SECTION 6

COWICHE CREEK SUB-BASIN
SHORELINE INVENTORY AND ANALYSIS
DISK #3

Table of Contents

COWICHE CREEK SUB-BASIN CONTEXT SUMMARY 4

Cowiche Sub-basin Overview 4

Hyporheic Flow 4

Riparian Habitat 4

General Fisheries Information 4

Salmon Habitat 5

Fisheries Issues 5
- Structural barriers 5
- Low flows 6
- False attraction 6
- Temperatures 6
- Sediments 6

(303(d) listings) 6

Action Recommendations 7

COWICHE CREEK SUB-BASIN REACH DESCRIPTIONS 8

Reach 1
- Reach Description 9
- Abiotic 9
- Biotic 10
- Cultural Modifications 11
- Cultural Jurisdictions 12
- Ecological Characterization Summary 13
- Ecological Protection Opportunities 13
- Ecological Restoration Opportunities 13

Reach 2
Reach Description 15
Abiotic 15
Biotic 16
Cultural Modifications 17
Cultural Jurisdictions 18
Ecological Characterization Summary 18
Ecological Protection Opportunities 19
Ecological Restoration Opportunities 20

Reach 3
Reach Description 21
Abiotic 21
Biotic 22
Cultural Modifications 24
Cultural Jurisdictions 24
Ecological Characterization Summary 25
Ecological Protection Opportunities 25
Ecological Restoration Opportunities 26

Reach 4
Reach Description 27
Abiotic 27
Biotic 28
Cultural Modifications 30
Cultural Jurisdictions 30
Ecological Characterization Summary 31
Ecological Protection Opportunities 32
Ecological Restoration Opportunities 32

APPENDIX 33

Figure C1. Geology and Geohazards in Cowiche Creek Sub-basin 34
Figure C2. Wetlands and Soil Characteristics in Cowiche Creek Sub-basin. 35
Figure C3. Cultural Modifications in Cowiche Creek Sub-basin 36
Figure C4. Public Resources and Access in Cowiche Creek Sub-basin. 37
Figure C5. SMP Jurisdiction Breaks for Cowiche Creek Sub-basin. 38

Table C1. SMP Reach Breaks for Inventory and Analysis, Cowiche Creek Sub-basin 39
Table C2. Geology and Geohazard Characteristics for Cowiche Creek Sub-basin 40
Table C3. Soil Characteristics for Cowiche Creek Sub-basin 41
Table C4. Stream Channel Characteristics for Cowiche Creek Sub-basin 42
Table C5. Habitat Characteristics for Cowiche Creek Sub-basin 43
Table C6. Fish Characteristics for Cowiche Creek Sub-basin 44
Table C7. GAP Analysis of SMP Jurisdiction for Cowiche Creek Sub-basin 45

Table C8. Land-use Characteristics for Cowiche Creek Sub-basin.....46
Table C9. Cultural Jurisdiction Characteristics for Cowiche Creek Sub-basin.....48
Table C10. Transportation Characteristics for Cowiche Creek Sub-basin.....49

COWICHE CREEK SUB-BASIN CONTEXT SUMMARY

Portions of the following text have been primarily taken, in whole or in part, from the following reports: Haring, (2004).

COWICHE SUB-BASIN OVERVIEW

Cowiche Creek is a major tributaries to the right bank of the Naches River. Cowiche Creek enters the Naches River near the northwestern corner of the City of Yakima. Lower reaches of the sub-basin within the Cowiche River drainage include irrigated orchards and agriculture, as well as the community of Tieton. Middle reaches course through irrigated agriculture land, and the upper reaches lie predominately in undeveloped shrub-steppe and forested lands.

The headwaters of Cowiche Creek and its tributaries reside within the Mt. Baker-Snoqualmie National Forest at an elevation of 5800 feet. The South Fork Cowiche Creek descends rapidly throughout the first 17 miles of its course to an elevation of 2200 feet. This uppermost reach of the stream exhibits a gradient of 4% (210 ft./mi.). At this point, which marks the uppermost boundary of the SMP jurisdiction (RM 15.8), the stream gradient lessens significantly (1.3%, 67 ft./mi.). The confluence of the North and South Fork Cowiche occurs at RM 5.7.

The moderate gradient of lower (RM 0 to 15.8) Cowiche Creek and its forks is associated with many pools, riffles, and glides. Large woody debris and overhanging/submerged vegetation is abundant in the mainstem and South Fork. Beaver dams are common on both the mainstem and the South Fork Cowiche Creek (Haring, 2004).

HYPORHEIC FLOW

Water from Cowiche Creek and the Tieton basin is believed to be important for recharge of shallow ground waters in the Yakima Valley.

RIPARIAN HABITAT

The riparian community of the lower 3-4 miles of Cowiche Creek consists of willows, alder, and aspen, and is dense along most reaches, even in areas of residential development or cropland. The same is true of the middle portion of the creek, and impacts due to agricultural development are minimal. Information regarding riparian condition and function in the upper part of the watershed is limited (Haring, 2004).

Most riparian areas of the South Fork are reported to have many pools and riffles where LWD is generally abundant. Rearing habitat is considered good to excellent along the South Fork of Cowiche Creek

GENERAL FISHERIES INFORMATION

Cowiche Creek supports spring chinook (presumed presence), summer steelhead, and coho, as well as other resident salmonids and non-salmonids. It is reported that bull trout were present Cowiche

Creek in the early 1970s. The USFWS stated that Cowiche Creek had been a good trout stream, supporting steelhead prior to extensive irrigation development.

Various fish distribution information sources differ in the extent of habitat use. The SASSI Report does not show spawner distributions extending up Cowiche Creek, but shows both spring chinook and steelhead spawn below in the Naches River. Similarly, the DFW priority habitat map does not show spring chinook spawning in Cowiche Creek, but does map steelhead spawning up Cowiche Creek nearly to the headwaters. The most recent fish distribution mapping effort carried out for the Conservation Commission Limiting Habitat Factors Analysis shows both spring chinook and steelhead distributions up the North and South Forks of the Cowiche nearly to the headwaters. The Cowiche Creek System shows extensive distributions up the South Fork system for steelhead but is not mapped for spring chinook. The CREP map shows USDA eligibility extends throughout Cowiche Creek. StreamNet maps show both species use the lower reaches of Cowiche Creek.

SALMON HABITAT

Cowiche Creek has many miles of good to excellent spawning and rearing habitats for steelhead and Coho. Riparian vegetation is dense in most areas and gravel bars are sufficient for spawning. Lower Cowiche Creek and a number of tributary channels are used for off-channel winter refuge for pre-smolt spring chinook and steelhead. Cowiche Creek could be a major steelhead and coho producer and minor spring chinook potential if passage problems were corrected.

A survey in July, 1998, indicated that Cowiche Creek had many miles of good/excellent spawning and rearing habitat for steelhead and coho. Cowiche Creek could be a major producer of steelhead and coho (and perhaps minor producer of spring chinook). Lower Cowiche Creek and a number of tributary channels are utilized as off-channel winter refuge for pre-smolt spring chinook and steelhead.

Overall, habitat conditions in the Cowiche watershed are in a disturbed state, although some stable, healthy channel segments or reaches can be found in upper South Fork Cowiche and headwater areas of Reynolds Creek. The presence of these stable sections provides an indication of the recovery potential of the disturbed channels.

Until recently, Cowiche Creek was considered of little value to migratory fish and attempts to improve or restock this creek were stated to be infeasible. However, fishery managers now view Cowiche Creek as having high restoration potential and projects are being proposed to remove barriers.

FISHERIES ISSUES

There are physical problems in the Cowiche Creek system related to migration barriers, low flows, false attraction, high water temperatures, and sedimentation.

Structural barriers

Adult access and juvenile passage is the primary limiting factor in Cowiche Creek (Haring, 2004). There are numerous diversions that serve irrigated agricultural development in the sub-basin. An

Alaska steep-pass fishway was installed at the Yakima City Canal at the mouth of Cowiche Creek and probably provides adequate passage for adults. A wooden plank diversion dam just below the confluence of the North Fork and South Fork may be passable at high flows, but three other concrete dams on the South Fork at RM 1.3, 3.9, and 4.4 are thought to be impassible at all flows. A debris jam was reported at a railroad trestle in the lower mainstem that blocked migration in 1990. Beaver dams might restrict access to Coho salmon once downstream passage problems are resolved. The status of these diversions and other blockages needs to be updated. The Yakima City Canal is screened, but the other four diversions are not.

Low flows

There are significant diversions for municipal and irrigation water use from Cowiche Creek. The impact of these diversions on instream flow is not well documented. Flow in the creek was reduced due to irrigation diversions and dry streambed reaches have been reported.

False attraction

There is a regulating reservoir on the North Fork of Cowiche Creek which facilitates water distribution within the Yakima-Tieton Irrigation District. Water from the Tieton River is diverted into the Cowiche Creek drainage for irrigation purposes. False attraction problems occur on Cowiche Creek as a result of irrigation return flows, causing delay in fish migration.

Temperatures

Temperatures in Cowiche Creek are apparently acceptable based on Northwest Power Planning Council information, although temperature criteria exceedances have been documented.

Sediments

Stream banks are considered to be relatively stable along Cowiche Creek, although some erosion problems such as grazing-induced bank sloughing occur on the South Fork. Cowiche Creek was reported as having steep to moderate gradients with siltation occurring on most spawning areas, however, sediment issues are not cited as major problems in Cowiche Creek watershed. From the mouth to the confluence of Little Rattlesnake, the creek is channelized.

303(D) LISTINGS

Cowiche Creek temperature exceedances have been documented at numerous locations by different agencies. Cowiche Creek is on the CWA Section 303(d) impaired water quality list for fecal coliform, instream flow, and temperature (Haring, 2004). The South Fork is listed for fecal coliform and temperature, and the South Fork tributary of Reynolds Creek is listed for water temperature.

ACTION RECOMMENDATIONS

The following are ranked salmonid habitat restoration actions are recommended for Cowiche Creek:

- Prioritize and correct identified fish passage barriers at water diversions and install fish screens.
- Consolidate diversions, where possible.
- Correct sedimentation from streamflow running down Cowiche Mill Road.
- Implement a comprehensive grazing program to protect riparian vegetation and streambank stability; restore riparian vegetation and function.
- Restore floodplain function, where impaired.
- Correct false attraction problems into lower NF Cowiche Creek during the irrigation season, by installing a fish passage barrier at the mouth or by providing persistent flow through the lower NF.

COWICHE CREEK SUB-BASIN REACH DESCRIPTIONS

The Cowiche Creek SMP jurisdiction is divided into four distinct reaches (Fig. C5; Table C1). Reach delineation was made based on gradient, landforms, and land use. **Reach 1** represents the lower portion of Cowiche Canyon and the connection of Cowiche Creek to the larger Naches River. This reach is dominated by irrigated agriculture and transportation infrastructure and is increasingly subject to urban development. **Reach 2** is distinguished by a narrowing of the canyon with the resultant confinement of the stream channel and restriction of the stream floodplain. This reach exhibits little residential or agricultural development and is currently dominated by Urban Natural Open Space land use. **Reach 3** represents a widening of the floodplain into a broad valley setting dominated by diverse, irrigated agriculture and intensifying residential development. **Reach 4** is notable for a constriction of the canyon walls and restriction in the width of the stream floodplain. This reach also exhibits a transition from broad-scale irrigated agriculture to restricted irrigated agriculture to dryland ranching activities. The Cowiche Creek SMP jurisdiction and its associated land uses represent a distinctive cultural landscape drastically changed over the past 150 years. The 303(d) listing of portions of Cowiche Creek in each of the four designated reaches reflects the cumulative effects of alterations occurring in the watershed.

REACH 1

General Description

Reach 1 comprises the lower 2.5 miles of Cowiche Creek from its confluence with the Naches River to the uppermost agricultural activity (orchards) in lower Cowiche Canyon. The average gradient of this reach is 1.7% (88 ft./mi.). Reach 1 represents the most geomorphically complex reach in the Cowiche Creek sub-basin. The complexity arises from the intersection of multiple different geologic formations and is amplified by the intersection of Cowiche Creek with the floodplain of the larger Naches River.

ABIOTIC- See Cowiche Physical Map and Physical (Soil Characteristics) Map *(Cowiche_physical.pmf and Cowiche_soil_characteristics.pmf)*

Geology/Landform (Table C2)
Within the downstream segment (0.7 mile) of this reach, Cowiche Creek exits its canyon mouth and flows across the alluvial deposits on the floodplain of the Naches River. Within the upper segment (1.8 miles) of this reach, the creek is confined within a canyon form typified by vertical and stepped cliffs interspaced with steep colluvial slopes with a relatively narrow (400-1000 ft.) floodplain. This upper "canyon" segment of Reach 1 lies at the intersection of flood basalts (to the south) with younger andesite flows from the Cascade Range (to the north) (Washington Department of Natural Resources [WDNR], 2000). Throughout Reach 1, the SMP jurisdiction occupies the majority of the floodplain. Approximately 54.8% of the reach is within the 100 year floodplain.

There are no geologic hazards noted for the lower segment of Reach 1 (Yakima County, 2003c). Areas within the upper "canyon" segment are categorized as High Risk areas that are prone to fail as a result of over-steepened slopes (Yakima County, 2003c). Landslides and slumps are known to occur along this segment and small alluvial fan deposits from side canyons often add complexity to canyon-bottom sediments and hydrologic structure.

Soils/Soil Properties (Table C3)
The floodplain segment of Reach 1 is dominated by alluvial deposits while the canyon segment is dominated by rock outcrops. Overall, 76% of the SMP jurisdiction is overlain by alluvium (Washington Department of Natural Resources [WDNR], 2000). Where soils are present within the SMP jurisdiction, the majority (72.8%) are Aquic, a direct reflection of stream and hyporheic flow across and through the floodplain (Yakima County, n.d.c). Soil permeability is primarily moderate, runoff is classed as slow, and the hazard of erosion is slight (USDA Natural Resources Conservation Service [NRCS], 2003).

Stream Type/Channel Form (Table C4)
Channel form throughout Reach 1 is currently classified as pool-riffle. It is likely that the channel form of this reach was once more complex. The canyon segment of Reach 1 is a confining reach which functions to maintain the concentration of flows, while the lower segment is a dispersal reach in which energy is dissipated. Reduction in velocity and volume through lateral movement

(channel migration) or braiding/distributaries (multiple channels), resulted in a depositional environment. Over 76% of the SMP jurisdiction in Reach 1 is underlain by alluvium; likely a thin veneer overlying flood basalts within the upper segment (WDNR, 2000). Throughout this reach, there exists the opportunity for flood waters to spread, shifting channel locations and alternately eroding and depositing materials. As a result, this reach has a potential for increased channel complexity. It is expected that Cowiche Creek water percolates into the alluvial deposits of the Naches River floodplain in the lower segment of this reach; however, the nature of this interaction remains unexplored.

Flow
Stream discharge for Cowiche Creek (based on extremely limited measurements) ranges from a low of approximately 2 cfs in late fall to a high of approximately 128 cfs in early spring. The flow regime is typical of that of streams throughout the region, exhibiting lowest flows in late fall and early winter, rapidly ascending flows commencing in early spring, and gradually declining flows throughout late spring and summer. The "typical" hydrograph currently exhibits an alteration to this pattern in late spring as a result of irrigation diversions.

Given the high proportion of the SMP jurisdiction and floodplain underlain by highly permeable fluvial deposits, the hyporheic zone is expected to span the entire breadth of the canyon bottom.

BIOTIC- See Cowiche Biological Map *(Cowiche_Biological.pmf)*

Natural Vegetation
Upland
Historic vegetation is non-forest (as designated by ICBEMP). Potential vegetation is primarily sagebrush-steppe.

Riparian (Table C5)
Riparian vegetation cover ranges from 18.8% to 20.3% of the SMP jurisdiction; however, this vegetation is restricted to a narrowed and confined stream channel by existing land use activities (WDFW, 2004b and Yakima County, 2003b). Cottonwood and willow constitute the major overstory species with an understory dominated by chokecherry and service berry. Introduced exotics are common among the riparian vegetation today.

Wetlands (Table C5)
Wetlands occupy 0.4% of the SMP jurisdiction (United States Fish and Wildlife Service [USFWS], 2003). Wetlands are sparsely scattered along the entire reach.

Wildlife
Aquatic (Table C6)
Bull trout and anadromous fish, once abundant in Cowiche Creek, are now only marginally present in the Cowiche sub-basin. Reach 1 is the critical aquatic connection between the larger Naches and Yakima River basins. Although upstream passage of steelhead does occur, the presence of culturally introduced migration barriers does not allow ready passage for juvenile or resident fish. Adult anadromous fish that manage to move into Cowiche Creek from the Naches River face an

array of intermingled barriers at irrigation water diversions, mid-summer low flows and high temperatures, and delays related to false-attraction as a result of irrigation return flows. Despite these problems, Reach 1 has been identified as spawning and rearing habitat for coho and spring chinook (Washington Department of Fish and Wildlife [WDFW], 2004c). Other resident fish species found in the reach include rainbow trout, Eastern brook trout, sculpin, and speckled dace (WDFW, 2004c).

Avian (Table C7)
GAP analysis data indicates that all of Reach 1 may provide habitat for one species of current concern, namely the burrowing owl (WDFW, 2004a). Raptors are common in the canyon segment of Reach 1, and migratory and resident waterfowl and songbirds utilize the diminished riparian and upland habitats.

Terrestrial (Tables C5 and C7)
GAP analysis data indicates that portions of Reach 1 may provide habitat for two species of current concern, including principally the Townsend's big-eared bat (100%), as well as smaller portions for the Townsend's ground squirrel (2.6%) (WDFW, 2004a). The entire riparian zone is listed as priority habitat ((WDFW, 2004b). Beaver are present in the stream system throughout Reach 1. Beaver are present, although they are often in conflict with existing land uses. This reach was primary winter range for elk and deer, but this use has largely been eliminated through historic land uses, either through habitat destruction, harassment, or migration barriers. A few deer are present in the area, currently, at least on a seasonal basis. Coyotes are present, but due to cultural developments, are limited in numbers. Amphibian species and their distributions are unknown.

CULTURAL MODIFICATIONS- See Cowiche Cultural Modifications Map
(Cowiche_Cultural_Modifications.pmf)

Land Use (Table C8)
The floodplain segment of Reach 1 was initially modified by historic floodplain agriculture, diversion of creek waters for irrigation, and through confinement of stream position by transportation infrastructure. The wider floodplain of this segment attracted early agricultural development of both orchards and pasture and was once characterized by dispersed farmsteads. Today, decreasing parcel size and intensifying residential density are reflected in an extreme channelization of the stream corridor. Normal channel migration and riparian ecological succession has been curtailed within this segment. The canyon segment was settled in the early 1880s, following a period of extensive grazing of cattle and sheep. Irrigation diversion, floodplain farming, and development of transportation infrastructure dominated land use through the 1970s.

Of the SMP jurisdiction lands along Reach 1, 16% remain vacant, 37.7% are in agricultural production, 28.6% is under residential development, and 17.6% is occupied by commercial/industrial development (Yakima County, 2004). Approximately 21.5% of the SMP jurisdiction is greater than 25% impervious. Yakima County is the only public owner of lands within the SMP jurisdiction, holding title to 1.2% of these lands. Approximately 47% of the SMP jurisdiction of this reach is under Urban Natural Open Space designation.

<u>Transportation</u> (Table C10)
The emergence of irrigated agriculture in the greater Cowiche Basin fostered the development of the North Yakima and Valley Railroad. The railroad confined Cowiche Creek along 2.1 miles of Reach 1, and markedly decreased the ability of the stream to move laterally by railroad bed and bridge construction (Washington State Department of Transportation [WDOT], 1997). Although the majority of the railroad bed is abandoned, it continues to influence the connectivity of the stream with its former floodplain.

A total of 1.7 miles of roadways are found in the SMP jurisdiction (Yakima County, n.d.a).

<u>Revetments</u> (Table C10)
A total of 0.8 miles of revetments (0.2 mile of road and 0.6 mile of dike) impinge directly on Cowiche Creek in this reach (Central Washington University [CWU], 2002).

CULTURAL JURISDICTIONS- See Cowiche Cultural Jurisdiction Map
(cowiche_cultural_jurisdictional.pmf)

<u>Zoning</u> (Table C9)
Current zoning within the SMP jurisdiction of Reach 1 is predominantly Suburban Residential (35.0%), Valley Rural (34.0%), and Single-Family Residential (13.5%). Minor portions of the jurisdiction are zoned Agriculture (10.9%), Two-Family Residential (6.0%), and Light Industrial (0.6%). Currently 92% of the reach is designated as Rural by the current SMP, with the other 8% designated as Conservancy (Yakima County, 2004c).

Cultural Resources
There are no Archeological Site Form records of cultural sites within the SMP jurisdiction of Reach 1 on file with the Washington State Historic Preservation Office (Washington State Historic Preservation Office [WSHPO], 2004).

Cultural resources are expected and known to exist in similar canyon-bottom settings in Yakima County (Uebelacker 1986). Winter villages and fishing, collecting, and hunting sites are expected to occur within the SMP jurisdiction of this reach. A winter village location is reported by early ethnographic accounts (Ray 1936) at the mouth of Cowiche Creek, a location that afforded favorable winter climate and access to a broad array of floodplain and upland resources.

DOE Sites/facilities and 303(d) Listings
There are no DOE sites/facilities found in the SMP jurisdiction of Reach 1. There is one 303(d)-listed stream segment (length 0.8 mile) in Reach 1: inadequate instream flow (Washington State Department of Ecology [WDOE], 1998).

ECOLOGICAL FUNCTION SUMMARY

Reach 1 Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 19.6% High soil runoff: 9.5% High erosion soils: 9.5% High soil permeability: 0.8% 100-Year Floodplain: 54.8%	Wetlands: 0.4% Undeveloped: 16% Riparian cover: 18.8% Priority habitats: 2 Species of concern: 3 Anadromous habitat: 2.5 mi Total fish species: 7	Public land: 1.2%	Principal land use: Residential >10% Imperviousness: 40.4% Roads: 1.7 mi Revetments: 0.8 mi

Ecological functions along Reach 1 are principally impaired by agricultural and residential development, which covers 66.3% of the jurisdiction. These land uses, in addition to the 1.7 miles of roads and 2.1 miles of active and abandoned railroad, account for the majority of the estimated 40.4% of the reach that is greater than 10% impervious. Upland vegetation has been removed and replaced with crops, buildings and lawns, which can promote increased runoff and nonpoint source pollution. Cowiche Creek has also been heavily diverted and extensive areas have lost floodplain connectivity, including approximately 0.8 miles of revetments within the jurisdiction. There is one 0.8 mile 303(d)-listed stream segment found in the SMP jurisdiction. Riparian vegetation, which is both a priority habitat and buffer for nonpoint pollution, covers approximately 18.8% of the reach, though this vegetation is restricted to a narrowed and confined stream channel by existing land use activities. Some of the reach is presently undeveloped (16%), while 0.4% is covered by wetlands. The reach provides habitat for three species of concern, as well as two priority habitats, riparian zones and urban natural open spaces, and aquatic habitat for seven fish species, including anadromous fish.

ECOLOGICAL PROTECTION OPPORTUNITIES- See Opportunity for Protection Map *(Opp_Protection.pmf)*

The following list refers to the similarly numbered locations on the digital ecological protection maps for Cowiche Creek.

1) Rationale: Existing riparian buffer on privately owned land protecting a recognized anadromous spawning and rearing habitat in an area with high soil erosion potential. Suggested Action: Work with private landowner to protect riparian buffer.
2) Rationale: Wetlands on private property. Suggested action: Work with landowner to protect wetlands.

ECOLOGICAL RESTORATION OPPORTUNITIES- see Opportunity for Restoration Map *(Opp_Restoration.pmf)*

The following list refers to the similarly numbered locations on the digital ecological restoration maps for Cowiche Creek.

1) Rationale: Levee, while protecting structures, is restricting floodplain processes. Suggested Action: Setback levee to new location to expand the active floodplain.
2) Rationale: Levee, while protecting structures, is restricting floodplain processes. Suggested Action: Setback levee to new location to expand the active floodplain.
3) Rationale: Marginal riparian buffer protecting an anadromous spawning and rearing habitat in a residential area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
4) Rationale: Marginal riparian buffer protecting an anadromous spawning and rearing habitat in an agricultural area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
5) Rationale: Marginal riparian buffer protecting an anadromous spawning and rearing habitat in a residential area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
6) Rationale: Marginal riparian buffer. Suggested Action: Work with private landowners to establish a larger riparian buffer.
7) Rationale: Marginal riparian buffer protecting an anadromous spawning and rearing habitat in an agricultural area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
8) Rationale: Marginal riparian buffer protecting an anadromous spawning and rearing habitat in an agricultural area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.

REACH 2

General Description

Reach 2 comprises the lower intermediate 3.0 miles of Cowiche Creek, from the upper end of agricultural activities in Cowiche Canyon to the upper end of the narrow confines of Cowiche Canyon. The average gradient of this reach is 0.6% (29 ft./mi.). The landscape of this reach is typified by bare volcanic rock hills interspersed with pockets of wind-blown loess and locally derived soils.

ABIOTIC- See Cowiche Physical Map and Physical (Soil Characteristics) Map *(Cowiche_physical.pmf and Cowiche_soil_characteristics.pmf)*

Geology/Landform (Table C2)

Reach 2 lies in a deeply incised synclinal canyon within flood basalts. The southern flanks and rim of the canyon, as well as the canyon bottom, are firmly embedded within flood basalts. Younger andesite flows cap the northern rim of the canyon (WDNR, 2000). The creek is confined within a canyon form typified by vertical and stepped cliffs interspaced with steep colluvial slopes with an extremely narrow (50-200 ft.) floodplain. Throughout Reach 2, the SMP jurisdiction occupies the majority of the floodplain and extends well up onto the flanking basalt canyon walls. Approximately 17.2% of the reach is within the 100 year floodplain.

There are geologic hazards noted throughout Reach 2 (Yakima County, 2003c). The southern canyon walls are categorized as Intermediate Risk areas exhibiting oversteepened slopes (Yakima County, 2003c). The northern canyon walls are categorized as High Risk areas that are prone to failure as a result of over-steepened slopes. Landslides and slumps are known to occur along this segment and small alluvial fan deposits from side canyons often add complexity to canyon-bottom sediments and hydrologic structure.

Soils/Soil Properties (Table C3)

Reach 2 is dominated (87.2%) by rock outcrops. Overall, only 12.8% of the SMP jurisdiction is overlain by alluvium (WDNR, 2000). Where soils are present within the SMP jurisdiction, 18.2% are Aquic, a direct reflection of the stream traversing bedrock with little hyporheic flow across and through the floodplain (Yakima County, n.d.c). Soil permeability is moderate, runoff is classed as medium with some rapid areas, and the hazard of erosion is moderate with some areas classified as high (NRCS, 2003).

Stream Type/Channel Form (Table C4)

Channel form throughout Reach 2 is currently classified as pool-riffle. It is unlikely that the channel form of this reach was ever more complex. Reach 2 is a geologically confined reach which functions to maintain the concentration of flows. The inability of the stream to reduce the velocity or volume through lateral movement (channel migration), braiding/distributaries (multiple channels), or percolation resulted in a erosional environment. Only 12.8% of the SMP jurisdiction in Reach 2 is underlain by alluvium; likely a thin veneer overlying flood basalts (WDNR, 2000). Throughout this reach, there exists little, if any, opportunity for flood waters to spread and, thus,

little likelihood for shifting channel locations and alternately eroding and depositing materials. As a result, this reach has little potential for increased channel complexity. Under extreme thunderstorm events or rain-on-snow events in the upper basin, the chance for flood flows exhibiting high velocities and turbulent flow is highly probable. During these episodes, the movement of large substrate materials is likely.

Stream Flow
Stream discharge for Cowiche Creek (based on extremely limited measurements) ranges from a low of approximately 2 cfs in late fall to a high of approximately 128 cfs in early spring. The flow regime is typical of that of streams throughout the region, exhibiting lowest flows in late fall and early winter, rapidly ascending flows commencing in early spring, and gradually declining flows throughout late spring and summer. The "typical" hydrograph currently exhibits an alteration to this pattern in late spring as a result of irrigation diversions.

Given the high proportion of the SMP jurisdiction and floodplain underlain by highly impermeable basalt flows, the hyporheic zone is expected to be extremely limited and, in some cases, non-existent.

BIOTIC- See Cowiche Biological Map *(Cowiche_Biological.pmf)*

Natural Vegetation
Upland
Historic vegetation is non-forest (as designated by ICBEMP). Potential vegetation is primarily sagebrush-steppe.

Riparian (Table C5)
Riparian vegetation cover ranges from 24% to 50.1% of the SMP jurisdiction (WDFW, 2004b and Yakima County, 2003b). The narrow canyon bottom, predominance of bare rock surfaces, and the limited amount of alluvium and soils explains, in part, a narrow and fragmented riparian community that is largely restricted to point bars and alluvial fan development from side canyons. Cottonwood and willow constitute the major overstory species with an understory dominated by chokecherry and service berry. Introduced exotics are common among the riparian vegetation today.

Wetlands (Table C5)
Wetlands occupy 1.4% of the SMP jurisdiction. Wetlands are sparsely scattered along the entire reach (USFWS, 2003). An additional 0.1 acres of wetland may be classified as associated wetlands within the final SMP jurisdiction, either intersecting the draft SMP jurisdiction boundary directly or being located in the 100-year floodplain.

Wildlife
Aquatic (Table C6)
Bull trout and anadromous fish, once abundant in Cowiche Creek, are now only marginally present in the Cowiche sub-basin. Reach 2 is a transitional reach between the lower connection to the Naches River and the upper spawning and rearing habitats. While little in the way of spawning

gravels or rearing habitat might be expected for anadromous fish, Reach 2 has been identified as spawning and rearing habitat for Coho, spawning habitat for summer steelhead, as well as rearing habitat for spring chinook (WDFW, 2004c).). In addition, this reach probably provides adequate resting pools during upstream migrations. Adequate habitat is expected for four species of resident fish in this reach, which are dominated by Eastern brook trout and rainbow trout.

Avian (Table C7)
GAP analysis data indicates that portions of Reach 2 may provide habitat for three species of current concern, including principally the sage sparrow and sage thrasher (87.4% each) as well as the burrowing owl (12.6%) (WDFW, 2004a). Raptors are common in the canyon segment of Reach 2, and migratory and resident waterfowl and songbirds utilize the diminished riparian and upland habitats.

Terrestrial (Tables C5 and C7)
GAP analysis data indicates that portions of Reach 2 may provide habitat for three species of current concern, including principally the Townsend's big-eared bat (100%), as well as slightly smaller portions for the black-tailed jack rabbit and Townsend's ground squirrel (87.4% each) (WDFW, 2004a). The entire riparian zone is listed as priority habitat (WDFW, 2004b). Beaver are present in the stream system throughout Reach 2, and, due to land use classification and the lack of large-scale agricultural development, are in little conflict with existing land uses. This reach was primary winter range for elk and deer, but this use has largely been eliminated through historic land uses, either through habitat destruction, harassment, or migration barriers. A few deer are present in the area, currently, at least on a seasonal basis. Coyotes are common. Amphibian species and their distributions are unknown.

CULTURAL MODIFICATIONS- See Cowiche Cultural Modifications Map
(Cowiche_Cultural_Modifications.pmf)

Land Use (Table C8)
Reach 2 was initially modified by historic domestic stock-raising and through confinement of stream position by transportation infrastructure. Early historic settlement was confined to domestic stock-grazing within the canyon, as suitable conditions for other forms of agriculture were not present.

Today, human use of Reach 2 is predominately recreational use of a trail constructed along the abandoned railroad bed. The Cowiche Canyon Conservancy is the primary advocate for continued access and use by the public.

Of the SMP jurisdiction lands along Reach 2, 86.2% remain vacant, 7.3% are in agricultural production, 2.3% is under residential development, and 4.3% is occupied by transportation development (Yakima County, 2004). Approximately 6.0% of the SMP jurisdiction is greater than 25% impervious. The Bureau of Land Management is the only public owner of lands within the SMP jurisdiction, holding title to 26.5% of these lands. Approximately 49% of the SMP jurisdiction of this reach is under Urban Natural Open Space designation.

<u>Transportation</u> (Table C10)
The canyon served as a transportation corridor for the North Yakima and Valley Railroad that once serviced the greater Tieton and Cowiche agricultural region. The railroad confined Cowiche Creek along 2.5 miles of Reach 2, and markedly decreased the ability of the stream to move laterally by railroad bed and construction of eleven bridges (WDOT, 1997). Although the railroad bed is abandoned, it continues to constrict the stream within an already narrow canyon-bottom.

No roadways are found in this reach, however, 2.5 miles of abandoned railroads are found in the SMP jurisdiction.

<u>Revetments</u> (Table C10)
There are no revetments found within the SMP jurisdiction of Reach 2 (CWU, 2002).

CULTURAL JURISDICTIONS- See Cowiche Cultural Jurisdiction Map *(cowiche_cultural_jurisdictional.pmf)*

Zoning (Table C9)
Current zoning within the SMP jurisdiction of Reach 2 is Valley Rural (92.0%) and Agriculture (8%). Currently 100% of the reach is designated as Conservancy by the current SMP.

Cultural Resources
There are six Archeological Site Form records of cultural sites within the SMP jurisdiction of Reach 2 on file with the Washington State Historic Preservation Office. Five of these sites are rock shelters, and one is a talus pit (WSHPO, 2004).

Other, as yet unrecorded, cultural resources associated with fishing, collecting, and hunting sites are expected to occur within the SMP jurisdiction of this reach.

DOE Sites/facilities and 303(d) Listings
There are no DOE sites/facilities found in the SMP jurisdiction of Reach 2 (WDOE, 1998). There is one 303(d)-listed stream segment (length 0.5 mile) in Reach 2: excursions for temperature and fecal coliform.

ECOLOGICAL FUNCTION SUMMARY
Reach 2 Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 35% High soil runoff: 35.6% High erosion soils: 35.6% 100-Year Floodplain: 17.2%	Wetlands:1.4% Undeveloped: 86.2% Riparian cover: 24% Priority habitats: 2 Species of concern: 6 Anadromous habitat: 3 mi Total fish species: 7	Public land: 26.5%	Principal land use: Vacant/natural >10% Imperviousness: 6%

Ecological functions along Reach 2 are principally impaired by agricultural, residential and industrial-transportation development, which covers 13.9% of the jurisdiction. These land uses, in addition to the 2.5 miles of abandoned railroad, account for the majority of the estimated 6% of the reach that is greater than 10% impervious. Upland vegetation has been removed and replaced with crops, buildings and lawns, which can promote increased runoff and nonpoint source pollution. There are no DOE sites/facilities found in the SMP jurisdiction, though there is one 0.5 mile 303(d)-listed stream segments. Riparian vegetation, which is both a priority habitat and buffer for nonpoint pollution, covers approximately 24% of the reach, though tends to be a narrow and fragmented riparian community that is largely restricted to point bars and alluvial fan development from side canyons. Much of the reach is presently undeveloped (86.2%), while 1.4% is covered by wetlands. The reach provides habitat for six species of concern, as well as two priority habitats for riparian zones and urban natural open spaces, and aquatic habitat for seven fish species, including anadromous fish.

ECOLOGICAL PROTECTION OPPORTUNITIES- See Opportunity for Protection Map *(Opp_Protection.pmf)*

The following list refers to the similarly numbered locations on the digital ecological protection maps for Cowiche Creek.

1) Rationale: Wetlands on private property. Suggested action: Work with landowner to protect wetlands.
2) Rationale: Existing riparian buffer on privately owned land protecting a recognized anadromous spawning and rearing habitat. Suggested Action: Work with private landowner to protect riparian buffer.
3) Rationale: Existing riparian buffer on privately owned land protecting a recognized anadromous spawning and rearing habitat. Suggested Action: Work with private landowner to protect riparian buffer.
4) Rationale: Cultural significant sites found on public land. Suggested Action: Protect cultural sites.
5) Rationale: Existing riparian buffer on privately owned land protecting a recognized anadromous spawning and rearing habitat. Suggested Action: Work with private landowner to protect riparian buffer.
6) Rationale: Cultural significant sites found on public land. Suggested Action: Protect cultural sites.
7) Rationale: Existing riparian buffer on privately owned land protecting a recognized anadromous spawning and rearing habitat adjacent to an upland area with high soil erosion potential. Suggested Action: Work with private landowner to protect riparian buffer.

ECOLOGICAL RESTORATION OPPORTUNITIES- See Opportunity for Restoration Map *(Opp_Restoration.pmf)*

The following list refers to the similarly numbered locations on the digital ecological restoration maps for Cowiche Creek.

1) Rationale: Abandoned bridge abutments are interfering with hydraulic geomorphic Processes in the stream channel. Suggested Action: Remove bridge abutments.

REACH 3

General Description

Reach 3 comprises the upper intermediate 5.7 miles of Cowiche Creek, from the upper end of the confines of Cowiche Canyon (immediately below Weikel) to the lower end of South Fork Cowiche Canyon (at the junction of Cowiche Mill Road and Sunset Way). The average gradient of this reach is 1.2% (63 ft./mi.). This reach lies in a relatively broad structural basin.

ABIOTIC -See Cowiche Physical Map and Physical (Soil Characteristics) Map *(Cowiche_physical.pmf and Cowiche_soil_characteristics.pmf)*

Geology/Landform (Table C2)
Reach 3 lies in a broad synclinal canyon largely overlain with alluvial deposits. The stream valley is bounded on the southeast by flood basalts and on the northeast by younger andesite flows (WDNR, 2000).

Examination of a topographic map indicates that South Fork of Cowiche Creek had once formed a rather extensive alluvial fan upstream of its confluence with the north fork. Subsequent uplift of the eastern portion of the fan, relative to the western, has resulted in the confinement of the South Fork of Cowiche Creek to the southern edge of the synclinal valley.

The southern flanks and rim of the anticlinal ridge to the south are comprised of flood basalts. Younger andesite flows cap the downward-sloping flank of the watershed to the north, eventually plunging beneath a veneer of alluvium deposited by the combined action of the North and South Forks of Cowiche Creek. The creek is flows unconfined across a broad valley and, throughout Reach 3, the SMP jurisdiction occupies a portion of the much broader (1500-3500 ft.) floodplain. Approximately 66.7% of the reach is within the 100 year floodplain.

Geologic Hazards (Table C2)
There are minimal geologic hazards noted throughout Reach 3 (Yakima County, 2003c). Oversteepened slopes pose an intermediate threat to 2.7% of the reach, while the intermediate risk of alluvial or flash flooding exists along 0.6% of the reach.

Soils/Soil Properties (Table C3)
Reach 3 is dominated (86.4%) by alluvial deposits (WDNR, 2000). The soils within the SMP jurisdiction are predominately silt loams. Within this reach, 34.9% of the soils are Aquic, a direct reflection of stream and hyporheic flow across and through much of the floodplain (Yakima County, n.d.c). Soil permeability is moderately slow to moderately rapid, runoff is classed as primarily slow, and the hazard of erosion is primarily slight (NRCS, 2003).

Stream Type/Channel Form (Table C4)
Channel form throughout the lower (1.7 mi.) segment of Reach 3 is currently classified as pool-riffle. Within this segment of the reach, the stream is increasingly confined by abrupt canyon walls and experiences increased flow as a result of the immediately upstream confluence of the

North Fork and upwelling of hyporheic flow. Channel form throughout the upper (4.0 mi.) segment of Reach 3 is classified as plane-bed. Upon exiting the confining canyon at the upper end of this segment, the stream flows through a broadening and ever-less confining alluvial fan.

Through this reach, Cowiche Creek is confined to a single channel. Numerous small tributaries join the creek and numerous diversions for irrigation purposes occur throughout this reach. It is apparent that several irrigation channels were former distributaries of the South Fork of Cowiche Creek. It is likely that the channel form of this reach was once more complex. This is a dispersal reach in which energy is dissipated. Reduction in velocity and volume through lateral movement (channel migration), braiding/distributaries (multiple channels), and percolation into the alluvial substrate resulted in a depositional environment. Over 86% of the SMP jurisdiction in Reach 3 is underlain by likely deep deposits of alluvium. Throughout this reach, there exists the opportunity for flood waters to spread, shifting channel locations and alternately eroding and depositing materials. As a result, this reach has a potential for increased channel complexity. Review of older aerial photography indicates that meandering and braiding were former characteristics of this reach.

Flow

Stream discharge for Cowiche Creek (based on extremely limited measurements) ranges from a low of approximately 2 cfs in late fall to a high of approximately 128 cfs in early spring. The flow regime is typical of that of streams throughout the region, exhibiting lowest flows in late fall and early winter, rapidly ascending flows commencing in early spring, and gradually declining flows throughout late spring and summer. The "typical" hydrograph currently exhibits an alteration to this pattern in late spring as a result of irrigation diversions. Lower water levels and higher water temperatures are annual occurrences in the stream below the confluence of the North and South Forks of Cowiche Creek.

Given the high proportion of the SMP jurisdiction and floodplain underlain by highly permeable alluvium, the hyporheic zone is expected to be extremely widespread. The nature of the alluvial deposits likely makes hyporheic flow highly complex.

BIOTIC -See Cowiche Biological Map *(Cowiche_Biological.pmf)*

Natural Vegetation

<u>Upland</u>

Historic vegetation is non-forest (as designated by ICBEMP). Potential vegetation is primarily sagebrush-steppe.

<u>Riparian</u> (Table C5)

Riparian vegetation cover ranges from 20% to 36% of the SMP jurisdiction; however, this vegetation is largely restricted to a narrowed and confined stream channel by existing land use activities (WDFW, 2004b and Yakima County, 2003b). The broad, largely unconfined stream bottom and predominance of alluvial deposits and loamy soils, suggest a much more expansive riparian community formerly. Cottonwood and willow constitute the major overstory species with

an understory dominated by chokecherry, wild rose, and grasses. Introduced exotics are common among the riparian vegetation today.

Wetlands (Table C5)
Wetlands occupy only 0.7% of the SMP jurisdiction today (USFWS, 2003). Wetlands are sparsely scattered along the entire reach. It is likely that numerous wetlands have been lost as a result of historic agricultural development.

Wildlife
Aquatic (Table C6)
Bull trout and anadromous fish, once abundant in Cowiche Creek, are now only marginally present in the Cowiche sub-basin. Reach 3 is a transitional reach between the lower, migrational, connection to the Naches River and the upper spawning and rearing habitats. The upper (4.6 mi.) segment of this reach likely was a major spawning and rearing habitat for salmonids, exhibiting large areas of graded substrates, hyporheic upwellings, and highly diverse channel morphology (meandering, braiding). The lower (1.7 mi.) portion of this reach probably afforded abundant resting pools during upstream migrations. Appropriate habitat is expected for resident fish throughout this reach. Currently, anadromous fish passage above the confluence of the North and South Forks is impeded as a result of irrigation withdrawal and the associated structures. Despite these problems, Reach 3 provides spawning habitat for summer steelhead, while portions of Reach 3 (1.4 miles) have been identified as spawning and rearing habitat for coho salmon (WDFW, 2004c). Adequate habitat is expected for four species of resident fish in this reach, which are dominated by Eastern brook trout and rainbow trout.

Avian (Table C7)
GAP analysis data indicates that portions of Reach 3 may provide habitat for three species of current concern, including principally the burrowing owl (98.2%), as well as smaller portions for the sage sparrow, and sage thrasher (1.5% each) (WDFW, 2004a). Raptors are common in the canyon segment of Reach 3, and migratory and resident waterfowl and songbirds utilize the diminished riparian habitats along both the main stream and irrigation canals and ditches.

Terrestrial (Tables C5 and C7)
GAP analysis data indicates that portions of Reach 3 may provide habitat for three species of current concern, including principally the Townsend's big-eared bat (100%), as well as smaller portions for the black-tailed jack rabbit and Townsend's ground squirrel (1.5% each) (WDFW, 2004a). The entire riparian zone is listed as priority habitat (WDFW, 2004b). Beaver are present in the stream system throughout Reach 3, and are in conflict with existing land uses. This reach was primary spring and winter range for elk and deer, but this use has largely been eliminated through historic land uses, either through habitat destruction, harassment, or migration barriers. A few deer are present in the area, currently, at least on a seasonal basis. Coyotes are common. Amphibian species and their distributions are unknown.

CULTURAL MODIFICATIONS- See Cowiche Cultural Modifications Map
(Cowiche_Cultural_Modifications.pmf)

Land Use (Table C8)
Reach 3 was initially modified by historic domestic stock-raising, and later, through early dry-land agricultural development. Later, direct irrigation withdrawal from the South Fork Cowiche Creek (expanded under the Tieton-Cowiche Irrigation Project, were developed which permitted a transition to an expanded, diverse, irrigated, agriculture.

Of the SMP jurisdiction lands within Reach 3, 2.1% remain vacant, 79.1% are in agricultural production, 16.6% is under residential development, and 2.2% is occupied by transportation and commercial development (Yakima County, 2004). Approximately 3.9% of the SMP jurisdiction is greater than 25% impervious. The Bureau of Reclamation is the only public owner of lands within the SMP jurisdiction, holding title to 0.8% of these lands. Approximately 0.3% of the SMP jurisdiction of this reach is under Urban Natural Open Space designation.

Transportation (Table C10)
The development of transportation infrastructure confined lateral movement of the stream channel through railroad bed and bridge placement within the historic floodplain. This is most obvious in the lower (1.7 mi.) segment of this reach where the creek has been crowded against the eastern valley wall. Although the railroad bed does not directly impinge upon the stream, combined with agricultural development of floodplain lands, the stream is no longer permitted to migrate as it had in the past.

Roadways occupy 1.0 miles of SMP jurisdiction land in this reach (Yakima County, n.d.a) along with 0.5 miles of abandoned railroad (WDOT, 1994).

Revetments (Table C10)
There are no revetments found within the SMP jurisdiction of Reach 3 (CWU, 2002).

CULTURAL JURISDICTIONS- See Cowiche Cultural Jurisdiction Map
(cowiche_cultural_jurisdictional.pmf)

Zoning (Table C9)
Current zoning within the SMP jurisdiction of Reach 3 is predominantly Agriculture (88.9%). Minor portions of the jurisdiction are zoned Remote/Extremely Limited (10.8%), and Valley Rural (0.3%). Currently 90% of the reach is designated as Rural by the current SMP, with the other 10% designated as Conservancy.

Cultural Resources
There are no Archeological Site Form records of cultural sites within the SMP jurisdiction of Reach 3 on file with the Washington State Historic Preservation Office (WSHPO, 2004).

The valley setting of Reach 3 was the site of an ethnographically recorded Native American winter village complex (Ray 1936), although the precise location is not known. Native Americans are

known to have hunted, fished, and collected plant resources within this reach; activities that undoubtedly resulted in, as yet unrecorded, cultural sites. Areas of high ground within and adjacent to broad floodplain areas are highly likely to contain cultural resources.

DOE Sites/facilities and 303(d) Listings
There are no DOE sites/facilities found in the SMP jurisdiction of Reach 3 (WDOE, 1998). There are two 303(d)-listed stream segments (total length 1.3 mile) in Reach 3: temperature and fecal coliform.

ECOLOGICAL FUNCTION SUMMARY

Reach 3 Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 2.7% 100-Year Floodplain: 66.7%	Wetlands: 0.7% Undeveloped: 2.1% Riparian cover: 20% Priority habitats: 2 Species of concern: 6 Anadromous habitat: 5.7 mi Total fish species: 6	Public land: 0.8%	Principal land use: Agriculture >10% Imperviousness: 7.7% Roads: 1 mi Barriers: Insufficient flow, dam

Ecological functions along Reach 3 are principally impaired by agricultural and residential development, which covers 95.7% of the jurisdiction. These land uses, in addition to the 1 mile of roads and 0.5 miles of abandoned railroad, account for the majority of the estimated 7.7% of the reach that is greater than 10% impervious. In addition, there is one insufficient flow dam along the reach. Upland vegetation has been removed and replaced with crops, buildings and lawns, which can promote increased runoff and nonpoint source pollution. Two 303(d)-listed stream segments are also found in the SMP jurisdiction. Riparian vegetation, which is both a priority habitat and buffer for nonpoint pollution, covers approximately 20% of the reach, though this vegetation is largely restricted to a narrowed and confined stream channel by existing land use activities. Little of the reach is presently undeveloped (2.1%), while 0.7% is covered by wetlands. The reach provides habitat for six species of concern, as well as two priority habitats for riparian zones and urban natural open spaces, and aquatic habitat for six fish species, including anadromous fish.

ECOLOGICAL PROTECTION OPPORTUNITIES- See Opportunity for Protection Map *(Opp_Protection.pmf)*

The following list refers to the similarly numbered locations on the digital ecological protection maps for Cowiche Creek.

1) Rationale: Existing riparian buffer on privately owned agricultural land protecting a recognized anadromous spawning or rearing habitat. Suggested Action: Work with private landowners to protect riparian buffer.

2) Rationale: Wetlands on private property. Suggested action: Work with landowner to protect wetlands.
3) Rationale: Existing riparian buffer on privately owned land protecting a recognized anadromous spawning and rearing habitat. Suggested Action: Work with private landowner to protect riparian buffer.
4) Rationale: Existing riparian buffer on privately owned agricultural land protecting a recognized anadromous spawning or rearing habitat. Suggested Action: Work with private landowners to protect riparian buffer.
5) Rationale: Wetlands on private property. Suggested action: Work with landowner to protect wetlands.
6) Rationale: Extensive riparian buffer on privately owned agricultural land protecting a recognized anadromous spawning habitat. Suggested Action: Work with private landowners to protect riparian buffer.

ECOLOGICAL RESTORATION OPPORTUNITIES- See Opportunity for Restoration Map *(Opp_Restoration.pmf)*

The following list refers to the similarly numbered locations on the digital ecological restoration maps for Cowiche Creek.

1) Rationale: Marginal riparian buffer protecting an anadromous spawning habitat in an agricultural area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
2) Rationale: Marginal riparian buffer protecting an anadromous spawning habitat in an agricultural area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
3) Rationale: Marginal riparian buffer protecting an anadromous spawning habitat in an agricultural area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
4) Rationale: Abandoned railroad in riparian zone. Suggested Action: Develop trail to provide public access.
5) Rationale: Marginal riparian buffer protecting an anadromous spawning habitat in an agricultural area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
6) Rationale: Marginal riparian buffer protecting an anadromous spawning habitat in an agricultural area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
7) Rationale: Marginal riparian buffer protecting an anadromous spawning habitat in an agricultural area. Suggested Action: Work with private landowners to establish a larger riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.

REACH 4

General Description

Reach 4 comprises the upper terminal 3.6 miles of Cowiche Creek that fall under SMP jurisdiction, from the lower end of South Fork Cowiche Canyon (at the junction of Cowiche Mill Road and Sunset Way to McDaniel Canyon. The average gradient of this reach is 1.7% (88 ft./mi.). This reach lies in a relatively confined structural basin.

ABIOTIC- See Cowiche Physical Map and Physical (Soil Characteristics) Map *(Cowiche_physical.pmf and Cowiche_soil_characteristics.pmf)*

Geology/Landform (Table C2)
Reach 4 lies in a narrow synclinal canyon largely overlain with basalt flows and younger sedimentary rocks (WDNR, 2000). The stream valley is bounded on both the north and south by flood basalts.

Examination of a topographic map indicates that the South Fork of Cowiche Creek has always been restricted to its present course. The creek flows within its confining canyon across a valley with a relatively narrow (400-1100 ft.) floodplain that progressively widens from upstream to downstream. Throughout Reach 4, the SMP jurisdiction occupies a portion of the floodplain. Approximately 41.5% of the reach is within the 100 year floodplain.

Geologic Hazards (Table C2)
Geologic hazards noted in Reach 4. The majority of the lower (1.9 mi.) segment of this reach is categorized as No Risk, however, there are two areas categorized as Intermediate Risk areas, exhibiting slopes between 15% and 40% that are less likely to fail, but still potentially hazardous (Yakima County, 2003c). The upper (1.7 mi.) segment of this reach (particularly the southern canyon wall) is categorized as Intermediate Risk areas that are prone to failure as a result of over-steepened slopes. Landslides and slumps are known to occur along this segment and small alluvial fan deposits from side canyons often add complexity to canyon-bottom sediments and hydrologic structure.

Soils/Soil Properties (Table C3)
Reach 4 is dominated by basalt flows (89.5%) (WDNR, 2000). Although the record indicates no alluvial deposits, it is felt this is in error. A review of aerial photography indicates a level valley floor covered with soils. Where soils are present within the SMP jurisdiction, they are predominately silt loams. Within this reach, 13.8% of the soils are Aquic, a direct reflection of the occurrence of alluvium and soils present through much of the floodplain (Yakima County, n.d.c). Soil permeability is primarily moderate rapid, runoff is classed as slow, and the hazard of erosion is slight (NRCS, 2003).

Stream Type/Channel Form (Table C4)
Channel form throughout the entirety of Reach 4 is classified as plane-bed. Through this reach, Cowiche Creek is alternately confined to a single channel and braids to multiple channels. The stream exhibits a high degree of sinuosity. Numerous small tributaries, issuing from side canyons, join the creek.

It is unlikely that the channel form of this reach was ever much more complex than it is currently. Reach 4 is a geologically confined reach which functions to maintain the concentration of flows. The ability of the stream to reduce velocity or volume through lateral movement (channel migration), braiding/distributaries (multiple channels), or percolation resulted in a depositional environment. Throughout this reach, there exists a good opportunity for flood waters to spread, shifting channel locations within the narrow and confined floodplain, and providing a high degree of alternately eroding and depositing materials. As a result, this reach was, and largely remains, one characterized by channel complexity. Further, the development of alluvial fans from side canyons functioned to force the stream alternately from one side of its valley to the other. Review of older aerial photography indicates that meandering, a result of both low-gradient and side-canyon alluvial fans, and braiding were former characteristics of this reach. Currently, the stream channel has become somewhat confined, particularly in the lower segment of this reach where agricultural development has occurred. Under extreme thunderstorm events or rain-on-snow events in the upper basin, the chance for flood flows exhibiting high velocities and turbulent flow is highly probable. During these episodes, the movement of large amounts of substrate materials is likely.

Flow
Stream discharge for Cowiche Creek (based on extremely limited measurements) ranges from a low of approximately 2 cfs in late Fall to a high of approximately 128 cfs in early spring. The flow regime is typical of that of streams throughout the region, exhibiting lowest flows in late fall and early Winter, rapidly ascending flows commencing in early spring, and gradually declining flows throughout late spring and summer. The "typical" hydrograph currently exhibits an alteration to this pattern in late spring as a result of irrigation diversions. Lower water levels and, potentially, higher water temperatures are annual occurrences in the stream below the confluence of the North and South Forks of Cowiche Creek.

Given the high proportion of the SMP jurisdiction and floodplain evidently underlain by highly permeable alluvial deposits, the hyporheic zone is expected to be extensive, although quite possibly intermittent. Examination of aerial photography exhibiting disjunctive riparian communities and springs is further evidence of this interpretation.

BIOTIC- See Cowiche Biological Map *(Cowiche_Biological.pmf)*

Natural Vegetation
<u>Upland</u> (Table C5)
Historic vegetation is non-forest (as designated by ICBEMP). Potential vegetation is primarily sagebrush-steppe.

Riparian (Table C5)
Reach 4 exhibits the highest degree of riparian vegetation within the entire Cowiche Creek SMP jurisdiction, covering 41.1% to 76.2% of the SMP jurisdiction (WDFW, 2004b and Yakima County, 2003b). This vegetation is dispersed across a larger portion of the floodplain rather than being restricted to close proximity to the stream channel. In the lower (1.9 mi.) segment, existing land use activities have resulted in a restriction in the spatial extent of the riparian community. Throughout the upper (1.9 mi.) segment, it is felt that the riparian community is as extensive as in the past. The composition of the riparian community in this reach is complex mosaic, consisting of the downstream extension of ponderosa pine and patches of oak woodland intermingling with cottonwood and willow. Shrub-steppe species occupy the elevated portions of alluvial fans in close proximity to the stream channel. Reach 4 plays a critical role in the transition from the forested canyon habitat to the west, the shrub-steppe dominated upland habitats to the north and south, and the riparian/meadow grassland habitats to the east.

Wetlands (Table C5)
Wetlands occupy 0.9% of the SMP jurisdiction today (USFWS, 2003). Wetlands are sparsely scattered along the entire creek. It is likely that numerous wetlands, the result of beaver activity, have been lost as a result of historic agricultural development.

Wildlife
Aquatic (Table C6)
Bull trout and anadromous fish, once abundant in Cowiche Creek, are now only marginally present in the Cowiche sub-basin. Reach 4 likely was a minor spawning and rearing habitat for salmonids. This reach exhibits areas of graded substrates, hyporheic upwellings, highly diverse channel morphology (meandering, braiding), ample cover, pools, and an abundance of large woody debris. The reach provides spawning habitat for summer steelhead. Abundant habitat is expected for four other resident fish species throughout this reach, including Eastern brook trout, rainbow trout, sculpin and speckled dace (WDFW, 2004c). Multiple irrigation diversions impede fish passage and result in low flows (and possibly higher water temperatures) during the summer irrigation season.

Avian (Table C7)
GAP analysis data indicates that portions of Reach 4 may provide habitat for three species of current concern, including principally sage sparrow and sage thrasher (9.6% each) and a small portion for the burrowing owl (0.7%) (WDFW, 2004a). Wildlife Heritage sites for golden eagles are found outside the SMP jurisdiction to the west (WDFW, 2003). Raptors are common in the canyon segment of Reach 4, and migratory and resident waterfowl and songbirds utilize the diminished riparian habitats along both the main stream and irrigation canals and ditches.

Terrestrial (Tables C5 and C7)
GAP analysis data indicates that portions of Reach 4 may provide habitat for three species of current concern, including principally the Townsend's big-eared bat (100%), as well as smaller portions for the black-tailed jack rabbit and Townsend's ground squirrel (9.6% each) (WDFW, 2004a). Wildlife Heritage sites are found outside the SMP jurisdiction to both the north and south. The entire riparian zone is listed as priority habitat (WDFW, 2004b). Oak woodland constitutes 60.4% of the habitat type of the SMP jurisdiction. Beaver are present in the stream system throughout Reach 4, and are in conflict with existing land uses in the lower (1.9 mi.) segment. It is

felt that beaver were once more plentiful throughout this reach and may have maintained the greater portion of the floodplain as a beaver-meadow complex. 98.4% of the SMP jurisdiction is noted as elk habitat. 60.4% is noted as mule and black-tailed deer habitat. This reach was, and remains, primary winter range for elk and deer, which are currently restricted to the western (majority) end of this reach by an elk fence during winter months in an attempt to minimize conflict with agricultural and residential development further to the east. Coyotes are common, and bobcat and cougar are known to utilize this area. Amphibian species and their distributions are unknown.

CULTURAL MODIFICATIONS- See Cowiche Cultural Modifications Map
(Cowiche_Cultural_Modifications.pmf)

Land Use (Table C8)
Reach 4 was initially modified by historic domestic stock-raising. Later, direct irrigation withdrawal from the South Fork Cowiche Creek was developed which permitted a transition to a highly-localized, irrigated, agriculture restricted to the floodplain of the lower (1.9 mi.) segment of this reach. This reach represents a transition from the intensive irrigated agricultural land use to the east and the ranching land use. This transition was in part due to the limited amount of arable lands along this reach, the transition to higher elevations, and the difficulty in distributing irrigation water from a stream exhibiting low flows during the summer and fall months.

Of the SMP jurisdiction lands along Reach 4, 76.7% remain vacant, 17.9% are in agricultural production, 5.0% is under residential development, and 0.4% is occupied by transportation development (Yakima County, 2004). Only 0.9% of the SMP jurisdiction is greater than 25% impervious. The Washington State Department of Fish and Wildlife is the major public owner of lands within the SMP jurisdiction, holding title to 63.3% of these lands. The Washington State Department of Natural Resources holds title to 0.3% of SMP jurisdiction lands.

Transportation (Table C10)
The development of transportation infrastructure has slightly confined lateral movement of the stream channel through road construction in the floodplain. Roadways occupy 1.3 miles of SMP jurisdiction land in this reach (Yakima County, n.d.a).

Revetments (Table C10)
There are no revetments found within the SMP jurisdiction of Reach 3 (CWU, 2002).

CULTURAL JURISDICTIONS- See Cowiche Cultural Jurisdiction Map
(cowiche_cultural_jurisdictional.pmf)

Zoning (Table C9)
Current zoning within the SMP jurisdiction of Reach 4 is Remote/Extremely Limited (98.2%) and Agriculture (1.8%). Currently 98.2% of the reach is designated as Conservancy by the current SMP, with the other 1.8% designated as Rural.

Cultural Resources
There are no Archeological Site Form records of cultural sites within the SMP jurisdiction of Reach 4 on file with the Washington State Historic Preservation Office (WSHPO, 2004).

Located at the intersection of a canyon opening of major forested uplands, shrub-steppe uplands, and valley riparian and moist meadow environments, Reach 4 represents a location that not only provided local resources of fish, game, and plants, but provided access to a diverse array of resources and places important to Native Americans. However, no formally recorded cultural resource sites currently exist in the SMP jurisdiction, although they are expected to be present.

DOE Sites/facilities and 303(d) Listings
There are no DOE sites/facilities found in the SMP jurisdiction of Reach 4 (WDOE, 1998). There is one 303(d)-listed stream segment (length 1.0 mile) in Reach 4: excursions for temperature and fecal coliform.

ECOLOGICAL FUNCTION SUMMARY

Reach 4 Characterization Summary

Hazard Potential	Habitat Conditions	Public Access	Key Modifications
Steep slopes: 69.5% High runoff soils: 24.6% High erosion soils: 24.6% High soil permeability: 11%	Wetlands: 0.9% Undeveloped: 76.7% Riparian cover: 41.1% Priority habitats:4 Species of concern: 6 Anadromous habitat: 3.6 mi Total fish species: 5	Public land: 63.6%	Principal land use: Vacant/natural >10% Imperviousness: 1.9% Roads: 1.3 mi

Ecological functions along Reach 4 are principally impaired by agricultural and residential development, which covers 22.9% of the jurisdiction. These land uses, in addition to the 1.3 miles of roads, account for the majority of the estimated 1.9% of the reach that is greater than 10% impervious. Upland vegetation has been removed and replaced with crops, buildings and lawns, which can promote increased runoff and nonpoint source pollution. There is one, 0.1 mile 303(d)-listed stream segments found in the SMP jurisdiction, though there are no DOE sites\facilities. Riparian vegetation, which is both a priority habitat and buffer for nonpoint pollution, covers approximately 41.1% of the reach, dispersed across a larger portion of the floodplain rather than being restricted to close proximity to the stream channel. Much of the reach is presently undeveloped (63.6%), while 0.9% is covered by wetlands. The reach provides habitat for six species of concern, as well as four priority habitats, and aquatic habitat for five fish species, including anadromous fish.

ECOLOGICAL PROTECTION OPPORTUNITIES- See Opportunity for Protection Map *(Opp_Protection.pmf)*

The following list refers to the similarly numbered locations on the digital ecological protection maps for Cowiche Creek.

1) Rationale: Rocky Mountain Elk Priority Species winter range habitat in riparian zone. Suggested Action: Protect Rocky Mountain Elk habitat and riparian buffer.
2) Rationale: Extensive riparian buffer on privately owned land protecting a recognized anadromous spawning habitat adjacent to an area with high soil erosion potential. Suggested Action: Work with private landowners to protect riparian buffer.
3) Rationale: Extensive riparian buffer on privately owned land protecting a recognized anadromous spawning habitat adjacent to an area with high soil erosion potential. Suggested Action: Work with private landowners to protect riparian buffer.
4) Rationale: Wetlands found on private land. Suggested Action: Work with landowner to protect wetlands.
5) Rationale: Important mule deer and black-tailed deer priority species habitat. Suggested Action: Protect habitat.
6) Rationale: Extensive riparian buffer on privately owned land protecting a recognized anadromous spawning habitat in an area with high soil erosion potential. Suggested Action: Work with private landowners to protect riparian buffer.

ECOLOGICAL RESTORATION OPPORTUNITIES- See Opportunity for Restoration Map *(Opp_Restoration.pmf)*

The following list refers to the similarly numbered locations on the digital ecological restoration maps for Cowiche Creek.

1) Rationale: Marginal riparian buffer on privately owned agricultural land protecting a recognized anadromous spawning habitat in an area with high soil erosion potential. Suggested Action: Work with private landowners to protect riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
2) Rationale: Marginal riparian buffer on privately owned agricultural land protecting a recognized anadromous spawning habitat. Suggested Action: Work with private landowners to protect riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.
3) Rationale: Marginal riparian buffer on privately owned land protecting a recognized anadromous spawning and rearing area. Suggested Action: Work with private landowners to protect riparian buffer and provide education regarding erosion and runoff controls and reduction of chemical applications.

APPENDIX

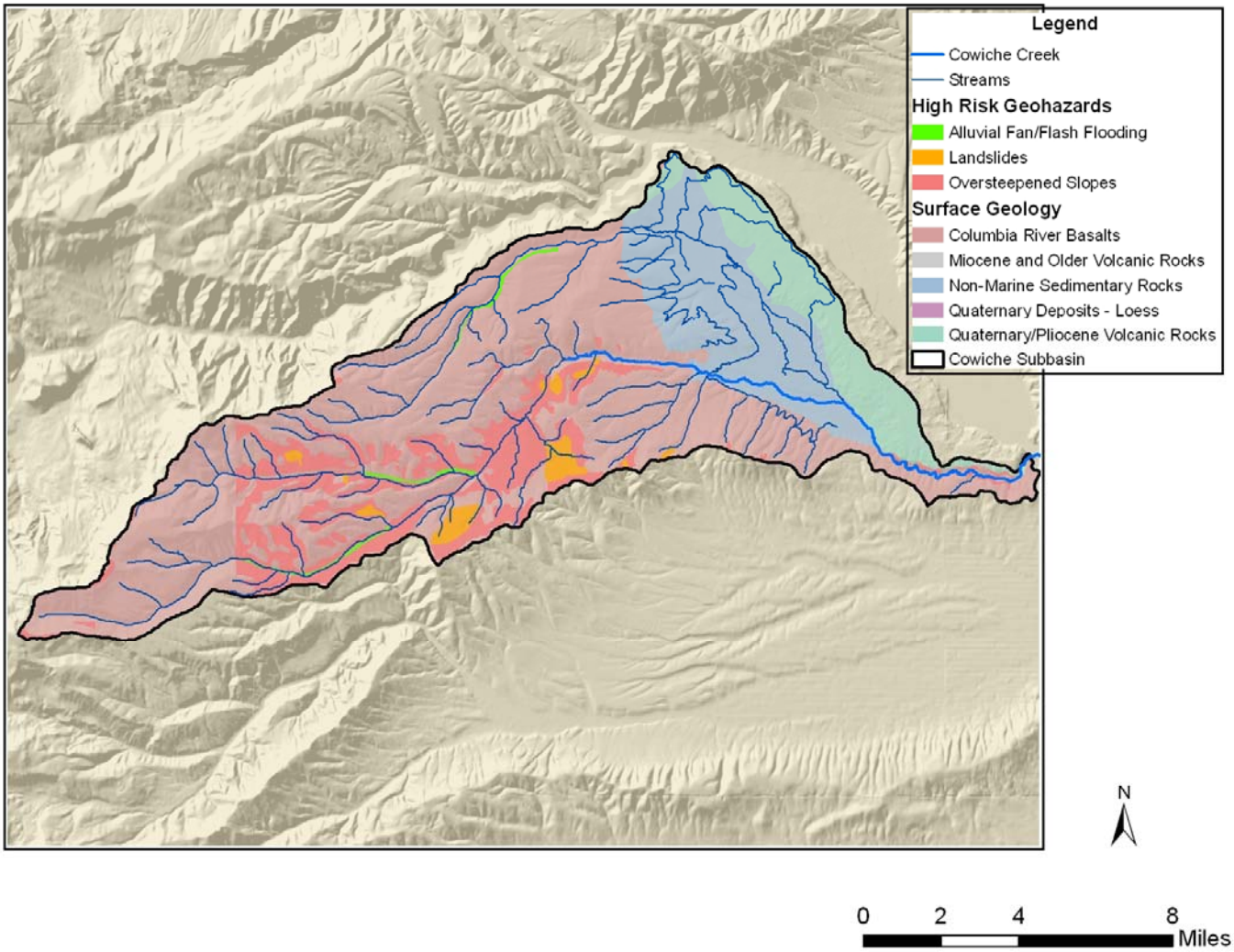

Figure C1. Geology and Geohazards in Cowiche Creek Sub-basin.

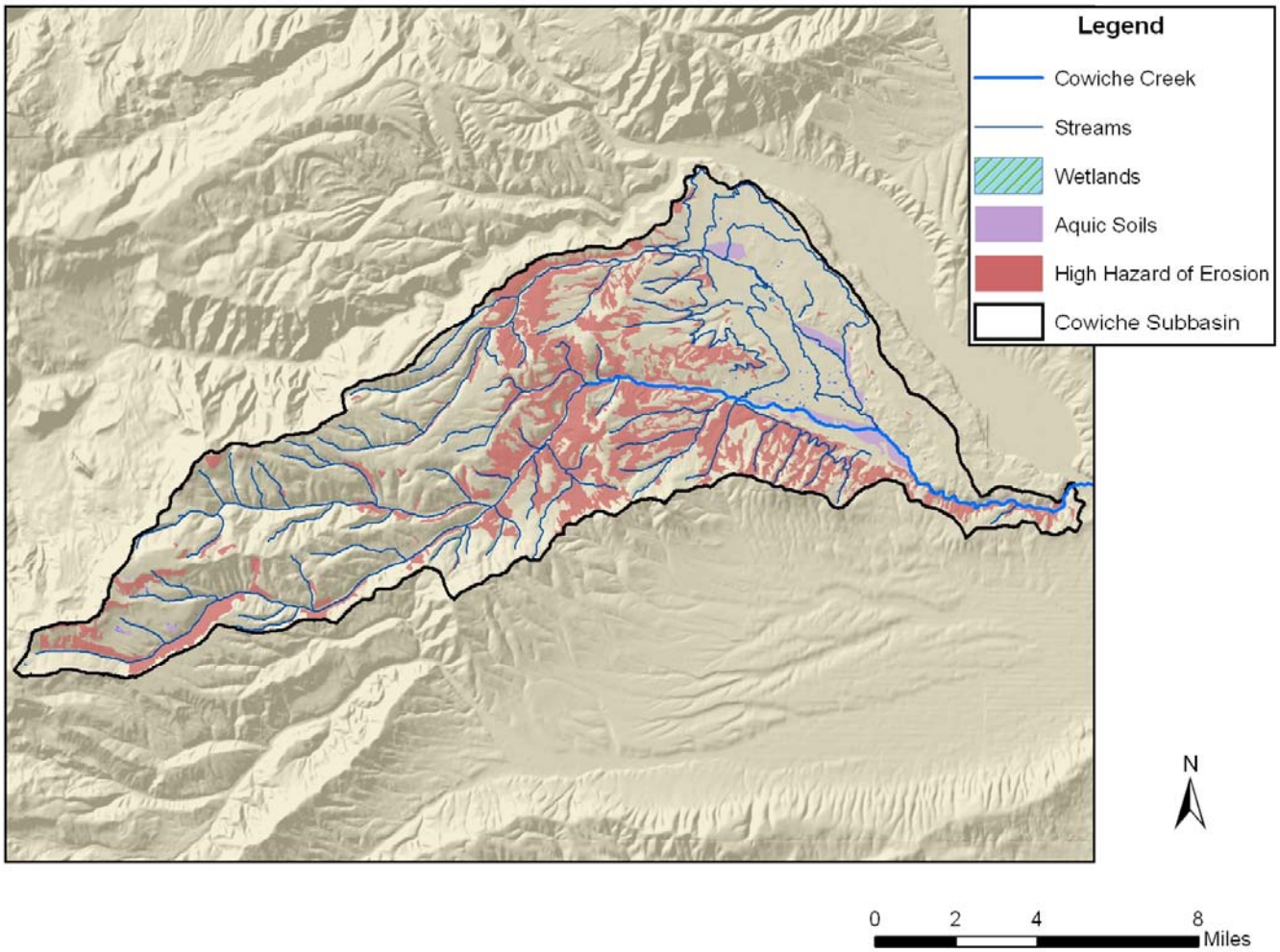

Figure C2. Wetlands and Soil Characteristics in Cowiche Creek Sub-basin.

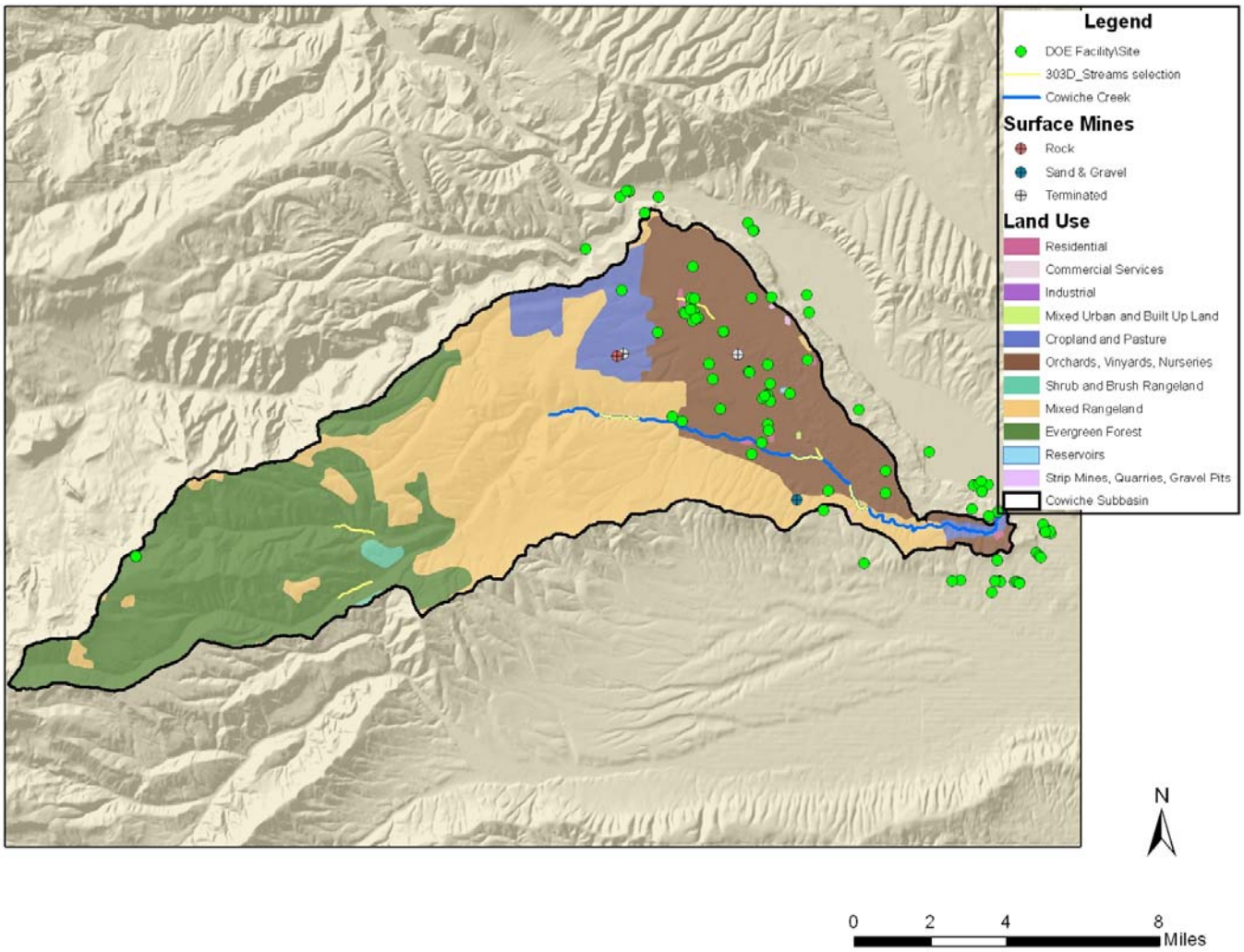

Figure C3. Cultural Modifications in Cowiche Creek Sub-basin.

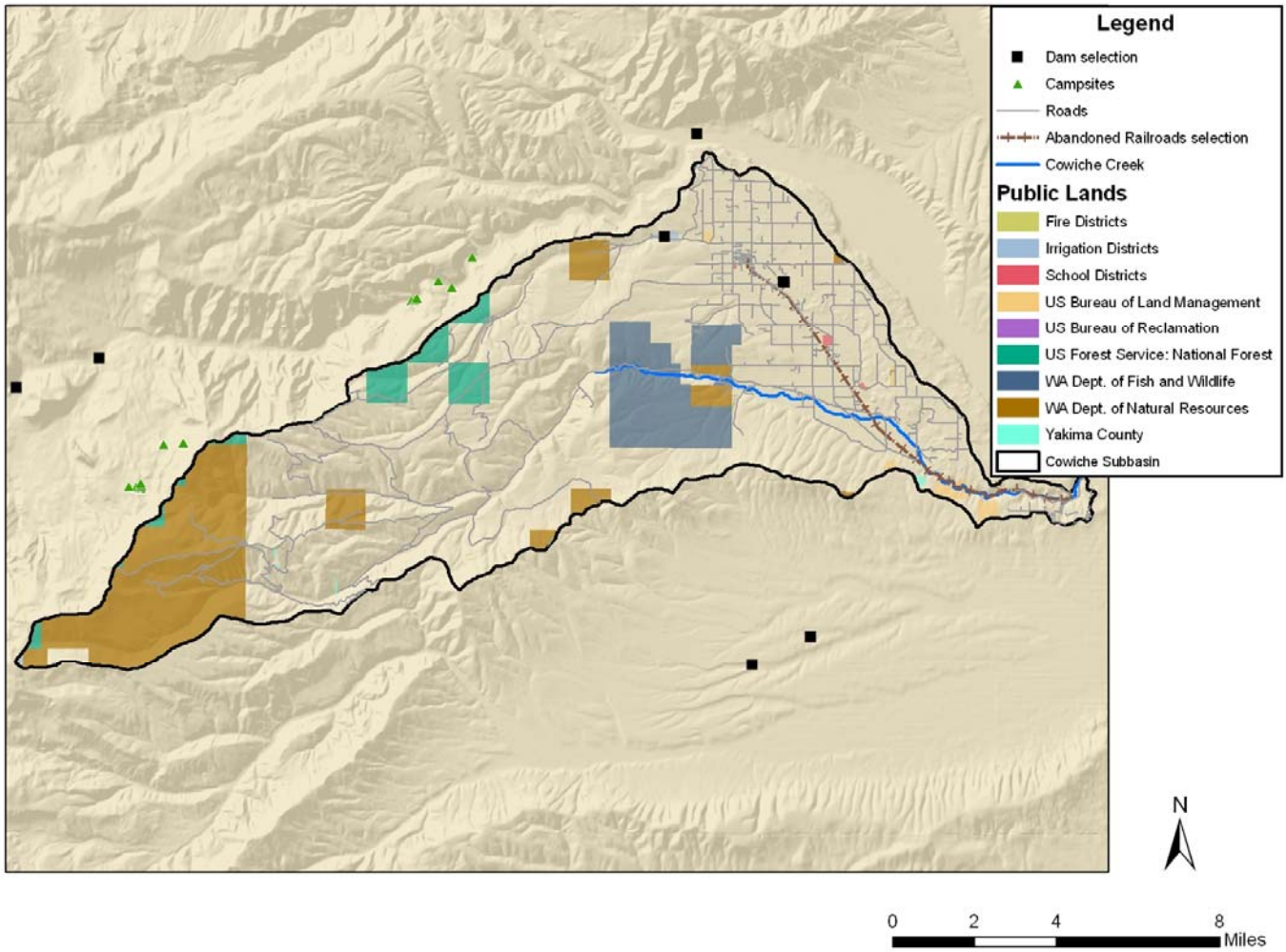

Figure C4. Public Resources and Access in Cowiche Creek Sub-basin.

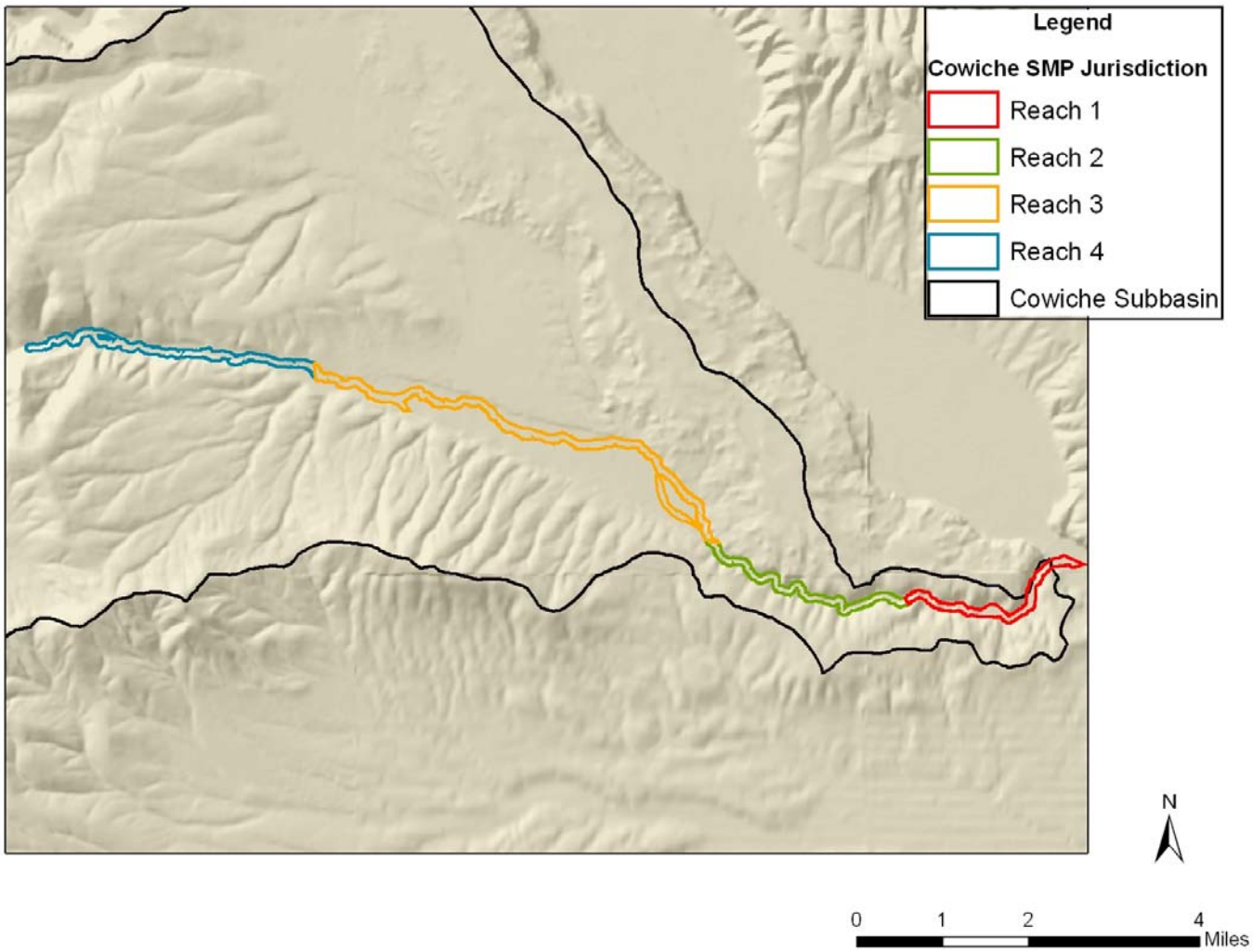

Figure C5. SMP Jurisdiction Breaks for Cowiche Creek Sub-basin.

Table C1. SMP Reach Breaks for Inventory and Analysis, Cowiche Creek Sub-basin.

Reach	Length	Start	Reach Break Justification	End
1	2.5 Miles	NE¼, SE¼, S9, T13N, R18E	Geomorphic: Confluence with Naches River.	NE¼, NE¼, S18, T13N, R18E
2	3.0 Miles	NE¼, NE¼, S18, T13N, R18E	Landuse: Changes from mixed rangeland to cropland and pasture.	SW¼, NE¼, S11, T13N, R17E
3	5.7 Miles	SW¼, NE¼, S11, T13N, R17E	Landuse: Changes from cropland and pasture to mixed rangeland.	SW¼, SW¼, S31, T14N, R17E
4	3.6 Miles	SW¼, SW¼, S31, T14N, R17E	Landuse: Changes from mixed rangeland and pasture to cropland.	SW¼, NE¼, S33, T14N, R16E

Table C2. Geology and Geohazard Characteristics for Cowiche Creek Sub-basin.

REACH	Geology		Geohazard	
	Lithology	**Area (%)**	**Geohazard**	**Area (%)**
1	Alluvium	76.0	Oversteepened Slopes (Intermediate Risk)	0.3
	Andesite Flows	9.2	Oversteepened Slopes (High Risk)	19.3
Area: 146.1 Acres	Basalt Flows	14.8	100-Year Floodplain	54.8
2	Alluvium	12.8	Oversteepened Slopes (Intermediate Risk)	18.1
	Andesite Flows	5.1	Oversteepened Slopes (High Risk)	16.9
Area: 155.3 Acres	Basalt Flows	82.1	100-Year Floodplain	17.2
3	Alluvium	86.4	Alluvial Fan/Flash Flooding (Intermediate Risk)	0.6
	Andesite Flows	1.2	Oversteepened Slopes (Intermediate Risk)	2.7
Area: 376.7 Acres	Basalt Flows	0.2	100-Year Floodplain	66.7
	Continental Sedimentary Deposits or Rocks	0.6		
	Continental Sedimentary Deposits or Rocks, Conglomerate	11.6		
4	Basalt Flows	89.5	Oversteepened Slopes (Intermediate Risk)	69.5
	Continental Sedimentary Deposits or Rocks, Conglomerate	10.5	100-Year Floodplain	41.5
Area: 219.4 Acres				

Table C3. Soil Characteristics for Cowiche Creek Sub-basin.

REACH	Soil Characteristics						Aquic Soils Area (%)
	Permeability	**Area (%)**	**Runoff**	**Area (%)**	**Hazard of Erosion**	**Area (%)**	
1	moderate	84.1	medium	4.4	high	9.5	72.8
	moderately rapid	13.9	rapid	9.5	moderate	4.4	
Area: 146.1 Acres	moderately slow	1.2	slow	86.1	slight	86.1	
	rapid	0.8					
2	moderate	83.4	medium	46.5	high	35.6	18.2
	moderately slow	16.6	rapid	35.6	moderate	46.5	
Area: 155.3 Acres			slow	10.2	slight	17.8	
			very slow	7.6			
3	moderate	18.1	medium	5.1	moderate	6.5	34.9
	moderately rapid	40.5	slow	65.5	N/A	18.1	
Area: 376.7 Acres	moderately slow	41.4	very slow	29.4	slight	75.4	
4	moderate	20.6	medium	2.4	high	24.6	13.8
	moderately rapid	59.3	rapid	24.6	moderate	3.6	
Area: 219.4 Acres	moderately slow	9.1	slow	71.5	slight	71.8	
	rapid	11.0	very slow	1.5			

Table C4. Stream Channel Characteristics for Cowiche Creek Sub-basin.

REACH	Stream Lengths		Channel Migration	
	Total Streams (Miles)	**SMP Stream (Miles)**	**Potential**	**Area (%)**
1 Length: 2.5 Miles	2.7	2.5	There are no channel migration areas in the jurisdiction.	
2 Length: 3.0 Miles	3.0	3.0		
3 Length: 5.7 Miles	5.9	5.7		
4 Length: 3.6 Miles	3.7	3.6		

Table C5. Habitat Characteristics for Cowiche Creek Sub-basin.

REACH	Wildlife Heritage Locations Common Name	Wildlife Heritage Locations (#)	Wetlands Area (%)	Riparian Areas Area (%)	Priority Species & Habitats		Barriers	
					Habitat	Area (%)	Type	Species Blocked
1 Area: 146.1 Acres	0	0	0.4	18.8	Riparian Zones Urban Natural Open Space	20.3 47.2	N/A	N/A
2 Area: 155.3 Acres	0	0	1.4	24.0	Riparian Zones Urban Natural Open Space	50.1 48.5	N/A	N/A
3 Area: 376.7 Acres	0	0	0.7	20.0	Riparian Zones Urban Natural Open Space	36.0 0.3	Insufficient Flow, Dam	Coho, Summer Steelhead
4 Area: 219.4 Acres	0	0	0.9	41.1	Elk Mule and Black-Tailed Deer Oak Woodland Riparian Zones	98.4 60.4 60.4 76.2	N/A	N/A

Table C6. Fish Characteristics for Cowiche Creek Sub-basin.

REACH	Anadromous Fish						Bulltrout		Resident Fish	
	Presence		Spawning		Rearing					
	Species	Length (Miles)	Species	Length (Miles)	Species	Length (Miles)	Presence	Length (Miles)	Species	Length (Miles)
1 Length: 2.5 Miles	Coho Spring Chinook Summer Steelhead	2.5 2.5 2.5	Coho Summer Steelhead	2.5 2.5	Coho Spring Chinook	2.5 2.4	Potentially Occupied	3.0	Eastern Brook Trout Rainbow Trout Sculpin Speckled Dace	2.5 2.5 2.5 2.5
2 Length: 3.0 Miles	Coho Spring Chinook Summer Steelhead	3.0 1.8 3.0	Coho Summer Steelhead	3.0 3.0	Coho Spring Chinook	3.0 1.8	Potentially Occupied	2.7	Eastern Brook Trout Rainbow Trout Sculpin Speckled Dace	3.0 3.0 0.5 0.5
3 Length: 5.7 Miles	Coho Summer Steelhead	1.4 5.7	Coho Summer Steelhead	1.3 5.7	Coho	1.4	Potentially Occupied	2.5	Eastern Brook Trout Rainbow Trout Sculpin Speckled Dace	5.8 5.8 4.2 4.2

4 Length: 3.6 Miles	Summer Steelhead	3.6	Summer Steelhead	3.6	None	0	Potentially Occupied	6.7	Eastern Brook Trout Rainbow Trout Sculpin Speckled Dace	3.6 3.6 3.6 3.6

Table C7. GAP Analysis of SMP Jurisdiction for Cowiche Creek Sub-basin.

REACH	**GAP Analysis**					
	Mammals		**Birds**		**Vegetation**	
	Type	**Area (%)**	**Type**	**Area (%)**	**Type**	**Area (%)**
1 Area: 146.1 Acres	Townsend's Big-Eared Bat Townsend's Ground Squirrel	100.0 2.6	Burrowing Owl	100.0	Central Arid Steppe	100.0
2 Area: 155.3 Acres	Black-Tailed Jack Rabbit Townsend's Big-Eared Bat Townsend's Ground Squirrel	87.4 100.0 87.4	Burrowing Owl Sage Sparrow Sage Thrasher	12.6 87.4 87.4	Central Arid Steppe	100.0
3 Area: 376.7 Acres	Black-Tailed Jack Rabbit Townsend's Big-Eared Bat Townsend's Ground Squirrel	1.5 100.0 1.5	Burrowing Owl Sage Sparrow Sage Thrasher	98.2 1.5 1.5	Central Arid Steppe	100.0
4 Area: 219.4 Acres	Black-Tailed Jack Rabbit Townsend's Big-Eared Bat Townsend's Ground Squirrel	9.6 100.0 9.6	Burrowing Owl Sage Sparrow Sage Thrasher	0.7 9.6 9.6	Central Arid Steppe	100.0

Table C8. Land-use Characteristics for Cowiche Creek Sub-basin.

REACH	Land Use		Land Use Type on Rapid Runoff Soil		Impervious Surface	
	Type	Area (%)	Type	Area (%)	Range	Area (%)
1	Agriculture-Orchard/Vineyard	15.6	Residential - Single Family	1.4	0	36.3
	Agriculture-Pasture/Grazing	22.1	Agriculture - Pasture/Grazing	0.8	1-10	23.2
Area: 1317.7 Acres	Industrial-Light Manufacturing	2.9	Agriculture - Orchard/Vineyard	0.0	11-25	18.9
	Industrial-Transportation	14.7	Industrial - Transportation	1.6	26-50	6.8
	Residential-Other	0.1	Vacant/Natural	5.7	51-75	1.8
	Residential-Single Family	28.5			76+	12.9
	Vacant/Natural	16.0				
2	Agriculture-Orchard/Vineyard	4.8	Residential - Single Family	0.4	0	65.0
	Agriculture-Pasture/Grazing	2.5	Agriculture - Pasture/Grazing	1.2	1-10	29.0
Area: 267.6 Acres	Industrial-Transportation	4.3	Agriculture - Orchard/Vineyard	0.0	11-25	0.0
	Residential-Single Family	2.3	Industrial - Transportation	1.3	26-50	6.0
	Vacant/Natural	86.2	Vacant/Natural	32.7	51-75	0.0
3	Agriculture-Hay	37.3	N/A	N/A	0	69.1
	Agriculture-Livestock	5.8			1-10	23.3
Area: 104.4 Acres	Agriculture-Orchard/Vineyard	10.9			11-25	3.8
	Agriculture-Pasture/Grazing	19.2			26-50	2.3
	Agriculture-Row Crops	5.9			51-75	0.0
	Commercial-Retail	0.3			76+	1.6
	Industrial-Transportation	1.9				
	Residential-Other	0.9				
	Residential-Single Family	15.7				
	Vacant/Natural	2.1				

REACH	Land Use		Land Use Type on Rapid Runoff Soil		Impervious Surface	
	Type	**Area (%)**	**Type**	**Area (%)**	**Range**	**Area (%)**
4	Agriculture-Hay	2.3	Residential - Single Family	0.2	0	53.4
	Agriculture-Pasture/Grazing	15.6	Vacant/Natural	24.4	1-10	44.7
Area: 284.4 Acres	Industrial-Transportation	0.4			11-25	1.0
	Residential-Single Family	5.0			26-50	0.5
	Vacant/Natural	76.7			51-75	0.0
					76+	0.4

Table C9. Cultural Jurisdiction Characteristics for Cowiche Creek Sub-basin.

REACH	Zoning		Public Land Ownership		Environmental Designation (1981)	
	Type	**Area (%)**	**Owner**	**Area (%)**	**Designation**	**Area (%)**
1 Area: 1317.7 Acres	Agriculture Light Industrial Single Family Residential Two Family Residential Suburban Residential Valley Rural	10.9 0.6 13.5 6.0 35.0 34.0	Yakima County	1.2	Conservancy Rural	8.0 92.0
2 Area: 267.6 Acres	Agriculture Valley Rural	8.0 92.0	US Bureau of Land Management	26.5	Conservancy	100.0
3 Area: 104.4 Acres	Agriculture Remote/Extremely Limited Valley Rural	88.9 10.8 0.3	US Bureau of Reclamation	0.8	Conservancy Rural	10.0 90.0
4 Area: 284.4 Acres	Agriculture Remote/Extremely Limited	1.8 98.2	WA Dept. of Fish and Wildlife WA Dept. of Natural Resources	63.3 0.3	Conservancy Rural	98.2 1.8

Table C10. Transportation Characteristics for Cowiche Creek Sub-basin.

REACH	Length of Revetments		Total Road Length (Miles)	Length of Railroads		Bridge Crossing (#)
	Type	Length (Miles)		Active (Miles)	Abandoned (Miles)	
1 Length: 2.5 Miles	Dike Road	0.6 0.2	1.7	0.2	1.9	0
2 Length: 3.0 Miles	N/A	0.0	0.0	0.0	2.5	0
3 Length: 5.7 Miles	N/A	0.0	1.0	0.0	0.5	0
4 Length: 3.6 Miles	N/A	0.0	1.3	0.0	0.0	0