoulder could be used.

**Willamette Pipeline**

*Operational and Maintenance Impacts (long term)*

Approximately 60 feet of the Willamette Pipeline corridor will need to be maintained as permanent easement for maintenance purposes. The vegetation in this area will allow for maintenance activities and will not be allowed to transition to scrub-shrub or forested wetlands.

*Construction Impacts (short term)*

Like the RWP, impacts associated with the Willamette Pipeline would occur during construction and would be temporary in nature. For the Willamette Pipeline, the construction corridor would vary from 50 to 140 feet wide, and construction activities would occur within public rights-of-way and developed areas to the extent practicable. Because the pipeline could be placed on either side of public roads but the location has not been determined yet, wetland impacts were estimated for the area within 140 feet on both sides of the alignment centerline, i.e., a 280-foot-wide corridor. Therefore, impact estimates are quite conservative. Potential wetlands and waterways in the corridor are shown on Figure 4.6-4; some of them would be avoided when the construction corridor is determined, and others could be avoided by limiting the actual area of disturbance and employing trenchless installation methods.

The Willamette Pipeline would cross 18 streams and a number of ditches. Named streams crossed by the pipeline alignment are: the Tualatin River, Coffee Lake Creek, Rock Creek, Cedar Creek, Chicken Creek, and Summer Creek. The pipeline would also cross tributaries to these streams, as well as several unnamed tributaries to Fanno Creek, and other unnamed drainages in the study corridor. The Tualatin River crossing and most other creek crossings would be accomplished with trenchless methods to avoid waterway and wetland impacts. However, minor creek crossings may be trenchless or open-cut. As described in Section 3.3.4.7, open-cut crossings would be done in a way to minimize impacts. While best management practices would be used, trenching may result in the loss of some native riparian vegetation, since crossings would take place within weedy areas.

A wetland delineation of the route would be required prior to construction. Wetland impacts that could occur within 280 feet of the alignment centerline are approximately: 21.5 acres of palustrine emergent, 2.9 acres of palustrine forested, and 2.9 acres of palustrine scrub-shrub, for a total of 27.3 acres.

Because specific locations have not been identified for the TVWD and Tualatin water tanks, wetland impacts were not estimated for these features. The site selection process would include avoidance of wetland areas, if feasible. Only minor, if any, impacts would be expected.
Since techniques such as laying the pipe in the roadway or roadway shoulder could be used, it is not anticipated that any temporary or permanent impacts to wetlands within the Tualatin River National Wildlife Refuge would be necessary as a result of construction.

4.6.2.3.2  Cumulative Impacts
Alternative 3 would result in the same cumulative wetland impacts for the region as described for Alternative 2.

4.6.3  Mitigation Measures

4.6.3.1 Alternative 1
No mitigation would be required for Alternative 1.

4.6.3.2 Alternative 2

4.6.3.2.1 Henry Hagg Lake
During construction, orange construction fencing would be installed along the allowed work zone in wetland areas to discourage people and equipment from entering wetland areas outside of the work zone.

4.6.3.2.2 Raw Water Pipeline
Wetland impacts along the RWP will mostly be temporary impacts resulting from trenching through emergent and farmed wetlands. Mitigation for these temporary impacts will occur through restoring these areas to pre-project conditions. Mitigation for impacts to wetlands along the RWP would be accomplished during and immediately after construction. Mitigation measures include:

Orange construction fencing will be installed along the allowed work zone in wetland areas to discourage people and equipment from entering wetland areas outside of the work zone.

The construction corridor within wetlands will be 75 feet wide, 65 feet narrower than the construction area outside of wetlands. No staging, storage, or equipment turn-arounds, or other non-essential disruptive activities will be allowed to occur in wetlands.

The top one foot of soil from the trench through wetlands will be stockpiled and stored for use in backfilling the upper level of the trench. To the extent practical, topsoil with substantial noxious weeds will not be stockpiled for re-use in restoring the trench.

The RWP corridor will be restored by grading it to its pre-project contours following installation of the pipe.

Areas of disturbed wetland soils will be re-seeded with an appropriate native seed mix. If any trenching occurs through forested or scrub-shrub wetlands, these areas will be replanted with appropriate native trees and/or shrubs.
Clay or concrete trench plugs will be used when necessary to prevent wetland dewatering.

4.6.3.3 Alternative 3

4.6.3.3.1 Henry Hagg Lake
During construction, orange construction fencing would be installed along the allowed work zone in wetland areas to discourage people and equipment from entering wetland areas outside of the work zone.

4.6.3.3.2 Raw Water Pipeline
Mitigation for impacts to wetlands within the RWP corridor would be the same for Alternative 3 as for Alternative 2.

4.6.3.3.3 Willamette Pipeline
Mitigation for impacts to wetlands within the Willamette Pipeline corridor would be the same as for the RWP.
4.6 **WETLANDS** ........................................................................................................... 4.6-1

4.6.1 Affected Environment.......................................................................................... 4.6-2
4.6.2 Environmental Impacts..................................................................................... 4.6-7
4.6.3 Mitigation Measures.......................................................................................... 4.6-17

Table 4.6-1. Wetland Impacts at Henry Hagg Lake, Scoggins Dam 40-Foot Raise 4.6-8
Table 4.6-2. Wetland Impacts at Raw Water Pipeline, Scoggins Dam 40-Foot Raise 4.6-10
Table 4.6-3. Changes to Water Surface Elevation Adjacent to Tualatin River National Wildlife Refuge and Wapato Lake Unit, Action Alternatives............... 4.6-11
Table 4.6-4. Wetland Impacts at Henry Hagg Lake, Scoggins Dam 25-Foot Raise 4.6-14

Figure 4.6-1. Reservoir Wetland Impacts Based on Cowardin Classifications (File Name: Fig 4.6-1 WtldImpacts Cowardin Sht1.pdf, Fig 4.6-1 WtldImpacts Cowardin Sht2.pdf and Fig 4.6-1 WtldImpacts Cowardin Sht3.pdf)........................................ 4.6-2
Figure 4.6-2. Reservoir Wetland Impacts Based on HGM Classifications (File Name: Fig 4.6-2 WtldImpacts HGM Sht3.pdf, Fig 4.6-2 WtldImpacts HGM Sht3.pdf, and Fig 4.6-2 WtldImpacts HGM Sht3.pdf) ............................................................. 4.6-2
Figure 4.6-3. Raw Water Pipeline Wetland and Water Crossings (File Name: Fig 4.6-3 Alt2 wetlands.pdf) ........................................................................................................ 4.6-6
Figure 4.6-4. Willamette Pipeline Wetland and Water Crossings (File Name: Fig 4.6-4 Alt3 Wetlands Sht1.pdf, Fig 4.6-4 Alt3 Wetlands Sht2.pdf, and Fig 4.6-4 Alt3 Wetlands Sht3.pdf) ............................................................................................... 4.6-6
Figure 4.6-5. Flood Elevations at Tualatin River Cross-Section near Wapato Lake Unit, Existing Condition and Action Alternatives......................... 4.6-12
Figure 4.6-6. Flood Elevations at Tualatin River Cross-Section near Tualatin River National Wildlife Refuge, Existing Condition and Action Alternatives ......... 4.6-13

4.6-19
Reservoir Wetland Impacts Based on Cowardin Classifications

Tualatin Basin Water Supply Project
Henry Hagg Lake, Washington County

Figure 4-1

Wetland Area and Impacts

<table>
<thead>
<tr>
<th>Wetland Type &amp; Map Symbols</th>
<th>25-ft Dam Raise Alt*</th>
<th>40-ft Dam Raise Alt*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palustrine, Emergent</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Palustrine, Forested</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Palustrine, Scrub-Shrub</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Open Water - Stream</td>
<td>7 miles (3.4 acres)</td>
<td>9 miles (4.4 acres)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>27.4</td>
<td>33.4</td>
</tr>
</tbody>
</table>

* Values are in acres, unless otherwise specified.

NOTE: Impacts for the proposed road and Scoggins Dam improvements are included in this acreage assessment for both the 25- and 40-ft alternative.
Reservoir Wetland Impacts Based on Cowardin Classifications

Tualatin Basin Water Supply Project
Henry Hagg Lake, Washington County

Wetland Area and Impacts

<table>
<thead>
<tr>
<th>Wetland Type &amp; Map Symbols</th>
<th>25-ft Dam Raise Alt*</th>
<th>40-ft Dam Raise Alt*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palustrine, Emergent</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Palustrine, Forested</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Palustrine, Scrub-Shrub</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>7 miles (3.4 acres)</td>
<td>9 miles (4.4 acres)</td>
</tr>
</tbody>
</table>

TOTAL 27.4 33.4

* Values are in acres, unless otherwise specified.

NOTE: Impacts for the proposed road and Scoggins Dam improvements are included in this acreage assessment for both the 25- and 40-ft alternative.
Reservoir Wetland Impacts Based on Cowardin Classifications

Tualatin Basin Water Supply Project
Henry Hagg Lake, Washington County

Wetland Area and Impacts

<table>
<thead>
<tr>
<th>Wetland Type &amp; Map Symbols</th>
<th>25-ft Dam Raise Alt*</th>
<th>40-ft Dam Raise Alt*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palustrine, Emergent</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Palustrine, Forested</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Palustrine, Scrub-Shrub</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>7 miles (3.4 acres)</td>
<td>9 miles (4.4 acres)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>27.4</td>
<td>33.4</td>
</tr>
</tbody>
</table>

* Values are in acres, unless otherwise specified.

NOTE: Impacts for the proposed road and Scoggins Dam improvements are included in this acreage assessment for both the 25- and 40-ft alternative.
## Tualatin Basin Water Supply Project

### Henry Hagg Lake, Washington County

#### Park Boundary
- Existing Roads
- Relocated Roads
- 25-ft Dam Raise (328.5')
- 40-ft Dam Raise (343.5')

### Open Water - Lake

### Reservoir Wetland Impacts Based on HGM Classifications

#### Wetland Area and Impacts

<table>
<thead>
<tr>
<th>Wetland Type &amp; Map Symbols</th>
<th>25-ft Dam Raise Alt*</th>
<th>40-ft Dam Raise Alt*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressional</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lacustrine-Fringe</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Riverine Flow-Through</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Impounded</td>
<td>0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>Slope</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Open Water - Stream</td>
<td>7 miles (3.4 acres)</td>
<td>9 miles (4.4 acres)</td>
</tr>
</tbody>
</table>

**TOTAL 27.4 33.4**

*Values are in acres, unless otherwise specified.

**NOTE:** Impacts for the proposed road and Scoggins Dam improvements are included in this acreage assessment for both the 25- and 40-ft alternative.
### Wetland Area and Impacts

<table>
<thead>
<tr>
<th>Wetland Type &amp; Map Symbols</th>
<th>25-ft Dam Raise Acre*</th>
<th>40-ft Dam Raise Acre*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressional</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lacustrine-Fringe</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Riverine Flow-Through</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Impounded</td>
<td>0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>Slope</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Open Water - Stream</td>
<td>7 miles (3.4 acres)</td>
<td>9 miles (4.4 acres)</td>
</tr>
</tbody>
</table>

**TOTAL** 27.4 33.4

* Values are in acres, unless otherwise specified.

**NOTE:** Impacts for the proposed road and Scoggins Dam improvements are included in this acreage assessment for both the 25- and 40-ft alternative.
Reservoir Wetland Impacts Based on HGM Classifications

**Tualatin Basin Water Supply Project**

*Henry Hagg Lake, Washington County*

- **Park Boundary**
- **Existing Roads**
- **Relocated Roads**
- **25-ft Dam Raise (330')**
- **40-ft Dam Raise (345')**

**Open Water - Lake**

**Figure 4-1**

**Sheet 3 of 3**

**Wetland Area and Impacts**

<table>
<thead>
<tr>
<th>Wetland Type &amp; Map Symbols</th>
<th>25-ft Dam Raise Alt*</th>
<th>40-ft Dam Raise Alt*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressive</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lacustrine-Fringe</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Riverine Flow-Through</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Impounded</td>
<td>0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>Slope</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Open Water - Stream</td>
<td>7 miles (3.4 acres)</td>
<td>9 miles (4.4 acres)</td>
</tr>
</tbody>
</table>

**TOTAL**

27.4            33.4

* Values are in acres, unless otherwise specified.

NOTE: Impacts for the proposed road and Scoggins Dam improvements are included in this acreage assessment for both the 25- and 40-ft alternatives.
Waterway Crossing
Raw Water Pipeline Alignment
Wetlands (Cowardin):
- Palustrine Emergent
- Palustrine Scrub-Shrub
- Palustrine Forested
- Not Inventoried

Data Sources:
- Waterway crossings - CH2M Hill
- Raw water pipeline - CH2M Hill
- Wetlands - CH2M Hill
- Metro RLIS
Willamette Pipeline
Wetland & Water Impacts

Tualatin Basin Water Supply Project
Henry Hagg Lake, Washington County

Waterway Crossing
Willamette Pipeline Alignment
280-Foot Buffer
General Location of Proposed Reservoirs

Wetlands (Cowardin):
- Palustrine Emergent
- Palustrine Scrub-Shrub
- Palustrine Forested

Data Sources:
Wetlands - DEA, Metro RLIS, NWI

Map Document: (P:\CW\WSD0000135880\WOS\ArcMap\EIS\EIS_figures\April 2007 Revisions\Fig_4_17_d02_wetlands_rev051007.mxd)

8/15/2007 -- 9:46:52 AM

Boones Ferry

Willamette Pipeline Alignment
280-Foot Buffer
General Location of Proposed Reservoirs
Palustrine Emergent
Palustrine Scrub-Shrub
Palustrine Forested

Data Sources:
Wetlands - DEA, Metro RLIS, NWI
Willamette Pipeline
Wetland & Water Impacts

Tualatin Basin Water Supply Project
Henry Hagg Lake, Washington County

Waterway Crossing
Willamette Pipeline Alignment
280-Foot Buffer
General Location of Proposed Reservoirs

Wetlands (Cowardin):
- Palustrine Emergent
- Palustrine Scrub-Shrub
- Palustrine Forested

Data Sources:
- Wetlands - DEA, Metro RLIS, NWI

Map Document: (P:\C\CWSD00000013\0600INFO\GS\arcmap\EIS\EIS_figures\April 2007 Revisions Fig 4_17_all\water\water.mxd)
8/15/2007 -- 9:46:52 AM

Locator Map

0 0.25 0.5 0.75
Miles
G

Waterway Crossing

Willamette Pipeline Alignment

280-Foot Buffer

General Location of Proposed Reservoirs

Wetlands (Cowardin):
- Palustrine Emergent
- Palustrine Scrub-Shrub
- Palustrine Forested

Data Sources:
- Wetlands: DEA, Metro RLIS, NWI

Map Document: (P:\C\CWSD00000001\0600INFO\GS\arcmap\EIS\EIS_figures\April 2007 Revisions\Fig_4_17_all\waterline_rev051007.mxd)

8/15/2007 -- 9:46:52 AM
4.7 NON-LISTED FISH AND MACROINVERTEBRATES

This section describes the affected environment and anticipated environmental impacts to non-listed (that is, not listed as endangered or threatened under the Federal and/or state endangered species acts) fish and aquatic species. The potential project areas include aquatic habitat for numerous resident native species such as sculpin (sp.), redside shiner, speckled and longnose dace, largescale sucker, and northern pikeminnow, as well as non-native warm-water game fish, such as large and smallmouth bass, bluegill, warmouth, white crappie, yellow perch, reedar sunfish, pumpkinseed, and yellow and brown bullheads. Several species of non-listed cool and coldwater fish also are found in the project areas, including rainbow trout, western brook lamprey, and coho salmon. Coho salmon within the Tualatin River basin are believed to have originated from past hatchery release programs in the Tualatin River and other Willamette River tributaries (Murtagh 2006).

Cutthroat trout and Pacific lamprey, while not listed under the ESA, are classified by FWS as *species of concern*. Along with listed fish species, cutthroat and Pacific lamprey are addressed in Section 4.9.

Aquatic macroinvertebrates in the Tualatin Basin include dipterans (flies, including mosquitoes), odonates (dragon flies and damsel flies), along with the mayfly (*Ephemeroptera*), caddisfly (*Trichoptera*) and stonefly (*Plecoptera*) families. Additional detail on macroinvertebrates is provided in Section 4.7.1.1.

4.7.1 Affected Environment

The Tualatin River Basin covers 712 square miles of Washington County, Oregon. The basin contains portions of two distinct ecoregions: the Coast Range Ecoregion and the Willamette Basin Ecoregion. The Coast Range portion of the basin is characterized by steep sloped drainages and a high density of streams, while the Willamette Basin portion is flatter with a lower density of lowland, floodplain dominated streams. Aquatic life in the Tualatin Basin has undergone substantial change by human activity which has influenced water quality, physical habitat and hydrological conditions. Aquatic species diversity and richness limitations reflect these alterations.

Beginning about 1850, the upper Tualatin and Scoggins watersheds were impacted by drainage of low-lying areas and their conversion to agricultural uses. Upland areas were impacted later, but by 1890, extensive logging was occurring in the Scoggins Creek watershed. The streams themselves (including Scoggins Creek) were significantly impacted by log drives (and the “stream cleaning” necessary to facilitate log drives), degradation of riparian areas, and the construction of dams for irrigation and lumber or flour mill operation. Hawksworth (2000) provides the following summary of significant historical milestones in the watershed.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1833</td>
<td>Smallpox and measles epidemic decimates Tuality tribe.</td>
</tr>
<tr>
<td>1834</td>
<td>Jason Lee expedition</td>
</tr>
<tr>
<td>1840s</td>
<td>First settlers arrive. William Doughty settles Yamhill County near Wapato Lake.</td>
</tr>
<tr>
<td>mid 1800s</td>
<td>LWD jams 300-5,000 feet in length observed on Tualatin River.</td>
</tr>
<tr>
<td>1850</td>
<td>Washington County has white population of 2,652.</td>
</tr>
<tr>
<td>1851</td>
<td>Treaty establishes 44 square mile Tualatin Indian reservation along Wapato Lake. Congress does not ratify the treaty.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1852</td>
<td>James Lee operates sawmill on Tualatin River at Lee Falls.</td>
</tr>
<tr>
<td>1856</td>
<td>Road built from Hinman Donation Land Claim to Lee’s Mill. Another road is laid out from Hinman DLC to Yamhill County.</td>
</tr>
<tr>
<td>1862</td>
<td>Patton Mill dam built near future site of Cherry Grove.</td>
</tr>
<tr>
<td>1865</td>
<td>Joseph Gaston surveys route for railroad through Wapato Valley. Homesteads 1 mile apart separated by dense forest and brush.</td>
</tr>
<tr>
<td>1872</td>
<td>West side railroad built through Wapato Valley.</td>
</tr>
<tr>
<td>1870s</td>
<td>Gaston area becomes popular hunting site. Special weekend passenger trains are run to facilitate hunting.</td>
</tr>
<tr>
<td>1879-1913</td>
<td>Log drives take place on Scoggins Creek and the Tualatin River.</td>
</tr>
<tr>
<td>1880</td>
<td>Joseph Gaston retires to Gaston, commences draining of Wapato Lake.</td>
</tr>
<tr>
<td>1889</td>
<td>Water-powered flour and feed mill starts operation at Gaston.</td>
</tr>
<tr>
<td>1889</td>
<td>Contract to clear Tualatin River between Dilley and Scoggins Creek, and Scoggins Creek to head of log navigation.</td>
</tr>
<tr>
<td>1890s</td>
<td>Surveys in conjunction with the clearing contract find &quot;little good timber available for cutting.&quot;</td>
</tr>
<tr>
<td>1890s</td>
<td>Patton and Holscher operate large sawmill on Scoggins Creek near RM 7.</td>
</tr>
<tr>
<td>1891</td>
<td>Hod Parsons builds &quot;flood dam&quot; on his property to drive logs to mill. The dam includes fish ladders.</td>
</tr>
<tr>
<td>1895</td>
<td>A report notes a 14-foot high dam across the Tualatin River at Dilley. The dam is used to power a flour mill.</td>
</tr>
<tr>
<td>1895</td>
<td>Drainage of Wapato Lake is nearly complete.</td>
</tr>
<tr>
<td>1896</td>
<td>Pattons contract for 10 million feet of logs to be delivered from McLeod homestead (&quot;RM 76&quot;) to Patton Mill (&quot;Rm 74&quot;). &quot;Flood dam&quot; was necessary to transport these logs.</td>
</tr>
<tr>
<td>1898</td>
<td>Drainage of Wapato Lake continues.</td>
</tr>
<tr>
<td>1891</td>
<td>Miller and Hawley rebuild &quot;flood dam&quot; at &quot;RM 76&quot;.</td>
</tr>
<tr>
<td>c. 1900</td>
<td>Patton Mill dam is dismantled by Fish Commission.</td>
</tr>
<tr>
<td>Early 1900s</td>
<td>Wallin and Nyland operate mill on south side of Patton Valley.</td>
</tr>
<tr>
<td>Early 1900s</td>
<td>Karl Hering and John Callahan operate mill on stream along Hering Road.</td>
</tr>
<tr>
<td>Early 1900s</td>
<td>Prune production begins along Williams Canyon and northern Patton Valley.</td>
</tr>
<tr>
<td>1890-1905</td>
<td>Large log drives on Scoggins Creek to sawmills at Dilley and Cornelius.</td>
</tr>
<tr>
<td>1901</td>
<td>Power plant constructed on Tualatin River at Haines Falls.</td>
</tr>
<tr>
<td>1903</td>
<td>Washington County Commissioners allow removal of gravel bar on Scoggins Creek.</td>
</tr>
<tr>
<td>1911</td>
<td>Cherry Grove is founded by August Lovegren as a Swedish cultural town.</td>
</tr>
<tr>
<td>1911</td>
<td>Lovegren builds railroad from Gaston to Cherry Grove. Second-growth timber along South Road is Harvested for railroad ties.</td>
</tr>
<tr>
<td>1911</td>
<td>Large lumber mill at Cherry Grove with capacity of 25,000 board feet is operating by September.</td>
</tr>
<tr>
<td>1912</td>
<td>Hydraulic ram is installed in Tualatin River near Little Lee Falls to provide water for Cherry Grove.</td>
</tr>
<tr>
<td>1913</td>
<td>Rock quarry is opened near Cherry Grove to facilitate dam construction.</td>
</tr>
<tr>
<td>1913</td>
<td>Lovegren completes large milldam across the Tualatin River at Cherry Grove in September, forming a 70 acre pond upstream.</td>
</tr>
<tr>
<td>1913</td>
<td>The Lovegren timber harvest operations are currently in Roaring Creek canyon.</td>
</tr>
<tr>
<td>1913</td>
<td>Photograph shows forest Cherry Grove to be in mature/old growth condition.</td>
</tr>
<tr>
<td>1913</td>
<td>&quot;Much of the timber in the Cherry Grove&quot; area is described as &quot;over-ripe&quot; from a</td>
</tr>
</tbody>
</table>

4.7-2
commercial timber perspective.

1914  Lovegren dam washes out during January storm. Stream course changes at dam site.

1913-1920. Wallin and Nyland operate mill in Tualatin River Canyon below Lee Falls
1915  Ross Quarry on Scoggins Road (2.5 miles NW of Gaston) is in operation.
1915  Haskell-Carpenter buys Lovegren operations.
1916  Large Haskell-Carpenter sawmill is in operation on Roaring Creek.
1916  Raines Brothers sawmill is operated on Scoggins Creek near Scoggins Junction. Soon after, the mill is moved 2 miles upstream.

1918-1958  Extensive logging on canyons along the upper Tualatin River.
1919  Raines Brothers sawmill is moved to the Laurelwood area.
1933  First Tillamook fire. Salvage logging and associated broadcast burning ensues.
1939  Saddle Mountain (second Tillamook) fire.
1945  Third Tillamook fire.
1945-1957  Koennecke family operates mill at Cherry Grove, cuts timber in upper Tualatin subwatersheds.
1957  Five dairies are in operation in Patton Valley.
1962  Columbus Day storm fells many trees adjacent to Tualatin River between Cherry Grove and Gaston.
1963  Tualatin Valley has 72 consecutive days without rain between July and September. Tualatin River near Little Lee Falls is at very low levels.
1975  Scoggins Dam constructed
1970-1980  Tualatin River channel in Patton Valley moves "laterally as much as 250 feet". About 15 acres of farmland are lost.

4.7.1.1 Fish and Macroinvertebrates

The analysis of project impacts on stream and river systems was based on an evaluation of three species that are species of concern for local fisheries managers: upper Willamette steelhead, cutthroat trout, and Pacific lamprey. Those species and their habitats are described in detail in Section 4.9 (Threatened, Endangered, and Sensitive Species) and in the Fish Habitat Technical Report prepared for the TBWSP (R2 2006). This section presents a more general discussion of the stream and river systems, non-listed fish species, and macroinvertebrates. For the stream and river systems, no warm-water fish impacts were assessed, because the project areas are managed for cool and coldwater species, not warm-water species.

The description of impacts of the project on Henry Hagg Lake, Scoggins Creek and the Tualatin River was evaluated based on an ecological guild approach. The guild approach for this project uses six representatives (rainbow trout, coho salmon, smallmouth bass, yellow perch, bluegill, and largescale sucker) as models to assess project impacts to all fish. These fish species were selected to represent all fish species, because they occupy representative ecological guilds within the reservoir and/or are important management species.
Non-listed fish species that are known to occur within the project area are listed in Table 4.7-1. The representative, non-listed fish and macroinvertebrates are described below.
Table 4.7-1. Non-Listed Fish Species that Occur within the Project Area

<table>
<thead>
<tr>
<th>Family/Common Name</th>
<th>Scientific Name</th>
<th>Life History</th>
<th>Origin</th>
<th>Management Status</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Salmonidae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coho Salmon*</td>
<td>Oncorhynchus kisutch</td>
<td>Anadromous</td>
<td>Introduced</td>
<td>Game</td>
<td>Lower Tualatin River, Middle Tualatin River, Upper Tualatin River to Haines Falls, Scoggins Creek, Gales Creek</td>
</tr>
<tr>
<td>Rainbow Trout</td>
<td>Oncorhynchus mykiss</td>
<td>Resident</td>
<td>Introduced</td>
<td>Game</td>
<td>Gales Creek, Henry Hagg Lake (introduced)</td>
</tr>
<tr>
<td>Western Brook Lamprey*</td>
<td>Lampetra richardsoni</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Lower Tualatin River, Middle Tualatin River, Scoggins Creek, Gales Creek, and other tributaries</td>
</tr>
<tr>
<td><strong>Cottidae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prickly Sculpin</td>
<td>Cottus asper</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Gales Creek</td>
</tr>
<tr>
<td>Reticulate Sculpin</td>
<td>Cottus perplexus</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Scoggins Creek, Gales Creek</td>
</tr>
<tr>
<td>Riffle Sculpin</td>
<td>Cottus gulosus</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Gales Creek</td>
</tr>
<tr>
<td>Torrent Sculpin</td>
<td>Cottus rhotheus</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Gales Creek</td>
</tr>
<tr>
<td><strong>Cyprinidae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Redside Shiner</td>
<td>Richardsonius balteatus</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Middle Tualatin River, Gales Creek</td>
</tr>
<tr>
<td>Speckled Dace</td>
<td>Rhinichthys osculus</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Lower Tualatin River, Middle Tualatin River, Henry Hagg Lake</td>
</tr>
<tr>
<td>Longnose Dace</td>
<td>Rhinichthys cataractae</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Gales Creek</td>
</tr>
<tr>
<td>Northern Pike Minnow</td>
<td>Ptychocheilus oregonesis</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Lower Tualatin River, Middle Tualatin River, Scoggins Creek</td>
</tr>
<tr>
<td><strong>Catostomidae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Largescale Sucker</td>
<td>Catostomus platyrhynchus</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Middle Tualatin River, Gales Creek, Henry Hagg Lake</td>
</tr>
<tr>
<td>Sucker sp.</td>
<td>Catostomus sp.</td>
<td>Resident</td>
<td>Native</td>
<td>Non-Game</td>
<td>Lower Tualatin River, Gales Creek</td>
</tr>
<tr>
<td><strong>Centrarchidae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Largemouth Bass</td>
<td>Micropterus salmoides</td>
<td>Resident</td>
<td>Introduced</td>
<td>Game</td>
<td>Lower Tualatin River, Middle Tualatin River, Henry Hagg Lake</td>
</tr>
<tr>
<td>Smallmouth Bass</td>
<td>Micropterus dolomieu</td>
<td>Resident</td>
<td>Introduced</td>
<td>Game</td>
<td>Soggins Creek, Henry Hagg Lake</td>
</tr>
<tr>
<td>Bluegill</td>
<td>Lepomis macrochirus</td>
<td>Resident</td>
<td>Introduced</td>
<td>Game</td>
<td>Lower Tualatin River, Middle Tualatin River, Scoggins Creek</td>
</tr>
<tr>
<td>Warmouth</td>
<td>Lepomis gulosus</td>
<td>Resident</td>
<td>Introduced</td>
<td>Game</td>
<td>Lower Tualatin River, Middle Tualatin River, Scoggins Creek</td>
</tr>
<tr>
<td>Pumpkinseed</td>
<td>Lepomis gibbosus</td>
<td>Resident</td>
<td>Introduced</td>
<td>Game</td>
<td>Lower Tualatin River, Middle Tualatin River, Scoggins Creek</td>
</tr>
<tr>
<td>Redear sunfish</td>
<td>Lepomis microlophus</td>
<td>Resident</td>
<td>Introduced</td>
<td>Game</td>
<td>Lower Tualatin River, Middle Tualatin River, Scoggins Creek</td>
</tr>
<tr>
<td>White Crappie</td>
<td>Promoxis annularis</td>
<td>Resident</td>
<td>Introduced</td>
<td>Game</td>
<td>Middle Tualatin River, Gales Creek</td>
</tr>
<tr>
<td>Family/Common Name</td>
<td>Scientific Name</td>
<td>Life History</td>
<td>Origin</td>
<td>Management Status</td>
<td>Distribution</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------</td>
<td>--------------</td>
<td>------------</td>
<td>-------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Black Crappie</td>
<td>Promoxis nigromaculatus</td>
<td>Resident</td>
<td>Introduced</td>
<td>Game</td>
<td>Intermittent, but not well known</td>
</tr>
<tr>
<td><strong>Percidae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow Perch</td>
<td>Perca flavescens</td>
<td>Resident</td>
<td>Introduced</td>
<td>Game</td>
<td>Lower Tualatin River, Middle Tualatin River, Scoggins Creek, Henry Hagg Lake</td>
</tr>
<tr>
<td><strong>Ictaluridae</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow Bullhead</td>
<td>Ameiurus natalis</td>
<td>Resident</td>
<td>Introduced</td>
<td>Non-Game</td>
<td>Scoggins Creek, Henry Hagg Lake</td>
</tr>
<tr>
<td>Brown Bullhead</td>
<td>Ameiurus nebulosus</td>
<td>Resident</td>
<td>Introduced</td>
<td>Non-Game</td>
<td>Scoggins Creek, Henry Hagg Lake</td>
</tr>
</tbody>
</table>

*Oregon conservation strategy species*
4.7.1.1  **Coho Salmon (Scoggins Creek, Tualatin River)**
Coho salmon, although not listed as a threatened or endangered species in the Tualatin river basin, have special protection under the Magnuson Stevens Fisheries Conservation and Management Act (MSA). Its biology and habitat requirements are discussed in section 4.9.1.3 relative to Essential Fish Habitat. Coho salmon are considered game fish by ODFW and are managed accordingly.

4.7.1.1.2  **Rainbow Trout (Henry Hagg Lake)**
Rainbow trout are habitat generalists. As opportunistic feeders, they forage in littoral, *benthic*, and pelagic habitats. Rainbow trout in Henry Hagg Lake are stocked (ODFW 2006a) and have not established a wild reproducing population. Cutthroat trout are native to the system, but are also a species of concern and are therefore discussed in Section 4.9, and rainbow trout were selected to be representative of this guild. When cutthroat utilize Henry Hagg Lake, their habitat and food preferences are likely much the same as rainbow trout, and therefore the effects of the project within Henry Hagg Lake are likely to be similar for the two species.

4.7.1.1.3  **Smallmouth Bass (Henry Hagg Lake)**
Smallmouth bass prefer littoral habitat with average depths greater than 30 feet (Moyle 2002). Optimal smallmouth bass habitat includes rocky shoals with limited vegetative growth. As water warms in the spring, they move into shallow water (approximately 5 feet deep) in the lake or into slow current areas of the tributary streams to spawn.

4.7.1.1.4  **Yellow Perch (Henry Hagg Lake)**
Yellow perch inhabit the littoral habitat and are often associated with areas of dense aquatic vegetation (weed beds) which are not present in much of Henry Hagg Lake. Yellow perch tend to occur in schools on or just above thick plant beds at depths of 3 to 33 feet (Moyle 2002).

4.7.1.1.5  **Bluegill (Henry Hagg Lake)**
Bluegill inhabit littoral habitat and exhibit a strong preference for habitat with cover or structure. Although warm water habitat is optimal, temperature tolerances are very broad for bluegill. Bluegills are opportunistic feeders, foraging in the *benthos*, in midwater, in aquatic vegetation, and on the surface (Moyle 2002).

4.7.1.1.6  **Largescale Sucker (Henry Hagg Lake and Tributaries)**
Largescale suckers inhabit benthic and littoral habitats, although juveniles are pelagic until they reach about 3 to 4 years old (FishBase 2006). Adults live on lake and river bottoms, generally in shallows, but occasionally as deep as 80 feet (Wydoski and Whitney 2003). Largescale suckers may migrate from deeper areas during the day to shallows at night (Wydoski and Whitney 2003). Adults migrate from the lake into the tributaries to spawn during the spring. Spawning may also occur along lakeshores (Wydoski and Whitney 2003).

4.7.1.1.7  **Macroinvertebrates**
Macroinvertebrate sampling conducted in the Upper Tualatin-Scoggins system in 1999 (Hawksworth, 2001a) found that at all sites, at least 75% of the macroinvertebrate community was composed of one
or more of three taxa: the relatively tolerant mayfly *Baetis tricaudatus*, and the dipteran families Chironomidae and Simuliidae. In general, dipterans are more tolerant than the taxa used to identify higher quality habitat (ephemeroptera, plecoptera, and tricoptera, or EPT Taxa).

There are essentially two distinct macroinvertebrate assemblages in the Tualatin Basin: one assemblage in the uplands, where human impacts are less pronounced, and a more tolerant assemblage in the more degraded low-gradient valley streams. Multivariate statistical analysis shows the environmental variables that are significantly correlated with macroinvertebrate assemblages are wetted and bankfull widths (indicative of stream size), percent urban land use, percent agricultural land use, dissolved oxygen, effective impervious area, and substrate composition. This suggests that recognizable patterns in community structure occur in the basin in relation to stream size, urban land use intensity, instream substrate composition, and low dissolved oxygen concentrations (Cole, 2001). Substrate composition, including embeddedness, percent fines, and percent sand and fines are the variables most highly correlated with the distribution of individual taxa. The taxa with the strongest correlation with substrate composition include *Acari* (mites) \( r = 0.499 \), *Optioservus* (riffle beetles) \( r = 0.548 \), *Chironomus* (midges) \( r = -0.419 \), *Parametriocnemus* (bloodworms) \( r = 0.449 \), *Procladius* (a chironomid) \( r = -0.531 \), *Chelifera* (flies) \( r = 0.453 \), *Baetis tricaudatus* \( r = 0.416 \), *Corixidae* (water boatmen) \( r = -0.591 \), *Sialis* (alder fly) \( r = -0.678 \), *Hydrobiidae* (mudsnaills) \( r = 0.488 \), *Juga* (snails) \( r = 0.410 \), and *Spheariidae* (fingernail clams) \( r = -0.499 \). Taxa with negative correlation coefficients \( r \) values increased in abundance with substrate conditions with higher percentage fines and greater embeddedness. In contrast, taxa with positive correlation coefficients \( r \) values decreased with substrate conditions with higher percentage fines and greater embeddedness.

Macroinvertebrate studies from 1999 to 2005 found that high-gradient reaches in the Tualatin basin support the richest and most sensitive macroinvertebrate communities. These high gradient reaches typically occur in heavily forested drainages and can be characterized as having intact and mature riparian zones, low levels of substrate embeddedness, high dissolved oxygen concentrations, low water temperatures, and high percentages of coarse substrates (coarse gravel, cobble, and boulder). However, high-gradient streams exhibited such a wide range in community conditions, that some reaches, including upper Fanno and Golf creeks, had macroinvertebrate communities that closely resembled those sampled from low-gradient reaches. Low-gradient reaches exhibited a much narrower range in both physical and benthic community conditions than did high-gradient reaches. Low-gradient, valley floor reaches typically are subjected to high water temperatures, low dissolved oxygen, extreme variation in discharge, and other extremes which have been exacerbated by human development. The results of this study show strong relationships between environmental conditions and macroinvertebrate community conditions. Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT Taxa) and other sensitive taxa were absent from many low-gradient reaches. Percent fine substrate, percent urban land use, effective impervious area, and dissolved oxygen concentrations were all correlated with major patterns in community composition.

As stated above, sampling in Scoggins Creek in 1999 found predominantly tolerant taxa. However, subsequent sampling at sites below Scoggins Dam in 2000, 2001 and 2005/2006, showed high biotic
integrity within its landscape class (for instance, upper Scoggins Creek scored high in the upland category, and lower Scoggins scored high within the lowland category, although lower Scoggins Creek was significantly more impaired than upper Scoggins) (Cole et al., 2006; Cole, 2002; Cole, 2000).

Aside from the inundated habitats (where the current stream macroinvertebrate assemblage will be replaced by a lake invertebrate fauna), there will be no impacts to macroinvertebrate assemblages above the dam. Below the dam, reduced flows will result in a somewhat smaller stream (decreasing wetted width during periods of the year), but the other indicators shown to be highly correlated with assemblage make up will be essentially unchanged (i.e., percent urban land use, percent agricultural land use, dissolved oxygen, effective impervious area, and substrate composition).

4.7.1.2 Aquatic Habitat
This section describes distinct aquatic habitats that are found in the areas of potential project impact:

- The middle and lower Tualatin River, from RM 0 to 60, and lower Scoggins Creek, from RM 0 to 5
- Henry Hagg Lake
- Tributaries to Scoggins Creek that currently drain into Henry Hagg Lake (Sain Creek, Tanner Creek and Wall Creek)
- Lower Gales Creek from RM 0 to 13 (tributary to the Tualatin River)
- RWP Route
- Willamette Pipeline Route

4.7.1.2.1 Middle and Lower Tualatin River and Scoggins Creek below Scoggins Dam
The mainstem Tualatin River flows approximately 80 miles from the Oregon Coast Range to the Willamette River. Within these 80 miles of riverine habitat, the Tualatin River has been divided into four distinct reach habitats (BLM 2000): Mountain, Meandering, Reservoir, and Riffle habitats. The Mountain (headwater) reach flows from RM 79.4 to 55.3 and is characterized by steeper gradient and fast water velocities with rock/cobble substrates and abundant riparian cover. The Meandering reach begins as the river reaches the valley floor (RM 55.3) and continues for approximately 20 miles. This lower gradient reach is characterized by slower moving water, an average width of 50 feet, substrate of sand/silt/organic matter and good riparian shading. At RM 33.3 the Reservoir (or backwater) reach begins. There is a reduction in water velocities due to a further reduced slope in combination with the effects of a low head dam at RM 3.4. The river widens within this 19-mile reach to widths of approximately 150 feet. The substrate is dominated by sand, silt, and organic matter. Both urban and agricultural development encroach the river channel and limit riparian cover along both sides of the river. A small increase in stream gradient demarcates the last 3.4 miles of the Tualatin River, the Riffle reach. Habitat near the mouth, located above the Willamette Falls in Oregon City, is characterized by small pools and riffles, swift water velocities, and bedrock substrates.

The Tualatin River is a rain-fed system with hydrologic changes that follow seasonal rainfall patterns. In average years, approximately 50 percent of the precipitation in the basin falls between December and February (Reclamation 2004b). Streamflow is highest from December through May. Precipitation is limited during the summer and early fall. During the low-flow summer period, streamflow is augmented
with releases from Barney Reservoir and Scoggins Dam. Clean Water Services maintains an average flow of 150 cfs, as measured at RM 33.3, for water quality management purposes. The Tualatin River has five major tributaries, Scoggins, Gales, Dairy, Rock, and Fanno creeks. Habitat conditions vary with the location of the tributaries within the basin.

The Tualatin River mainstem only provides migration habitat (no spawning or rearing) from its mouth up to its confluence with Dairy Creek. Both rearing and migration habitat is present in the Tualatin mainstem from the Dairy Creek confluence upstream to Gaston. However, while some fish migrate to and rear in the Tualatin mainstem in fall and winter, most steelhead and coho rearing takes place in tributaries (Hawksworth, 2001).

Both Scoggins Creek and Tualatin River have been impacted by human activities. Scoggins Creek below the dam has been channelized for agricultural and flood control purposes and is impacted by dam operations, agriculture, and operations of the Stimson Lumber Company mill. The Tualatin River has been channelized, and berms have been placed along the riverbanks as a result of agricultural and urban development throughout the historic floodplain. The resulting channels are very uniform, highly entrenched, U-shaped, and lack habitat complexity. Riparian degradation contributes to poor aquatic habitats within the project area. Non-native riparian species such as grasses and Himalayan blackberry are abundant and provide little shade or cover for the Scoggins Creek and Tualatin River systems.

In Scoggins Creek, substrate generally consists of fine sediments or limited bedrock with some boulders. Limited cobble/gravel substrate suitable for salmonid spawning habitat exists at two locations on lower Scoggins Creek. Loss of large trees over time has resulted in a lack of large wood in the stream and, consequently, a loss of pool habitat.

Historically, the Tualatin River watershed supported populations of steelhead trout as well as Pacific lamprey. Chinook salmon may have historically occurred in the Tualatin Basin, but it is unlikely that the Tualatin River ever supported large runs of this species (Ward 1995). Leader (2002) reported finding 10 species of fish within three sites on the mainstem Tualatin, including three salmonid species – cutthroat trout, coho salmon, and Chinook salmon. The remaining seven species included an unidentified salmonid, carp, largescale sucker, largemouth bass, pumpkinseed, sculpin, and yellow perch.

The Tualatin River system continues to provide significant habitat with soft sediments suitable to Pacific lamprey rearing. Hydrologic and hydraulic modeling conducted by Montgomery Watson Harza in 2003 states the following in regard to lamprey presence in the project area:

“Recent inventories of fish communities in Washington County streams suggest lamprey species are present throughout the Tualatin River Subbasin. During ODFW sampling in 1999-2000, Pacific lamprey were captured in Fanno Creek (RM 15.0). Fanno Creek is located within the Urban Growth Boundary (UGB) for Washington County, Oregon (Hughes and Leader, 2000). Pacific lamprey were also captured in the lower reach of Chicken Creek (RM 25.9), which is located outside of the UGB (Hughes and Leader 2000). In other streams located outside the UGB, Western brook lamprey were the most abundant lamprey species, and Pacific lamprey were not noted (Leader and Hughes..."
Unidentified lamprey species were found in the middle and upper reaches of Gales Creek (Leader and Hughes 2000); it is uncertain whether these specimens were Pacific lamprey or Western brook lamprey. Limited data are available to evaluate lamprey presence/absence in Scoggins Creek. During recent field surveys of lower Scoggins Creek and an unnamed tributary to lower Scoggins Creek, a single lamprey ammocete was documented (White 2003a). It is not known whether this ammocete was an anadromous Pacific lamprey or the resident Western brook lamprey.”

The mainstem Tualatin is an important migration corridor for salmonids, but seems to lack rearing habitat (although little fish sampling has taken place in the late fall, winter and spring when use may be more extensive) (Murtagh, pers. comm. 2009). The general lack of salmonid species in the mainstem reaches of the Tualatin River is likely related in part to the physical habitat characteristics of the stream channel as well as water quality conditions, including elevated water temperatures during the summer months. According to ODFW (1990), the majority of mainstem reaches are gently sloping and nearly flat, resulting in long, slow-moving segments of river. As a result, the substrates within the mainstem Tualatin River are largely comprised of silts and sands; gravels suitable for salmonid spawning are generally absent. No salmonid spawning conditions are known in the Tualatin mainstem within the project’s area of effect. The sediments at all sites in the meander and reservoir reaches of the mainstem and most sites on the tributaries are composed mainly of silt and clay-sized particles. Only Gales Creek exhibits evidence of much sand (visual inspection). In several short reaches of the main-stem Tualatin River, the river bottom does have large rocks and cobbles where the river flows over bedrock sills. Most of the river bed, however, has a clayey bottom that typically is covered with a few inches to several feet of loose silt embedded with detritus such as leaves, twigs, and other plant material. The river is often blocked by logjams in many locations; even where such logs are not visible from the surface, they are common on the river bed. In some places, the clayey bottom is swept clear of silt by the flowing water. In low-velocity depressions, very fine-grained detritus tend to accumulate.

The primary water quality concerns in the Tualatin River are temperature, algae, pH, DO, and ammonia (ODEQ 2001). In 1998, portions of the Tualatin Subbasin were listed on the Oregon 303(d) list for temperature, bacteria, DO, chlorophyll a, toxics (arsenic, iron, and manganese), biological criteria, and pH. TMDLs have been implemented and all Tualatin River mainstem sections were removed from the most recent 303(d) list (CH2MHill 2006).

4.7.1.2.2 Henry Hagg Lake

Henry Hagg Lake is the impoundment that was created by the completion of Scoggins Dam in 1975. The reservoir is 5.4 miles long and has maximum depth of approximately 110 feet. The reservoir has been stocked extensively for a variety of warm-water recreational fisheries.

The aquatic habitat in Henry Hagg Lake can be grouped into three categories: pelagic, benthic, and littoral. Littoral habitat is nearshore, shallow (up to 19.6 feet deep) habitat that is penetrated by light and therefore supports submerged aquatic vegetation. Aquatic vegetation in the littoral zone in Henry Hagg Lake is limited because of the frequency and magnitude of drawdown. Benthic habitat is the area associated with the reservoir subsurface. For this analysis, the benthos is calculated as all areas within
5.25 feet from the bottom of the reservoir, outside of the littoral zone. Pelagic habitat is all open water habitat outside of the littoral and benthic zones.

Henry Hagg Lake supports healthy numbers of warm water fish, including bluegill, yellow perch, pumpkinseed, brown and yellow bullhead, largemouth bass, and smallmouth bass. According to the ODFW warm water game fish records, the state record smallmouth bass was caught at Hagg Lake in 2005, and the state record bullhead catfish was caught there in 2001 (ODFW 2007). The reservoir also supports two cold water game fish: rainbow trout and cutthroat trout. ODFW currently stocks rainbow trout in Henry Hagg Lake. Recreational fishing is very popular in Henry Hagg Lake, and would likely increase if more structure was present (such as that afforded by inundated trees).

4.7.1.2.3 Scoggins Creek above and below the dam, and Tributaries above Henry Hagg Lake

Habitat in Scoggins Creek is divided by the presence of Scoggins Dam/Henry Hagg Lake at RM 5.1. Above the reservoir, the Scoggins Creek watershed is heavily forested and managed almost exclusively for timber production. The relatively high gradient tributaries support resident populations of fish. According to OWRRI (1993), species present in “upper river” areas of the Tualatin Basin, that could occur upstream of Scoggins Dam include:

- Western Brook Lamprey
- Cutthroat Trout
- Rainbow trout
- Redside shiner
- Longnose dace
- Speckled dace
- Largescale sucker
- Mountain sucker
- Prickly Sculpin
- Reticulate sculpin

In Scoggins Creek above the dam, reconnaissance surveys of habitat types in three representative reaches indicated that the stream contains 20 percent pool, 47 percent riffle, and 33 percent glide habitat types (White 2003). In Sain Creek, riffles (48 percent) and glides (47 percent) were the predominant habitat type, with only occasional pools (5 percent) present (White 2003). In Tanner Creek, habitat is composed of pools (23 percent), riffles (27 percent), and glides (50 percent) (White 2003). All percentages are approximate.

Data from the upper portion of Scoggins Creek and its tributaries prior to dam construction documented only small numbers of salmon and steelhead (Thompson et al. 1960, as cited in R2 2006). Evidence suggested there was good potential for salmon and steelhead production but low summer flows likely limited production, as did habitat impacts and reduced stream function due to historic logging practices.
Although Pacific Lamprey may have historically been present above the dam it is very unlikely that they currently occur above the dam. Land locked populations of Pacific lamprey are known to occur in other basins (e.g., Klamath River) but it is highly unlikely that a land locked population has become established above the dam without some form of documentation of their presence. In the Klamath River, trout have been found with lampreys attached and many have scars from lamprey attacks. No such observations have been reported from Henry Hagg Lake. Hawksworth (2000) states:

“Lamprey species are susceptible to many of the same habitat concerns as salmonids. Increases in water temperature have provided conditions detrimental to lamprey populations. Additionally, Pacific lamprey in their larval stages make extensive use of fine substrate portions of the watershed. Thus, high water temperatures in stream reaches in the Tualatin River valleys upstream of Scoggins Creek are likely to have substantial detrimental impacts to lamprey populations. Conversely, the cool water conditions promoted by summer flow releases from Scoggins Dam may promote lamprey development in Scoggins Creek and portions of the Tualatin River above Rock Creek.”

Scoggins Creek, immediately below the dam, offers spawning habitat for coho salmon and cutthroat trout, while steelhead are believed to use the area for spawning intermittently (Murtagh, 2009). ODFW conducted a coho spawning survey in the Scoggins Creek channel below the dam in 2006. They found 19 redds (nests), seven carcasses, and three live coho salmon. ODFW concluded that Scoggins Creek is a fairly high use spawning area (Murtagh 2006). The area surveyed is approximately 300 yards long, between the Scoggins Dam spillway and the Stimson Mill bridge crossing. The straightened stream channel has a low gradient, with gravel and mixed fines. The riparian vegetation is dominated by reed canarygrass. The productivity of these redds is assumed to be low due to seasonal inundation and the rapid ramping rates of releases from Scoggins Dam during periods when coho eggs and fry are present in the fall and winter.

4.7.1.2.4 Gales Creek
At 77.9 square miles, Gales Creek is one of the larger watersheds in the Tualatin River Basin, and is listed as Critical Habitat for Upper Willamette Steelhead. The mainstem of Gales Creek is 23.5 miles long with over 55 miles of tributary habitat. Gales Creek enters the Tualatin River at RM 56.8, approximately 3.2 miles downstream of the mouth of Scoggins Creek. Like all of the Tualatin River tributaries, Gales Creek is rain dominated and thus is characterized by high winter and low summer flows. Riparian habitats in the lower reaches of Gales Creek support a mixed canopy of Douglas-fir, western red cedar, red alder, big-leaf maple, and black cottonwood, and an understory with red osier dogwood, Himalayan blackberry, snowberry, hawthorn, oceanspray, sedges, and reed canary grass.

Habitat surveys conducted in upper Gales Creek (Hughes and Leader 2000) documented a good pool to riffle ratio. The middle section of the creek was dominated by glide and riffle habitat; pools were uncommon. In the lower reach, glides dominated the habitat, with pools even less abundant and no riffles observed. Lower Gales Creek is not listed on the Oregon 303(d) list; a TMDL has been approved. Fish habitat constraints on Gales Creek can be characterized by low habitat diversity, riparian and water quality degradation in the lower system, and fish passage barriers (Bruener 1998).
4.7.1.2.5 RWP Route
Alternatives 2 and 3 include construction of a raw water pipeline from Henry Hagg Lake to the Spring Hill Pumping Plant with a connection to the JWC Water Treatment Plant at Fern Hill. See Section 3 for a description of the RWP. Scoggins Creek would be crossed twice, the upper crossing using trenchless techniques and the lower crossing being trenched with cofferdams and a bypass flume. An unnamed tributary of the Tualatin River also would be crossed using the same trenching technique.

4.7.1.2.6 Willamette Pipeline Route
The pipeline alignment would cross Coffee Lake Creek, Rock Creek, Cedar Creek, Chicken Creek, Summer Creek, the Tualatin River, and several smaller streams and drainages. The Willamette Pipeline would also cross the lower Tualatin River near RM 20. The stream reaches are generally characterized as highly impacted urban streams with substrates consisting of gravel, silt, and clay mixtures. The stream corridor conditions can be highly variable, though all the streams suffer from channelization, streambank cutting, floodplain disconnection, and urban runoff. Habitat conditions are degraded, though restoration actions in specific locations have attempted to restore more healthy conditions. Although many of the streams crossed by the pipeline in the lower system are degraded, they continue to provide valuable habitat for most fish species in the basin, including coho and cutthroat trout.

4.7.2 Environmental Impacts
Impacts to fisheries habitat in three tributaries (Sain, Scoggins, and Tanner creeks) above Henry Hagg Lake were evaluated using GIS spatial analysis software. The number of linear stream miles of fish habitat in Sain, Scoggins, and Tanner creeks were calculated and were assumed to include the full extent of fish habitat. For these purposes, fish habitat was considered to include all accessible areas above the reservoir. The linear distance that would be inundated by the 40-foot dam raise was calculated for the three tributaries to Scoggins Creek. It was conservatively assumed that 100 percent of the stream habitat being inundated was used by resident stream fishes for spawning and rearing. The distance of stream habitat that would be inundated was then compared to the total distance of fish habitat currently available to assess potential impacts.

Impacts to Henry Hagg Lake aquatic resources were determined using literature reviews and agency consultations, principally ODFW. Impacts to Scoggins Creek below the dam and impacts to the Tualatin River were evaluated using the “Physical Habitat Simulation” (PHABSIM) methodology as a surrogate indicator. The methodology is described in the TBWSP Fish Habitat Technical Report (R2 2006). The technical team also conducted numerous site visits. Impacts to stream crossings of the Willamette Pipeline were assessed by field reconnaissance, literature reviews, and agency consultations.

4.7.2.1 Alternative 1 – No Action

4.7.2.1.1 Potential Construction Impacts
Alternative 1 is the No Action alternative and requires no in-water construction. Therefore, no construction-related impacts are expected with Alternative 1.

4.7.2.1.2 Potential Operational Impacts (direct, indirect)
Increased demands on stored water would lead to earlier and longer drawdowns. Therefore, the reservoir would provide less habitat for fish and aquatic species more frequently and for longer durations. In particular, earlier and longer reservoir drawdowns would reduce the amount of open water habitat available during the late summer and fall. More frequent and longer drawdowns of the reservoir could lead to heating of reservoir water (Reclamation 2004b), which, when released, could actually increase water temperatures in Scoggins Creek and the Tualatin River. However, extra water would be available to release less often, so the Tualatin River system would not supplemented as frequently compared to the existing condition.

4.7.2.1.3 Cumulative Impacts
Development is anticipated to continue under the No Action Alternative, but expected water shortages would likely restrict development in Washington County. This could decrease development pressures on the unprotected natural areas that drain to the Tualatin River Basin. However, easing development pressures would not inherently lead to protection and may only result in fewer natural areas being converted through development. In addition, some development would still occur, converting natural areas to agricultural or more urban uses. Existing water rights throughout the region likely would be maximized under the No Action Alternative. This, combined with additional construction and development in the region, would contribute to a reduction in the quantity and quality of habitat available for fish and macroinvertebrate species.

Implementation of the Clean Water Services program activities, described in Section 1.6.2, would help diminish some of the effects of the No Action Alternative. The incentive programs for farmers (see Section 1.6.2.3), Storm Water Management Plan, Healthy Streams Plan, Reclaimed Water Master Plan, and facilities plans would all contribute to improved water quality in the Tualatin River over existing conditions. Development of the Wapato Unit of the Tualatin River National Wildlife Refuge would also improve water quality in the Tualatin River. However, additional water demands that would occur under Alternative 1 would reduce the amount of water available for Clean Water Services to implement other programs, such as the Revised Temperature Management Plan, and could affect Clean Water Services’ ability to meet the requirements of the watershed-based NPDES permit.

4.7.2.2 Alternative 2 – Scoggins Dam 40-Foot Raise

4.7.2.2.1 Potential Construction Impacts

Henry Hagg Lake
ODFW will be consulted prior to reservoir filling to identify which areas of trees are to be removed for boater safety, and which are to be left in place to provide in-lake structure. Where trees are to be cleared, best management practices employed during logging efforts will minimize erosion and runoff, however some suspended solids and turbidity may enter the reservoir prior to filling. These increases are not anticipated to be sufficient to result in measurable effects on fishery resources of the reservoir.

Scoggins Dam Structure
Alternative 2 will involve in-water work on both sides of the dam. The installation of a new intake structure within the reservoir and the removal and restructuring of the existing spillway crest structure
will require dewatering of work areas through the use of temporary cofferdams. New fish screens designed to meet NMFS screening and approach velocity criteria will be installed at the pumping plant. A Temporary Water Management Plan will be developed and followed for inwater construction activities to ensure turbidity releases from the project will not enter downstream reaches and that flows will be maintained below each project to prevent channels from drying up, address water right needs, and provide for fish and wildlife needs at all times. ODFW inwater work timing guidelines for Tualatin River tributaries (July 15 to September 30) will be followed and/or negotiated with ODFW and NMFS.

Potential direct loss of fish within the areas isolated by cofferdams will be minimized through the use of standard fish salvage techniques prior to dewatering. Fish salvage will follow NMFS and ODFW fish salvage protocols. Loss of benthic invertebrates in the isolated work areas is expected to be short term, as the area of impact would be rapidly recolonized. The use of cofferdams will limit increases in turbidity to relatively short-term pulses during installation and removal. No significant short term or long term detrimental effects to fishery resources are anticipated from these actions. However, during dam remodel or replacement, the current spawning habitat below Scoggins dam could be disturbed or destroyed. The fate of the area immediately below the dam will depend on the final dam design, and therefore the actual impacts to these spawning areas cannot be assessed at this time.

**Raw Water Pipeline**

The RWP will employ two methods of stream crossing (i.e., open cut and trenchless tunneling). Open-cut crossings are planned for the upper Scoggins Creek crossing an un-named tributary to the Tualatin River while all other crossings will be trenchless using horizontal directional drilling (HDD). Streams will be temporarily diverted around the in-stream work area which will be isolated and dewatered using cofferdams and screened pumps. As mentioned previously, the Temporary Water Management Plan will ensure sufficient flow for all downstream water needs. Fish will be removed from the work area (following NMFS and ODFW salvage protocols) and released downstream prior to dewatering to minimize the potential for direct loss. Benthic invertebrates should rapidly recolonize the area once natural flows are reinstated through downstream drift. The use of temporary cofferdams will limit turbidity increases to short pulses during their installation and removal. Diversion pipes will allow downstream fish migration during construction and crossings will not be conducted during periods of upstream migration of anadromous fish. All inwater work will be conducted during ODFW inwater work periods for the streams in question. Following construction, streambeds and banks will be restored to pre-construction contours. Disturbed banks will be revegetated with appropriate native shrubs and trees. With these precautions, impacts to fishery resources should be short-term and minimal.

Clearing of the temporary construction easement could, depending on existing site-specific conditions result in the temporary decrease in riparian vegetation at the open-cut stream crossings along the pipeline corridor. Following construction, riparian areas will be restored with native vegetation to decrease the potential for increased sedimentation and decreases in shading and cover.

The trenchless, or HDD, crossings planned for the upper Scoggins Creek crossing and the Tualatin River crossing will comply with industry standards and are unlikely to increase sedimentation. Fish passage would not be affected during trenchless crossings and riparian vegetation would not be cleared.
Although direct impacts to the stream channel are largely avoided by using HDD, there are instances where drilling mud has entered the stream channel during the boring process. This is usually associated with drilling through fractured bedrock and is referred to as a “frac-out” (see section 3.4.4.6 for more detail). A Horizontal Directional Drill Contingency Plan will be completed to outline contingency measures for containment and cleanup in the event of a frac-out. Bentonite powder and bentonite chips used on the HDD crossings for this project will be naturally occurring, inert, non-toxic materials that meet the National Sanitation Foundation/American National Standards Institute (NSF/ANSI) Standard 60 and 61 Drinking Water Additives Standards. Therefore, any inadvertent release of drilling fluid containing only water and bentonite will not have toxicity impacts to ESA-listed fish.

Although nontoxic per sanitation and drinking water standards, bentonite released into streams could clog the gills of fish, resulting in suffocation. In addition, the bentonite could fill interstitial spaces in the substrate, reducing the suitability of spawning gravels. Furthermore, they could smother vegetation and macroinvertebrate habitats and interfere with filter-feeding of invertebrates. Frac-outs are not anticipated and the implementation of the proposed conservation measures should reduce the extent of potential impacts to an insignificant level.

The probability of an inadvertent release of drilling mud is greatest when the drill bit is working near the surface (i.e., near the entry and exit points); however, the risk is dependent on numerous factors including substrate characteristics, head pressure of the drilling mud, topography, elevation, and subsurface hydrology. The HDDs will be designed so that areas at greatest risk to a potential inadvertent release (entry and exit points) would be located in upland areas at least 150 feet from the stream bank. The HDD contingency plan will describe how the drilling operations will be conducted and monitored to minimize the potential for inadvertent drilling mud releases. The plan will also include procedures for cleanup of drilling mud releases and for sealing the hole if a drill cannot be completed.

If, in spite of the observance of best management practices and implementation of the HDD contingency plan, HDD drilling fluid is released to water, appropriate local, state, and Federal agencies will be notified, and determination on whether or not to cease operations will be made in accordance with the plan. The extent of the release will be assessed, and appropriate corrective actions will be taken. These corrective actions may range from simple monitoring in the case of small releases, to active cleanup using specialized pumps and filters, to abandonment of the HDD and sealing of the hole. In the event of an HDD drilling fluid release to land, the release and drilling hole entry point will be contained with berms, pumps, hay bales, sediment fencing, wood products, or other appropriate means, and the fluid will be cleaned up immediately using hand tools or vacuum trucks and transported to an approved disposal location.

**Spring Hill Pumping Plant**

Spring Hill Pump Station will be expanded for increased capacity. New fish screens designed to meet NMFS screening and approach velocity criteria will be installed at the pumping plant. In-water work could result in some temporary increases in turbidity and/or direct loss of fish and other aquatic species. Work will be scheduled in accordance with the ODFW in-water work windows for the Tualatin River. Cofferdams will be used to isolate the work site and fish salvage will be conducted prior to dewatering
following ODFW and NMFS protocols. Effects on fishery resources are expected to be short-term and minimal.

Road Relocation
Road relocation and associated bridge construction is planned for roads crossing Wall, Scoggins and Sain creeks. Birds and bats may use the Scoggins and Sain Creek bridges, and their presence and usage will be addressed prior to demolition. No impacts to fish passage are expected, as bridge abutments would be placed on the bank above the ordinary high water line and standard construction BMPs would prevent disturbed sediment from entering the waterway. However, should isolation and fish salvage be necessary, these fish would be negatively impacted. Culvert installation on Tanner Creek would be conducted during low flow conditions thus limiting sediment transfer. Some increases in turbidity would be expected during construction. However, these increases would be short-term and not expected to have lasting detrimental affects to fishery resources. All new stream crossing structures will comply with ODFW fish passage criteria, and in-water work will be conducted during ODFW inwater work periods.

Fish Passage Mitigation at Balm Grove Dam on Gales Creek
Removal of Balm Grove Dam will have significant long-term positive impact on fish migration in the Gales Creek Drainage by removing a partial obstacle to migration. This is discussed below under operational impacts. Removal of the dam will result in a short-term increase in turbidity and suspended sediments during the removal process and during restructuring of the stream channel following removal. Due to the low elevation of the dam, there is little sediment accumulation behind the dam. Through use of best management practices and by scheduling the work during the ODFW approved in-water work period, sediment generation during dam removal will kept to a minimum and is not expected to rise to levels that would cause fish mortality. Some short-term, localized loss of fish food organisms is anticipated but recovery will be rapid.

Fish Passage Mitigation at Lake Oswego Corporation Diversion Enhancements
Enhancement made to the Lake Oswego Diversion Dam fish passage facility in the Tualatin River (RM 3.5) will require some in-water work that potentially could impact fishery resources in the area. The primary concern would be increases in turbidity and suspended sediment. Through the use of best management practices such increases can be minimized and should not result in any measurable detrimental impacts to fish or their food resources.

Additional mitigation measures for other negative project impacts are currently under consideration and will be addressed through the CEP process, and addressed in the overall mitigation strategy. Additional discussion of mitigation is provided in Section 4.7.3.

Potential Operational Impacts (direct, indirect)
Under Alternative 2, Scoggins Dam would be modified and raised by 40 feet. For about a year and a half during construction, elevation of the reservoir would be limited to a maximum of 280 feet. Upon completion of the dam raise, Alternative 2 would increase Henry Hagg Lake’s active storage from 53,323 acre-feet at a full pool elevation of 303.5 feet to 105,873 acre-feet at a full pool elevation of 343.5 feet.
With the change, the area of inundation during normal full pool conditions would increase from 1,117 acres to 1,487 acres.

**Henry Hagg Lake**

Project impacts to rainbow trout, smallmouth bass, yellow perch, bluegill, and largescale sucker were evaluated by comparing the availability of preferred aquatic habitat niches between Alternative 1 and Alternative 2. Water quality tolerances and optimal conditions for these species can be used as a model for project impacts to other species in the same guild.

Under Alternative 2, overall fish habitat in Henry Hagg Lake for species that prefer lentic habitats would increase in all months due to the larger pool size. The reservoir hydrograph would be similar to that under the No Action Alternative because operations would be similar, but the water elevation would be higher in all months.

The amount of benthic and pelagic habitats would increase in all months and all water year types (wet, dry, and average). This would benefit habitat generalists, such as rainbow trout, and the largescale sucker, which prefers benthic habitats. When considering the minimum reservoir elevation for all years in the modeling period, some decreases in benthic and pelagic habitat are observed; however, the overall annual increases in benthic and pelagic habitat are greater than the overall annual decreases.

Overall, littoral habitat would increase. Littoral habitat is projected to decrease in some months (October, December, January, August, and September in average years), even though total habitat volume increases in those months. The decrease in littoral habitat is due to the topography of the area surrounding the reservoir. Under Alternative 2, steeper areas would be inundated, which would decrease the overall shallow water habitat in some months, even though overall reservoir volume increases. The overall annual decrease in littoral habitat is less than the magnitude of the annual increase, however.

The increase in overall aquatic habitat in wet, dry, and average year types is expected to result in an overall net benefit for all reservoir fish species. Overall habitat increases range from 7 to 104 percent per month during average water years. Similarly, most habitat niches were projected to have a monthly increase in wet, dry, and average years, and overall annual niche habitat increases always exceeded annual decreases. Inundation of trees and other bank vegetation would contribute significant cover and habitat diversity and would likely benefit each of the fish guild representatives.

Inundation of shore zones after dam raise would have a significant positive short-term effect on macroinvertebrates, due to increased sources of detritus and habitat afforded by inundated trees and other vegetation. Smokorowski et al. (2006) found that removing woody debris from lake systems permanently reduced a dynamic and concentrated biomass of primary and secondary productivity. They found that invertebrate biomass was greater on wood than in sediment, and that highly decayed wood supported greater chlorophyll a concentrations and more invertebrate biomass and diversity than fresh wood. This suggests that the positive effect would persist, as submerged trees are slow to decompose and would provide substrate, cover and nutrients for macroinvertebrates long-term. The increased cover and food resources (in the form of macroinvertebrates) also would benefit fish.
Likewise seasonal exposure of the banks would allow non-woody vegetation to regrow each year. The inundation of this vegetation would provide an annual input of biomass for utilization by invertebrates both as food and cover. Furey et al. (2005) found that macroinvertebrate density and biomass in littoral areas were usually greater in a reservoir with seasonal fluctuations than in a natural lake with a stable water level.

Section 4.3.2.2 describes the potential impacts to water quality from the implementation of Alternative 2. As part of the water quality evaluation, water quality modeling was conducted to predict changes in DO and other water quality parameters. An increase in DO was modeled under Alternative 2 as compared to Alternative 1. Under Alternative 1, the annual, whole lake average DO concentration was 9.2 mg/L in the 2001 water year (a very dry year) and 9.5 mg/L in the 2002 water year (a more typical water year). Under Alternative 2, model results increased to 9.6 mg/L in the 2001 water year and to 10.0 mg/L in the 2002 water year. Model results also indicated that the number of days of low DO would decrease under Alternative 2 (53 days for 2001 and 11 days for 2002, as compared to 85 days for 2001 and 64 days for 2002 under Alternative 1) (CH2MHill 2006).

Model results also indicate a decrease in ammonia and chlorophyll a and substantially reduced duration of blue-green algae blooms under Alternative 2 as compared to Alternative 1. Improvement in DO, ammonia, and chlorophyll a are expected to benefit all species. No changes to any other water quality constituents are expected.

**Scoggins Creek and Tributaries above Henry Hagg Lake**

Expansion of the reservoir would inundate portions of tributaries upstream of Henry Hagg Lake. The total length inundated under the normal full pool of Alternative 2, as compared to that of Alternative 1, would be approximately 1.8 miles (0.7 mile of Scoggins Creek, 0.6 mile of Sain Creek, 0.4 mile of Tanner Creek, and 0.1 mile of Wall Creek). Based on Oregon Department of Forestry fish use maps, 263 miles of stream are present upstream of Henry Hagg Lake (including Scoggins Creek and other tributaries). Of these, 177 miles are either confirmed as being fish bearing or their fish-bearing status is unknown. The remaining 86 miles are non-fish bearing. Alternative 2 would inundate 1.8 miles of stream, or 1% of the fish-bearing and unknown status stream miles.

In 2008, 135,122 “legal” sized and larger rainbow trout were stocked in Henry Hagg Lake (Chilton, 2009). Therefore, rainbow trout, as well as cutthroat trout could be utilizing the tributaries to Henry Hagg Lake for spawning and rearing, although rainbow trout spawning has not been documented. Methods are currently under development to quantify and mitigate for the negative impacts to stream habitats that would be lost to inundation. If spawning and tributary rearing habitat is extensive at the tributary mouths that would be inundated under alternative 2, this spawning habitat will be lost and the quality of the rearing habitat will be degraded.

**Scoggins Creek below the Dam and the Tualatin River**

Three locations in Scoggins Creek below the dam and three locations in the Tualatin River mainstem below Scoggins Creek were evaluated for Weighted Usable Area (WUA), a modeled assessment of habitat quantity and quality for fish. The results of this modeling effort are described in Section 4.9. The
habitat requirements of applicable life stages (spawning, rearing, larval, juvenile and adult) were identified and modeled for potential future conditions. These instream habitat evaluations targeted fish species that are listed under the ESA (discussed in Section 4.9); however, for this evaluation, it was assumed that the impacts to winter steelhead are comparable to the potential impacts to coho salmon (R2 2006) as both species have similar habitat requirements.

However, seasonal use between the two species (Table 4.7-2) is different and lifestages therefore, are exposed to different flow regimes. Because both steelhead and coho rear year-round, the effects of the alternatives on rearing habitat would be very similar for the two species. Juvenile migration of coho also overlaps with and peaks concurrently with juvenile steelhead migration, and therefore any impacts to migration habitat would be similar between the two species. The effects to steelhead are discussed in Section 4.9. In general, juvenile rearing habitat in Scoggins Creek could be expected to decrease more often than increase, and substantial decreases were projected for critical summer rearing. Thus, Alternative 2 could have negative impacts to coho rearing and holding habitat in Scoggins Creek. The magnitude of these impacts will be evaluated through the functions and values assessment process.

Table 4.7-2. Typical and approximate timing of steelhead and coho within the Tualatin River tributaries.

<table>
<thead>
<tr>
<th>Species ESU/DPS</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steelhead Trout</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Willamette River</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult Migration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult Spawning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egg Incubation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juvenile Migration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juvenile Rearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coho</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coho (hatchery-origin, no defined ESU)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult Migration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult Spawning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult Holding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egg Incubation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juvenile Rearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juvenile Migration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Represents peak level of use.

Represents lesser level of use.

Represents known presence with uniform or unknown level of use.

Note: Information collected from ODFW.

ESU/DPS = Evolutionarily Significant Unit/Distinct Population Segment.
Aside from rearing and migration, coho use is primarily restricted to the period September – February, and the majority of the spawning takes place in December. In Scoggins Creek, flow in December under both Alternatives 2 and 3 would be greater than baseline (25 cfs, versus 10 cfs) during dry and moderate flow years, which would be an improvement. During the wettest flow years, spawning WUA would also be improved under both scenarios. This is due to the fact that under current conditions, high flow during the wettest years (610 cfs) is too high for spawning, and the reduced flow provided by the two alternatives would allow for spawning in the creek, even though the flows (25 cfs and 192 cfs) are not optimal (with optimal flows for spawning being approximately 60 - 80 cfs at the Scoggins Creek upper site and 125-150 cfs at the Scoggins Creek lower site). The changes in flow during November would offer a minor increase in spawning habitat during the driest and median flow years and a slight decrease in the wettest years.

Altering the flows in the Tualatin River under the two alternatives and the three scenarios (dry, median and wet years), has variable effects on coho, with some changes being slightly positive during particular years, while others would be slightly negative. Overall, the impacts would likely balance out over time, and under all scenarios, the magnitude of flow changes during coho holding periods are not optimal.

**Fish Passage Mitigation at Balm Grove Dam on Gales Creek**

Alternative 2 would include the removal of a known fish barrier at Balm Grove on Gales Creek. There are no other project-related actions on Gales Creek (flow, construction, etc.). Currently Balm Grove dam is a complete barrier to cutthroat trout and a partial barrier to steelhead, especially during low-flow periods.

The project is seeking a fish passage waiver for the dam improvements (see Section 3.3.5). Fish passage waivers allow an artificial obstruction to not provide fish passage if an "alternative to fish passage" is provided. ODFW considers mitigation to be an alternative to fish passage. In order to obtain a waiver, the proposed mitigation must provide a net benefit to native migratory fish beyond what the benefit of providing passage at the artificial obstruction in question would be. The mechanism for granting waivers and assuring the benefit provided by mitigation is an official “Agreement”. If the waiver is approved, this Agreement must be signed by both the owner/operator and ODFW. If all provisions of the Agreement are met, waivers are valid until the next trigger event at the artificial obstruction, which may be indefinitely. The project is proposing mitigation at Balm Grove Dam and Lake Oswego Corp. diversion dam (discussed below) as mitigation for fish passage in order to obtain the waiver. If passage was provided at Scoggins Dam, only minimal habitat would be available above the dam to steelhead, cutthroat trout or coho salmon. However, removing the Balm Grove dam and improving the fish ladder at Lake Oswego would provide significantly improved access to these target species. Removal of Balm Grove dam alone, would provide free passage for fish species to more than 43 miles of aquatic habitat that comprises approximately 23 miles of “Essential Habitat for Anadromous Indigenous Salmonids” and a majority of the spawning and juvenile rearing habitat in Gales Creek, one of the more productive tributaries for steelhead in the Tualatin Basin. Therefore, a net benefit should be achieved by the proposed passage improvements, despite the fact that passage would not be provided at Scoggins Dam. Removal of the dam would also provide a net benefit to rainbow trout and western brook lamprey compared to Alternative 1 conditions (R2 2006).
Fish Passage Mitigation at Lake Oswego Corporation Diversion Enhancements

Improvements made to the diversion dam and existing fish ladder are expected to improve access to the upper Tualatin River. Improved fish passage at this point would increase migratory success to spawning, rearing and holding habitats upriver.

4.7.2.2.3 Cumulative Impacts

Compared to the No Action Alternative, more development would be expected under Alternative 2, resulting in natural areas being used for residential, agricultural, and urban purposes. Such conversion would lead to greater amounts of chemical contamination of fish habitat due to stormwater runoff. This, combined with additional construction and development in the region, would contribute to a reduction in the quantity and quality of habitat available for fish and macroinvertebrate species. This may interact with some of the improvements made to the Tualatin River system by this project.

Implementation of the Clean Water Services program activities, described in Section 1.6.2, would add to the beneficial water quality effects of Alternative 2. Clean Water Services would be better able to implement the Revised Temperature Management Plan, meet the requirements of the watershed-based NPDES permit, and meet flow targets at Farmington (Table 2-2). Cumulatively, the programs would benefit water quality in the Tualatin River Basin. Development of the Wapato Unit of the Tualatin River National Wildlife Refuge would also benefit water quality in the Tualatin River. Program activities described in Section 1.6.2 would not likely affect water quality in Henry Hagg Lake.

Future development in the Tualatin Basin would likely have negative impacts on water quality from stormwater runoff, increased wastewater discharges, etc. Such impacts would partially offset the benefits achieved by Alternative 2. However, the negative impacts of existing and future development would be lessened by the region’s TMDLs, which consider the effects of stormwater runoff and which have been developed to protect the region’s water quality and beneficial uses.

4.7.2.3 Alternative 3 – Multiple Source Option

4.7.2.3.1 Potential Operational Impacts (direct, indirect)

Under Alternative 3, Scoggins Dam would be modified and raised by 25 feet. For about one and a half years during construction, elevation of the reservoir would be limited to a maximum of 280 feet. Upon completion of the dam raise, Alternative 3 would increase Henry Hagg Lake’s active storage from 53,323 acre-feet at a full pool elevation of 303.5 feet to 84,317 acre-feet at a full pool elevation of 328.5 feet. With the change, the area of inundation during normal full pool conditions would increase from 1,117 acres to 1,352 acres.

Henry Hagg Lake

Changes in aquatic habitat in Henry Hagg Lake under Alternative 3 would be similar to those under Alternative 2. The reservoir hydrograph would be similar to that under Alternative 1 because operations would be similar, but the water elevation would be higher in all months. Overall, habitat would increase compared to Alternative 1, though these increases would be less than those seen under Alternative 2. Benthic and pelagic habitats would increase in all water year types (wet, dry, and average), benefiting habitat generalists and species that prefer benthic habitats. When considering the minimum reservoir
elevation for all years in the modeling period, some decreases in benthic and pelagic habitat are also observed. The overall annual decreases in benthic habitat are less than the overall annual increases (R2 2006).

The increase in overall habitat in wet, dry, and average year types is expected to result in an overall net benefit for all reservoir fish species. Overall habitat increases range from 16.0 percent to 58.8 percent per month in the average of all years. Similarly, most habitat niches were projected to show monthly increases in wet, dry, and average years, and overall annual niche habitat increases always exceeded annual decreases.

Under Alternative 1, the annual whole lake average DO concentration was 9.2 mg/L in the 2001 water year and 9.5 mg/L in the 2002 water year. Under Alternative 3, model results showed an increase to 9.6 mg/L in the 2001 water year and 9.9 mg/L in the 2002 water year. Model results also indicated that the number of days of low DO would decrease under Alternative 3 (53 days for 2001 and 32 days for 2002, as compared to 85 days for 2001 and 64 days for 2002 under Alternative 1).

Model results also indicate a decrease in ammonia compared to Alternative 1. Chlorophyll a would substantially decrease under Alternative 3; levels would be similar to Alternative 2. The duration of blue-green algae blooms under Alternative 3 would be substantially less than Alternative 1 and Alternative 2. These water quality changes are expected to benefit all species. No changes to any other water quality constituents are expected.

**Scoggins Creek and Tributaries above Henry Hagg Lake**
Expansion of the reservoir would inundate portions of tributaries upstream of Henry Hagg Lake. The increased total length inundated under the normal full pool of Alternative 3 as compared to that of Alternative 1 would be approximately 1.6 miles (0.6 mile of Scoggins Creek, 0.6 mile of Sain Creek, 0.3 mile of Tanner Creek, and 0.1 mile of Wall Creek). The total stream length of Scoggins Creek and its tributaries above Scoggins Dam is 56.3 miles. The portion inundated under Alternative 3 would be less than 3 percent of the total length (R2 2006). Based on Oregon Department of Forest fish use maps, 263 miles of stream lie upstream of Henry Hagg Lake (including Scoggins Creek and all other tributaries). Of these, 177 miles are either confirmed as being fish bearing or their fish-bearing status is unknown. The remainder (86 miles) are non-fish bearing. The 1.6 miles inundated under alternative 2 represents 1% of the fish-bearing and unknown status stream miles.

**Scoggins Creek below the Dam and Tualatin River Mainstem**
The increased minimum flows in Scoggins Creek under Alternative 2 are expected to generally improve aquatic habitat conditions (less potential for dewatering, more cooling). Alternative 3 is also expected to provide overall improvements to aquatic life in the Tualatin River. The flow changes are not expected to change the existing geomorphic conditions, or increase turbidity or eliminate existing habitats. Increased flows during the summer and fall will improve water quality conditions, specifically temperature and algae conditions. These improvements are expected to benefit all coldwater fish and macroinvertebrate populations.
As described above, potential impacts to steelhead rearing and migration are comparable to the potential impacts to coho salmon. In Scoggins Creek, flow in December (peak spawning time for coho) under both Alternatives 2 and 3 would be greater than baseline (25 cfs, versus 10 cfs) during dry and moderate flow years, which would be an improvement. During the wettest flow years, spawning WUA would also be improved under both scenarios. This is due to the fact that under current conditions, high flow during the wettest years (610 cfs) is too high for spawning, and the reduced flow provided by the two alternatives, would allow for spawning in the creek, even though the flows (25 cfs and 192 cfs) are not optimal (with optimal flows for spawning being approximately 60 - 80 cfs at the Scoggins Creek upper site and 125-150 cfs at the Scoggins Creek lower site). The changes in flow during November would offer a minor increase in spawning habitat during the driest and median flow years and a slight decrease in the wettest years.

Altering the flows in the Tualatin River under the two alternatives and the three scenarios (dry, median and wet years), provides variable effects to coho, with some changes being slightly positive during particular years, while others would be slightly negative. Overall, the impacts would likely balance out over time and in any case the magnitude of flow changes during coho holding periods are not optimal.

Overall, habitat improvements are expected in both Scoggins Creek and the Tualatin River under Alternative 3 for aquatic species. Temperature management would have higher controls with a multi-stage reservoir discharge system. Instream minimum flows would be increased to 25 cfs for habitat improvements, and M&I releases would be more modulated using the RWP instead of Scoggins Creek for conveyance.

**Fish Mitigation at Balm Grove Dam on Gales Creek**
Potential impacts resulting from the removal of Balm Creek Dam would be identical to those previously detailed in Alternative 2 discussion.

**Fish Mitigation at Lake Oswego Corporation Diversion Enhancements**
Enhancements to the diversion facilities would have the same impacts as discussing for Alternative 2.

**Willamette Pipeline Route**
Construction of the Willamette Pipeline would involve diverting water from the Willamette River at the Willamette River Water Treatment Plant intake in Wilsonville (Section 22, Township 3 South, Range 1 West, Willamette Meridian in Clackamas County). This diversion has the potential to impact fish and macroinvertebrate species by decreasing habitat volume within the Willamette River. However, conservation measures have been incorporated into the Willamette River diversion permit (OWRD 2007) to meet minimum fish flow needs, especially during low flows, as measured in Salem (USGS gage number 14191000). When target flows are not being met by the Willamette River, the amount that would be diverted would be reduced proportionally. During April, May, and June, the maximum that the diversion amount can be reduced would be 20 percent. Public messages will be released when flows has fallen to ten percent below target flows for 15 consecutive days. These messages will encourage and educate water users on conserving water, thereby maintaining more water for fish and aquatic species in the Willamette River.
4.7.2.3.2 Potential Construction Impacts
Potential construction impacts previously described for Alternative 2 would also be expected in association with Alternative 3. Additional potential impacts to fish and aquatic species not already detailed in section 4.7.2.2 follow.

Willamette Pipeline
The pipeline alignment would cross Coffee Lake Creek, Rock Creek, Cedar Creek, Chicken Creek, Summer Creek, the Tualatin River, and several smaller streams and drainages. The pipeline would be bored under the Tualatin River and may be bored under other streams to avoid impacts to aquatic resources. Trenching is being considered as a design option for the smaller Willamette Pipeline crossings, but not for the Tualatin River. Trenching would only be used where it can be demonstrated that the stream would realize a net benefit through stream habitat enhancements made as part of the project, and if it is acceptable to the resource agencies. The temporary impacts of construction include the potential to increase erosion and sedimentation, and removal of riparian vegetation to install the pipe. In general, impacts to the crossed streams during construction would be similar to those resulting from crossings of the RWP. Although some open-cut stream crossings are possible, trenchless construction methods will be used where feasible. As previously detailed in section 4.7.2.2 trenchless stream crossings would be less likely to adversely affect fishery resources as they reduce potential for increased sedimentation, do not require dewatering the work area, and reduce disturbance of riparian vegetation. The only direct effects of trenchless (HDD) stream crossings would be those associated with a frac out, which are discussed in Section 4.7.2.2 above. If open trench construction methods are used for crossing any of these stream, the procedures described previously in Section 4.7.2.2 would be employed to minimize impacts to fishery resources.

Use of construction equipment within the riparian zone may lead to the removal of some riparian vegetation. Because most of the proposed stream crossings in are located in previously disturbed areas, it is expected that impacts to high quality native riparian vegetation will be minimal. Following construction, riparian areas will be restored with native vegetation.

4.7.2.3.3 Cumulative Impacts
Cumulative impacts would be the same as for Alternative 2.

4.7.3 Mitigation Measures

4.7.3.1 Alternative 1
For Alternative 1, no mitigation measures are required or proposed.

4.7.3.2 Alternatives 2 and 3
In addition to mitigation at Balm Grove Dam and the Lake Oswego fish ladder, which would be done to obtain a fish passage waiver at Scoggins Dam, several other projects are planned to mitigate for other negative impacts. While, overall, Scoggins Creek flows below the dam would increase under Alternatives 2 and 3, flows would be reduced at certain times of the year. To mitigate for those reduced flows, a stream habitat management plan will be developed and implemented, which would provide seasonal flow benefits for 30 river miles. Overflow channels would be constructed within the existing dam outlet.
channel, and clean gravel would be placed within the Scoggins Creek channel between the spillway and the Stimson Mill bridge, on an as-needed basis (that is, when fines or sediment reduce production potential for spawning fish). Additional mitigation measures would consist of stream channel improvements in the Gales Creek and McKay-Dairy Creek watersheds and would include culvert replacement and repair, and habitat enhancements. A culvert would also be replaced along an unnamed tributary to Scoggins Creek.

To mitigate for inundation of Scoggins Creek and tributaries above Henry Hagg Lake, the Sain Creek dam would be removed, opening up about five miles of additional habitat. Downstream of the dam, improvements would be made to diversion dams within the City of Forest Grove watershed to improve fish passage and habitat, benefiting 892 feet of Roaring Creek and 1.4 mile of Clear Creek. Habitat restoration projects with the goal of improving riparian vegetation will also be pursued.

For aquatic resource impacts related to construction activities, mitigation measures include erosion and sediment control plans, and the revegetation of any riparian areas where vegetation had to be removed for construction purposes. If trenching is approved for any stream crossings, fish passage or trapping will be required to minimize any fish losses during construction. For trenchless crossings, entry and exit pits will be placed in upland areas, away from stream banks; work areas will be protected with erosion control; and spill prevention and clean-up plans will be implemented in case of a frac-out. All in-water work will be done in coordination with ODFW and will comply with ODFW and NMFS designated in-water work periods.
4.7 NON-LISTED FISH AND MACROINVERTEBRATES ............ 4.7-1

4.7.1 Affected Environment ............................................................ 4.7-1
4.7.2 Environmental Impacts ............................................................ 4.7-14
4.7.3 Mitigation Measures ................................................................. 4.7-26

No table of figures entries found.

Table 4.7-1. Non-Listed Fish Species that Occur within the Project Area .......... 4.7-5
Table 4.7-2. Typical and approximate timing of steelhead and coho within the Tualatin River tributaries ................................................................. 4.7-21
### 4.8 Non-Listed Wildlife and Vegetation

This section addresses non-listed vegetation and wildlife, species which have not been added to specific lists, but may be affected by the project. Species that are proposed for listing or are listed as threatened or endangered, either federally or by the State of Oregon, are addressed in Section 4.9. Generally, non-listed species that are strictly aquatic are addressed in Section 4.7; however, non-listed amphibian species are addressed in this section. Wetlands are described in this section with regard to wildlife habitat, but are addressed from a jurisdictional and regulatory perspective in Section 4.6.

The information in this section is based upon review of relevant available, communication with wildlife experts and agency representatives, as well as reconnaissance level or better field visits to the study area. Reviewed materials include the following documents (although not all are listed here):

- Elk Mitigation Meadows Maintenance and Monitoring Plan Henry Hagg Lake, Tualatin Project, Oregon (Reclamation 2003b)
- Environmental Conditions Reconnaissance Memorandum regarding the TVWD pipeline alignment and water tank sites (Adolfson 2006b)
- Henry Hagg Lake Resource Management Plan (Reclamation 2004a)
- JWC Raw Water Pipeline Corridor Preliminary Environmental Screening Assessment (CH2M Hill 2003)
- Raw Water Pipeline Preliminary Design Report (MSA 2006)
- TBWSP Recreation Impact and Master Plan (Atlas 2005)
- Tualatin Basin Water Supply Feasibility Study (MWH 2004)
- Upper Tualatin-Scoggins Watershed Analysis (BLM 2000)

Hydrology information is summarized from Surface Water Hydrology Technical Report (MWH 2006d), and provides a basis for much of the impacts discussion. The technical report documents the hydrologic modeling methodology, assumptions, and effects of the alternatives on surface water hydrology in Henry Hagg Lake, Scoggins Creek, and the Tualatin River. The technical report also presents stream flows and river stages at several locations, as well as reservoir levels, based on simulation results from a water balance model developed for the analysis.

In addition, the Upper Tualatin-Scoggins Watershed Analysis (Hawksworth 2000) and the Lower Tualatin Watershed Analysis (Hawksworth 2001) provided valuable information on the vegetation and wildlife habitats within the project area. Communication with wildlife experts and agency representatives included ODFW, USFWS, METRO, CWS, Reservoir staff, and others. Full citations for these documents and all others that were used in preparing this section are located in the References Cited section.

#### 4.8.1 Affected Environment

The Tualatin River Basin sits within the interior valley zone as described by Franklin and Dyrness (1988). The majority of the upper basin consists of coniferous forest, while the majority of the lower basin is composed of a mosaic of urban and rural development and residential, agriculture, mixed forest, and
grasslands. Where it exists, the native vegetation is in the early to mid-successional seral stages and structurally fragmented. Late seral habitats may exist in very small, isolated patches. The patchiness of the current landscape is favorable to wildlife that prefer “edge” habitats. The changes in vegetation have also made these habitats less desirable to those species that are dependent upon late-successional vegetation (Hawksworth 2000).

### 4.8.1.1 Vegetation

Following are brief summaries of the vegetation and wildlife habitat in the study areas for the reservoir, RWP corridor, and Willamette Pipeline corridor. These summaries are then followed by descriptions of the habitat types that are found in all three areas.

#### 4.8.1.1.1 Henry Hagg Lake – General Description

Descriptions of existing vegetation associations around Henry Hagg Lake are found in the Henry Hagg Lake Resource Management Plan (Reclamation 2004a), which focused on areas within the park boundary. Figure 4.8-1 shows the vegetation associations identified by the Resource Management Plan. These vegetation types (and this map) have been refined as described below.

As described in the Resource Management Plan (RMP) forested areas account for almost 70 percent of the upland habitat around Hagg Lake: Conifer Forest, Mixed (coniferous/deciduous) Forest, Oak Forest, Clearcuts 5-15 years old, and Managed Tree Farms (Reclamation 2004b). For the TBWSP vegetation was mapped at a finer scale than for the RMP. For example, areas mapped as Conifer Forest or Mixed Forest in the RMP may be mapped as Oak Forest for the TBWSP. Such as those areas with higher percent cover by Oregon white oak (generally greater than 20% cover), as described in the Oak Forest section. All forested areas are early or mid-successional, with scattered patches of remnant mature trees in places. Vegetation complexity and percentage of native/non-native vegetation varies, but forested areas are generally complex (more than four layers) and are dominated by native vegetation. Large trees (greater than 100 feet tall) occur in a few areas (URS 2003).

Grassland areas account for almost 30 percent of habitat in the vicinity of the reservoir and include upland grassland (typically used for agricultural purposes), upland grassland with a shrub component, and those grassland areas designated as elk mitigation meadows (existing designated elk meadows are illustrated on Figure 4.8-2).

Other vegetation categories identified during the Resource Management Plan study include developed areas as well as riparian areas and wetlands, which were added to the vegetation mapping following extensive field work conducted by DEA in 2009 on riparian areas, wetlands and developed areas (Reclamation 2004b). Vegetation association acreage quantities within Reclamation lands surrounding Henry Hagg Lake are listed in Table 4.8-1.

#### Table 4.8-1. Henry Hagg Lake Resource Management Plan Vegetation Associations

<table>
<thead>
<tr>
<th>Vegetation Association</th>
<th>Area (acres)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conifer Forest</td>
<td>810</td>
</tr>
<tr>
<td>Habitat Type</td>
<td>Acres</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Mixed Forest</td>
<td>111</td>
</tr>
<tr>
<td>Upland Grassland</td>
<td>140</td>
</tr>
<tr>
<td>Elk Meadow</td>
<td>110</td>
</tr>
<tr>
<td>Mixed Shrub/Upland Grassland</td>
<td>195</td>
</tr>
<tr>
<td>Riparian</td>
<td>14</td>
</tr>
<tr>
<td>Wetland</td>
<td>34</td>
</tr>
<tr>
<td>Developed</td>
<td>35</td>
</tr>
</tbody>
</table>

Source: Reclamation 2004b.

*Acre quantities are approximate.

The Henry Hagg Lake Biological Resources Report (URS 2003) indicates there is high quality forested habitat located in three locations around the reservoir; north of Boat Ramp A on the east side of Henry Hagg Lake, along Scoggins Creek, and along Sain Creek. These areas contain large patches of coniferous forest with large trees and several layers of native vegetation. High quality oak forest habitat (mixed with coniferous and deciduous forest) occurs in scattered patches around the lake.

During drawdown, the reservoir shoreline is dominated by extensive unvegetated ‘mudflats’ consisting of bathymetric sediment deposits. Depending on the topography and the drawdown levels, these mudflats can consist of mud or sandier, well-drained sediments. These mudflats can extend up to 1,000 feet in the summer and fall months as well as when the water level is lowered to provide storage for winter flood control. Shoreline vegetation near and above the full pool elevation includes emergent wetlands, riparian shrub, upland grassland and forested habitats (Reclamation 2004b). Slopes leading up from Henry Hagg Lake are steep in places, but generally range from 5 to 25 percent.

Human disturbance is an important factor affecting wildlife habitat in the vicinity of the reservoir. Trends show increasing annual attendance at Scoggins Valley Park over the years. The most popular activities, by order of importance, are: fishing, picnicking, boating, biking, swimming, hiking, and wildlife viewing (Atlas 2005). Recreational use of the park decreases in winter, and most park facilities are closed from November 20 through March 4 each year, including boat ramps and all picnic or recreation areas with gates. The perimeter road is open all year, but receives relatively little traffic in winter.

### 4.8.1.1.2 Raw Water Pipeline – General Description

The 6.5-mile RWP study corridor follows the proposed pipeline route from the base of Scoggins Dam, across Stimson mill property, along agricultural areas adjacent to Scoggins Creek and east to Highway 47, then northeast along the agricultural bottomlands of the Tualatin River toward the Spring Hill Pumping Plant and JWC Water Treatment Plant at Fern Hill. The study corridor is dominated by agricultural lands and rural residential areas with highly fragmented patches of conifer and mixed forest near the reservoir and in narrow riparian bands (Table 4.8-2). The corridor crosses Scoggins Creek and at least one unnamed creek as well as the Tualatin River. Wildlife use in this area is primarily affected by...
varying levels of human disturbance and habitat fragmentation. Farmed wetlands are mapped separately from upland agricultural areas, although they are kept in an unvegetated state and are not similar to other vegetated emergent wetlands found around the lake or in ditches along the RWP.

Table 4.8.2. Raw Water Pipeline Corridor Vegetation Associations

<table>
<thead>
<tr>
<th>Vegetation Association</th>
<th>Area (acres)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conifer Forest</td>
<td>4</td>
</tr>
<tr>
<td>Mixed Forest</td>
<td>0</td>
</tr>
<tr>
<td>Upland Grassland</td>
<td>19</td>
</tr>
<tr>
<td>Elk Meadow</td>
<td>4</td>
</tr>
<tr>
<td>Mixed Shrub/Upland Grassland</td>
<td>0</td>
</tr>
<tr>
<td>Grassland</td>
<td>4</td>
</tr>
<tr>
<td>Riparian</td>
<td>4</td>
</tr>
<tr>
<td>Wetland (non-agricultural)</td>
<td>0</td>
</tr>
<tr>
<td>Agricultural Areas**</td>
<td>77</td>
</tr>
<tr>
<td>Developed</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: Reclamation 2004b
*Acre quantities approximate.
**Includes farmed wetland areas

4.8.1.1.4 Willamette Pipeline – General Description

The study corridor for the proposed Willamette Pipeline runs from the Willamette River Water Treatment Plant at Wilsonville (near RM 39) to a Tualatin Valley Water District (TVWD) connection point with the Washington County Supply Line at SW Beaverton-Hillsdale Highway and SW Western Avenue in Beaverton. The potential TVWD water tank areas are on south-facing slopes north of Scholls Ferry Road, in agricultural and rural residential areas. Nearly all of the corridor follows road rights-of-way and passes through rural and urban developed areas. Wildlife habitats within urban areas are highly fragmented and have been further degraded by noise, pollution, and close proximity to humans. Wildlife habitats in rural areas have been affected by agriculture, logging, and mining.

Three general vegetative communities have been mapped throughout the less urban Portland metropolitan area: grass or open field, woody or shrub, and forest (Metro 2003a). The grass or open field communities include agricultural lands, and undeveloped lands. The shrub and woody communities include orchards; riparian shrub lands, which may include willows (Salix spp. and red-osier dogwood (Cornus sericea)); and upland shrublands. The forested areas include riparian forests that could include red alder (Alnus rubra), big-leaf maple (Acer macrophyllum), Oregon ash (Fraxinus latifolia), and black cottonwood (Populus balsamifera ssp.trichocarpa); and upland forests that may include Douglas-fir (Pseudotsuga menziesii), ponderosa pine (Pinus ponderosa) and Oregon white oak (Quercus garryana). A mixture of native and exotic vegetative species occurs within the urban portion of the corridor.
Reclamation 2004b; Metro 2003a). For purposes of this evaluation, the habitats within the project area are divided into communities similar to those used in Metro’s vegetation classification system (Metro 2003a). Although other habitat types (such as clearcuts) are present outside the immediate project area, this section describes only the habitats that are found within the TBWSP project area. Use of these habitats by wildlife is described by species or species group (i.e., mammals, reptiles, amphibians, birds, and fish) in the Non-listed Wildlife section below.

The three major elements of the project: the dam raise, the RWP, and the Willamette Pipeline, are combined in the discussions of this section because their vegetation communities share similar attributes and provide habitats to similar suites of species (although use by these species varies greatly between project elements, as described below). Six vegetation communities/habitat types were used for this evaluation:

- Forest (includes coniferous forest, mixed forest, oak forest, and tree farms)
- Grassland/Open Field (includes upland grasslands, elk meadows, and agricultural areas, and mixed shrub/upland grassland)
- Riparian Areas
- Wetlands
- Open Water
- Developed Areas

**Forest**

**Conifer Forest.** Conifer forest in and around the project area is dominated by second growth Douglas-fir and smaller proportions of western hemlock (*Tsuga heterophylla*) and western red cedar (*Thuja plicata*). The understory in these stands is dependent upon its position on the landscape but often includes beaked hazelnut (*Corylus cornuta*) and vine maple (*Acer circinatum*), occasionally mixed with snowberry (*Symphoricarpos albus*), salal (*Gaultheria shallon*), Oregon grape (*Mahonia aquifolium*), Himalayan blackberry (*Rubus armeniacus*), trailing blackberry (*Rubus ursinus*), and swordfern (*Polystichum munitum*). Within Scoggins Valley Park, near the reservoir where the forested areas are no longer managed for timber harvest, most stands have not been thinned, resulting in dense coniferous stands with a poorly developed understory. A recent exception is Recreation Area A East, where some marketable timber was removed and underbrush was thinned.

The forested land throughout the study area has, at one time, been harvested. Thus, all forested areas in the region are second-growth, with the older mid-seral forested areas estimated at approximately 100 to 120 years old (Reclamation 2004b). Much of this older forest is located along the southeastern portion of Henry Hagg Lake near Boat Ramp A.

In most of the conifer forest, snags and downed wood are generally lacking due to past and present forest management practices. The trend would be for slow recruitment of these features under existing management practices, and a slow trend toward mature conifer forest. Figure 4.8-3 shows the habitat types within the Henry Hagg Lake area.
**Mixed Forest.** This vegetation community includes the large, mixed stands of deciduous and coniferous trees but also includes the smaller woodlots that are likely remnants of the larger lowland forest that covered the region. Big-leaf maple is often a major stand component in mixed forests, with Oregon white oak in small patches (less than 25% cover) and scattered Oregon ash in wetter areas. Understory is commonly dominated by upland shrubs such as ocean spray (*Holodiscus discolor*) poison oak (*Toxicodendron pubescens*), and elderberry (*Sambucus* spp.), snowberry, and trailing blackberry, among others. Wetter sites may include red-osier dogwood and vine maple in the understory. In most of the mixed forest, snags and downed wood are generally lacking due to past and present forest management practices. Over time and under existing management practices, the mixed forest would slowly recruit snags and downed wood, and would also slowly trend towards mature conifer forest as conifers outcompete deciduous species.

**Oak Forest.** In the research literature describing oak habitat in Oregon and Washington, a wide variety of forest types are referred to as “oak forest”. They range from very open savannahs with a grass understory to dense forest stands, and from pure oak to mixed stands with an abundance of conifer species, particularly Douglas-fir and ponderosa pine (Ryan and Carey, 1995). Oaks tend to be dominant where soils are well drained and droughty in summer or where soils are saturated in spring and fall. For the purposes of this document, oak savannah was not mapped within the project area because only a few scattered oaks occurred in otherwise artificially maintained grasslands (elk meadows). Thus, these scattered oak areas were mapped as oak forest.

Recommendations for managing oak forest to provide habitat for species such as western gray squirrel suggest maintaining oak canopy cover at 40-60% (Ryan and Carey, 1995). Based on aerial photographs and field work conducted in 2009, oak forest was mapped where Oregon white oak provided 20% or more canopy cover. In most cases, the presence of oak within the project area has declined over time due to competition by conifers. Understory conditions in oak forest were similar to those found in mixed forest, and included species such as Indian plum (*Oemleria cerasiformis*), bitter cherry (*Prunus emarginata*), and beaked hazelnut. In most of the oak forest, snags and downed wood are generally lacking due to past and present forest management practices. Similar to the other forest types, over time and under existing management practices, the oak forest would slowly recruit snags and downed wood and slowly trend towards mature conifer forest as conifers outcompete deciduous species, including oak.

**Tree Farm.** While tree farms are usually dominated by a single conifer species and devoid of understory vegetation, they are still recognized as a component of the forest habitat. Several Christmas tree farms are located adjacent to the reservoir, outside the current park boundary, as well as along the Willamette Pipeline corridor. These Christmas tree farms differ from young clearcuts present in areas managed for timber because of they have regularly spaced conifers and uniform height and growth characteristics.

**Grassland/Open Field**
**Upland Grasslands.** Upland grasslands can be found scattered throughout the project area. Upland grassland areas near Henry Hagg Lake include a mixture of unmaintained grasslands mixed with scattered native shrubs and Himalayan blackberry, and pasture, usually located near homesteads. Beyond the reservoir study area, the upland grassland habitat consists primarily of heavily managed pasture or lawn. Frequently disturbed grass fields currently managed solely for agricultural purposes are not mapped as grassland, but are categorized as agricultural areas.

The grassland habitat that occurs along the northern margin of the reservoir may contain pockets of remnant prairie vegetation (Reclamation 2004b). Site visits to potential prairie remnants conducted during the development of the Resource Management Plan did not discover prime native grassland habitat or individual listed species, but more recent surveys may need to be conducted to determine presence or absence of these species prior to construction.

**Elk Meadows.** Elk meadows are designated mitigation sites which are maintained in upland grassland condition around Henry Hagg Lake as replacement of elk habitat lost by inundation during the original construction of Scoggins Dam. The designated elk meadows are discussed further in Section 4.8.1.2. These meadows do not contain remnant native habitats, and prior to conversion to elk mitigation meadows, were likely managed for agricultural purposes. They are dominated by non-native grasses such as tall fescue, common velvetgrass, and colonial bentgrass, as well as a mixture of native, non-native, and invasive forbs. These meadows are dominated by non-native species, many of which were planted specifically for elk forage. Additionally, these meadows are currently managed by mowing and pesticide application. Agricultural Areas. Agricultural areas consist primarily of frequently plowed and harvested fields. There are no agricultural habitats in the vicinity of the reservoir; however, nearly the entire RWP corridor has been converted to agricultural pasture. This agricultural pasture is frequently plowed, replanted with tall fescue and other pasture grasses, harvested, and then managed with various herbicides and pesticides. The Willamette Pipeline alignment travels through agricultural areas for much of its length – from Wilsonville to Sherwood and from Sherwood to Tigard. However, nearly all of the pipeline would be constructed within public rights-of-way. Figure 4.8-4 shows the habitat types within the reservoir area.

**Mixed Shrub/Upland Grassland**

Mixed shrub/upland grassland consists of a wide range of habitats. This range includes patches of Himalayan blackberry interspersed with tall fescue and oxeye daisy to remnant patches of native shrubs such as beaked hazelnut, with non-native species such as common velvetgrass (*Holcus lanatus*) and tall fescue (*Festuca arundinacea*) in the understory. Native grass species, if present, represent a very small fraction of herbaceous cover within all the grassland habitats in the project area. In much of the unmanaged upland grassland habitat, a well-developed shrub layer is present, consisting of native shrub species or young trees, mixed with non-native or invasive species. These non-native invasive species include Scotch broom (*Cytisus scoparius*), Canada thistle (*Cirsium arvense*) and Queen Anne’s lace.
Shrub cover was generally less than 50% in areas mapped as mixed shrub/upland grassland.

**Riparian Habitat**

Riparian areas are dynamic zones of interaction between upland and aquatic systems. A riparian area can be defined as the zone of transition from any water body to a terrestrial ecosystem. Aquatic systems and riparian areas greatly influence each other, changing the landscape and over time, maintaining soil moisture, and creating new soil surfaces on which plants can grow. Riparian zones provide important travel corridors for wildlife. In addition, functioning riparian areas act as buffers to potential pollutants because their vegetation and soil filters pollutants picked up as rainfall flows over roads, lawns, and fields. Additional beneficial effects of riparian vegetation on aquatic life include cooling, balanced water chemistry, and nutrient assimilation from the surrounding soil, among others.

Refer to Section 4.3 for more information on water quality conditions within the project vicinity. As mentioned previously, many of the riparian areas within the project area have been impacted by human activities, as described below.

“Ecosystems within the Tualatin River watershed have been significantly affected by human development and encroachment with resultant changes to the natural Scoggins Creek and Tualatin River watercourses including: channel straightening and relocation, bank armoring, draining of peripheral and associated wetland habitat, riparian vegetation removal, general urbanization of adjacent lands, and the damming of the natural stream channels…” (TRWC 2002).

**Henry Hagg Lake.** The riparian areas around the reservoir are fairly well-developed (although they may not be as wide as optimal conditions) and provide habitat for a wide variety of wildlife. Vegetation within these riparian bands includes Oregon ash, red alder, big-leaf maple, and willow and patches of native shrubs such as snowberry, twinberry (*Lonicera involucrata*), and elderberry mixed with Himalayan blackberry other weedy shrub and herb species. Along portions of the riparian corridor, many of the large trees that formerly surrounded streams have been cleared, resulting in reduced canopy and increased summer temperatures. This has negatively altered the habitat available to species, especially those that benefit from cool, humid sites, such as amphibians (Hawksworth 2001). In recent years much of the forested habitat immediately adjacent to the major creeks above the reservoir has been harvested, leaving a fairly narrow riparian corridor in places. This is true of Sain Creek upslope of the park boundary, and portions of Scoggins Creek as well as smaller tributaries. Much of the land immediately upslope of the park is privately owned and managed almost exclusively for timber production. Therefore the potential habitat condition for a number of miles above the lake has the potential to change from its current early and mid-seral condition to clearcut or young forest condition. This has been the trend in recent years, and may continue to contribute to lost acre-feet of storage in the reservoir from sediment loads carried by runoff (Murtagh, pers. Comm. 2009). Sedimentation in these creeks can also decrease their suitability as amphibian habitat.
Riparian habitat in the reservoir area is found along the three major tributaries to the reservoir: Sain, Scoggins, and Tanner creeks. Sain and Scoggins creeks are perennial. In a normal year Tanner Creek may not have flow during the late summer season. The percentage flow contribution for each significant tributary is estimated at 69 percent for Scoggins Creek, 28 percent for Sain Creek, and 3 percent for Tanner Creek (Reclamation 2004b). The riparian vegetation is continuous along these creeks near their confluence with the reservoir; therefore, amphibian habitat is fairly well protected along these riparian zones. A notable exception is within the Tanner Creek drainage, where only a thin riparian zone remains within the park boundary. Because of the surrounding steep slopes, soil erosion has long been a concern for this area (Reclamation 2004b).

**Raw Water Pipeline.** Jurisdictional waters crossed by the RWP include the following seven waterways: Scoggins Creek (two crossings), one unnamed tributary to Scoggins Creek (ditched), four unnamed tributaries to the Tualatin River, and the Tualatin River itself (CH2M Hill 2005a). Scoggins Creek, at the western end of the RWP corridor, is a moderately sized, low-gradient stream that has been modified by the construction and operation of Scoggins Dam and adjacent agricultural activities. These tributaries are ditched to a greater or lesser degree where they run through the project area, and do not contain riparian vegetation, but a mix of weedy herbaceous species such as reed canarygrass (*Phalaris arundinacea*), common teasel (*Dipsacus fullonum*), and tall fescue, as well as Himalayan blackberry in places. To the east, the RWP corridor crosses the Tualatin River and associated riparian zones. While the Tualatin River is much wider and carries more flow than Scoggins Creek, its riparian zone is similar to that described for Scoggins Creek at the pipeline crossing point. The riparian area along this section of the Tualatin River is somewhat less disturbed, with patches of native trees and shrubs, including thickets of red alder, willow, and a few Oregon oak and large cottonwoods in places.

Vegetation within the narrow riparian bands along the RWP is similar to those found along the reservoir, but the understory includes large patches of Himalayan blackberry and other weedy species such as reed canarygrass. Outside of this strip of buffer vegetation, the riparian vegetation has largely been cleared and converted for agricultural use, as have the banks of the unnamed tributaries that are crossed by the alignment. In spite of the presence of non-native vegetation, degraded habitats still provides structure and other wildlife value along the RWP.

Although all riparian areas along the RWP are disturbed to some degree, they provide habitat for a wide range of wildlife, and the value of the riparian zones along the RWP is great due to their scarcity and function within a highly degraded landscape.

**Willamette Pipeline.** Numerous riparian areas are located in the vicinity of the proposed Willamette Pipeline corridor. The Willamette Pipeline would cross 18 streams (including the Tualatin River) and a number of ditches. All of the crossings would occur along roads. The ditches are along roadsides or are tributaries to streams that have been altered by agricultural or residential development. They contain little, if any, riparian vegetation other than weedy species such as Himalayan blackberry. Vegetation in some of the other riparian areas varies—some areas are dominated by Himalayan blackberry with some willows and other native shrubs; others are dominated by reed canarygrass; and others contain red alder, mature trees, native shrubs, or both.
The Tualatin River flows from west to east near the halfway point of the Willamette Pipeline corridor. The pipeline crossing would be along SW Roy Rogers Road Bridge. Riparian forest is present on both sides of the river at this location; the forested corridor varies from about 50 to 100 feet wide along each side. Trees are primarily mature Oregon ash and Douglas fir.

Part of one of the potential TVWD water tank areas is managed as a vineyard; the rest of that area is a riparian forest surrounding a small stream. The forest supports semi-mature black cottonwood and Scouler’s willow \((Salix scoulariana)\) with some semi-mature Douglas-fir and big-leaf maple as well as Himalayan blackberry (Adolfson 2006b).

**Wetlands**

This section addresses wetlands in terms of their value as wildlife habitat. Wetlands, from a jurisdictional and regulatory perspective, are addressed in Section 4.6.

The site visits confirmed interpretation of aerial photography showing that, other than narrow bands of weedy emergent vegetation in places at the edge of the reservoir and occasional narrow bands of scrub-shrub or forested wetlands along creeks, relatively few wetlands exist within the reservoir study area. Most of them are at the outlets of Tanner and Scoggins creeks. In most areas moderate slopes lead from the reservoir edge at full pool, and the creeks leading into the reservoir flow through narrow, relatively steep drainages. In a few areas, level ground can be found adjacent to the reservoir, particularly at Tanner Creek and north of the Sain Creek cove. In these areas wetland vegetation lies within a wider band adjacent to water features. Downstream of the dam, Scoggins Creek flows through a wide, level valley dominated by agriculture.

The wetland types, according to Cowardin classifications (FWS 1979), that lie within the study area include: **palustrine emergent**, **palustrine scrub-shrub**, **palustrine forested**, and **lacustrine littoral emergent**. The majority of wetlands in the reservoir study area (20 acres) are covered by herbaceous vegetation. Of the remaining wetland area, vegetative cover is composed of slightly less forest (3 acres) than shrub (6 acres). No vegetated shallows were identified during the site visits or in recent studies by others. Conditions around the reservoir (soil types, degree of inundation, and drawdown patterns) do not encourage the formation of these wetlands.

**Palustrine Emergent.** Within the reservoir study area, the palustrine emergent wetland areas were dominated by herbaceous vegetation, most commonly non-native reed canarygrass. In less disturbed forested settings, emergent species were dominated by native species such as skunk cabbage \((Lysichiton americanus)\), lady fern \((Athyrium filix-femina)\), and stinging nettle \((Urtica dioica)\). The emergent wetlands were generally located within the lacustrine fringe areas, riverine wetlands, and depressional wetland areas.

**Palustrine Scrub-Shrub.** Palustrine scrub-shrub wetlands in the reservoir study area are generally located within the riverine wetlands along the drainages. There is a large area of scrub-shrub wetland where Scoggins Creek enters the reservoir. In this shallow water area, a wetland complex dominated by willows \((Salix spp.)\) has developed and is partly inundated when the reservoir is at full pool elevation. Scrub-shrub wetlands were also identified along natural shallow drainage swales and in some wetlands.
formed where existing roadcuts intersect the ground water table. Willow and Nootka rose (Rosa nutkana) were typically found in these settings.

**Palustrine Forested.** Palustrine forested areas were generally located along drainages and depressional areas, and are dominated mainly by red alder, with an understory of salmonberry (Rubus spectabilis), twinberry, and herbaceous species such as piggyback plant (Tolmeia menziesii), water-parsley (Oenanthe sarmentosa), and creeping buttercup (Ranunculus repens).

**Lacustrine Littoral Emergent.** The lacustrine littoral community was found along the margins of Henry Hagg Lake from the ordinary high pool elevation extending downward roughly six feet deep. The lacustrine littoral emergent community is dominated by reed canarygrass.

**Open Water**
Open water habitat is provided by the reservoir. Depending on season and stage of drawdown, the majority of open water consists of deep water habitats with limited interface with wetlands or shoreline vegetation, except in the larger reservoir arms where shallower slopes support a wider area of fringe wetlands (especially along Scoggins Creek as it flows into the lake). The area of open water habitat ranges from approximately 449 acres at low pool to approximately 1,117 acres at full pool. Full pool elevation only occurs from mid-March to mid-June during a normal water year. Info on wildlife use of the various habitats is provided by species and species group below. It is important to note that waterbirds, such as ducks and geese, are the most prevalent wildlife groups which utilize the open water habitats of the reservoir.

**Developed Areas**
Developed areas within the project area include urban and rural residential areas, industrial areas (e.g., Stimson lumber mill), other urban areas (along the Willamette Pipeline alignment), transportation rights-of-way, and developed recreation areas (such as those around the reservoir). These areas are included in this discussion because they represent a dominant land use within the project area, and they do provide some (often limited) wildlife habitat for species that have adapted to humans and their environments. The urbanized areas within the project area are likely to provide habitat for species that are tolerant of human disturbance. Common wildlife species in these areas include many non-natives; however, many native species also thrive in urban areas (such as coyote, raccoon, bats, reptiles, amphibians, crows and many other birds).

### 4.8.1.1.5 ODFW Habitat Categories

The purpose of ODFW’s fish and wildlife habitat mitigation goals and standards is to further the Wildlife Policy (ORS 496.012) and the Food Fish Management Policy (ORS 506.109) of the State of Oregon through the application of consistent goals and standards to mitigate impacts to fish and wildlife habitat caused by land and water development actions. The policy provides goals and standards for general application to individual development actions, and for the development of more detailed policies for specific classes of development actions or habitat types.

ODFW defines six habitat categories and establishes mitigation goals and implementation standards for each category. As part of the TBWSP compliance with ODFW’s Habitat Mitigation Policy, these will be
mapped and described for all project elements, and mitigation for each habitat category will be completed in accordance with ODFW policy within the TBWSP Mitigation Framework. All habitats with the potential to be impacted by the project will be reviewed using existing habitat maps, aerial photos, experience from extensive site visits, and literature pertaining to similar habitats within the Willamette Valley and Coast Range foothills. The results of the ODFW habitat mapping for the lake and the RWP are summarized in Table 4.8-3.

Table 4.8-3. As illustrated in Figure 4.8-1 and Figure 4.8-2, the following permanent impacts can be anticipated from the implementation of the TBWSP Preferred Alternative:

<table>
<thead>
<tr>
<th>Category 1</th>
<th>Category 2</th>
<th>Category 3</th>
<th>Category 4</th>
<th>Category 5</th>
<th>Category 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hagg Lake</td>
<td>None known at this time</td>
<td>Xx acres</td>
<td>30.5 acres</td>
<td>534.6 acres</td>
<td>1.3 acres</td>
</tr>
<tr>
<td>RWP</td>
<td>None known at this time</td>
<td>None known at this time</td>
<td>None known at this time</td>
<td>25% of 6-foot wide corridor of x linear feet = x acres</td>
<td>50% of x linear feet = x acres</td>
</tr>
</tbody>
</table>

4.8.1.1.6 Weeds and Weed Management

The following description of noxious weeds within the project area was adapted from the Henry Hagg Lake Resource Management Plan (Reclamation 2004a).

For the purpose of this study, noxious weeds include plant species on the Oregon Department of Agriculture (ODA) Oregon Noxious Weed List. The Oregon State Weed Board, a division of ODA, defines a noxious weed as “…exotic, non-indigenous, species that are injurious to public health, agriculture, recreation, wildlife, or any public or private property” (ODA 2005).

Noxious weeds are found throughout the project area, particularly in disturbed areas. They tend to be aggressive colonizers and typically are found in fields, waysides, and similarly disturbed habitats. Prominent invasive species include Himalayan blackberry, reed canarygrass, Scotch broom, purple loosestrife (*Lythrum salicaria*) and thistle (*Cirsium* spp.). Himalayan blackberry is often the dominant vegetation found in riparian zones. Reed canarygrass is also dominant in riparian areas, and is particularly pervasive in wetlands within the project area. Purple loosestrife is also found in wetlands within the Lower Tualatin watershed. Scotch broom is common within disturbed areas, while English ivy (*Hedera helix*) and Japanese knotweed (*Polygonum cuspidatum*) are mostly concentrated within the more urbanized portions of the Lower Tualatin watershed (Hawksworth 2001). Within agricultural areas, tansy ragwort (*Senecio jacobaea*) and spotted knotweed (*Polygonum persicaria*) are a concern since they can be toxic to livestock (Hawksworth 2001).

Infestations of noxious weeds have established themselves in Scoggins Valley Park in areas of previous disturbance. Major infestations of noxious weeds in the park are primarily limited to Himalayan blackberry and Scotch broom. These species are found in grassland habitats around the reservoir. Himalayan blackberry, in particular, is common and dense in many portions of the trail surrounding the reservoir. Both species are ODA “B” designated weeds; this indicates “a weed of known economic
importance which is reasonably abundant, but which may have limited distribution in some counties” (ODA 2005). In 2006, Reclamation completed a comprehensive Integrated Pest Management Plan for the areas around the reservoir. The plan will provide direction for weed control in Scoggins Valley Park. The managing partner actively manages noxious weeds in the park through a program of seasonal mowing of the elk mitigation meadows, and herbicide spraying along trails, parking areas, and picnic areas.

4.8.1.2 Non-Listed Wildlife
The project area can generally be characterized as Westside (west of the Cascades), lowland, conifer/hardwood forest overlaid by a patchwork of agricultural and urban/mixed development (Johnson and O’Neil 2001). This type of vegetation provides habitat to a wide variety of wildlife species that are found throughout the northwest and have adapted to the moderate to high level of human activity present in the region. The following section addresses the non-listed wildlife species that inhabit the variety of habitats present in the project area.

Information regarding the non-listed wildlife and their habitats within the reservoir study area is adapted from the Henry Hagg Lake Biological Resources Report (URS 2003) and Henry Hagg Lake Resource Management Plan (Reclamation 2004a). Information regarding the non-listed wildlife and their habitats along the RWP corridor is adapted from the JWC Raw Water Pipeline Corridor Preliminary Environmental Screening Assessment (CH2M Hill 2003). Descriptions of site visits to the project area, including the Willamette Pipeline corridor, are included in this discussion.

The following section describes the non-listed mammals, reptiles and amphibians, and birds that use the habitats within the project area. Oregon Conservation Strategy (OCS) species are addressed within the wildlife sections below, and are labeled as such.

4.8.1.2.1 Mammals
The diversity of vegetation communities within the study area provides habitat for a variety of native and non-native mammals, especially those that can tolerate a wide range of habitat conditions and levels of human disturbance. Although not an exhaustive list, common mammal species found in the vicinity of Henry Hagg Lake are provided in Table 4.8-4. In addition, numerous rodent species are present, including squirrels, voles, and mice, as well as various bat species. Non-native rodents are primarily found in agricultural, recreational, and rural residential areas, and include black rat (Rattus rattus) and house mouse (Mus musculus).

Table 4.8-4. Common mammal species occurring in the vicinity of Henry Hagg Lake.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black-taileddeer</td>
<td>Odocoileus hemionus columbiaus</td>
<td>Managed game species / Abundant</td>
</tr>
<tr>
<td>Roosevelt elk</td>
<td>Cervus elaphus roosevelti</td>
<td>Managed game species / Locally somewhat common</td>
</tr>
<tr>
<td>Cougar</td>
<td>Puma concolor</td>
<td>Locally somewhat common</td>
</tr>
<tr>
<td>Bobcat</td>
<td>Lynx rufus</td>
<td>Widespread and abundant</td>
</tr>
<tr>
<td>Coyote</td>
<td>Canis latrans</td>
<td>Widespread and abundant</td>
</tr>
</tbody>
</table>

4.8-13
**Fur-bearers**

“Fur-bearers” are species that are hunted for their fur. In the project vicinity, these species include black bear, cougar, bobcat, gray fox, river otter, mink, beaver and western gray squirrel. Western gray squirrel will be addressed separately because it is an OCS species. According to the Reservoir Superintendent, who has worked at the reservoir since 1982, furbearers are present as follows (Otto, pers. comm. 2010):

- **Black bear** are known to be present within the park, but only occasionally. Black bears or signs of their presence are detected several times annually; however, park staff rarely has trouble with bear stealing garbage or encountering humans, indicating a low overall presence and tendency to shy away from people (Otto, pers. comm. 2010). They may occasionally move into the park or the RWP from adjacent timber lands, but likely find sufficient habitat in the foothills above Henry Hagg Lake. Presence of human disturbance is likely the most limiting factor, since black bear continue to thrive in the forested parts of Oregon and coastal mountains, which contain some of the highest black bear population densities in Oregon (ODFW 1993).

- **Around the reservoir, cougars are less common than black bear, with approximately one spotting per year. Cougar are fairly common in the coast range, having increased following management from an estimated 214 in 1961 to 3,114 in 1994. The 2003 statewide cougar population was estimated to be 5,101 (ODFW 2003).**

- **Bobcat** are present and fairly common, especially during winter months.

- **Gray fox** are present in the forest above the reservoir, but are rarely, if ever, seen in the project area, most likely due to the presence of coyotes.

- **River otter**, while not common above the dam, are occasionally seen in Scoggins Creek and in the abandoned Scoggins Creek channel immediately below the dam. Their presence above the dam is also likely limited by human disturbance in the lake, and by lack of sufficient prey or size of rivers above the lake.
• Mink are not known to occur within the project area, although various terrestrial weasels (short-tailed and long-tailed) are common (Otto, pers. comm. 2010).

• Beaver are occasionally seen on tributaries above the dam, especially Tanner Creek, where maintenance personnel regularly remove dams built close to the perimeter road. Tanner Creek has the widest floodplain in the park, which may explain their consistent presence in the area. Another group was noted by DEA during wetland delineation site visits southeast of the lake in a small pond adjacent to a forest road. They are present below the dam as well, though they may be controlled by landowners to some degree. Beaver presence was noted adjacent to the Tualatin near the Spring Hill treatment plant.

Furbearer presence along the RWP is similar in extent to that described for the reservoir, although they would be expected to be present in much lower numbers due to greater human disturbance.

Roosevelt Elk
Roosevelt elk are an important big-game species in the region. The following description of elk and their habitat within the reservoir study area was adapted from the Henry Hagg Lake Resource Management Plan (Reclamation 2004a) while the description of elk habitat along the RWP pipeline corridor was adapted from the JWC Raw Water Pipeline Corridor Preliminary Environmental Screening Assessment (CH2M Hill 2003). Additional information was provided by ODFW (Vandebergh, pers. comm., 2009).

Habitat needs for Roosevelt elk (elk) are determined by quality, quantity, and arrangement of basic elements such as food, water, shelter, and space. In spring and summer, elk seek nutritious forage and escape from heat and insects. In late summer and fall, rangelands tend to dry out, and elk often move to private irrigated croplands. In winter, elk seek thermal cover and refuge in order to protect themselves from weather and human disturbance. This refuge is particularly important for the elk to conserve energy during the winter months. Elk utilize both wetlands and riparian areas for forage and thermal regulation occurs throughout the year, but use increases during high ambient temperature periods in the summer and fall. Elk also utilize agricultural areas. Utilization of agricultural areas is dependent upon many factors including; the types of crops grown, and location of crops in relationship to available cover, and can occur throughout the year, not only during the summer and fall months.

Daily, seasonal and annual elk movements are influenced by terrain and habitat manipulation and loss by humans and natural causes, and female (cow) and male (bull) movement patterns vary considerably according to these changes. In general, elk move to lower elevations during the winter periods to find forage and avoid adverse weather conditions. Movement locations can change due to habitat manipulation. Even though Roosevelt elk in the coast range do not exhibit a definitive migratory characteristic, they do readily move around the landscape. Flooding of the Scoggins Valley has impacted their historic ability to move across the valley floor to adjacent habitats. Since the construction of the dam, elk movements have been changing due to recreational, agricultural, and residential pressures (Vandebergh 2005).

Historically elk were abundant throughout Oregon, but were nearly extirpated from Oregon by the late 1890s due to un-regulated and/or market hunting (ODFW 2003). A rough estimate of 300 elk, in
approximately 10 to 12 herds, currently utilize the entire Scoggins Creek basin, and approximately 50 to 80 Roosevelt elk are known to use the Scoggins Valley Park area on a year-round basis.

As mitigation for the loss of elk-grazing (wintering) habitat that resulted from construction of Scoggins Dam, nine grassland areas, totaling approximately 140 acres, were set aside in 1974 to be managed as elk grazing meadows. These areas were all located within Scoggins Valley Park. While there is no record of a final written agreement between ODFW and Reclamation, historic meeting notes indicate the intended management of these parcels was regular fertilizing and mowing to maintain healthy grass forage for wintering elk. The existing elk mitigation meadows were initially seeded with a grass-legume mixture specifically designed to encourage elk foraging. Management of the elk mitigation meadows is currently limited to yearly mowing, and non-native invasive plant species have established in limited areas in the meadows.

Over the years, there were changes to the management and location of some of the elk meadows. Some areas that were originally designated as elk meadows were not implemented, either because of unstable soils in designated meadows or development that took place in proposed meadows prior to implementation (Vandeburgh 2005). Two areas that were not originally designated as elk meadows (Areas 3 and 4a on Figure 4.8-2) are currently managed for elk forage. Areas 3 and 4 are managed by Tualatin Valley Irrigation District (TVID) through a lease agreement with a local farmer. Currently there are eight parcels, totaling approximately 110 acres, within Scoggins Valley Park designated as elk meadows and maintained by Washington County. Figure 4.8-1 illustrates the parcels currently managed as elk meadows (1, 2a, 2b, 2c, 3, 4, 5a, and 5b). An additional 29.2 acres have been designated by Reclamation as elk habitat (Areas 6a and 6b) but have not yet been implemented, i.e. they are not currently managed for elk habitat. Therefore, at present, the total area designated for elk habitat is approximately 139.2 acres.

Reclamation worked with ODFW and FWS through the Resource Management Plan process to develop an appropriate management plan for the elk meadows that satisfies the goals that were originally established between Reclamation and FWS. The collaboration resulted in the Elk Mitigation Meadows and Monitoring Plan (Reclamation 2003b), which includes provisions for monitoring elk use of the meadows. If elk do not use the rehabilitated meadows, additional implementation strategies will be determined by Reclamation in coordination with FWS and ODFW at the end of the 10-year Resource Management Plan planning period (Reclamation 2003b).

Along the RWP corridor, two elk meadows (#3 and #4) between Scoggins Dam and the Stimson mill are managed to produce grass hay for winter elk forage. Elk use below the dam (called the Mill Site) is currently very heavy, with large trails leading upslope to the west and heavy elk sign throughout the existing site. During 2006 site visits to the RWP corridor elk sign was visible within several of the agricultural fields downstream of the Stimson mill, especially near the ponds and tree farms. It is likely that elk use these grass fields and associated riparian areas for forage and cover, and move to and from these areas from the adjacent hills, which are covered by conifer forest and recent clearcuts. Elk utilize the agricultural fields between the dam and the junction of Old Highway 47, and are also known to use the flats along the pipeline corridor in moving toward the Chehalem Valley to the east (Vandeburgh 4.8-16).
In general, ODFW would like to move the elk away from agricultural fields, the dam area, and other areas of human development and disturbance in order to reduce conflicts with landowners.

Data on elk use of the meadows has also been provided by Pacific University (Alkaslassy and Lopez 2007). Pacific University conducted field surveys of the existing elk habitat mitigation meadows during 2 winter seasons (2006-07 and 2007-08). The Pacific University data show that only two of the mitigation meadows, Meadow 5 and proposed Meadow 6, which are the largest of the mitigation meadows, showed significant use. The Pacific University study found little evidence that elk are using Meadows 1 and 2. Pacific University also compiled visual estimates of elk numbers in the lower field below the Stimson mill pond, indicating consistent and intensive use of the meadows between Scoggins Creek and Scoggins Valley Road (Meadows 3 and 4).

The proposed Willamette Pipeline corridor is a mosaic of dense rural and residential, light industrial, agricultural and scattered woodlot areas with a moderate to high-level of human disturbance. Because of the fragmented nature of the vegetation within the vicinity of the proposed Willamette Pipeline corridor, and its distance from suitable elk habitat, it is highly unlikely that elk use this area.

**Western Gray Squirrel**

Although their current population size or density within the project area is unknown, the western gray squirrel is present around Henry Hagg Lake (Otto, pers. comm. 2010). Western gray squirrels are closely associated with Oregon white oak conifer communities in mixed forest, prairie, and wetland areas (Ryan and Carey 1995), all of which are present within the park. Oak forest occupies approximately 136 acres within the park. Western gray squirrel is an OCS strategy species (ODFW 2006).

According the Ryan and Carey (1995), limiting factors for presence of western gray squirrel within its historic range includes degree of habitat availability and composition. In general, gray squirrels are only able to survive in mature oak stands (oaks >5 inches in diameter) greater than 5 acres in size and less than 1,300 feet yards from water. Isolated small islands of oak (<5 acres) do not appear to adequately support western gray squirrels. Additionally, car traffic can be a serious threat to gray squirrels (Ryan and Carey 1995). All of these factors combined provide further impetus for conserving larger tracts of habitat in order to reduce the need for wildlife crossing the perimeter road to access habitat and fulfill life history needs.

Oak forest occupies 136 acres within the park, and approximately 42 acres of this habitat would be impacted by the project. Since oak forest restoration is planned for mitigation, conditions for gray squirrel may be improved within the park compared to existing condition.

**Bats**

Numerous species of bats are present within the study area, especially within the forested areas adjacent to the reservoir. These bat species include common species such as the little brown myotis, *Myotis lucifugus*, the big brown bat (*Myotis lucifugus*), as well as several sensitive bat species such as silver-haired bat (*Lasionycteris noctivagans*, OCS species). Sensitive species are addressed in a separate section below. Forested areas, as well as riparian and remnant forest patches along the RWP can provide suitable roosting, and in some cases, nesting habitat for bats. Foraging habitat occurs
throughout the study area, since the entire study area lies within ¼ mile of water and likely supports healthy insect populations.

### 4.8.1.2.2 Birds

The diversity of habitats within the project area provide habitat to an equally diverse suite of bird species ranging from passerines (perching birds) to waterfowl to raptors. A list of common bird species is provided in Table 4.8-7. Although this list is not exhaustive, it provides an indication of common resident and migratory species present in the project area, followed by a discussion of habitat use by various species.

Table 4.8-5. Common bird species occurring in the vicinity of Henry Hagg Lake.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pied-billed grebe</td>
<td>Podilymbus podiceps</td>
<td>Winter and migrant visitor.</td>
</tr>
<tr>
<td>Great blue heron</td>
<td>Ardea herodias</td>
<td>Nests near Henry Hagg Lake.</td>
</tr>
<tr>
<td>Mallard</td>
<td>Anas platyrhynchos</td>
<td>Winters in large numbers on reservoir.</td>
</tr>
<tr>
<td>Green-winged teal</td>
<td>Anas crecca</td>
<td>Winters in large numbers on reservoir.</td>
</tr>
<tr>
<td>American wigeon</td>
<td>Anas americana</td>
<td>Winters in large numbers on reservoir.</td>
</tr>
<tr>
<td>Northern pintail</td>
<td>Anas acuta</td>
<td>Winters in large numbers on reservoir.</td>
</tr>
<tr>
<td>Ring-necked duck</td>
<td>Aythya collaris</td>
<td>Winters in large numbers on reservoir.</td>
</tr>
<tr>
<td>American coot</td>
<td>Fulica Americana</td>
<td>Nests on Henry Hagg Lake.</td>
</tr>
<tr>
<td>Mourning dove</td>
<td>Zenaida macroura</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Red-tailed hawk</td>
<td>Buteo jamaicensis</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Great horned owl</td>
<td>Bubo virginianus</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Rufous hummingbird</td>
<td>Selaphorus rufus</td>
<td>Breeding resident.</td>
</tr>
<tr>
<td>Northern flicker</td>
<td>Colaptes auratus</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Hairy woodpecker</td>
<td>Picoides villosus</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Steller’s jay</td>
<td>Cyanocitta stelleri</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>American crow</td>
<td>Corvus brachyrhynchos</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Tree swallow</td>
<td>Tachycineta bicolor</td>
<td>Breeding resident.</td>
</tr>
<tr>
<td>Cliff swallow</td>
<td>Petrochelidon pyrrhnotata</td>
<td>Breeding resident.</td>
</tr>
<tr>
<td>Black-capped chickadee</td>
<td>Poecile atricapillus</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Bushtit</td>
<td>Psaltriparus minimus</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Red-breasted nuthatch</td>
<td>Sitta Canadensis</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Winter wren</td>
<td>Troglodytes troglodytes</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Golden-crowned kinglet</td>
<td>Regulus satrapa</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Swainson’s thrush</td>
<td>Catharus ustulatus</td>
<td>Breeding resident.</td>
</tr>
<tr>
<td>American robin</td>
<td>Turdus migratorius</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>European starling</td>
<td>Sturnus vulgaris</td>
<td>Introduced / pest species.</td>
</tr>
<tr>
<td>Golden-crowned kinglet</td>
<td>Regulus satrapa</td>
<td>Year-round resident.</td>
</tr>
<tr>
<td>Orange-crowned warbler</td>
<td>Vermivora celata</td>
<td>Breeding resident.</td>
</tr>
<tr>
<td>Yellow-rumped warbler</td>
<td>Dendroica coronata</td>
<td>Breeding resident.</td>
</tr>
</tbody>
</table>

4.8-18
Western tanager  
Spotted towhee  
Song sparrow  
White-crowned sparrow  
Dark-eyed junco  
Black-headed grosbeak  
Red-winged blackbird  
Brewer’s blackbird  
House finch  
American goldfinch  

*Source: Prepared by EDAW 2002.*

Passerines (perching birds) are the most abundant birds in the project area because of the dominance of forested, grassland and urban habitats. Non-native species, such as the rock pigeon, European starling, and house sparrow are most abundant in the rural residential and agricultural areas. As shown in the table, common, native passerine species include the American robin, black-capped chickadee, dark-eyed junco, song sparrow, American crow, western scrub jay, rufous hummingbird, and others. These species utilize a mixture of forest and open land, as well as more developed and disturbed sites around recreation areas and homes, as well much of the RWP.

Less common species that are known to occur within the project area include solitary and warbling vireos, western tanager, numerous warblers (orange-crowned, hermit, black-throated gray and yellow-rumped), white-breasted and red-breasted nuthatch and mountain quail, Swainson’s thrush, band-tailed pigeon, chestnut-backed chickadees, black-headed grosbeaks, nesting wood ducks and occasionally ruffed grouse. These species have more specific habitat requirements and are generally more sensitive to human disturbance and habitat fragmentation. Most require conifer or mixed forest with well-developed structure for foraging, roosting, and breeding. Clearcuts, shrubby areas, and very young forest provide habitat for resident spotted towhees, California quail, Bewick’s wren and northern flicker. Winter wrens, hairy woodpeckers, brown creeper, golden-crowned kinglet and pileated woodpeckers are residents in more mature forests (The Bird Guide, 2010).

In summer, Wilson’s warbler, evening grosbeak, brown-headed cowbird, warbling vireo, cedar waxwing, MacGillivray’s warbler, and lazuli bunting may be present. These species, as well as species that use open grassy areas are present along much of the RWP.

Meadows and other open, grassy areas and areas near and above water provide habitat for various swallows (northern rough-winged, tree, barn and violet-green) as well as Vaux’s swifts, bushtits, and Bewick’s wrens, American goldfinches, white-crowned sparrows, and dark-eyed juncos, among others. Winter sparrow flocks contain fox sparrows and, rarely, white-throated sparrows. Willow flycatchers and yellow-breasted chats are uncommon, but are sometimes present in summer on brushy hillside areas and water. Other less-common migrant and wintering birds include varied thrushes, fox sparrows, red-breasted sapsuckers, hermit thrushes, Hutton’s vireos, and Townsend’s warblers (The Bird Guide 2010).
Common wetland and waterway species include red-winged blackbirds, sparrows, Wilson’s warblers and common yellowthroats. American Dippers are present in some of the larger tributaries.

Habitat for waterfowl and wading birds can be found in the open waters of the reservoir, as well as the seasonal wetland and riparian areas around Henry Hagg Lake and the RWP, and in the agricultural fields along the RWP. Dabbling (or surface-feeding) species can be found along the edges of the reservoir or in shallower riparian areas, wetlands or agricultural fields with standing water. Dabbling species in the project area include the following: Canada goose, mallard, American wigeon, and teal, among others.

The deep, open water of the reservoir provides primarily winter habitat for diving ducks, such as common merganser, bufflehead, Barrow’s goldeneye, horned grebes, double-crested cormorants, and common loons. Gulls of various species, especially California gulls, are regular migrants and winter visitors. Rare spring and fall migrants include caspian terns and Bonaparte’s gulls. Other wintering birds include Ring-necked ducks, lesser scaups, and common mergansers. More unusual birds include greater scaups, Pacific and red-throated loons, and red-necked grebes.

Waterbird use at the reservoir is typical of other large reservoirs with fringe wetland habitat that is typically inundated for only a brief portion of the year. Fringe wetland habitat present is temporally limited due to drawdown regimes which occur from mid-March to mid-June under normal conditions. This limits the value of the fringe wetland habitat for breeding birds and decreases hiding and resting habitat for overwintering birds. Waterfowl presence is concentrated mainly in the northern half of the reservoir due to a floating barrier that splits the reservoir in two; the northern half is a “no wake” zone. Breeding and wintering habitat for waterfowl is limited at the reservoir by lack of edge habitat and year-round herbaceous forage. Wintering habitat may be greatest within the less-disturbed arms of the reservoir in the northern half.

Rare water birds such as loons, Clark’s grebes, scoters, and western grebes are sometimes present in winter. In the distant shores across the lake, spotted sandpipers are often present. The brushy line of trees along the back side of the parking lot contains many common large wading birds such as great blue heron, green herons, and great egret. These wading bird species are also found along undisturbed margins of the lake, open wetlands with standing water, and ponded areas in agricultural fields near forested riparian zones, such as those found along the RWP.

Smaller wading birds such as spotted sandpipers, long-billed dowitcher, and greater yellowlegs are fairly common migrants, and may be present in winter. They may use the drawdown zone when recreational and human disturbance do not interfere (Washington County 2010).

Common, non-listed, raptors in the project area include red-tailed hawk, American kestrel and osprey. Red-tailed hawk and American kestrel hunt over open areas and nest primarily in forest conditions. The Kestrel nests in natural holes in trees, abandoned woodpecker holes, holes in buildings or cliffs, and readily use nest-boxes (Natureserve, 2010).

Accipiters (forest-hunting birds), including sharp-shinned and Cooper’s hawk are present in older forests with a fairly open understory, and may be resident in some cases. Turkey vultures are present
throughout summer. Goshawk habitat is not present in the park, although individuals may visit Henry Hagg Lake from adjacent forest lands. Various owls such great-horned, western screech-owls, and barred owls are present in many areas around the lake (one barred owl was noted by DEA field staff along the northern end of the lake in 2010). Northern saw-whet, long-eared, and northern pygmy-owls are less common, but are present in some forest areas in the project vicinity.

4.8.1.2.3 Migratory Bird Treaty Act
All birds that are present or have the potential to be present in the project area are protected by the Migratory Bird Treaty Act (MBTA), except for pigeon, starling, and house sparrow. Numerous neotropical migratory songbird species utilize the habitat within the project area. The majority of the species identified by Adamus et al. (2001) that are most strongly associated with the vegetation types found within the project area nest between the dates of March 1 to September 1 (Black, pers. comm. 2010).

4.8.1.2.4 Amphibians and Reptiles
Much of the area around Henry Hagg Lake provides suitable habitat for a wide variety of amphibians and reptiles. The habitat preferences during breeding and non-breeding seasons for amphibians and reptiles common in the vicinity of Henry Hagg Lake are described in Table 4.8-5.

Table 4.8-6. Common amphibian and reptile species occurring in the vicinity of Henry Hagg Lake.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibians</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northwestern salamander</td>
<td>Ambystoma gracile</td>
<td>Common and widespread in open grassland, woodland, and forest near breeding ponds. Breed in ponds, lakes, and slow-moving streams.</td>
</tr>
<tr>
<td>Long-toed salamander</td>
<td>Ambystoma macrodactylum</td>
<td>Common and widespread in dry woodlands, humid forests, and mountain lakes. Breeds in temporary or permanent ponds, or in quiet water at the edge of lakes and streams</td>
</tr>
<tr>
<td>Cope's giant salamander</td>
<td>Dicamptodon copei</td>
<td>Streams and rivers in moist coniferous forests (water temperatures usually range from 8 to 14° C)</td>
</tr>
<tr>
<td>Western toad</td>
<td>Bufo boreas</td>
<td>Utilize a wide variety of habitats, and migrates between various uplands habitats around ponds, lakes, reservoirs, and slow-moving rivers and streams.</td>
</tr>
<tr>
<td>Ensatina</td>
<td>Ensatina eschscholtzii</td>
<td>Common. Douglas-fir/maple forests, forest clearings. Eggs are laid underground, or under the bark of or within rotting logs.</td>
</tr>
<tr>
<td>Rough-skinned newt</td>
<td>Taricha granulosa</td>
<td>Forests, woodlands, grasslands, open valleys, and ranchland. Found on land (in open or under rocks, logs, etc.) or in ponds, lakes, reservoirs, and slow-moving streams.</td>
</tr>
<tr>
<td>Western red-backed salamander</td>
<td>Plethodon vehiculum</td>
<td>Widespread and abundant. Humid coniferous forests; damp talus slopes and shaded ravines.</td>
</tr>
<tr>
<td>Pacific tree frog</td>
<td>Pseudacris regilla</td>
<td>Widespread and abundant in a wide variety of habitats:</td>
</tr>
</tbody>
</table>
Adapted from HHL RMP (BOR, 2004) Other Sources: Csuti et al. 1997, Natureserve, ODFW.

All of these common reptile and amphibian species (none are OCS species) would be present along the RWP, with the possible exception of long-toed and ensatina salamanders. These salamanders are not likely to be along the RWP because they are more common in forested areas with a robust downed wood component, habitats that are not found along the RWP. Pacific tree frogs are common in most riparian areas around Henry Hagg Lake and have been detected in large numbers during the Metro Lovejoy wetlands annual surveys (from 2006 to present). The Northwestern salamander is present in the Lovejoy wetlands but in much lower numbers (Weil, pers. comm. 2010).

Less common (but non-listed) amphibian and reptile species that may be found in the project area include Cope’s giant salamander, Northern alligator lizard, and western painted turtle (an OCS species). The western toad may be present within the project area, but is not known to occur, and has been extirpated from many areas in Oregon (Leonard et al. 1993). Therefore, its presence is fairly unlikely. Currently, it is unknown whether any of these species is present within the project area and none have been documented. In general, the presence of pets and heavy human recreation in some portions of the park may have decreased habitat suitability for some herpetiles.

### 4.8.2 Environmental Impacts

#### 4.8.2.1 Alternative 1 – No Action

The annual drawdown at Scoggins Dam would be more severe than existing conditions (minimum pool elevation would be reached more often). Clean Water Services would not be able to enhance stream flow in the Tualatin River to protect water quality. Reclamation would make needed safety modifications to Scoggins Dam. The high water level at Henry Hagg Lake (when reservoir is full) would be the same as at present (normal full pool elevation of 303.5 feet). However, the additional water demands (water providers demanding full Henry Hagg Lake contract amounts each year) would mean that the reservoir would be drawn down to lower elevations than under current conditions. Even with
increased drawdown, Henry Hagg Lake would still fill on a regular basis. Reservoir water levels would reach within 5 feet or less of the normal full pool approximately 85 percent of the time during a normal year. A more complete discussion of the No Action Alternative is found in section 3.2.

4.8.2.1.1 Potential Impacts (direct, indirect)

Vegetation
The extent and duration of reservoir drawdown would increase the total area and duration of mudflats exposed, particularly during late summer and fall. While the 668 acres of mudflats present at low pool would not change, low-pool conditions would be more frequent and for longer periods of time. Exposing these mudflat areas for longer periods of time increases the opportunity for non-native, weedy plant species to colonize. In addition, the perimeter vegetation could be impacted by the potential decrease in water elevations and make hydrophytic species and/or communities more vulnerable to invasive species.

Non-Listed Wildlife
More frequent and longer drawdowns of the reservoir could lead to heating of reservoir water (Reclamation 2004b), which, when released, could actually increase water temperatures in Scoggins Creek and the Tualatin River. Existing temperature, dissolved oxygen, ammonia, and chlorophyll concerns in Henry Hagg Lake are as follows:

- Outflows occasionally exceed downstream water temperature standards;
- Water with low dissolved oxygen concentrations is released in the fall;
- Ammonia concentrations increase in the hypolimnion in the fall;
- Moderate algal blooms (approximately 20 µg/L chlorophyll a), including a blue-green algal bloom in August, typically occur every year in Hagg Lake (Sullivan and Rounds 2005; CH2M Hill 2006).

It is assumed that these existing water quality conditions would continue, potentially impacting wildlife which use Henry Hagg Lake, such as fish, birds, amphibians, reptiles, and some mammals.

Existing amphibian habitats within the reservoir and its fringe habitats could be affected, as well as downstream amphibian habitat in Scoggins Creek and the Tualatin River. Species more sensitive to thermal changes, such as salamanders, would have the highest potential risk. Populations of non-native species, such as the bullfrog, would not be affected because they are much more adaptable to habitat modifications; they may even do better in compromised conditions. Earlier and longer reservoir drawdowns would also reduce the amount of open water habitat available during the late summer and fall.

While there is no planned recreational facility development under the no build alternative, recreational use in the project area would increase due to increased population growth in surrounding areas. As such, noise levels would increase, potentially disturbing wildlife. The estimated increase would be by 2 A-weighted decibels (dBA; decibels [dB] adjusted to account for the frequency of human hearing) for weekdays and weekends by the year 2010 (Reclamation 2004b). Increased noise levels may disturb the non-listed wildlife that use the habitats in the vicinity of Scoggins Valley Park; however, noise levels...
would increase gradually over time, therefore, it’s anticipated that wildlife would be able to adjust to these changes. In summary, increased recreation in the area under the No-Action alternative could negatively affect native wildlife, and could increase use by species more tolerant of human disturbance.

**Elk**

In spring and summer, elk seek nutritious forage and escape from heat and insects. In late summer and fall, rangelands tend to dry out, and elk often move to private irrigated croplands or other areas of nutritional forage. In winter, elk seek thermal and hiding cover in order to protect themselves from weather and human disturbance (ODFW 2003). Washington County manages the recreational facilities around the reservoir. County figures indicate that highest recreational use is from June through August, with little use of the park in winter (Blake 2005). Impacts from wildlife viewing and dog walking take place along the perimeter road and trails, especially in areas with views to the reservoir. Mountain biking is generally limited to the established trails; however biking is difficult to regulate and could cause disturbance to elk meadows in winter. Elk may not use wetlands and riparian areas in the park to the degree possible due to the prevalence of human disturbance in these areas. This may cause elk to move towards private lands, where disturbance may be less prevalent. Therefore, impacts from the No-Action alternative may include ongoing damage to private lands from elk use.

Recreational activities in winter include limited wildlife viewing, cycling, and dog walking. Therefore, impacts from the No-Action alternative would increase little from existing conditions.

**Cumulative Impacts**

Should water shortages result in development restrictions in Washington County, these restrictions could decrease existing development pressures on the unprotected natural areas in the region. However, easing development pressures would not inherently lead to protection, and may only result in fewer natural areas being converted through development. In addition, some development would still occur, converting natural areas to agricultural or more urban uses and fragmenting remaining habitat. Existing water rights throughout the region likely would be maximized under the No Action Alternative. In addition, increased construction and development in the region could contribute to the spread of invasive species.

### 4.8.2.2 Alternative 2 – Scoggins Dam 40-foot Raise

#### 4.8.2.2.1 Potential Reservoir-related Impacts (direct, indirect): Vegetation Operations and Maintenance Impacts (Long Term)

An expanded Henry Hagg Lake could not be filled every year with only the natural inflow from the upstream drainage area. Therefore, in the winter (December through April), the RWP would operate in the reverse direction and would pump available winter water from the Tualatin River into the reservoir to supplement the natural inflows and fill the reservoir. In years when such pump-back is needed (expected to be in dry and normal years), an average of about 30,000 acre-feet and up to a maximum of 53,000 acre-feet of river water would be withdrawn during winter and early spring flows at the Spring Hill Pumping Plant and pumped through the RWP to Henry Hagg Lake.
Additional land (about 167 acres) would be acquired and incorporated into Scoggins Valley Park, as described in Section 4.13.3. With the land acquisition, the amount of park land not inundated (above the reservoir surface) at normal full pool would decline by 203 acres – from 1,404 acres to 1,201 acres. Under Alternative 2, the area of mudflats exposed at low pool would increase from 668 acres to approximately 1,038 acres.

Operational (permanent) impacts from alternative 2 were based on an inundation line from the 40-foot dam raise and a 100-foot corridor centered on the proposed new roadway alignments around the lake. Construction (temporary) impacts are based on an additional 50 feet to either side of the proposed 100-foot permanent roadway disturbance corridor. Figure 4.8-1 shows the habitat types within the reservoir area.

Alternative 2 will result in the disturbance/removal of approximately 511 acres of vegetation around the lake, approximately 61 acres of which will be temporarily disturbed on either side of the proposed new roadways, as shown in Table 4.8-8. Temporary impacts are addressed by species in the following sections, including temporary impacts to elk meadows immediately below the dam, where construction staging would take place. These meadows would be replaced in more favorable areas prior to and during construction in order to minimize impacts, as described in the elk section.

Table 4.8-7. Vegetation Impacts at Henry Hagg Lake from Alternative 2, in Acres

<table>
<thead>
<tr>
<th>Vegetation Type</th>
<th>Permanent</th>
<th>Temporary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conifer Forest</td>
<td>143</td>
<td>13</td>
</tr>
<tr>
<td>Mixed Forest</td>
<td>88</td>
<td>24</td>
</tr>
<tr>
<td>Oak Forest</td>
<td>42</td>
<td>6</td>
</tr>
<tr>
<td>Upland Grassland</td>
<td>37</td>
<td>4</td>
</tr>
<tr>
<td>Elk Meadow</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Mixed Shrub/Upland Grassland</td>
<td>88</td>
<td>7</td>
</tr>
<tr>
<td>Riparian</td>
<td>30</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Wetland</td>
<td>12</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Developed (Including roads)</td>
<td>45</td>
<td>6</td>
</tr>
<tr>
<td>Tree Farm</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>511</strong></td>
<td><strong>61</strong></td>
</tr>
</tbody>
</table>

Source: Adapted from Reclamation 2004b. *Acreage is approximate. ** Elk meadow directly impacted by the project. Other impacts described under elk section

Conifer forest, mixed forest, non-native upland grassland and mixed shrub/upland grassland habitats are not limited on a landscape level. Impacts to non-limited vegetation types listed in the Table 4.8-1 are discussed by species and species group in the following sections. Elk meadows would be replaced prior to or during construction, resulting in no net loss of habitat, and likely an improvement to habitat quality and location.
In general, isolated patches of habitat that have lost connection to similar adjacent habitats due to dam construction and inundation will limit the utilization of those habitats by smaller, less mobile wildlife species. Oak forest is very limited on the landscape, and loss of 42 acres could greatly reduce habitat availability and suitability for oak-dependent species in and around Henry Hagg Lake and the RWP (however, RWP construction is not anticipated to directly impact oak habitat). The majority of wildlife present within the vicinity use riparian habitat for at least a portion of their life cycle. Riparian habitats can provide foraging and breeding habitat for a diversity of passerines, waterfowl, wading birds, and numerous species of amphibians and reptiles.

Expansion of the reservoir would also inundate lower portions of tributaries flowing into Henry Hagg Lake. The total length inundated under the normal full pool of Alternative 2 would increase by approximately 1.8 miles.

Riparian vegetation may be impacted along the downstream waterways as a result of hydrologic changes (see Section 3.6). The 38 percent reduction in flows in Scoggins Creek (between June and October) is anticipated to reduce the amount of vulnerable hydrophytic species within the riparian area of Scoggins Creek. Less vulnerable species, such as those with deeper root systems, likely would not be affected. There would be only a slight reduction in Tualatin River flows, and no impacts to riparian vegetation are expected along the Tualatin. Impacts to downstream wetlands, such as the Wapato Unit of the Tualatin River National Wildlife Refuge, are described in Section 4.6 (Wetlands). In summary, it does not appear the potential changes in water surface elevations would substantively affect the frequency and magnitude of the overbank flows on the Tualatin River in the vicinity of the Wapato Lake Unit or the main Tualatin River National Wildlife Refuge; therefore, little impact to wetland vegetation is expected with implementation of Alternative 2. As mentioned previously, impacts to wetland habitat are addressed separately in the wetland section.

**Weed Management.** In July 2006, Reclamation completed a comprehensive Integrated Pest Management Plan for the areas around the reservoir. The plan will provide direction for weed control in these areas. The reduction in flows along Scoggins Creek, downstream of the dam, may make its riparian areas more vulnerable to weed infestations by opening up unvegetated banks to colonization by reed canarygrass. Also, unless preventative measures are employed, nuisance species would likely populate the new lakeshore areas.

**Construction Impacts (Short Term)**

Of the approximate 511 acres of vegetation in and around Hagg Lake that would be affected over the long term, approximately 61 acres would be impacted only temporarily by ground-disturbing activities during construction. Vegetation would be cleared from the proposed new roadway corridor. Standard forest practices would be employed, though advanced erosion protection measures would be used for all areas that drain into the reservoir. The specific logging plans would be developed during future design efforts.

Table 4.8-9 displays impacts to wetlands located above the full pool level of the reservoir. Impacts to wetland habitats along the margin of Henry Hagg Lake (fringe wetlands) are much more extensive, and
are addressed in greater detail in the wetland section (Section 4.6). Furthermore, additional information on the ability to establish fringe wetlands for mitigation purposes is provided in the wetland section (Section 4.6).

Table 4.8-8. Wetland Impacts at Henry Hagg Lake, Scoggins Dam 40-Foot Raise

<table>
<thead>
<tr>
<th>Classification</th>
<th>Impact (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowardin</td>
<td></td>
</tr>
<tr>
<td>Lacustrine Littoral Emergent</td>
<td>22.96</td>
</tr>
<tr>
<td>Palustrine Emergent</td>
<td>16.55</td>
</tr>
<tr>
<td>Palustrine Scrub-Shrub</td>
<td>13.91</td>
</tr>
<tr>
<td>Palustrine Forested</td>
<td>3.94</td>
</tr>
<tr>
<td>Total</td>
<td>57.36</td>
</tr>
<tr>
<td>Other Waters</td>
<td></td>
</tr>
<tr>
<td>Perennial Streams</td>
<td>1.78 (2.83 miles)</td>
</tr>
<tr>
<td>Intermittent Streams</td>
<td>3.66 (5.77 miles)</td>
</tr>
<tr>
<td>Ephemeral Streams</td>
<td>0.17 (0.34 miles)</td>
</tr>
<tr>
<td>Total</td>
<td>5.61 (8.94 miles)</td>
</tr>
</tbody>
</table>

Source: DEA wetland Delineation 2010. Note: RWP impacts not included, but provided in following discussion.

Weed Management. Noxious weeds have the potential to spread as a result of the ground-disturbing activities related to the project. It is anticipated that Reclamation's Integrated Pest Management Plan will provide direction for weed control around the reservoir and along the RWP.

4.8.2.2.2 Potential Reservoir-related Impacts (direct, indirect): Non-Listed Wildlife Operations and Maintenance Impacts (Long Term)

Approximately 511 acres of varying quality wildlife habitat would be permanently affected around Henry Hagg Lake. Impacts would include the removal of trees; inundation of grasslands, riparian areas, and wetlands; and conversion of open areas to developed recreation facilities, road relocation, and larger dam footprint. Mammals that may be displaced include raccoons, squirrels, rodents, black-tailed deer, bats, and coyote, among many others.

Some birds (shorebirds) may benefit from more exposed mudflat habitats resulting from drawdowns. While bullfrogs may benefit from increased water temperatures, if the amount of open water surface area is decreased, there would be less available breeding habitat. Overall, Alternative 2 water quality conditions would be significantly improved compared to the No-Action Alternative, likely benefiting many species, particularly furbearers, reptiles, amphibians, and other species which use the lake.

Construction Impacts (Short Term)

Wildlife would be temporarily (but directly) affected by project construction on approximately 61 acres. In addition, indirect impacts from the construction period for the dam raise and other facilities for Alternative 2 would be about four to five years. Indirect construction-related impacts include additional traffic in and out of the area and an increase in noise, light, and pollution levels during construction. Impacts specific to species and species groups are provided in the following sections.

Mammals
**Bats**

*Operations and Maintenance Impacts (Long Term)*

Permanent impacts to foraging, roosting, and nesting habitat would occur as a result of inundation of habitats and placement of new roadways. Roosting and nesting habitat in larger trees would be irreplaceable over the short term within the project vicinity, but could be improved within adjacent forest or off-site. Bats would also potentially be affected by an increase in recreational use as facilities are upgraded and enlarged.

*Construction Impacts (Short Term)*

Bats would be temporarily affected by noise from construction, which may cause them to move to adjacent suitable habitat or abandon existing areas. If non-migratory bat species are present, and construction commenced during or immediately prior to the overwintering period, mortality to these species could occur as a result of construction noise.

**Fur-bearers**

*Operations and Maintenance Impacts (Long Term)*

Habitat for furbearers such as bobcat, cougar, and bear would decrease somewhat from existing habitat, although these species currently tend to avoid the project area due to human presence, and would be expected to utilize adjacent forested habitats. As mentioned previously, water quality conditions would improve under Alternative 2 which may benefit many furbearer species that utilize habitat in and around Henry Hagg Lake.

*Construction Impacts (Short Term)*

Furbearers would be temporarily affected by noise and pollution from construction, but would be expected to move to adjacent suitable habitat. However, denning animals would be less mobile, and disturbance to breeding and birthing areas could cause adults to abandon young. Table 4.8-11 provides the approximate denning seasons for various species and species groups found within the project area. Mortality to young would be most likely to occur if construction were to commence between breeding and birthing (which generally, for most species, begins in April). Therefore, timing of commencement of construction is important for furbearers and all other species.

Table 4.8-11. Breeding and Birthing Season of selected common mammal species occurring in the vicinity of Henry Hagg Lake.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Breeding Season</th>
<th>Approximate Birthing Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roosevelt elk</td>
<td>Late August to early October</td>
<td>Late May to early July</td>
</tr>
<tr>
<td>Black-tailed deer</td>
<td>Breeding peaks mainly late November to mid-December.</td>
<td>Mostly in May-June in much of range, sometimes through July or August</td>
</tr>
<tr>
<td>Bobcat</td>
<td>Breeds mid-winter through spring, or possibly at any time of year in some areas.</td>
<td>Often April – August.</td>
</tr>
<tr>
<td>Cougar</td>
<td>Mostly Feb- July</td>
<td>most births occur in April-September, or June - October</td>
</tr>
<tr>
<td>Coyote</td>
<td>Mates in late winter.</td>
<td>Young are born March-May.</td>
</tr>
</tbody>
</table>
Elk

Operations and Maintenance Impacts (Long Term)

Figure 4.8-2 illustrates the existing elk meadow habitat around the reservoir and those areas that would be impacted by the implementation of Alternative 2. There are currently approximately 110 acres of managed elk meadow habitat within the Henry Hagg Lake area, with an additional approximate 29.2 acres that have been designated by Reclamation as elk meadow habitat but not yet implemented (Areas 6a and 6b). Under Alternative 2, Areas 1 and 6b would be the location of the new park administration and maintenance facility. Table 4.8-12 illustrates the direct impacts to elk habitat that would result from Alternative 2.

Table 4.8-10. Direct Impacts to Elk Meadow Habitat at Henry Hagg Lake, Alternative 2

<table>
<thead>
<tr>
<th>Elk Habitat</th>
<th>Impact (acres)</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.4</td>
<td>Inundation</td>
</tr>
<tr>
<td>1</td>
<td>10.7</td>
<td>Relocation of recreation facility</td>
</tr>
<tr>
<td>2a</td>
<td>1.3</td>
<td>Inundation/ Reduction in meadow viability from project</td>
</tr>
<tr>
<td>2b</td>
<td>0.4</td>
<td>Inundation/ Reduction in meadow viability from project</td>
</tr>
<tr>
<td>2c</td>
<td>6.4</td>
<td>ODFW requests move due to existing recreation impacts</td>
</tr>
<tr>
<td>3</td>
<td>3.0</td>
<td>Increase in dam footprint/ ODFW movement request</td>
</tr>
<tr>
<td>4</td>
<td>23.4</td>
<td>To be used for construction staging and wetland mitigation, and ODFW movement request</td>
</tr>
<tr>
<td>5a</td>
<td>1.5</td>
<td>Inundation</td>
</tr>
<tr>
<td>5b</td>
<td>7.3</td>
<td>Inundation</td>
</tr>
</tbody>
</table>


Black bear
Breeds in June-July. Young are born in January-February, but stay with mother until emergence in March births peak in late winter-early spring (April)

River otter
Spring

Raccoon
Late January to mid-March. late April to early May.

American Beaver
January-March late April to June.

Squirrels and lesser rodents
Peaks in Spring and summer April - September
Area 4 is currently designated an elk meadow but would be used to provide for wetland mitigation under the Action Alternatives. While this meadow would continue to provide forage and cover habitat for elk after its transition to a wetland mitigation area, this 23.8-acre transition is considered an impact for purposes of this evaluation. Area 6b, which is not currently managed as elk habitat, was identified by Reclamation as potential elk meadow in the Henry Hagg Lake Resource Management Plan (Reclamation 2004a). This meadow would be displaced by the relocation and construction of the park administration and maintenance facility and would, therefore, be considered an impact from this project. Area 1 would be affected by inundation, as well as the relocation of an existing recreation facility that would make the meadow unsuitable for use as elk habitat because of increased human activity in the area.

Alternative 2 would result in a direct, long-term impact to 58.1 acres of elk habitat. Temporary impacts to elk habitat would be associated with the construction staging area at the base of the dam but these areas would be restored to their original condition following construction. Area 2c is the only existing meadow that would not be impacted by Alternative 2; however, because ODFW requests that it be moved, its acreage is included for mitigation purposes.

As described for Alternative 1, elk and other wildlife may be affected by the increased recreation, and accompanying noise and human disturbance, in the Henry Hagg Lake area. This would occur with the No Action or Action Alternatives. Because most human recreation occurs during the summer months, disturbance to elk would be minor. In addition, the disturbance would increase gradually over time, and elk and other wildlife are anticipated to habituate to these gradual noise increases over time.

**Construction Impacts (Short Term)**

Elk and other wildlife would be temporarily affected by project construction. The construction period for the dam raise and other facilities for Alternative 2 would be about four to five years. Construction staging would be located in the elk meadows below the dam; the area would be unavailable for elk use during construction, and has been removed from consideration as future elk meadow. This impact has been addressed in the elk mitigation section. Other construction-related impacts include additional traffic in and out of the area and an increase in noise levels.

**Birds**

**Operations and Maintenance Impacts (Long Term)**

**Passerines.** A loss of 511 acres of vegetated habitat would permanently reduce the habitat available for foraging, roosting, and nesting for many passerines. Bird species that would be impacted by vegetation clearing include forest-dwelling birds, such as the winter wren, dark-eyed junco and warblers, and tree-nesting species, such as tree swallows, chickadees, and woodpeckers. In general, habitat for these species is not limited in the project vicinity. Assuming that tree-clearing prior to inundation would occur outside the nesting season, it is anticipated that these species would move to adjacent suitable habitat.
Habitat for riparian-dependent species such as yellow-breasted chat, song sparrow, and red-winged blackbirds, though temporarily disturbed, would increase with the increased length of reservoir shoreline; however, 1.8 miles of streams would be inundated. These habitat changes may impact how riparian-dependent species use the habitats within the project area, but is not expected to impact populations.

**Shorebirds and Waterbirds.** At normal full pool, the surface area of Henry Hagg Lake would increase by 370 acres under Alternative 2—from 1,117 to 1,487 acres. However, shorebirds and waterbirds would benefit from increased open water and drawdown area habitats, particularly during winter and spring months. Open water habitat is used by waterfowl, such as mergansers, mallards and other ducks, and other water-dependent species, such as osprey and kingfisher. The increased open water area and fringe wetland habitat would be expected to increase foraging opportunities for waterbirds. The increased footprint of bare soil and mud may increase foraging for shorebirds such as sandpipers, dowitchers, great blue heron, and great egret.

**Construction Impacts (Short Term)**

Songbird species that utilize the habitat within the project area generally nest from March 1 to September 1. Assuming that tree-clearing prior to inundation would occur outside this nesting season, it is anticipated that these species would not be greatly impacted by Alternative 2 since they would move to adjacent suitable habitat upslope of the park such as the newly created fringe habitats and adjacent forest habitats. Additionally, in coordination with Audubon Society of Portland staff, surveys will be conducted prior to construction to identify potential nest sites. Construction-related nesting site impacts will be minimized through the implementation of methods to discourage nesting in construction areas.

Habitat for riparian-dependent species such as yellow-breasted chat, song sparrow, and red-winged blackbirds, though temporarily disturbed, would increase with the increased length of reservoir shoreline. The amount of open water habitat would increase in winter and spring. At normal full pool, the surface area of Henry Hagg Lake would increase by 370 acres under Alternative 2.

**Amphibians and Reptiles**

**Amphibians**

**Operations and Maintenance Impacts (Long Term)**

The footprint of new roads and bridges and the inundation of large areas of habitats, including wetland and riparian areas, could permanently reduce habitat available for amphibians. This reduced available habitat could result in mortality to individuals that cannot readily move to adjacent habitats. Based on 1977-2009 water levels, Figure 4.8-5 displays the normal (average) water levels for a typical year based on daily measurements. As visible from the graph, water levels rise sharply in mid-March to the typical full pool level of 303.6 feet in elevation. Water remains at this level for approximately three months until mid-June, when it drops sharply for the remainder of the year.

Figure 4.8-5. Historical Scoggins Dam & Hagg Lake Storage and Elevation Data
During wetland delineations it was found that herbaceous vegetation along the reservoir edge (dominated by reed canarygrass) extended a maximum of six feet below the typical full pool level of 303.6 feet in elevation, while willow species extended a maximum of 10 feet below this level. Therefore, when drawdowns fell below an elevation of 293.6 feet, only rapidly colonizing herbaceous species (generally facultative wetland, annual and often invasive) would be present along the growing shoreline area, primarily on shallower slopes. Therefore, as the water levels drop rapidly in mid-June, fringe wetlands along the shoreline, where present, are rapidly de-watered, which likely limits the capacity of these wetlands to provide habitat for most amphibians. This is due to desiccation of eggs or stranding of tadpoles, juveniles, and adults along the drying water edge.

Under alternative 2, timing and nature of drawdowns would change little compared to existing conditions. Projections of water levels for Alternative 2 were created using monthly data to model future conditions at the reservoir (MWH 2006d). Figure 4.8-6 displays the normal (average) water levels for a typical year based on these projections. As visible from the graph, water levels for projected future conditions mimic existing conditions nearly exactly. They rise sharply in mid-March to the typical full pool level of 343.6 feet in elevation. Water remains at this level for approximately three months until mid-June, when it drops sharply for the remainder of the year.

Figure 4.8-6. Projected Future Scoggins Dam & Hagg Lake Storage and Elevation Data under Alternative 2
Based on these projections, alterations to water availability for breeding amphibians would be a result of topography of the new shoreline, rather than changes in timing or the nature of the drawdowns. These changes could include alteration of size and location of wetlands along the edge of the reservoir based on topography, soils, and aspect. As discussed in the wetlands section, based on 1-foot contours, fringe wetlands along the reservoir would likely increase in overall acreage and decrease in width, generally due to an overall increase in steepness of the shoreline. These changes may be easiest to understand by discussing breeding behavior and timing of selected individual species. Table 4.8-13 provides egg laying, hatching, and other data for species common to the reservoir area in order to provide a basis for the discussion.

Table 4.8-11. Amphibian and Reptile Reproductive Timeline and Habitat Use

<table>
<thead>
<tr>
<th>Species</th>
<th>Habitat</th>
<th>Breeding/ egg laying</th>
<th>Egg Hatching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frogs</td>
<td>In non-breeding season they occupy a wide variety of habitats: grassland, chaparral, woodland, forests, farmland. <a href="http://nrimp.dfw.state.or.us/nrimp/feature/2003/11-2003.htm">http://nrimp.dfw.state.or.us/nrimp/feature/2003/11-2003.htm</a></td>
<td>Jan- March. Treefrogs are found in both permanent and temporary ponds during the breeding season.</td>
<td>3-5 weeks (Feb-April)</td>
</tr>
<tr>
<td>Species</td>
<td>Habitat</td>
<td>Breeding/ egg laying</td>
<td>Egg Hatching</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>---------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Northern Red-Legged Frog</td>
<td>Red-legged frogs may be found in cool, shady coniferous or deciduous upland areas some distance away from water in the non-breeding season.</td>
<td>Feb. Breeding may occur in permanent, or temporary ponds.</td>
<td>3-4 weeks (March-early April). Aquatic vegetation is needed to anchor the egg mass.</td>
</tr>
<tr>
<td>Bullfrog</td>
<td>In the West, bullfrogs usually require at least one winter before metamorphosis can occur, so breeding is concentrated in permanent ponds.</td>
<td>June to August</td>
<td>1-2 weeks (June-August)</td>
</tr>
</tbody>
</table>

**Aquatic salamander**

<table>
<thead>
<tr>
<th>Species</th>
<th>Habitat</th>
<th>Breeding/ egg laying</th>
<th>Egg Hatching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rough-skinned Newt</td>
<td>Forests, woodlands, grasslands, open valleys, and ranchland. Found on land (in open or under rocks, logs, etc.) or in ponds, lakes, reservoirs, and slow-moving streams. The most aquatic western newt. Breeds in ponds, lakes, reservoirs and slow-moving streams.</td>
<td>Breeds primarily from late December to July. Lays eggs singly on aquatic plants or submerged twigs</td>
<td>Eggs hatch in 3-10 weeks (Jan-Sept).</td>
</tr>
<tr>
<td>Northwestern salamander</td>
<td>Open grassland, woodland, and forest near breeding ponds. Eggs are laid in ponds, lakes, and slow-moving streams; usually attached to vegetation in shallows</td>
<td>Feb-June. Variable.</td>
<td>Hatch in 2-4 weeks (March-June)</td>
</tr>
<tr>
<td>Cope's Giant Salamander</td>
<td>Streams and rivers in moist coniferous forests (water temperatures usually range from 8 to 14 C)</td>
<td>Lays eggs in streams on the underside of rocks or in chambers under stones, cutbanks, or logs</td>
<td>Apparently breeding and egg laying occur throughout spring, summer, and fall.</td>
</tr>
<tr>
<td>Long-toed salamander (temporary or permanent ponds, or in quiet water at the edge of lakes and streams) and nonbreeding habitat (Conifer, Hardwood, Forest, Mixed, Grassland/herbaceous)</td>
<td>Fall-early spring.</td>
<td>Unknown. Late fall to mid-spring? Eggs are attached to vegetation or loose on bottom.</td>
<td></td>
</tr>
</tbody>
</table>

**Non-aquatic salamanders**

<table>
<thead>
<tr>
<th>Species</th>
<th>Habitat</th>
<th>Breeding/ egg laying</th>
<th>Egg Hatching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensatina</td>
<td>Douglas-fir/maple forests, forest clearings. Eggs are laid underground, or under the bark of or within rotting logs.</td>
<td>Breeding occurs primarily in spring and fall (Stebbins 1985).</td>
<td>Eggs hatch in fall or early winter. There is no aquatic larval stage.</td>
</tr>
<tr>
<td>Western red-backed salamander</td>
<td>Humid coniferous forests; damp talus slopes and shaded ravine</td>
<td>December-March</td>
<td>Hatchlings appear in autumn</td>
</tr>
</tbody>
</table>

**Reptiles**

4.8-34
<table>
<thead>
<tr>
<th>Species</th>
<th>Habitat</th>
<th>Breeding/ egg laying</th>
<th>Egg Hatching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western pond turtle</td>
<td>Permanent and intermittent waters of rivers, creeks, small lakes and ponds, marshes, irrigation ditches, and reservoirs.</td>
<td>peaks in June-July</td>
<td>10-12 weeks (sept and oct)</td>
</tr>
<tr>
<td>Western painted turtle</td>
<td>shallow, slow-moving water of streams, lakes and rivers; preferably with a soft, muddy bottom with vegetation and submerged logs.</td>
<td>June and July</td>
<td>fall</td>
</tr>
</tbody>
</table>

In general, reservoir fringe wetland habitats are not considered prime habitat for amphibians due to lack of structural complexity, wave action (which can dislodge eggs) and predation by fish. Amphibians are more likely to use sheltered habitats upslope of the reservoir, which are not subject to rapid drawdown. However, some amphibians may use the more sheltered arm areas, which also contain greater wetland acreage. Reservoir drawdown and associated human and vegetative disturbance interrupts amphibian access to egg-laying territories along the edge of the reservoir. Amphibians are not expected to risk traveling across the unvegetated drawdown zone to lay eggs in water, but prefer to utilize wetlands upslope of the reservoir, with hydrology independent from Henry Hagg Lake. The drawdown zone would increase in size from existing conditions. Under Alternative 2, the area of mudflats exposed at low pool would increase from 668 acres to approximately 1,038 acres.

Both the current and projected future drawdown timing and extent appears to discourage use of the fringe wetlands by invasive bullfrogs (bullfrogs were not noted during the wetland delineation site visits, although they may be present at other times). Bullfrogs lay their eggs in a thin film on open water, in areas of submerged vegetation, where the eggs sink and attach to vegetation before hatching (Corkran and Thoms 1996). Breeding and egg-laying is from June to August, with hatching 1-2 weeks later. Therefore as water levels drop rapidly along the reservoir in mid-June, eggs deposited along the shore would presumably dessicate.

Rough-skinned newt, on the other hand, does not appear to be hampered greatly by reservoir conditions, and may even benefit from the increased water surface because they utilize standing water (especially reservoirs) to a greater degree than other native amphibians. They may be better suited to drawdowns due to their longer and more variable breeding and egg-hatching season, which may allow them to be impacted to a lesser degree than bullfrogs by the rapid drawdown in Mid-June.

Long-toed salamander, which breeds and lays eggs in fall and early spring, has little access to egg-laying territories along the edge of the reservoir because water levels do not rise to the edge of upland vegetation until the very end of their breeding season.

In summary, the timing of drawdowns would not change greatly, but the distance to the water’s edge during drawdowns would increase, potentially decreasing the likelihood that amphibians would use reservoir fringe habitats. In addition, although acreage of fringe wetlands may increase under Alternative 2, it appears likely that the width of wetlands along the reservoir edge may decrease slightly due to the increased steepness of shorelines along the new proposed full pool elevation. This decrease
in wetland width may also reduce the sink effect of wetlands along the fringe, which may trap amphibians during drawdown under existing conditions. The greatest impacts to amphibians would likely occur as a result of the initial inundation. The extent of this impact depends on the timing and speed of the initial inundation of fringe wetland and other wetland habitats.

Other operational impacts could include changes to water temperature and chemistry from the proposed dam raise. Based on water quality modeling, Alternative 2 would result in a lower whole-lake average temperature, higher DO levels, lower ammonia concentrations, lower chlorophyll concentration and less frequent algal blooms compared to the No-Action Alternative (CH2MHill and Sullivan and Rounds 2005). Therefore water quality conditions would be improved under Alternative 2, potentially benefiting amphibian species.

Although amphibian metamorphosis rates are sensitive to relatively slight changes in water temperature, it is unlikely that such minor increases or decreases in average annual or maximum surface water temperature would affect amphibian populations. Additional information on Alternative 2 water quality conditions and its potential effects on amphibians is provided in the Water Quality section.

Construction Impacts (Short Term)

Although presumably less affected by drawdown levels, non-aquatic species such as Western red-backed salamander or Ensatina, which do not utilize water for their life history, are included in Table 4-11 because impacts to these species could result from the footprint of the new reservoir and associated structures (rather than in changes caused by drawdowns). Logging of forested areas prior to inundation could impact terrestrial amphibians through direct mortality as well as alterations to available moisture and forage. Depending on the speed of the initial reservoir inundation, amphibians remaining within the logged areas may be drowned if they cannot migrate upslope to suitable habitat, and migration itself would increase the risk of predation.

Impacts from road relocation and bridge construction could include temporary and permanent loss of riparian and wetland habitats which support amphibians. Although wetlands would be replaced around the reservoir and waterways, construction could result in mortality of individuals or egg masses, depending on timing of construction. As a species, terrestrial salamanders would likely benefit from an increase in woody debris and old-growth forest conditions proposed as part of the project, and potentially from creation of new wetlands away from the reservoir edge. The inundation of riparian habitats along the creeks flowing into the reservoir may result in the greatest impact to amphibian species that depend on these areas, and some individuals may be lost as a result of the rising water level. However, these individual losses are not anticipated to affect the populations of these species.

Reptiles

Operations and Maintenance Impacts (Long Term)

The operation of the reservoir would likely have less effect on common reptile species than on amphibians, since they can often adapt more readily to changes in microclimate. Species such as garter snake, rubber boa, and western fence lizard would be expected to move upslope to other habitats which could provide for their needs. As with other species, inundation of habitats between the breeding and
birthing seasons would have the greatest impact on the next generation of reptiles, causing the adults to abandon nests or young. Since water quality conditions would improve in the project area under Alternative 2, these improvements are not anticipated to impact reptile species in the project area.

Long-term and short-term impacts to the western pond turtle and western painted turtle are discussed in Section 4.9.

**Construction Impacts (Short Term)**
Noise disturbance and other temporary impacts from construction activities may impact reptiles and cause them to abandon their current habitat and move to areas not immediately affected by disturbance. Although the entire reservoir perimeter is heavily disturbed by humans and pets from spring through fall, additional construction disturbance from large machinery and increased heavy traffic would occur. This increased noise may lead to abandonment of nest sites or habitat areas. Construction may lead to decreased recreation and therefore less human disturbance; however, increased noise levels would also potentially disturb areas that are not currently or have not been disturbed, such as those not actively being constructed.

**4.8.2.2.3 Potential RWP-related Impacts (direct, indirect): Vegetation**
Preliminary pipeline routing alignment alternatives were designed to minimize impacts to wetlands and riparian areas that may function as important habitat for wildlife, as well as known locations of listed species such as Nelson’s checker-mallow. Most impacts associated with the RWP would occur during construction and would be temporary in nature.

**Operations and Maintenance Impacts (Long Term)**
As shown in Figure 4.8-4, the vast majority of the RWP alignment is in grass production (frequently disturbed) and does not contain native plant communities. In spite of this, edges of agricultural lands can contain remnant native plant populations, as evidenced by the presence of Nelson’s checker-mallow in the Lovejoy wetlands (Weil, pers. comm. 2010).

Permanent impacts from the RWP are based on a 12-foot wide corridor centered on the proposed alignment, which will need to be maintained as permanent easement for maintenance purpose, and will contain above-ground structures in some cases. Since the majority of the RWP impacts within this 12-foot corridor would be temporary, this represents a conservative estimate of less than 20 acres of permanent impact.

The RWP would be trenched for most of the route, temporarily disturbing the agricultural, forested and developed habitats that lie within the 60- to 140-foot-wide, 6.5-mile-long, construction corridor. Table 4.8-14 summarizes the impacts to vegetation along the RWP corridor.

**Table 4.8-12. Vegetation Impacts along the Raw Water Pipeline Corridor, in Acres**

<table>
<thead>
<tr>
<th>Vegetation Association</th>
<th>Permanent</th>
<th>Temporary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conifer Forest</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mixed Forest</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

4.8-37
Approximately 60 feet of the RWP corridor will need to be maintained as permanent easement for maintenance purposes. The vegetation in this area will allow for maintenance activities and will not be allowed to transition to scrub-shrub or forested wetlands.

Mowing of the corridor is anticipated approximately XX times per year. Forested and scrub-shrub wetlands within the maintenance corridor would not be impacted in terms of lost acreage; however, wetland function, particularly habitat functions, would be reduced or altered. Approximately XX and XX acres of forested and scrub-shrub wetlands respectively would be affected, resulting in their conversion to emergent wetlands.

**Construction Impacts (Short Term)**

RWP construction would include eight crossings of jurisdictional waterways: Scoggins Creek (two crossings), one unnamed tributary to Scoggins Creek (ditched), four unnamed tributaries to the Tualatin River, and the Tualatin River. The Tualatin River and upper Scoggins Creek crossings would be trenchless, thereby avoiding impacts. Tunnel exit and entry pits would be placed outside of the riparian area to avoid impacts to riparian habitat. Open-cut dry crossings are being considered for Scoggins Creek and the other waterways. As described in Section 3.3.4.7, open-cut crossings would be done in a way to minimize impacts. While best management practices would be used, trenching may result in the loss of some native riparian vegetation, since crossings would take place within weedy areas.

Since it is assumed that access roads and staging areas would be removed and restored following construction, no long-term impacts are anticipated, with the exception of those resulting from vaults or other permanent structures (within the permanent 12-foot easement) required for maintenance purposes. These permanent structures within wetlands would result in a very small permanent footprint relative to the size of the pipeline.

It is estimated that 158 acres will be temporarily disturbed based on the more conservative range of the 140-foot corridor study area. Field surveys of the pipeline corridors found that the vegetation communities that would be impacted by pipeline construction are not unique within the region and are dominated by agricultural pastures and small riparian areas. After pipeline placement, disturbed areas would be revegetated to pre-construction conditions to the greatest extent practical. Entry pits will be located in areas which minimize impacts to terrestrial and aquatic vegetation to the greatest extent practical. However, if mature trees were impacted during pipeline construction, there would be a
greater lag time between replanting and reestablishment of habitat, thereby representing a more long-term impact.

Assuming disturbance throughout the 140-foot-wide construction corridor, approximately 4 acres of scrub/shrub wetlands, 5 acres of un-inventoried wetlands, and 121 acres of emergent wetlands could be temporarily disturbed during installation of the pipeline. Impact areas are shown in 4.6-1 and summarized in Table 4.8-10. No forested wetlands would be impacted during the installation of the RWP. Since it is assumed that access roads and staging areas would be removed and restored following construction, no long-term impacts are anticipated, other than those associated with the vaults or other structures required for maintenance purposes. These permanent structures within wetlands would result in a very small permanent footprint relative to the size of the pipeline.

Table 4.8-13. Wetland Impacts at Raw Water Pipeline, Scoggins Dam 40-Foot Raise

<table>
<thead>
<tr>
<th>Classification</th>
<th>Impact (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowardin Palustrine Emergent</td>
<td>121</td>
</tr>
<tr>
<td>Cowardin Palustrine Scrub-Shrub</td>
<td>4</td>
</tr>
<tr>
<td>Uninventoried</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>130</strong></td>
</tr>
</tbody>
</table>

Although little, if any, native vegetation would be disturbed by RWP construction, temporary impacts to wildlife habitat would occur. These include temporary disturbance of weedy vegetation at the bore sites, and clearing and grubbing of vegetation along trenched areas. While these areas would be revegetated with native vegetation (and thereby improved for wildlife use compared to existing condition) and cleared outside the migratory bird nesting period, lag time would occur between disturbance and revegetation, making wildlife use difficult at that time. However, entry pit locations will be selected to minimize impacts to terrestrial and aquatic habitats of particular importance to certain species.

4.8.2.2.4 Potential RWP-related Impacts (direct, indirect): Non-Listed Wildlife Operations and Maintenance Impacts (Long Term)
The placement of the 6.5-mile pipeline would result in the temporary disturbance of agricultural, forested, and developed habitats. The wildlife associated with these habitats would be temporarily displaced due disturbance from construction-related activities and noise. These agricultural, forested, and developed habitats that would be affected are not limited within the area, and wildlife is anticipated to disperse to adjacent, suitable habitat. It is anticipated there may be loss of species with limited mobility, such as small rodents; however, such losses would not be distinguishable on a population level.

As visible in Figure 4.8-4 the vast majority of the RWP alignment is in grass production (frequently disturbed) and does not contain native plant communities. In spite of this, these agricultural lands provide a variety of wildlife values. In some areas, portions of the agricultural fields are subject to regular flooding, which can attract migrating waterfowl, gulls, and shorebirds.
Although these habitats are prone to colonization by invasive species, frequent disturbance, and inputs of chemicals, many wildlife species utilize edge habitats for portions of their life histories. Migratory and resident birds forage in the fields and roost in adjacent riparian areas, as do snakes and a few harder amphibians. Pesticides and herbicides from farm operation may hinder use of the area by sensitive amphibian species. Raptors, most commonly red-tailed hawk, but also osprey, bald eagle, and migratory raptors, also forage on rodents which are commonly present in these fields. This wildlife use would be temporarily disturbed by construction, and mortality to less mobile species such as amphibians may occur during trenching of waterways or operation of boring equipment along the periphery of riparian zones. In addition, mortality of the slower-moving displaced species may occur due to reductions in food sources, competition for existing food sources, potential for increased disease transfer, and other indirect factors.

Mammals

**Bats**

**Operations and Maintenance Impacts (Long Term)**

Very little, if any impact to roosting or nesting habitat for bats would occur as a result of the permanent footprint of the RWP, since the vast majority of the impacts would occur to grassland agriculture areas, which may provide foraging opportunities, but no structure for nesting or roosting.

**Construction Impacts (Short Term)**

Bats could be temporarily affected by noise from construction, especially within riparian areas adjacent to bore sites for the RWP. This may cause them to move to adjacent suitable habitat or abandon existing areas. If non-migratory species are present, and construction commenced during or immediately prior to the overwintering period, mortality to these species could occur as a result of construction noise.

**Fur-bearers**

**Operations and Maintenance Impacts (Long Term)**

Habitat for furbearers such as bobcat, cougar, and bear would not decrease from existing habitat due to the 12-foot wide corridor of permanent impacts, since these species currently tend to avoid the project area due to human presence, and would be expected to utilize adjacent forested habitats rather than the permanently impacted areas.

**Construction Impacts (Short Term)**

Furbearers could be temporarily affected by noise from construction, which may cause them to move to adjacent suitable habitat or abandon existing areas. They may use the larger riparian areas along the Tualatin River, and noise from bore rigs adjacent to these habitats may cause them stress or to be unable to connect to other habitats. In addition, impacts could occur at entry pit sites. However, BMPs and entry pit site screening will implemented to reduce impacts to the greatest extent practical.

**Elk**

**Operations and Maintenance Impacts (Long Term)**

Elk are known to use sections of the RWP corridor for forage and movement, although ODFW preference is to focus their activity away from the RWP in order to decrease impacts to private property.
Therefore, elk habitat along the RWP would not be permanently impacted by the project. They would be expected to utilize adjacent forested habitats rather than the permanently impacted areas.

**Construction Impacts (Short Term)**
RWP construction could temporarily disrupt elk use of the corridor and disturb vegetative and foraging habitats. In addition, these disturbances could prevent elk movements between areas of high use during construction of the pipeline. ODFW expressed concern with daily and seasonal movement across the valley floor during construction of the RWP (Vandebergh, pers. comm. 2009). The main area of concern is the dam face to Highway 47. The open trench of the RWP would be covered daily to reduce entrapment effects on wildlife. If the RWP were constructed in a linear fashion, from one end of the alignment toward the other, or in sections, it is expected that elk would avoid the areas being constructed, and cross the valley as needed in areas that are not being disturbed. If, however, the entire pipeline were to be constructed at once, other mitigation measures would be needed to ensure connectivity during construction.

ODFW is also concerned that if elk were pushed out of the project area by construction, they could remain in the agricultural areas east of Highway 47, and would like to encourage them to remain higher up in the valley, preferably north of the reservoir. The existing elk mitigation plan would accomplish this goal as part of project mitigation. If mitigation for lost elk habitat were to occur prior to construction, disturbances to elk during winter periods (such as limited food supplies, poor body condition, etc) could be less significant.

**Birds**

**Operations and Maintenance Impacts (Long Term)**
Permanent impacts are related to the removal of habitat used by birds along the 12 foot maintenance corridor. This loss of habitat affects primarily agricultural and grassland species. Due to the abundance of these habitat types in the vicinity of the RWP, it is predicted that these individuals will utilize similar, adjacent habitats and that there will be no long-term impacts to these populations.

**Construction Impacts (Short Term)**
Temporary impacts could result from noise and disturbance, although if these impacts took place outside the nesting season, little effect to riparian-dependent species would be expected.

The construction activities would be limited to a corridor varying from 60 to 140 feet wide, and suitable migratory and foraging habitats are not limited within the vicinity of the RWP corridor. Construction along Scoggins creek and the Tualatin River would limit the use of these streams for eagle foraging during the construction period. It is not known the degree to which eagles use the affected reaches for foraging, but they would constitute a small minority of available rivers and streams in the project area. It is unlikely that eagle foraging would be compromised by construction of the RWP because of the abundance of suitable, alternative foraging areas.

Open water habitat along the RWP is very limited, although seasonal farmed wetlands provide. Only 12 feet of the RWP corridor (a conservative estimate) would be permanently impacted by the project, resulting in a loss of 12 acres of farmed wetland and grass field habitat for wintering waterbirds. This
habitat is ubiquitous in the surrounding area. Temporary, direct impacts to approximately 130 acres could occur within the construction corridor, and other impacts could result from noise and disturbance, although if these impacts took place outside the nesting season, little effect to waterbirds would be expected.

**Amphibians and Reptiles**

**Amphibians**

**Operations and Maintenance Impacts (Long Term)**

Approximately 12 feet of the RWP would be permanently impacted by the project. Since the farmed wetland portions of the heavily impacted agricultural habitats may be used temporarily by amphibians as egg-laying areas, this loss of habit may affect certain species, such as Pacific tree frog. However, since these temporary breeding areas can result in mortality to amphibians from pesticides or physical disturbance, impacts to the species from loss of this habitat may not greatly affect the populations.

**Construction Impacts (Short Term)**

The temporarily impacted corridor could result in habitat unavailable for amphibians, especially during breeding season, although similar habitats are ubiquitous in the area. Entry pits could temporarily impact amphibians; however BMPs will be implemented to reduce these impacts as much as possible. In addition, increased mortality of the displaced species due to reductions in food sources, competition for existing food sources, and potential for increased disease transfer could occur as a result of the lost habitat.

**Reptiles**

**Operations and Maintenance Impacts (Long Term)**

A path of approximately 12 feet along the length of the RWP would be permanently impacted by the project. Since the farmed wetland portions of the heavily impacted agricultural habitats may be used temporarily by amphibians as egg-laying areas, this loss of habit may affect certain species, such as the Pacific tree frog. However, since these temporary breeding areas can result in mortality to amphibians from pesticides or physical disturbance, impacts to the species from loss of this habitat may not greatly affect reptile populations.

**Construction Impacts (Short Term)**

The temporarily impacted corridor could impact amphibian habitat, especially during breeding season, although similar habitats are ubiquitous in the area. Therefore, it is anticipated that amphibians would be able to relocate to adjacent, undisturbed habitats. Entry pits could temporarily impact reptiles; however BMPs will be implemented to reduce these impacts as much as possible.

4.8.2.2.5 Alternative 2 – Cumulative Impacts

Cumulative impacts to vegetation and wildlife would occur in association with the reasonably foreseeable development that would occur in the region. Development would convert natural areas to agricultural or more urban uses and fragment remaining habitat. Habitat losses associated with Alternative 2 would contribute to these effects. Similarly, construction-related impacts associated with Alternative 2 would contribute to the cumulative impacts to vegetation and wildlife, including the spread of invasive species.
Alternative 2 would increase the amount of open-water habitat available in winter and spring. Open water habitat is particularly important for wintering and migrating waterfowl. Cumulative, beneficial effects on waterfowl would accrue with development of the Wapato Unit of the Tualatin River National Wildlife Refuge.

4.8.2.3 Alternative 3 – Multiple Source Option

This section describes potential direct, indirect, short term, and long term impacts resulting from Alternative 3. The Biological Resources Report (URS 2003) was prepared for the WSFS and assesses potential effects of a 40-foot and 20-foot Scoggins Dam raise. Alternative 3, incorporating a 25-foot dam raise, was developed subsequent to the report. Therefore, vegetation impacts provided in this section have been estimated using the data and maps available in the URS report. Approximately 614 acres of vegetation surrounding the reservoir would be affected by Alternative 3 (see Table 4.8-15). Some higher quality coniferous forest and deciduous habitats along Henry Hagg Lake fringe and near Boat Ramp A would be inundated (URS 2003). Construction activities would disturb about the same amount of land as Alternative 2—640 acres.

<table>
<thead>
<tr>
<th>Vegetation Type</th>
<th>Impact (acres)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coniferous Forest</td>
<td>282</td>
</tr>
<tr>
<td>Mixed Forest</td>
<td>12</td>
</tr>
<tr>
<td>Scrub-shrub</td>
<td>38</td>
</tr>
<tr>
<td>Herbaceous</td>
<td>230</td>
</tr>
<tr>
<td>Developed and bare ground</td>
<td>52</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>614</strong></td>
</tr>
</tbody>
</table>

* Acreage is approximate.

Expansion of the reservoir would inundate the lower portions of tributaries flowing into Henry Hagg Lake. The total length inundated under the normal full pool of Alternative 3 would be increased by approximately 1.6 miles.

As with Alternative 2, vegetation would be cleared from the staging areas at the base of the dam, and trees would be cleared from the proposed borrow areas and many areas to be inundated, especially in the southern half of the reservoir. Standard forest practices would be employed, though advanced erosion protection measures would be used for all areas that drain into the reservoir. The specific logging plans would be developed during future design efforts.

RWP impacts on vegetation would be the same as for Alternative 2, except the area disturbed by construction would likely be less because the pipe would be smaller in diameter (72 inches) than under Alternative 2 (96 inches). Impacts on riparian vegetation and habitat also would be similar to Alternative 2. RWP impacts would be short-term; disturbed areas would be revegetated to pre-construction conditions to the greatest extent practical.
Vegetation would be cleared in portions of a 50- to 140-foot-wide corridor along the 22-mile length of the Willamette Pipeline. Because much of the Willamette Pipeline would be placed within road rights-of-way, a large portion of the construction corridor is already paved, graveled, or mowed. Conservatively estimated, construction could temporarily affect 130 to 375 acres. Based on field surveys of the construction corridor, vegetation communities that would be affected are not unique within the region. As with the RWP, disturbed areas would be revegetated to pre-construction conditions to the greatest extent practical, so impacts would be short-term.

Vegetation would be cleared in the water tank sites associated with the Willamette Pipeline—potentially 6.5 to 11 acres would be cleared for each water tank. Some of this area would be revegetated after construction, but development of the three water storage tanks would affect approximately 15 acres in the long-term.

Vegetation may be impacted along the waterways downstream of Scoggins Dam as a result of hydrologic changes, but to a slightly less extent than what would occur under Alternative 2. The 31 percent reduction in flows in Scoggins Creek associated with Alternative 3 is anticipated to reduce the amount of vulnerable hydrophytic species within the Scoggins Creek riparian area. Less vulnerable species, such as those with deeper root systems, probably would not be affected. There would be only a slight reduction in Tualatin River and Willamette River flows, and no impacts to riparian vegetation are expected.

Impacts to downstream wetlands, such as the Wapato Unit of the Tualatin River National Wildlife Refuge, are described in Section 4.6 (Wetlands). In summary, it does not appear the potential changes in water surface elevations would substantively affect the frequency and magnitude of the overbank flows on the Tualatin River in the vicinity of the Wapato Lake Unit or the main Tualatin River National Wildlife Refuge; therefore, little impact to wetland vegetation is expected with implementation of Alternative 3.

**Weeds and Weed Management**

As described for Alternative 2, noxious weeds have the potential to spread as a result of the ground-disturbing activities related to the project, such as staging areas and pipeline construction. Alternative 3 would involve greater ground disturbance for pipeline construction than Alternative 2 because of the inclusion of the approximately 22-mile-long Willamette Pipeline, so there could be more opportunity for noxious weed invasion. However, because the Willamette Pipeline would be constructed in previously disturbed areas (primarily public rights-of-way) the impact would be low. Raising the reservoir elevation would inundate some existing areas of noxious weed infestation, and it is anticipated that, unless preventative measures are employed, these nuisance species would occur in the new lacustrine edge areas. Reclamation is developing a comprehensive Integrated Pest Management Plan (Reclamation 2004a) for the areas around the reservoir, which should facilitate weed control in these areas.

The reduction in flow along Scoggins Creek, downstream of the dam, may make riparian areas along the creek more vulnerable to weed infestations. The slight flow reductions in the Tualatin and Willamette rivers would not increase the potential for weed infestation.

**Non-Listed Wildlife**
**Reservoir-related Impacts**

Approximate 614 acres of varying quality terrestrial wildlife habitat would be affected around Henry Hagg Lake. Impacts would include the removal of trees; inundation of grasslands, riparian areas, and wetlands; and conversion of open areas to developed recreation facilities, road relocation, and larger dam footprint. Impacts to non-listed wildlife would be similar, but of a slightly lesser magnitude than those described for Alternative 2. The same habitat types and wildlife species would be affected by the inundation.

Similar to Alternative 2, the habitat for lacustrine edge species, though temporarily disturbed, would increase with the increased length of reservoir shoreline, and open water habitat would increase in winter and spring. At normal full pool, the surface area of the reservoir would increase by approximately 235 acres.

Impacts to elk habitat would be similar to those described for Alternative 2, but 5.5 fewer acres would be affected, as shown in Table 4.8-16. Figure 4.8-2 illustrates the elk meadow habitat areas around the reservoir and potential impacts from implementation of Alternative 3.

**Table 4.8-15. Impacts to Elk Meadow Habitat at Henry Hagg Lake, Alternative 3**

<table>
<thead>
<tr>
<th>Elk Habitat Area</th>
<th>Impact (acres)</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.9</td>
<td>Inundation</td>
</tr>
<tr>
<td>1</td>
<td>15.2</td>
<td>Relocation of recreation facility</td>
</tr>
<tr>
<td>2a</td>
<td>0.1</td>
<td>Inundation</td>
</tr>
<tr>
<td>3</td>
<td>3.0</td>
<td>Increase in dam footprint</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To be used for wetland</td>
</tr>
<tr>
<td>4a</td>
<td>23.8</td>
<td>mitigation</td>
</tr>
<tr>
<td>5a</td>
<td>0.8</td>
<td>Inundation</td>
</tr>
<tr>
<td>5b</td>
<td>4.1</td>
<td>Inundation</td>
</tr>
<tr>
<td>6a</td>
<td>1.7*</td>
<td>Relocation of park administration and maintenance facility</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52.6</strong></td>
<td></td>
</tr>
</tbody>
</table>

* Area 6a is designated but not currently managed as elk habitat.

Implementation of Alternative 3 would result in a direct, long-term impact to 52.6 acres of elk meadow habitat. Temporary impacts to elk meadow habitat would be associated with the construction staging areas at the base of the dam but these areas would be restored to their original condition following construction. Areas 2b and 2c would not be affected by Alternative 3.

Potential impacts to elk and elk habitat from increased recreation in Scoggins Valley Park would be the same as those described for Alternatives 1 and 2.

As under Alternative 2, there would be temporary construction impacts to bald eagles by reduction in foraging area from construction noise at the dam and a decrease in reservoir elevation during
construction. The duration of construction activities would be shorter under Alternative 3, however, so impacts are expected to be somewhat less. Upon completion of construction activities, Alternative 3 would add approximately 235 acres to the surface area of Henry Hagg Lake at normal full pool elevation compared to Alternative 1. This would increase the potential foraging area for bald eagles and is expected to result in a beneficial long-term effect.

As under Alternative 2, the timing of maximum and minimum reservoir elevations would be similar to Alternative 1, with maximum pool elevation generally occurring in May in all year types (wet, dry, and normal) and minimum elevation generally occurring in October in all year types. Because the operational timing is similar to Alternative 1, bald eagle foraging during nesting activities and over-wintering are expected to be affected only by relative increases in elevation and area as compared to Alternative 1.

**RWP-related Impacts**

The impacts associated with the construction of the RWP are similar to those described for Alternative 2; however, because the pipeline would be smaller (72 inches in diameter, compared to 96 inches in diameter for Alternative 2) the construction corridor could be slightly narrower for Alternative 3, resulting in slightly less ground disturbance and less impact to wildlife. Other construction-related impacts would be the same as for Alternative 2.

**Willamette Pipeline-related Impacts**

The placement of the approximately 22-mile-long Willamette Pipeline would result in the temporary disturbance of habitats, nearly all of which are developed or agricultural. Similar to the impacts associated with the RWP, the wildlife associated with the habitats along the Willamette Pipeline corridor would be temporarily displaced, and wildlife that use the adjacent habitats would be disturbed by construction-related activities and noise. The types of habitat that would be affected are not limited within the area, and wildlife would likely disperse to adjacent, suitable habitat. It is anticipated there would be losses to species with limited mobility, such as small rodents; however, such losses would not be distinguishable on a population level.

The water tank sites would be at least partially cleared and graded, potentially affecting between 16 and 27 acres of developed, agricultural, and forested habitat.

The Willamette Pipeline corridor and potential water tank sites do not provide suitable elk habitat, and elk are not known to use those areas. ODFW has not expressed concern over impacts to elk from the construction of the Willamette Pipeline.

One bald eagle nest is located along Chicken Creek, which is approximately 2 miles from the Willamette Pipeline corridor (ORNHIC 2006). Willamette Pipeline construction activities would not impact this bald eagle nest.

**4.8.2.3.1 Alternative 3 – Cumulative Impacts**

Implementation of Alternative 3 would result in similar cumulative impacts to wildlife and vegetation as those described for Alternative 2.
4.8.3 Mitigation Measures

4.8.3.1 Alternative 1
Reclamation committed to providing 140 acres of elk meadow habitat as partial mitigation for construction of Scoggins Dam. At present, approximately 103 acres are managed for elk habitat, and another 29.2 are designated but not managed for elk (Areas 6a and 6b). Under Alternative 1, Reclamation will designate an additional 7.8 acres of elk habitat as well as area 6a and 6b, in order to provide an additional 37 acres of managed elk habitat. This would meet Reclamation’s existing mitigation agreement for development of the project.

4.8.3.2 Alternatives 2 and 3

4.8.3.2.1 General Mitigation Strategies for Non-listed Wildlife Species
Following are the general mitigation measures that would be employed to reduce or eliminate the impacts to vegetation and non-listed wildlife as a result of the implementation of Alternative 2 or 3.

- To mitigate for the temporary impacts to construction staging areas and areas along the RWP corridor (and, for Alternative 3, Willamette Pipeline corridor), Revegetation Plans would be prepared and implemented.
- Standard best management practices will be used to prevent the spread of invasive species during all related construction and restoration activities. Certified noxious-weed-free seed, mulches, and hay bales would be used. Straw should be from fields that grow State of Oregon certified grass seed (which is certified free of Oregon noxious weeds) or other sources that are determined to be free of noxious weeds. Mulch species would be from native seed sources, annual rye, or cereal grain fields. Re-vegetation with native seed or a return to pre-construction agricultural conditions would be conducted as appropriate.
- Standard erosion and sediment control measures would be implemented throughout all construction operations.
- Standard best management practices would be utilized to minimize potential construction-related impacts.
- Standard Forest Practices would be implemented for the clearing of any trees.
- All impacts to jurisdictional wetlands would be mitigated for according to state and federal requirements.
- All equipment would use standard noise-control devices and would comply with pertinent noise standards to minimize disturbance to wildlife.
- Signage would be installed in the park and would describe appropriate use of the area, e.g. no collecting, no depositing, unlawful to harass, etc.
- Bird and bat habitat will be taken into consideration during the replacement of the Sain and Scoggins Creek bridges and other structures with the potential to provide habitat for mitigation.
- Roadway embankment could provide turtle nesting sites with removal of asphalt. If these areas were protected from disturbance, they could function as a potential turtle mitigation area as turtles like disturbed, sunny exposed sites.
• CWS and the Partners have expressed interest in working with ODFW to leave trees behind in designated areas in the newly formed inundation zone (where management allows), to enhance habitat for warm water game fish and trout, as well as for birds and other wildlife. This is a safety issue, which will be addressed in future negotiations.

• Generally, traffic will increase slightly from both options. Wildlife crossings would be included in design/mitigation discussions.

• Invasive species would continue to be managed.

• Construction of a new road alignment to accommodate new lake levels would consider nesting birds and the MBTA during the sequencing and construction of the project.

• Riparian Zones would be restored to normal function at each crossing by decommissioning staging structures and access roads and revegetating impacted areas under an agreed upon site re-vegetation plan. Project proponents would look for additional opportunities to improve the bordering riparian areas and instream channel habitat function where possible.

• A revegetation plan will be developed as part of the permitting and design process. Potential enhancement opportunities along the RWP will be addressed in the CEP mitigation discussion.

• Entry pit locations would be selected to minimize impacts to terrestrial and aquatic habitat types. BMPs will be implemented to the greatest extent practical to minimize impacts. As mentioned, entry pit holes will be covered to prevent wildlife entrapment. In addition, all sites will be restored with native vegetation upon completion of construction.

4.8.3.2.2 Specific Mitigation Strategies for Non-listed Wildlife Species

Elk and Elk Habitat Mitigation

Approximately 58.1 acres of designated elk meadow habitat around the reservoir would be impacted through the implementation of Alternative 2. For Alternative 3, approximately 52.6 acres of designated elk meadow habitat around the reservoir would be impacted.

Factors affecting elk security (and therefore successful elk meadow mitigation) are topographic relief, vegetation density, and proximity to human activity. Therefore, the elk meadow mitigation will be designed to improve the distribution of cover and forage, enhance forage quality and quantity, and maintain cover structure to meet thermal and security requirements. The following factors were considered during the design of the elk meadow mitigation:

• Elk meadows for mitigation were identified in areas less traveled and infrequently accessed by people.
• Herbaceous and woody vegetative buffers will be incorporated as part of elk meadow rehabilitation and creation (Reclamation 2003b).
• Areas outside the park boundaries would be more expensive to construct and maintain; meadows within the park are preferred.
• Smaller meadows (Meadow 2 a, b, and c, although only partially impacted by the dam raise, were eliminated from consideration.
• Potential elk meadows near Recreation Area C were eliminated at the request of ODFW due to potential conflicts with landowners.
• Several areas on the north end of the reservoir were not feasible as elk meadow mitigation due to steepness of slopes, presence of landslides, and presence of existing oak forest and native prairie remnant habitat.

Elk mitigation meadows will be located as far from human disturbance as possible because human disturbance may be the most important factor for elk use (Reclamation 2003b; ODFW 2003). Disturbance from hiking, biking, and other recreational trails and areas of concentration were avoided to the extent practical. To avoid conflicts, mountain bike trails could be shielded from elk meadows, since human use is generally limited to the established trail. For meadows split by the road, vegetative buffers would help mitigate disturbance, and measures would be taken to allow safe passage for elk moving to the water’s edge.

Several efforts to identify potential future elk meadow mitigation areas have occurred in the last few years. In 2007 and 2008, DEA and ODFW discussed characteristics of elk meadow habitat in and near the park, and identified potential areas for mitigation. From this effort, approximately 48 acres on-site (within Scoggins Valley Park) were identified as mitigation for direct impacts to elk and elk habitat. In addition, a 40-acre forested site, adjacent to Sain Creek, but outside the park boundaries, was identified as a potential site. The Partners have committed to replacing all elk habitat lost as a part of the project. This includes the entirety of meadows 1, 2a, 2b, and 2c, portions of which would be impacted by inundation, recreation, and other human disturbance.

In 2008, CWS developed a GIS model in order to better identify potential elk meadow mitigation sites (CWS, 2008). First they researched the physical (terrain) and biological habitat components of winter range habitat: slope, elevation, aspect, and vegetation. Next, they defined spatial criteria for mapping each component with GIS data and combined the GIS layers to represent winter range habitat suitability using neighborhood analysis. This approach highlights areas that contain high levels of habitat value described by the criteria. Large areas of potential elk meadow habitat with high suitability terrain features were identified across the project area.

By visually reviewing the habitat model results with aerial photos, taxlots, and roads, CWS then narrowed the potential mitigation sites by eliminating sites clearly inappropriate for mitigation. Generally, the highest suitability meadows with the fewest visible structures emerged as target areas. The selection of target areas was biased toward connectivity with existing USBR or other public lands, but they included private lands in several instances.

Determining the final elk mitigation sites for the TBWSP will require analysis of several more practical factors, including local site conditions, land owner negotiations, integration of additional elk distribution data (if available), and agency/peer review. Therefore the results of the study will remain as a separate document to be developed and incorporated into future mitigation planning. ODFW is concerned that if pushed out of the project area by construction, elk could remain in the agricultural areas lower in the valley. However, ODFW would like them to remain higher up in the valley. The Partners intend to implement the elk mitigation prior to construction of the dam in order to encourage use of the new meadows by elk and thereby reduce or eliminate temporary impacts to elk from construction in and
near existing elk meadows. The completed mitigation would decrease human conflicts and provide much better habitat for elk in and near the park.

**Western Gray Squirrel Mitigation**
Management recommendations for the squirrel include removing overtopping Douglas-fir trees (except old-growth trees); thinning dense understory oak and Douglas-fir to release remaining oaks; maintaining or developing habitat corridors to link scattered oak patches; using prescribed burning to prevent dense shrub competition; and promoting oak woodland conservation and enhancement on public and private lands through information, education, and legislation.

**Bird Mitigation**
Pre-Construction planning will include a survey plan to conduct nest searches prior to construction. In addition, measures will be implemented to prevent nesting from occurring. Furthermore, construction will be sequenced in order to avoid impacts to migratory birds. DEA has worked with construction firms for such large-scale projects in the past, and will coordinate with Audubon care staff prior to construction and develop a contingency plan if nests are disturbed.

Other mitigation for impacts to bird habitat would focus on migratory species which are listed in the Oregon Conservation Strategy, such as acorn woodpecker, chipping sparrow, great blue heron, and western bluebird, among others. Specific strategies that would benefit these species include oak restoration and reduction of human disturbance in portions of the park.

**Amphibian Mitigation**
Timing and extent of reservoir drawdown is not projected to alter impacts to amphibians greatly. However, since the surface area of the lake will increase and thereby increase the sink effects of the reservoir for species that may attempt to lay their eggs along the reservoir edge, mitigation should be addressed. Potential mitigation for drawdown impacts to amphibians could include management of fringe wetlands to maintain hydrology longer into the summer and fall. Temporary wetlands could be constructed on site, with a goal of discouraging use by invasive bullfrogs.

- Amphibians will be removed from work area isolation measures (coffer dams, et al.) during fish salvage operations.
- Cattle grazing exclusion can result in riparian tree recruitment and the formation of pools, which can lead to the expansion of frog populations (CRWC, 2004)
- Gain of 5 miles of accessible stream on Sain Creek from removal of Sain Creek dam.
- Gain of 23 miles of salmonid habitat in Gales Creek from dam removal.
- Improved water quality in Tualatin River.

**Reptile Mitigation**
As discussed previously, timing and extent of reservoir drawdown is not expected to greatly impact turtle behavior at the lake since it will not change greatly from existing conditions. Drawdown may impact existing turtle nesting habitat, and will alter the location and duration of existing preferred foraging and basking habitat. Turtle haul-out sites can be created as mitigation for these impacts.
Mitigation measures proposed for northwestern pond turtle would benefit the painted turtle, but should be designed to keep the following considerations in mind:

“Conservation actions to improve conditions for western painted turtles in Oregon include improving aquatic and terrestrial habitats especially in managed waterways such as the Columbia Slough, increasing connectivity among populations, and reducing loss of adults by decreasing road mortality and reducing illegal removal by the public. Improving or creating nest habitat, hatchling habitat, and basking structures in some aquatic habitats and managing recreation near turtle-use areas are feasible management actions. Populations of introduced and invasive species, especially the red-eared slider and more recently thecommon snapping turtle, need to be managed.” (Conservation Assessment of the Western Painted Turtle in Oregon. 2009).
4.8 NON-LISTED WILDLIFE AND VEGETATION .............................. 4.8-1

4.8.1 Affected Environment .................................................................... 4.8-1
4.8.2 Environmental Impacts ..................................................................... 4.8-22
4.8.3 Mitigation Measures ......................................................................... 4.8-47

Figure 4.8-1. Vegetation Associations, Henry Hagg Lake (File Name: Fig 4.8-1 Veg Associations.pdf) ................................................................. 4.8-3
Figure 4.8-2. Elk Meadow Habitat, Henry Hagg Lake (File Name: Fig 4.8-2 Elk Habitat.pdf) ............................................................................. 4.8-3
Figure 4.8-3. HHL Habitat Types (File Name: Fig 4.8-3 ODFW Habitat.pdf) ...... 4.8-6
Figure 4.8-4. RWP Habitat Types (File Name: Fig 4.8-4 RWP Habitat Sheet 1 of 3.pdf, Fig 4.8-4 RWP Habitat Sheet 2 of 3.pdf, and Fig 4.8-4 RWP Habitat Sheet 3 of 3.pdf) 4.8-7
Figure 4.8-5. Historical Scoggins Dam & Hagg Lake Storage and Elevation Data 4.8-31
Figure 4.8-6. Projected Future Scoggins Dam & Hagg Lake Storage and Elevation Data under Alternative 2 ......................................................... 4.8-32

Table 4.8-1. Henry Hagg Lake Resource Management Plan Vegetation Associations 4.8-2
Table 4.8-2. Raw Water Pipeline Corridor Vegetation Associations .............. 4.8-4
Table 4.8-3. As illustrated in Figures 1 and 2, the following permanent impacts can be anticipated from the implementation of the TBWSP Preferred Alternative: 4.8-12
Table 4.8-4. Common mammal species occurring in the vicinity of Henry Hagg Lake. 4.8-13
Table 4.8-5. Common amphibian and reptile species occurring in the vicinity of Henry Hagg Lake ................................................................. 4.8-21
Table 4.8-7. Common bird species occurring in the vicinity of Henry Hagg Lake 4.8-18
Table 4.8-8. Vegetation Impacts at Henry Hagg Lake from Alternative 2, in Acres 4.8-25
Table 4.8-9. Wetland Impacts at Henry Hagg Lake, Scoggins Dam 40-Foot Raise 4.8-27
Table 4.8-11. Breeding and Birthing Season of selected common mammal species occurring in the vicinity of Henry Hagg Lake ........................................ 4.8-28
Table 4.8-12. Direct Impacts to Elk Meadow Habitat at Henry Hagg Lake, Alternative 2 4.8-29
Table 4.8-13. Amphibian and Reptile Reproductive Timeline and Habitat Use .. 4.8-33
Table 4.8-14. Vegetation Impacts along the Raw Water Pipeline Corridor, in Acres 4.8-37
Table 4.8-10. Wetland Impacts at Raw Water Pipeline, Scoggins Dam 40-Foot Raise 4.8-39
Table 4.8-15. Long-Term Vegetation Impacts at Henry Hagg Lake, Alternative 34.8-43
Table 4.8-16. Impacts to Elk Meadow Habitat at Henry Hagg Lake, Alternative 34.8-45

4.8-52
Vegetation Associations
Henry Hagg Lake

40' Dam Raise
25' Dam Raise
Road Relocation
Existing Road Location

Vegetation Associations

Conifer Forest
Clearcut: 1-5 years
Clearcut: < 1 year
Mixed Forest
Mixed Shrub/Upland Grassland
Upland Grassland
Elk Meadow
Wetland
Riparian
Open Water
Developed

Data Sources:
Reclamation, 2004
Proposed 40-acre Sain Creek Elk Meadow Mitigation Area

RECREATION AREA C

SCOGGINS CREEK PICNIC AREA

RECREATION AREA A

SCOGGINS CREEK PICNIC AREA

ELKS PICNIC AREA

Borrow Area

Admin & Main Facility

Legend

- Park Boundary
- Existing Roads
- Road Relocation
- 25-ft Dam Raise (330')
- 40-ft Dam Raise (345')
- Existing Elk Meadow
- Designated Future Elk Meadow (not yet implemented)
- Elk Meadows Impacted by Inundation and Construction
- Elk Meadows Impacted by Recreation Plan or ODFW Request

File: P:\C\CWSD00000016\0600INFO\GS\arcmap\EIS\EIS_figures\February 2010\EIS\drawing\4_21_ElkHabitat_012610.mxd
Printing Date: Wednesday, February 24, 2010 9:24 AM
Legend

Survey Corridor
Potential Raw Water Pipeline Centerline
Open Water
Vegetation Associations

Agriculture
Developed
Mixed Forest
Riparian
Tree Farm

Figure 1
ODFW Habitat Mapping - RWP
Sheet 3 of 3

Locator Map

Sheet 3
Sheet 1
Sheet 2

0 800 1,600 Feet
4.9 Threatened, Endangered, and Sensitive Species

This section evaluates the potential effects on Threatened, Endangered, and Sensitive (TES) species and their habitats, as well as Essential Fish Habitat (EFH) designated under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). TES species are those that are state and/or federally listed, considered sensitive by the state or are included within the Oregon Conservation Strategy (ODFW 2006c). Non-listed vegetation and wildlife are addressed separately in Section 4.8. The list of species considered was compiled from the following list of sources:

- FWS consultation letter and county species’ lists (FWS 2003; FWS 2006a; FWS 2006b, FWS 2010)
- Oregon Natural Heritage Information Center (ORNHIC) database results (2005a, 2005b, 2006, 2009)
- USFWS Federally Listed, Proposed, Candidate, Delisted, and Species of Concern in the state of Oregon (May 2009)
- ODFW Oregon Threatened, Endangered, and Candidate Species in the state of Oregon (accessed August 2009)
- ODFW Sensitive Species List (December 2008)
- NMFS website (http://www.nwr.noaa.gov)
- ODFW Distribution and Habitat Maps (2004)
- TES species identified and described in the Henry Hagg Lake Resource Management Plan, issued by Reclamation in May 2004 (Reclamation 2004a)

This section is limited to the species specified in the sources listed above and by available information regarding those species habitat preferences, life histories, and distribution. This section focuses on state and federally listed TES species identified as potentially occurring or potentially having suitable habitat in the project area. The following are additional studies that were used in the preparation of this section:

- Tualatin Basin Water Supply Feasibility Study (MWH 2004)
- Raw Water Pipeline Preliminary Design Report (MSA 2006)
- Henry Hagg Lake Resource Management Plan (Reclamation 2004a)
- Henry Hagg Lake Resource Management Plan, Final Environmental Assessment (Reclamation 2004b)
- Upper Tualatin-Scoggins Watershed Analysis (BLM 2000)
- Endangered Species Act, Section 7 Considerations technical memorandum regarding the TVWD water supply improvements program (Adolfson 2006a)
Environmental Conditions Reconnaissance Memorandum regarding the TVWD pipeline alignment and water tank sites (Adolfson 2006b)

A description of these documents (except for Adolfson 2006a, 2006b) is provided in the MWH TES report (MWH 2006e) and each is included in the reference section. Information in the fish habitat section is summarized from the Fish Habitat Technical Report (R2 2006). Effects from the potential construction of the Willamette Pipeline have not been addressed in other reports, although Adolfson (2006a, 2006b) notes the presence of salmonid habitats in streams crossed by the pipeline corridor, and also notes the absence of listed plant species. MWH summarized the findings from the CH2M Hill technical memorandum and provided an analysis of the impacts from potential modifications to Scoggins Dam in a technical report (MWH 2006e).

4.9.1 Affected Environment

Descriptions of existing habitat conditions in the project area are provided in the sections addressing vegetation and non-listed wildlife (Section 4.8) and non-listed aquatic species (Section 4.7). This section provides a description of the TES species identified as potentially affected by the project alternatives, including ESA status, species range and occurrence in project area, and life history. Effects on the following species have been eliminated from further analysis because their range is not within the project area, they have not been recorded in or near the project area, or they have been extirpated from the State of Oregon.

- Pacific fisher
- Washington ground squirrel
- Oregon spotted frog
- Southern torrent salamander
- Marbled murrelet
- Yellow-billed cuckoo
- Lewis’ woodpecker
- Upper Willamette River chinook salmon
- Oregon giant earthworm
- American acetropis grass bug
- Fender’s blue butterfly
- Oregon silverspot butterfly
- Peacock larkspur
- Willamette Valley daisy
- Water howellia (extirpated)

1 Upper Willamette Chinook salmon is not known to occur in the project area but is an MSA species with potentially suitable habitat elements in and free access to the project area. Therefore, Upper Willamette Chinook is discussed in section 4.9.1.3 relative to EFH.
- Bradshaw’s lomatium
- Golden paintbrush (extirpated)
- Queen-of-the-forest
- Bog anemone
- White-top aster
- Willamette Valley larkspur
- Coast range fawn lily

Additional information about these species and their habitats is available in the Administrative Record. Table 4.9-1 lists all TES species that are addressed further in this document.
### Table 4.9-1. Federally Listed Threatened, Endangered, Candidate, and Species of Concern, State Threatened and Endangered Species, State Sensitive Plant and Wildlife Species, and Oregon Conservation Strategy Key Species addressed further in this document

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Federal Status</th>
<th>Oregon State Status</th>
<th>Heritage Program List</th>
<th>Oregon Conservation Strategy Key Species</th>
<th>Known to Occur in Project Area?</th>
<th>Potential Habitat in Project Area?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fringed myotis</td>
<td>Myotis thysanodes</td>
<td>SoC</td>
<td>SV</td>
<td>2</td>
<td>No</td>
<td>Roost sites include buildings,</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>caves, bridges</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Forested areas with rock</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>outcrops; uses snags/hollow</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>trees for roost</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Montane coniferous forests;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>roosts in buildings, rock crevices,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>under bark</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Variable but generally prefers</td>
<td></td>
</tr>
<tr>
<td>Long-eared myotis</td>
<td>Myotis evotis</td>
<td>SoC</td>
<td>--</td>
<td>4</td>
<td>No</td>
<td>forested or riparian areas</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Forested areas adjacent to lakes,</td>
<td></td>
</tr>
<tr>
<td>Long-legged myotis</td>
<td>Myotis volans</td>
<td>SoC</td>
<td>SV</td>
<td>4</td>
<td>No</td>
<td>ponds, and streams; uses</td>
<td>No</td>
</tr>
<tr>
<td>Pacific western big-eared</td>
<td>Corynorhynchus townsendii townsendii</td>
<td>SoC</td>
<td>SC</td>
<td>2</td>
<td>Yes</td>
<td>snags/hollow trees for roost</td>
<td></td>
</tr>
<tr>
<td>bat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Riparian, desert scrub, moist</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>woodland and forest habitats</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>near open water</td>
<td></td>
</tr>
<tr>
<td>Silver-haired bat</td>
<td>Lasionycteris noctivagans</td>
<td>SoC</td>
<td>SV</td>
<td>4</td>
<td>No</td>
<td>Old growth coniferous forests</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>provide optimum habitat but they</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>can be found in younger</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>conifer stands</td>
<td></td>
</tr>
<tr>
<td>Yuma myotis</td>
<td>Myotis yumanensis</td>
<td>SoC</td>
<td>--</td>
<td>4</td>
<td>No</td>
<td>riparian-alder thickets found</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>along smaller streams</td>
<td></td>
</tr>
<tr>
<td>Red tree vole</td>
<td>Arborimus longicaudus</td>
<td>SoC</td>
<td>SV</td>
<td>4</td>
<td>Yes</td>
<td>Early seral plant communities</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or cultivated areas that resemble</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>such communities</td>
<td></td>
</tr>
<tr>
<td>White-footed vole</td>
<td>Arborimus albipes</td>
<td>SoC</td>
<td>--</td>
<td>4</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gamas pocket gopher</td>
<td>Thomomys bulbivorous</td>
<td>SoC</td>
<td>--</td>
<td>4</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bald Eagle</td>
<td>Haliaeetus leucocephalus</td>
<td>--</td>
<td>T</td>
<td>4</td>
<td>No</td>
<td>Forested areas in the vicinity of</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>lakes/rivers</td>
<td></td>
</tr>
<tr>
<td>Band-tailed pigeon Northern</td>
<td>Patagioenas fasciata Strix occidentalis</td>
<td>SoC</td>
<td>--</td>
<td>4</td>
<td>No</td>
<td>Oak canyons, foothills, chaparral,</td>
<td>No</td>
</tr>
<tr>
<td>spotted owl</td>
<td>carina</td>
<td>LT</td>
<td>LT</td>
<td>1</td>
<td>No</td>
<td>mountain forests</td>
<td></td>
</tr>
<tr>
<td>Mountain quail</td>
<td>Oreortyx pictus</td>
<td>SoC</td>
<td>--</td>
<td>4</td>
<td>No</td>
<td>Mature or old growth forests</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Melanerpes formicivorus</td>
<td>SoC</td>
<td>--</td>
<td>4</td>
<td>No</td>
<td>preferred for nesting</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dense brushy slopes in foothills</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>and mixed conifer forests</td>
<td></td>
</tr>
<tr>
<td>Acorn woodpecker</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>In Oregon, the species is closely</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>associated with oak woodlands</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Coniferous or mixed forests.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Prefers tall trees or snags for</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>singing/feeding perch in burned</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or wetland areas</td>
<td></td>
</tr>
<tr>
<td>Olive-sided flycatcher</td>
<td>Contopus cooperi</td>
<td>SoC</td>
<td>SV</td>
<td>4</td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

4.9-4
<table>
<thead>
<tr>
<th><strong>Oregon vesper sparrow</strong></th>
<th>Pooecetes gramineus affinis</th>
<th>SoC</th>
<th>SC</th>
<th>2</th>
<th>Yes</th>
<th>Grasslands, pastures, juniper woodlands, meadows, and agricultural lands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purple martin</strong></td>
<td>Progne subis</td>
<td>SoC</td>
<td>SC</td>
<td>2</td>
<td>Yes</td>
<td>Nests in tree cavities, boxes near open areas</td>
</tr>
<tr>
<td><strong>Streaked horned lark</strong></td>
<td>Eremophila alpestris strigata</td>
<td>C</td>
<td>SC</td>
<td>1</td>
<td>Yes</td>
<td>Open, thinly-vegetated land such as fields, prairies, dunes, upper beaches, and airports</td>
</tr>
<tr>
<td><strong>Yellow-breasted chat</strong></td>
<td>Icteria virens</td>
<td>SoC</td>
<td>SC</td>
<td>4</td>
<td>Yes</td>
<td>Second-growth forest, scrubland, and thickets including low wet places near streams, pond edges, and swamps</td>
</tr>
</tbody>
</table>

**Fish**

<table>
<thead>
<tr>
<th><strong>Pacific Lamprey</strong></th>
<th>Lampetra tridentata</th>
<th>SoC</th>
<th>SV</th>
<th>4</th>
<th>Yes</th>
<th>Spawning: gravels (0.5 inch diameter) just upstream of riffles; rearing: silty pools and banks for burrowing and filter feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper Willamette River Coastal Cutthroat Trout</strong></td>
<td>Oncorhynchus kisutch</td>
<td>--</td>
<td>-</td>
<td>4</td>
<td>No</td>
<td>Spawning: low-gradient riffles in smaller cold water tributary streams and headwaters with pea-sized gravels; rearing: edge habitats in off-channel areas with complex cover</td>
</tr>
<tr>
<td><strong>Winter steelhead (Upper Willamette River)</strong></td>
<td>Oncorhynchus mykiss</td>
<td>LT</td>
<td>SV</td>
<td>1</td>
<td>No</td>
<td>Spawning: clean 1 to 4 inch diameter gravel in small streams, often in pool tailouts; rearing: fast pools, glides, riffles, complex cover</td>
</tr>
<tr>
<td><strong>Willamette River Chinook (fall and spring)</strong></td>
<td>Oncorhynchus mykiss</td>
<td>LT</td>
<td>SV</td>
<td>1</td>
<td>No</td>
<td>Spawning: clean 1 to 4 inch diameter gravel in small streams, often in pool tailouts; rearing: fast pools, glides, riffles, complex cover</td>
</tr>
</tbody>
</table>

**Reptiles and Amphibians**

<table>
<thead>
<tr>
<th><strong>Northern red-legged frog</strong></th>
<th>Rana aurora aurora</th>
<th>SoC</th>
<th>SV</th>
<th>4</th>
<th>Yes</th>
<th>Vegetated margins of slow-moving water bodies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Western pond turtle</strong></td>
<td>Actinemys marmorata</td>
<td>SoC</td>
<td>SC</td>
<td>2</td>
<td>Yes</td>
<td>Slow-moving water bodies with basking sites on logs, rocks, mudbanks, or cattail mats</td>
</tr>
<tr>
<td><strong>Western painted turtle</strong></td>
<td>Chrysemys picta</td>
<td>--</td>
<td>SC</td>
<td>2</td>
<td>Yes</td>
<td>Slow-moving, shallow water with basking sites; streams, marshes, ponds, lakes, creeks</td>
</tr>
</tbody>
</table>

**Plants**

| **Kincaid’s lupine** | Lupinus sulphureus var. kincaidii | LT | LT | 1 | Yes | Native upland prairie |

4.9-5
Nelson's checker-mallow

*Sidalcea nelsoniana*

LT  
LT  
1  
Yes  
Meadow swales, field and stream edges, roadside ditches  
No  
Yes

Thin-leaved peavine

*Lathrys holochlorus*

SoC  
-  
1  
No  
Roadsides, fencerows, grassland, open forests  
No  
Yes

White rock larkspur

*Delphinium leucophaeum*

SoC  
LE  
1  
Yes  
Dry bluffs, fields, rocky ledges  
No  
Yes

Sources: ORNHIC 2007; ODFW Sensitive Species List 2008; Reclamation 2004a; Meinke 1982; Natureserve 2008


2. Oregon Department of Fish and Wildlife Classifications (for state-listed animals): LE = Listed Endangered, LT = Listed Threatened, SC = Critical (species for which listing as threatened or endangered would be appropriate if immediate conservation actions were not taken), SV = Vulnerable (species that are not in imminent danger of being listed as threatened or endangered, but which could become SC, LT, or LE with changes in populations, habitats, or threats), SU = Undetermined Status (species for which status is unclear; they may be susceptible to population declines that may result in a listing as LE, LT, SC, or SV, but additional research is needed).


4. Oregon Natural Heritage Information Center List Number: 1 = taxa which are endangered or threatened throughout their range or which are presumed extinct, 2 = taxa which are threatened, endangered, or possibly extirpated from Oregon but which are stable or more common elsewhere, 4 = Watch List (currently stable). A null value indicates the species is not currently on the ORNHIC rare species list.


6. Willamette Falls were historically a barrier to upstream migration of fluvial type cutthroat, but the falls are no longer an impediment due to the installation of a fish ladder. Sea-run type cutthroat below Willamette Falls have declined and are not believed to migrate through the fish ladder, and therefore would not be found in the Tualatin River. Large fluvial type life histories of cutthroat are represented, and some will move from the Willamette River into the Tualatin River to spawn and rear.
4.9.1.1 Federally Listed (Threatened and Endangered), Candidate, and Sensitive Species
This section provides species range, life history information and the potential to occur within the project area for the following federally listed species: Northern spotted owl, streaked horned lark, Upper Willamette River steelhead trout, and Nelson’s checker-mallow. Species are grouped for discussion according to their general taxonomic group Birds, Fish and Plants. Discussions of other TES species are provided in Section 4.9.1.2.

4.9.1.1.1 Federally Listed and Candidate Bird Species
Northern Spotted Owl
The FWS listed the northern spotted owl as a threatened species on June 26, 1990 (Federal Register 55:26114). Northern spotted owls have been documented approximately 15 miles from Henry Hagg Lake (Reclamation 2004b). Although there is no critical habitat located within the Tualatin Basin, in 1993 the Forest Ecosystem Management Assessment Team identified isolated areas of suitable northern spotted owl nesting, roosting, or foraging habitat along some areas near Scoggins Creek tributaries above Henry Hagg Lake (Regional Ecosystem Office 2004b). However, no suitable habitat or species occurrences have been documented in areas that would be disturbed by construction activities (Regional Ecosystem Office 2004b; ORNHIC 2010). In summer 2010, DEA conducted site visits throughout the entire project area to determine if potentially suitable northern spotted owl habitat was present. Upon conducting these surveys, it was determined that, while some scattered mature trees were present, there were no large, continuous blocks of suitable habitat present within the project area. In addition, adult barred owls were detected twice along the northern edge of Henry Hagg Lake near some of the moderately sized blocks of more mature forest. Since barred owls are highly territorial and often prey on spotted owls, their presence indicates that spotted owls are unlikely to inhabit the project area. The northern spotted owl will not be addressed further.

Streaked Horned Lark (Candidate Species)
The streaked horned lark was listed as a federal candidate species under the ESA on October 30, 2001, and is listed as State Sensitive in Oregon. The federal candidate listing applies only to the Willamette Valley breeding population (subspecies streaked horned lark); however there are no recent breeding records in the Willamette Valley area (Reclamation, 2004a; Marshall, 1992; ORNHIC). There is no federally designated critical habitat for the streaked horned lark. They historically used native grassland and savanna in Oregon, however it is estimated that greater than 99 percent of these habitats may have been converted (Federal Register 66:54808). Streaked horned larks nests in grasslands and open fields in short sparse vegetation such as grazed pastures, fallow fields, seasonal mudflats, airports, and Columbia River dredge spoils (USFWS, 2003d; Marshall, 1992).

The streaked horned lark was historically common in western Oregon (Marshall et al., 2003; Marshall, 1992). It is now estimated that there are less than 200 breeding pairs in the state, none of which are known to originate from Washington County. The last known nesting habitat for streaked horned lark occurred on a dredged industrial site owned by the Port of Portland (USFWS 2008). The subspecies breeds in the Willamette Valley, but are most common near the Corvallis Airport and in the central Willamette Valley.
Streaked horned lark over-winter in large groups in the Willamette Valley, especially among grass seed farms. Wintering habitat requirements in the Willamette Valley are as follows (Pearson and Altman, 2005): areas with a high percent of bare ground (sites with flocks > 20 birds averaged greater than 85% bare ground) and large expanses of treeless areas. Most streaked horned larks use agricultural fields, particularly rye grass fields with sparse ground cover.

Overwintering birds may be present in portions of the project area, especially along the RWP. A small flock of streaked horned larks foraged in a tilled area for several days during site preparation work in summer 2006, shortly after the breeding season was likely over. In addition, singing male streaked horned larks were confirmed along the northern edge of the RWP on Metro property in 2007 and 2008 (in the Lovejoy wetlands mitigation site near the Fern Hill WTP near the northern terminus of the RWP [Weil, pers. comm., 2010]). Although these sightings do not prove active breeding, they do indicate use of the habitat by the species and the potential for breeding habitat for streaked horned lark within the Lovejoy wetlands mitigation site.

The Lovejoy wetlands mitigation site includes mesic prairie restored from agricultural lands. This wetland mitigation site was implemented according to a plan approved jointly by Metro and NRCS to maximize plant diversity for use by waterfowl, songbirds, terrestrial amphibians and mammals. The area has been seeded with native wetland plants including small-fruited bulrush (Scirpus microcarpus), one-sided sedge (Carex unilateralis), and rice cutgrass (Leersia oryzoides) (Weil, pers. comm., 2010).

The RWP corridor consists mainly of agricultural lands, including grass fields with bare ground areas and fallow fields potentially used by the species. Therefore nearly the entire corridor could qualify as potential habitat. Due to an ever-changing regime of crop rotation, disturbance, and fallowing, breeding habitat is unlikely to be present along the RWP.

The Hagg Lake area is not likely to be used by streaked horned lark because habitat conditions for streaked horned lark are not believed to be favorable around Henry Hagg Lake, and the species has not been documented within Scoggins Valley Park. While streaked horned larks are unlikely to breed in the vicinity of Henry Hagg Lake, they could potentially over-winter in the suitable grassland habitat and unvegetated flats limited to Scoggins Valley Park (BOR 2004a).

The elk meadows and other grassy fields around Henry Hagg Lake are kept at heights and bare ground ratios which make it unlikely they would be used by streaked horned larks. Little bare ground is present within the grasslands and average grass height is maintained at or above 6 inches. Tree farms along the southern end of Henry Hagg Lake may also provide breeding habitat for streaked horned lark as supported by research showing that streaked horned lark in the Willamette Valley may at times utilize tree farms for breeding habitat (Pearson and Altman 2005).

4.9.1.1.2 Federally Listed and Candidate Fish Species

**Upper Willamette River Steelhead Trout**

In 1992, the FWS developed a draft listing determination for 10 distinct population segments of West Coast steelhead (Federal Register 71:834). The NMFS Biological Review Team concluded that the Upper Willamette River steelhead ESU is “...not at risk of extinction or likely to become endangered within the
foreseeable future” and therefore concluded that the ESU would be listed as threatened. Critical habitat for the Upper Willamette ESU was revised on September 2, 2005 (Federal Register 70:52630). For Upper Willamette River steelhead, all watersheds within the Tualatin River subbasin were proposed to be excluded from critical habitat, with the exception of the Gales Creek watershed and the mainstem Tualatin River from the mouth of Gales Creek to the mouth of McKay Creek. However, even though McCay Creek, the Dairy Creek system, and the upper Tualatin Basin above Lees Falls, are not documented as critical habitat, steelhead do utilize these areas. In addition, winter steelhead spawned and reared in upper Scoggins Creek before construction of the existing Scoggins Dam.

Although the Oregon Native Fish Status Report (ODFW 2005) identifies four populations on the west side of the Willamette Valley, other authorities assume that the West Side Tributaries (primarily the Tualatin and Yamhill Rivers) represent an area of intermittent use by steelhead, which may be important for ESU, but is not considered to have historically been an independent population (Myers et al. 2006). Nonetheless, ODFW has stressed that winter steelhead are considered to be native to the basin by the agency, and that they continue to utilize the Tualatin and tributaries.

Over the period of record (1971 – 2007 (USFWS) returns of native late winter steelhead at Willamette Falls (ODFW 2007), have averaged 7,613. Returns of steelhead have shown a slight increase in the last ten years compared to the overall 20 year average. During the ten year period from 1998 to 2007, returns ranged from 2,921 to 11,106 with an average of 5,985 while the overall average for the 20 years between 1988 and 2007 was 5,540.

Steelhead are present in some of the streams that would be crossed by the Willamette Pipeline such as the Tualatin River and Johnson Creek. Steelhead migrate through the portion of the Tualatin River that would be crossed by the Willamette Pipeline (Adolfson 2006a). In addition, there are four unnamed tributaries that would be crossed along SW Beef Bend Road as well as a crossing at Summer Creek; however these sites are not documented as steelhead habitat (Adolfson 2006a). Steelhead spawning and rearing habitat is located downstream of the southern crossing of Johnson Creek, and rearing and migration habitat is downstream of the northern crossing of Johnson Creek (Adolfson 2006a).

Steelhead are an anadromous form of *Oncorhynchus mykiss*, an adaptable salmonid that expresses both resident and migratory life histories. Juvenile steelhead can spend up to 4 years rearing in freshwater before migrating to the ocean as smolts; however, most steelhead smolts leave for the ocean after two or three years in fresh water. They will then spend up to 3 years in the ocean growing and maturing before returning to natal streams to spawn. Adults returning to spawn enter fresh water in March and April and spawn in late April and May. Steelhead are unique among Pacific salmon in that they can spawn more than once. After completion of a first spawning, a kelt (term used to describe spent steelhead adults) will migrate downstream to the ocean for an additional period of growth and return to spawn again in a later year.

Steelhead spawning typically occurs at the downstream end of pools (where they grade into a faster moving habitat type) or in riffles with gravel substrate. The female digs a pit in the gravel where she deposits her eggs. Often more than one male will fertilize the eggs before the female covers the eggs.
with gravel, creating a redd (nest). During the egg incubation period, sufficient water must circulate through the redd to supply embryos with oxygen and remove waste products. Abundant fine sediments can interfere with this process and result in embryo mortality.

Rearing juveniles prefer water temperatures ranging from 12 to 15 °C (53.6 to 59 °F). Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects, and older juveniles sometimes prey on emerging fry. Juvenile steelhead emerge from the gravel after approximately five to eight weeks, typically between March and April, depending on water temperature. Young-of-the-year steelhead (steelhead produced during the same year) often utilize riffle and run habitat during the growing season (spring and summer) and move to deeper, slower water habitat during the high-flow months. Larger juvenile steelhead, usually yearlings or older, have been observed to use heads of pools for feeding. The pools provide deeper water with sufficient cover to hide from predators and a food source as water enters the head of the pools carrying invertebrate prey. Productive steelhead rearing habitat is characterized by complexity, primarily in the form of large and small wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Busby et al. 1996).

ODFW stocked hatchery winter steelhead trout in the upper Tualatin River and Scoggins Creek between 1976 and 1998 to mitigate for loss of habitat from construction of Scoggins Dam. Approximately 10,000 smolts were planted each year in the Tualatin River and Scoggins Creek. ODFW discontinued release of hatchery steelhead trout into the system in 1999 (Upper Tualatin/Scoggins Watershed Plan) (BLM 2000) and chose to instead focus on habitat improvement as mitigation.

Today the Tualatin River continues to serve as a migratory corridor for adult steelhead returning to spawn in its tributaries and its upper mainstem reaches. Winter steelhead were estimated to use 46 percent of the Tualatin River habitat between miles 7.5-44.6 for migration, 22 percent of stream habitat between miles 44.6-62.5 primarily for rearing and migration, and 15 percent of stream habitat between stream miles 62.5-66.3 and again between stream miles 66.8-74.5 primarily for spawning and rearing (Streamnet 2008). While the mainstem Tualatin River below Scoggins Creek does not support steelhead spawning, the lower reach of Scoggins Creek and other downstream tributaries may provide spawning habitat (ODFW 2003, Streamnet 2008, ODEQ 2001).

Steelhead run timing through the project area can be estimated from passage counts at Willamette Falls. Adult steelhead migrate past Willamette Falls from November to May, with peak migrations in March (PGE and BHPC 2002). Juvenile steelhead migrate past Willamette Falls from March-July (ibid).

According to ODFW (2003), winter steelhead emergence in tributaries to the Tualatin can occur from mid-January through mid-July, though peak occurrence is limited to mid-February through June. Length of steelhead egg incubation varies greatly in response to water temperature. At 4°C, steelhead eggs incubate as long as 85 days while at 12°C eggs only take 26 days to reach 50% hatch. In general, eggs spawned in the Willamette basin can be expected to emerge within 5 to 16 weeks (Shapovalov and Taft 1954, Moyle 1976, NMFS 1998).

Steelhead require a minimum depth of 0.18 meter and a maximum velocity of 2.44 meters/second for active upstream migration. Spawning and initial rearing of juvenile steelhead generally takes place in
small, moderate-gradient (generally 3 to 5%) tributary streams. A minimum depth of 0.18 meters, water velocity of 0.30-0.91 meters/second (Smith 1973), and clean substrate of 0.6-10.2 centimeters (cm) are required for spawning. Steelhead spawn in 3.9-9.4°C water.

Streamnet database reports steelhead use only 28.4% of the 5.1 miles below Scoggins dam for spawning and rearing. Additionally, Scoggins Creek has been given a subjective rating of “Poor” to “Poor to Fair” based on the limiting factors for salmonids in Scoggins Creek (White 2003). These factors included spawning area, pool and riffle abundance, presence of undercut banks, aquatic invertebrate production, bank cover, and instream structure.

The recent IFIM study of Scoggins creek, between Scoggins dam and the Tualatin River, found an average gradient of 0.19% (R2 2006). Riffle habitat comprises only 0.5% of this reach. The riparian condition of the upper 1/3 of this reach was dominated by grasses providing little or no instream coverage, while the lower 2/3 of the reach was lined with medium to large hardwoods and Himalayan blackberry. The channel ranged from 15-20 ft wide, including the uppermost 2,200 ft, which has been straightened and channelized. Habitat characteristics specific to the three PHABSIM sites established for this reach are shown in Table 4.9-2.

Table 4.9-2. Characteristics of Scoggins Creek study reaches (CWS 2007).

<table>
<thead>
<tr>
<th>Scoggins Creek Study Reach</th>
<th>Depth (ft)(^1)</th>
<th>Habitat Type</th>
<th>Gradient</th>
<th>Substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper</td>
<td>1.3</td>
<td>Glide: 99%</td>
<td>0.09%</td>
<td>Some small patches of suitably clean gravel, otherwise silt, sand and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Riffle: 1%</td>
<td></td>
<td>vegetation dominate.</td>
</tr>
<tr>
<td>Middle</td>
<td>6.9</td>
<td>Glide: 100%</td>
<td>0.04%</td>
<td>Silt and sand</td>
</tr>
<tr>
<td>Lower</td>
<td>1.4</td>
<td>Glide: 99%</td>
<td>2.4%</td>
<td>Cobble dominant with areas of bedrock, boulder, gravels and sand and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Riffle: 1%</td>
<td></td>
<td>silt.</td>
</tr>
</tbody>
</table>

\(^1\) Average maximum depth of three transects completed in each study reach at approximately 60 cfs.

Based on extensive modeling, Weighted Usable Area (WUA) for adult and juvenile steelhead habitat in the Tualatin River would be slightly higher or remain similar to baseline conditions in most months at all sites. Therefore, Alternative 2 would have a slightly positive impact on the Tualatin River sites within the project area. Furthermore, steelhead in other Tualatin basin streams located upstream of the lowest modeled Tualatin River reach (such as Gales and Dilley Creeks) would benefit from increased rearing habitat in the Tualatin. Tributaries downstream of the lowest modeled reach (such as McKay and Dairy Creeks) would also presumably benefit from the increases in WUA in the Tualatin River\(^1\), if those effects extend downstream past the lowest modeled reach. However, it is expected that the positive effects of altered flow would be “diluted out” with increasing distance downstream from Scoggins Creek.

In the Tualatin River watershed, the greatest hazard faced by salmonids such as steelhead is the lack of quality habitat. Threats to salmonid habitat in the watershed include loss of habitat diversity, diminished water quality (including elevated water temperatures and low dissolved oxygen), and low summer and

4.9-11
fall stream flow. Migratory impediments, stream diversions, predation, and competition are other factors affecting salmonid populations. While predation and competition are natural ecological processes in aquatic systems, human activities can increase pressures from these sources by reducing the amount and diversity of available habitat, causing accidental predator introduction (Hawksworth 2001).

Both Scoggins Creek and the Tualatin River have been impacted by human activities. Scoggins Creek below the dam has been channelized for agricultural and flood control purposes. The Tualatin River has been channelized as a result of agricultural and urban development throughout the historic floodplain, and is dammed at approximately river mile 3.4. The channels in both systems are very uniform, highly entrenched, U-shaped, and lack habitat complexity. As the Tualatin River descends from the hills and enters the valley, the gradient declines dramatically; the river becomes wide, very flat, and the water slows accordingly. For both systems, substrates generally consists of fine sediments or bedrock with some boulders. Limited cobble/gravel substrate suitable for salmonid spawning habitat exists within the project area. However, two locations with suitable substrate but outside of the project area are approximately 1,000 feet downstream of Scoggins Dam on lower Scoggins Creek and upstream of the Old Highway 47 bridge. Riparian degradation contributes to poor aquatic habitats within the area. Loss of large trees over time has resulted in a lack of large wood in the stream and consequently a loss of pool habitat. Non-native riparian species such as grasses and Himalayan blackberry are abundant and provide little shade or cover for these systems.

4.9.1.1.3 Federally Listed and Candidate Plant Species

**Kincaid’s lupine**

Kincaid’s lupine was listed as threatened under the ESA on January 25, 2000. There is no federally designated critical habitat for the species. Kincaid’s lupine is thought to have been historically widespread in native upland prairies in the Willamette Valley. Currently it is restricted to remnant native upland prairie at only 54 sites across a 370-acre area. Outside of the Willamette Valley, Kincaid’s lupine is known to occur at four other sites in Oregon and two small sites in southern Washington (Federal Register 65:3875). No recent surveys have been conducted for the species.

Kincaid’s lupine’s preferred habitat is native upland prairie. Plant species associated with Kincaid’s lupine include fescues (*Festuca spp.*), Tolmie’s mariposa (*Calochortus tolmiei*), Hooker’s catchfly (*Silene hookeri*), broadpetal strawberry (*Fragaria virginiana*), rose checker-mallow (*Sidalcea virgata*), and desert parsley (*Lomatium spp.*). Kincaid’s lupine and suitable native upland prairie habitat are not known to occur within the project area (ORNHIC, 2005, 2006, 2009; Reclamation, 2004a). However, the 2009 ORNHIc search identified the species slightly more than one mile south of Henry Hagg Lake. Its presence is somewhat unlikely due to a lack of undisturbed, native habitat within the project area, but if suitable habitat is present, it may need to be inventoried to determine whether the species is present.

**Nelson’s checker-mallow**

Nelson’s checker-mallow was listed as threatened under the ESA on February 12, 1993 (Federal Register 58:8235). There is no federally designated critical habitat for this species.
Nelson’s checker-mallow is endemic to the Willamette Valley and Oregon Coast Range (Eastman, 1990). Six historic population centers have been identified in Oregon for the species: one in the Coast Range, and the remaining in the Willamette Valley. Five of these historic populations are currently populated. There is also an additional population center in Cowlitz County, Washington. In Oregon, the five population centers encompass 48 extant sites. The species has been extirpated from four previously known sites (Federal Register 58:8235). The species has been identified along the RWP near the Metro Lovejoy mitigation wetlands but outside the study area (Weil, pers. comm., 2010).

The decline of Nelson’s checker-mallow has been attributed to loss and degradation of wet prairie habitat from activities including agricultural conversion, changes in hydrology, and herbicide application. Other factors for decline include competition from nonnative plants and reproductive limitations (USFWS, 1998; Federal Register 58:8235).

Nelson’s checker-mallow can tolerate a variety of environmental conditions, and therefore suitable habitat may occur within the project area. There are no known occurrences of the species within the project area (ORNHIC, 2005, 2006; Reclamation, 2004a; USFWS, 1998), although suitable habitat may be present around the reservoir and along remnant native habitats along the pipelines, if such exist. As mentioned previously, it is known to occur along the RWP near the Metro Lovejoy mitigation wetlands, outside of the project area (Weil, pers. comm., 2010). Since native wet prairie is being restored within portions of the study area, there is a potential that the species could spread to the mitigation habitat as well.

4.9.1.2 Other Sensitive Species
This section summarizes non-federally listed TES species that may be present in the project area. Species are grouped for discussion according to their general taxonomic group Birds, Fish, Mammals, and Plants.

4.9.1.2.1 Sensitive Mammal Species
Sensitive mammal species that may be present within the project area are described below. These species include bats, voles, and other small mammals.

Bats
Pacific western (or Townsend’s) big-eared bat, silver-haired bat, fringed myotis, long-legged myotis, long-eared myotis, and Yuma myotis are all noted as occurring within Washington and/or Yamhill County by the FWS and are all listed as federal Species of Concern (FWS 2006a and FWS 2010). The Pacific western big-eared bat, Yuma myotis and fringed myotis are habitat generalists, while the silver-haired bat, long-legged myotis and long-eared myotis prefer forested areas. None of the species have been recorded within the study area, though no surveys are known to have occurred.

All of the bat species listed above are nocturnal, with most foraging activity focused in the early evening hours and daytime activities spent roosting in small crevices in trees, structures, and cliff faces. These species are insectivorous aerial foragers and may fly over a wide range of terrestrial habitats, depending on the location of the roost site. Roost sites include a variety of protected sites such as caves, crevices in cliffs, holes in trees or under bark, and in both occupied and unoccupied human structures with suitable
apertures and cavities (attics, eaves, bridges etc.). Suitable habitat may exist for all of these species within portions of the project area.

One occurrence of Pacific-western big-eared bat was noted within two-miles of the alignment proposed for the Willamette Pipeline (ORNHIC 2006); however, a location is not provided due to the sensitivity of the information. There were no documented occurrences of silver-haired bat, fringed myotis, long-legged myotis, long-eared myotis or Yuma myotis by Reclamation or the ORNHIC database search (Reclamation 2004a; ORNHIC 2005, 2006, 2009).

**Red Tree Vole**
The red tree vole is a federal Species of Concern and is one of the world’s most specialized voles, subsisting on a diet limited almost exclusively to Douglas fir needles (Csuti et al. 1997). Red tree voles are an arboreal vole that occasionally travels across the ground; however, since they are nocturnal, they are rarely detected. On the other hand, red tree vole nests are more commonly found. They often nest in large Douglas-fir trees in the lower third of the live crown (Natureserve, 2010). Threats to the red tree vole include loss of preferred old-growth forest habitat and forest fragmentation by clear-cutting practices.

Additional habitat for red tree vole includes mixed evergreen forests, especially wetter old-growth Douglas-fir forest and various other mesic habitats, including those dominated by grand fir, Sitka spruce, or western hemlock. They rarely inhabit young managed timber lands, and young stands may serve as barriers to dispersal.

Red tree vole may be present around the lake, although there are no documented occurrences. They are unlikely to occur along the RWP due to the extremely patchy and scattered nature of Douglas fir forest present along the alignment.

**White-Footed Vole**
The white-footed vole is a federal Species of Concern and is found along small, alder-lined streams, and is associated with density of alder and percent cover of hazelnut. This species is nocturnal and therefore it is difficult to document its presence.

Total population estimates for white footed vole are unknown. Despite various reports stating it is one of the as the rarest North American voles, it’s likely more common than documented occurrences indicate (Natureserve, 2010). While white footed vole is sometimes found in disturbed forests and early successional habitats, indicating some compatibility with standard forest practices, primary threats to white-footed vole include loss of habitat due to human activity.

Suitable white footed vole habitat is present along the alder and hazelnut lined tributaries to Henry Hagg Lake; however, its presence has not been documented. They are unlikely to occur along the RWP due to extremely patchy and scattered nature of alder-lined streams along the alignment.

**Camas Pocket Gopher**
The Camas pocket gopher is a federal Species of Concern and one of three mammals endemic only to Oregon (Csuti et al. 1997). Camas pocket gophers are restricted to the Willamette Valley area and are thought to have persisted by readily adapting to land converted for agricultural purposes. As such, they are common in agricultural and pastoral lands.

Camas pocket gophers generally inhabit unwooded hilly areas and lowlands and are associated with early seral plant communities or newly cultivated areas and areas of human inhabitance. Suitable habitat is usually found in deep, heavy clay soils, and can include weedy lawns, land disturbed by clearing, fields of alfalfa, wheat, or oats, or filbert orchards (Verts and Carraway 1998). Camas pocket gophers generally avoid wetlands and poorly drained grassy fields. They eat roots and tubers of various forbs, fruit and nut trees, root crops, plantains, and grasses. Pocket gophers are ecologically important as prey for a variety of raptors and mammals and provide additional ecological benefit by altering and aerating soils and creating microtopography.

They may be present around Henry Hagg Lake in elk meadows or upland grasslands, although they have not been documented there, and disturbance regimes and heavy soils are generally absent from the lake area. The RWP may provide some suitable habitat for camas pocket gophers; however much of the RWP consists of both wetlands and frequently inundated upland soils which are considered unsuitable conditions for camas pocket gophers.

4.9.1.2.2 Sensitive Bird Species

**Bald Eagle**

On July 9, 2007, the bald eagle was removed from the federal ESA (72 FR 37345 37372). However, it is still listed as state threatened and protected by the Bald and Golden Eagle Protection Act (Eagle Act) and the Migratory Bird Treaty Act (MBTA). The Eagle Act (16 USC 668-668c), enacted in 1940, and amended several times since then, prohibits anyone without a permit from taking, possessing, selling, purchasing, bartering, transport, export, or import any bald eagle, alive or dead, or any part, nest, or egg of a bald eagle. It also prohibits anyone from pursuing, harming, or disturbing bald eagles in any way. The MBTA (16 USC 703-712), enacted in 1918, prohibits the taking of any migratory bird or any part, nest, or egg, except as permitted by regulation. In 1972, the act was expanded to include the bald eagle.

National Bald Eagle Management Guidelines (FWS 2007b) have been developed by the FWS for advising landowners, land managers, and others that have public or private lands used by bald eagles. The guidelines provide information on how to comply with the protective provisions of the Eagle Act and the MBTA. To avoid disturbing nesting bald eagles, the guidelines recommend maintaining a distance between activity and the nest (distance buffers), maintaining forested (or natural) areas between activities and around nest trees (landscape buffers), and avoiding particular activities during the breeding season. The purpose of these buffers is to protect existing nest trees and provide for alternative or replacement nest trees. Eagles are unlikely to be disturbed by the ongoing routine use of roads, homes, and facilities, where such use pre-dates the eagles’ successful nesting activity in a given area.

4.9-15
However, intermittent, occasional, or irregular uses are likely to disturb eagles, even if they pre-date occupancy. In most cases, impacts of activities vary based on their visibility from a nest and the degree to which similar disturbance activities are already occurring in the area. Eagles are more prone to disturbance by an activity when it occurs in full view. To avoid impacts to bald eagle foraging areas, the National Bald Eagle Management Guidelines recommend minimizing potentially disruptive activities and development in eagles’ direct flight path between their nest or roost sites and important foraging areas.

Further natural history information and recommendations for complying with the Eagle Act and MBTA for bald eagle protection are provided in the FWS (2007) National Bald Eagle Management Guidelines.

Bald eagles frequently over-winter in Scoggins Valley Park (Reclamation 2004b) and the Oregon Natural Heritage Information Center (ORNHIC) shows three bald eagle nests in the vicinity of the project area. The first nest site (Nest 1) is located near Sain Creek approximately 0.9 mile west of Henry Hagg Lake. This nest has been known to produce young for several years, including 2006 (Manzer 2006; Isaacs and Anthony 2003; Isaacs and Anthony 2004; ORNHIC 2005). The second nest site (Nest 2) is located in the Fernhill Wetlands approximately 0.75 mile south of the city of Forest Grove. This nest is more than 0.5 mile from the RWP (CH2M Hill 2005b). The third nest (Nest 3) is located along Chicken Creek, approximately 1.5 miles north of the city of Sherwood and approximately 2 miles from the Willamette Pipeline corridor (ORNHIC 2006).

Numerous large trees with proximity to open water are available in the park and vicinity (URS 2003). Reclamation has identified seven primary bald eagle perch sites in Scoggins Valley Park. Park personnel maintain a 165-foot vegetation buffer around perch sites and restrict construction and other potentially disturbing activities during the months of October through May within a 0.5-mile radius of the perch sites (Reclamation 2004a).

**Band-tailed Pigeon**

The band-tailed pigeon is North America’s largest pigeon. In the Pacific Northwest, it inhabits coniferous forests and can also be attracted to feeders in suburban areas. The band-tailed pigeon is a federal Species of Concern and State Sensitive. Breeding Bird Survey data indicates this species is declining across its range; however, hunting of this species has long been popular and continues in many states, including Oregon.

Mineral springs and mineral graveling sites are important for nutritional purposes, especially during the nesting season, and pigeons show strong fidelity to these sites. Site use probably depends not only on mineral content, but also vegetation structure, development, level of human activity, and traditional use by pigeons (Natureserve, 2010).

The band-tailed pigeon is known to use the Scoggins Creek Picnic Area at Henry Hagg Lake (Gillson, 2006), and it is presumed to use other forested habitats around Henry Hagg Lake and along the RWP and Willamette pipeline corridors. In Oregon, they are most abundant in the western third of the Coast Range. They are associated with distribution of Pacific red elder and cascara, which they use as food sources, and will often forage in diverse habitats not used for nesting (Natureserve, 2010). Pacific red
elder and cascara as well as other food sources are present around Henry Hagg Lake, therefore suitable band tailed pigeon habitat exists within the project area.

**Mountain Quail**
The mountain quail is the largest native quail in North America, and is little understood due to its secretive nature (Marshall, et al. 2003). It inhabits brushy mountainsides, coniferous forest, forest and meadow edges, dense undergrowth, and favors areas with tall dense shrubs, close to water (Natureserve, 2010). Mountain quail have been located about 4 miles above the reservoir on Scoggins Valley Road, and they are thought to move to lower elevations nearer the reservoir during the winter (Reclamation 2004a). They are unlikely to be present near the RWP. Nesting occurs mainly from April to mid-July, with geographic variability (earliest at low elevations). In spring and summer mountain quail feed on herbaceous vegetation such as leaves, buds, and flowers of legumes, and insects, and eats seeds, acorns, and fruits during the rest of the year.

**Acorn woodpecker**
The acorn woodpecker is a medium-sized, brightly-colored woodpecker. The woodpecker is a federal Species of Concern and State Sensitive, and is locally common in the south Willamette Valley, but uncommon just south and west of Portland (Marshall, et al. 2003).

Their primary food source during winter months is acorns, which it stores in holes drilled in tree bark. In summer it feeds on insects, tree sap and some fruit, rarely small lizards, bird eggs and nestlings. It nests cooperatively in parts of range, and may nest as late as September or October (Natureserve, 2010).

As described in Section 4.8, oak forest occupies approximately 136 acres within Scoggins Park. Thick understory vegetation throughout much of the habitat in the study area may limit use of the area by acorn woodpecker. Although it has not been documented within the study area, it may use the oak forest or mixed forest around Henry Hagg Lake. While less likely, it may also use the patches of oak habitat remaining along the RWP and Willamette pipeline corridors.

**Purple Martin**
The purple martin is a common neo-tropical swallow species with a fairly continuous breeding distribution in the eastern United States but a patchy distribution throughout the west. In Oregon, the species is an uncommon summer resident in the Coast Range and Willamette Valley and breeds in regionally distinct areas, generally west of the Cascade Mountains. Purple martin is a federal Species of Concern with an ODFW status of sensitive critical (SC). The species has particular breeding requirements, preferring to nest in tree cavities or nest boxes near open forage areas, such as rivers, lakes, marshes, fields, and above the forest canopy.

There is at least one known record of this species in Scoggins Park (Reclamation 2004a). Additionally, purple martins are thought to occasionally nest in the forested habitat surrounding Henry Hagg Lake (Marshall et al. 2003).

**Olive-sided Flycatcher**
The olive-sided flycatcher is considered a federal Species of Concern and is State Sensitive. Olive-sided flycatchers nest in forested areas and forage in open forested areas. Several timber management techniques such as clear-cutting and selective thinning may increase foraging opportunities for olive-sided flycatcher. This species uses the suitable, forested habitats around Henry Hagg Lake (Gillson, 2006), and presumably portions of suitable habitat along sections of the RWP and Willamette Pipeline corridors.

**Oregon Vesper Sparrow**
The Oregon vesper sparrow is a federal Species of Concern with an ODFW status of sensitive critical. The protected subspecies breeds west of the Cascades. Vesper sparrows occur in open habitats such as grasslands, pastures, juniper woodlands, meadows, and agricultural lands. The species is rare to locally common in Christmas tree farms in the Willamette Valley and foothills (Marshall et al. 2003). The species breeds in Oregon during the summer months and winters in south to central California, the southwestern United States, and Mexico (Reclamation 2004a). Vesper sparrows were once common in western Oregon but have nearly vanished from the region since the early part of the century. While rare, this species has been reported to breed in the unmanicured Christmas tree farms around Scoggins Park and has been heard in the lower clearcuts around the reservoir (Reclamation 2004a, Marshall et al. 2003).

**Yellow-breasted Chat**
The yellow-breasted chat is considered a federal Species of Concern and is State Sensitive. The chat prefers early successional forests, shrubby pastures, and thickets, particularly in low, wet places near water features. In western Oregon, the chat breeds from May to June and is locally common. The species was observed displaying territorial behavior in shrubby areas west of Henry Hagg Lake during spring 2009 site visits. The yellow-breasted chat is also known to occur along Tanner Creek (Gillson, 2006) and may use other shrubby areas within the project area.

**4.9.1.2.3 Sensitive Fish Species**

**Pacific Lamprey (Stream and River Systems)**
Pacific lamprey was petitioned for listing under the Federal ESA but FWS determined that listing was not warranted. Pacific lamprey are an anadromous and parasitic species. The parasitic phase is restricted to the marine environment where lamprey can attach to large fish and marine mammals. Pacific lamprey return to freshwater in the summer and early fall, estivate in the substrate in fall and winter, and re-emerge in spring to move upstream into natal streams to spawn. Hormones emitted from young ammocoetes rearing in upstream reaches may be the attractant that facilitates this migration. Spawning Pacific lamprey are often observed during steelhead spawning surveys, and they often spawn in similar habitat. It is commonly thought that Pacific lamprey die after spawning but Kostow (2002) documents observation of out-migrating lamprey and evidence of repeat spawning.

Juvenile Pacific lamprey, termed ammocoetes, swim up from the nest and are washed downstream where they burrow into mud or sand to feed by filtering organic matter and algae. The ammocoetes generally remain buried in the substrate for five or six years, moving from site to site (Wydoski and Whitney 2003). Such an extended freshwater residence makes them especially vulnerable to degraded
stream and water quality conditions, including bedload disturbances. But the Tualatin basin has an abundance of soft sediments available for amocoete rearing.

Recent inventories of fish communities in Washington County streams suggest lamprey species are present throughout the Tualatin River Subbasin, including Scoggins Creek. Li and Gregory (1993) include Pacific lamprey in their description of the upper Tualatin River fish community and occasional lamprey of unidentified species have been documented by ODFW during electrofishing surveys of Henry Hagg Lake (ODFW unpublished data). The USGS has conducted, as yet, unpublished radio telemetry studies documenting Pacific lamprey migration over the Willamette Falls (Schreck 2008). Clemens et al (2006) further detailed their movements above the falls, noting that none of these tagged lamprey were detected within the Tualatin River. However, the number of tagged lampreys was small and other studies are underway to better understand Pacific lamprey use in the Tualatin basin.

**Willamette River Coastal Cutthroat Trout**

Willamette Falls was historically a complete barrier to cutthroat trout, and therefore, the sea-run form would not have historically existed in the project area. Currently, populations of sea-run cutthroat in the Willamette River below Willamette Falls have declined, and are not believed to migrate through the existing, upgraded fish ladder. However, streams in the project area are home to resident populations of Willamette River coastal cutthroat trout. Life history forms present likely include adfluvial, which reside in the large mainstems of the Willamette and Tualatin Rivers and migrate into tributaries to spawn, and resident forms, that reside for their entire lives within smaller tributary streams. Some potadromous cutthroat, who reside in lakes and move into tributaries to spawn, may be present above Scoggins Dam.

In Oregon, the cutthroat trout spawning season generally occurs from December through July. Stolz and Schnell (1991) reported that cutthroat trout spawning is initiated at 50°F (10°C) water temperature. Cutthroat trout spawn in low gradient reaches of small tributaries, or in the lower regions of streams. Use of this spawning habitat is likely an adaptation to reduce competition from other, more competitive species such as steelhead (Stolz and Schnell 1991). The preferred spawning substrate is pea- to walnut-sized gravel, in 15 to 45 cm of water, with pools nearby for escape cover. Spawning by individual females may extend over a period of two to three days (Trotter 1997).

Cutthroat trout are found in the mainstem Tualatin River and its tributaries such as Scoggins Creek and Gales Creek, and in Henry Hagg Lake and its tributaries. The resident forms are found in the upper tributary habitats, while adfluvial forms migrate into the Tualatin for a period of rearing, to return to the tributaries to overwinter and spawn.

In Henry Hagg Lake, cutthroat trout would be considered habitat generalists. Because cutthroat trout are opportunistic feeders, foraging in Henry Hagg Lake likely occurs in littoral, benthic, and pelagic habitats. Cutthroat trout may use littoral habitats more frequently in lakes where they co-occur with rainbow trout. Foraging and refuge are probably the main use of the lake by the lacustrine portion of the population. However, all lake dwelling cutthroat trout are dependent on the tributaries for spawning habitat (Wydoski and Whitney 2003).

4.9.1.2.4 Other Sensitive Fish Species Protected Under the Magnuson Stevens Act
Salmon fishery EFH includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except those above the impassable barriers identified by the Pacific Fishery Management Council. Chief Joseph Dam, Dworshak Dam, and the Hells Canyon Complex (Hells Canyon, Oxbow, and Brownlee Dams) are among the listed man-made barriers that represent the upstream extent of the Pacific salmon fishery EFH. Salmon EFH excludes areas upstream of longstanding naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). In the estuarine and marine areas, proposed designated salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (230.2 mile) offshore of Washington, Oregon, and California – north of Point Conception. Within the project area, this definition requires the inclusion of coho and chinook salmon in the discussion of sensitive species.

**Coho Salmon**
Coho populations are abundant above Willamette Falls and present in most tributaries of the Willamette upstream to the Santiam River. Adults spawn in many tributaries of the Tualatin and juveniles can be found rearing in many of the tributary streams where good access is available, including Chicken, Rock and Johnson Creeks, all of which are crossed by the Willamette Pipeline under Alternative 3. Coho salmon are known to occur within Scoggins Creek below Scoggins Dam and the mainstem Tualatin River within the project area. This population of coho is thought to be the lasting product of a hatchery release program conducted by ODFW prior to 1996 (Murtagh 2006).

Adult coho salmon begin migrating through the Tualatin River and its tributaries in September and continue through December (ODFW 2003). Within the lower tributaries of the Tualatin River (i.e. below Scoggins Creek), spawning generally occurs mid-October thru December. Juveniles generally spend about one year in fresh water before migrating to the ocean. Juvenile coho salmon within the Tualatin River and its tributaries below and including Scoggins Creek are likely to begin their downstream migration in mid-February, peak from mid-March through mid-May, and finish by mid-July (ibid).

**Upper Willamette River Fall Chinook Salmon**
Prior to 1996, ODFW released large numbers of sub-yearling fall chinook in the upper Willamette River watershed. Descendants of some of these hatchery fish established naturally spawning populations. Due to their hatchery origin and historic absence above Willamette Falls, fall chinook above Willamette Falls are not protected under the ESA. During the past five years (2003-2007) returns of adult fall chinook salmon at the Willamette Falls fish ladder have ranged from 162 to 1,937. Since the mouth of the Tualatin River is located just upstream from Willamette Falls it can be assumed that some of the fall chinook passing over the falls enter the Tualatin River. Water temperatures in the lower Tualatin during late September and October are usually suitable for chinook salmon migration. Fall chinook presence within the project area has not been documented, but it is reasonable to assume that they could utilize spawning and rearing habitats within the project area. Therefore, fall Chinook salmon have been included in the EFH analysis.

Adult fall chinook migration at Willamette Falls occurs primarily in September but ranges from mid-August to mid-October. Spawning occurs immediately after arrival on the spawning grounds and
incubation extends through the end of December. Juvenile rearing is variable with some juveniles migrating downstream shortly after hatching and some remaining for nearly a year before beginning their downstream migration. From review of the monthly counts of sub-yearling fall chinook at the Sullivan Hydroelectric Plant bypass at Willamette Falls, it appears that when hatchery fish were present, downstream migration peaked in April. Outmigration data for 1996 and 1997 (Domina 1998), following cessation of hatchery releases, indicated that the peak of the fall chinook out-migration shifted to late May or early June. However, the peak outmigration from the project area would most likely occur one or two weeks earlier due to its proximity to Willamette Falls.

**Upper Willamette River Spring Chinook**

The Lower Tualatin River provides potential migratory and rearing habitat for spring chinook salmon, although it is unlikely they have ever been abundant in this area (Hawksworth 2001, Murtagh pers. comm. 2005). A few anecdotal sightings of adult chinook salmon have been reported, but according to Murtagh (2008) it is more likely they were fall chinook rather than spring chinook. It is possible that spring Chinook may have historically ascended into the upper reaches of Gales, and Scoggins Creeks and the upper Tualatin River below Lees Falls, as these are the only streams that may have had the over-summer holding areas adults need prior to spawning in September and October. Water quality in the Tualatin now precludes summer-time holding throughout the entire system (Murtagh pers. comm. 2008). However, since they may have used the area historically, spring chinook habitat is included in the EFH analysis.

If spring chinook were to utilize the Tualatin River, ODFW timing tables (2003) for the Tualatin River below Scoggins Dam indicate mid-March, April and May as peak periods of adult migration, with some migration extending into June. If adults moved into the Tualatin to hold prior to spawning, they would encounter lethal water temperature conditions in July and August in the mainstem, and would need to be well into the upper watersheds to successfully hold all summer. Juvenile rearing could potentially occur year round in tributaries where water temperature remains suitable. Juvenile out migration would be expected to occur from the tributaries from mid February through November, with a peak from March through mid August (ODFW 2003).

**4.9.1.2.5 Sensitive Amphibian and Reptile Species**

**Northern red-legged frog**

The northern red-legged frog is a State Sensitive species and federal Species of Concern. It lives in moist coniferous or deciduous forest and forested wetlands. They are found within the vicinity of permanent waters of stream pools, marshes, ponds, and other quiet bodies of water, in damp woods and meadows some distance from water, especially during wet weather. The native range of the species extends from British Columbia south to Baja California. The northern red-legged frog was once common in the Willamette Valley region but has recently declined dramatically. Possible causes for decline include competition with the introduced bullfrog and the effects of pesticides and herbicides.

They breed in the winter to early spring in water that is approximately one to six feet deep in cool, usually well-shaded ponds, or lake edges, or slow streams. They attach their eggs to a submerged branch or stem. During the summer, froglets and adults live along streams, in moist sedge or brush, on
shaded pond edges, or under logs and debris. During damp conditions, they are likely to occur in forests far from water (Corkran and Thoms 1996).

Potentially suitable red-legged frog habitat exists in shallows of stagnant or slow-moving water bodies throughout the project area, particularly in areas with dense ground cover and aquatic or overhanging vegetation. The ORNHIC database reports several occurrences of this species in the vicinity of the reservoir, most recently within the Tanner Creek arm in 1993 (ORNHIC 2009). In addition, red legged frogs have been identified in the Metro Lovejoy mitigation wetlands along the RWP, where the species seems to have benefitted from improvements to wetland hydrology and vegetation. Overall, an increase in Northern Red-legged frog breeding activity in the area has been noted, and since surveys began in 2006, egg masses recorded have increased from 22 in 2006 to 40 in 2008. Red legged frogs have been detected every year since 2006 during the Metro Lovejoy wetlands annual surveys in that area since 2006, (Weil, pers. comm. 2010), and were detected by DEA during wetland delineation site visits in 2010.

There are no known records of occurrence for the species in the vicinity of Hagg Lake (CH2M Hill, 2005; ORNHIC, 2009; Reclamation, 2004a; Marshall, 1992), although they are likely present in wetlands and riparian areas upslope of the reservoir. The inundation fringe zone between high and low water levels does not provide optimal basking habitat. This inundation fringe zone would provide very little hatchling cover for juveniles emerging from the nest during the low water levels of September and October, presumably during peak hatchling activity.

Currently, basking habitat is limited around much of the lake due to reservoir operations and maintenance, steep sides of the banks, and water level fluctuations. During 2002 surveys, areas with limited potential pond turtle basking sites were identified in Scoggins Creek, but not in Tanner Creek or Sain Creek (URS 2003). However, prior to 1993 more than one individual was documented in the arm of Tanner Creek (ORNHIC 2009), indicating at least historic use of this drainage. Beaver dams in the arm may promote basking sites and other habitat features used by turtles, although these dams are regularly removed for maintenance.

**Western Pond Turtle**
The western pond turtle is one of two freshwater turtles native to Oregon (the other being the painted turtle). It is listed by the state as sensitive and by the federal government as a Species of Concern. Western pond turtles prefer stagnant or slow-moving water in small lakes, ponds, rivers, and sluggish streams and require basking sites on logs, rocks, mudbanks, or cattail mats (Reclamation 2004a).

Western pond turtles were formerly considered a common species in the Willamette Valley area, but populations have declined dramatically in recent years. Population declines are thought to be from both the introduction of predator species such as bullfrogs (*Rana catesbeiana*) and bass, which feast on pond turtle hatchlings, and the transformation and degradation of suitable habitat.

The Western Aquatic Turtle Research Consortium conducted a reconnaissance survey for pond turtles prior to 1995 and documented an occurrence of the species within the Scoggins Park boundary. The Pacific Northwest Turtle Project indicates that in 1999 a pregnant western pond turtle was picked up by...
children near Sain Creek within the park. A turtle rehabilitator was called and picked up the turtle, which subsequently lost her eggs. A western pond turtle was reported in the spring of 2003 approximately one half mile southeast of Henry Hagg Lake in an unnamed drainage (Reclamation 2004a).

In addition, a western pond turtle was reported crossing Graham’s Ferry Road, north of Wilsonville; however, a specific date and location are not known (ORNHIC 2005). It is possible this was in the vicinity of the Seely Ditch, which is slightly less than one half mile from the Willamette Pipeline corridor. Another two occurrences were noted near the Willamette Pipeline corridor; one occurrence at the Oregon Episcopal School pond in 1991 and another in 1996 in Greenway Park, near Fanno Creek, approximately 1.25 miles and 1.9 miles from the Willamette Pipeline northern terminus, respectively. Potentially marginal western pond turtle exists along the Willamette Pipeline corridor, particularly as it crosses the Tualatin River; however, none were observed at any of the proposed stream crossings during surveys (CH2M Hill 2005b).

Western pond turtles require shoreline aquatic and riparian vegetation for cover, nest sites, hibernation and hatchling cover. Under existing operations, Henry Hagg Lake surface elevation can vary by up to 68.2 feet between full pool and dead storage (Reclamation 2004a). In 1999, one species occurrence was reported in an oak scrub community on the south side of Cooper Mountain, approximately 1.5 miles from the Willamette Pipeline corridor and within one mile of a Tualatin Valley Water District (TVWD) water tank area (ORNHIC 2006). It is listed as Endangered with ODA and is a federal Species of Concern with an ORNHIC rank of 1 (ORNHIC 2005a 2005b 2006; Reclamation 2004a, Meinke 1982).

**Painted Turtle**

The painted turtle is the more aquatic of Oregon’s two freshwater turtles. It is listed by the state as sensitive-critical but is not listed by the federal government. It was formerly considered a common species in the Willamette Valley area, but populations have declined.

The painted turtle prefers slow-moving, shallow water with a soft bottom in streams, marshes, ponds, lakes, and creeks. Important habitat elements include presence of basking sites and aquatic vegetation. The turtle hibernates in water in mud and bottom substrate, and may colonize seasonally flooded areas near permanent water. It nests in soft soil in open areas up to several thousand feet or so from water. The species is an omnivore which feeds opportunistically on various plants and animals, living or dead, obtained from the bottom of waterbodies or among aquatic plants (NatureServe 2008). The ORNHIC (2005) identified a painted turtle population as occurring near the town of Aurora in 1993, but this population occurs more than two miles from the project area, east of Interstate 5 and south of the Willamette River and the southern terminus of the Willamette Pipeline project area. No records of the species occur within or near the project area.

**4.9.1.2.6 Sensitive Plant Species**

**Pale (White Rock) Larkspur**

Pale (white rock) larkspur is a federal Species of Concern and is listed Endangered by the State of Oregon. It is a slender perennial that grows from a cluster of bulbs. Suitable habitat for the species...
includes undisturbed sites on dry bluffs, fields, and rocky ledges, although it is now largely restricted to roadside ditches. In Oregon, its presence is restricted to the north Willamette Valley.

While recent surveys have not been conducted for this species, there are no records of the species in or near Henry Hagg Lake or the RWP. The ORNHIC database documented an occurrence approximately one mile south of Henry Hagg Lake (ORNHIC 2005), although its presence is somewhat unlikely due to a lack of undisturbed, native habitat in the vicinity.

**Shaggy Horkelia**
Shaggy horkelia is a federal Species of Concern and is a candidate for listing in the State of Oregon. It is generally restricted to wetland prairie vegetative communities, grassland and oak savannah remnants, and grassy fields. Although the USFWS identified the species as potentially occurring in the project area (USFWS 2009), it is unknown whether suitable habitat currently exists. Many of the oak savannah remnants around the project area have non-native understory, making it unlikely that shaggy horkelia is present.

**Thin-leaved Peavine**
Thin-leaved peavine is a federal Species of Concern. It is a stout, rhizomatous perennial that grows up to three feet tall. The species is endemic to the Willamette Valley and southwestern Washington and is known to occur in Washington County, Oregon. The species occupies forest borders and openings. It is found along margins of woods and fence rows, along roadsides in grasslands, or climbing in low shrubby vegetation (Gilkey and Dennis 2001).

### 4.9.2 Environmental Impacts
Effects on terrestrial and aquatic species were evaluated based on existing reports (as listed at the beginning of Section 4.9), database search results, research and summary documents, site visits by DEA, and extensive meetings with stakeholders and agencies. Field surveys for the presence of terrestrial TES species have been conducted in the project area as part of other analyses related to the TBWSP. These include:

- TES surveys in the vicinity of Henry Hagg Lake in June and July 2002 (URS 2003)
- Survey of the entire RWP route in October and November 2004 and between March and May 2005 (CH2M Hill 2005b)
- Rare plant surveys in riparian areas of the RWP route during April 2005 (CH2M Hill 2005b)
- Reconnaissance survey for rare plants in the vicinity of the Willamette Pipeline and TVWD water tank areas (Adolfson 2006b)

Evaluation of the potential for species occurrence and potential impact is based on following factors:

- Known occurrence in the project area based on information from previous field surveys, ORNHIC data, and/or other sources
- Correlation between project area habitat types and TES species habitat requirements
- Agency communication
Because systematic surveys have not recently been performed in the Henry Hagg Lake area and along the Willamette Pipeline corridor, impact evaluations for these parts of the project area are focused primarily on habitat evaluation and best professional judgment.

Impacts to TES terrestrial species are expected to result primarily from inundation as a result of dam raise and construction activities associated with the project, including ground disturbance and noise. Therefore this analysis includes both long term and short term impacts. Project impacts on TES aquatic species are expected to result primarily from changes in hydrology as a result of modified operations; therefore, the impact assessment for TES fish species focuses on long term impacts.

4.9.2.1 Alternative 1 – No Action

4.9.2.1.1 Potential Impacts (direct, indirect)
Since alterations to terrestrial habitats would remain similar to existing conditions, new impacts to terrestrial species would not be anticipated. More frequent and longer drawdowns may lead to heating of reservoir water (Reclamation 2004b), which, when released, may increase water temperatures in Scoggins Creek and the Tualatin River. These operations would negatively impact salmonid spawning, rearing, and migration habitat. Also, extra water would be available to release less often, so the Tualatin River system would not be supplemented as frequently compared to the existing condition. This also would likely lead to increased heating of streams during summer months and a decrease in the amount of available fish habitat.

4.9.2.1.2 Cumulative Impacts
Water shortages would lead to development restrictions in Washington County, thereby decreasing existing development pressures on the unprotected natural areas that drain to the Tualatin River Basin. However, easing development pressures would not inherently lead to protection, and may only result in fewer natural areas being converted through development. In addition, some development would still occur, converting natural areas to agricultural or more urban uses. Existing water rights throughout the region likely would be maximized under the No Action Alternative. This, combined with additional construction and development in the region, would contribute to a reduction in the quantity and quality of habitat available to listed fish, wildlife, and plant species.

4.9.2.2 Alternative 2 – Scoggins Dam 40-foot Raise
The impacts to terrestrial wildlife habitat and from the implementation of Alternative 2 are described in Section 4.8.2.2. Effects on fish habitat are described in Section 4.7.2.2, with more detailed information on hydrologic changes in Section 3.6 and water quality impacts in Section 4.3.2. Alternative 2 impacts specific to individual TES species or species groups are described in this section.

4.9.2.2.1 Alternative 2 Potential Impacts (direct, indirect)
Mammals
Bats
Suitable habitat may exist within the Henry Hagg Lake for all of the rare bat species with potential habitat in the project area. In general, these rare bat species can be found roosting in trees or man-made structures, such as buildings or bridges, as well as foraging in the vicinity of lakes, ponds, or rivers,
and several buildings and bridges that would be impacted by the implementation of Alternative 2. Approximately 273 acres of forest would be removed or inundated around the Henry Hagg Lake perimeter because of the 40-foot increase in water level and some trees may be removed because of the road relocation, increased dam footprint, or placement of the RWP. In addition, construction activity would likely disrupt roosting areas within several hundred feet of impact areas, if they currently exist. However, trees are not limited in the project area and it is assumed that potential roosting areas would be displaced to similar, adjacent habitat. Since bats are primarily nocturnal, the diurnal construction activity would not be expected to disturb their evening foraging activities. The implementation of Alternative 2 would increase the surface area of Henry Hagg Lake at full pool elevation by approximately 370 acres which would increase the potential foraging area for bats, thus potentially benefiting bat species.

Forest habitat is more limited along the RWP, although construction noise could impact species that are foraging over agricultural lands or roosting in riparian vegetation. The RWP corridor crosses several waterways; however, these crossings are not expected to impact the amount or quality of bat foraging habitat since trenchless technology would be used under the larger crossings and very little impact to riparian vegetation would occur as a result of the project.

**Red Tree Vole**
The red tree vole could be impacted by forest clearing for inundation or roadway construction around Henry Hagg Lake, and are unlikely to be present or impacted along the RWP. Impacts resulting from the RWP are unlikely because construction activities would impact minimal Douglas fir trees within the Tualatin River riparian area. If impacts at the lake were to occur during the hibernation season, they would be more likely to induce direct mortality or predation while fleeing the area for adjacent habitats.

**White-Footed Vole**
Similar to the red tree vole, the white-footed vole could be impacted by forest clearing for inundation or roadway construction around Henry Hagg Lake, and are unlikely to be present or impacted along the RWP. Impacts resulting from the RWP are unlikely because construction activities would impact minimal amounts of alder-lined streams within the Tualatin River riparian area.

**Camas Pocket Gopher**
The Camas pocket gopher could be impacted by inundation or roadway construction around Henry Hagg Lake, or by excavation, staging, or road construction along the RWP. If these impacts were to occur during the hibernation season, they would be more likely to induce direct mortality or predation while fleeing the area for adjacent habitats.

**Birds**

**Bald Eagle**
It is unknown whether established roosting sites in the vicinity of Henry Hagg Lake would be impacted by the inundation level associated with Alternative 2; however, roost sites are not limited in the vicinity of Henry Hagg Lake and the implementation of Alternative 2 would not result in a local shortage of bald eagle roost sites. The number of perch sites may be increased in the northern portion of the reservoir.
and the tributary arms if trees inundated by the higher water levels could be left standing; however, this may result in recreational boating safety issues. The increased open water area would be expected to increase foraging opportunities for bald eagle. After completion of dam construction activities, Alternative 2 would add approximately 370 acres to the surface area of Henry Hagg Lake at normal full pool elevation compared to Alternative 1. This would increase the potential foraging area for bald eagles and is expected to result in a beneficial long-term effect.

The timing of maximum and minimum reservoir elevations would be similar to Alternative 1 conditions under Alternative 2, with maximum pool elevation generally occurring in May in all year types (wet, dry, and normal) and minimum elevation generally occurring in October in all year types. Because the operational timing is similar to Alternative 1, bald eagle foraging during nesting activities and overwintering are expected to be affected only by relative increases in elevation and area as compared to Alternative 1.

**Band-tailed Pigeon**
The band-tailed pigeon inhabits coniferous forests and is known to use the Scoggins Creek Picnic Area at Henry Hagg Lake (Gillson 2006). Additionally, it is presumed to use other forested habitats around Henry Hagg Lake and along the RWP corridor. Approximately 143 acres of coniferous forest in the vicinity of Henry Hagg Lake would be permanently impacted by the implementation of Alternative 2 and scattered coniferous forests along the RWP may be temporarily impacted by RWP construction; however, coniferous forest is not limited in the project area and any band-tailed pigeons that use these areas would most likely disperse to similar, adjacent habitat.

However, some habitat elements may be limited within the landscape. Since mineral springs and mineral graveling sites are important for nutritional purposes, especially during the nesting season, and pigeons show strong fidelity to these sites, project related loss or impact to these mineral sites, such as quarry activities, may impact this species.

**Mountain Quail**
Mountain quail have been located about 4 miles above the reservoir on Scoggins Valley Road, and they are thought to move to lower elevations nearer the reservoir during the winter (Reclamation 2004a). They inhabit coniferous forest, forest and meadow edges, dense undergrowth, and favors areas with tall dense shrubs, close to water (NatureServe, 2010). The clearing and inundation of the wooded areas adjacent to the lake and its tributaries as a result of Alternative 2 has the potential to impact this species and its habitat.

**Acorn Woodpecker**
Although the acorn woodpecker has not been documented within the study area, it is dependent on the Oregon white oak and may use the oak forest or mixed forest around Henry Hagg Lake. While less likely, it may also use the patches of oak habitat remaining along the RWP and Willamette pipeline corridors. As described in Section 4.8, 42 acres of oak forest will be permanently impacted and 6 acres temporarily impacted as a result of Alternative 2.

**Olive-sided Flycatcher**
The olive-sided flycatcher prefers forested habitats with low canopy cover. It is presumed this species uses the forested habitats around Henry Hagg Lake and along the RWP corridor, although there are no recorded occurrences.

Approximately 143 acres of coniferous forest in the vicinity of Henry Hagg Lake would be permanently impacted by the implementation of Alternative 2 and scattered coniferous forests along the RWP may be temporarily impacted by RWP construction; however, coniferous forest is not limited in the project area and the olive-sided flycatchers that may use these areas are anticipated to disperse to similar, adjacent habitat.

**Oregon Vesper Sparrow**
The Oregon vesper sparrow has been reported to breed rarely in the un-manicured Christmas tree farms around Scoggins Park and has been heard in the lower clearcuts around the reservoir (Reclamation 2004a, Marshall et al. 2003). The implementation of Alternative 2 would impact a very small portion of these Christmas tree farms. Tree clearing would take place outside the nesting season, and since clearcuts are not limited on a landscape scale, individuals would be expected to move to adjacent habitat. A small area of experimental tree farm may be impacted along the RWP corridor, and these minimal impacts are assumed to be similar to those around Henry Hagg Lake.

**Purple Martin**
The purple martin prefers to nest in tree cavities or nest boxes near open forage areas, such as rivers, lakes, marshes, fields, and above the forest canopy. There is at least one known record of this species in Scoggins Park (Reclamation 2004a). Additionally, purple martins are thought to occasionally nest in the forested habitat surrounding Henry Hagg Lake (Marshall et al. 2003). Some trees around the existing Henry Hagg Lake shoreline would be removed or inundated with the 40-foot increase in water level associated with Alternative 2. This may impact existing purple martin nesting habitat. It is assumed that, because trees are not limited in the vicinity around Henry Hagg Lake, the purple martins would relocate to trees along the new shoreline. Inundation is anticipated to benefit purple martin habitat at Henry Hagg Lake by creating snags that provide nest cavities.

The RWP corridor does not contain suitable purple martin habitat; therefore, construction of the RWP is not expected to impact purple martins or their habitat.

**Streaked horned lark**
The Hagg Lake area is not likely to be used by streaked horned lark because habitat conditions for streaked horned lark are not believed to be favorable around Henry Hagg Lake, and the species has not been documented within Scoggins Valley Park. While streaked horned larks are unlikely to breed in the vicinity of Henry Hagg Lake, they could potentially over-winter in the suitable grassland habitat and unvegetated flats limited to Scoggins Valley Park (BOR 2004a).

Although some habitats around the lake could be marginally suitable for overwintering or migratory streaked horned lark, human use and disturbance at Henry Hagg Lake is quite high during the spring, summer, and fall. Areas adjacent to the lake are utilized heavily by mountain bikes, hikers, boats, frisbee golfers, and dogwalkers. All these activities would greatly reduce the potential for streaked horned lark
to utilize the habitats. If they were present, it is assumed they would displace to similar, adjacent habitat; therefore, there are no anticipated impacts to the streaked horned lark at Henry Hagg Lake.

The RWP corridor consists mainly of agricultural lands, including grass fields with bare ground areas and fallow fields potentially used by the species. Therefore nearly the entire corridor could qualify as potential habitat depending on an ever-changing regime of crop rotation, disturbance, and fallowing. However, disturbance along the RWP would be temporary rather than permanent. In the unlikely event that nesting occurs within the RWP, streaked horned lark could disperse to adjacent habitat prior to and during the breeding season. If impacts to the Lovejoy property are avoided and impacts to the agricultural habitats occur outside of the nesting season, no impacts to the streaked horned lark would be anticipated.

**Yellow-breasted Chat**

The yellow-breasted chat is known to occur in areas around Henry Hagg Lake and may use shrubby areas along the RWP corridor, although this use has not been documented. Expansion of the reservoir would inundate portions of tributaries upstream of Henry Hagg Lake, including Tanner Creek (0.7 mile of Scoggins Creek, 0.6 mile of Sain Creek, 0.4 mile of Tanner Creek, and 0.1 mile of Wall Creek) which may impact chat habitat. In addition, construction activities in riparian or shrubby areas along the RWP corridor may temporarily impact potential chat habitat. In both instances, it is assumed the chats would displace to similar, adjacent habitat.

The size of Henry Hagg Lake would increase by approximately 370 acres as a result of the implementation of Alternative 2 and there would be a corresponding increase in riparian fringe habitats, which could provide an overall benefit to the yellow-breasted chat.

**Fish**

**Upper Willamette River Steelhead Trout**

According to water quality modeling conducted for the TBWSP, average temperatures in Scoggins Creek (55.8 ºF/13.2 ºC in a dry year; 53.6 ºF/12.0 ºC in a typical year) would be higher than Alternative 1 (53.2 ºF/11.8 ºC in a dry year; 48.4 ºF/9.1 ºC in a typical year). However, temperature standards would be exceeded much less under Alternative 2 (0.5 day, dry year; 0 days, typical year) than under Alternative 1 (111 days, dry year; 60 days, typical year). This would be a significant improvement over current conditions. Water temperatures would be warmer in late spring/summer under Alternative 2 than under Alternative 1. However, the configuration of the outfall has not been finalized, and depending on its design, could have a significant impact on temperatures in Scoggins Creek and the Tualatin River. Although average DO levels would decrease at the outlet, DO would remain near or above saturation in Scoggins Creek just downstream of the dam due to aeration that occurs at the outlet. Changes in ammonia, chlorophyll a, and orthophosphate levels would be insignificant. Because the residence time in Scoggins Creek is very short, changes in water quality are not expected to cause adverse impacts.

In the Tualatin River, water temperatures would be warmer in summer and cooler in fall at RM 55 under Alternative 2 as compared to Alternative 1. Farther downstream, temperatures would be slightly warmer under Alternative 2 than under Alternative 1. Modeled DO levels under Alternative 2 were...
higher than Alternative 1 conditions in some months and lower in others, but there would be no change in compliance with DO criteria between Alternative 2 and Alternative 1. Ammonia levels under Alternative 2 would be similar to Alternative 1, and algae levels would generally be lower than Alternative 1. No changes to any other water quality constituents in the Tualatin River are expected.

The removal of the Balm Grove Dam on Gales Creek, which will be done as mitigation for fish passage at Scoggins Dam (see Section 3.3.5) would provide free passage to more than 43 miles of aquatic habitat, including approximately 23 miles of essential habitat for anadromous indigenous salmonids, such as steelhead, and a majority of the spawning and juvenile rearing habitat in Gales Creek.

Stream crossings associated with the RWP could adversely affect steelhead, as well as other aquatic species, particularly if the crossings are trenched. Trenched crossings would disturb soils in and adjacent to streams, resulting in temporary impacts to water quality (turbidity and sedimentation). In addition, if trenching cannot be done in “the dry” (that is, when an intermittent stream is not flowing), stream flow would be piped around the in-water work area, which would be temporarily isolated and de-watered. Work area isolation requires salvaging fish that may become trapped in the area being de-watered. Fish salvage involves netting individual fish, placing them in aerated buckets, and releasing them downstream of the construction site. During fish salvage operations, there is potential for “take” to occur, so formal consultation with ODFW and NMFS is required. A qualified fish biologist would conduct the fish salvage and would provide a summary to NMFS of the number and species of fish removed from the de-watered area. However, it is expected that all stream-crossings containing steelhead habitat would be bored rather than trenched; therefore, fish salvage would not be required.

Trenchless stream crossings would be less likely to adversely affect aquatic species and habitat. However, frac-out may occur when boring under a stream or wetland, releasing bentonite into the surrounding environment. Provisions for avoiding frac outs and dealing with any frac outs that may occur are discussed in the water quality section 4.7.

**Spawning and Incubation**

The PHABSIM model showed that the WUA estimates for Alternative 2 exceeded those for Alternative 1 conditions approximately 60 percent of the time, in the upper Scoggins Creek study reach below Scoggins Dam. The greatest and most consistent increase in habitat would be expected during low flow years, when spawning WUA would increase for the peak spawning months of April and May as well as during incubation in early to mid-July (ODFW 2003). These increases result from higher minimum flows with Alternative 2 (25 cfs) versus Alternative 1 (10 cfs). During median flow years, the implementation of Alternative 2 would result in spawning habitat gains during May and July and losses during April and June. During high flow conditions, there would be little difference between Alternatives 1 and 2.

---

2 Habitat duration curves showing modeled steelhead habitat and WUA estimates referenced in this section are available in the Fish Habitat Technical Report (R2 2006).
Interactions between predicted flow and estimated WUA are depicted in Figure 4.9-1. Results for the lower Scoggins PHABSIM site spawning habitat were similar to the upper study reach. In general month-to-month fluctuations in WUA evident under Alternative 1 conditions were reduced somewhat under Alternative 2, which would slightly reduce the risks to steelhead associated with dewatering or scouring of redds as flows change from April to May and June to July.

**Juvenile Rearing and Adult Holding Habitat**

Modeling results predicted that in the upper and middle Scoggins Creek study reaches; Alternative 1 WUA would exceed Alternative 2 WUA approximately 65 percent of the time. Habitat decreases in these reaches would be expected during median and high flow years in late summer, fall and winter months due to a reduction in flow under Alternative 2. During low flow years, all reaches would experience increases in rearing habitat during all months except June and October due to increases in the minimum flow. Figure 4.9-2 depicts rearing WUA in the upper study reach in response to changes in flows over time. Though more pronounced in the upper study reach, the trend is similar to that of the middle study reach.

For the lower Scoggins Creek site, the estimated WUA for Alternative 2 was predicted to be higher than Alternative 1 approximately 70 percent of the time. This difference likely resulted from the presence of an area of higher gradient riffle habitat as compared the upper and middle sites where uniform glide habitat was present. Within this study reach, Alternative 2 would result in habitat gains for most of the year during low flow years. Habitat losses would occur in June, September and October due to flow reductions. Median flow years would result in slight decreases in WUA as a result of flow reduction. During high flow years habitat levels would be maintained or increased for all months of the year except November when Alternative 2 flow would be slightly lower than Alternative 1 flow.

For the Tualatin River, the habitat model showed that Alternative 2 effects on steelhead rearing habitat would be similar throughout the river, although the WUA would increase slightly from the upper to the lower site. Steelhead habitat under Alternative 2 would be similar to or slightly improved over Alternative 1 (No Action), and Alternative 2 would result in slightly more habitat than Alternative 1 approximately 90 percent of the time, at the lower site on the Tualatin River.
Figure 4.9-1. Predicted average monthly flows under Alternatives 1 and 2 and corresponding estimates for steelhead spawning WUA within the upper study reach of Scoggins Creek
Figure 4.9-2. Predicted Average monthly flows for Alternatives 1 and 2 and corresponding estimates of steelhead rearing WUA within the upper study reach of Scoggins Creek.
**Pacific Lamprey**
Lamprey larvae habitat would decrease in the upper study reach of Scoggins Creek, remain the same in the middle study reach, and increase in usable habitat area in the lower study reach.

**Cutthroat Trout**
Cutthroat spawning habitat would improve in the upper reaches of Scoggins and remain similar in the lower reaches of the creek under Alternative 2. Juvenile rearing habitat for cutthroat would be reduced in upper Scoggins Creek; some large reductions in habitat would occur during summer when tributary habitats are critical. There would be slight increases in cutthroat rearing habitat in lower and middle Scoggins Creek as well as the upper and middle Tualatin, and reductions in the lower Tualatin. Overall, impacts to juvenile cutthroat habitat would be negatively affected. For adult cutthroat, habitat would be reduced in upper and middle Scoggins Creek, including moderate to large summer reductions that would negatively affect adult trout. In lower Scoggins Creek and throughout the Tualatin River, small to moderate increases in adult cutthroat habitat would likely balance out the negative impacts in upper and middle Scoggins Creek.

**Magnuson-Stevens Act Species**
Criteria for coho salmon spawning habitat is similar to that of steelhead trout. Based on WUA estimates provided for steelhead spawning habitat, potential impacts to coho salmon EFH under Alternative 2 would generally increase under all flow conditions in the lower and upper study reaches of Scoggins Creek. Potential benefits would generally result from increased flows during peak coho spawning months (November and December). However, during high flow conditions, predicted decreases in extreme flow conditions and high velocities relative to Alternative 1 conditions during December act to increase spawning habitat whereas decreases during high flows in November result in a potential loss of spawning habitat. Impacts to juvenile rearing EFH would be similar to those previously detailed for winter steelhead (i.e. slight losses within Scoggins Creek below Scoggins Dam and no change or slight increases within the Tualatin River).

Potential impacts to spring chinook EFH resulting from Alternative 2 would include an overall increase from Alternative 1 levels in available spawning habitat within the project area. This increase corresponds to a consistent reduction in flows throughout the chinook spawning season (August, September and October). Only during September and October of the lowest flow years would these reductions bring flows below optimal spawning levels and thereby reduce potential spawning habitat. Potential rearing and holding EFH within Scoggins Creek below Scoggins Dam would be expected to decrease as previously described for winter steelhead, while Tualatin River rearing and holding EFH within the project area would remain unchanged or increase slightly.

Fall chinook spawning habitat within the Scoggins Creek study area would be expected to increase under Alternative 2 due to predicted increases in flow during September and October during both median and high flow years. Low flow conditions however would require reduction in flows through Scoggins Creek and spawning EFH would decrease as a result. Potential rearing and holding EFH within Scoggins Creek below Scoggins Dam would be expected to decrease as previously described for winter steelhead.
whereas Tualatin River rearing and holding EFH within the project area would remain unchanged or increase slightly.

**Amphibians and Reptiles**

**Amphibians**

**Operational Impacts (long term)**

Around Henry Hagg Lake, the footprint of new roads and bridges and inundation of large areas of habitat, including wetland and riparian areas, could permanently reduce habitat available for amphibians. Mortality could occur for some individuals that could not move to adjacent habitats. The following section discusses impacts to amphibians which could occur at the lake due to reservoir level fluctuations.

Figure 4.9-3 displays average water levels for a typical year based on daily measurements collected between 1981 and 2009 (MWH 2009). As visible from the graph, water levels rise sharply in mid-March to the typical full pool level of 303.6 feet in elevation. Water remains at this level for approximately three months until mid-June, when it drops sharply for the remainder of the year.

![Figure 4.9-3. Historical Scoggins Dam & Hagg Lake Storage and Elevation Data](image)

During the wetland delineation conducted for the project, it was found that herbaceous vegetation along the reservoir edge (dominated by reed canarygrass) extended a maximum of six feet below the...
typical full pool level of 303.6 feet in elevation, while willow species extended a maximum of 10 feet below this level. Therefore, when drawdowns fell below an elevation of 293.6 feet, only rapidly colonizing herbaceous species (generally facultative and annual, and often invasive) would colonize the drawdown area, and generally only on shallower slopes where water and seeds would remain long enough to germinate.

Under Alternative 2, timing and nature of drawdowns would change little compared to existing conditions. Projections of water levels for Alternative 2 were created using monthly data to model future conditions at the reservoir (MWH 2009). The following graph displays the average water levels for a typical year based on these projections. As visible from the graph, water levels for projected future condition mimic existing conditions nearly exactly. They rise sharply in mid-March to the typical full pool level of 343.6 feet in elevation. Water remains at this level for approximately three months until mid-June, when it drops sharply for the remainder of the year.

As water levels drop rapidly in mid-June, fringe wetlands along the shoreline, where present, are rapidly de-watered. This likely limits the capacity of these wetlands to provide habitat for most amphibians, and may act as a population sink for amphibians that do attempt to breed along the reservoir edge. Under existing and proposed future conditions breeding attempts around the reservoir fringe likely often result in amphibian mortality due to dessication of eggs or stranding of tadpoles, juveniles, and adults along the drying water edge. Figure 4.9-4 displays the future water levels for a typical year.
Based on future water level projections, alterations to water availability and fringe wetland quality for breeding amphibians (that may or may not occur) would change from existing conditions more as a result of topography of the new shoreline than due to changes in timing or nature of drawdowns (which would remain similar). These changes to wetland habitat could include alteration of size and location of wetlands along the edge of the reservoir due to changes in topography, soils, and aspect. As discussed in the wetlands section, based on 1-foot contours, fringe wetlands along the reservoir would likely increase in overall acreage, but would likely decrease in width generally due to an overall increase in steepness of the shoreline.

Fringe wetland changes may be easiest to understand by discussing breeding behavior and timing of northern red legged frogs. In general, reservoir fringe wetland habitats are not considered prime habitat for the red legged frog due to lack of structural complexity within most fringe wetlands, wave action (which can dislodge eggs), predation by fish, and other factors. Northern red legged frogs are much more likely to use sheltered habitats upslope of the reservoir, which are not subject to rapid drawdown. However, they may use the more sheltered arm areas, which also contain greater wetland acreage than the more open shorelines. However, under existing and future conditions, reservoir drawdown and associated human and vegetative disturbance interrupts amphibian access to egg-laying territories along the edge of the entire reservoir. Presumably, Northern red legged frogs do not typically risk traveling across the drawdown zone to lay eggs in water, and if they did so, aquatic vegetation would be lacking except within approximately 10 vertical feet of full pool level.

If, on the other hand, amphibians currently successfully use the drawdown zone, increased mortality could occur, since the drawdown zone would increase in size from existing conditions. Under Alternative 2, the area of mudflats exposed at low pool would increase from 668 acres to approximately 1,038 acres. However, we assumed that amphibians currently do not cross the drawdown area to access the reservoir, but rather utilize wetlands upslope of the reservoir, with hydrology independent from Henry Hagg Lake.

It appears that future drawdown timing and extent would not improve bullfrog habitat around the reservoir. Therefore increased predation of Northern red legged frog by bullfrog is not anticipated. Both the current and projected future drawdown timing and extent appears to discourage use of the fringe wetlands by invasive bullfrogs, and bullfrogs were not noted during the wetland delineation site visits, although they may be present at other times. Bullfrogs lay their eggs in a thin film on open water, in areas of submerged vegetation, where the eggs sink and attach to vegetation before hatching (Corkran and Thoms 1996). Breeding and egg-laying is from June to August, with hatching 1-2 weeks later. Therefore, as water levels drop rapidly along the reservoir in mid-June, bullfrog eggs deposited along the shore would presumably dessicate.

In summary, since the timeline of drawdowns would not change greatly, impacts to Northern red legged frog would not change greatly for the existing condition. However, several factors would further decrease likelihood of use of reservoir fringe habitats by Northern red legged frog.
water’s edge during drawdowns would increase, making travel to the water more risky for all age groups of Northern red legged frog. In addition, although acreage of fringe wetlands may increase under Alternative 2, it appears likely that width of wetlands along the reservoir edge may decrease slightly due to the increased steepness of shorelines along the new proposed full pool level.

Finally, since extent and timing of drawdown would not change greatly compared to existing conditions, the greatest impacts to Northern red legged frogs would likely occur as a result of the initial inundation, depending on seasonal timing and speed of the initial inundation of fringe wetland and other wetland habitats.

Other operational impacts at Henry Hagg Lake could include changes to water temperature and chemistry from the proposed dam raise. Potential impacts to water quality are addressed in Section 4.3. Based on the modeling of water quality effects completed at Hagg Lake between 2002 and 2006, little change to water temperature is anticipated. In the 2002 base case, the annual average lake temperature was 10.9°C (52 F). All 2002 dam-raise scenarios produced cooler annual average temperatures, ranging from 8.7 to 10.7°C (48 to 51 F). Scenarios with selective withdrawal, which allowed some of the warmer water near the top of the lake to be discharged downstream, were cooler (9.4°C, standard deviation [SD] 0.3°C), than those with only the original fixed-elevation outlet (10.3°C, SD 0.2°C). The maximum lake surface water temperature (averaged over the top 2 m) in the base case was 26.6°C. In the 2002 dam-raise scenarios, the peak surface water temperature ranged between 25.3 and 26.7°C (Sullivan and Rounds, 2006). Although amphibian metamorphosis rates are sensitive to relatively slight changes in water temperature, it is unlikely that such a minor increase or decrease in average annual or maximum surface water temperature would affect amphibian populations. It should be noted that temperature thresholds for tadpoles and adults of some amphibian species lie near the maximum summer water temperature at Henry Hagg Lake. Although specific heat exposure indices are not currently known for northern red legged frog, it is assumed that under existing conditions, maximum water temperatures around the fringes of Henry Hagg Lake may reduce habitat suitability for the species. Therefore if the maximum water temperature can be lowered slightly by dam water outlet design, conditions for amphibians along the reservoir edge may be made slightly more favorable.

In addition, “All 2002 scenarios resulted in fewer days with low (<1 mg/L) dissolved oxygen in the lake (0 to 53.2 days), compared to the base case” (Sullivan and Rounds, 2006). Therefore dam construction would tend to improve dissolved oxygen conditions in the lake overall, resulting in better overall water quality for Northern red legged frog in the reservoir.

**Construction Impacts (short term)**

Logging of forested areas prior to inundation could impact northern red legged frog through direct mortality as well as alterations to available moisture and forage. Depending on the speed of the initial reservoir inundation, amphibians remaining within the logged areas may be drowned if they cannot migrate upslope to suitable habitat, and migration itself would increase the risk of predation.

Impacts from road relocation and bridge construction could include temporary and permanent loss of riparian and wetland habitats which may support northern red-legged frog. Although wetlands would be
replaced around the reservoir and waterways, construction could result in mortality of individuals or egg masses, depending on timing of construction. Northern red legged frog would potentially benefit from creation of new wetlands away from the reservoir edge. The inundation of riparian habitats along the creeks flowing into the reservoir may result in the greatest impact to northern red legged frog, and some individuals may be lost as a result of the rising water level.

Reptiles
Operational Impacts (long term)
The operation of the reservoir would likely have less effect on reptile species than on amphibians, since reptiles move more quickly and can generally adapt more readily to changes in microclimate. Turtles, including western pond turtle, may be impacted directly in several ways. Although nesting sites around the reservoir are not known precisely, it is possible that they would occur within the inundation zone, since western pond turtles choose nesting sites close to aquatic habitats. Of 402 nests studied in the Willamette River Basin in Oregon, distances from the edge of the water to the nest site ranged from 10 to 1,319 feet, with most nests located within 164 feet of water (Rosenberg, et. al. 2009). Additionally, although turtles may nest on steeper slopes, studies have revealed a preference for gentler slopes (0-40%), thereby potentially inundating nesting areas. If the initial water raise would not occur during the nesting season (including nest selection period), direct impacts to turtles would be less significant, providing that sufficient suitable habitat is present upslope of the new full pool.

Turtles may be impacted directly in several ways. In Oregon, western painted and western pond turtles have been found to use similar habitat (Gervais, et al. 2009). The primary difference appears to be the painted turtle’s greater dependence on aquatic habitat for over-wintering and selection of slower, more stagnant aquatic habitats. Although nesting sites around the reservoir are not known precisely, it is possible that they would occur within the inundation zone, since western painted turtles choose nesting sites close to aquatic habitats. Painted turtles nest as close to the water as suitable habitat allows in order to decrease dehydration of hatchlings and to increase survival rates during the hatchlings’ return to aquatic habitat in the spring. The few studies conducted in Oregon to date found turtle nests within 300 feet of aquatic habitat, and usually much closer (Gervais, et al. 2009). If the initial water raise would not occur during the nesting season (including the nest selection period), and assuming that sufficient suitable habitat is present upslope of the new full pool, direct impacts to turtles would be less compared to the No Action Alternative.

Painted turtles are more aquatic than the western pond turtle, therefore, impacts to waterways may cause greater direct effects to painted turtles than pond turtles. Dam construction would be unlikely to cause direct mortality because it would occur in an area that does not have important turtle habitat, such as basking or breeding areas.

Relocation of the perimeter road could cause turtle mortality by road kills or excavation and/or crushing of nest sites. The specific number of individuals that might be killed cannot be estimated; however, because they tend to nest close to water, it is likely that inundation would impact nests during the nesting season rather than perimeter road relocation.
The western painted turtle may also experience some negative effects if the change in operations decreases production of emergent aquatic or adjacent wetland vegetation on the margins of the reservoir. This could result in an increase in the distance that turtles need to travel to foraging and refuge areas, and could increase turtle vulnerability to predators, particularly for juveniles. Current operations of Scoggins Dam with a maximum 68.2 vertical feet change in elevation between full pool and dead storage is not favorable to northwestern pond turtle habitat and reproduction requirements.

The reservoir bank inundation fringe zone between high and low water does not support the vegetation needed by turtles for nesting and hibernation. Increasing the inundation fringe by expanded operations would further adversely affect potential pond turtle use of Henry Hagg Lake by further reducing emergent aquatic and wetland vegetation. There would be an increase in vertical change in elevation of the reservoir of 39.7 feet as compared to Alternative 1, which would result in 370 acres of additional drawdown area when the lake is at its lowest level. This increase in drawdown area would increase the travel distance necessary between the nest and the water’s edge, providing increased opportunity for human disturbance to adults or juveniles and/or predation by various animals.

In addition, 1.8 miles of streams would be inundated. This could decrease the side-channel habitat available to turtle species. Turtles may use these streams and adjacent wetlands and riparian areas for foraging, resting, and escape habitat.

Although unlikely, the species could be present in ditches and ditched tributaries within the agricultural lands along the RWP (they have not been detected along the RWP, or within the Metro Lovejoy property, where monitoring and surveys take place regularly). According to previous documents, negative effects from construction of the RWP are not expected to occur under this alternative because suitable painted turtle habitat was not observed at any of the proposed crossings (CH2M Hill 2005b).

**Construction Impacts (short term)**

Turtles, foraging, basking, or nesting western pond turtles, may be impacted by noise disturbance, which could cause them to abandon the reservoir area entirely, or move to other coves not immediately affected by noise disturbance. This disturbance could cause them to move from nesting grounds, lose their eggs, or experience a decrease in fitness from stress. If human disturbance were to be decreased in portions of the reservoir, a net benefit to turtles could be achieved, as discussed in the mitigation section.

**Summary**

Alternative 2 would have a positive effect on steelhead spawning and incubation habitat within Scoggins Creek below the dam as modulated flows would slightly reduce the potential for both dewatering and scouring. Minimum flows in Scoggins Creek would increase from 10 to 25 cfs. However, Alternative 2 would have significant negative impacts to steelhead rearing and adult holding habitat in Scoggins Creek below the dam to downstream of the Tualatin River, with substantial decreases projected for critical summer rearing habitat due to the projected decrease in monthly average flows associated with Alternative 2.
Adult and juvenile habitat in the Tualatin River would be similar or slightly increased over Alternative 1 conditions in most months, indicating a positive impact associated with Alternative 2.

It is difficult to assess the overall impact of the project. For instance, increased spawning and incubation in Scoggins Creek along with positive effects in the Tualatin River could offset the lost rearing habitat in Scoggins Creek. The overall functions and values gains and losses within the project area are currently being evaluated, and a comprehensive mitigation strategy is being developed.

**Plants**

**Kincaid’s lupine**
Although its presence is unlikely due to a lack of undisturbed, native habitat within the project area, the species has the potential to be impacted by ground-disturbing activities associated with the project, if it is present.

**Nelson’s checker-mallow**
This species is known to occur in the vicinity of Henry Hagg Lake, and is known to occur along the RWP near the Metro Lovejoy mitigation wetlands (Weil, pers. comm., 2010). Therefore, Alternative 2 has the potential to impact the species due to ground-disturbing activities associated with the project.

**Pale (White Rock) Larkspur**
Pale larkspur has not been documented in the vicinity of Henry Hagg Lake. In addition, no suitable habitat exists in the vicinity of Henry Hagg Lake or the RWP; therefore, Alternative 2 would not affect this species.

**Shaggy Horkelia**
Although its presence is somewhat unlikely due to a lack of undisturbed, native oak savannah habitat within the project area, the species has the potential to be impacted by ground-disturbing activities associated with the project.

**Thin-leaved Peavine**
Although its presence is somewhat unlikely due to a lack of undisturbed, native habitat within the project area, the species has the potential to be impacted by ground-disturbing activities associated with the project.

4.9.2.2 **Cumulative Impacts**
Several of the ongoing and proposed activities within the project vicinity involve improvements to the aquatic and terrestrial habitats on which TES species rely. Cumulative impacts to TES species may be associated with future housing and urban development projections within the region. Construction-related impacts associated with the implementation of Alternative 2 may contribute to the cumulative impacts on TES species. These cumulative impacts would be lessened, however, by the region’s long-term plans that have been developed to protect the region’s TES species.

4.9.2.3 **Alternative 3 – Multiple Source Option**
The impacts to terrestrial wildlife habitat from the implementation of Alternative 3 are described in Section 4.8.2.3. Effects on fish habitat are described in Section 4.7.2.3, with more detailed information
on hydrologic changes in Section 3.6 and water quality impacts in Section 4.3.2. Alternative 3 impacts specific to individual TES species are described in this section.

### 4.9.2.3.1 Alternative 3 Potential Impacts (direct, indirect)

#### Mammals

##### Bats

The potential impacts to rare bat species from the implementation of Alternative 3 are similar to those described for Alternative 2 in terms of RWP corridor and dam raise construction. In the vicinity of Henry Hagg Lake, the implementation of Alternative 3 would raise the lake level by 25-feet and would not require the partial relocation of the road; which minimizes the amount of trees, or potential bat roosts that would be removed. The surface area of Henry Hagg Lake would increase by approximately 235 acres, which may be a potential benefit in terms of bat foraging area.

One occurrence of Pacific western big-eared bat was noted within two miles of the Willamette Pipeline (ORNHIC 2006). The construction of the Willamette Pipeline would not remove any buildings or bridges but limited tree removal may be required and there may be some temporary disturbance within bat roosting areas. The Willamette Pipeline corridor does not contain any unique forested or riparian areas; therefore, it is assumed that bats, if disturbed by construction activities, would disperse to suitable, adjacent habitats. Because bats are nocturnal, their feeding patterns would not be disturbed by the diurnal construction activities.

#### Birds

##### Bald Eagle

Potential impacts to the bald eagle and its habitat around Henry Hagg Lake under implementation of Alternative 3 are similar to those described for Alternative 2. The Willamette Pipeline corridor is at least two miles from any known bald eagle nests and there are no known roosting sites in the vicinity, therefore, there are no anticipated short-term or long-term impacts.

##### Band-tailed Pigeon

Impacts to the band-tailed pigeon and their suitable habitat in the vicinity of Henry Hagg Lake and the RWP from the implementation of Alternative 3 are similar to those described for Alternative 2. The Willamette Pipeline corridor may contain suitable band-tailed pigeon habitat and there may be temporary, construction-related disturbances in these areas, but the coniferous forest habitats are not limited in the project area and it is assumed that, if present, the band-tailed pigeons would disperse to similar, adjacent habitats.

##### Mountain Quail

Implementation of Alternative 3 would result in similar impacts to the mountain quail as those described for Alternative 2. There is no known use of the Willamette Pipeline corridor by this species.

##### Acorn Woodpecker

Implementation of Alternative 3 would result in similar impacts to the acorn woodpecker as those described for Alternative 2. There is no known use of the Willamette Pipeline corridor by this species, but any impacts to oak woodlands would have the potential to impact the acorn woodpecker.
**Olive-sided Flycatcher**
Implementation of Alternative 3 would result in less impact to coniferous forest in the vicinity of Henry Hagg Lake than that described for Alternative 2 because of the proposed lower water level. Impacts from the RWP are the same as those described for Alternative 2. There is some scattered suitable habitat along the Willamette Pipeline corridor and there may be temporary, construction-related disturbances in these areas, but coniferous forest is not limited in the project area and the olive-sided flycatchers that may use these areas are anticipated to disperse to similar, adjacent habitat.

**Oregon Vesper Sparrow**
There would be no impacts to the Oregon vesper sparrow from the dam raise or RWP construction associated with the implementation of Alternative 3. There are no recorded occurrences of the Oregon vesper sparrow within the vicinity of the Willamette Pipeline corridor; however, there may be some suitable grassland or scrub-shrub habitat. Construction of the Willamette Pipeline may cause temporary disturbances to potentially suitable habitat but it is anticipated that vesper sparrows, if present, would disperse to similar, adjacent habitats.

**Purple Martin**
There would be fewer potential impacts to purple martin habitat from the implementation of Alternative 3 than those described for Alternative 2 because fewer shoreline trees would be impacted by the 25-foot increase in lake levels. As suggested for Alternative 2, it is assumed that, because trees are not limited in the vicinity around Henry Hagg Lake, the purple martins would relocate to trees along the new shoreline. The 235-acre increase in surface water and corresponding increase in riparian fringe is anticipated to benefit purple martin habitat at Henry Hagg Lake by creating nesting snags. The RWP corridor does not contain suitable purple martin habitat; therefore, construction of the RWP is not expected to impact purple martins or their habitat.

There are no recorded occurrences of purple martin along the Willamette Pipeline corridor and there is limited suitable habitat. Suitable habitat may exist along the Willamette River or along the Tualatin River; however, there would be no impacts to these riparian areas from the implementation of Alternative 3. Therefore, construction of the Willamette Pipeline may cause temporary disturbances to potentially suitable habitat but it is anticipated that purple martin, if present, would disperse to similar, adjacent habitats.

**Streaked Horned Lark**
Similar to the description of impacts for Alternative 2, the current habitat conditions and the level of human disturbance around the lake greatly minimizes the potential for the streaked horned lark to occur in these areas. There are no known occurrences of streaked horned lark along the Willamette Pipeline and similarly limited habitat; therefore, no significant impacts to the streaked horned lark are anticipated as a result of Alternative 3.

**Yellow-breasted Chat**
Under Alternative 3, expansion of the reservoir would inundate riparian areas around Henry Hagg Lake, including Tanner Creek, where the chat is known to occur (0.6 mile of Scoggins Creek, 0.6 mile of Sain...
Creek, 0.3 mile of Tanner Creek, and 0.1 mile of Wall Creek), and this inundation may impact chat habitat. In addition, construction activities in riparian or shrubby areas along the RWP corridor may temporarily impact potential chat habitat. In addition, while there are no documented occurrences, there may be suitable chat habitat in shrubby, riparian areas along the Willamette Pipeline corridor. These areas may be temporarily disturbed by construction-related activities; however, there are no permanent impacts proposed in potential chat habitat along the Willamette Pipeline corridor. In all of these cases, it is assumed the chats would displace to similar, adjacent habitat.

The size of Henry Hagg Lake would increase by approximately 235 acres as a result of the implementation of Alternative 3 and there would be a corresponding increase in riparian fringe habitats, which could provide an overall benefit to the yellow-breasted chat.

**Fish**

**Upper Willamette River Steelhead Trout**

According to water quality modeling conducted for the TBWSP, average temperatures in Scoggins Creek (55.8°F/13.2 ºC in a dry year and 54.0°F/12.2 ºC in a typical year) under Alternative 3 would be higher than Alternative 1 (53.2°F/11.8 ºC in a dry year and 48.4°F/9.1 ºC in a typical year). However, temperature standards would be exceeded much less under Alternative 3 (less than 1 day in a dry year and 0 days in a typical year) than under Alternative 1 (111 days, dry year; 60 days, typical year). Although average dissolved oxygen (DO) levels would decrease at the outlet, DO would remain near or above saturation in Scoggins Creek just downstream of the dam due to aeration that occurs at the outlet. Changes in ammonia, chlorophyll a, and orthophosphate levels would be insignificant. Because the residence time in Scoggins Creek is very short, the water quality changes are not expected to cause adverse impacts.

In the Tualatin River, modeled water quality results for Alternative 3 were similar to those for Alternative 2.

Alternative 3 would involve the installation of the RWP, previously detailed for Alternative 2 and the Willamette Pipeline, unique to Alternative 3. The Willamette Pipeline will cross Rock Creek, Cedar Creek, and Chicken Creek, which provide rearing and migration habitat for winter steelhead, and the Tualatin River, which provides migration habitat (ODFW 2004). Potential construction impacts to these streams have been detailed in section 4.7.2.3. It is most likely that streams consisting of steelhead habitat would be crossed using lower impact trenchless methods. Should open-cut crossing be necessary, work would be scheduled during no flow periods when possible. Crossings that require dewatering isolated work areas would employ fish salvage techniques. During fish salvage operations, there is potential for “take” to occur, so formal consultation with ODFW and NMFS is required. A qualified fish biologist would conduct the fish salvage and would provide a summary to NMFS of the number and species of fish removed from the de-watered area.

The removal of the Balm Grove Dam on Gales Creek, which will be done as mitigation for fish passage at Scoggins Dam (see Section 3.3.5), would provide free passage to more than 43 miles of aquatic habitat,
including approximately 23 miles of essential habitat for indigenous anadromous salmonids, such as steelhead, and a majority of the spawning and juvenile rearing habitat in Gales Creek.

**Spawning and Incubation**
The PHABSIM model showed that the WUA estimates for Alternative 3 exceeded those for Alternative 1 in the upper Scoggins Creek study reach approximately 55 percent of the time. During the months of steelhead spawning and incubation, the proposed monthly flow regime for Alternative 3 differs only slightly from that of Alternative 2. Therefore increases and decreases in spawning habitat are essentially identical to those previously described for Alternative 2 (Figure 4.9-1). Just as in Alternative 2, results for lower Scoggins Creek spawning habitat were similar to those of upper Scoggins Creek. Month-to-month fluctuations in WUA that would occur under Alternative 1 and Alternative 2 conditions would be alleviated somewhat under Alternative 3. As such, the risks to steelhead associated with dewatering or scouring of redds as flows change from April to May and June to July would be reduced. The habitat increases associated with Alternative 3 are related to increases in minimum flow conditions during April and May and maintenance of spawning flows throughout the incubation periods. These flow increases are expected to be smaller and occur less often than those expected under Alternative 2.

**Juvenile Rearing and Adult Holding Habitat**
Modeling results predicted that, in the upper and middle study reaches of Scoggins Creek, Alternative 1 WUA would exceed Alternative 3 WUA approximately 65 percent of the time. Habitat decreases would be expected to follow the same annual pattern depicted in Figure 4.9-2 for Alternative 2. Compared to Alternative 2, Alternative 3 WUA is slightly closer to Alternative 1 WUA 20 percent of the time in the upper Scoggins Creek and 55 percent of the time in the middle part of the creek. Like Alternative 2, habitat would increase in the lower Scoggins Creek site (instead of decrease as in the upper and middle creek), due to the presence of higher gradient riffle as opposed to only glide habitat. In lower Scoggins Creek, WUA values for Alternative 3 would be similar to or greater than Alternative 1 conditions for most months that juveniles would be rearing and adults holding during wet, average, and dry years. The predicted WUA for Alternative 3 would be nearly identical to that of Alternative 2 in lower Scoggins Creek.

For the Tualatin River, the habitat model showed that Alternative 3 effects on steelhead rearing and adult habitat would be similar throughout the river, although the WUA would increase slightly from the upper to the lower parts of the river. Steelhead habitat under Alternative 3 would be similar to or improved over Alternative 1 (No Action). The habitat effects of Alternatives 2 and 3 would be nearly the same in the upper and middle parts of the river. In the lower part of the river, Alternative 2 would have slightly more steelhead rearing habitat than Alternative 3.

In summary, Alternative 3 would have a positive effect on steelhead spawning and incubation. In addition, the potential effects of dewatering and scouring would be slightly reduced under this Alternative. Minimum flows in Scoggins Creek would increase from 10 to 25 cfs. However, Alternative 3 would have significant negative impacts to steelhead rearing and adult holding habitat in Scoggins Creek, with substantial decreases projected for critical summer rearing habitat. Adult and juvenile
habitat in the Tualatin River would be similar or slightly increased over Alternative 1 conditions in most months, indicating a positive impact associated with Alternative 3. Overall, Alternative 3 changes from Alternative 1 were more moderated than Alternative 2, so both the positive and negative effects to steelhead habitat would be less than those associated with Alternative 2.

**Pacific Lamprey**
Similar to Alternative 2, lamprey larvae habitat would decrease in the upper study reach of Scoggins Creek remain the same in the middle study reach, and increase in usable habitat area in the lower study reach.

**Cutthroat Trout**
Cutthroat spawning habitat would improve in the upper reaches of Scoggins Creek (although Alternative 3 would provide less benefit than Alternative 2) and remain similar to Alternative 1 (and the same as Alternative 2) in the lower reaches of the creek. Juvenile cutthroat rearing habitat would be negatively impacted under Alternative 3, especially in upper Scoggins Creek and in the lower Tualatin River. Adult cutthroat habitat would decrease in upper and middle Scoggins Creek, particularly during the summer. However, habitat increases in lower Scoggins Creek and in the Tualatin River would balance out the negative effects in upper and middle Scoggins Creek.

**Magnuson-Stevens Act Species**
Criteria for coho salmon spawning habitat is similar to that of steelhead trout. Based on WUA estimates provided for steelhead spawning habitat, potential impacts to coho salmon EFH under Alternative 3 would generally increase under all flow conditions in the lower and upper study reaches of Scoggins Creek. Potential benefits would generally result from increased flows during peak coho spawning months (November and December). However, during high flow conditions, predicted decreases in extreme flow conditions and high velocities relative to Alternative 1 conditions during December act to increase spawning habitat while decreases in flow during high flow Novembers result in a potential loss of spawning habitat. Impacts to juvenile rearing EFH would be similar to those previously detailed for winter steelhead (i.e. slight losses within Scoggins Creek below Scoggins Dam and no change or slight increases within the Tualatin River). Differences between Alternatives 2 and 3 are expected to be slight, with predicted habitat impacts and flow regimes for Alternative 3 being closer to those of Alternative 1.

Potential impacts to spring Chinook EFH resulting from Alternative 3 would include an overall increase over Alternative 1 levels in available spawning habitat within the project area. This increase corresponds to a consistent reduction in flows throughout the chinook spawning season (August, September and October). Only during lowest flow conditions in September and October would these reductions bring flows below optimal spawning levels and thereby reduce potential spawning habitat. Potential rearing and holding EFH within Scoggins Creek below Scoggins Dam would be expected to decreases as previously described for winter steelhead, while Tualatin River rearing and holding EFH within the project action area would remain unchanged or increase slightly. Both the potential increases and decreases associated with Alternative 3 would be slightly less than those expected under Alternative 2.
Fall chinook spawning EFH within the Scoggins Creek study area would be expected to increase under Alternative 3 due to predicted increases in flow during September and October for both median and high flow years. Low flow conditions, however, would require reduction in flows through Scoggins Creek under Alternative 3 and spawning EFH would decrease as a result. Potential rearing and holding EFH within Scoggins Creek below Scoggins Dam would be expected to decrease as previously described for winter steelhead, while Tualatin River rearing and holding EFH within the project area would remain unchanged or increase slightly.

Mitigation Measures

4.9.2.4 Alternative 1 Mitigation
No additional mitigation measures would be implemented under Alternative 1. Ongoing mitigation efforts to improve habitat in the Gales Creek Watershed would continue.

4.9.2.5 Alternatives 2 and 3 Mitigation
The following section addresses species-specific mitigation. See Section 4.8 for a discussion of mitigation related to general construction impacts.

4.9.2.5.1 Mammals

Bats
Although it is believed that bats would avoid the construction areas and move to adjacent suitable habitat, large areas of potentially suitable nest trees would be impacted by Alternatives 2 and 3. Therefore, cost-effective and relatively permanent enhancements to bat habitat are recommended. These could include constructed bat habitat on the bridges surrounding the reservoir as well as snag creation in the forest adjacent to the new water level.

Camas Pocket Gopher
In order to avoid disturbance or entrapment of camas pocket gophers, the trench would be closed daily following construction. Crews would be trained in removal of individuals found in the morning, thereby limiting impacts from construction.

Red Tree Vole and White-Footed Vole
Both vole species could be impacted by forest clearing for inundation or roadway construction around Henry Hagg Lake. Mitigation for potential impacts to these species could be in the form of protection or improvements to coniferous forests in the project vicinity.

4.9.2.5.2 Birds

Bald Eagle
It is unknown whether established roosting sites in the vicinity of Henry Hagg Lake would be impacted by the inundation level associated with Alternative 2; however, roost sites are not limited in the vicinity of Henry Hagg Lake and the implementation of Alternative 2 would not result in a local shortage of bald eagle roost sites. The number of perch sites may be increased in the northern portion of the reservoir and the tributary arms if trees inundated by the higher water levels could be left standing; however, this may result in recreational boating safety issues. The increased open water area would be expected to
increase foraging opportunities for bald eagle and is expected to result in a beneficial long-term effect. No additional mitigation is suggested.

The Willamette Pipeline is at least two miles from any known bald eagle nest; therefore, no additional mitigation is suggested for Alternative 3 and construction of the Willamette Pipeline.

**Band-tailed Pigeon**
The band-tailed pigeon utilizes mineral springs and mineral gravel sites, therefore, mitigation for loss of these sites may provide appropriate mitigation for this species.

**Mountain Quail**
Impacts to the mountain quail are expected to be minimal; therefore no mitigation measures are proposed.

**Acorn Woodpecker**
Similar to the mitigation suggested for the Western Gray Squirrel in Section 4.8, mitigation for the acorn woodpecker would consist of managing for oak woodlands. Management recommendations include removing overtopping Douglas-fir trees (except old-growth trees); thinning dense understory oak and Douglas-fir to release remaining oaks; maintaining or developing habitat corridors to link scattered oak patches; using prescribed burning to prevent dense shrub competition; and promoting oak woodland conservation and enhancement on public and private lands through information, education, and legislation.

**Olive-sided Flycatcher**
Since low-canopy cover forested areas are present in relative abundance outside the park, and timing of construction impacts would be initiated to avoid impacts to all nesting migratory birds (as described in Section 4.8) impacts from the implementation of Alternatives 2 and 3 are expected to be minimal; therefore no additional mitigation measures are proposed. In addition, the maintenance of elk meadows for open foraging habitat and the creation of snags for enhancement of old growth forest would enhance olive-sided flycatcher habitat in the future.

**Oregon Vesper Sparrow**
Impacts to the Oregon vesper sparrow are expected to be minimal; therefore no mitigation measures are proposed.

**Purple Martin**
To mitigate for potential impacts to purple martin nesting habitat, it may be possible to facilitate purple martin use of the new Henry Hagg Lake shoreline by erecting purple martin nest boxes around the perimeter or leaving tall trees within the inundation zone to create natural nest cavities.

**Streaked Horned Lark**
Mitigation for potential impacts to streaked horned lark could include many of the following recommendations suggested by Pearson and Altman, 2005:
- Alter the timing or location of the activities that disturb breeding birds to avoid Lark breeding habitats.
- Encouraging farming practices that create and maintain bare ground within grass and forb dominated fields.
- Birds in the Willamette Valley use human managed habitats that provide appropriate habitat conditions. These sites are ephemeral in nature both between seasons and within seasons (as vegetation matures from late winter through summer). Thus we recommend establishing sites dedicated to Lark habitat that would be managed to provide appropriate habitat year round. This core population would then be supplemented by breeding birds finding appropriate habitats in the dynamic landscape outside the core.

**Yellow-breasted Chat**

Since chat habitat appears to be fairly abundant around the lake, it is anticipated that the species would move to adjacent suitable habitat, assuming that tree-clearing prior to inundation would occur outside the nesting season. The size of Henry Hagg Lake would increase under both action alternatives and there would be a corresponding increase in riparian fringe habitats, which could provide an overall benefit to the yellow-breasted chat. Therefore, no additional mitigation is proposed.

4.9.2.5.3 **Fish (Winter Steelhead, Cutthroat Trout, Pacific Lamprey, Coho Salmon)**

A stream habitat management plan would be developed and implemented for Scoggins Creek, which would provide seasonal flow benefits for 30 river miles. Overflow channels would be constructed within the existing dam outlet channel. Additional mitigation proposed for fish and aquatic species would also benefit steelhead, cutthroat, and lamprey. These mitigation measures would consist of stream channel improvements in the Gales Creek and McKay-Dairy Creek watersheds. Activities would include culvert replacement and repair, and habitat enhancements. A culvert would also be replaced along an unnamed tributary to Scoggins Creek, adding over 1,420 feet of spawning habitat to the stream for cutthroat and steelhead.

To improve spawning habitat for steelhead and cutthroat in over 1,000 feet of the Scoggins Creek channel, clean gravel will be placed between the spillway and the Stimson Mill bridge on an as-needed basis (when fines or sediment reduce production potential for spawning fish) (Murtagh, 2006).

To improve fish passage and habitat access in the tributaries to Scoggins Creek above Henry Hagg Lake, the City of Hillsboro’s Sain Creek Dam will be removed as mitigation. This would increase the length of cutthroat habitat available for rearing and spawning by approximately 1.8 miles. Downstream of the dam, improvements would be made to diversion dams within the City of Forest Grove watershed to improve fish passage and habitat, benefiting 892 feet of Roaring Creek and 1.4 mile of Clear Creek. Habitat restoration projects with the goal of improving riparian vegetation will also be pursued.

For fish impacts related to construction activities, mitigation measures include erosion and sediment control plans, and revegetation of any riparian areas where vegetation had to be removed for construction purposes. If trenching is approved for any stream crossings, fish passage or fish salvage will be required to minimize any fish take during construction. For trenchless crossings, entry and exit pits
will be placed in upland areas, away from stream banks; work areas will be protected with erosion control; and spill prevention and clean-up plans will be implemented in case of a frac-out. All in-water work will comply with the ODFW/NMFS designated in-water work periods.

4.9.2.5.4 Amphibians and Reptiles

Northern red-legged frog
Opportunities for red-legged frog mitigation exist in the project vicinity, especially in the wetland mitigation areas downstream of the dam and at Jackson bottom wildlife refuge, where the species is currently known to exist. Mitigation could consist of habitat enhancements and control of predators.

In order to avoid disturbance or entrapment of northern red legged frog, the trench would be closed daily following construction. Crews would be trained in removal of individuals found in the morning, thereby limiting impacts from construction.

Northwestern Pond Turtle
Opportunities for northwestern pond turtle mitigation exist in the project vicinity, especially in Tanner and Sain Creek, where large woody debris could be added to provide basking sites. It is important that these locations are set away from areas of human disturbance. Any proposed wetland mitigation could be augmented and designed with pond turtle habitat in mind, and should include basking sites on logs, rocks, mudbanks, or cattail mats. Fish habitat mitigation could also benefit pond turtles, particularly juveniles, if side channels and other areas of warmer, slow-moving water are created or enhanced. Areas identified to benefit juvenile pond turtles should be free of predators or should include some type of predator control. Bullfrog control of some kind would likely be necessary to avoid predation on young turtles. Bullfrogs are susceptible to annual fluctuations in water levels, which, if managed correctly, could interrupt their life cycle. Other, more labor-intensive mitigation measures include reptile fencing and collection of egg masses to prevent take.

4.9.2.5.5 Plants (Pale [White Rock] Larkspur, Thin-leaved Peavine, Kincaid’s Lupine, Nelson’s Checkermallow)
Although these species are not known to occur near Henry Hagg Lake, along the RWP, or the Willamette Pipeline, if they are present, they could be impacted by the project. Therefore, mitigation for potential impacts from Alternatives 2 and 3 would include additional plantings or conservation easements on known habitat or populations.
4.9 THREATENED, ENDANGERED, AND SENSITIVE SPECIES ................. 4.9-1

4.9.1 Affected Environment............................................................... 4.9-2
4.9.2 Environmental Impacts............................................................ 4.9-24

Figure 4.9-1. Predicted average monthly flows under Alternatives 1 and 2 and corresponding estimates for steelhead spawning WUA within the upper study reach of Scoggins Creek................................................................. 4.9-32

Figure 4.9-2. Predicted average monthly flows for Alternatives 1 and 2 and corresponding estimates of steelhead rearing WUA within the upper study reach of Scoggins Creek...................................................................................... 4.9-33

Figure 4.9-3. Historical Scoggins Dam & Hagg Lake Storage and Elevation Data4.9-35
Figure 4.9-4. Projected Future Scoggins Dam & Hagg Lake Storage and Elevation Data under Alternative 2. .......................................................... 4.9-37

Table 4.9-1. Federally Listed Threatened, Endangered, Candidate, and Species of Concern, State Threatened and Endangered Species, State Sensitive Plant and Wildlife Species, and Oregon Conservation Strategy Key Species addressed further in this document ......................................................................... 4.9-4

Table 4.9-2. Characteristics of Scoggins Creek study reaches (CWS 2007). .... 4.9-11
4.10 Historic Properties
Archaeological Investigations Northwest, Inc. (AINW) completed a cultural resource survey for the proposed TBWSP in 2006 and 2007.

The AINW study for the Tualatin Basin Water Supply Project (AINW 2007) provided data on archaeological and historical resources on lands that would be affected by inundation and road relocations around Hagg Lake, the Raw Water Pipeline, and the proposed Willamette Pipeline alignment. The study included the following tasks:

- A review of records of the Oregon State Historic Preservation Office (SHPO) for information on previous cultural resource surveys and other archaeological and historical studies in the project area. The SHPO records search also gathered information on previously identified archaeological and historical resources in the project area.
- A review of published and unpublished information on the environmental history, archaeology, prehistory, Native peoples, and Euroamerican historical development of the project area.
- A field reconnaissance survey of the project areas to assess current conditions and environmental setting and identify historic-period buildings, structures, and other features along the alignment.

A previous proposed alignment of the RWP was surveyed by CH2M Hill in 2005. The report on that survey (CH2M Hill 2005c) has not been submitted SHPO for review and concurrence. In addition, the currently proposed RWP alignment differs slightly from the alignment surveyed in 2005. Based on a review of the current RWP alignment and a recommendation by Janet Joyer of the USFS on behalf of Reclamation, AINW conducted a pedestrian survey of an approximately 3,835-foot segment of the proposed RWP alignment west of the intersection of Scoggins Valley Road and Old Highway 47. AINW also undertook a reconnaissance-level survey of the remainder of the proposed RWP alignment to identify areas considered to have a high probability for archaeological resources (that is, “high-probability areas” [HPAs]). The RWP alignment extends primarily across open fields, most of which are farmed.

4.10.1 Affected Environment

4.10.1.1 Archaeological
The entire TBWSP project area lies within the traditional homeland of the Tualatin people. Their homeland extended through most of the Tualatin River drainage and south to the North Yamhill River. Historically known Tualatin settlements were concentrated around Wapato Lake near modern Gaston and extended north to the area around modern Forest Grove. Two Tualatin villages may have been situated in the lower Scoggins Valley. The village of Chalal may have been around the mouth of Scoggins Creek. The village of Chatagshish may have been along Scoggins Creek below the current location of the Stimson Mill. Tualatin villages were politically independent and each village had its own chief or headman. The Tualatin recognized their shared language and culture, and all of the Tualatin groups met each fall to gather wapato at Wapato Lake. A few Tualatin villages were located east of the Gaston-
Forest Grove area. According to local tradition (Spang 1971), Indians continued to camp in the Scoggins Valley in the early settlement period (late 1840s and early 1850s).

4.10.1.2 Historic
The Willamette Valley and the Tualatin River Basin were the centers of Euroamerican settlement in the Pacific Northwest, beginning in the late 1820s and early 1830s. The pace of settlement accelerated in the mid-1840s and continued through the 1850s.

The RWP alignment lies close to some of the first Euroamerican settlement in the Tualatin Valley and extends across seven Donation Land Claims (DLCs): those of Norman Martin, Thompson Speaks, Joseph Davis, Joshua Dickson, R.F. Tupper, William Gibson, and William B. Chatfield (from west to east). However, there were no fields, residences, or other buildings shown along the pipeline alignment on the General Land Office (GLO) map of 1862 (AINW 2007).

The Willamette Pipeline alignment crosses or is in close proximity to five DLCs. DLCs in the general project area were clustered along the Willamette River and in the northern project area at the southern edge of central Tualatin Valley that was the heart of early Euroamerican settlement. The southern terminus of the Willamette Pipeline alignment is within the Robert V. Short DLC, but the alignment itself is to the north of the residence shown on the 1852 GLO map of Township 3 South, Range 1 West. Moving north, the proposed alignment passes through the Samuel B. Franklin DLC within close proximity of the homestead location shown on the 1852 map. Just north of the Franklin homestead, an “Indian Trail” crossed the proposed alignment from east to west.

The Willamette Pipeline alignment is located east of the developments near modern-day Sherwood, following the eastern edge of the James Canfield DLC and crossing the H.H. Hicklins DLC as shown on the 1861 GLO map of DLC boundaries for Township 2 South, Range 1 West. While the alignment crosses the Hicklins DLC, no developments were shown in this area on the 1852 GLO map of Township 2 South, Range 1 West. Near the present corner of SW Roy Rogers Road and SW Scholls Ferry Road, the proposed alignment passes an agricultural field and the Merrill residence shown on the 1852 map. An 1888 map of land claims for Township 2 South, Range 1 West (GLO 1888), shows all of the township as claimed, but it is unclear if these claims were accompanied by actual settlement and development rather than land speculation.

After passing through lands for which no developments or DLCs are shown on the 1852 GLO maps of Township 1 South, Range 1 West, the northern end of the proposed alignment is at the southern end of developments in the vicinity of modern Beaverton. Although the proposed alignment passes through the Samuel G. Stott DLC, actual developments associated with this claim were located to the west of the project area.

4.10.1.3 Traditional Cultural Properties
The Confederated Tribes of the Grand Ronde were contacted about the project. The Tribes did not identify any traditional cultural properties within the project area that require protection.

4.10.2 Environmental Impacts
4.10.2.1 **Alternative 1 – No Action**

4.10.2.1.1 **Potential Impacts (direct, indirect)**
The No Action Alternative would have no effect on historic or cultural resources.

4.10.2.1.2 **Cumulative Impacts**
The No Action Alternative would not contribute to effects on historic or cultural resources.

4.10.2.2 **Alternative 2 – Scoggins Dam 40-Foot Raise**

4.10.2.2.1 **Potential Impacts (direct, indirect)**
The survey of lands around Henry Hagg Lake identified 17 archaeological and historical resources, consisting of two prehistoric isolates, seven historic-period archaeological sites, four historic-period isolates, two locations associated historic-period aboveground resources, one archaeological feature (a blazed cedar tree), and one multi-component site (historic-period and prehistoric components). During the survey, 10 areas that were considered to have a high probability for buried archaeological resources (HPAs) were identified on Reclamation lands. Subsurface shovel testing within these 10 areas resulted in the discovery of one additional cultural resource, a prehistoric isolate.

Of the 18 cultural resources identified around Hagg Lake within the proposed TBWSP area, one was determined to be eligible for listing in the National Register of Historic Places (NRHP): the Pitman Cabin, temporary number 07/1443-17). Additional investigations are recommended for seven of the resources (07/1443-1, -2, -5, -7, -11, -15, and -18) in order to determine their eligibility; and the remaining 10 are recommended as not eligible for listing on the NRHP.

The reconnaissance-level survey of the proposed RWP alignment resulted in identification of nine areas considered to have a high probability of containing archaeological resources (HPAs).

4.10.2.2.2 **Cumulative Impacts**
No cumulative impacts have been identified.

4.10.2.3 **Alternative 3 – Multiple Source Option**

4.10.2.3.1 **Potential Impacts (direct, indirect)**
Potential impacts on historic and cultural resources would be similar to those of Alternative 2 in the vicinity of Henry Hagg Lake and along the RWP corridor.

The pedestrian survey of the Willamette Pipeline alignment identified one historic-period archaeological resource (07/1443-21). In addition, eight HPAs for prehistoric archaeological resources and two HPAs for historic-period archaeological resources were identified along the Willamette Pipeline alignment. Additional studies would be conducted to determine the presence and extent of cultural resources along the alignment.

4.10.2.3.2 **Cumulative Impacts**
No project impacts have been identified.

4.10-3
4.10.3 Mitigation Measures

4.10.3.1 Alternative 1
No mitigation is proposed.

4.10.3.2 Alternatives 2 and 3
To ensure further compliance with the requirements of the National Historic Preservation Act, the following mitigation measures are recommended.

- For lands around Henry Hagg Lake and along the Willamette Pipeline route for which access was not granted at the time of the AINW surveys, those lands should be surveyed if and when access is granted.
- For the Pitman Cabin, which AINW has recommended as NRHP eligible, the known or likely effects from the TBWSP need to be determined. If adverse effects are anticipated, appropriate mitigation measures will need to be defined and implemented.
- For those archaeological resources for which further research and/or field studies are recommended to assess NRHP eligibility, those recommendations should be implemented unless project effects to the resources can be avoided.
- For the HPAs along the RWP alignment, further field studies should be conducted to determine if archaeological resources are present. The additional field studies should minimally consist of a systematic pedestrian survey. If the surveys encounter conditions of poor ground surface visibility or a high likelihood of buried archaeological deposits, the pedestrian survey should be supplemented by limited subsurface exploratory probes.
- For the HPAs along the Willamette Pipeline route, a systematic pedestrian survey (supplemented with limited subsurface exploratory probes as needed or appropriate) should be conducted if construction-related activity would extend outside public rights-of-way.
4.10 HISTORIC PROPERTIES................................................................. 4.10-1
4.10.1 Affected Environment......................................................... 4.10-1
4.10.2 Environmental Impacts...................................................... 4.10-2
4.10.3 Mitigation Measures.......................................................... 4.10-4
4.11 Indian Trust Assets

4.11.1 Affected Environment
Reclamation complies with Interior’s guidance to protect Indian Trust Assets from adverse impacts of its programs and activities, and to enable the Secretary of the Interior to fulfill responsibilities to Indian tribes. Indian Trust Assets are legal interests in property held in trust by the United States for Indian tribes or individuals. Examples of Indian Trust Assets include lands, minerals, hunting and fishing rights, and water rights. Indian Trust Assets can be found both on and off reservation lands. The United States has an Indian trust responsibility to protect and maintain rights reserved by or granted to Indian tribes or individuals by treaties, statutes, and executive orders.

The tribes that comprise the modern Confederated Tribes of the Grand Ronde Community of Oregon (Grand Ronde Tribes) and Confederated Tribes of Siletz Indians (Siletz Tribes) lived throughout western Oregon. Historically, the tribes and their ancestors have hunted, fished, and gathered along the rivers and wetlands of the Willamette River Basin. Scoggins Dam and Henry Hagg Lake are within a hunting and fishing area set forth in a 1986 consent decree between the Grand Ronde Tribes, the State of Oregon, and the United States (“Agreement among the State of Oregon, the United States of America and the Confederated Tribes of the Grand Ronde Community of Oregon to Permanently Define Tribal Hunting, Fishing, Trapping, and Animal Gathering Rights of the Confederated Tribes of Grand Ronde”).

The Confederated Tribes of the Warm Springs Reservation (Warm Springs Tribes) reserved the right to fish, hunt, and gather roots and berries at all usual and accustomed places through the June 25, 1855, Treaty with the Tribes of Middle Oregon. These usual and accustomed places include the lower Willamette River valley.

Pacific lamprey is of great importance to Columbia River tribes for cultural, subsistence, medicinal, ceremonial and spiritual needs. The last viable harvesting place for lamprey in the Columbia River basin is at Willamette Falls, located on the lower Willamette River below the confluence of the Tualatin and Willamette Rivers. Besides the Warm Springs, Siletz and Grande Ronde Tribes, the Confederated Tribes of the Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation and the Nez Perce Tribe traditionally harvest lamprey at Willamette Falls. The Yakama, Umatilla and Nez Perce tribes all entered into treaties with the United States in 1855. In these treaties, the tribes reserved the right to take fish in all usual and accustomed areas.

4.11.2 Environmental Impacts

4.11.2.1 Alternative 1 – No Action
Alternative 1 would have no impact on Indian Trust Assets.

4.11.2.2 Alternatives 2 and 3

4.11.2.2.1 Potential Impacts (direct, indirect)
None of the alternatives would diminish the hunting, fishing, trapping, and gathering rights set forth in the consent decree with the Grand Ronde Tribes or the treaty rights of the Warm Springs, Umatilla,
Yakama and Nez Perce Tribes to hunt, fish, and gather at usual and accustomed places in common with other citizens of the United States. However, Alternatives 2 and 3 would affect fish and wildlife habitat as described in Section 4.7 (Non-Listed Fish and Other Aquatic Species), Section 4.8 (Non-Listed Wildlife Habitat and Vegetation), and Section 4.9 (TES Species).

4.11.2.2  Cumulative Impacts
None of the alternatives would contribute to impacts on Indian Trust Assets.

4.11.3 Mitigation Measures
Mitigation for impacts to fish and wildlife habitat are described in Sections 4.7, 4.8, and 4.9. No other mitigation is necessary.
4.11 INDIAN TRUST ASSETS

4.11.1 Affected Environment

4.11.2 Environmental Impacts

4.11.3 Mitigation Measures
4.12 Indian Sacred Sites

4.12.1 Affected Environment
Indian sacred sites are defined in Executive Order 13007 as, “any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or an Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religions significance to, or ceremonial use by, and Indian religion; provided that the Tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such site.” Federal agencies are required, to the extent practicable, to accommodate access to and ceremonial use of Indian sacred sites by Indian practitioners and to avoid adversely affecting the physical integrity of such sites.

As discussed in Section 4.11 (Indian Trust Assets), the study area lies within the home area of the tribes that comprise the modern Grand Ronde and Siletz tribes. Those tribes were contacted by letter and asked to inform Reclamation if they were aware of any Indian sacred sites that might be in the study area. To date, no such sites have been identified; therefore, Reclamation is unaware of any sacred sites in the study area.

4.12.2 Environmental Impacts
Because no Indian sacred sites have been identified in the study area, none of the alternatives are expected to adversely affect such sites.

4.12.3 Mitigation Measures
No mitigation is necessary.
4.12 INDIAN SACRED SITES ................................................................. 4.12-1
4.12.1 Affected Environment.............................................................. 4.12-1
4.12.2 Environmental Impacts........................................................... 4.12-1
4.12.3 Mitigation Measures............................................................... 4.12-1
4.13 Land Use and Planning

4.13.1 Affected Environment

4.13.1.1 Scoggins Valley Park and Vicinity
Scoggins Valley Park encompasses Henry Hagg Lake, as well as open space and actively managed recreation areas including trails, boat ramps, fishing piers, picnic areas, concession stands, and parking lots. Washington County collects entry fees and operates and manages the park, which is owned by the federal government and administered by Reclamation.

Scoggins Valley Road is the primary vehicular access directly to and within the park. The road enters the park from the southeast, runs along the north and east perimeter of Henry Hagg Lake, and then continues outside of the park boundaries. West Shore Road continues around the reservoir on the west and south shores and then crosses the dam and intersects with Scoggins Valley Road northeast of the dam. Washington County owns and maintains the perimeter road, which is functionally classified as a collector in the Washington County Transportation Plan. It travels southeast and east to eventually connect to Old Highway 47 and Oregon Route (OR) 47, an ODOT facility.

Land just outside the park boundary is rural and forested, with some private residences on large lots scattered along the limited road network. Most of the land is owned by private timber companies and is in forest use. There is also a small quarry (Scott Quarry) that supplies pit-run for logging roads in the vicinity, primarily for the owner’s logging operations. Eight local roads maintained by Washington County intersect with the perimeter road, four of which primarily serve residences (Herr, Nelson, Scott Hill, and Hankins roads) while four primarily serve logging vehicles (Tanner Creek, Stepien, Sain Creek, and Lee roads). Approximately twelve other roads intersect with the perimeter road that are maintained by Washington County but are used for fire protection access. While intended for fire protection access, the roads also have easements to provide access to more than 300 homes and properties.

4.13.1.2 Raw Water Pipeline Corridor
Along the RWP corridor, the first major land use immediately south of the Scoggins Dam is the Stimson Mill. Across from the mill facility are several older residential buildings. Development along Scoggins Valley Road is on the north side, composed of small rural residences and businesses until the junction with Old Highway 47. The RWP corridor runs south of the mill through mill-owned property and south of the P&W Railroad tracks. At Old Highway 47, the landscape and uses become generally agricultural. From the intersection at OR 47, the RWP corridor crosses OR 47 and the P&W Railroad tracks and then heads northward alongside State Highway 47 for approximately a quarter-mile, adjacent to agricultural fields with some farm residences. The RWP corridor then veers northeastward to cross agricultural fields, as well as the Tualatin River and an unnamed tributary, until it reaches the JWC Fern Hill Water Treatment Plant (see Figure 4.13-1).

4.13.1.3 Willamette Pipeline Corridor
The Willamette Pipeline is a feature of Alternative 3 (Multiple Source Option) only. In general, the pipeline would run northward from the Willamette River Water Treatment Plant in Wilsonville and...
terminate in Beaverton at SW Western Avenue and SW Beaverton-Hillsdale Highway. The Willamette Pipeline corridor travels through urban and rural areas in Clackamas and Washington counties. It passes through the cities of Wilsonville and Sherwood, and along the northern city limit of Tigard (Figure 4.13-2). The Willamette Pipeline would be installed primarily within existing road rights-of-way. Small portions of the pipeline would also cross private and public properties. The alignment is described in Section 3.4.3.7.

Urbanized areas along the Willamette Pipeline corridor are primarily within city limits. In Wilsonville, it follows the Morey’s Landing greenbelt through a residential neighborhood; it also follows the city limits adjacent to a public school (north of Wilsonville Road) and a correctional facility (near Day Road). It follows the Sherwood city limits, adjacent to residential areas, to SW Oregon Street. Along Oregon Street, the corridor is bordered by light industrial land on the north and residential areas on the south. As it travels north along the unimproved SW Adams Street right-of-way, the corridor borders single-family and multi-family residential development and a private school, then the corridor travels west through residential and commercial areas before leaving the city limits. The corridor enters Beaverton along SW Scholls Ferry Road, which is a main thoroughfare bounded by relatively new commercial, multi-family, and single-family developments. Between SW Barrows Road and SW 125th Avenue, Scholls Ferry is the boundary between Beaverton and Tigard. Land uses along 125th Avenue and north to SW Denny Road are primarily residential. The remainder of the corridor follows rights-of-way through commercial and mixed-use, multi-family residential areas to SW Beaverton-Hillsdale Highway.

The rural areas between the cities are characterized by farms, small-scale horse ranches, large-lot rural residential developments, nurseries, and open areas. The pipeline corridor lies adjacent to the Tualatin River National Wildlife Refuge along SW Roy Rogers Road and SW Tonquin Road, north and south of Sherwood. A large sand and gravel quarry with an associated concrete and asphalt plant, operated by Morse Bros., borders the corridor along SW Tonquin Road just west of Grahams Ferry Road.

Water storage tanks would be constructed at two points near the corridor. Although specific sites have not been identified, the City of Tualatin water tank would likely be located near the intersection of Oregon Street and Tualatin-Sherwood Road, and the TVWD water tanks would be built on the southern slopes of Cooper Mountain. The areas being considered for the TVWD water tanks are north of SW Scholls Ferry Road in unincorporated Washington County. The areas are privately owned and are near low-density residential areas. Most of one of the areas is managed as a vineyard (Adolfson 2006b). One residence is within another area. Otherwise, the areas are generally forested.

4.13.1.4 Land Uses Associated with Water Use

4.13.1.4.1 Municipal and Industrial
Land uses in the Tualatin Basin and Washington County are served by local agency and city providers. There are twelve cities and a total population of about half a million. According to the WSFS, existing capacity to serve the entire variety of residential, commercial, industrial, and institutional uses is about 21 billion gallons or 64,000 acre-feet, from a combination of stored water in Henry Hagg Lake and Barney Reservoir, natural flow rights on the Tualatin River and its tributaries, groundwater, and purchase from the City of Portland.

4.13.1.4.2 Agricultural
Major irrigated crop varieties include berries, silage corn, vegetables, clover, and nursery stock. The T VID receives irrigation water through a contract between T VID and Reclamation. Up to 17,000 acres are eligible for irrigation in any one year and the annual allotment is 37,000 acre-feet, of which 27,000 acre-feet is stored in Henry Hagg Lake. The remaining 10,000 acre-feet comes from river and tributary flow.

4.13.1.4.3 River Flow Augmentation
In the context of water demand to support existing and future land uses, it is important to remember that the water supply is divided between serving human-related land uses and the needs of the Tualatin Basin natural environment. Water flow augmentation in the Tualatin River and its tributaries is needed in the summer months. Low water flows combined with high ambient phosphorous levels and high temperatures have created chronic water quality problems. Many of these derive from urban development and farming, and have contributed to the decline of water quality. The state and federal governments have established water quality standards for the Tualatin River and its tributaries. Clean Water Services is the agency responsible for ensuring that the waters meet the minimum standards. Augmenting flow demonstrably improves water quality.

4.13.2 Applicable Plans and Policies

4.13.2.1 Henry Hagg Lake Resource Management Plan
The Resource Management Plan was adopted in May 2004. It describes existing conditions and the goals, objectives, and management actions that will guide management and development of the area until 2014.

The Henry Hagg Lake Resource Management Plan discusses the relationship of the Resource Management Plan to the WSFS and the options under examination in this Draft PR/EIS. The Resource Management Plan notes that raising the dam 20 or 40 feet would inundate most recreation facilities at the shoreline and portions of the perimeter road as well as some lands acquired to mitigate construction impacts to elk migration patterns. The timeline for the dam raise falls within the planning period of the Resource Management Plan, which was developed with the understanding that the potential dam raise project would include replacing any affected recreation amenities and elk mitigation land on a one-for-one basis. Acknowledging the potential implementation of the dam raise project, the Resource Management Plan focused on improvements that would be portable and/or would not require large capital expenditures for permanent facilities.

4.13.2.2 Statewide Planning Policies
The foundation of Oregon’s land use planning program is a set of nineteen Statewide Planning Goals. Oregon’s statewide goals are achieved through local comprehensive plans which must be consistent with the Statewide Planning Goals. State law requires each city and county to adopt a comprehensive plan and the zoning and land-division ordinances needed to put the plan into effect. The local comprehensive plans are reviewed for consistency with the Statewide Planning Goals by the State’s Land Conservation and Development Commission (LCDC). When LCDC officially approves a local government’s plan, the plan is said to be “acknowledged.” It then becomes the controlling document for land use in the area covered by that plan. Washington County and other local governments with jurisdiction in the project area have acknowledged comprehensive plans that implement the Statewide Planning Goals.

4.13.2.3 Local Plans
Henry Hagg Lake and the RWP are outside the urban growth boundary (UGB) of the Portland metropolitan area and outside of city limits. The local plan that applies to land uses outside of city limits is the Washington County Comprehensive Plan, specifically, the Rural/Natural Resource Plan Element. The comprehensive plan designations are the same as the zoning districts, discussed in more detail in the impacts section. In addition, the Washington County 2020 Transportation Plan would apply to the reconstruction of the perimeter road.

The Willamette Pipeline corridor lies within a number of jurisdictions. Outside of city limits, the southern part of the pipeline would be in unincorporated Clackamas County and much of the middle part of the pipeline would be in unincorporated Washington County. Applicable local plans, therefore, are the Clackamas County Comprehensive Plan and the Washington County Comprehensive Plan. In Washington County, the Washington County Rural/Natural Resource Plan Element applies to land use outside the UGB; inside the UGB but outside of city limits (that is, in urban, unincorporated parts of the project area), these Washington County Community Plans apply: Aloha-Reedville-Cooper Mountain, Bull Mountain, and Sherwood. Within city limits, the public facilities elements of the comprehensive plans for Wilsonville, Sherwood, and Beaverton apply to land uses and development. As noted above, a short section of the Willamette Pipeline corridor along Scholls Ferry Road lies along the city limits of Tigard. If the pipeline would be placed along the south side of the road in that area, the Tigard comprehensive plan would apply.

Land use designations in the project vicinity shown on Figure 4.13-1 (Henry Hagg Lake and RWP) and Figure 4.13-2 (Willamette Pipeline) are derived from Metro, the regional planning agency. The Metro land use designations were used on the figures in this section because they are standardized across the local jurisdictions in the Portland metropolitan region. Because the Willamette Pipeline would cross numerous jurisdictions, showing each of the jurisdictions’ specific land use designations on the figures would be impractical. By referring to the figure legends, the reader may gain a reasonable understanding of the local land use designations in the project area.

4.13.2.3.1 Washington County Comprehensive Plan/Zoning Districts (Action Alternatives)
Nearly all of the land surrounding Scoggins Valley Park is designated and zoned Exclusive Forest and Conservation (EFC) in the Washington County Comprehensive Plan Rural/Natural Resource Plan Element, Map #6. EFC derives from Statewide Planning Goal #4 (Forest Lands) and is intended to protect forest uses and the continued use of lands for renewable forest resource production, retention of water resources, recreation, and other related or compatible uses.

Land use designations along the RWP corridor are for agriculture and forest (AF) uses, except for the Rural Industrial (R-IND) designation (shown as Rural Residential or Future Urban [Washington County classification] on Figure 4.13-1). The agriculture and forest districts have different minimum lot sizes, reflected by the number following “AF-“, except AF-20, which is an Exclusive Farm Use zone. The Willamette Pipeline would also cross Exclusive Farm Use (EFU) land for portions of its route.

- **Exclusive Forest and Conservation (EFC).** The purpose of this District is to encourage forestry as the dominant use of such lands, to conserve and manage efficiently the forest resources of the County and to prohibit uses of land which are not compatible with the management and development of forest resources, in order to minimize the potential for damage from fire, pollution, soil erosion and conflict caused by development. This District is suited for application to forest land as well as associated scenic lands, recreation land, wildlife habitat or other sensitive land forms or watershed areas.

- **Exclusive Farm Use (EFU).** The purpose of the Exclusive Farm Use District is to preserve and maintain agricultural lands for farm use consistent with existing and future needs for agricultural products, forests and open spaces; to conserve and protect scenic resources; to maintain and improve the quality of the air, water and land resources of the County and to establish criteria and standards for farm use and related supportive uses.

- **AF-20 District** has an 80-acre minimum lot size. The intent of the Agriculture and Forest-20 District is to provide an exclusive farm use zone within the county which recognizes that certain lands therein may be marginal. The purpose of the AF-20 district is to allow EFU uses and, through the provisions of Section 425 of the County Community Development Code (which implements the Comprehensive Plan), to provide a process and criteria for identifying marginal lands within the District. In addition, Section 344-8 of the Community Development Code provides for special uses for lands so identified.

- **AF-10 District (Agriculture and Forest, 10-acre minimum lot size).** The AF-10 District is intended to retain an area’s rural character and conserve the natural resources while providing for rural residential use in areas so designated by the comprehensive plan.

- **AF-5 District (Agriculture and Forest, 5-acre minimum lot size).** The AF-5 District is intended to retain an area’s rural character and conserve the natural resources while providing for rural residential use in areas so designated by the Comprehensive Plan.

- **Rural Industrial (R-IND).** The Rural Industrial District is intended to provide areas for industrial uses outside the UGB where an exception to Goal 3 (Agricultural Lands) or Goal 4 (Forest Lands) has been taken, and where a full range of urban services will not be required. The R-IND district provides for the processing and manufacture of timber and forest related products, farm crops
and produce, minerals and aggregates near the resources, and for the repair of mechanical equipment related to farm and forest uses.

**Overlay Districts and Other Requirements**

Several types of significant natural resources identified with overlay zones on the County’s Significant Natural Resources Area map would be directly affected by the project:

- Water Areas and Wetlands (Henry Hagg Lake and portions of tributaries, floodplain of the Tualatin River east of OR 47)
- Water Areas and Wetlands and Fish and Wildlife Habitat (creeks and tributaries associated with Henry Hagg Lake and the Tualatin River)
- Wildlife Habitat (all of the project and vicinity east to approximately Old Highway 47)
- Scenic Routes (Henry Hagg Lake perimeter road)

**Article VII**

The intent of Article VII is to identify public transportation improvements that are subject to development review and establish the standards and procedures for such review. The perimeter road relocation would be subject to review under Article VII of the Washington County Development Code. For both Action Alternatives the perimeter road would be relocated near Nelson Road, Tanner Creek Road, Scoggins Valley Road, Sain Creek Road, and on the southeast side of the reservoir near the dam structure. A 40-foot dam raise (Alternative 2) would include an additional approval for relocation at Cascara Road. Relocation on EFC-zoned land could require a finding that the changes do not cause a significant change in, or cost of, farm or forest practices. That requirement implements state law protecting farm and forest land.

**4.13.2.3.2 Washington County 2020 Transportation Plan**

The Washington County 2020 Transportation Plan was adopted in October 2002. The Roadway System section of the Transportation Plan establishes several system priorities and design attributes and standards for the existing transportation network and for future roadway improvements. Policy 6.11 requires that “new development or redevelopment projects...comply with local street connectivity, access management, parking and other applicable regulations in the Community Development Code, the Community Plans and the Rural/Natural Resource Plan.”

Scoggins Valley Road is classified as a collector, and Highway 47 is classified as a principal arterial on the Classification System map of the Transportation System Plan. Although the RWP would cross OR 47, no changes to the highway are proposed by any of the alternatives. Overall, the Scoggins Valley/West Shore road is an 10.5-mile-long, paved, two-lane road with 6- to 8-foot-wide paved shoulders. The Transportation Plan does not contain any planned roadway improvement projects for the perimeter road.

With respect to Scoggins Valley Road as a Collector, the Transportation Plan lists the following characteristics:
Collectors connect neighborhoods to nearby centers, corridors, station areas, main streets and nearby destinations in the urban area. Land development should not be sited to obstruct the logical continuation of collector streets.

In the rural area, collectors are a primary link between the local street system and Arterials for freight, people, goods and services.

Access control on collectors is lower than on arterials. Commercial, industrial and institutional uses will be eligible for direct access to collectors in accordance with the provisions of Article V of the Washington County Community Development Code. Direct access to new residential lots is not permitted.

The Bicycle System Map of the Transportation Plan designates Scoggins Valley Road as a Rural Bikeway. Under the Transportation Plan, Rural Bikeways are to have paved shoulders at least five feet wide. Therefore, the road meets current standards.

4.13.2.3.3 Washington County Community Plans for Urban Unincorporated Areas (Alternative 3 Only)

Aloha-Reedville-Cooper Mountain Community Plan
This community plan applies to the unincorporated area on the west side of Beaverton. Zoning is mostly residential (R-5) in this area.

Bull Mountain Community Plan (Washington County)
This community plan applies to the unincorporated area on the west side of Tigard and south of Beaverton city limits. The Willamette Pipeline follows Roy Rogers Road in this area. Adjacent zoning is either R-5 or future development (FD-20).

Sherwood Community Plan (Washington County)
This community plan applies to the unincorporated areas around Sherwood, including two small areas, one near Tonquin and Dahle roads and one south of the Onion Flats at the city limits and Bonneville Power Administration (BPA) powerline corridor. Zoning is industrial (IND).

4.13.2.3.4 Clackamas County Comprehensive Plan and Zoning and Development Ordinance (Alternative 3 only)
Land in the vicinity of the Willamette Pipeline is designated and zoned Exclusive Farm Use or Rural Residential/Future Urban in the Clackamas County Zoning and Development Ordinance.

- Exclusive Farm Use (EFU). The purpose of the EFU District is to preserve agricultural use of agricultural land; to protect agricultural lands from conflicting uses, high taxation and the cost of public facilities unnecessary for agriculture; to maintain and increase the agricultural economic base of Clackamas County; to increase agricultural income and employment by creating conditions which further the growth and expansion of agriculture and which attract related industries; to maintain and improve the quality of air, water and land resources; to conserve scenic and open space; to protect wildlife habitats; to ensure compatibility with forest and agricultural operations; and to maintain opportunities for economically efficient forest and agricultural practices.
• Rural Residential Farm/Forest 5-Acre District (RRFF-5). The intent of the RRFF-5 District is to implement the policies of the Comprehensive Plan for areas designated Rural.
• Future Urbanizable 10-Acre District (FU-10). The FU-10 District is intended to preserve for future development at urban densities the future urbanizable areas of the County as defined in the Comprehensive Plan.

4.13.2.3.5 City of Beaverton (Alternative 3 only)
The Public Facilities and Services element of the Beaverton Comprehensive Plan notes that most of the public services are provided by other agencies or districts and their planning documents contribute to the City’s Public Facilities Plan. The general goal is to ensure long-term provision of adequate urban services within existing city limits and areas to be annexed in the future. The discussion of water supply lists the contributing agencies and a policy to continue to participate in the JWC and work with the West Slope, Raleigh, and Tualatin Valley Water districts to ensure the provision of adequate water service to present and future customers in Beaverton. The Comprehensive Plan contains no specific reference to the proposed project to increase water supply.

4.13.2.3.6 City of Sherwood (Alternative 3 only)
The Community Facilities and Services element of the Sherwood Comprehensive Plan contains a water supply plan, but it has not been updated for population growth past 2008. The general Public Facilities Goal and objectives focus on providing community services and facilities that are adequate to support existing development and to coordinate for future levels of services and facilities to future urban areas. The Comprehensive Plan contains no specific reference to the proposed project to increase water supply.

4.13.2.3.7 City of Wilsonville (Alternative 3 only)
The Public Facilities and Services element of the Wilsonville Comprehensive Plan contains a goal to ensure that good quality public facilities and services are available with adequate capacity to meet community needs as development occurs. The plan notes the construction of the Willamette River Water Treatment Plant and indicates that the treatment plant will be expanded as demand increases, which includes up to 50 additional MGD available to be pumped to neighboring communities north of Wilsonville. System expansion will occur on a regular basis. There is no specific reference to the proposed project in the Comprehensive Plan.

4.13.3 Environmental Impacts

4.13.3.1 Alternative 1 – No Action

4.13.3.1.1 Potential Impacts (direct, indirect)
The No Action Alternative would have no immediate direct effects on land uses. Land use impacts from the No Action Alternative could occur in the near-to-long term as a result of localized water shortages. The severity of impacts from water shortages are projected to increase as planned growth in the basin occurs. The WSFS reports that peak season M&I demand would exceed existing supplies before 2010, while some local jurisdictions would experience shortages in the next few years. Water shortages could affect agriculture as well as residential, commercial, and industrial growth.
Measures such as water conservation and wastewater reuse described in this Draft PR/EIS are included as part of the No Action Alternative. Shortages would occur even with implementation of these measures and would affect all land uses, acting as a brake on agricultural and industrial uses that are dependent on a predictable water supply, and eventually on patterns of residential growth, if adequate service and fire protection pressures cannot be maintained. There are still large areas of undeveloped or underdeveloped land within the UGB that are planned for more intensive urban uses in accordance with the comprehensive plans of Wilsonville, Tualatin, Tigard, Sherwood, and Beaverton. Over time the water supply may be insufficient to support those planned uses. Urban intensities of development may not be sustainable.

A shortage of water could also lead to a reduction in the contracted amounts of irrigation water from the TVID to users, and a reduction in the amount of irrigated land. The WSFS noted that there is little opportunity for major conservation by irrigators. Virtually all irrigation water is conveyed by closed pipeline so there is little loss through evaporation. Although 99 percent of users have sprinkler systems, rather than the more efficient drip systems, the latter are expensive and used exclusively for high-value crops, not traditional row crops. Wastewater reuse could be a potential supply for agricultural users, but its use on food crops may be unlikely due to negative public perceptions.

Oregon water rights laws give priority to owners of older water rights. The more recent the application for water rights, the lower the priority. Therefore, when a shortage occurs, the OWRD has the authority to order water rights holders with junior priority dates to stop using water. A spillover impact would be potential changes to the types of crops that can be grown in the basin and consequently on the local economy as only high value crops tend to be irrigated. If the water shortages appear to be permanent, the value of the land for agriculture could decline, if only non-irrigated crops can be grown. This could result in increased pressure to convert the land to other uses that can generate more income for the property owners as well as the local taxing agency.

An insufficient water supply to meet planned growth may force local cities and Washington and Clackamas counties to implement measures to limit growth. Local jurisdictions and the water providers would need to implement measures such as moratoriums on building and development or strict water conservation measures (for example, legal restrictions on outdoor landscaping, irrigation, and vehicle washing). Oregon law limits development moratoriums to two years so this would be a limited response. Another option could be to redraw planned land use patterns, perhaps reducing the amount of land in the UGB to prohibit urban levels of service from being extended until water supply can meet demand. Local jurisdictions may decide to revise their comprehensive plans to redraw boundaries to limit future growth. Statewide Planning Goal 11 (Urbanization) addresses the timely and orderly extension of public facilities, and states that urban and rural development shall be guided and supported by types and levels of urban and rural public facilities and services appropriate for, but limited to, the needs and requirements of the urban, urbanizable, and rural areas to be served. The carrying capacity of the land should be considered when extending the UGB, but the goal does not mandate changes once the UGB has been approved if planned uses begin to exceed carrying capacity later on.
Metro’s Title 11 of the Urban Growth Management Functional Plan requires new urban areas to be annexed into a city or into service districts prior to urbanization of the territory and completion of a conceptual plan for providing water and other facilities and utilities, including preliminary cost estimates and funding strategies. A key component of determining which lands come into the UGB is the ability and willingness of a service provider to provide service. If water could not be provided to a new urban area, it most likely would sit there until service was worked out as the land inside the UGB is a 20-year supply of land. However, if a water provider has agreed to provide water to the future urban area inside the UGB based on expansion of Hagg Lake and that expansion does not occur, and there is insufficient water for all of the land within the UGB, it would seem that refusal by the local water providers to serve new urban users may be one method that could limit growth.

Overall, widespread shortages in the Tualatin Basin that would restrict population growth rates would also affect local economies because revenues from property and business taxes would not grow as anticipated.

4.13.3.1.2 Cumulative Impacts
Projected growth in other parts of the Portland metropolitan area that rely on other sources of water would create additional demand and could further limit growth in the Tualatin Basin. For example, additional demand in Portland would reduce the amount of Bull Run water available for sale to water suppliers serving the Tualatin Basin.

4.13.3.2 Alternative 2 – Scoggins Dam 40-Foot Raise

4.13.3.2.1 Potential Impacts (direct, indirect)
Temporary impacts would consist of construction-related activities that create noise and dust, traffic diversions, and changes in access to some properties. Construction activities are described in Section 3.3.4. Descriptions of other construction impacts are presented in Section 4.16 (Air Quality), Section 4.17 (Noise), and Section 4.21 (Transportation and Access), among others. Tree clearing, grading, road relocation, recreation area development, noise, dust, truck traffic, and construction equipment would cause the most noticeable short-term impacts to nearby residents and park visitors. Impacts on recreation facilities and use are described in Section 4.14.

Access to commercial businesses along OR 47 would be affected by construction traffic to and from Scoggins Valley Park, which is estimated to be approximately 60 trucks per day. Temporary access changes to individual residences and recreation sites around Henry Hagg Lake would also occur during the road relocation. A few farm residences along Fern Hill Road may have their access temporarily disrupted by construction of the RWP. However, access would be maintained throughout the construction period to all parcels in the project area with existing authorized access.

RWP construction would affect the Stimson lumber mill parcels and land designated for agriculture along the 6.5-mile-long corridor. RWP construction would affect approximately 36 lots. The RWP would be placed in a trench approximately 12 feet wide for most of its length, and the construction corridor would be from 60 to 140 feet wide to accommodate construction equipment, equipment maneuvering, and material stockpiles. Therefore, the total area of temporary impact would be between 47 and 110
acres. Where feasible, the width of the construction corridor would be narrowed to limit impacts. The trenching, temporary stockpiling of backfill, and movement of equipment could disrupt irrigation systems or patterns, drainage tiles, and crop rotations. Construction activities could also affect other seasonal agricultural activities on adjacent areas, such as spraying pesticides or fertilizers (if construction workers are nearby). The area affected by construction would remove those areas from agricultural use for the duration of construction, and may affect soil structure due to the depth of excavation. Access to adjacent agricultural areas could be affected. Construction could interfere with crop rotation and introduce weed species into agricultural fields during the movement of equipment.

Long-term impacts around Henry Hagg Lake would consist of the conversion of forest, pasture, recreation, and residential land to the reservoir and transportation uses. Residential and forest land would also be converted to recreation use. Impacts to recreation facilities and use are described in Section 4.14 (Recreation).

With a 40-foot dam raise, the normal full pool elevation would be at 343.5 feet and the reservoir would cover an area of 1,487 acres (increasing from 1,117 acres). The higher water level would inundate approximately 370 acres of land within Scoggins Valley Park and on adjacent private land; therefore, Alternative 2 would convert a total of 370 acres of land used for open space, recreation, and rural residential to a reservoir use.

Reclamation’s general policy for reservoir projects is to acquire any privately-owned land that is within 300 feet of the edge of an area of inundation, as well as privately-owned land that lies between the park boundary and the relocated perimeter road. For Alternative 2, Reclamation would acquire up to 167 acres of private property, adjacent to Scoggins Valley Park, affecting 18 tax lots. The land would be incorporated into the park and converted to open space and recreation use; a minor amount of this land, near Scoggins and Sain creeks, would be converted to transportation use for relocation of the perimeter road. Even after the land acquisition, the amount of land in Scoggins Valley Park not inundated (above the reservoir surface) at normal full pool would decline by 203 acres—from 1,404 acres to 1,201 acres.

The private properties that would be affected are in rural residential use. They are concentrated on parcels that extend into the low areas associated with Tanner, Scoggins, and Sain creeks. Property owners would be compensated for land acquired and for impacts to their remaining crops in compliance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended. The proposed expanded park boundary and properties that would be affected are shown on Figure 4.13-3. Affected properties are also listed in Table 4.13-1. Only land within the proposed park boundary would be acquired.

Table 4.13-1. Tax Lots near Henry Hagg Lake that May Be Affected under the Action Alternatives

<table>
<thead>
<tr>
<th>Tax Lot Number</th>
<th>Alt. 2 – 40-foot raise</th>
<th>Alt. 3 – 25-foot raise</th>
<th>Access affected?*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1S4000000800</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Yes</td>
</tr>
<tr>
<td>1S4000000900</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
<tr>
<td>1S4060001600</td>
<td>Partial acquisition</td>
<td>No Impact</td>
<td>Not likely</td>
</tr>
</tbody>
</table>

4.13-11
<table>
<thead>
<tr>
<th>Tax Lot Number</th>
<th>Alt. 2 – 40-foot raise</th>
<th>Alt. 3 – 25-foot raise</th>
<th>Access affected?*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1S40600001700</td>
<td>Displaced</td>
<td>Partial acquisition</td>
<td>Yes</td>
</tr>
<tr>
<td>1S40800000900</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
<tr>
<td>1S4080001000</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
<tr>
<td>1S41800000400</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Yes</td>
</tr>
<tr>
<td>1S5120000200</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
<tr>
<td>1S5120000300</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Yes</td>
</tr>
<tr>
<td>1S5120000400</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Yes</td>
</tr>
<tr>
<td>1S5120000502</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Yes</td>
</tr>
<tr>
<td>1S5130000700</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
<tr>
<td>1S5130000802</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
<tr>
<td>1S5130000900</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
<tr>
<td>1S5130001000</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
<tr>
<td>1S51300011200</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
<tr>
<td>1S5130001300</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
<tr>
<td>1S5130001400</td>
<td>Partial acquisition</td>
<td>Partial acquisition</td>
<td>Not likely</td>
</tr>
</tbody>
</table>

* Access impacts are positively assessed based on whether the parcel has a current site address, if the location of road access is visible and if the area of inundation appears to cover the access point to the public road network. If there is no site address, it is assumed that the lot does not have any structures and site access consequently may be fairly informal (through adjacent properties), not used year-round or difficult to identify from the road. As a result, impacts to a site’s access are considered likely only in the first instance. Property owners may identify more impacts through the NEPA public involvement process and through future right-of-way negotiations. All properties with current access to the public road network would continue to have such access. Partial acquisitions will need to be evaluated for consistency with current zoning requirements and legal cases.

Figure 4.13-3. Henry Hagg Lake and Properties affected by 40-foot Dam Raise and 25-foot Dam Raise (File Name: Fig 4.13-3 Hagg Affected Properties.pdf)

The southwestern part of a large parcel (1S4080000900) east of Nelson Road would be inundated. Part of the adjacent lot (1S4080001000) would be acquired because it is within 300 feet of the edge of the expected inundation.

At Tanner Creek, 70 percent of one parcel (1S40600001700) would be significantly affected by inundation, while the parcel to the north (1S4060001600) would be affected on its southwestern quadrant. The parcel to the east (1S4000001800) would have most of its frontage inundated for part of the year, affecting the current access to the parcel. Two residences on these parcels could be displaced in the upstream portion of the Tanner Creek area. The small northwest corner portion of another parcel on Tanner Creek Road would be affected (1S4000000900).

At Scoggins Creek, the area of inundation would extend for some distance northwest of the existing shoreline, crossing four parcels (1S5120000200, 1S5120000300 1S5120000400, and 1S5120000502). Scott Quarry is on one of the parcels. If the quarry is acquired, the loss of pit-run material from the quarry would affect logging road construction for the owner and for operators logging privately-owned areas in the vicinity. There are commercial quarries outside the affected area but within a reasonable
distance of the logging operations in the Scoggins Creek drainage (such as in Gaston and Carpenter Creek), although it would increase operating costs for foresters to use them.

North of the Sain Creek picnic area, the southern third of one parcel (1S4180000400) would be needed to accommodate the perimeter road realignment while only a small corner of the adjacent property (same owner, 1S5130000700) would be affected. Further west along Sain Creek itself, areas of inundation would affect six abutting parcels along their shared southern or northern property lines (1S5130000802, 1S5130000900, 1S5130001000, 1S5130001200, 1S5130001300, and 1S5130001400). Residences that appear to be associated with those properties take access from Sain Creek Road, north of the acquisition area where slopes are gentler.

No private properties would have direct frontage on Hagg Lake because Reclamation would acquire additional land, as needed, to maintain at least 300 feet between the inundation area and private properties around the lake. State and local land use regulations would prevent resource land uses (such as farm and forestry) on properties around Scoggins Valley Park from being converted to commercial uses. See Section 4.13.2.3 “Local Plans” for more discussion.

Long-term land use impacts from the RWP would typically be limited to requiring the right to access the pipe for maintenance or repair from private property owners. Pipeline easements would be obtained for this purpose. However, impacts on existing agricultural uses could occur from the importation of non-native plant material or impacts on soils from equipment use both during construction and during maintenance visits. Productive use of agricultural land may be lost where the pipe is located in cultivated areas because certain types of agriculture would not be allowed to remain (such as deep-rooted crops, orchards, vineyards). It is estimated that approximately 40 percent of the easement could be re-cultivated. Contractors would be required to implement best management practices to limit impacts to soils and the risk of accidental transport of noxious weed seeds to the site. Re-vegetation with native seed or a return to pre-construction agricultural condition would be conducted as appropriate; this requirement would be included in construction contracts for the RWP.

4.13.3.2.2 Cumulative Impacts
Alternative 2 would convert approximately 167 acres of land from private, rural residential use to public open space and reservoir uses. Although most of the direct impacts would be on the residential use portion of affected lands, the land is primarily in EFC or EFU land use designations. Therefore, the conversion would add to past and future removal of farm and forest land from those uses. In addition, the land areas required to mitigate for wetlands and to replace stream, upland, and riparian habitats would also add to that total removal of the potential for future farm and forest production. A minor amount of this land would be converted to transportation use for relocation of the perimeter road. Future urban development in the region would contribute to additional conversion of rural residential lands to other uses—primarily urban uses.

4.13.3.3 Alternative 3 – Multiple Source Option

4.13.3.3.1 Potential Impacts (direct, indirect)
The types of temporary construction impacts would be the same as under Alternative 2 for the properties around Henry Hagg Lake and the RWP. Tree clearing, grading, road relocation, noise, dust, truck traffic, and construction equipment would cause the most noticeable short-term impacts to nearby residents and park visitors. The total construction area for the RWP could be somewhat less, as the pipeline would be 72 inches in diameter instead of 96 inches as proposed for Alternative 2.

Alternative 3 would have construction impacts along the 22-mile length of the proposed Willamette Pipeline. The pipeline would be installed in an open trench from 11 to 12 feet wide; in some locations, shoring would be used to make the trench even narrower. However, a wider construction corridor would be needed to accommodate for machinery access, temporary excavation materials stockpiling, temporary imported backfill materials stockpiling, and pipe materials staging. The construction corridor would be between 50 and 140 feet wide. Conservatively estimated, Willamette Pipeline construction could temporarily affect 130 to 375 acres.

The Willamette Pipeline would be placed within road rights-of-way to the extent feasible, thereby limiting property impacts. As with the RWP, disturbed areas would be restored to pre-construction conditions to the greatest extent practical. In general, crossings of streams and major roads would be accomplished using trenchless construction methods, thereby avoiding many environmental impacts and traffic disruptions. However, property access and traffic would be disrupted along the Willamette Pipeline corridor while construction is in progress, as described in Section 4.21 (Transportation and Access). Construction of the TVWD and City of Tualatin water storage tanks would generate noise, dust, truck traffic, and other temporary impacts typical of construction activities.

Temporary construction easements would be obtained for all areas in which construction activities would occur outside of public rights-of-way. According to the Pipeline Routing Study completed as part of the TVWD Water Supply Improvements Program Phase 1 study (Carollo and MSA 2006), temporary easements would be needed in the Morey’s Landing greenspace, across properties owned by the State of Oregon and Metro near SW Grahams Ferry Road, in numerous locations adjacent to and parallel to road rights-of-way, and, potentially, near the Tualatin River and Highway 99W crossings.

Potential long-term impacts of Alternative 3 would be similar in kind to those described under Alternative 2 for the areas around Henry Hagg Lake; that is, conversion of forest, pasture, recreation, and residential land to the reservoir and transportation uses. Impacts to recreation facilities and use are described in Section 4.14 (Recreation). With a 25-foot dam raise, the normal full pool elevation would be at 328.5 feet and cover an area of 1,352 acres (increasing from 1,117 acres). The higher water level would inundate approximately 235 acres of land within Scoggins Valley Park or on adjacent private land; therefore, Alternative 3 would convert a total of 235 acres of land used for open space, recreation, and rural residential to a reservoir use.

Reclamation’s general policy for reservoir projects is to acquire any privately-owned land that is within 300 feet of the edge of an area of inundation, as well as privately-owned land that lies between the park boundary and the relocated perimeter road. For Alternative 3, Reclamation would acquire up to 115 acres of private property, adjacent to Scoggins Valley Park, affecting 17 tax lots. The land would be
incorporated into the park and converted to open space and recreation use; a minor amount of this land, near Scoggins and Sain creeks, would be converted to transportation use for relocation of the perimeter road. Even after the land acquisition, the amount of land in Scoggins Valley Park not inundated (above the reservoir surface) at normal full pool would decline by 120 acres—from 1,404 acres to 1,284 acres.

Near Henry Hagg Lake, Alternative 3 would affect one fewer private property than Alternative 2 (17 tax lots instead of 18). Tax lots affected are listed in Table 4.13-1 and shown on Figure 4.13-3. No displacements would occur with the 25-foot dam raise. Property owners would be compensated in compliance with the regulations under the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Reclamation’s general acquisition policy for reservoir projects is to purchase any privately-owned land that is within 300 feet of the edge of an area of inundation and any privately-owned land that lies between the park boundary and the relocated perimeter road. The proposed expanded park boundary and properties that would be affected are shown on Figure 4-24. Only land within the proposed expanded boundary would be acquired.

Long-term impacts of the RWP would be the same for both Action Alternatives. Impacts on existing agricultural uses could occur from the importation of non-native plant material or impacts on soils from equipment use both during construction and during maintenance visits. Productive use of agricultural land may be lost where the pipe is located in cultivated areas because certain types of agriculture would not be allowed to remain (such as deep-rooted crops, orchards, vineyards). It is estimated that approximately 40 percent of the easement could be re-cultivated. Pipeline easements would be obtained for purposes of access, maintenance, and repair. To minimize long-term impacts from RWP installation on soils and vegetation, contractors would be required to implement best management practices during construction. Re-vegetation with native seed or a return to pre-construction agricultural condition would be conducted as appropriate; this requirement would be included in construction contracts for the RWP.

For the Willamette Pipeline, permanent pipeline easements would be obtained where needed. According to the Pipeline Routing Study completed as part of the TVWD Water Supply Improvements Program Phase 1 study (Carollo and MSA 2006), permanent easements would be needed in the Morey’s Landing greenspace, properties owned by Metro and the State of Oregon near Grahams Ferry Road, adjacent to SW Grahams Ferry Road, and in a commercial parking area near the Highway 99W crossing. Along Grahams Ferry Road, additional right-of-way may be acquired, rather than a permanent easement. As with the RWP, contractors would be required to implement best management practices to limit post-construction impacts on soils and vegetation, and construction areas would be restored to pre-project conditions to the greatest extent practical.

Acquisition of land for the TVWD water tank(s) and City of Tualatin water tank (between 6.5 and 11 acres each) would be required. At the time of the writing of this Draft PR/EIS, property-specific impacts are unknown because specific water tank locations have not been selected. The TVWD water tank(s) would affect private properties; each could result in conversion of 6.5 to 11 acres of agricultural land or rural residential land. One residence may be affected, depending upon the site selected.
4.13.3.3.2 Cumulative Impacts
Cumulative impacts would be the same as for Alternative 2, except Alternative 3 would convert approximately 115 acres of land from private, rural residential use to public open space and reservoir uses.

4.13.4 Impacts on Other Federal and Non-Federal Projects and Plans

4.13.4.1 Henry Hagg Lake Resource Management Plan
Chapter 5.0 of the Henry Hagg Lake Resource Management Plan contains the Goals, Objectives, and Management Actions applicable to the project. Goals cover five main topics: Natural Resources (Section 5.2.1), Cultural Resources (Section 5.2.2), Indian Sacred Sites (Section 5.2.3), Indian Trust Assets (Section 5.2.4), Recreation and Access (Section 5.2.5), and Land Use, Management, and Implementation (Section 5.2.6).

Goal NAT 1: Protect, conserve, and enhance wildlife habitat and natural resources on Reclamation lands.

Management Action NAT 1.1.2: Limit construction and any necessary live tree removal to between March 31 and October 31 to protect wintering eagles.

Management Action NAT 1.1.4: Protect eagle perch trees on Reclamation lands around reservoir.

Impacts on wildlife habitat in and near Henry Hagg Lake would occur during construction and in the longer term, as described in Sections 4.6 (Wetlands), 4.7 (Fisheries and Other Aquatic Species), 4.8 (Non-Listed Wildlife Habitat and Vegetation), and 4.9 (TES Species). Mitigation would be provided as described in those sections to compensate for impacts. While some types of terrestrial habitat would decline in area, the amount of managed elk habitat would increase with implementation of either Action Alternative. Open water habitat would also increase.

Construction activities would occur year ‘round, although earthwork and concrete work would likely be limited during the wet winter months. Tree clearing could also occur throughout the year. Trees would be cleared for the perimeter road relocation and, for boating safety, within parts of the reservoir in areas to be inundated by the dam raise. Trees would remain within “no wake” zones, which include the northern portion of the reservoir and the tributary arms. Tree clearing would likely also occur in some areas that would be developed with replacement recreation sites (that is, to replace recreation areas inundated by the Action Alternatives as described in Section 4.14). In the replacement recreation sites, trees would be cleared only where appropriate (for example, for safety, for maintaining views, or for specific recreation facilities). Maintaining trees near recreation areas is desired. Eagle perch trees would be protected to the greatest extent practical. Additional perch sites for eagles and other raptors, like osprey, would likely be created in northern part of the reservoir as trees inundated by higher water levels die and become snags.

Objective NAT 1.5: Manage lands designated as elk meadows for the primary purpose of providing forage areas for elk; other uses of these areas should be considered secondary in importance and allowed only if shown to not pose disturbance to elk unless mitigated.
Management Action NAT 1.5.4: Mitigate for any impacts to elk habitat from future development as needed.

Impacts on elk meadow habitat would occur under Alternative 2 (58.1 acres) or Alternative 3 (52.6 acres). Approximately 87.7 acres have been identified for potential elk meadow mitigation areas: 47.7 acres within Scoggins Valley Park and 40 acres nearby, adjacent to Sain Creek. See Section 4.8.3 for more information.

Objective NAT 1.6: Manage lands located between developed recreation sites as land use buffer zones to protect habitat for waterfowl, other migratory birds, and upland wildlife.

Locations of the proposed replacement recreation sites would allow for continued management consistent with this objective.

Objective REC 1.7: When specific plans for the dam raise are finalized, the development of tent and RV camping opportunities shall be more thoroughly explored, and if feasible, implemented at a suitable location within Scoggins Valley Park.

Currently open recreation facilities would be replaced one-for-one, with the following exceptions. Recreation Area A East will be replaced by locating its constructed features, such as parking spaces and toilets, to other recreation sites around the lake. The 18-hole disk golf course will be replaced by a 9-hole course. At this time, no additional camping sites are proposed. Future campsite development would not be precluded, but there would be one less recreation site to accommodate that use.

Goal REC 4: Provide appropriate vehicular and non-motorized access to recreation sites at Henry Hagg Lake consistent with natural, cultural resource, and safety and security objectives.

Objective REC 4.1: Coordinate with Washington County to provide for adequate vehicular access to and parking at all designated recreation areas at Henry Hagg Lake; this includes appropriate motor vehicle parking and staging areas adjacent to or near sites designated for non-motorized uses. Such access and parking should be sized in a manner reflecting the physical constraints and safe use of the area being served.

The two Action Alternatives would relocate portions of the perimeter road and 12 of 20 parking turnout areas. No authorized accesses to private or public property would be permanently removed or restricted. All would be replaced following construction. Off-road vehicle access would be restricted with design features.

Objective REC 4.2: Coordinate with managing partner (Washington County) and County road department to widen road shoulders adjacent to designated recreation areas to accommodate parking outside of the bike lane, where possible.

Management Action REC 4.2.1: Where feasible, widen the perimeter road shoulder from 7’ to 10’ and sign/stripe for bicycles, pedestrians, and overflow parking.

4.13-17
The perimeter road is maintained by Washington County. The Washington County 2020 Transportation Plan (see below) states that, as a Rural Bikeway, the Scoggins Valley Road portion should have at least 5-foot-wide paved shoulders to accommodate cyclists. The current shoulders, 6 to 8 feet wide, exceed the County standard minimum for the classification. Where shoulders are 7 feet wide or wider, they would be consistent with Management Action REC 4.2.1. Shoulder widths would not be reduced under the Action Alternatives, and relocated road segments would have shoulders that would be consistent with this Management Action. Designated roadside parking areas in relocated road segments would be replaced.

4.13.4.2 Statewide Planning Policies
Because Henry Hagg Lake and Scoggins Valley Park are federally-owned, the federal government’s Henry Hagg Lake Resource Management Plan is the only planning document that officially applies. However, the Partners intend to comply with the Washington County Comprehensive Plan requirements within the park. Outside the Reclamation boundary, the Washington County and other relevant comprehensive plans and zoning regulations apply (see next section).

4.13.4.3 Local Comprehensive Plans
Only Washington County’s comprehensive, rural/natural resource, and transportation plans apply to Alternative 2. They also apply to the rural portions of Alternative 3 (the dam raise, road relocation, RWP, and portions of the Willamette Pipeline). The Washington County Comprehensive Plan and Community Plans, the Clackamas County Comprehensive Plan, and the city plans apply only to the Willamette Pipeline portion of Alternative 3.

4.13.4.3.1 Washington County Comprehensive Plan
Policy 2, Citizen Involvement: It is the policy of Washington County to encourage citizen participation in all phases of the planning process and to provide opportunities for continuing involvement and effective communication between citizens and their county government.

The action as proposed by all alternatives would be consistent with General Policy 2. Clean Water Services has a website containing details about the project alternatives, including a list of all available public information to-date. See http://www.cleanwaterservices.org/PlansAndProjects/Plans/WaterSupply/SteeringCommittee.aspx

One avenue for public input has been the Policy Steering Committee. The Policy Steering Committee was established in the summer of 2003 to provide guidance and input from policy makers for the WSFS. The committee is composed of elected and appointed officials from the local partners in the study. Among their roles are the following:

- Act as a liaison to the partners (elected officials), keeping them up-to-date on the progress of the study
- Provide a forum for the public to offer input to policymakers about the study (that is, at hearings or other types of communication)
- Make policy recommendations to the study partners
The committee does not have a regular meeting schedule but is expected to meet approximately quarterly through the completion of a Final PR/EIS and Record of Decision for the TBWSP. Meetings of the committee are open to the public and are announced in local newspapers, through direct mail, and on the Clean Water Services website.

More information about the public involvement activities related to the TBWSP is available in Section 7.2 and Appendix B of this Draft PR/EIS.

**Policy 6, Water Resources:** *It is the policy of Washington County to maintain or improve surface and ground water quality and quantity.*

The proposed Action Alternatives would be consistent with General Policy 6 because both would improve the ability of the local water supply agencies to meet the long-term needs of the Tualatin Basin and serve existing and projected growth. The purpose of the project is to provide water to meet existing peak season, agricultural and environmental needs within the Basin, and to ensure reliable water supplies to 2050. In addition, a major component of existing and future unmet need in the Basin is water for flow restoration in the Tualatin River and its tributaries. Low water flows in the summer combined with high natural phosphorous levels and high temperatures have created chronic water quality problems. (Refer to Tualatin Basin WSFS [MWH 2004].) The Action Alternatives would increase the amount of water stored and available for release to increase summer flows, and the RWP component would allow cooler stored water to be released directly to the Tualatin River (instead of Scoggins Creek) and would aid in filling the reservoir during the winter. Both Action Alternatives would improve surface water quality and quantity for the Tualatin River (see Section 4.3, Water Quality). The No Action Alternative would not improve surface water quality and quantity for the river to the same extent as the Action Alternatives, even with conservation, because of continuing and planned development in the basin.

**Policy 10, Fish and Wildlife Habitat:** *It is the policy of Washington County to protect and enhance Significant Fish and Wildlife Habitat.*

The Washington County rural and Natural Resource Plan identifies four significant natural resource areas that would be affected by this project. They include: Water Areas and Wetlands, Water Areas and Wetlands and Fish and Wildlife Habitat, Wildlife Habitat, and Scenic Routes. The habitat designations refer to surface waters (Henry Hagg Lake, streams and drainages, and wetlands), riparian corridors, and uplands. Compliance with Policy 10 is also included as part of the land use approvals for any alterations to Significant Fish and Wildlife Habitat. The County has determined that Significant Fish and Wildlife Habitat does not include floodplains for the purpose of this policy, but does apply to wetlands, riparian corridors, and upland habitats.

This Draft PR/EIS and its supporting documents contain inventories of vegetation and wildlife habitats that would be affected by the Action Alternatives. Section 4.8 contains a detailed description of the impacts under each alternative and proposed mitigation measures. In general, there is high quality habitat in three locations around the reservoir; north of Boat Ramp A on the east side of the lake, along Scoggins Creek, and along Sain Creek. These areas contain large patches of coniferous forest containing
large trees and several layers of native vegetation. Other, smaller areas of high quality habitat occur in deciduous forests along the lake margin containing oak trees. When the water level is high, the shoreline vegetation includes emergent wetlands, riparian shrub, upland grassland and forested habitats (Reclamation 2004b). Beyond the reservoir shoreline the vegetation cover types are generally upland, mesic communities with low-to-moderate slopes ranging from 5 to 25 percent (URS 2003).

The RWP corridor is dominated by agricultural lands and rural residential areas overlaid by a fragmented mosaic of conifer forest (near the reservoir and Scoggins Creek), narrow riparian bands and small woodlots. The corridor crosses Scoggins Creek and at least one unnamed creek as well as the Tualatin River. Wildlife use in this area will be primarily affected by human disturbance levels and habitat fragmentation.

The Willamette Pipeline corridor winds through rural and dense residential, agricultural, light industrial, and small woodlots. Wildlife habitats within the UGB are highly fragmented and have been further degraded by noise, pollution, and close proximity to humans while most of the wildlife habitat outside the UGB has been impacted by agricultural practices, logging and mining. The less-impacted natural vegetation along the corridor is a mixed, primarily deciduous, lowland forest that is predominately in the early and mid-seral stages and is highly fragmented. This type of habitat provides for species that prefer edge habitat and those that are tolerant of human activity. Higher quality riparian and upland habitats are found near the corridor along Rock Creek, Coffee Lake Creek, and Metro’s Cooper Mountain Natural Area. The Action Alternatives would be consistent with this policy.

Low flow conditions in the Tualatin River have adversely affected fish and aquatic species in the river. Clean Water Services developed a plan for augmenting the flows in the Tualatin River and has flow targets for the summer and fall months. The Action Alternatives would benefit fish because increased storage of water in Henry Hagg Lake mean a larger increment of water quality improvement would be provided through increased releases of water directly to the river.

The increase in reservoir levels associated with Alternatives 2 and 3 would result in inundation of elk meadow habitat—approximately 58.1 acres with Alternative 2 and 52.6 acres with Alternative 3. A total of approximately 87.7 acres have been identified, for both Action Alternatives, as potential mitigation for the loss of elk meadow habitat. More information is provided in Section 4.8.

Most of the project area that would be affected most intensely by the project is already heavily impacted by human activity. In the identified areas of high quality habitat around Boat Ramp A, and Scoggins and Sain creeks, mitigation measures could reduce potential impacts through timing of construction, and best management practices. Refer to Section 4.8 (Non-listed Wildlife Habitat and Vegetation) for more descriptions of impacts and proposed mitigation for project impacts on vegetation and wildlife habitat. The Action Alternatives would be consistent with Washington County Comprehensive Plan Policy 10.

**Policy 16, Exclusive Forest Lands:** It is the policy of Washington County to conserve and maintain forest lands for forest uses consistent with existing and future needs for agricultural products, forest
management and open space. Exceptions to this policy may be allowed pursuant to the provisions of
LCDC Goal 2, OAR Chapter 660 Division 04, and the applicable plan amendment criteria in Policy 1.

All of the lands surrounding Henry Hagg Lake are designated as exclusive forest lands (EFC) in the
Washington County Development Code. The Action Alternatives would remove approximately 370
(Alternative 2) or 235 (Alternative 3) acres of forestland, open recreation areas, and other wildlife
habitat due to inundation on EFC land. Further upland acreage would be converted where the perimeter
road would be relocated, though this would represent only marginally different impacts between the
two Action Alternatives. The road and impoundment uses are allowed in the district as long as the
project can meet the approval criteria (particularly related to not forcing a significant change in forest
practices or significantly increasing the cost of forest practices). Therefore, the project is consistent with
Policy 16.

Policy 17, Agriculture and Forest-20 Land: *It is the policy of Washington County to designate those lands
as Agriculture and Forest-20 that were zoned AF-5 and AF-10 by the 1973 Comprehensive Framework
Plan and for which a Goal 2 Exception has not been provided, and in doing so strive to retain small scale
and part-time agriculture and forest production. Exceptions to this policy may be allowed pursuant to the
provisions of LCDC Goal 2, OAR Chapter 660 Division 04, and the applicable plan amendment criteria in
Policy 1.*

Neither a 40-foot nor 25-foot raise of Scoggins Dam would affect land designated AF-20, AF-10, or AF-5.
The RWP would traverse land designated AF-20, AF-10, and AF-5 as well as rural residential (RR).
Approximately 95 acres of AF-zoned land would be temporarily disturbed by trenching for the
installation of the RWP, and approximately 93 acres of AF-zoned land would be temporarily disturbed
for installation of the Willamette Pipeline. However, no land would be permanently removed from
agricultural use by the pipelines because disturbed areas would be restored to their pre-project state
following construction. Therefore, the agricultural and forest land would continue to be protected for
those uses. The water storage tanks associated with the Willamette Pipeline could be built on AF-zoned
land. Both Action Alternatives are consistent with Policy 17 of the Comprehensive Plan.

Policy 18, Rural Lands: *It is the policy of Washington County to recognize existing development and
provide lands which allow rural development in areas which are developed and/or committed to
development of a rural character.*

In general, the proposed activities would create only minor disturbances to existing rural development.
Therefore, the Action Alternatives are consistent with this policy.

Policy 22, Public Facilities and Services: *It is the policy of Washington County to provide Public Facilities
and Services in the Rural/Natural Resource Area in a coordinated manner, at levels which support rural
type development are efficient and cost effective, and help maintain public health and safety.*

The implementing strategies, the summary findings, and the conclusions for Policy 22 discuss the public
services the County provides and its coordination with other agencies to provide adequate services for
county residents. Strategies “k” and “l” deal with provision of public water lines to rural areas. The
policies limit the circumstances in which the water transmitted within urban service lines can be tapped into by residences along the route. Resource-zoned land may tap into these lines only when groundwater becomes unavailable. The RWP and Willamette Pipeline do not fall within the policy discussion because the water in the pipelines would not be potable water and no individual access to the pipelines would be provided. However, to the extent that the project supports and furthers the district provision of sufficient supply of clean water for existing and future county residents, the Action Alternatives are consistent with this policy.

**Policy 23, Transportation:** *It is the policy of Washington County to regulate the existing transportation system and to provide for the future transportation needs of the County through the development of a Transportation Plan as an Element of the Comprehensive Plan.*

The perimeter road consists of West Shore Road and a portion of Scoggins Valley Road, and both are classified as collectors in the Washington County Transportation Plan. The project would not affect the transportation network except for the relocation of portions of the road and during construction of the dam. The project would not affect future transportation demand. One of the strategies under Policy 23 requires that amendments to the Rural/Natural Resource Plan be consistent with the Transportation Plan. Any code amendments that may be required would address the standards of the Transportation Plan in the application for approval of a code change. Due to the limited impacts on the rural transportation network, no conflicts of either Action Alternative with the requirements of the Transportation Plan are anticipated.

**Policy 24, Recreation:** *It is the policy of Washington County to ensure that open space and recreational facilities are provided which reflect the needs of the county residents.*

The No Action Alternative would allow the large flat open space needed for the large gatherings, thus meeting the policy. Under the Action Alternatives, most of the existing and open recreation facilities affected by the inundation would be replaced with the following exceptions. Recreation Area A-East will be replaced by locating its constructed features, such as parking spaces and toilets, to other recreation sites around the lake. The 18-hole disc golf course will be replaced by a 9-hole course. All new construction must be fully accessible and meet current federal accessibility standards. Therefore, all alternatives would be consistent with this policy.

**4.13.4.3.2 Washington County 2020 Transportation Plan**

The Transportation Plan includes a road junction capacity analysis of rural intersections for the forecasted Year 2020. The OR 47/Scoggins Valley Road intersection is included in this analysis. The PM Peak Hour Level of Service for the minor approach was C¹ and for the major approach was A². These results indicate that the existing roadways serving Scoggins Valley Park will continue to function at a

---

¹ Level of Service C refers to a medium level of service, which means that congestion at the intersection was generally moderate but acceptable.

² Level of Service A represents the lowest level of congestion and therefore meets the minimum standard.

---

4.13-22
level under capacity for the next 20 years. Scoggins Valley Road has 6- to 8-foot-wide paved shoulders as a rural bike route and meets current County design standards. It has adequate capacity for existing traffic. No permanent impacts would occur with either of the Action Alternatives. No changes to access to the road or to its connections with other local roads and OR 47 would occur. All alternatives are consistent with the classification policies for collectors.

4.13.4.3.3 Washington County Community Plans for Urban Unincorporated Areas (Alternative 3 Only)
There are no references in the Community Plans (Aloha-Reedville-Cooper Mountain, Bull Mountain, and Sherwood) affecting the alignment of the Willamette Pipeline in Washington County. The applicable Community Plans state the current (as of 1983, and updated in 2004) source for water supplies for each city: Wolf Creek Highway District for Aloha-Reedville-Cooper Mountain area, City of Sherwood for unincorporated land near Sherwood, and the City of Tigard for the Bull Mountain area. The three Community Plans state that providing water supply is considered sufficient to serve development in those areas until 2000.

4.13.4.3.4 Clackamas County Comprehensive Plan (Alternative 3 only)
Chapter 4, Land Use: Future Urban Lands Applicable Goals:

- Encourage development in areas where adequate public services and facilities can be provided in an orderly and economic way.
- Provide for an orderly and efficient transition to urban land use.

Future urban areas are lands within urban growth boundaries but outside immediate urban areas. Future urban areas are planned to be provided with public facilities, but currently lack providers of those facilities. Future urban areas are substantially underdeveloped and will be retained in their current use to ensure future availability for urban needs. The most directly applicable policy to the Willamette Pipeline would as it relates to provision of a public service in a Future Urban Land would be Policy 7.1 Control premature development (before services are available)

The Willamette Pipeline would not affect this policy for orderly transition of rural to urban uses because no individual access to the pipeline would be provided and the pipeline would have no effect on the developability of Future Urban areas. Alternative 3 is consistent with this policy.

Chapter 4, Land Use: Rural Applicable Goals:

- To provide a buffer between urban and agricultural or forest uses.
- To perpetuate the rural atmosphere while maintaining and improving the quality of air, water, and land resources. (4/13/06)
- To conserve open space and protect wildlife habitat.

Rural lands are exception lands, as defined in OAR 660-004-0005(1), that are outside UGBs and unincorporated communities, and are suitable for sparse settlement, such as small farms, woodlots, or acreage home sites. They lack public facilities or have limited facilities and are not suitable, necessary, or
intended for urban, agricultural, or forest use. Applicable implementing policies for Rural lands relating to the Willamette Pipeline in Clackamas County include Policy 7.0: Public facilities should be expanded or developed only when consistent with maintaining the rural character of the area; and Policy 8.0: Increased water service to an area shall not be used in and of itself to justify reduced lot sizes.

In general, the proposed activities would create only minor disturbances to existing rural development. Therefore, Alternative 3 is consistent with this policy because it would not provide a public utility that would increase growth in rural areas.

Chapter 4, Land Use: Agriculture Applicable Goals:

- Preserve agricultural use of agricultural land.
- Protect agricultural land from conflicting uses, high taxation and the cost of public facilities unnecessary for agriculture.
- Maintain the agricultural economic base of the County and increase the County’s share of the agricultural market. (4/13/06)
- Conserve scenic and open space.
- Protect wildlife habitats.

Agriculture areas are those of predominantly Class I through IV soils as identified by the NRCS or as identified in more detailed data; and other lands that are suitable for farm use due to soil fertility, suitability for grazing, climatic conditions, existing or future potential for irrigation, land use patterns, or accepted farming practices or are necessary to permit farming practices to be undertaken on adjacent or nearby lands. Relating to the Willamette Pipeline, the most directly applicable implementing policies are Policy 2.0: Agriculturally related industries shall be encouraged; and Policy 3.0: Land uses that conflict with agricultural uses shall not be allowed.

As with Rural Resources described above, the proposed activities would create only minor disturbances to existing agricultural activities primarily during construction and would not provide a public utility that would increase growth in rural areas because no direct connection to the pipeline would be provided that could cause growth. Therefore, Alternative 3 is consistent with these policies.

Chapter 7, Public Facilities and Services: Applicable Goals Related to Water

- Provide for the location and development of drinking water facilities to support existing and future land development.
- Protect the quantity and quality of drinking water supplies.
- Coordinate the location and size of drinking water facilities with appropriate water purveyors.

The provision of public facilities and services is a key ingredient in the development of Clackamas County and the implementation of its Comprehensive Plan. All development requires a certain level of public facilities and services. The objective of this element is to provide the level of public facilities and services to support the land use designations, and to provide those facilities and services at the proper time to
serve development in the most cost effective way. Applicable policies related to the Willamette Pipeline include:

**Policy 14.0:** *Require all public water purveyors to design the extension of water facilities at levels consistent with the land use element of the Comprehensive Plan.*

- No extension of public services is proposed because the Willamette Pipeline would not provide any direct connections for local water service within Clackamas County. Alternative 3 is consistent with Policy 14 because it would not affect the development patterns identified within the Comprehensive Plan.

**Policy 15.0:** *Require water purveyors in urban areas to coordinate the extension of water services with other key facilities, i.e., transportation, sanitary sewers, and storm drainage facilities, necessary to serve additional lands.*

- No additional lands within Clackamas County would be served because there would be no direct connection to the pipeline, therefore, extending other services described in Policy 15 would not be required.

**Policy 16.0:** *Encourage development in urban areas where adequate urban water facilities already exist.*

- Alternative 3 is consistent with Policy 16 because it would not affect the development patterns identified within the Comprehensive Plan for the reasons addressed under Policies 14 and 15.

**Policy 17.0:** *Require water service purveyors to provide water services for non-urban areas at levels appropriate for non-urban use.*

- Alternative 3 is consistent with Policy 16 because it would not affect the development patterns identified within the Comprehensive Plan for the reasons addressed under Policies 14 and 15.

Overall, the Willamette Pipeline does not fall within these policy discussions because no individual access to the pipeline would be provided.

**4.13.4.3.5 City of Wilsonville**

Alternative 3 would not conflict with the Public Facilities element of the Comprehensive Plan. The element states that, as future growth occurs, it will be necessary to incrementally expand the existing water system to provide additional storage, pumping, and pipeline capacity. To the extent that implementation of Alternative 3 ensures adequate future supply of water, it is consistent with this element. Alternative 2 and the No Action Alternative would not affect land within Wilsonville. Alternative 2 would be consistent with the goals of providing adequate water to support planned development. The No Action Alternative eventually could negatively affect the City’s ability to have adequate water to support planned development.

**4.13.4.3.6 City of Sherwood**
Alternative 3 would not conflict with the public facilities element of the Sherwood Comprehensive Plan. Alternative 2 and the No Action Alternative would not affect land within Sherwood.

4.13.4.3.7  City of Beaverton
Alternative 3 would not conflict with the public facilities element of the City of Beaverton Comprehensive Plan. To the extent that implementation of Alternative 3 ensures adequate future supply of water for planned development, it would help implement this element. Alternative 2 and the No Action Alternative would not affect land within Beaverton.

4.13.4.3.8  City of Tigard
Alternative 3 would not conflict with the public facilities and services element of the City of Tigard Comprehensive Plan. Alternative 2 and the No Action Alternative would not affect land within Tigard.

4.13.4.4  Local Permitting Requirements for Alternative 2
All of the features associated with Alternative 2 are within unincorporated Washington County and outside the UGB.

4.13.4.4.1  Washington County
Meetings with Washington County staff revealed that both Action Alternatives would consist of the following defined uses or actions:

- Expanding a Reservoir
- Expanding a Utility Facility
- Necessary Public Utility
- Altering a Flood Plain
- Altering Significant Natural Resource Areas (Water Areas and Wetlands and Fish and Wildlife Habitat)
- Public Road Project (Realignment)
- Expanding a Public Park
- Expansion of a Special Use
- Gravel or rock extraction
- Excavation and fill

One or more of these uses occur in the following rural districts: EFC, EFU, R-IND, AF-20, AF-10, AF-5, and RR-5. For the most part these uses are allowed or conditionally allowed in the affected districts. One major land use permitting issue was identified, which relates to altering a Significant Natural Resource Area in the EFC district. The reservoir expansion currently would not be allowed in the EFC because it would affect existing wetlands and creeks associated with Henry Hagg Lake. There is a provision to allow such alteration for any uses associated with the Barney Reservoir.

The process for allowing local parks and park uses in EFC zones is not entirely clear because the timing of the transfer of ownership to the Partners from Reclamation may affect the process. Currently, the County assumes that the existing Management Plan would continue to be in effect until a new Master Plan is developed and adopted. Washington County staff have indicated that previous master plans for
parks were established by a legislative ordinance, although approval of a quasi-judicial plan amendment could be possible. In the absence of an adopted Master Plan the land use approvals would require demonstration of consistency with OARs 660-006-0025 (Uses Authorized in Forest Zones) and 660-034-0040 (Planning for Local Parks).

Uses in EFC zones are listed in OAR 660-006-0025. Section (4)(f) allows public parks with uses included under OAR 660-034-0040 subject to the review standards in OAR 660-006-0025(5), which require that the use will not force a significant change in, or significantly increase the cost of accepted farming or forest practices or significantly increase fire hazards or fire suppression costs or risks to fire fighters (sometimes also referred to as the farm or forest impact test). OAR 660-034-0040(1) notes that local park providers may prepare local park master plans and local governments may amend their comprehensive plans to include such master plans. However, local governments are not required to adopt a local park master plan in order to approve a land use decision on forest lands under the provisions of OAR 660-006-0025(4).

Some of the uses listed in OAR 660-034-0035(2)(a) to (g) are campgrounds, day use areas, recreational trails, boating and fishing facilities, amenities for park visitors and employees, support facilities and park maintenance facilities. Some of those uses are not allowed on agricultural or forest land without an exception to Goal 3 or Goal 4. However, Washington County is not required to take an exception to Goals 3 or 4 to allow such uses on land within a local park as long as the uses meet all other statewide goals and are described and authorized in a local park master plan. To qualify, the local park master plan must be adopted as part of the local comprehensive plan, applying criteria comparable to those required for uses in state parks under OAR chapter 736, division 18 and meeting the farm/forest impact test.

Local Washington County zoning compliance for road relocation would be subject to land use review under Article VII of the Community Development Code. The transportation review could be integrated into the land use review. The RWP would be a “utility facility” subject to the requirements and permitting criteria of the underlying zone.

**4.13.4.5 Local Permitting Requirements for Alternative 3**

Alternative 3 would have the same requirements as Alternative 2, plus the added public utility use associated with the Willamette Pipeline in urban unincorporated Washington County, Clackamas County, and the cities of Wilsonville, Sherwood, Beaverton, and perhaps Tigard. In the urban districts of Washington County, and in the cities of Wilsonville, Tigard, and Beaverton, the Willamette Pipeline would primarily be in single-family residential (R-5 or R-6) districts. The impacts on the flood plain and other Significant Natural Resource Areas around Henry Hagg Lake would be less than under Alternative 2, but more than under Alternative 1 (no impact). The same permitting issues exist for Alternative 3 with respect to prohibiting the alteration of Significant Natural Resource Areas and the establishment of new or relocated park facilities in the EFC district. Impacts within Clackamas County would occur primarily within the EFU district with small pockets of RRFF-5 and FU-10 also affected.

**4.13.4.5.1 Washington County**
Local Washington County zoning compliance for the Willamette Pipeline portion of the project would consist of land use review as a “utility facility” subject to the land use provisions for the underlying zone.

4.13.4.5.2 Clackamas County
Local Clackamas County zoning compliance for the Willamette Pipeline portion of the project would likely require a land use review as a conditional use and also require compliance with each land use zone. The County may also require engineering reviews/permits and/or natural resource protection compliance.

4.13.4.5.3 City of Beaverton
Land use permits would only be needed if the work would disturb previously-approved landscaped trees or significant trees protected by ordinance. If the right-of-way is required to be widened, the project may meet the threshold for a Public Transportation Facility permit.

4.13.4.5.4 City of Sherwood
The City of Sherwood would require right-of-way permits for all work within the public right-of-way or other city-owned land. If the Willamette Pipeline crosses sensitive lands, a permit from either the City or Clean Water Services would be needed (Harrington 2006).

4.13.4.5.5 City of Wilsonville
No land use reviews would be required for installing the Willamette Pipeline in public rights-of-way. The City may require engineering reviews/permits and/or natural resource protection compliance.

4.13.5 Mitigation Measures

4.13.5.1 Alternative 1 – No Action
No mitigation measures are proposed.

4.13.5.2 Alternative 2
Available mitigation measures and identification of non-compensable construction impacts related to dust emissions, noise, and traffic circulation and access restrictions are discussed in the mitigation sections for Air Quality (4.16.3), Noise (4.17.3) and Transportation (4.21.3). All residents with existing access to the perimeter road would continue to have access to their residences during and after construction. Some, as indicated previously, may have their access points relocated, a permanent impact for which there would be no mitigation other than rebuilding the driveways to the public roads.

The project is consistent with land use plans and allowed uses except for an expansion of the reservoir in the EFC zone. Mitigation for this inconsistency would consist of a Planning Director interpretation to allow the use or by a code amendment to allow an expansion of the Henry Hagg Lake reservoir similar to that for Barney Reservoir. Clean Water Services submitted a letter to Washington County on February 6, 2006, to initiate that process. The project would be able to meet other land use approval criteria so no other mitigation measures for land use approvals would be required.
Property owners whose land would be acquired in whole or in part would be compensated in accordance with the regulations of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

4.13.5.3 Alternative 3
Mitigation for Alternative 3 impacts would be the same as for Alternative 2.
4.13 LAND USE AND PLANNING

4.13.1 Affected Environment ............................................................. 4.13-1
4.13.2 Applicable Plans and Policies ............................................... 4.13-3
4.13.3 Environmental Impacts .......................................................... 4.13-8
4.13.4 Impacts on Other Federal and Non-Federal Projects and Plans 4.13-16
4.13.5 Mitigation Measures ............................................................. 4.13-28

Table 4.13-1. Tax Lots near Henry Hagg Lake that May Be Affected under the Action Alternatives .................................................. 4.13-11

Figure 4.13-1. Henry Hagg Lake and Raw Water Pipeline Land Use Designations (File Name: Fig 4.13-1 Hagg Alt2 Zoning.pdf) ................................................................. 4.13-2
Figure 4.13-2. Willamette Pipeline Land Use Designations (File Name: Fig 4.13-2 Alt3 Zoning Sht1.pdf, Fig 4.13-2 Alt3 Zoning Sht2.pdf and Fig 4.13-2 Alt3 Zoning Sht3.pdf) ........................................................................ 4.13-2
Figure 4.13-3. Henry Hagg Lake and Properties affected by 40-foot Dam Raise and 25-foot Dam Raise (File Name: Fig 4.13-3 Hagg Affected Properties.pdf) 4.13-12
Data Sources:
- Land Use and Zoning - Metro RLIS
Henry Hagg Lake and Properties Affected by 25-ft and 40-ft Dam Raise

Tualatin Basin Water Supply Project
Henry Hagg Lake, Washington County

Note:
Inundation levels shown are at normal full pool elevations.

Data Sources:
Tax Lots - Metro, RLIS
Impacted Tax Lots - Clean Water Services

Henry Hagg Lake, Washington County
Tualatin Basin Water Supply Project