Dement Creek Basin Assessment and Restoration Prioritization

A Tributary of the South Fork Coquille River

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Introduction

This assessment provides a prioritization of watershed restoration actions proposed to enhance ecological function for anadromous fish and working landscapes within the Dement Creek 6th field HUC in Coos County, Oregon. Dement Creek is a 9,700-acre tributary drainage to the South Fork Coquille River (SFCR) located about 1-mile south of Broadbent, OR. Dement Creek has been prioritized for restoration by the Coquille Watershed Association (CoqWA) because it has reaches with high intrinsic potential for coho salmon (Figure 1) and provides spawning and rearing habitat for coho, fall Chinook, winter steelhead, coastal cutthroat trout, and Pacific lamprey.

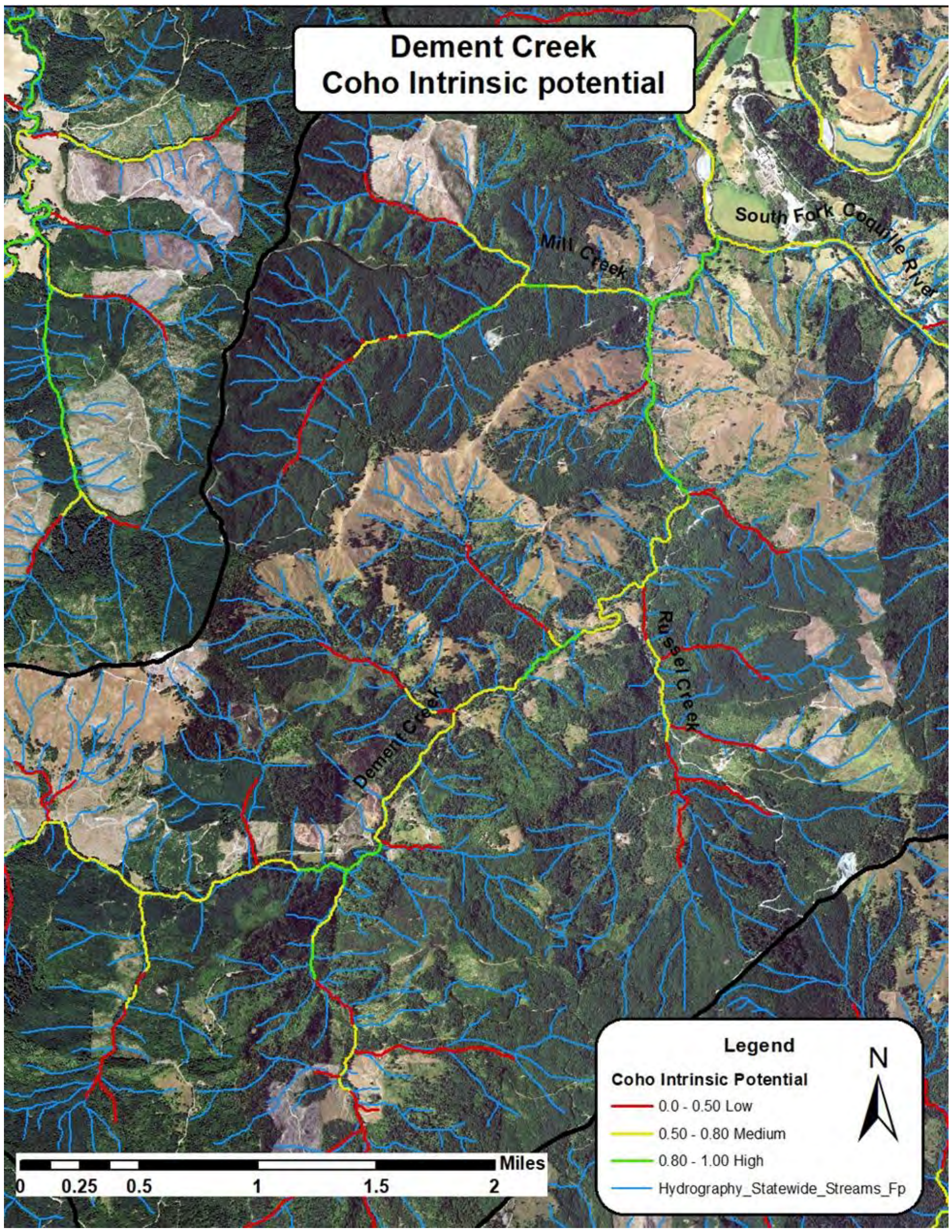

Figure 1: Map showing low, medium, and high intrinsic potential for coho salmon within the Dement Creek basin.

Historically, Dement Creek was splash dammed for logging (Figure 2), subjected to stream cleaning, and logged in the riparian areas resulting in a current lack of sufficient large woody debris (LWD). The sub-watershed has riparian corridors impacted by road construction, timber harvest, and agricultural practices. Primary limiting factors for anadromous fish in the sub-watershed are lack of stream habitat complexity and water quality. Dement Creek is not currently 303d listed by the Oregon Department of Environmental Quality (DEQ) due to lack of available data. However, based on observations made throughout the assessment water quality likely is impaired for biological criteria and the lower 5 miles of Dement creek is impaired for temperatures that exceed federal and state cold water standards during summer months.

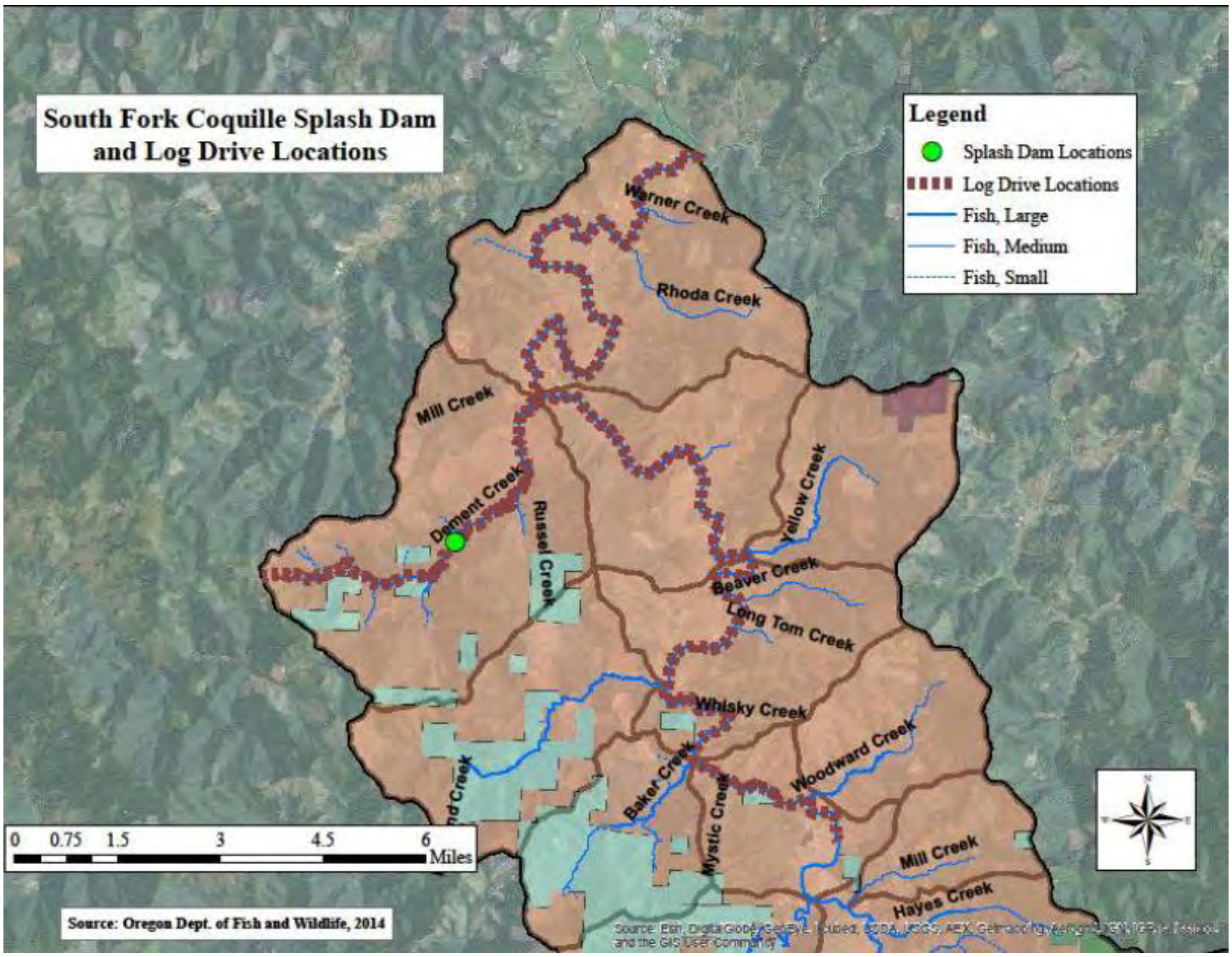

Figure 2: Map of locations of splash dams and log drive channels within the South fork Coquille River (Miller 2010).

Assessment Actions & Resources used in Developing this Report

Dement Creek has about 8 River Miles (RM), including tributaries, of coho salmon habitat. During the summer of 2018, five reaches within Dement Creek were identified and surveyed (Figure 3), which equals roughly 5 RM. However, access was not granted in the upper reaches of Dement Creek, therefore about 3 RM were un-surveyed for in-stream and riparian habitat features. The road system within this basin was also surveyed during 2018-2019 using the Geomorphic Road Analysis and Inventory Package (GRAIP) that allowed us to identify the impacts of this road system on erosion and sediment delivery to streams in the basin. A little over 15 miles of roads were surveyed in the Dement Creek Basin.

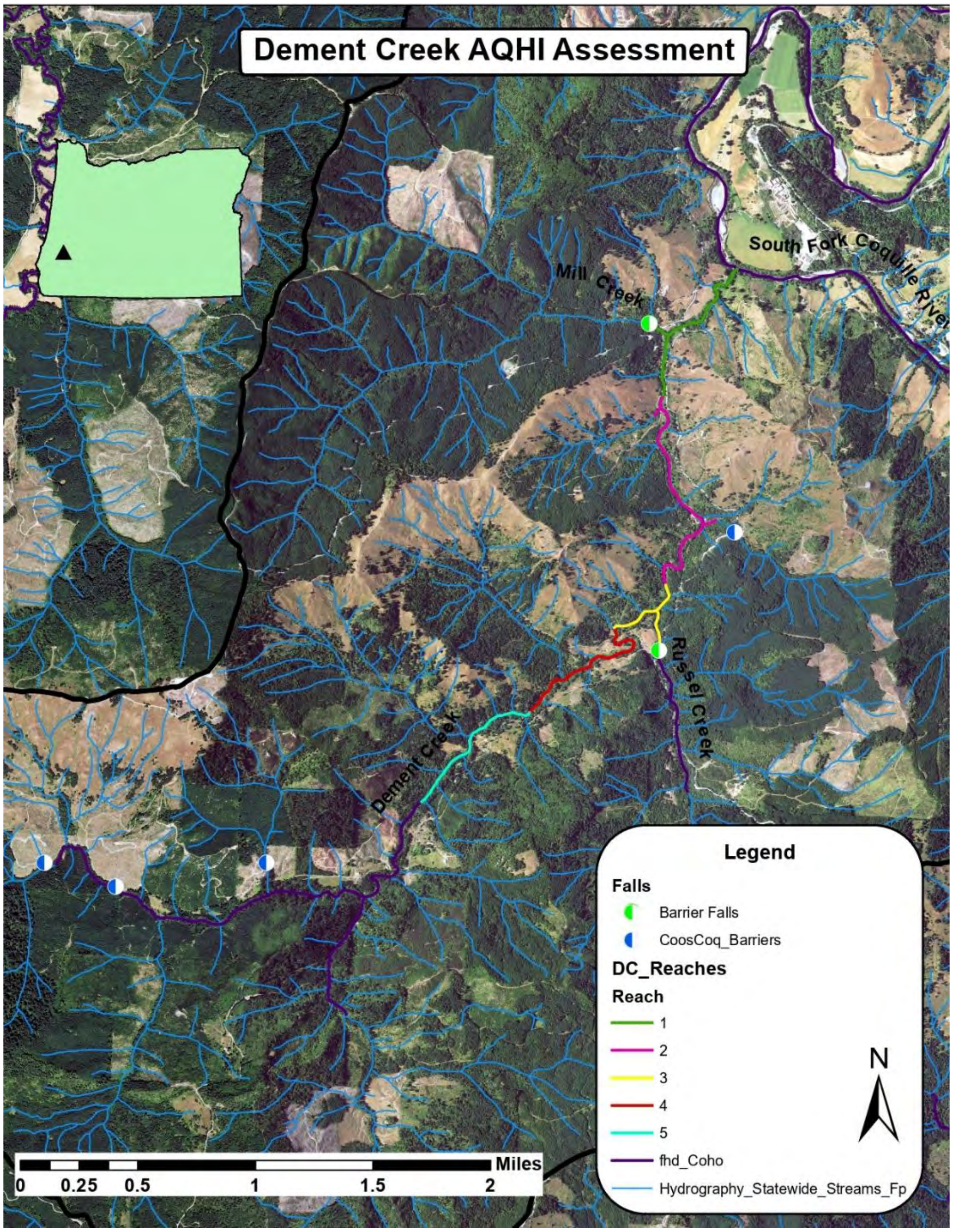

Figure 3: Map of AQHI surveyed reaches within Dement Creek

Technical assistance funds from the Oregon Watershed Enhancement Board (OWEB) and Oregon Department of Environmental Quality (ODEQ) have been used to facilitate the review of watershed habitat conditions in order to develop, prioritize, and design habitat enhancement projects in the sub-watershed. Assessments have included surveying fish passage impediments on county and private road crossings, conducting road network surveys using GRAIP methods, assessing in-stream habitat features using the ODFW Aquatic Inventories Project (AQI) methods, evaluating riparian conditions, and monitoring water quality metrics (sediment and temperature).[1]

General Questions that Guide the Assessment

1. What are the existing habitat limiting factors of Dement Creek?
2. What are the observed summer water temperatures throughout the basin?
3. Where are the fish passage barriers?
4. What is the sedimentation state of the system?
5. What restoration actions need to be completed to enhance the habitat function for all life stages of salmon and other fish and wildlife?
6. What riparian restoration actions should be completed to support the instream work?

Stream Survey Analysis

Dement Creek and its tributaries were originally surveyed in the summer 1992 by the Oregon Department of Fish and Wildlife (ODFW) using the same AQI methods. This previous survey started at the confluence of Dement Creek and the South Fork Coquille River and continued to 9,108m to an unnamed tributary junction. Land uses at the time were predominately light grazing with agriculture and second-growth and clear-cut forest. Stream reaches were constrained by a broad valley floor and a mixture of steep, moderate and open v-shaped hillslopes. The dominate habitat types were primarily scour pools (43%), glides (36%), and riffles (15%). The dominate substrate types included gravel (37%), cobble (35%), and sand (20%). Dement Creek was re-surveyed 26 years later by CoqWA staff where more details on the results of this survey are found below.

Reach Summary

A **reach** is the length of stream defined by some functional characteristic, such as geomorphology, significant changes in riparian vegetation, or land use type. The **active channel width (ACW)** is the distance across the channel at “bank full” flow and is used to evaluate channel and valley characteristics. The **valley width index (VWI)** is the number of active channels that fit between hillslopes across the valley floor and reflects the potential for the stream to meander back and forth or create new channels within the valley. Valley characteristics and channel morphology are especially significant during high flow events, where streams may form secondary channels on broad valley floors. Secondary channels provide important resting

[1] Please go to this website to learn more about the Oregon Department of Fish & Wildlife (ODFW) AQI survey methods: https://odfw.forestry.oregonstate.edu/freshwater/inventory/methods.html and here to learn more about U.S. Forest Service GRAIP survey methods: https://www.fs.fed.us/GRAIP/.

and over-wintering habitat for fish because they help them escape from high velocity winter flows (Foster et al. 2001). According to the average measured ACW for each reach and the calculated VWI, Dement Creek has the capacity to meander and form new channels, especially in reaches 1, 2, 4, and 5, whereas reach 3 becomes narrow and is constrained from lateral movement by hillslopes.

Channel characteristics and dimensions describe the stream with respect to the adjacent landforms. These measurements indicate the degree of channel constraint and the ability of the stream to interact with its floodplain. Interactions with floodplains enhance bank stability, secondary channel formation, riparian vegetation, and the shade it produces. These variables contribute to habitat complexity. The **height of the active channel** is measured from the bottom of the channel to the height at bankfull flow. The average **wetted width** and **depth** indicate the size of the stream. In general, stream channels with significant depth compared to width have a higher potential for productive fish habitat. A high **width to depth ratio** increases the water's exposure to solar radiation, resulting in potentially higher temperatures Undercut banks are often reduced, affecting critical cover preferred by many salmonids. (Foster et al. 2001).

Within the Dement Creek Basin, land use beyond the riparian zone include grazing, rural residential, some livestock exclusion fencing, and large timber or timber harvest. However, past and present activities are degrading the riparian areas of Dement Creek. For example, reach 1 and 2 are dominated by large deciduous trees and shrubs. The shrub component is mostly comprised of Himalayan blackberry (*Rubus armeniacus*), which is not a good bank stabilizer, with few native shrubs in-between. The riparian area continues to be dominated by deciduous trees and some conifers that vary in size. The riparian vegetation in reaches 1 and 2 is limited in providing bank stability, shade over the channel, or recruitment of large woody debris. Higher reaches of Dement Creek do provide a healthier riparian canopy that shades the stream channel, which helps to reduce high summer water temperatures. Table 1 below gives a reach summary for the mainstem of Dement Creek.

Table 1: Dement Creek Mainstem Reach Summary

Dement Creek Mainstem					
Reach	**1**	**2**	**3**	**4**	**5**
Valley Characteristic	Broad valley	Broad valley	Narrow valley: Moderate V-shape	Broad valley with multiple terraces	Broad valley
Channel Morphology	Constrained by terraces	Constrained by multiple terraces or alternating terraces and hills	Constrained by hillslopes	Unconstrained single channel	Constrained by multiple terraces or alternating terraces and hills
Length Surveyed (includes secondary channels)	1,150 m	1,821 m	581 m	1,550 m	1,080 m
Active Channel Width	10.3 m	8.7 m	11.4 m	8.6 m	7.4 m
Average Valley Width Index (VWI)	4.8	4.3	2.3	6.8	4.0
Land Uses	Grazing and rural residential	Grazing and rural residential	Large timber and grazing	Grazing and livestock exclusion fencing	Rural residential and timber harvest
Riparian Vegetation	Dominated by large deciduous trees and shrubs	Dominated by large deciduous trees and shrubs	Dominated by large deciduous trees and conifers	Second growth deciduous trees and conifers	Second growth deciduous trees and grasses/ other herbaceous species
Average percent Shade	73% (range 38-100%)	67% (range 33-100%)	82% (range 64-100%)	80% (range 28-100%)	91% (range 58-100%)
Total LWD (>=3m x 0.15m)	42	20	12	51	49
Total LWD Key Pieces (>=12m x 0.6m)	0	0	2	8	7

Unit Summary by Reach

The Habitat Unit summary describes the mix of habitat types, average dimensions of the habitat units, and the amounts of substrate types and large boulders. Units are categorized as either pools (lateral scour, straight scour, trench, plunge, beaver pools, dammed pools, alcoves, backwaters, and isolated pools), riffles, rapids (rapids over boulder or bedrock), cascades, or steps and waterfalls. Habitat types are described according to the slope of the water's surface, flow characteristics, and substrate. Large boulders are those that have a diameter of 0.5 m or greater, and protrude from the water surface. Substrate types are visually estimated for each unit and large boulders are counted. The number of different habitat units indicates the complexity of the reach. For example, backwater pools, alcoves, and dammed beaver pools provide refuge habitat for fish during high flows. Depth of the units indicates the flow at the time of the survey and the potential for high quality fish habitat. Depth in both pool and fast water habitat is important for juvenile and adult fish. Each unit's substrate composition provides information about stream roughness and hydrologic complexity. Substrate also influences survival of salmonids at different life stages. High percentages of silt and sand in riffle areas may indicate poor quality spawning habitat, while cobbles and boulders in pools are important winter rearing habitat (Foster et al. 2001).

During the summer of 2018, 261 units of the Dement Creek mainstem were surveyed. In total, 6,183 meters were surveyed resulting in an average width of 3.6m and an average depth of 0.39m. On average, for the entire surveyed mainstem, the substrate comprised of 2% silt/ organics, 18% sand, 54% gravel, 17% cobble, 5% boulder, and 4% bedrock. Figure 4 shows the average percent substrate by reach and shows gravel as the dominate substrate for each reach. However, this data can be deceiving as the gravel in each unit appeared to have some level of embeddedness. Dement Creek also showed to have five habitat types, with scour pools and riffles being the main types (Figure 5). Pools and riffles are great fish habitat; however, this data shows Dement Creek as not being highly complex.

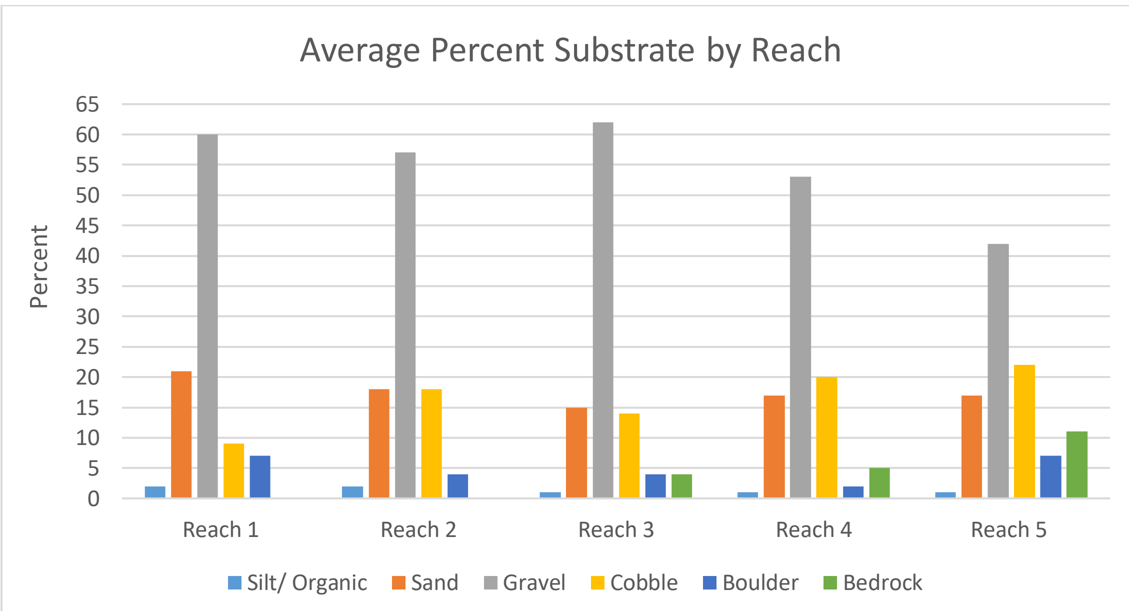

Figure 4: Average percent substrate for Dement Creek

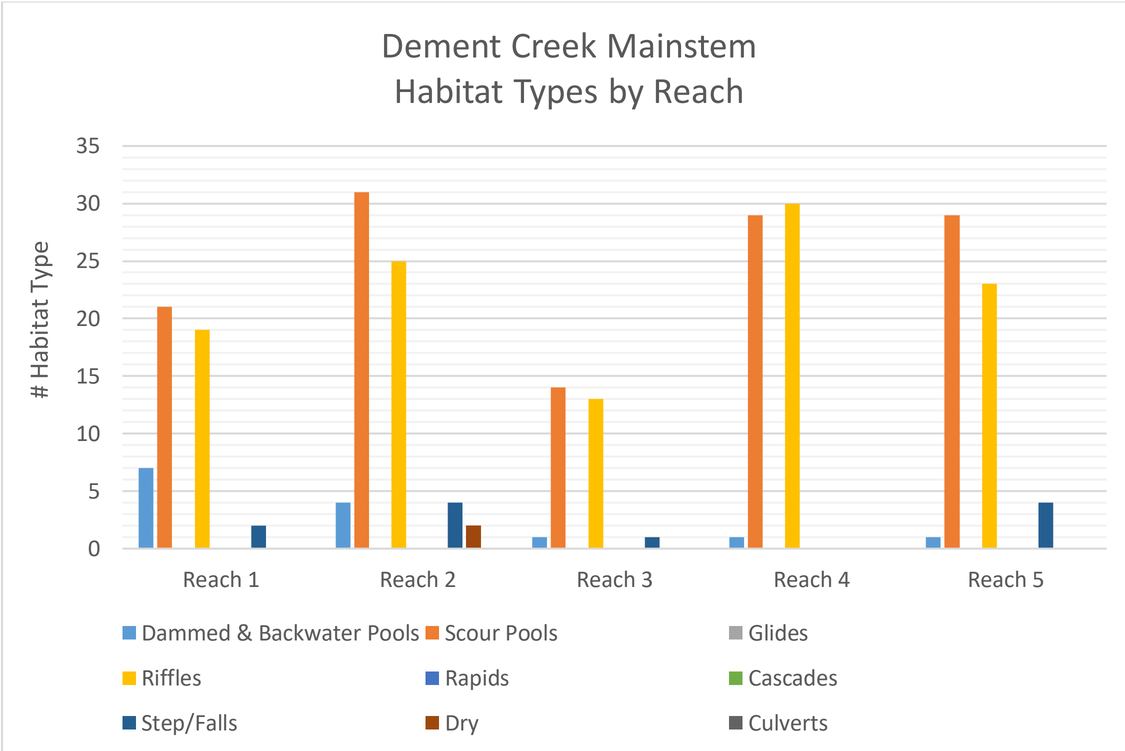

Figure 5: Habitat types by reach for Dement Creek

Pool Summary

Pools, particularly deep pools, are important habitat for juvenile and adult fish. Pools provide slow water habitat, critical over-wintering habitat for some species and sometimes, the only habitat available for fish during the summer low flow period. Pools with depth and/or large wood are particularly desirable for increased space and complexity (Foster et al. 2001). Figure 5 shows that the dominant habitat type of Dement Creek are scour pools, however, Table 1 shows that Dement Creek is lacking in complex pools, such as deep pools, pools with LWD, and other diverse and dynamic habitat types, such as alcoves and backwater pools. Figure 6 is a map showing total pools per mile by surveyed reach in Dement Creek.

Table 2: Pool summary for Dement Creek

Pool Summary: Dement Creek Mainstem					
Total by Reach:	**Reach 1**	**Reach 2**	**Reach 3**	**Reach 4**	**Reach 5**
All Pools	28	35	15	30	30
Pools >=1m deep	12	6	4	8	4
Complex Pools (LWD pieces>=3)	5	3	1	8	4
Pool Frequency (channel widths/pool)	4.0	6.0	3.4	6.0	4.8
Average Residual Pool Depth	0.92	0.62	0.73	0.69	0.51

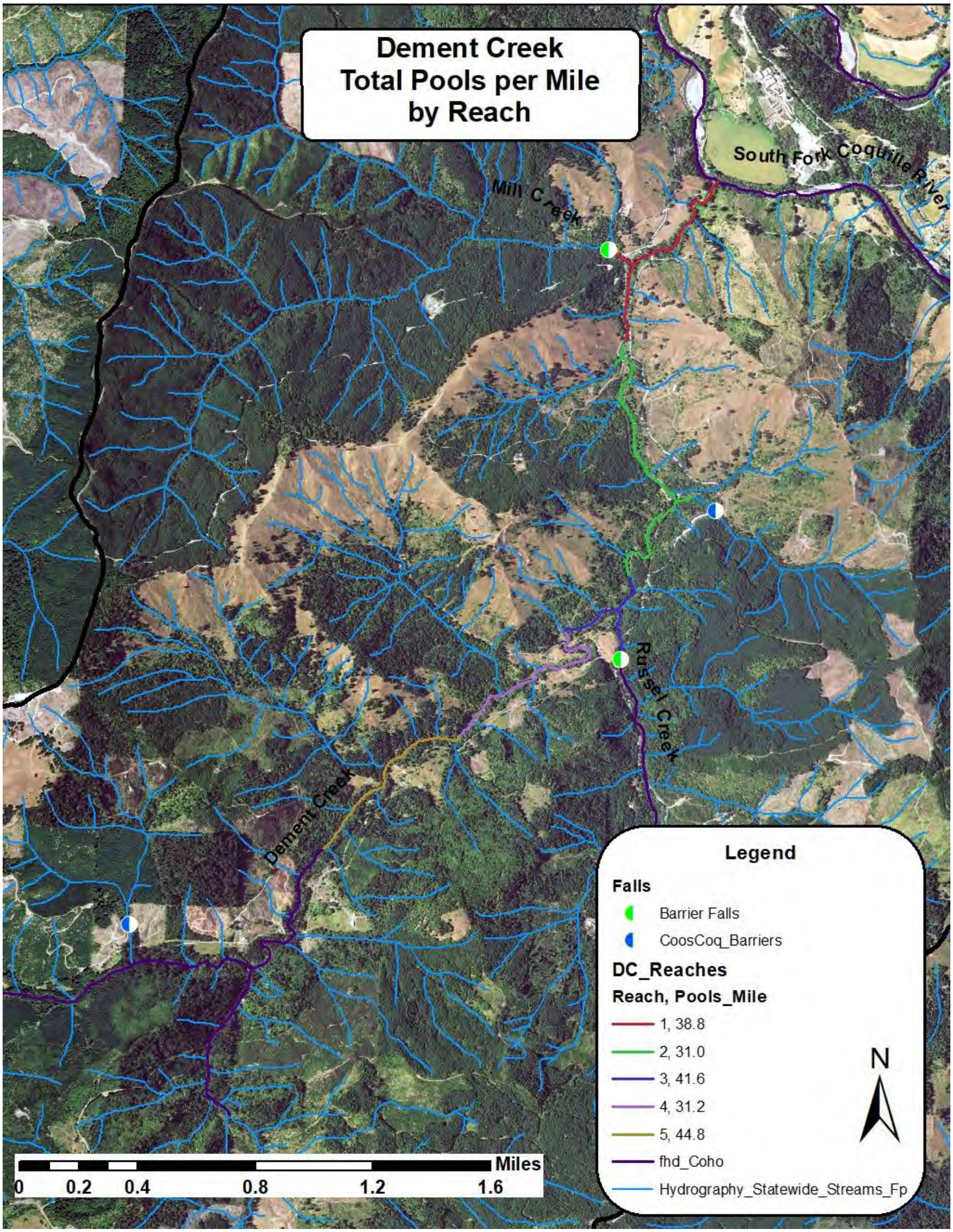

Figure 6: Total pools per mile by surveyed reach in Dement Creek

Riparian Zone Vegetation Summary

Riparian vegetation is a key component of fish habitat. A healthy riparian canopy shades the stream channel, which can help reduce high summer water temperatures. Healthy riparian vegetation stabilizes stream banks by interconnected root systems that protect the banks from high water velocity. With healthy vegetation the stream is also more likely to develop bank **undercut**, which provides important cover for fish. Stable stream banks are unlikely to provide fine sediments, which can embed spawning gravels and fill in pools. Riparian trees also generate the majority of large woody debris (LWD) recruitment into the stream (Foster et al. 2001).

All five reaches within Dement Creek are dominated by large or second growth deciduous trees, then shrubs and other herbaceous species. Conifers are more abundant in the riparian areas of reach 3 and in higher areas of the basin where there is timber harvesting (however were not surveyed beyond reach 5). Figure 7 shows an overview of percent conifers versus hardwoods according to the 30m transects taken every 10 units during the survey. Figure 8 shows the percent shade for all surveyed riparian areas of the five reaches.

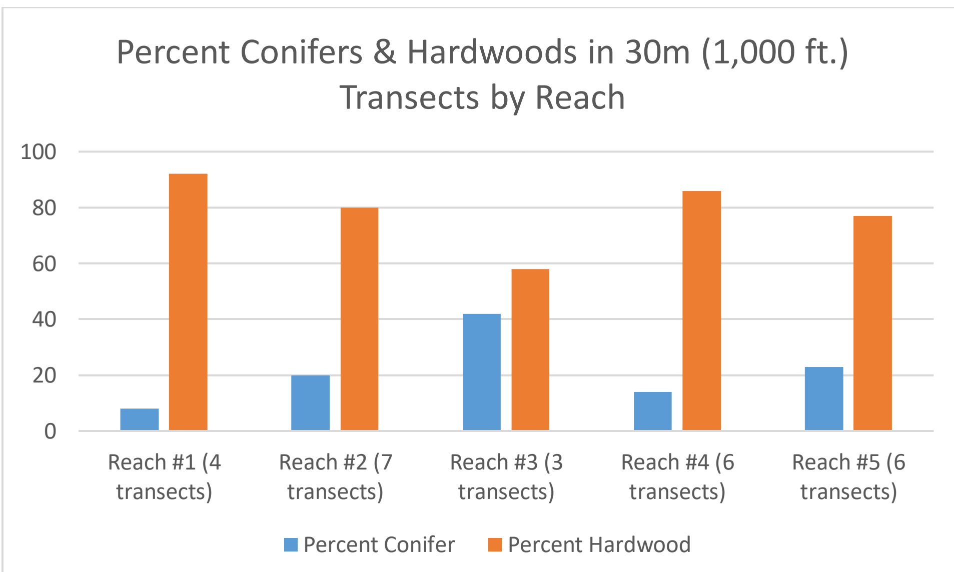

Figure 7: This graph shows the percent of conifers and hardwoods in the riparian areas by reach. Riparian vegetation transects were taken every 10 units or at the start of a new reach, so the number of transects in each reach is dependent on how many units are in that reach.

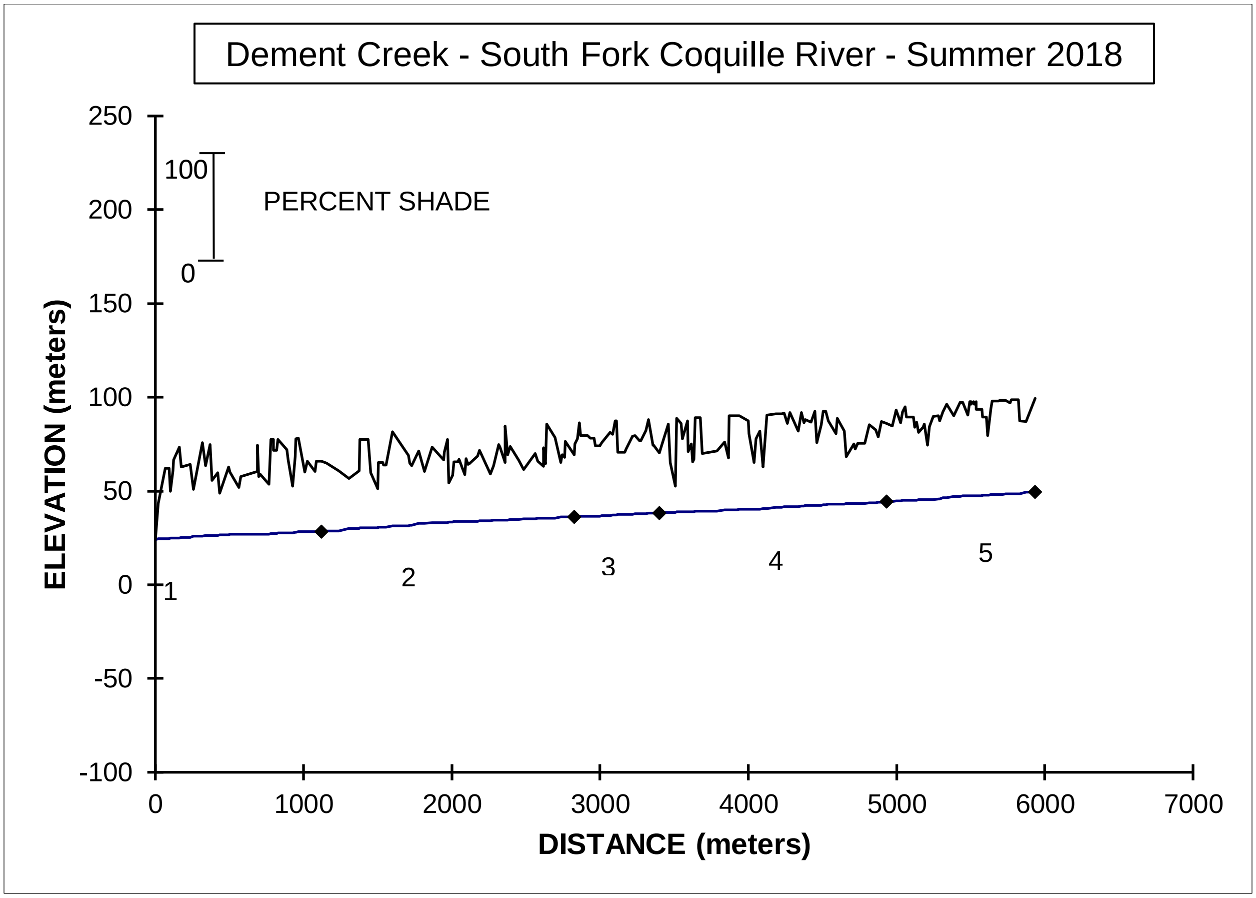

Figure 8: Percent shade for all surveyed reaches within Dement Creek

The Oregon Department of Environmental Quality (ODEQ) has created a Coquille River Watershed Total Daily Maximum Load (TMDL) Mapping Tool[2] where shade can be analyzed by looking at the current thermal loading and the potential change in thermal loading in British thermal units (BTU). BTUs help to quantify the amount of heat energy provided by the sun and the shade model looks at how much of this energy is blocked by shade under current vegetative conditions preventing the heating of the stream water. This model also looks at how much of the sun's energy would be shaded under potential mature vegetative conditions for a site. This tool was made to help those working to enhance riparian areas within the Coquille Watershed and prioritize sites that will improve water quality (ODEQ). Table 3 displays the relationship between percent shade and BTUs.

[2] Go to https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-South-Coast-Basin.aspx to learn more about the Coquille River Watershed TMDL Mapping Tool.

Table 3: This table shows the relationship between percent shade and BTUs. For example, if existing shade is improved from 25% to 50% then pollutant loads are reduced by 610 BTUs (1830 BTU – 1220 BTU = 610 BTU).

Percent Shade	Flat Plane British Thermal Units (BTU)
0	2440
5	2318
10	2196
15	2074
20	1952
25	1830
30	1708
35	1586
40	1464
45	1342
50	1220
55	1098
60	976
65	854
70	732
75	610
80	488
85	366
90	244
95	122
100	0

While using the shade mapper tool, a query was made to analyze thermal loading for Dement Creek using ODEQ identified reaches, where DEM-1 begins at the confluence of Dement Creek and the SFCR (Table 4). In the second column, B is defined as when both stream banks have similar characteristics, or the reach is denoted with an E or W If the characteristics of the stream bank differ on the east bank or west bank. The current percent shade of Dement Creek ranges between 55% - 93% with an average of 75% shade. However, Dement Creek has the potential to increase the percent shade range between 87% - 95% with an average of 92% shade. Dement Creek also has the potential to decrease thermal loading by 360 BTU on average, where the greatest potential to decrease thermal loading will be within DEM-1 – DEM-6 (AQI reaches 1-4 and part of reach 5).

Table 4: This table shows the change in the amount of thermal loading between existing and site potential vegetative conditions (BTU) and percent change in the amount of thermal loading between existing and site potential vegetative conditions for Dement Creek.

Model Reach ID	W_B_E1	Current Thermal Load (BTU)	Potential Thermal Load (BTU)	Potential Change in Thermal Loading (BTU)	Potential Percent Change in Thermal Loading (percent)
DEM-1	B	1074	342	732	214
DEM-2	B	976	293	683	233
DEM-3	B	1147	317	830	262
DEM-4	B	781	317	464	146
DEM-5	B	1098	293	805	275
DEM-6	W	634	268	366	136
DEM-7	B	293	220	73	33
DEM-8	B	488	220	268	122
DEM-9	B	488	195	293	150
DEM-10	B	220	146	74	50
DEM-11	B	195	146	49	33
DEM-12	B	512	122	390	320
DEM-13	E	244	122	122	100
DM1-1	B	390	171	219	129
DM1-2	E	561	171	390	229
DM2-1	B	220	171	49	29
DM3-1	B	317	171	146	86
DM6-1	E	195	146	49	33
DM6-2	B	171	146	25	17
DM7-1	E	220	146	74	50
DM7-2	B	1903	146	1757	1200
DM8-1	W	171	122	49	40

Large Woody Debris Summary

Large woody debris (LWD) was counted with a minimum diameter of 0.15m and a length of 3m, whereas key pieces were counted with a minimum diameter of 0.6m and a length of 12m. LWD is displayed in total pieces and as the number of pieces per 100 meters of stream channel per reach (Figure 9). Figure 10 shows the distribution of large wood pieces throughout the surveyed reaches of Dement Creek and that overall, large wood is a limiting factor. Dement Creek does have a small distribution of key pieces in reaches 3, 4, and 5, however is a limiting factor in reaches 1 and 2 (Figure 11).

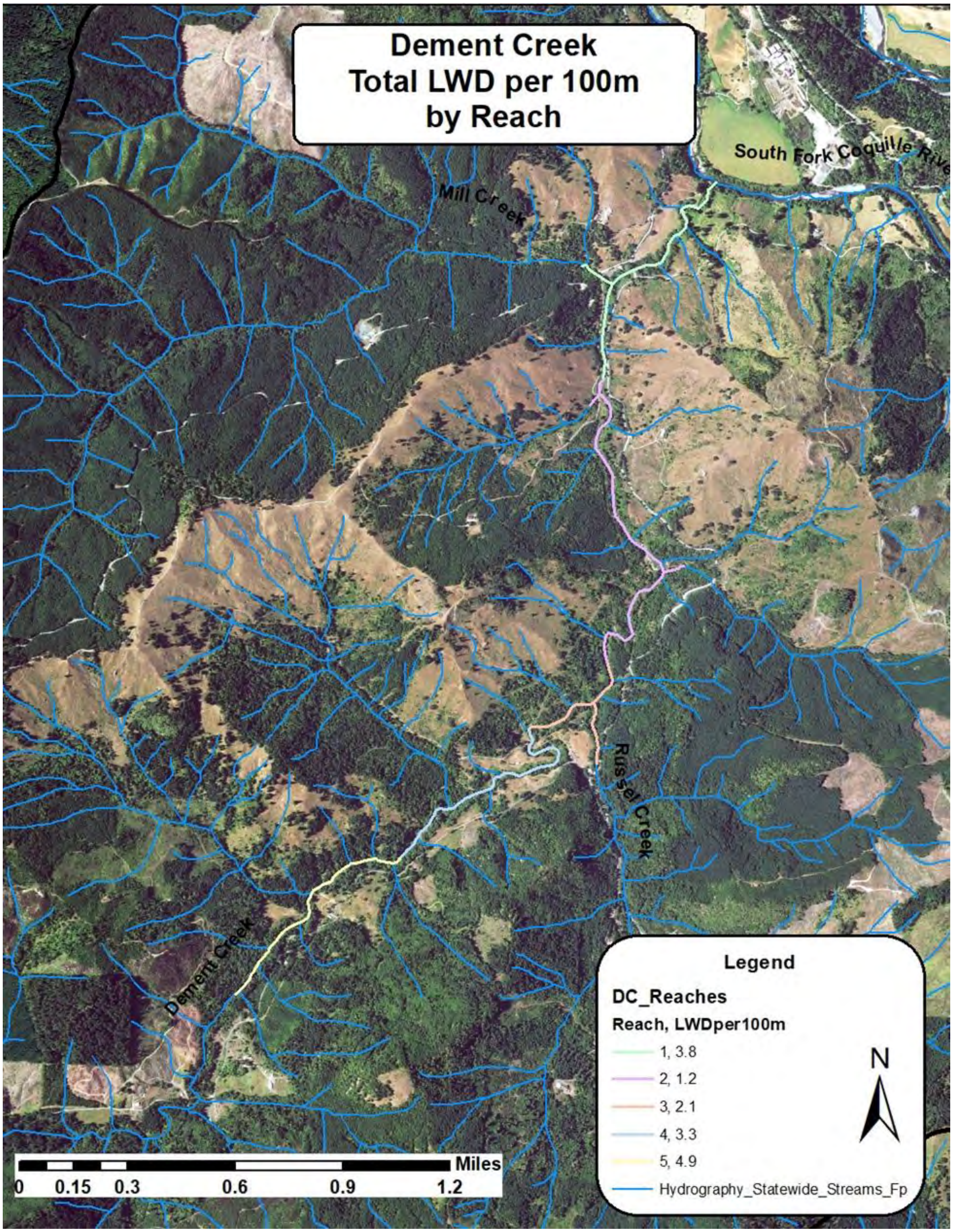

Figure 9: LWD per 100m within the surveyed reaches of Dement Creek

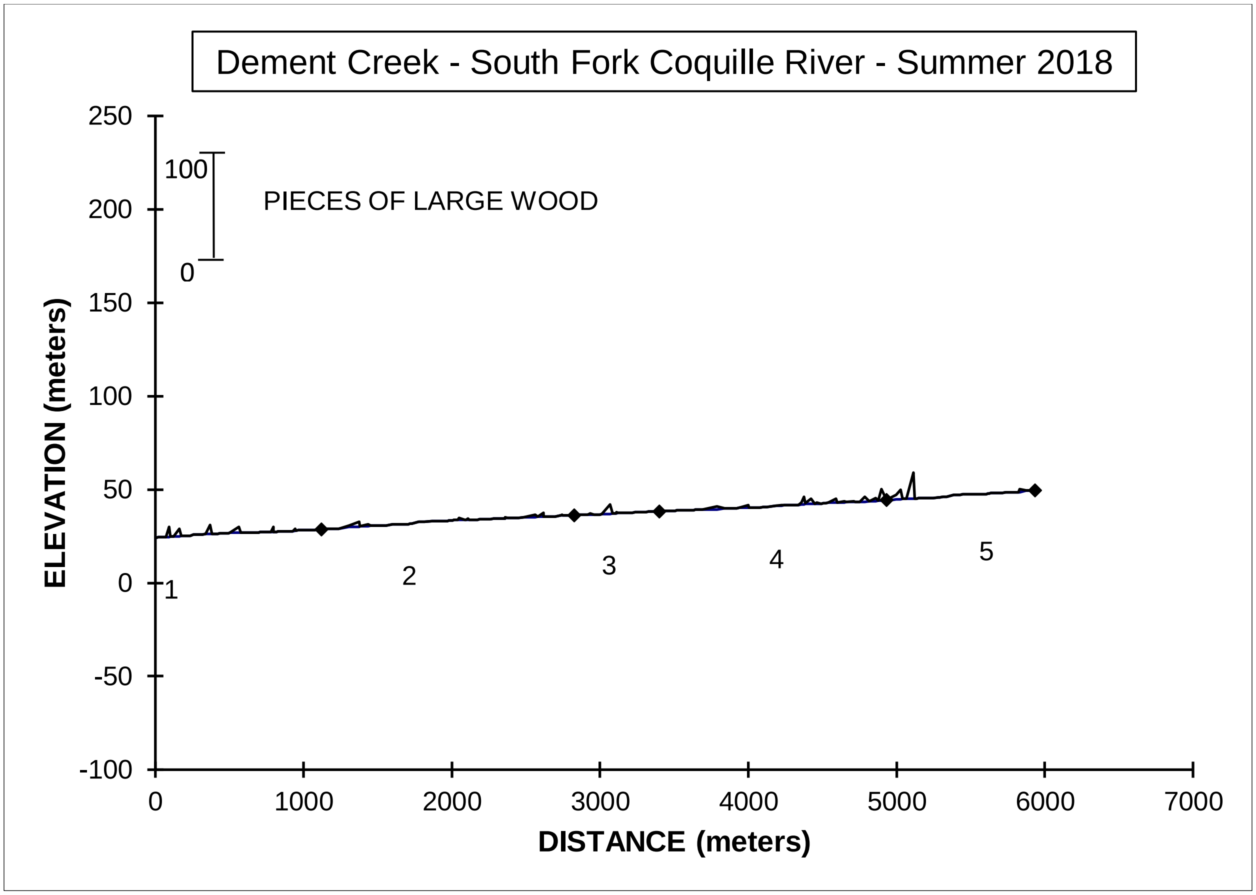

Figure 10: Distribution of large wood pieces throughout the surveyed reaches of Dement Creek

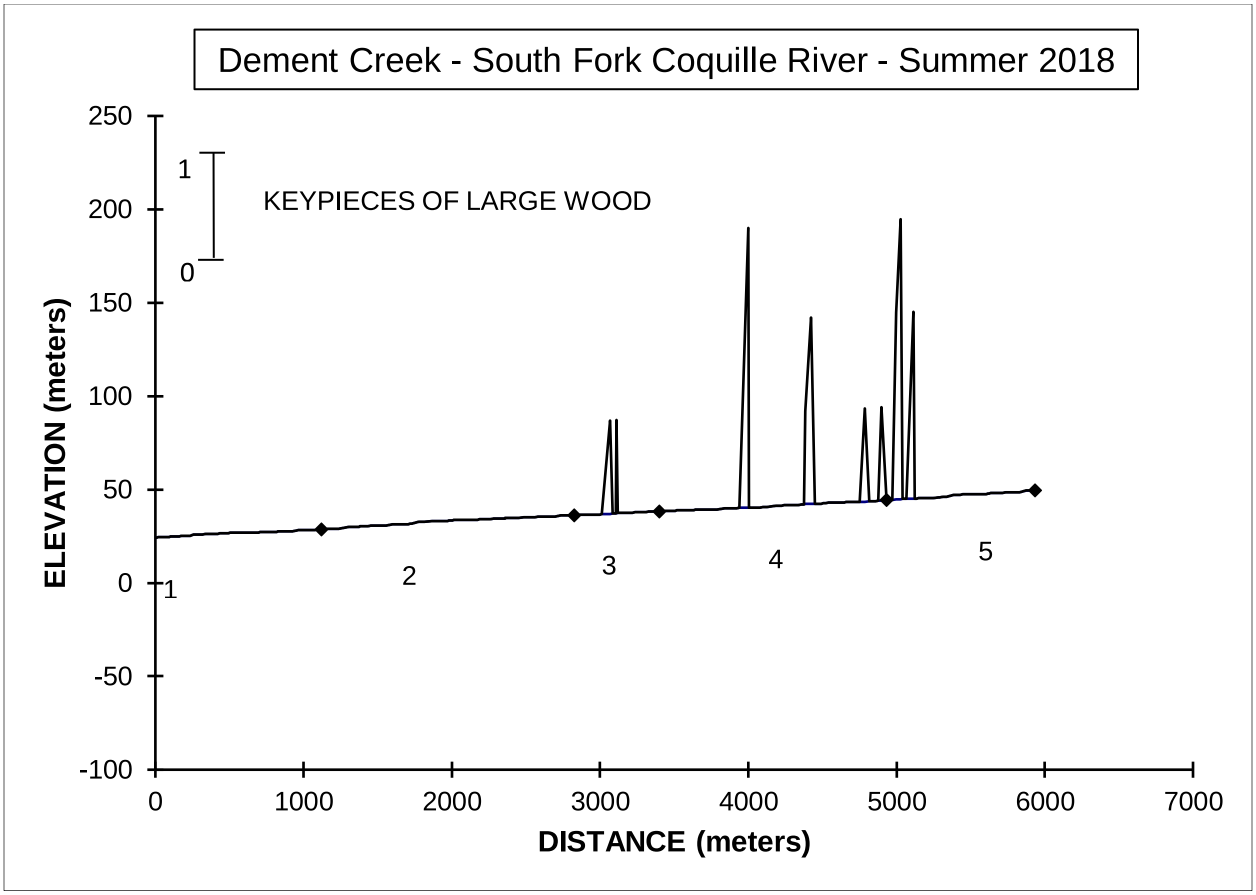

Figure 11: Distribution of LWD key pieces greater than or equal to 12m in length and 0.6m DBH

Temperature Monitoring

Temperature is an important water quality parameter in freshwater salmonid habitats. All salmonids found in Oregon are considered to be cold-water fish species, requiring cold water during all life-stages to survive. As water temperatures rise they have a negative effect on salmonid health and can even lead to death. Oregon Department of Environmental Quality (DEQ) has set water temperature standards to protect these cold water species, they are referred to as cold water protection criteria. Within the Dement Creek Basin these standards are split into two time periods, spawning and rearing. The cold water protection criteria during spawning (Nov-Jun) is a 7-day average of daily maximum temperatures (7-DADMax) no greater than 12.8˚C (55°F) and during rearing (Jul-Oct) a 7-DADMax no greater than 17.8˚C (64°F).

A component of the Dement Creek Basin Assessment is temperature monitoring to determine if the Dement Creek Basin meets the temperature criteria set by DEQ and if not how and where temperature could be improved. We used 8 Onset HOBO Temperature ProV2 Data loggers to continually measure temperature at 8 locations from late spring to early fall during the 2018 and 2019 field seasons (April to October). 7 locations were within the Dement Creek Basin ranging from 0.42- 5.99 miles from the confluence of Dement Creek and the South Fork Coquille River (SFCR) with two locations in main tributaries of Dement Creek (Russell Creek, D-1.9, and an unnamed tributary, D-4.2). Temperature was also monitored at the SFCR (river mile 51) but the logger was lost in the summer of 2018 so only the 2019 field season is presented below. The specific dates of temperature logger deployments at all 8 locations for both years can be found in Table 5. All loggers and corresponding data meet DEQ's requirements for A level accuracy and precision.

Table 5. Dement Creek temperature monitoring deployment dates for all 8 locations.

	Dement Creek						Tributararies		S. Fk Coquille River
	D - 0.5	D - 1.2	D - 3.5	D - 5.1	D - 5.9	D - 6.0	Dt - 1.9	Dt - 4.2	SFk - 51
2018	5/29-10/9	5/29-10/9	5/31-10/9	6/6-10/16	6/6-10/16	6/6-10/16	6/6-10/9	6/6-10/16	-
2019	5/21-10/23	5/31-10/23	6/17-10/23	6/17-10/23	6/17-10/23	6/17-10/23	5/21-10/23	5/21-10/23	5/21-10/23

The temperature monitoring locations are spread throughout the Dement Creek Basin, Figure 12. There are 2 monitoring locations in lower Dement Creek (D – 0.5 and D -1.2), 1 in mid-Dement Creek (D – 3.5) and 3 in the upper reaches of Dement Creek (D – 5.1, D – 5.9 and D – 6.0). One of the sites in upper Dement Creek (D-5.9) is located at the confluence of a small tributary, therefore parts of the monitoring period when the tributary is flowing it could be more representative of the tributary than Dement Creek. Although this lead to confounding temperature dynamics the data is still presented in this report. Additionally, two tributaries were monitored (Dt – 1.9 and Dt – 4.2). The two tributaries had the lowest average daily maximum temperature for the month of August. The average daily maximum temperature for the month of August within Dement Creek was coldest in the upper reaches and warmed downstream reaching a maximum at the D – 0.5 location. A warming trend downstream is typical of river and creek systems in the Coquille watershed.

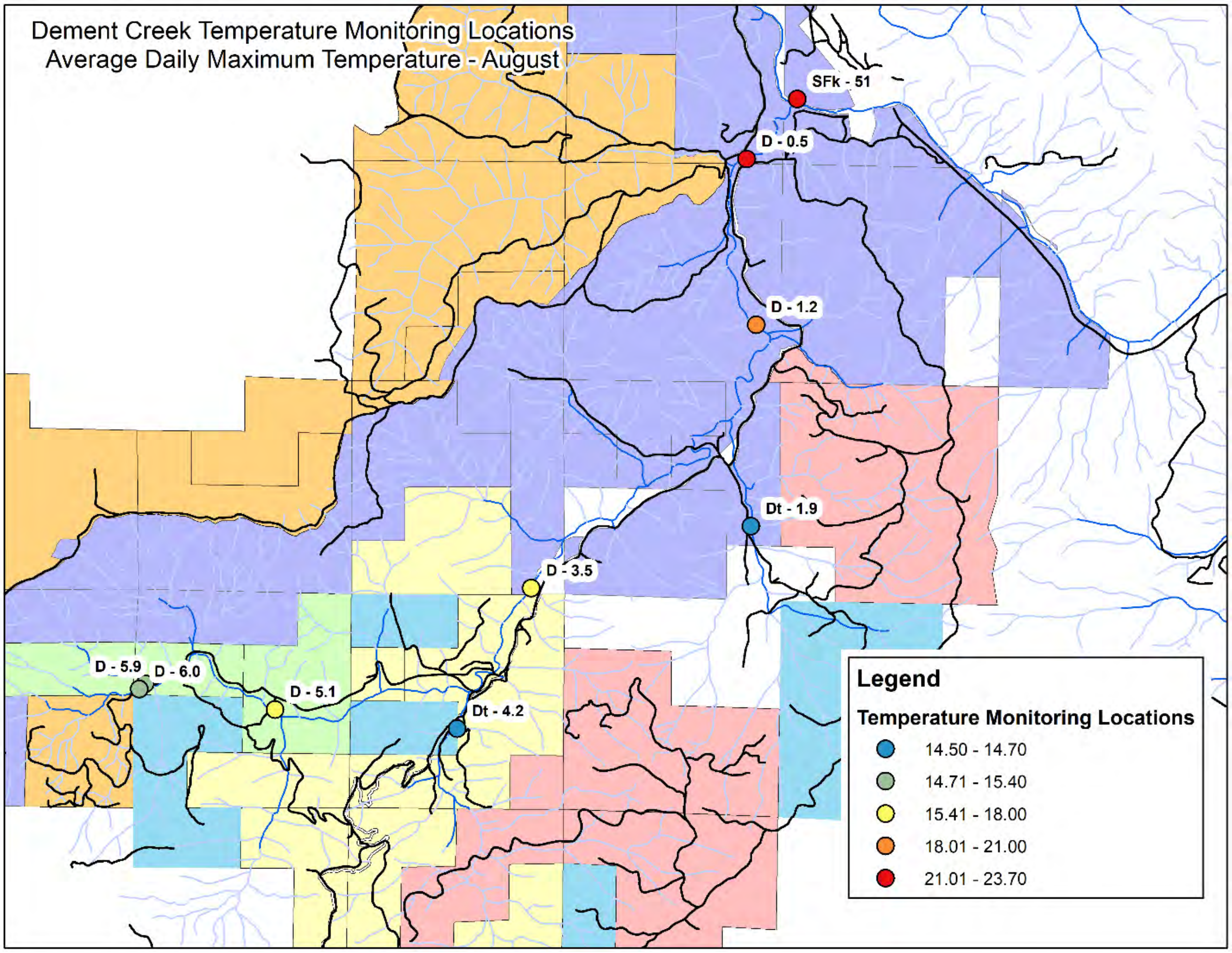

Figure 12. Dement Creek temperature monitoring locations and corresponding average daily maximum temperature for the month of August.

The salmonid spawning period of the monitoring season, May and June, has a DEQ cold water protection criteria set at the 7-DADMax of no greater than 12.8 ˚C. All of the monitoring locations exceeded this requirement with the D – 6.0 logger exceeding a minimum of 3 days and the D – 0.5 logger exceeding a maximum of 68 days. Although these sites exceeded the criteria of cold water spawning habitat, monitoring only occurred at the end of the spawning period and does not reflect the more critical cold water period in the winter and early spring.

During the monitoring season base flows are usually highest in May and June and air temperatures are more moderate, which reflects in the mean temperature being cooler than later in the summer, Table 5 and Table 6. Although the maximum temperature for the spawning period the lower Dement Creek locations (D – 0.5 and D – 1.2) are still extremely high, 24.5 ˚C and 25.1 ˚C, respectively. The lower Dement Creek is used for livestock grazing and the riparian vegetation cover is poor. Additionally, the county road follows the creek closely in the lower reaches and limits the size of the possible riparian corridor. Furthermore, Dement Creek has a north-south orientation from the logger D – 1.2 location to the confluence of the SFCR. For these reasons there are high rates of solar radiation reaching the creek and warming it and its small tributaries in the lower portions of the basin.

There is also significant warming in the lower 3 miles of Dement Creek during the rearing period of the cold water protection criteria, signified by an increase of more than 3 ˚C in mean temperature from D – 3.5 to both D – 0.5 and D – 1.2, Table 7. In addition, the only monitoring locations that did not meet DEQ requirements for the rearing cold water protection criteria were D – 0.5 and D – 1.2, which each exceeded the requirement on 140 days and 147 days, respectively, from July to October. Again, this is likely a result of a poor riparian corridor which allows significant heating from solar radiation.

Table 6. Dement Creek temperature monitoring statistics for the spawning period (May – June) of the DEQ's cold water protection criteria, 2018 and 2019 combined.

May-Jun	Dement Creek						Tributararies		S. Fk Coquille River
	D - 0.5	D - 1.2	D - 3.5	D - 5.1	D - 5.9	D - 6.0	Dt - 1.9	Dt - 4.2	SFk - 51
River Mile	0.5	1.2	3.5	5.1	5.9	6.0	1.9	4.2	51
Day Count	74	65	44	38	38	38	67	66	41
Mean	17.0	17.1	14.0	13.1	12.1	12.0	12.4	12.2	18.3
Median	17.1	17.1	13.8	12.9	12.1	12.0	12.3	12.0	19.0
Min	10.5	11.0	9.1	9.7	9.8	9.6	9.1	9.1	11.9
Max	24.5	25.1	18.9	17.1	14.5	14.1	16.0	16.9	23.5
7-DADMax>12.8 °C	68	62	37	23	9	3	25	17	38
Mean Daily ΔT	4.9	4.4	3.8	3.1	1.4	1.3	1.9	1.6	1.8

Table 7. Dement Creek temperature monitoring statistics for the rearing period (July - October) of the DEQ's cold water protection criteria, 2018 and 2019 combined.

Jul-Oct	Dement Creek						Tributararies		S. Fk Coquille River
	D - 0.5	D - 1.2	D - 3.5	D - 5.1	D - 5.9	D - 6.0	Dt - 1.9	Dt - 4.2	SFk - 51
River Mile	0.5	1.2	3.5	5.1	5.9	6.0	1.9	4.2	51
Day Count	216	216	216	223	223	223	215	223	62
Mean	18.1	18.2	15.0	13.9	13.3	13.3	13.0	13.0	22.3
Median	18.5	19.1	15.4	14.4	13.6	13.6	13.3	13.3	22.5
Min	8.2	8.1	6.3	6.1	8.3	8.0	10.2	6.6	18.9
Max	26.2	23.1	21.0	18.7	17.2	16.8	15.2	17.7	25.2
7-DADMax>17.8 °C	140	147	0	0	0	0	0	0	58
Mean Daily ΔT	4.3	1.9	2.8	2.2	1.3	1.1	0.7	0.9	1.7

The 2018 and 2019 7-day moving average and 7DADMax for all temperature monitoring locations are presented in Figure 13 – Figure 16. During both the 2018 and 2019 monitoring seasons the maximum 7-day moving average temperatures of D – 0.5 and D – 1.2 reached nearly the same peak, ~21 ˚C, while the 7DADMax was higher in 2018 than 2019. Additionally, for both 2018 and 2019, D – 0.5 and D – 1.2 had significantly different 7-day average and 7DADMax trends. This is likely due to the difference in mean daily change in temperature (Mean Daily ΔT, Table 6 and Table 7) as cooler night time temperatures of D – 0.5 help drop its 7-day moving average temperature whereas 7-DADMax just reflects the maximum temperatures which are similar for D – 0.5 and D – 1.2. In both the 2019 7-day moving average temperatures and 7-DADMax location D-5.9 is cooler than the logger just upstream of it, logger D-6.0. Therefore, it is likely that at location D-5.9, where the logger is placed in upper Dement Creek at the confluence of a small tributary, it is recording temperatures that are influenced by the tributary at the beginning of the monitoring season.

Weather differences are noticeable in the temperature trends of 2018 and 2019. In 2018 there was a more gradual warming of water temperatures unlike in 2019 that experienced a hot spell in mid-June. Additionally, it was a wet and cold late summer in 2019 and water temperatures dropped quickly and had less variation between sites. Even with these dramatic differences in weather there is still an overall warming trend in the lower reaches of Dement Creek during summer months.

Overall, much of Dement Creek and its tributaries meet the cold water protection temperature criteria. Unfortunately, there are natural falls that act as partial to full barriers at the beginning of Russell Creek and the upper reach of Dement Creek limiting access to the coldest waters of the basin. Although habitat is limited in these reaches they still create cold water refugia during the warmest parts of the summer below the barriers and it is important continue to protect these cold reaches. As for the lower reach of Dement Creek it is evident from the temperature statistics (Table 6 and Table 7) and the plots (Figure 13 -Figure 16) that it warms significantly from the mid and upper reaches. As noted, this is likely due to stream orientation and a lack in riparian vegetation both from agricultural use and the county road prism.

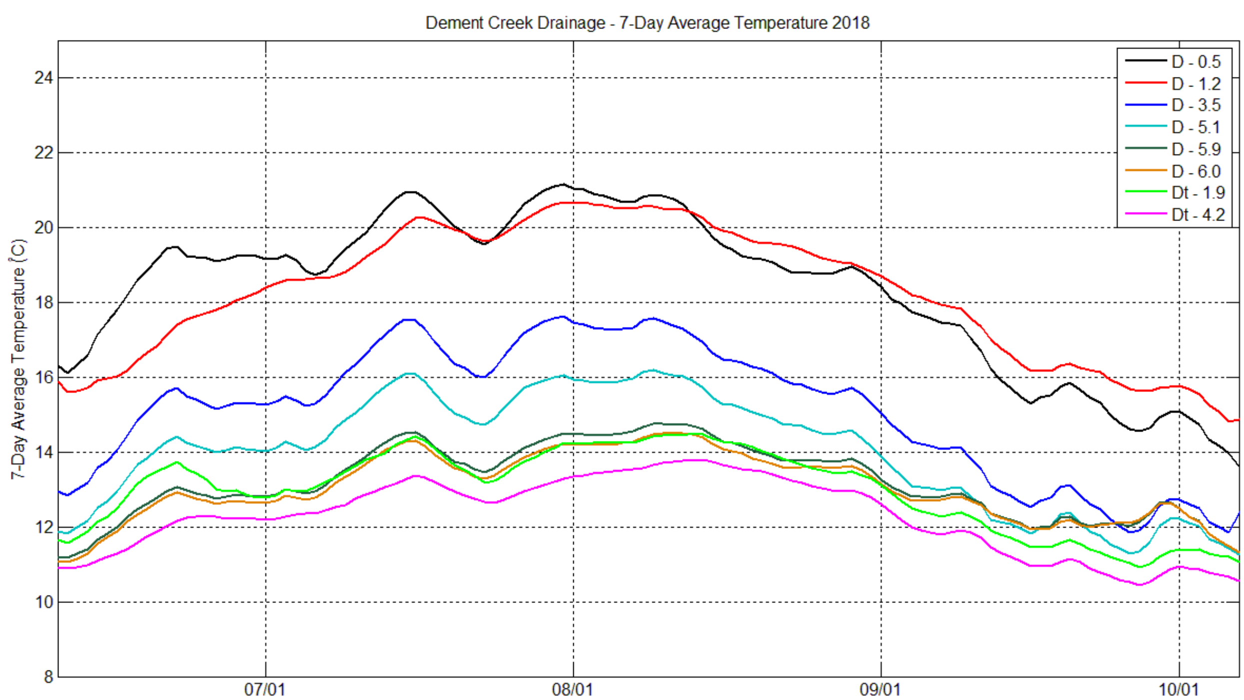

Figure 13. 7-day moving average temperature of Dement Creek temperature monitoring for the 2018 season.

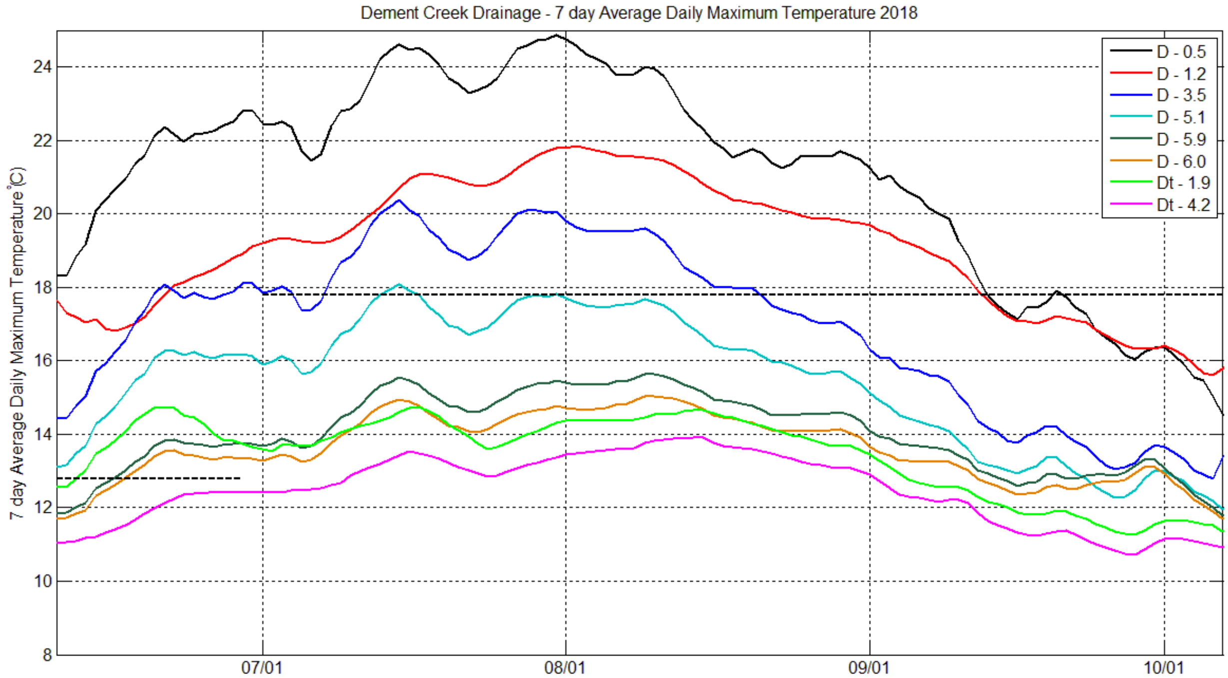

Figure 14. 7-day average daily maximum temperature of the Dement Creek temperature monitoring study for the 2018 season. The cold water protection criteria are displayed as a dashed black line.

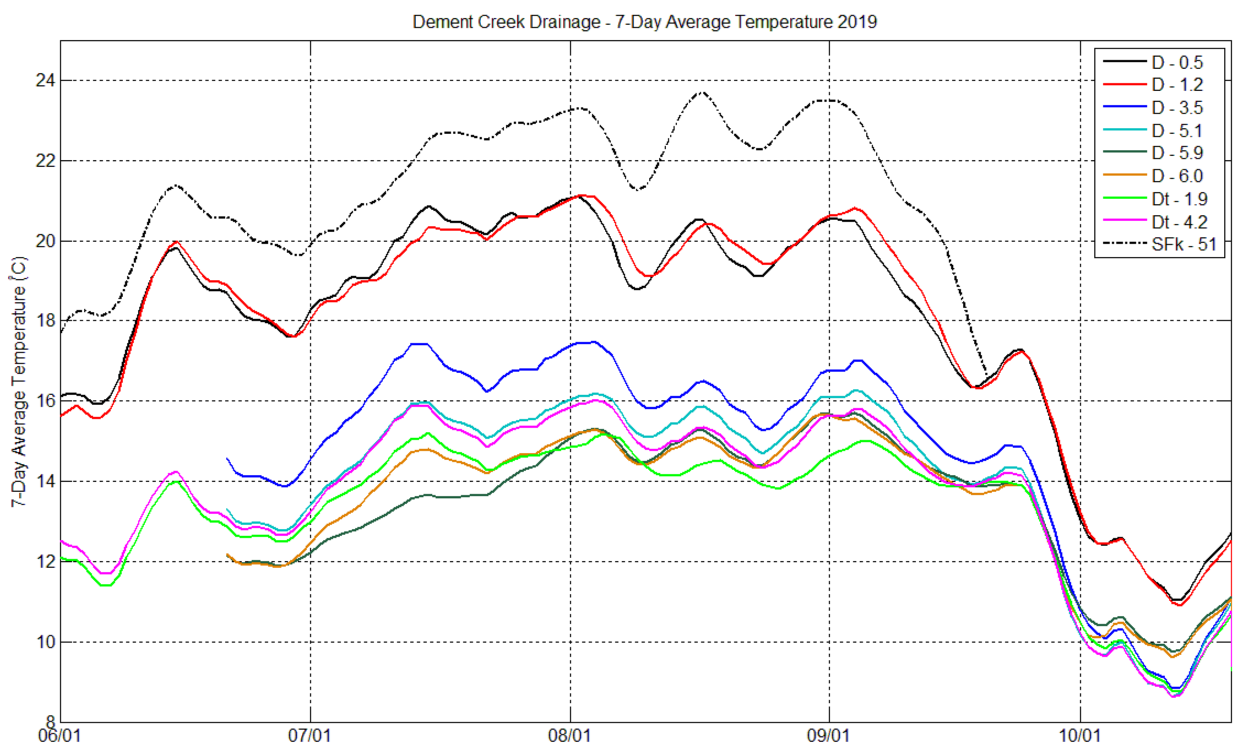

Figure 15. 7-day moving average temperature of Dement Creek temperature monitoring for the 2019 season.

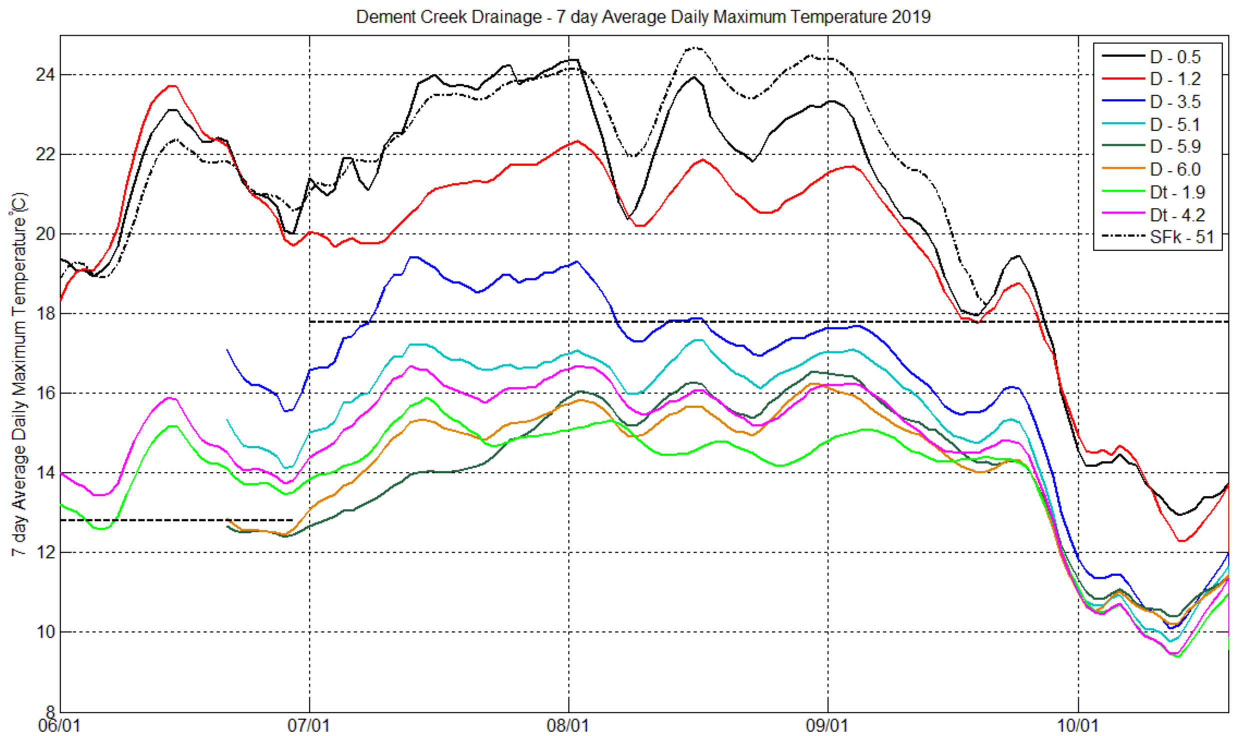

Figure 16. 7-day average daily maximum temperature of the Dement Creek temperature monitoring study for the 2019 season. The cold water protection criteria are displayed as a dashed black line.

Road Sediment Delivery Surveys and Analysis – GRAIP

Although sediment entering streams and rivers is a necessary and natural process there has been an increase in the amount of fine sediments entering these aquatic ecosystems due to anthropogenic activities, primarily from roads networks. Fine sediments can smother fish eggs that have been laid in spawning gravels, high levels cause damage to respiratory systems in fish and negatively affect macroinvertebrate species. Naturally added sediment typically comes from mass-wasting events (e.g. landslides, debris torrents, etc.) that occur infrequently and effect only a portion of a watershed, fish and other aquatic species are adapted to these events by migrating to other areas in the watershed or a different watershed altogether. The sediment delivered to stream systems from road networks tend to be a finer sediment and at a lower level than mass-wasting events but because it occurs throughout the entire watershed there is a constant low-level pressure on the aquatic ecosystem. Overtime, this low-level pressure can affect population numbers of sensitive species (e.g., salmonids, trout, etc.) watershed wide. Therefore, it is important to monitor, manage and improve road networks to ensure they are not delivering large quantities of sediment to streams and rivers.

One protocol to assess road networks is the USFS Geomorphic Road Analysis and Inventory Package[3] (GRAIP). GRAIP uses an on-the-ground survey and assessment to define

[3] https://www.fs.fed.us/GRAIP/

and characterize the road segments and drain points[4] (e.g. water bars, ditch relief culverts, etc.) of the road network. The surveys are then used in a sedimentation model to identify which roads and drain points produce and deliver the largest quantities of sediment to the stream. The most significant inputs to the sedimentation model are slope of road, base erosion rate, road surface cover and whether there is vegetation growing in the flow path of the draining water. All of the inputs are determined by the survey except base erosion rate which was estimated to be the same as the Siuslaw National Forest base rate.

GRAIP surveys were completed on over 15 miles of roads in the Dement Creek Basin, these roads are managed by the county, BLM and private landowners. Within these roads there were 31 stream crossings, 117 ditch relief culverts, 20 lead off ditches, 147 other miscellaneous drain points, 18 gullies and 6 active and inactive landslides.

Top Sediment Producing Drain Points

The GRAIP model identified 111 number of drain points that produced and delivered sediment to Dement Creek and 6 number of gullies that produced and delivered sediment to Dement Creek. The top 7 delivering drain points and the top 2 delivering gullies are identified as candidates for road improvements, Table 8 and Figure 17. Gully 0 produces over 17,000 kg/yr of sediment and is more than the next 8 sediment producers combined. This gully is located on BLM's Eckley Mtn. Rd and is a result of excessive water draining to a single ditch relief culvert (DRC). The next highest sediment producers, DRC 224 and Gully 4, produce close to 4,000 kg/yr and 3,000 kg/yr, respectively. DRC 224 is a rusted culvert high in the watershed that drains a steep section of eroded ditch and the outlet drains into a gully further producing sediment. Gully 4 is on the outlet of a DRC draining onto a steep hillslope.

DRC 110, lead off ditch 228 and stream crossing 278 are draining long stretches of road that contain few cross drains and are stream connected. Although the road is in decent shape, it is steep and has few cross drains and a stream crossing is at the base of the road. DRC 155 drains a wet swale and a long wet section of road, the combined volume of these two flow sources and a steep hillslope on the culvert outlet have produced a gully that is stream connected. The stream crossing at 290 drains a steep and wet section of county road at the county bridge; cross drains on either side of the bridge are suggested. High in the road system, lead off ditch 244 drains a steep section of road directly into the stream.

[4] A list of GRAIP terminology can be found in Appendix A

Table 8. Top 9 drain points and gullies that deliver sediment to Dement Creek

Drainpoint ID	Drainpoint Type	Sediment Produced (kg/yr)
0	Gully	17,003
224	Ditch Relief Culvert	3,928
4	Gully	3,061
278	Stream Crossing	1,643
228	Lead Off Ditch	1,599
244	Lead Off Ditch	1,424
155	Ditch Relief Culvert	1,412
110	Ditch Relief Culvert	1,280
290	Stream Crossing	1,233

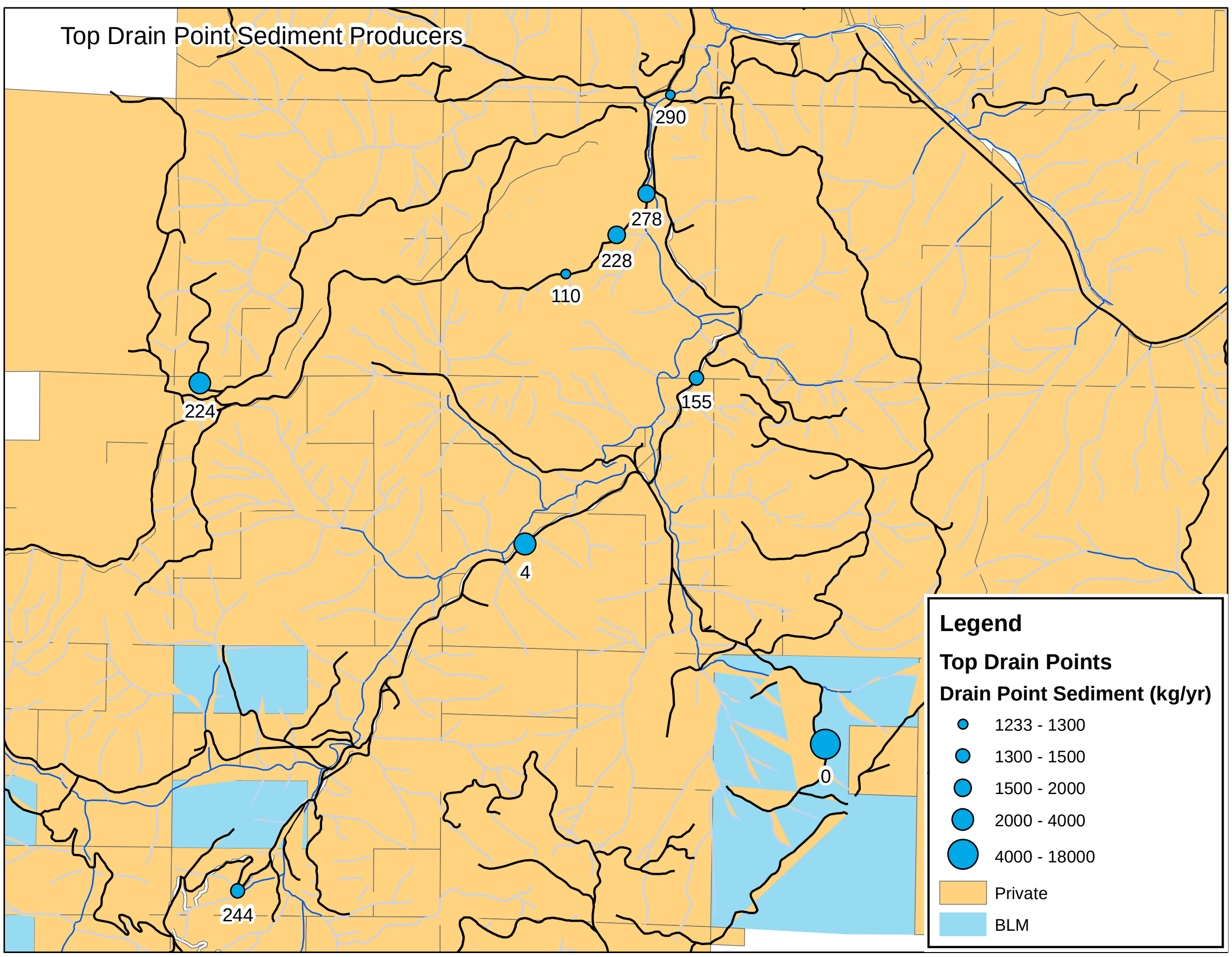

Figure 17. Top sediment delivering drain points and gullies of the Dement Creek GRAIP survey.

Top Sediment Producing Road Segments

The GRAIP survey and analysis identified 164 segments of road whose drain flow paths connect to the stream and deliver sediment. Of these the top 7 have been identified as candidates for road improvements, Table 9 and Figure 18, and all drain to the top sediment producing drain points and gullies listed above. The top sediment producing road, Road 271, is the section of road that drains to DRC 224, listed above. Road 2 and 10 are sections of the steep road that has few cross drains and drains to DRC 110, lead off ditch 228 and stream crossing 278, listed above. Road 130 is a segment of road whose ditch runs across a wet hillside and drains into DRC 155. Road 211 is another steep section of road where the water leaves the road via lead off ditch 244 straight into the stream. Road 106 drains a wet and steep portion of road at the county bridge, drain point 290.

Table 9. Top sediment delivering road sections

Road ID	Road Length (m)	Sediment Produced (kg/yr)
271	102	1,622
2	292	1,516
130	184	1,165
211	167	1,130
106	284	817
10	200	675
217	39	674

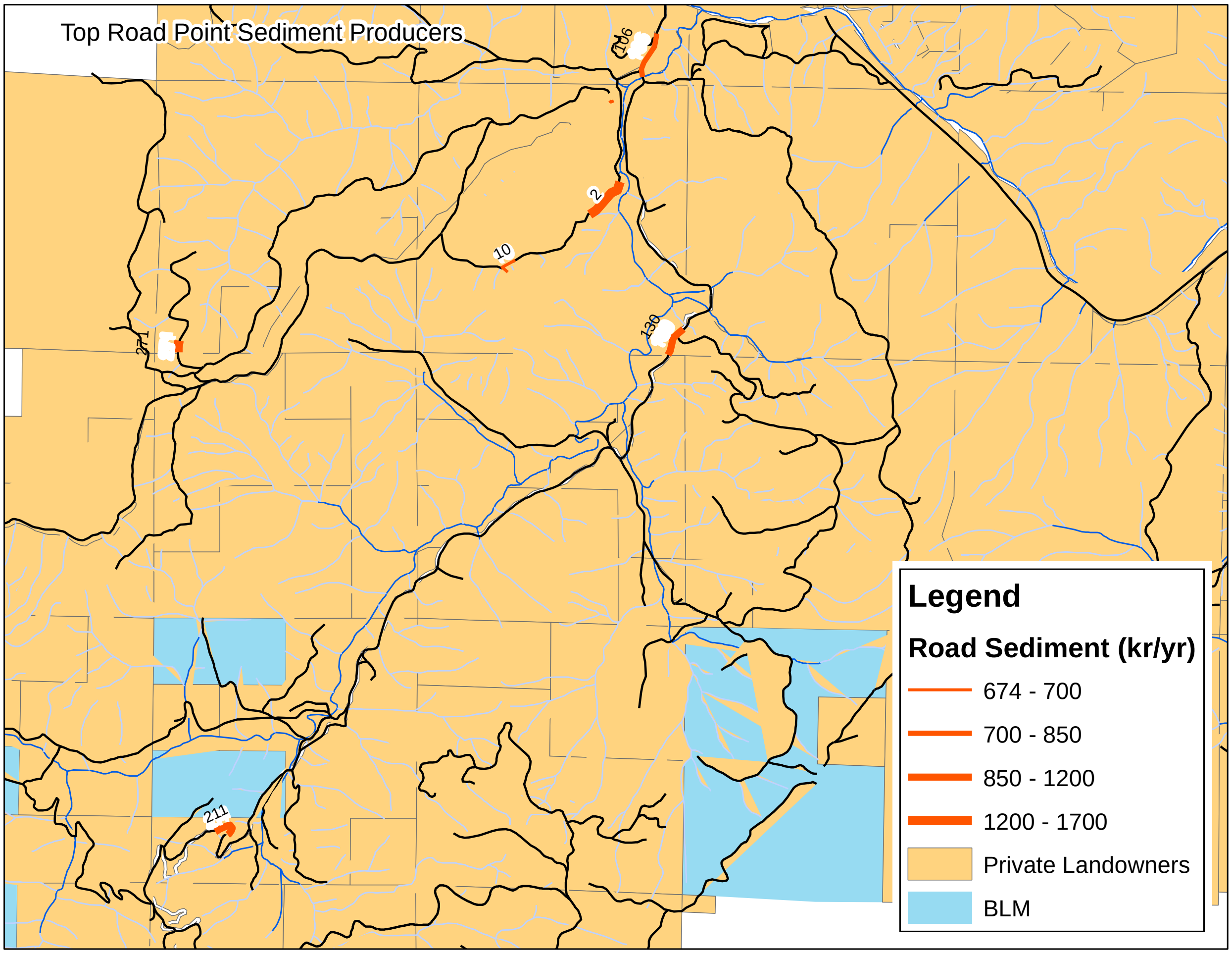

Figure 18. Top sediment producing roads identified by the GRAIP survey and model in the Dement Creek Basin.

Gully Formation and Drain Points in Poor Condition

An indication of a drain point or road segment that is draining too much water is the formation of a gully. When the hillslope or road beds are steeper gullies will form more easily from smaller quantities of water than when the grade is gentler. A map of gully locations on the outlet of drain points and flow paths (e.g., ditches) that have been gullied or eroded identifies stretches of road that would benefit from more cross drains, Figure 19. Even though some of these gullies don't connect to streams they are still moving road material from the road prism onto the hillslope requiring costly maintenance more frequently. Some of these road segments have been identified in the above analysis as benefiting from more cross drains, such as Roads 10, 2 and 271. There are 4 roads that could use multiple additional cross drains: 1) Unnamed Timber Rd, 2) Eckley Mtn. Rd, 3) ECK400, and 4) a private rd.

In addition, many of the drain points that were surveyed were in poor condition, Figure 20. There is a range of how poor the drain point is from being 20-80% blocked all the way to being totally blocked and diverting the course of a stream. There is only one blocked stream crossing (ID 295), located on ECK400 Rd, that has diverted the stream course into the ditch and then onto the road. All of the identified blockages and diverted stream crossings on the Lone

Rock Timber property have been addressed shortly after the GRAIP survey was completed. A list of drain points in poor condition will be provided to all land managers to aid in maintenance.

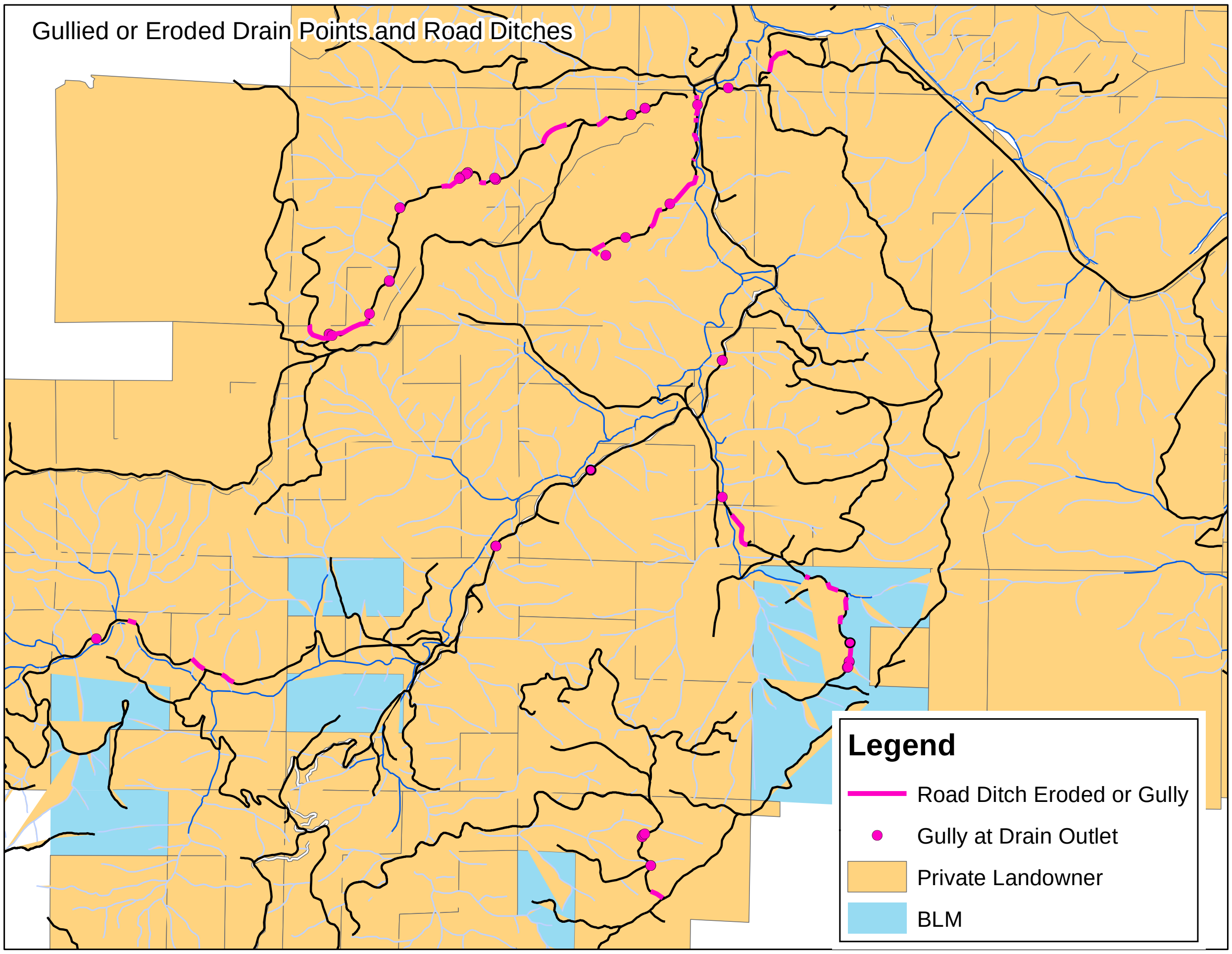

Figure 19. Gullied or eroded drain points and road ditches or flow paths identified in the GRAIP surveys of Dement Creek.

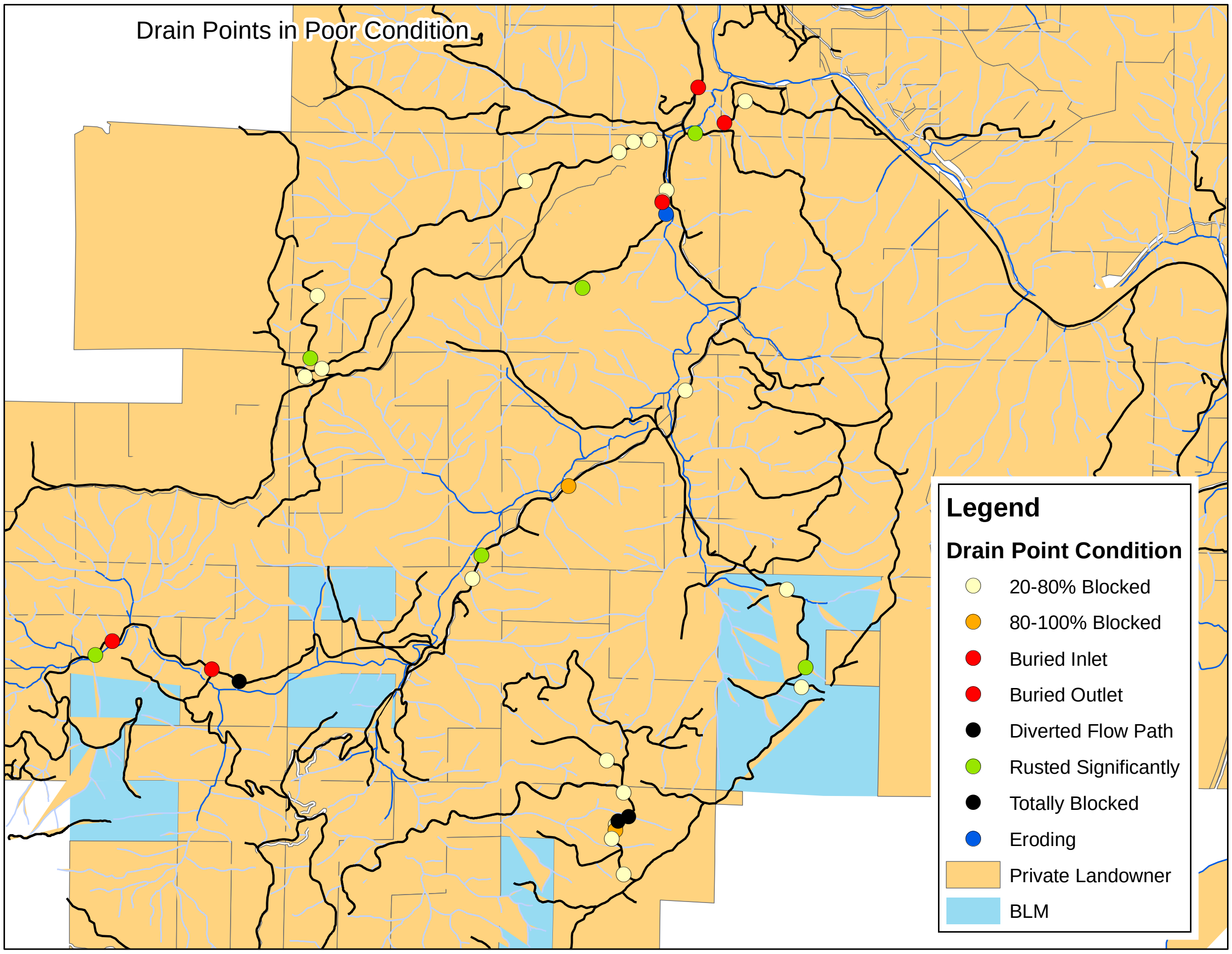

Figure 20. All drain points identified in the Dement Creek GRAIP survey that are in poor condition.

Suspended Sediment Monitoring

Suspended sediment monitoring has been initiated in the Dement Creek watershed to develop a long-term assessment of future restoration actions focused on water quality, such as road improvements. Specifically, a Campbell Scientific PVS5120D discrete water quality sampler has been deployed in the lower mile of Dement Creek. The sampler was configured to sample 100 mL every 24 hrs. The samples were transferred to smaller bottles and transported to the office where a vacuum filter fitted with United filter paper was used to filter the sediment out of the water. The samples were left to dry and the difference in weight of the dry filter paper and the dried sediment and filter paper were used in the sediment concentration calculations. Although flow measurements were not obtained (due to limited staff time) the sediment concentration was compared to discharge of the South Fork Coquille River measured at Powers, OR.

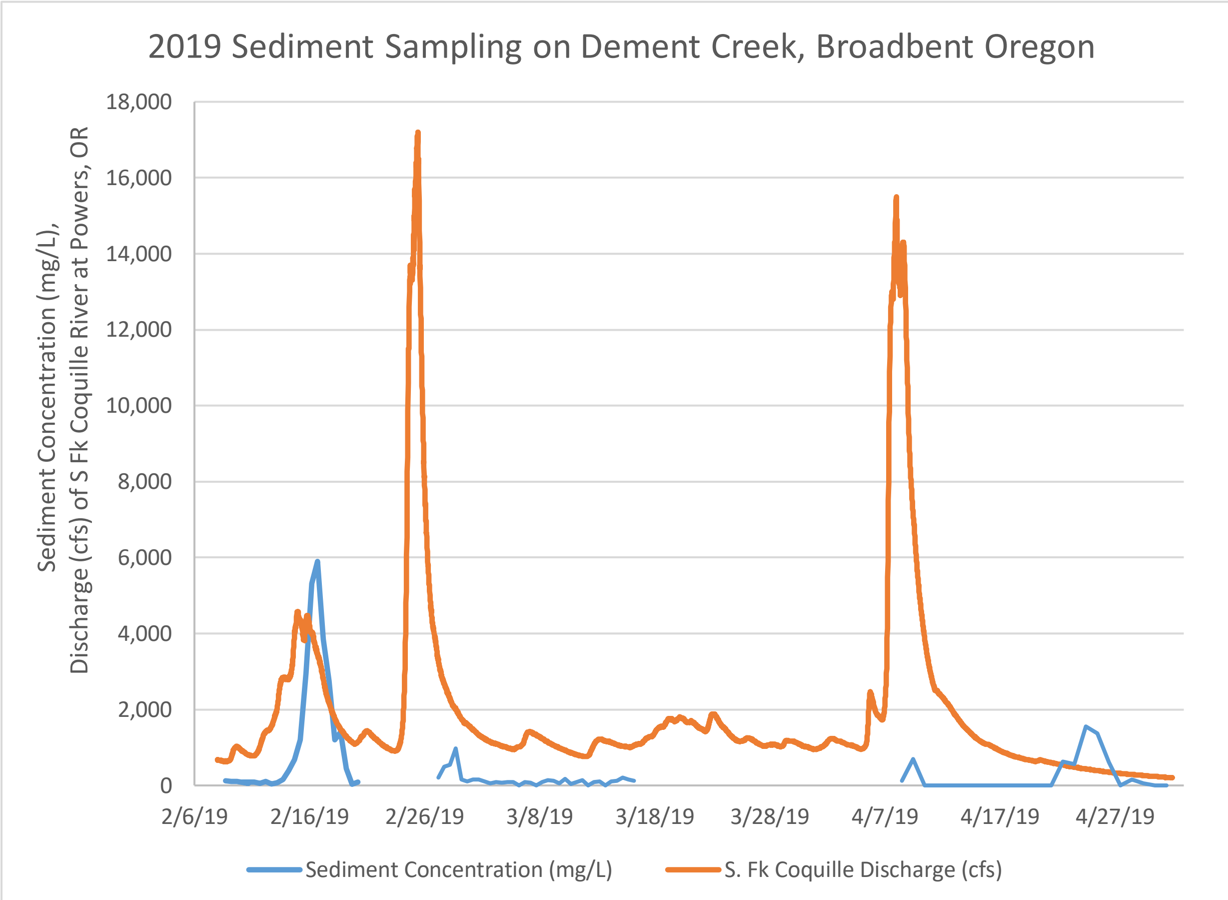

Figure 21. Suspended sediment concentrations of Dement Creek and corresponding flows of the South Fork of the Coquille River at Powers, OR.

Many hurdles were encountered throughout the sampling season therefore the data obtained is intermittent as seen in Figure 21, above. The reasons are as follows: First, during the initial purchasing conversations with Campbell Scientific we were assured the equipment would be compatible with our sampling intervals and remote field location. This was not the case, the solar power setup did not work correctly and it took weeks of troubleshooting before the problem was discovered. Then our sampling interval was not compatible with the equipment, which took another few weeks of troubleshooting to determine. This was rectified by the installation of an internal datalogger, given in-kind by Campbell Scientific therefore sampling at a known date and time did not start until February 8th, 2019. During troubleshooting the sediment sampler was taking samples intermittently (at unknown dates and times) although it was unusable for data analysis it allowed us to further refine of our field installation. In addition to equipment troubles there were a few issues with the field location. One of the main problems occurred during the flood of February 25th when high water velocities tipped over the sediment sampler spilling out all of the samples. The sampler was redeployed in a more secure fashion on February 26th but the floodwaters had reshaped the stream bed and caused the location of our intake hose to become a dry gravel bed when the high flows receded on March 16th. Although it had been noted on March 7th that the channel had been reconfigured it was unknown at that time that the intake hose would be completely dry when water level dropped further. This caused a gap (3/16-

4/8) in our data until there was sufficient time to relocate the in-take hose. The next issue occurred in the first half of April when the sampler was found upright but more than half the bottles had little to no water with remnant sediment in the bottles. It's suspected that cattle had tipped it over as there was evidence that cattle had been close to the sampler and that an unknown person had righted the sampler. A full table of results can be found in Appendix C. Although the first year didn't produce a robust dataset the 2020 deployment (funding secured) of the discrete sediment sampler will be improved upon through the lessons learned in 2019.

Assessment Conclusions

Dement Creek provides spawning and rearing habitat for salmonid species, however this basin has been subject to historical land use practices such as stream cleaning, riparian logging, and splash dams that have negatively affected the habitat. Other anthropogenic activities have caused elevated water temperatures to significantly increase leading to thermal conditions unsuitable for salmonids. For example, the removal of riparian vegetation decreases the amount of shade that blocks solar radiation and increases solar heating of streams. Removal of streamside vegetation also reduces bank stability, thereby causing bank erosion and increased sediment loading into the stream (U.S. EPA 2003). Currently, Dement Creek is a mixed land use basin with a patchwork of ownership comprised of small private landowners, large industrial timberlands and county and federal lands. The resultant of mixed ownership and land use is a discontinuous riparian corridor, stream reaches lacking in habitat complexity, a myriad of access roads leaking sediment into the water ways and high summer temperatures.

Large wood in a stream can accomplish multiple purposes such as diverting water flow and changing velocity, which helps to trap gravel above the structure, creating pools and increasing the connection with the floodplain. Gravel can provide substrate for macroinvertebrates, a main source of food for salmonids, it can also fill voids in wood and boulder structures to slow water and create pool habitat and, lastly, provide spawning substrate for fish. The limiting factors of Dement Creek will influence the number of structures, the spacing between structures and number of logs per structure (ODFW 2010). According to Rogers et al. 2005 (Appendix A), an adequate number of pieces of LWD per 100m for coho salmon habitat is greater than 21 and an adequate number for key pieces is greater than 3 per 100m. As identified in Figure 9, all 5 reaches in Dement Creek are below the critical threshold for coho salmon habitat. Therefore, Dement Creek is a good candidate for large wood placements because it has ideal conditions for habitat improvement, which include an average bankfull width between 7.4-11.4 m (24-37 ft.) throughout all 5 reaches and is a low gradient stream. Boulders can also accomplish the retention of gravel by physically intercepting the bed load or slowing the water, increase the interaction with the floodplain habitat by increasing the bed elevation and providing pool habitat (ODFW 2010). It is recommended to build LWD and boulder structures for all 5 reaches of the mid and lower Dement Creek, whereas the headwaters can hold structures with just LWD.

Dement Creek is at an adequate level in all five reaches for the percent of primary channel area represented by pool habitat (more than 45%) and between fair and good for having deep pools greater than 1m per km. Reach 1 is at a good level for % slackwater pool habitat (more than 7%) and reach 2 is at a fair level being just under 7% of the primary channel being represented by slackwater pools. Reaches 3, 4, and 5 are considered at a fair level as well, but these reaches are only represented by 1% of slackwater pools. Placing large wood and boulder structures in Dement Creek is recommended to increase pool complexity (backwater, alcoves, isolated pools, etc.)

A good range for percent shade is greater than 91%. On average, none of the five reaches make this range for good percent shade. Reaches 1, 2, and 4 are within a poor range on average (less than 76%) and reaches 3 and 5 are within the fair range on average for percent shade (between 76% and 91%). All five reaches are at a poor range for number of conifers larger than 50cm DBH (less than 22) or larger than 90cm DBH (0) on average. It is recommended to treat the blackberry and plant the riparian areas of Dement Creek with a diverse selection of native shrubs and trees for bank stability and shade.

The temperature throughout Dement Creek Basin varies from cooler water year round in the headwaters to lethally warm waters low in the system. The headwaters tend to be smaller streams, are more forested and have more intact riparian corridors which helps decrease solar radiation inputs in the summer months. Overall, we found temperatures in all the tributaries and in Dement Creek higher than river mile 5.1 to pass the salmonid rearing temperature criteria of 17.8°C (64°F) from July to October. All locations below river mile 5.1 exceeded the temperature criteria for the rearing period with some locations exceeding the criteria by up to 6°C.

The sediment inputs to Dement creek that are caused by the road network are from a myriad of issues such as gullies, stream crossings and ditch relief culverts. Many of the sediment issues are a result from steep roads and terrain. Steep roads that drain excessive amounts of water cause the road surface to erode and will carry fine sediment to the road drain point and then causes further erosion on the hillslope, in the form of gullies, on the outlet of the drain point. The GRAIP road surveys were able to identify and locate major issues of the road network in the Dement Creek Basin and sediment loading can be significantly decreased when these road issues are addressed.

Overall, Dement Creek has the potential to increase riparian shade and decrease thermal loading, which will improve water quality, cold water temperatures for fish, and more forest floor for sediment to dissipate. A report completed by Clearwater Biostudies (2003) assessing the lower SFCR also shows the extensive opportunities for improving shade conditions in the Dement Creek system than the other tributaries assessed. Dement Creek could be a haven for salmonids as it has medium to high intrinsic potential for coho salmon within all 5 reaches surveyed, however, the limiting factors such as sediment and nutrient input, warm summer temperatures, a lack of pool complexity and riparian diversity need to be addressed. With restoration projects that encompass large wood and boulder placements, riparian planting, and road improvements along with agricultural improvements, Dement Creek can be holistically restored.

Restoration Prioritization

In 2009, nine large wood and boulder structures were placed in a 700-foot reach of Dement Creek. Project partners included the CoqWA, U.S. Fish and Wildlife Service, and ODFW. In the project reach, Dement Creek displayed limited large wood, pool habitat and overall pool complexity, minimal available spawning habitat, with a majority of streambed consisting of bedrock and small boulders. The riparian corridor had areas of sparse vegetation consisting of conifers, hardwoods, dense understory shrubs and invasive plant species. Each structure consisted of 3-5 key logs, some smaller logs, and boulders larger than one cubic yard. A total of 37 key logs and 37 smaller logs were used to construct the nine log structures. Key logs were 28-36-inch diameter and 55-65 ft. long while the smaller logs were less than 24-inch diameter and a minimum of 33 ft. long. Bank armoring was installed at the nine structures to help them withstand flood events. Project design was based on the Oregon Aquatic Habitat Restoration and Enhancement Guide for large wood placement (Dammann 2014).

After four years, all nine structures were stable and performing well. The project had withstood a 20-year flood event. Additional wood was being trapped, backwater pools were forming and secondary channels were developing. In 2014, it was reported that eight structures are intact and functioning as designed. The full width structures are trapping wood, retaining gravel and scouring pools. The channel margin structures are creating backwater eddies for refugia from flood flows. All structures provide cover for juvenile salmonids from predators. Two key logs that moved downstream have created a structure above the confluence with Russell Creek that is highly functional and stable (Dammann 2014). Future restoration improvements will build upon this successful project with the following proposed actions:

- Extensive planting in reaches 1 and 2 and supplemental planting in reaches 3 and 4
- Greater fencing setbacks and fencing repairs in reaches 1 and 2 along with bank re-sloping in eroding areas
- Placements of key LWD pieces in reaches 2, 3, 4, 5, and beyond on private timber
- Add complexity to pools and already existing key LWD in reaches 3, 4, 5
- Prioritize removing and/or replacing the top three sediment producing ditch relief culverts
- Upgrade at least the top two sediment producing stream crossings
- Road improvements to fix the top two sediment producing gullies
- Work with landowners on other sediment producing road issues, such as locating lead off ditches for general maintenance and other drainage upgrades

Instream Restoration

Dement Creek will need logs for structures to be 16-18' diameter for areas that are between 6-10m bankfull and 22" or greater for areas that are over 10m bankfull. At least two key pieces should be used at each structure and have a rootwad attached if possible because roots add stability and create hiding habitat for juvenile fish. Boulders can be effective at reducing the downstream movement of wood when other anchor points are limited. Sizes of boulders added to structures will be based on what is occurring naturally.

About 17 sites have been identified for LWD structure placement between reaches 2-5. For instream restoration shown in Figure 22, sites will need between 5-7 logs and at least 2-3 of those need to have rootwads. These sites will also need 10-12 boulders, with some needing up to 15, between 0.5-1 cubic yard (cy). Many of these sites will need to be designed to protect the banks (see example in Figure 23) as Dement Creek is prone to erosion and has many sites actively eroding or currently healing from a major event.

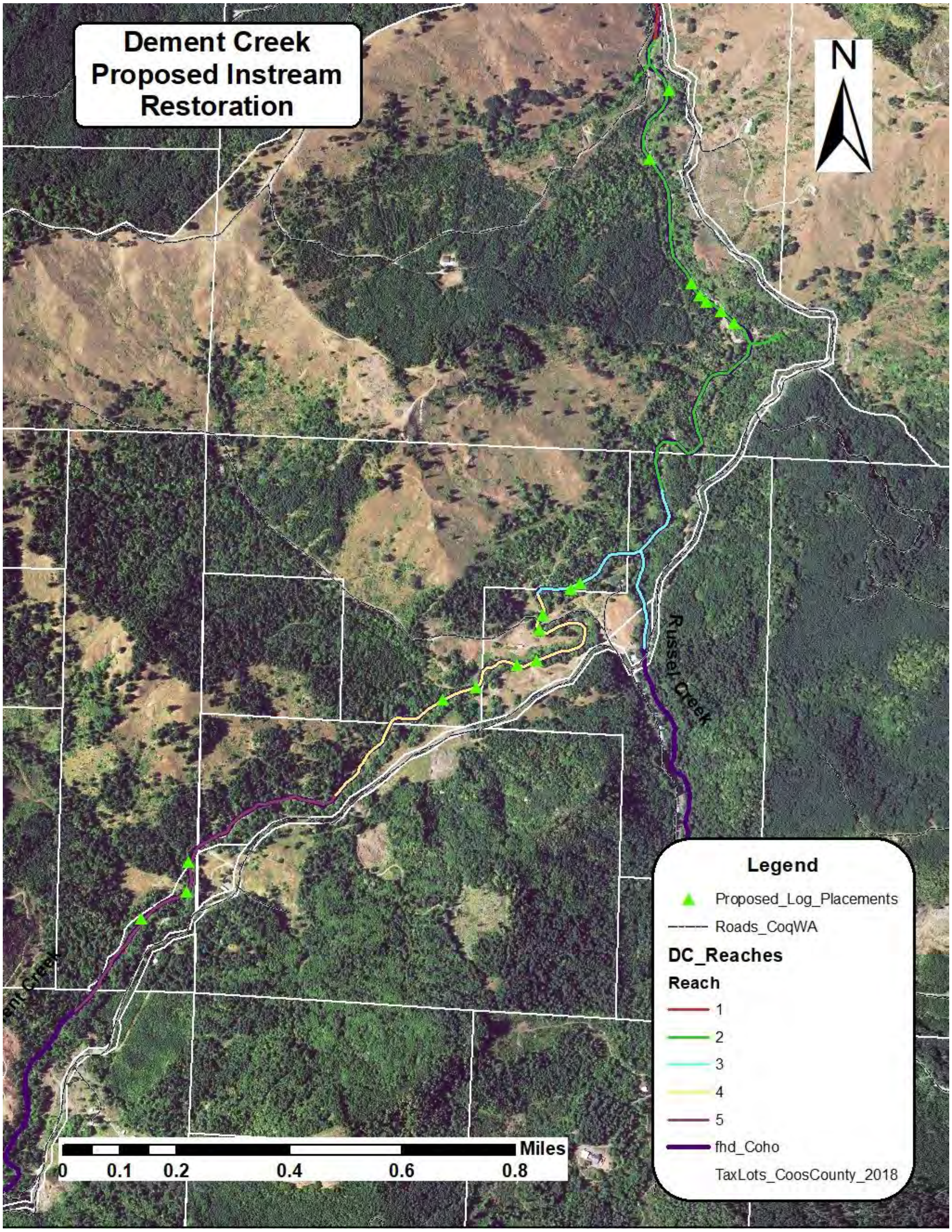

Figure 22: Map of proposed instream restoration within reaches 2-5. All sites will need large wood and boulder structures.

Figure 23: Example site for large wood and boulder placement that needs to be designed to protect the bank. Design options would include placing LWD upstream of this spot. Rootwads would be strategically placed to deflect water to the left side of the bank and slow down water velocity. There are also existing conifers to key into above this area.

Access for log and boulder structures shown in Figure 22 will be a challenge as the private landowners have the riparian area well fenced off with little to no gates. In some stretches, one or both sides of the bank are too steep for excavator access. A budget will need to include fence repairs and excavator time to build ramp access and road maintenance. Some sites may also need a temporary road crossing to haul equipment and boulders. Some areas with multiple instream sites only have one way of access, so an excavator will need to ford the stream to reach any upper and lower sites. There is a railcar bridge near some of the proposed instream sites, so landowner approval will be needed to cross this bridge. Structures are not being proposed in reach 1 as the landowner wants to avoid erosion and bank undercutting of the lower pastures (Figure 24).

Figure 24: Example area within reach 1 that has a natural structure creating fish habitat, however it also appears to be assisting in the bank erosion near a pasture. Other design options would include reshaping the bank 1:1, setting the fence back, and replanting.

Landowner access was not granted to complete the stream surveys beyond reach 5, however restoration actions were able to be determined on private timber on the upper reaches of Dement Creek. A total of 15 instream restoration sites were identified with this survey (Figure 25). These sites also border some BLM property where trees could potentially be identified to harvest for a restoration project. Access for these sites include using old skid roads for excavator and fording the stream at some sites. However, some trees will need to be taken out for access, but can be used for the log placements.

Some of these sites only need 4-6 logs, whereas others will need up to 10 logs. These sites do not need boulders because there are trees to key into, good floodplain connection, low gradient, and shorter bankfull length. Only one site needs boulders since there is not much to key into. There are plans to harvest this area over the next couple summers (2021-22), so if a project is funded at the same time, harvested trees could be donated as match.