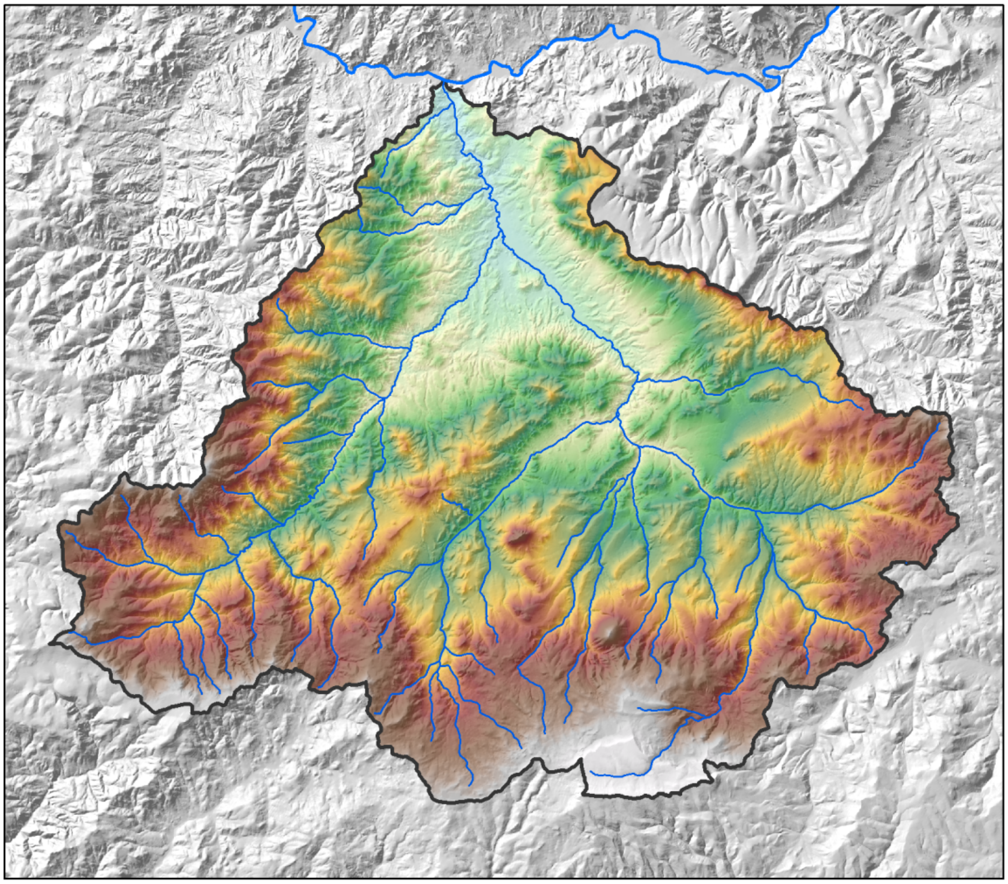
BRIDGE CREEK WATERSHED ASSESSMENT



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BACKGROUND

Bridge Creek, a tributary of the John Day River, is located in Wheeler County in North Eastern Oregon. The Bridge Creek watershed drains a total of 269 square miles and contains 69 miles of summer steelhead (*Oncorhynchus mykiss*) spawning habitat. Wheeler Soil and Water Conservation District (SWCD) staff surveyed 23.6 miles of the mainstem of Bridge Creek during the summer of 2013. The data from this survey was entered into a spatially referenced geodatabase of the stream channel. The purpose of this reach evaluation is to identify the severity of the limiting factors on a reach by reach basis and create an interactive GIS framework with the purpose of improving the effectiveness of restoration work conducted within the Bridge Creek watershed. Resource Specialists Inc. was commissioned to analyze the data and examine trends within the watershed. The results of the analysis are contained within this report.

Steelhead are currently listed as a threatened species. The overall health of the steelhead population in the middle Columbia River along with limiting factors and guidelines for recovery were detailed in "Conservation and Recovery Plan for Oregon Steelhead Populations in the Middle Columbia River Steelhead Distinct Population Segment," henceforth referred to as the "Mid-C Recovery Plan."

WATERSHED HISTORY

A historical assessment of the Bridge Creek Watershed was completed by Wheeler SWCD staff and is provided in **Appendix A**. The historical report details the topographic, geomorphic, and anthropic characteristics of the watershed. Extensive interviews were conducted with longtime residents of Wheeler County in order to obtain firsthand accounts of the changes that have occurred. One of the more profound events occurring within the watershed where firsthand accounts were still available was the flood on July 13, 1956. This flood occurred due to a large thunderstorm in the hills to the south. A large amount of damage was done to low lying buildings in the town of Mitchell with several structures being completely destroyed.

UPLANDS INFORMATION

Upland analysis was conducted as part of this assessment. The analysis includes existing landuse information, juniper prevalence, road information, and a spring assessment. Where appropriate, the analysis work and maps were broken out by subwatershed to allow for a better understanding (and greater resolution) of the information. Prioritization of spring developments and a juniper ranking system is also presented. This information and the resulting maps are provided in **Appendix B** through **Appendix F** with the contents as follows:

- **Appendix B** - Bridge Creek Landuse
- **Appendix C** - Landuse Within the Floodplain
- **Appendix D** - Maximizing Juniper Treatment Impact
- **Appendix E** - Road Distribution
- **Appendix F** - Maximizing Spring Development Impact

HYDROLOGY

PEAK FLOW ESTIMATION

Bridge Creek is a flashy system prone to flood events from large isolated thundershowers and rain on snow events. There are several methods of estimating what the peak event flows will be within a watershed, two of which are examined here.

A USGS gauging station (14046778) at the lower end of Bridge Creek (Figure 1) has data available going back to water year 2008, providing six full years of useable data. The average daily flows from the past six water years are plotted in Figure 2. Exceedance flows at the 5%, 50%, and 95% are provided within the figure.

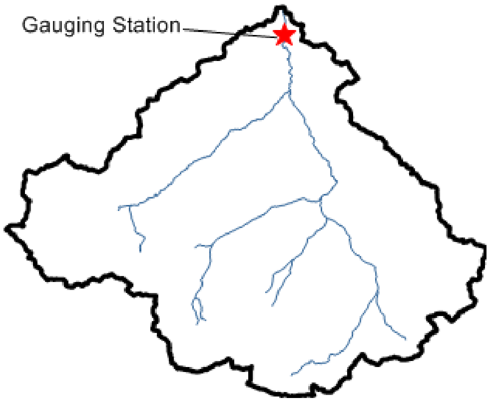


FIGURE 1 - LOCATION OF USGS GAUGING STATION

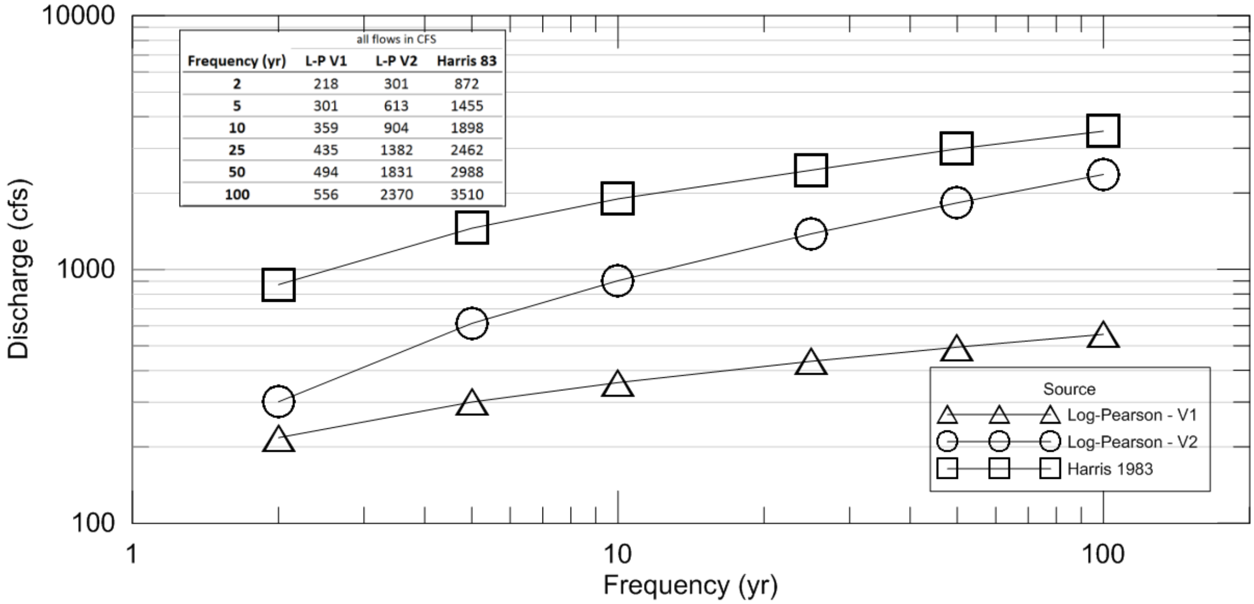
The peak flow values from each water year were extracted and examined. All of the peak flows were below 320 CFS except for an event on August 1, 2009 where a peak value of 1400 CFS was recorded. Historical records show a heavy rainstorm coinciding with the peak flows, but the highest peak value is suspect due to the time duration of the event. The values reported at the gauge are provided in Table 1. The reading at 23:45 was the last reading provided until August 22, 2009, suggesting that the gauge was damaged, further calling into question the high instantaneous value reported at 21:15. As a side note, this data gap can be seen on the plot in Figure 2, but the instantaneous peak is not shown since daily average values are plotted.

TABLE 1 - DISCHARGE MEASUREMENTS ON 8/1/09

Time	Flow (CFS)
20:45	9.5
21:00	70
21:15	1400
21:30	601
21:45	232
22:00	105
22:15	81
22:30	104
22:45	82
23:00	57
23:15	42
23:30	32
23:45	24

If the data from August 1, 2009 is disregarded, the second highest peak flow for water year 2009 was only 182 CFS. Both of these values were used to build a set of two peak flow estimates; Version 1 (V1) with the 182 CFS value, and Version 2 (V2) with the 1400 CFS value. Peak discharge information was determined using a log-Pearson Type III distribution with a skew value of 0.2. Peak flows estimates were also calculated using the methodology outlined in "Magnitude and Frequency of Floods in Eastern Oregon" (Harris, 1983). This methodology uses the watershed characteristics of drainage area, percent forested land, average annual precipitation, and average minimum January temperature in a series of exponential calculations for the determination. All three estimates are tabulated and graphed in Figure 3.

FIGURE 2 - DAILY AVERAGED FLOW DATA FROM USGS GAUGE 14046778 ON BRIDGE CREEK; FLOWS IN CFS



all flows in CFS

Frequency (yr)	L-P V1	L-P V2	Harris 83
2	218	301	872
5	301	613	1455
10	359	904	1898
25	435	1382	2462
50	494	1831	2988
100	556	2370	3510

FIGURE 3 - PEAK FLOW ESTIMATES FOR BRIDGE CREEK NEAR THE USGS GAUGING STATION

The short period of record produces high standard deviations with the Log-Pearson approach, especially when a singular high value (such as 1600 CFS) is introduced into the calculations. The equations from Harris (1983) produced much higher results than either of the Log-Pearson approaches, which has been typical of other similar hydrologic analysis performed in the Wheeler County area.

WATER AVAILABILITY

The Oregon Water Resources Department has a useful online tool called the "Water Availability Reporting System." The address for this site is provided in the References section. Monthly streamflow analysis is provided for two watersheds: "Bridge Creek" - which consists of the entire Bridge Creek watershed, and "Upper Region" which includes all areas of Bridge Creek above the confluence with the West Branch of Bridge Creek. Data is tabulated for two flow regimes; 80% exceedance flows (Table 2) and 50% exceedance flows (Table 3). A breakdown of the consumptive uses for both watersheds is provided in Table 4.

TABLE 2 - WATER AVAILABILITY AT 80% EXCEEDANCE FLOWS

Bridge Creek - 80% Exceedance Flows (all units CFS)

Month	Natural Stream Flow	Consumptive Use	Expected Stream Flow	Instream Requirement	Net Water Available
JAN	10.3	2.21	8.09	25	-16.9
FEB	16.1	2.19	13.9	40	-26.1
MAR	17.5	5.27	12.2	40	-27.8
APR	32.3	14.2	18.1	40	-21.9
MAY	46.3	29.5	16.8	40	-23.2
JUN	32.7	24.2	8.48	25	-16.5
JUL	9.6	8.76	0.841	15	-14.2
AUG	5.1	4.3	0.801	6	-5.2
SEP	4.1	3.22	0.881	6	-5.12
OCT	6.2	1.99	4.21	6	-1.79
NOV	6.8	1.86	4.94	25	-20.1
DEC	7.2	1.92	5.28	25	-19.7

Upper Region - 80% Exceedance Flows (all units CFS)

Month	Natural Stream Flow	Consumptive Use	Expected Stream Flow	Instream Requirement	Net Water Available
JAN	4.43	0.757	3.67	7.25	-3.58
FEB	6.17	0.757	5.41	6.23	-0.817
MAR	7.1	1.73	5.37	10	-4.63
APR	14.5	5.41	9.09	15	-5.91
MAY	23	12.6	10.4	15	-4.63
JUN	17.3	10.9	6.41	10	-3.59
JUL	5.19	4.48	0.706	6.41	-5.7
AUG	2.83	2.56	0.266	2.95	-2.68
SEP	2.26	1.94	0.316	3	-2.68
OCT	3.36	1.07	2.29	3	-0.707
NOV	3.53	0.757	2.77	4.8	-2.03
DEC	3.35	0.757	2.59	5.05	-2.46

In general, the watershed is lacking excess water during much of the year. At the 80% exceedance level the only months where the natural stream flow exceeds the instream requirement are May, June, and October. The situation is slightly improved at a 50% exceedance level, but the natural stream flow is still less than the instream requirement for over half of the year in the lower watershed. Irrigation withdrawals are the largest proportion of the consumptive use category for both watersheds. Water storage is also a significant use in the lower watershed.

TABLE 3 - WATER AVAILABILITY AT 50% EXCEEDANCE FLOWS

Bridge Creek - 50% Exceedance Flows (all units CFS)

Month	Natural Stream Flow	Consumptive Use	Expected Stream Flow	Instream Requirement	Net Water Available
JAN	21.9	2.21	19.7	25	-5.31
FEB	21.6	2.19	19.4	40	-20.6
MAR	38.9	5.27	33.6	40	-6.37
APR	57.1	14.2	42.9	40	2.94
MAY	71.0	29.5	41.5	40	1.51
JUN	51.9	24.2	27.7	25	2.68
JUL	14.4	8.76	5.64	15	-9.36
AUG	5.9	4.3	1.6	6	-4.4
SEP	8.4	3.22	5.18	6	-0.819
OCT	8.4	1.99	6.41	6	0.408
NOV	16.4	1.86	14.5	25	-10.5
DEC	17.4	1.92	15.5	25	-9.52

Upper Region - 50% Exceedance Flows (all units CFS)

Month	Natural Stream Flow	Consumptive Use	Expected Stream Flow	Instream Requirement	Net Water Available
JAN	8.73	0.757	7.97	7.25	0.723
FEB	8.21	0.757	7.45	6.23	1.22
MAR	15.1	1.73	13.4	10	3.37
APR	25.1	5.41	19.7	15	4.69
MAY	34.9	12.6	22.3	15	7.27
JUN	27.5	10.9	16.6	10	6.61
JUL	7.89	4.48	3.41	6.41	-3.00
AUG	4.33	2.56	1.77	2.95	-1.18
SEP	3.49	1.94	1.55	3	-1.45
OCT	4.47	1.07	3.40	3	0.403
NOV	7.68	0.757	6.92	4.8	2.12
DEC	7.34	0.757	6.58	5.05	1.53

TABLE 4 - CONSUMPTIVE USES FOR THE FULL AND UPPER BRIDGE CREEK WATERSHEDS

Month	Storage F/U[1]		Irrigation F/U		Municipal F/U		Domestic F/U		Agriculture F/U		Total F/U	
JAN	1.42	0.02	0	0	0.537	0.537	0.22	0.2	0.035	0	2.21	0.757
FEB	1.4	0.02	0	0	0.537	0.537	0.22	0.2	0.035	0	2.19	0.757
MAR	2.53	0.03	1.95	0.96	0.537	0.537	0.22	0.2	0.035	0	5.27	1.73
APR	3.98	0.05	9.38	4.62	0.537	0.537	0.22	0.2	0.035	0	14.2	5.41
MAY	4.71	0.08	24	11.8	0.537	0.537	0.22	0.2	0.035	0	29.5	12.6
JUN	3.46	0.06	19.4	9.56	1.07	1.07	0.22	0.2	0.035	0	24.2	10.9
JUL	0.94	0.02	6.49	3.19	1.07	1.07	0.22	0.2	0.035	0	8.76	4.48
AUG	0.38	0.01	2.59	1.28	1.07	1.07	0.22	0.2	0.035	0	4.3	2.56
SEP	0.55	0.01	1.34	0.66	1.07	1.07	0.22	0.2	0.035	0	3.22	1.94
OCT	0.55	0.01	0.65	0.32	0.537	0.537	0.22	0.2	0.035	0	1.99	1.07
NOV	1.07	0.02	0	0	0.537	0.537	0.22	0.2	0.035	0	1.86	0.757
DEC	1.13	0.02	0	0	0.537	0.537	0.22	0.2	0.035	0	1.92	0.757

1 - F/U - Water use separated by (F)ull Watershed and (U)pper Region

All values in Cubic Feet per Second (CFS)

MID-C RECOVERY PLAN

The Mid-C Recovery Plan was adopted by NOAA Fisheries in 2009 as a planning document for the recovery of steelhead within the Middle Columbia River basin. Bridge Creek is one of 11 major spawning areas (MaSAs) that collectively make up the Lower Mainstem John Day River unit. According the criteria developed in the Mid-C Recovery Plan, the summer steelhead population in the Lower Mainstem John Day River Unit is at moderate risk, and is not classified as "viable." In order to achieve a rating of "viable," the "population must improve in both Abundance/Productivity and Spatial Structure/Diversity." A "gap approach" was used by the Interior Columbia Technical Recovery Team (ICTRT) to provide an overview of recovery actions necessary for a given population to improve from the currently defined status to a level deemed "viable." The "Abundance/Productivity" gap for the Lower Mainstem John Day River was identified to be 28%; a 10-year mean abundance of 1,800 current spawners compared to a threshold abundance of 2,250. The "Spatial Structure/Diversity" gap was divided into three categories: 1) Major life history strategies, 2) Genetic variation and 3) Spawner composition, with risk ratings of moderate, moderate and, high respectively. The overall risk rating of the Spatial Structure/Diversity gap was classified as moderate.

EDT LIMITING FACTORS

One of the main determining factors for the conclusions drawn by the authors was data from the Ecosystem Diagnosis and Treatment (EDT) model. Output from that model for the Middle John Day subbasin is shown in Table 5. It can be seen that Bridge Creek has a medium protection benefit and a high restoration benefit. The high priority restoration actions are obstructions, sediment load, and key habitat quantity. Temperature and habitat diversity are classified as medium priority for the watershed while flow and channel stability are classified as low priority. What is interesting to note is that while sediment load is a high priority restoration action, channel stability is classified as low priority. It can be argued that one is a precursor to the other and that increasing channel stability may be the best way to prevent excessive sediment loads into the system.

TABLE 5 - ECOSYSTEM DIAGNOSIS AND TREATMENT (EDT) MODEL OUTPUT (MID-C RECOVERY PLAN, TABLE 8-21)

Geographic area priority			Attribute class priority for restoration															
Geographic area	Protection benefit	Restoration benefit	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Bridge Creek	○	◯	•				•		●		⬤				⬤	●		⬤
Butte Creek	∘	○	•				•		●				•		⬤	●		⬤
Fields Creek									⬤						•			⬤
Grass Valley Canyon			•				●		•				•	•	⬤	●		●
JDR Johnson Creek	∘	○	•				●		●				•	•	●	●		●
Lower JDR Clarno	∘		•		•				●				•	•	•	●		●
Lower JDR Ferry Canyon		∘	•		•		●		●				•	•	●	●		●
Lower JDR Kahler Creek	∘	◯	•				●		●		⬤		•		●	●		⬤
Lower JDR McDonald Ferry	○				•				⬤					●	⬤	•		●
Lower JDR Muddy Creek	○	◯	•				●		●		⬤		•	•	⬤	●		●
Lower JDR Scott Canyon	∘	◯	•		•		●		●				•	•	⬤	●		●
Lower JDR Service Creek		○	•				●		●				•	•	●	●		⬤
Lower NF JDR									•							●		●
Lower Rock Cr		∘	•				●		●		⬤				⬤	•		●
Mountain Creek	○	◯	●				•		●				•		●	●		●
Pine Hollow		∘	•				●		●	•			•		⬤	●		⬤
Rock Creek	◯	○	●				•		•		●				●	•		●
Thirtymile Creek		◯	•				●		●		⬤		•	•	⬤	⬤		⬤
Upper Middle JDR	◯	◯	•				•		●				•		●	●		●
Upper Rock Creek		○	•				●		●						⬤	●		⬤

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A		B		C		D & E	
◯ ⬤	High	○ ●	Medium	∘ •	Low		Indirect or General

Many tributary habitat limiting factors were identified for the Lower Mainstem John Day River with the primary factors being "degraded floodplain and degraded channel structure (key habitat quantity and habitat diversity), altered sediment routing, water quality (temperature), and altered hydrology." Obstructions were identified as high priority limiting factors in 5 of the 11 MaSAs, including Bridge Creek. Agriculture, grazing of livestock, transportation corridors, as well as other development activities are identified as sources for the degraded floodplain. The lower portion of Bridge Creek is listed as an example of an area with limited habitat diversity and lacking large woody debris (LWD). The lower reaches of Bridge Creek have had a high level of agricultural activities (crop and livestock) conducted in the richer soils along the stream channel for many decades. There is also the presence of the main access road in close proximity to Bridge Creek. These two factors have contributed to the above degradation. Streambank hardening along with channelization are widespread throughout the tributaries of the Lower John Day River, further contributing to the degraded channel structure. Habitat and channelization issues are more prominent in the lower reaches of most drainages including Bridge Creek.

Altered sediment routing is listed as a high priority limiting factor for Bridge Creek and many other MaSAs within the Lower Mainstem John Day River. Gravel embeddedness is also listed as a significant limiting factor for the lower portion of the watershed. These sediment issues are regularly associated with agricultural practices which lead to displacement of native plant communities.

Another consequence of widespread agricultural practices in the Bridge Creek drainage is altered hydrology due to "water withdrawals, riparian corridor alterations, grazing, channel alterations, and wetland losses." The lower portion of Bridge Creek is identified as a reach where base flows are below the established benchmark. A byproduct of the low flows is elevated temperatures during the summer months. Temperature is listed as a medium priority limiting factor for Bridge Creek.

Three high priority (Obstructions, Sediment load, & Key habitat quantity), two medium priority (Habitat diversity, & Temperature), and two low priority (Channel stability & Flow) limiting factors were identified within Bridge Creek. The EDT data also identified Bridge Creek as having a high restoration benefit and a medium protection benefit.

These limiting factors impact Bridge Creek by reducing "productivity, abundance, spatial structure, and diversity." The threats to the watershed are largely agriculturally driven with livestock grazing practices and irrigation withdrawals being the principal components. These threats affect steelhead life history stages from the egg incubation through out-migrating juvenilles.

RECOVERY STRATEGIES

Using a combination of the EDT data and expert panel input, a suite of recovery strategies were developed for addressing the threats and limiting factors in order to facilitate the steelhead recovery process. The eight strategies outlined in the Mid-C Recovery Plan are as follows:

- Strategy 1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.
- Strategy 2. Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.
- Strategy 3. Maintain and restore floodplain connectivity and function.
- Strategy 4. Restore degraded and maintain properly functioning channel structure and complexity.
- Strategy 5. Restore riparian condition and LWD recruitment and maintain properly functioning conditions.
- Strategy 6. Restore natural hydrograph to provide sufficient flow during critical periods.
- Strategy 7. Improve degraded water quality and maintain unimpaired water quality.
- Strategy 8. Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.

Each strategy encompasses multiple action items with specific streams identified as either first or second priority for each action.

STRATEGY 1:

In the first action item of Strategy 1; "protect high quality habitats through acquisition or conservation easements," Bridge Creek is listed as a first priority watershed. This action item addresses all of the limiting factors previously identified for Bridge Creek.

STRATEGY 2:

Two action items of Strategy 2 identify Bridge Creek as a first priority watershed: "Provide screening at 100% of irrigation diversions" and "Replace screens that do not meet criteria." Both of these actions seek to improve conditions for steelhead by addressing possible issues with irrigation diversions. Although Bridge Creek is not listed under the two action items addressing push up dams and other barriers, 11 culverts were identified in the watershed that need to be addressed.

STRATEGY 3:

The loss of floodplains and other off-channel habitats is deemed a threat to the health of the Lower Mainstem John Day River steelhead population. Current activities within the basin have led to degraded floodplains, altered hydrology, degraded water quality, and altered sediment routing. The action items identified for Strategy 3 are as follows:

- Reconnect floodplains to channels
- Restore wet meadows
- Reconnect side channels and off-channel habitats to stream channels
- Promote the maintenance and creation of beaver dams to restore their role in natural ecological processes

Bridge Creek is listed as a first priority watershed for all four action items. Addressing these actions will likely yield increases in both abundance and productivity by providing rearing habitat for juvenile steelhead.

STRATEGY 4:

Strategy 4 seeks to enhance steelhead habitat by addressing channel structure and complexity. The removal of large woody debris as well as riparian vegetation has led to degraded channel structure and altered sediment routing, ultimately leading to stream channelization. The action items for Strategy 4 along with Bridge Creek's priority for each are listed below:

- Restore natural channel form (Second priority)
- Place stable wood and other large organic debris in streambeds and in floodplains (First Priority)
- Stabilize streambanks (Second priority)

Passive methods such as fencing could be combined with more active techniques such as rock and woody debris placement in carrying out these actions.

STRATEGY 5:

Strategy 5 focuses on maintaining/restoring the riparian vegetative communities. Degraded riparian communities are severely detrimental to the overall health of steelhead spawning stream and contribute to a number of limiting factors. The Mid-C Recovery Plan proposes two actions to address the riparian conditions:

- Restore natural riparian vegetative communities including vegetative planting
- Develop grazing strategies that promote riparian recovery

Both actions have "portions of Bridge Cr" identified as first priority reaches.

STRATEGY 6:

Agricultural withdrawals have put high demands on the tributaries to the Lower John Day River. Restoring these flows, especially during critical times, would mitigate low flow limiting factors and as a byproduct would reduce temperatures during low-flow periods. Seven actions are proposed in the Mid-C Recovery Plan to address this concern:

- Implement agricultural water conservation measures
- Improve irrigation conveyance and efficiency
- Promote the maintenance and creation of beaver dams to restore their role in natural ecological processes
- Lease or acquire water rights and convert to instream water rights
- Monitor/regulate water withdrawals
- Restore natural functions and processes through actions identified in strategies 1,3,4,5,8
- Assess existing and future water needs, complete statewide inventory of above and below ground potential storage, complete assessment of conservation opportunities, provide incentive funding to develop strategies to meet long-term needs

Bridge Creek is identified as a first priority reach in the first three actions, a second priority reach for converting water rights to instream, and the last three actions have locations defined as "Population wide."

STRATEGY 7:

Strategy 7 focuses on improving water quality, with the primary limiting factor being temperature. The sole action in which Bridge Creek is listed (second priority) is "Increase riparian shading," which is the core component of Strategy 5.

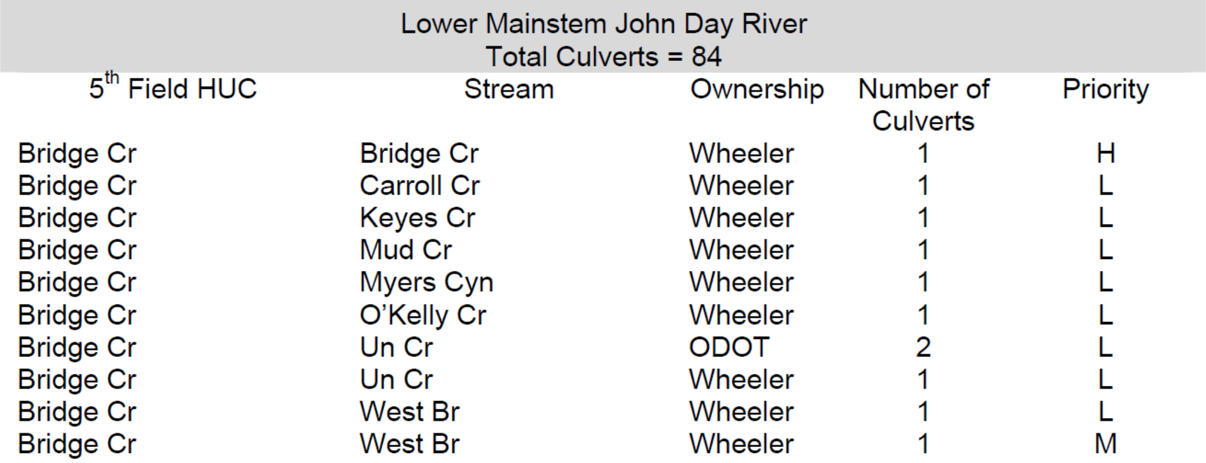
STRATEGY 8:

The final recovery strategy proposed by the Mid-C Recovery Plan addresses a variety of upland processes with the desired result being to reduce/minimize sediment load from erosion and runoff. Bridge Creek is identified as a first priority watershed for the action titled "Restore native upland plant communities." Bridge Creek was not identified as a priority watershed for any of the other upland recovery strategies.

CULVERTS

Existing culverts that needed work or replacement were tabulated in Appendix G of the Mid-C Recovery Plan. Eleven of the identified culverts fell within the Bridge Creek Watershed (Table 6). No location information for the culverts were provided other than ownership and tributary. Work is currently underway to obtain coordinates for the 11 culverts identified in Bridge Creek Watershed. Since 2002 there have been four culverts replaced on private lands within the Bridge Creek Watershed. At least two of these culverts are believed to be part of the 11 identified in the Mid-C Recovery Plan. The first one to be replaced was the Hashknife Culvert which was located on Bridge Creek within the Headwaters of Bridge Creek Sub-watershed. The culvert was undersized and was a 0.75 meter jump barrier. The second was the Painted Hills Culvert located in the lower watershed and was a 1 meter jump barrier into a failing structure. Both of these culverts were significant barriers to upstream adult steelhead migration at critical locations and as such greatly impacted the productivity of the watershed. Both culverts were replaced with pre-fabricated steel bridges that provide passage to all aquatic species.

TABLE 6 - CULVERTS WHICH NEED TO BE IMPROVED OR REPLACED IN THE BRIDGE CREEK WATERSHED (APPENDIX G IN THE MID-C RECOVERY PLAN)



Lower Mainstem John Day River
Total Culverts = 84

5th Field HUC	Stream	Ownership	Number of Culverts	Priority
Bridge Cr	Bridge Cr	Wheeler	1	H
Bridge Cr	Carroll Cr	Wheeler	1	L
Bridge Cr	Keyes Cr	Wheeler	1	L
Bridge Cr	Mud Cr	Wheeler	1	L
Bridge Cr	Myers Cyn	Wheeler	1	L
Bridge Cr	O'Kelly Cr	Wheeler	1	L
Bridge Cr	Un Cr	ODOT	2	L
Bridge Cr	Un Cr	Wheeler	1	L
Bridge Cr	West Br	Wheeler	1	L
Bridge Cr	West Br	Wheeler	1	M

ACTION-IDS

The Oregon Department of Fish and Wildlife (ODFW) synthesized the information from the Mid-C Recovery Plan as part of their implementation toolkit. One of the results of this analysis was the development of a spreadsheet consisting of individual Action-IDs with a corresponding restoration activity within a specific watershed. There were 29 specific Action-IDs identified for the Bridge Creek Watershed including 10 Action-IDs for each of the culvert line items defined in Table 6. A summary of the Action-IDs defined by ODFW is presented in Table 7. The Action-IDs for the 11 culverts were omitted from the table for brevity.

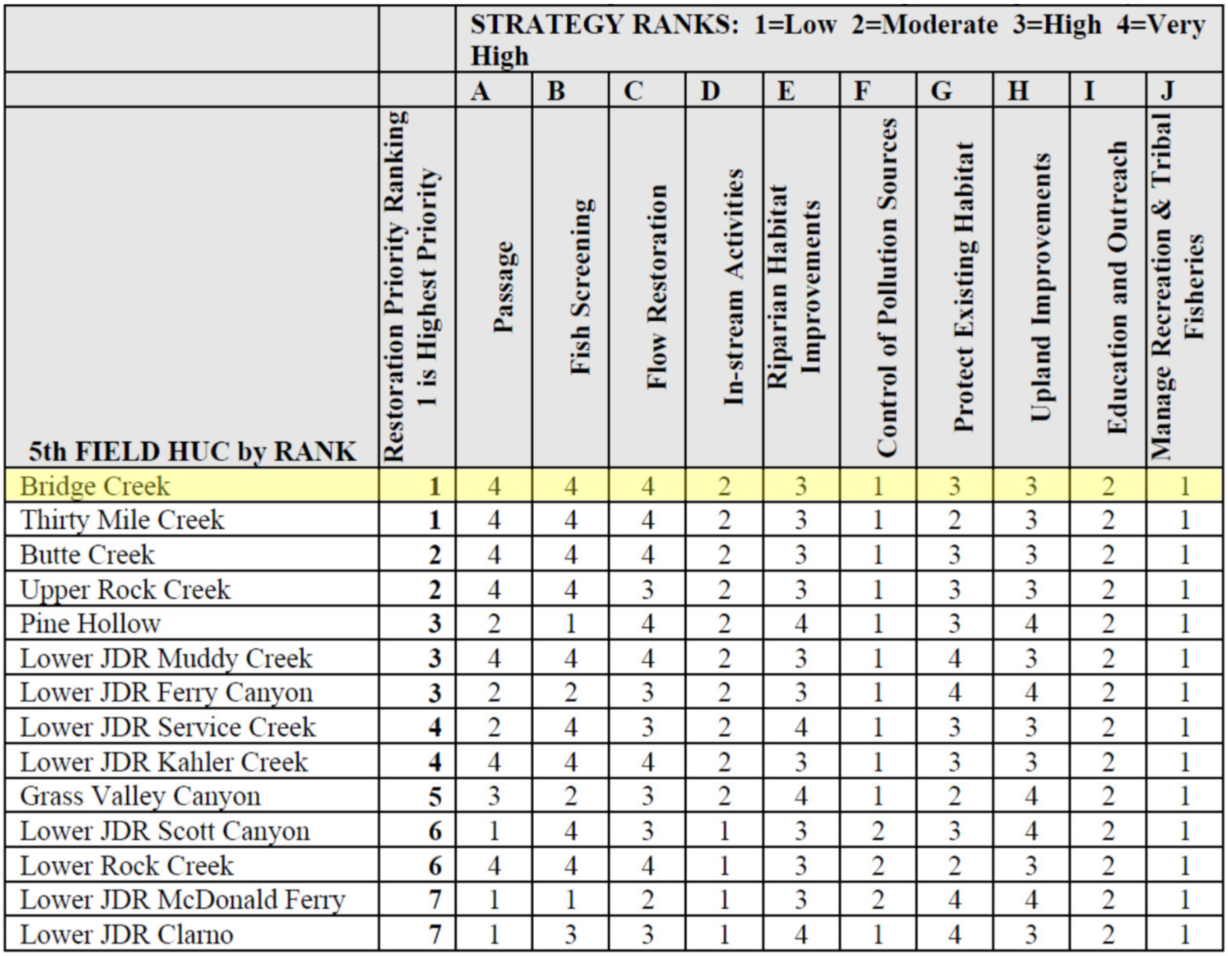
TABLE 7 - ACTION IDS DEFINED FOR BRIDGE CREEK

Action ID	Tributary Recovery Strategy	Tributary Recovery Action	Limiting Factor(s) Addressed	Threat Sub-Category	Implementation Timeframe	Initial Action Prioritization
MC-LMJD-23	**1 -** Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.	Protect high quality habitats through acquisition or conservation easements	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	Livestock overgrazing of riparian area, channelization, stream bank armoring, agricultural practices (fertilizers, herbicides, sediments, changes in plant communities), water withdrawals, loss of beaver dams	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years or more.	1 (HP)
MC-LMJD-24	**1 -** Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.	Special management designations in forest and BLM plans	Degraded floodplain connectivity and function, degraded channel structure and complexity, degraded riparian area, altered hydrology, degraded water quality, altered sediment routing	Livestock grazing of riparian area, changes in plant communities	Many complete, potentially subject to change in Forest Plan revisions	1
MC-LMJD-25 thru 34 correspond to the previously identified culverts						
MC-LMJD-35	**2 -** Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	Provide screening at 100% of irrigation diversions	Impaired fish passage	Irrigation diversions	Approximately 16 diversions need to be screened, should take 5-10 years	1 (HP)
MC-LMJD-36	**2 -** Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly functioning passage and connectivity.	Replace screens that do not meet criteria	Impaired fish passage	Irrigation diversions	Approximately 10 screens need to be replaced, should take 5-10 years	1 (HP)
MC-LMJD-37	**3** - Maintain and restore floodplain connectivity and function.	Reconnect floodplains to channels	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Short term, once identified	1
MC-LMJD-38	**3** - Maintain and restore floodplain connectivity and function.	Restore wet meadows	Degraded floodplain, altered hydrology	Removal of wetlands	Intermediate	1
MC-LMJD-39	**3** - Maintain and restore floodplain connectivity and function.	Reconnect side channels and off-channel habitats to stream channels	Degraded floodplain, altered hydrology	Removal of wetlands, side channels, off-stream habitat; conversion of floodplain for agricultural use; roads; loss of beaver dams	Long term, because of widespread need	1
MC-LMJD-40	**3** - Maintain and restore floodplain connectivity and function.	Promote the maintenance and creation of beaver dams to restore the role in natural ecological processes	Degraded floodplain, altered hydrology, altered sediment routing, degraded water quality	Removal of wetlands, side channels, off-stream habitat	Long term, due to acceptance by landowners and widespread need	1
MC-LMJD-41	**4** - Restore degraded and maintain properly functioning channel structure and complexity.	Restore natural channel form	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature, flows	Stream channelization, bank armoring, large wood removal, beaver removal, removal of riparian vegetation, livestock overgrazing in riparian areas	Short term, once identified	2
MC-LMJD-42	**4** - Restore degraded and maintain properly functioning channel structure and complexity.	Place stable wood and other large organic debris in streambeds and in floodplains	Degraded channel structure and complexity, habitat diversity, sediment routing, water temperature	Large wood removal, channelization	Short term, once identified	1
MC-LMJD-43	**4** - Restore degraded and maintain properly functioning channel structure and complexity.	Stabilize streambanks	Degraded channel structure and complexity, habitat diversity, sediment routing, flows	Stream channelization, berming, bank armoring, overgrazing in riparian areas	Passive stabilization techniques are preferred and take longer to implement	2
MC-LMJD-44	**5** - Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	Restore natural riparian vegetative communities including vegetative planting	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Livestock overgrazing of riparian area, channelization, stream bank armoring, cutting of trees in riparian areas, changes in plant communities (including invasive plants), loss of beaver dams	Long term because of widespread need	1 (HP)
MC-LMJD-45	**5** - Restore riparian condition and LWD recruitment and maintain properly functioning conditions.	Develop grazing strategies that promote riparian recovery	Degraded riparian area, channel structure and complexity, floodplain degradation, altered hydrology, sediment, water quality	Livestock overgrazing of riparian area	Long term because of widespread need	1 (HP)
MC-LMJD-46	**6** - Restore natural hydrograph to provide sufficient flow during critical periods.	Implement agricultural water conservation measures	Altered hydrology, low flows, high temperatures	Water withdrawals, land conversion on uplands, road network	Long term and dependent upon landowner willingness to participate and availability of projects.	1 (HP)
MC-LMJD-47	**6** - Restore natural hydrograph to provide sufficient flow during critical periods.	Improve irrigation conveyance and efficiency	Low flows, high temperatures	Water withdrawals, loss during conveyance	Long term and dependent upon landowner willingness to participate and availability of projects.	1 (HP)
MC-LMJD-48	**6** - Restore natural hydrograph to provide sufficient flow during critical periods.	Increase pool habitat (beaver ponds)	Low flows, high temperatures	Channel incision, loss of water table	Long term	1
MC-LMJD-49	**6** - Restore natural hydrograph to provide sufficient flow during critical periods.	Lease or acquire water rights and convert to instream	Low flows, high temperatures	Water withdrawals	Long term and highly dependent upon landowner willingness to lease.	2
MC-LMJD-50	**7** - Improve degraded water quality and maintain unimpaired water quality.	Increase riparian shading	High water temperatues	Degraded riparian forests	Long term because of widespread need	2
MC-LMJD-51	**8** - Restore degraded and maintain properly functioning upland processes to minimize unnatural rates of erosion and runoff.	Restore native upland plant communities	Altered hydrology, sediment routing, channel stability, floodplain and riparian area degradation, water quality	Upland land use practices, loss of water storage capacity	Long term	1

JOHN DAY SUBBASIN PLAN

The John Day Subbasin Plan was created to guide implementation of restoration efforts of the Northwest Power and Conservation Council's Fish and Wildlife Program. The plan was last updated in March 2005 and is expected to have a useful lifespan of 10 to 15 years. Just as the Mid-C Recovery Plan, the John Day Subbasin Plan relied heavily on EDT model output for formulation of the rankings. The final rankings from this plan put Bridge Creek as the highest restoration priority in the region (Table 8).

TABLE 8 - PRIORITY RANKINGS FOR LOWER AND MIDDLE MAINSTEM JOHN DAY RIVER AND TRIBUTARIES. (JOHN DAY SUBBASIN PLAN - TABLE 70)



		STRATEGY RANKS: 1=Low 2=Moderate 3=High 4=Very High									
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
5th FIELD HUC by RANK	**Restoration Priority Ranking 1 is Highest Priority**	**Passage**	**Fish Screening**	**Flow Restoration**	**In-stream Activities**	**Riparian Habitat Improvements**	**Control of Pollution Sources**	**Protect Existing Habitat**	**Upland Improvements**	**Education and Outreach**	**Manage Recreation & Tribal Fisheries**
Bridge Creek	**1**	4	4	4	2	3	1	3	3	2	1
Thirty Mile Creek	**1**	4	4	4	2	3	1	2	3	2	1
Butte Creek	**2**	4	4	4	2	3	1	3	3	2	1
Upper Rock Creek	**2**	4	4	3	2	3	1	3	3	2	1
Pine Hollow	**3**	2	1	4	2	4	1	3	4	2	1
Lower JDR Muddy Creek	**3**	4	4	4	2	3	1	4	3	2	1
Lower JDR Ferry Canyon	**3**	2	2	3	2	3	1	4	4	2	1
Lower JDR Service Creek	**4**	2	4	3	2	4	1	3	3	2	1
Lower JDR Kahler Creek	**4**	4	4	4	2	3	1	3	3	2	1
Grass Valley Canyon	**5**	3	2	3	2	4	1	2	4	2	1
Lower JDR Scott Canyon	**6**	1	4	3	1	3	2	3	4	2	1
Lower Rock Creek	**6**	4	4	4	1	3	2	2	3	2	1
Lower JDR McDonald Ferry	**7**	1	1	2	1	3	2	4	4	2	1
Lower JDR Clarno	**7**	1	3	3	1	4	1	4	3	2	1

FIELD SURVEY

The field survey of Bridge Creek was conducted from September 4, 2012 through October 30, 2012. Field technicians systematically walked and surveyed the stream channel starting at the confluence with the John Day River up to River Mile 22. The spatial extent of the survey is shown in Figure 4. A 0.86 mile section through the town of Mitchell was not surveyed due to the high density of landowners and the time and effort that would have been required to obtain landowner agreements.

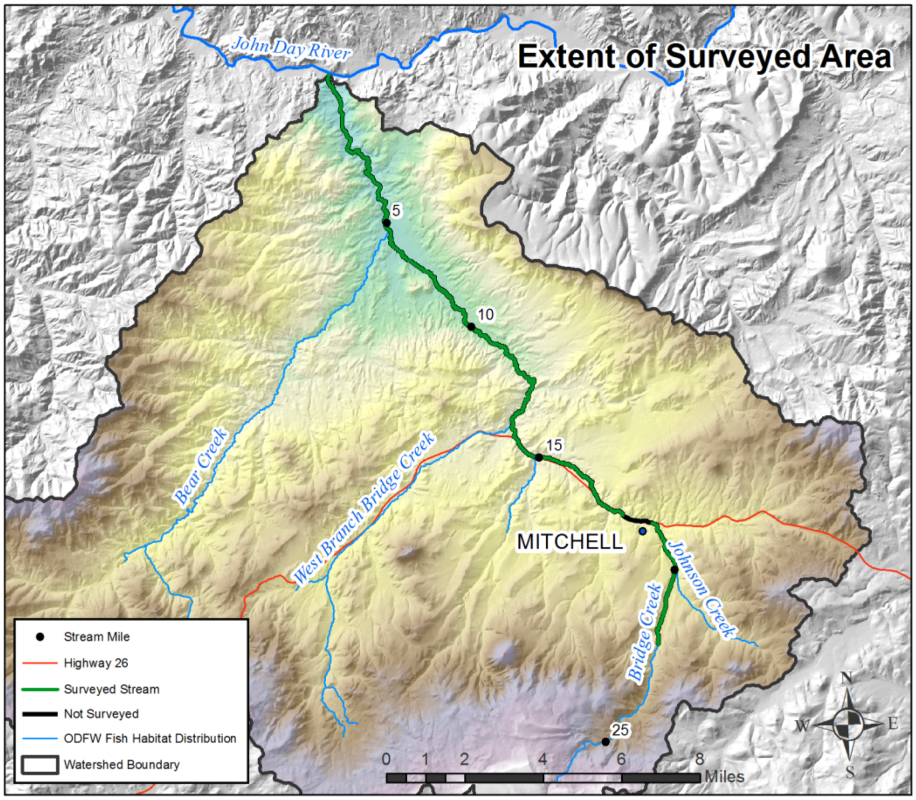
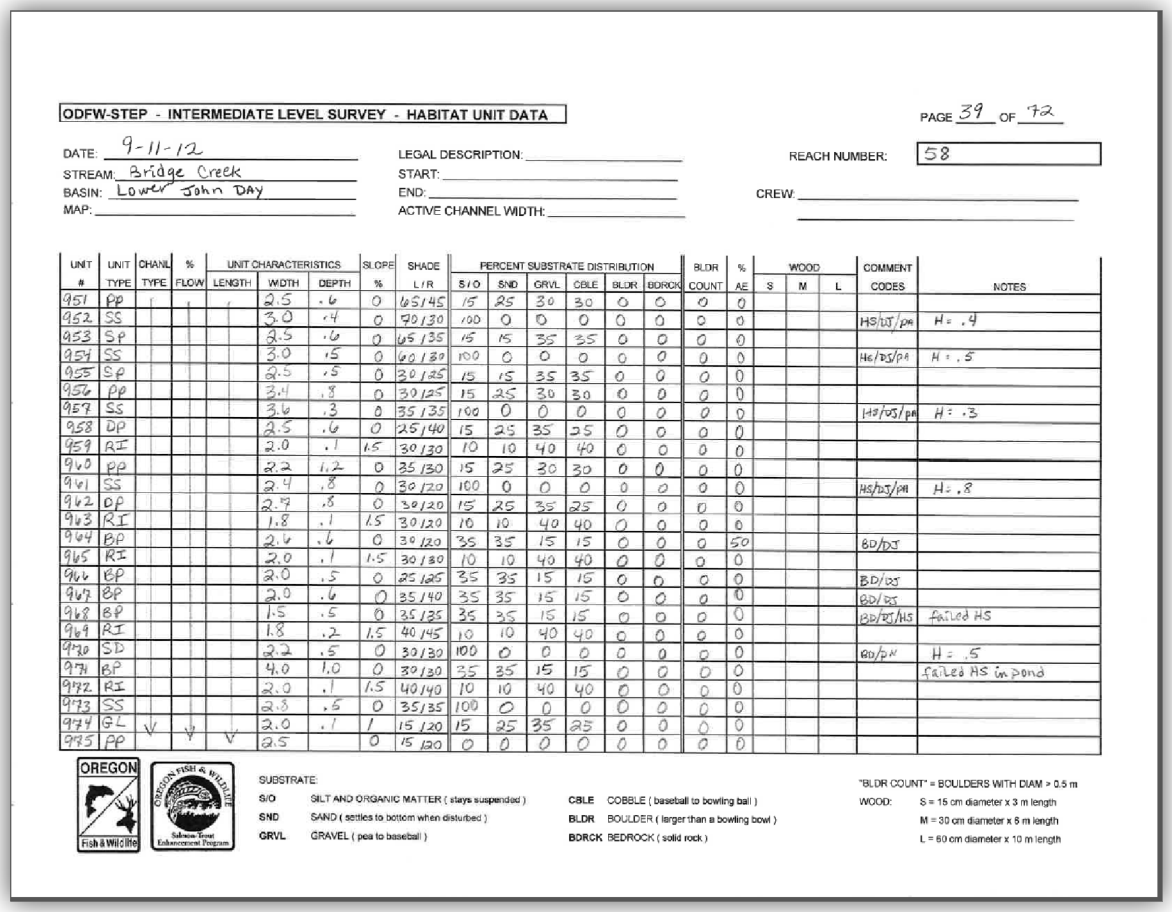


FIGURE 4 - GEOGRAPHIC EXTENT OF FIELD SURVEY

The survey was conducted using an "Intermediate Survey Level" as defined by "Surveying Oregon's Streams 'A Snapshot In Time': Aquatic Inventory Project Training Materials and Methods for Stream Habitat Surveys."

An example data sheet collected during the survey is shown in Figure 5. Each unit had the following information recorded:

- Unit Number (consecutive numeration for record keeping)
- Unit Type (pool, riffle, glide, etc.)
- Channel Type (main channel, side channel, etc.)
- Percent Flow (for determining relative size of side channels)
- Width (m)
- Depth (m)
- Percent Slope
- Shading (measured in degrees for both the left and right bank using an inclinometer)
- Percent Substrate Composition (measured as percent of each type)
    - Silt and Organic Matter, Sand, Gravel, Cobble, Boulder, Bedrock
- Boulder Count (boulders > 0.5 m in diameter)
- Percent Active Erosion
- Count of Small, Medium, and Large Woody Debris
- Comments and notes deemed relevant by surveyor
- Location coordinates for the beginning of each unit (recorded on GPS)



ODFW-STEP - INTERMEDIATE LEVEL SURVEY - HABITAT UNIT DATA

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DATE: 9-11-12
STREAM: Bridge Creek
BASIN: Lower John DAY
MAP:

LEGAL DESCRIPTION:
START:
END:
ACTIVE CHANNEL WIDTH:

REACH NUMBER: 58

CREW:

UNIT	UNIT	CHANL	%	UNIT CHARACTERISTICS			SLOPE	SHADE	PERCENT SUBSTRATE DISTRIBUTION						BLDR	%	WOOD			COMMENT	
#	TYPE	TYPE	FLOW	LENGTH	WIDTH	DEPTH	%	L/R	S/O	SND	GRVL	CBLE	BLDR	BDRCK	COUNT	AE	S	M	L	CODES	NOTES
951	PP				2.5	.6	0	65/45	15	25	30	30	0	0	0	0					
952	SS				3.0	.4	0	70/30	100	0	0	0	0	0	0	0				HS/DJ/PA	H = .4
953	SP				2.5	.6	0	65/35	15	15	35	35	0	0	0	0					
954	SS				3.0	.5	0	60/30	100	0	0	0	0	0	0	0				HS/DS/PA	H = .5
955	SP				2.5	.5	0	30/25	15	15	35	35	0	0	0	0					
956	PP				3.4	.8	0	30/25	15	25	30	30	0	0	0	0					
957	SS				3.6	.3	0	35/35	100	0	0	0	0	0	0	0				HS/DS/PA	H = .3
958	DP				2.5	.6	0	25/40	15	25	35	25	0	0	0	0					
959	RI				2.0	.1	1.5	30/30	10	10	40	40	0	0	0	0					
960	PP				2.2	1.2	0	35/30	15	25	30	30	0	0	0	0					
961	SS				2.4	.8	0	30/20	100	0	0	0	0	0	0	0				HS/DJ/PA	H = .8
962	DP				2.7	.8	0	30/20	15	25	35	25	0	0	0	0					
963	RI				1.8	.1	1.5	30/20	10	10	40	40	0	0	0	0					
964	BP				2.6	.6	0	30/20	35	35	15	15	0	0	0	50				BD/DJ	
965	RI				2.0	.1	1.5	30/30	10	10	40	40	0	0	0	0					
966	BP				2.0	.5	0	25/25	35	35	15	15	0	0	0	0				BD/DJ	
967	BP				2.0	.6	0	35/40	35	35	15	15	0	0	0	0				BD/DJ	
968	BP				1.5	.5	0	35/35	35	35	15	15	0	0	0	0				BD/DJ/HS	failed HS
969	RI				1.8	.2	1.5	40/45	10	10	40	40	0	0	0	0					
970	SD				2.2	.5	0	30/30	100	0	0	0	0	0	0	0				BD/PN	H = .5
971	BP				4.0	1.0	0	30/30	35	35	15	15	0	0	0	0					failed HS in pond
972	RI				2.0	.1	1.5	40/40	10	10	40	40	0	0	0	0					
973	SS				2.8	.5	0	35/35	100	0	0	0	0	0	0	0					
974	GL	↓	↓	↓	2.0	.1	1	15/20	15	25	35	25	0	0	0	0					
975	PP				2.5		0	15/20	0	0	0	0	0	0	0	0					

SUBSTRATE:

S/O	SILT AND ORGANIC MATTER (stays suspended)
SND	SAND (settles to bottom when disturbed)
GRVL	GRAVEL (pea to baseball)
CBLE	COBBLE (baseball to bowling ball)
BLDR	BOULDER (larger than a bowling bowl)
BDRCK	BEDROCK (solid rock)

"BLDR COUNT" = BOULDERS WITH DIAM > 0.5 m

WOOD:
S = 15 cm diameter x 3 m length
M = 30 cm diameter x 6 m length
L = 60 cm diameter x 10 m length

FIGURE 5 - EXAMPLE FIELD DATA SHEET USED DURING THE SURVEY

During the survey 1779 total units were identified encompassing 23.6 miles (37.9 km) of stream corridor. Images of the surveyed stream with the relevant recorded parameters are provided at multiple locations throughout the watershed in **Appendix G.**

GIS FRAMEWORK DEVELOPMENT

All of the data that was collected during the field survey was entered into a database along with GPS coordinates for the beginning (downstream) point of each unit. The database was converted into a point shapefile using these downstream coordinates. A highly detailed stream network was digitized from georeferenced aerial photos. The point coverage was used to define breakpoints in the line network and the attributes from the point coverage were mapped onto the newly developed stream network.

For watershed-scale analysis it was necessary to aggregate the units into larger segments. Quarter mile (~400 m) lengths were used to define the larger reaches starting at the confluence with Rock Creek. Divisions between the reaches were made at breakpoints between units. The resulting data set aggregated the 1778 units into 96 reaches. Figure 6 illustrates the difference between the unit and reach resolutions of the dataset. The original resolution of the data was maintained; the aggregated reaches simply provide the data in a format that can be viewed and analyzed at a watershed-scale. The final database of the aggregated reach data is included with this report in **Appendix H**.

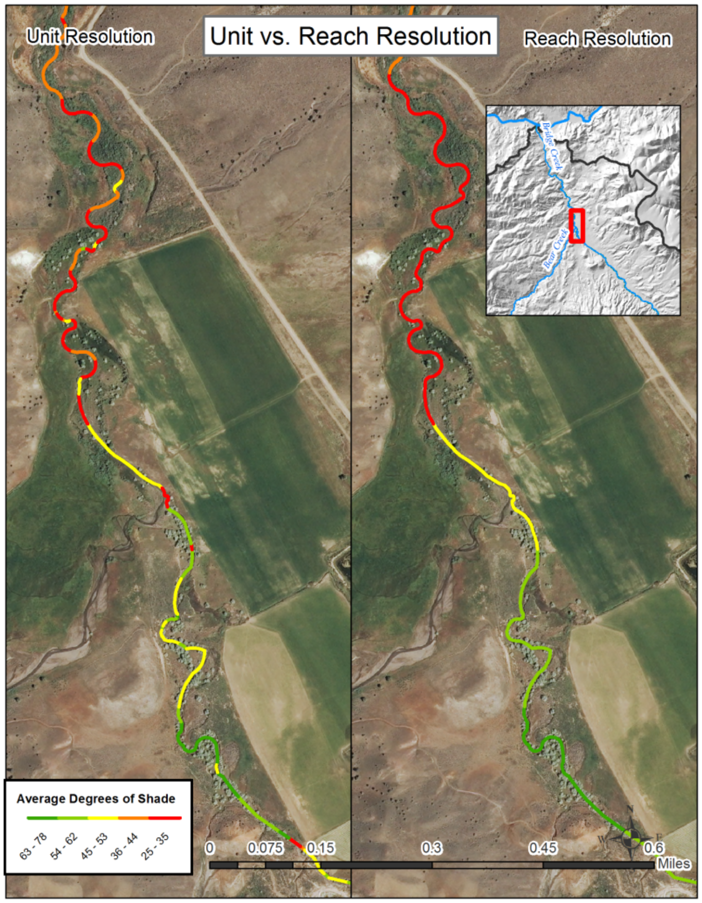

FIGURE 6 - EXAMPLE OF UNIT VS REACH RESOLUTION FOR CHANNEL SHADING

A slight variance in total reach length was introduced (Average = 395 m, Standard Deviation = 38.8 m), but the integrity of the unit divisions defined in the field survey were maintained. In areas with multiple channel sections, the smaller side channels were disregarded and only the data from the main channel was used.

RATING CRITERIA

The data collected along Bridge Creek was used to calculate several metrics used to develop rating criteria for the quarter mile segments. The different metrics were separated into six categories: active erosion, shading, habitat complexity, substrate composition, percent pool habitat, and barriers. For clarity, the metrics are presented in two plots each, one for the upper half of the watershed, and one for the lower. There are four HUC 6 watersheds represented in the survey; from the mouth at the John Day River going upstream they are:

- Lower Bridge Creek
- Middle Bridge Creek
- Upper Bridge Creek
- Headwaters Bridge Creek

The lower two are plotted as the Lower Watershed and the upper two are plotted as the Upper Watershed; HUC 6 boundaries are also provided on the figures.

ACTIVE EROSION

Each unit was assigned a value for percent active erosion determined by the amount of bare soil present along the stream bank. Due to stream dynamics, active erosion was typically only observed on one side of the stream. If active erosion was deemed present on one side of an entire unit, but none on the other, the percent active erosion was recorded as 50%. The formula for determining the total active erosion for a quarter mile reach is as follows:

$$Total\ Active\ Erosion = \frac{\sum_{i=1}^{n}(Length_i \cdot Active\ Erosion_i)}{\sum_{i=1}^{n} Length_i} \qquad (1)$$

The formula takes into account the relative length of each unit in determining the overall measure of the total active erosion. The spatial breakdown of shading for the four respective HUC 6 watersheds is shown in Figure 7. The distribution of Total Active Erosion values for Bridge Creek is shown in Figure 8. Maps of active erosion are provided for the lower (Figure 9) and upper (Figure 10) watersheds. The areas with the highest degree of active erosion were concentrated between RM 4 and RM 10. This corresponds to the large private ranch located at the confluence of Bridge Creek and Bear Creek and the portion of Bridge Creek that borders the Painted Hills National Monument. There is a small portion of high erosion in the upper reaches (RM 21) but the remainder of the surveyed stream reach does not have any significant erosional issues. The area with the lowest active erosion was the three mile section just above the confluence with the John Day River. This section is very well vegetated and has had very little cattle pressure.

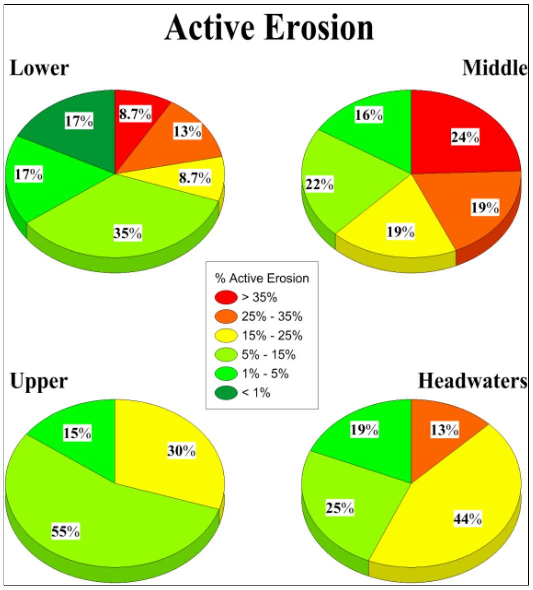

FIGURE 7 - REACH AVERAGED EROSION DISTRIBUTION

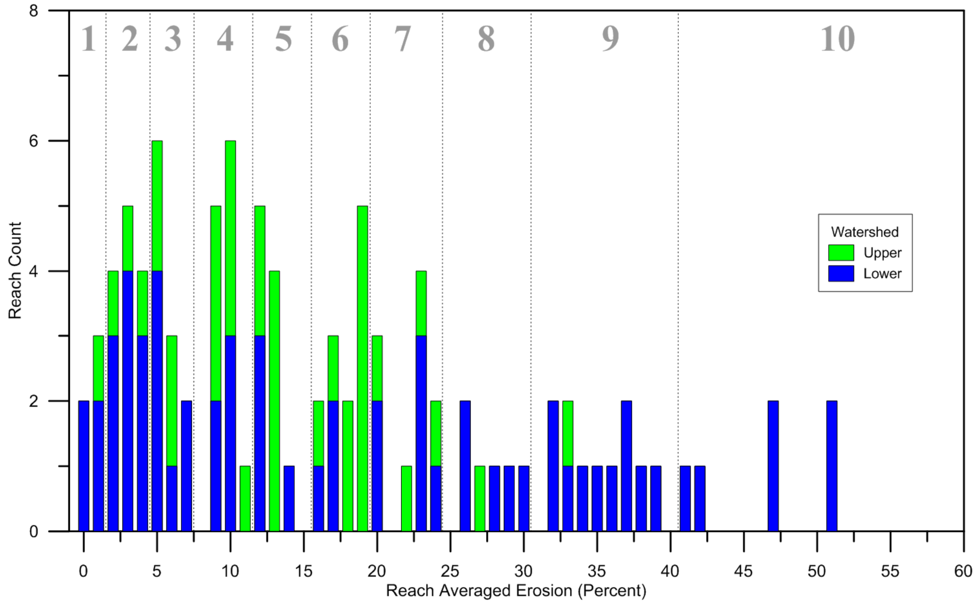

FIGURE 8 - DISTRIBUTION OF TOTAL ACTIVE EROSION VALUES

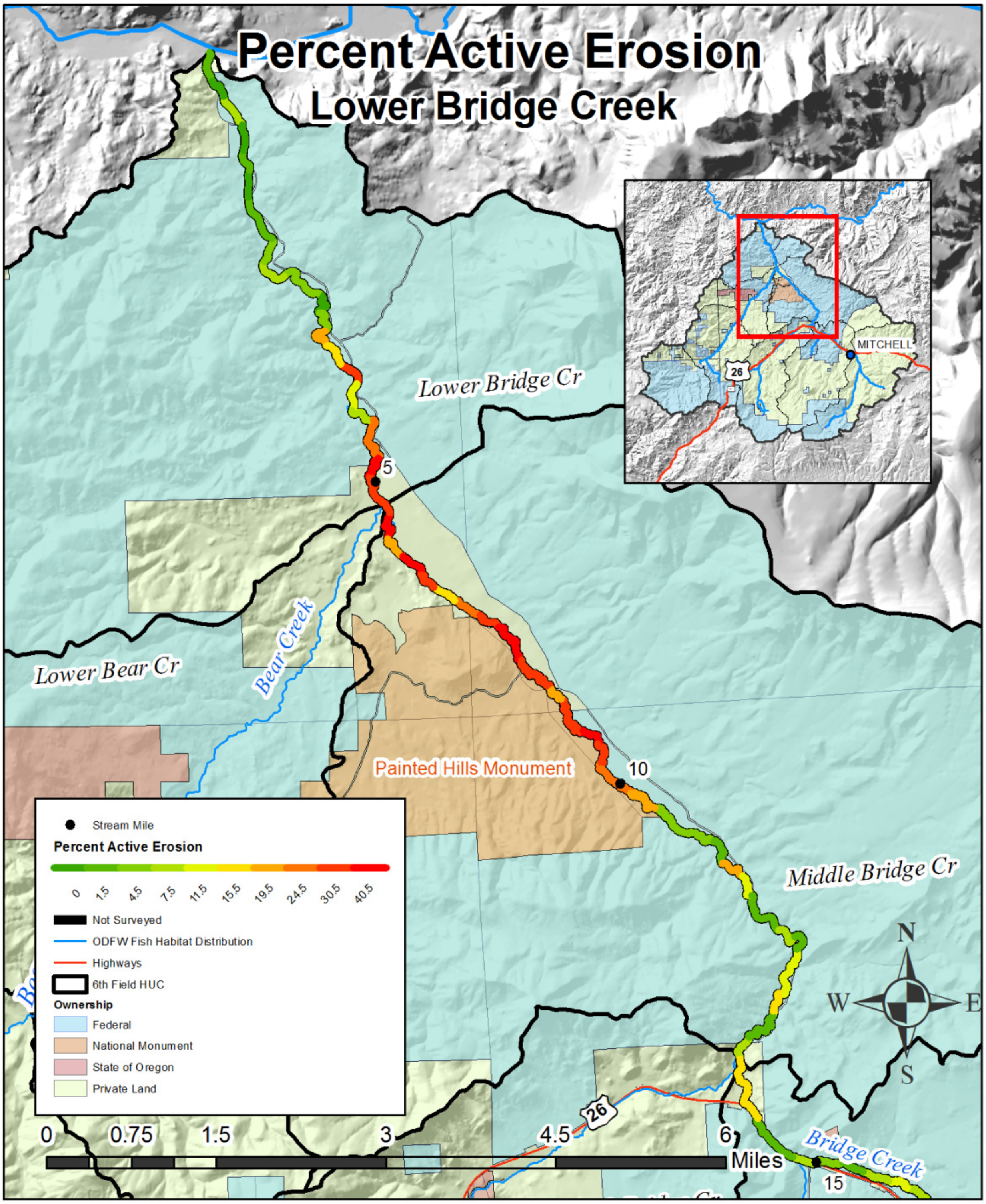

FIGURE 9 - SPATIAL DISTRIBUTION OF TOTAL ACTIVE EROSION (LOWER WATERSHED)

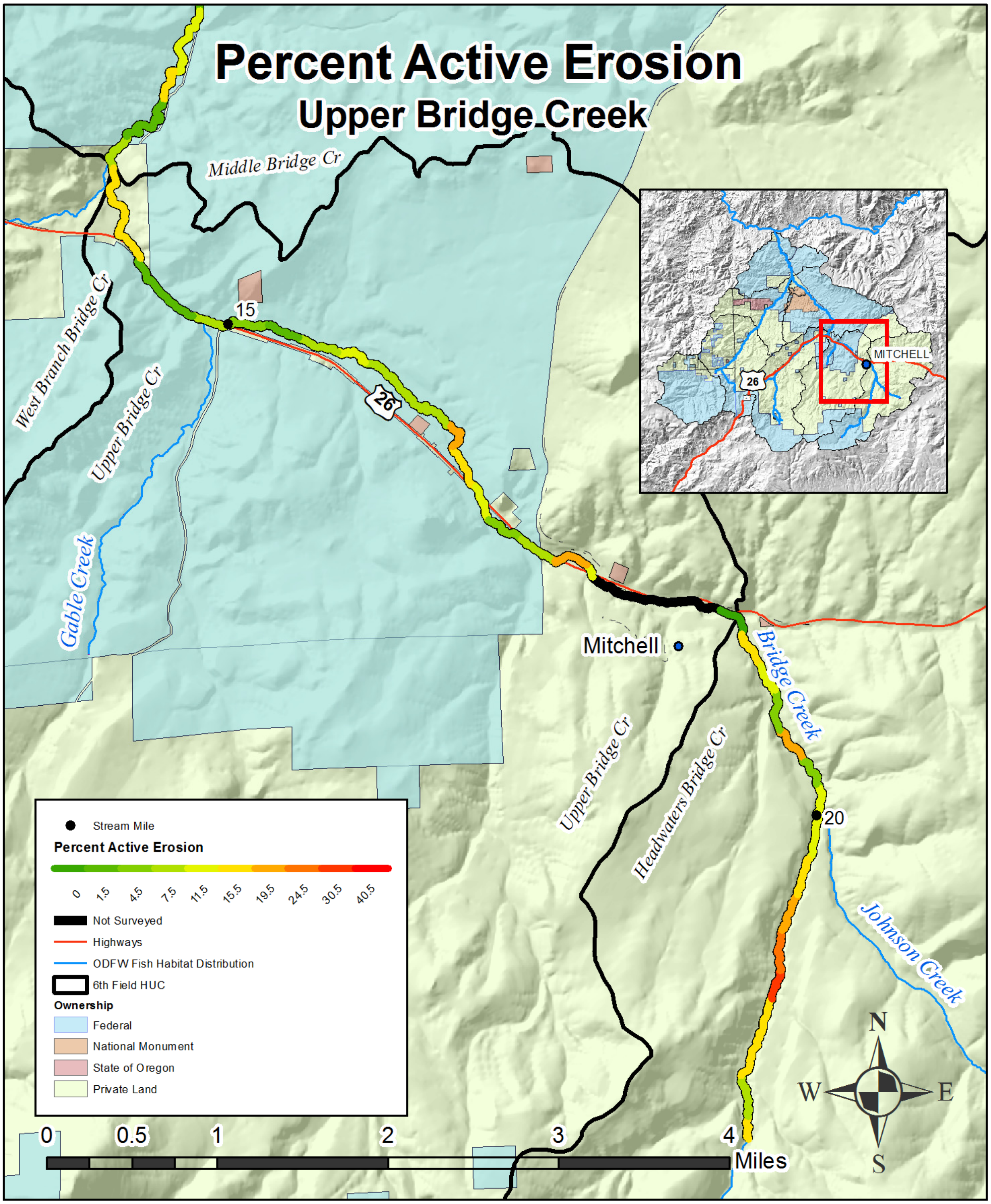

FIGURE 10 - SPATIAL DISTRIBUTION OF TOTAL ACTIVE EROSION (UPPER WATERSHED)

SHADING

Shading was measured for both the left and right bank of each unit using an inclinometer and recorded in degrees. The maximum shading possible for a given unit was a vertical 90 degrees. In determining the overall shading of a quarter-mile reach, the left and right shading angles of each unit were averaged and then averaged again on a length basis over the entire reach using the following formula:

$$Total\ Shading = \frac{\sum_{i=1}^{n}\left[Length_i \cdot \frac{Left\ Shading_i + Right\ Shading_i}{2}\right]}{\sum_{i=1}^{n} Length_i} \tag{2}$$

The distribution of the total shading metric is shown in Figure 11 and Figure 12. The spatial distribution of the total shading metric is shown in Figure 13 and Figure 14. The areas of poor shading are predominantly in the lower watershed with the lowest five river miles having the poorest ratings. There are areas of poor shading scattered through RM 8 - RM 17 with the majority of reaches showing good shading upstream of RM 17. Much of Bridge Creek between RM 5 and RM 8 shows a high degree of shading; but this may not indicate desirable stream conditions. Wheeler SWCD is currently working on a large scale multi-phase project in this reach that involves removal of Russian olive. Russian olive is an invasive species that was widespread throughout the watershed. Large-scale removal efforts have left this private landholding near the confluence of Bridge and Bear Creek as the last remaining stand of Russian olive in the watershed. Once the Russian olive trees are removed the shading through this segment will initially decrease, but eventually native vegetation will proliferate, resulting in increased shading and a more natural stream system.

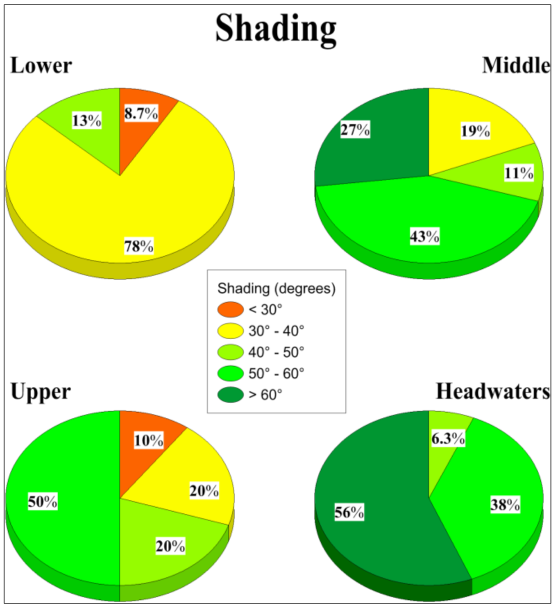

FIGURE 11 - REACH AVERAGED SHADING DISTRIBUTION

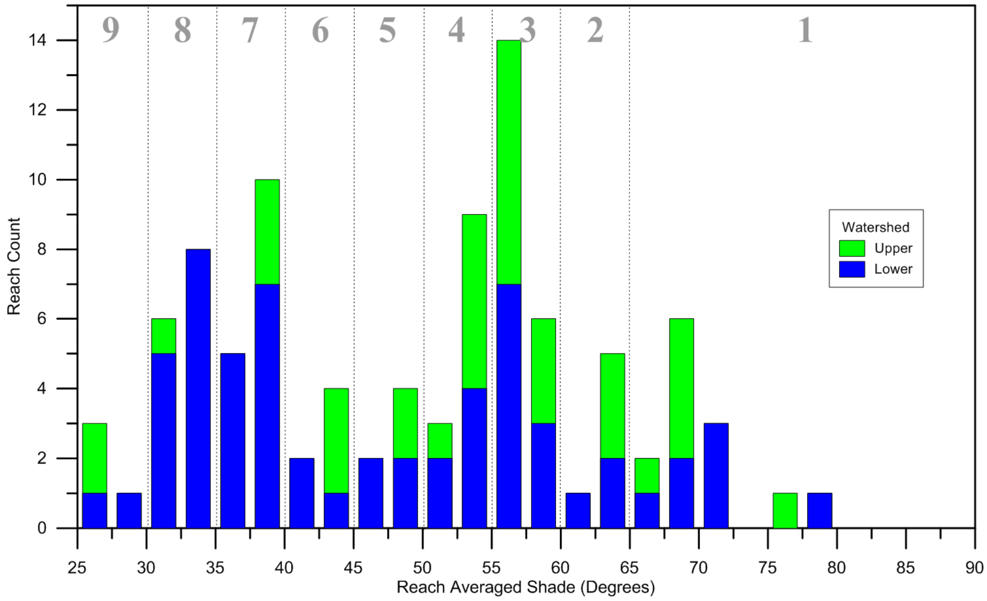

FIGURE 12 - DISTRIBUTION OF TOTAL SHADING METRIC

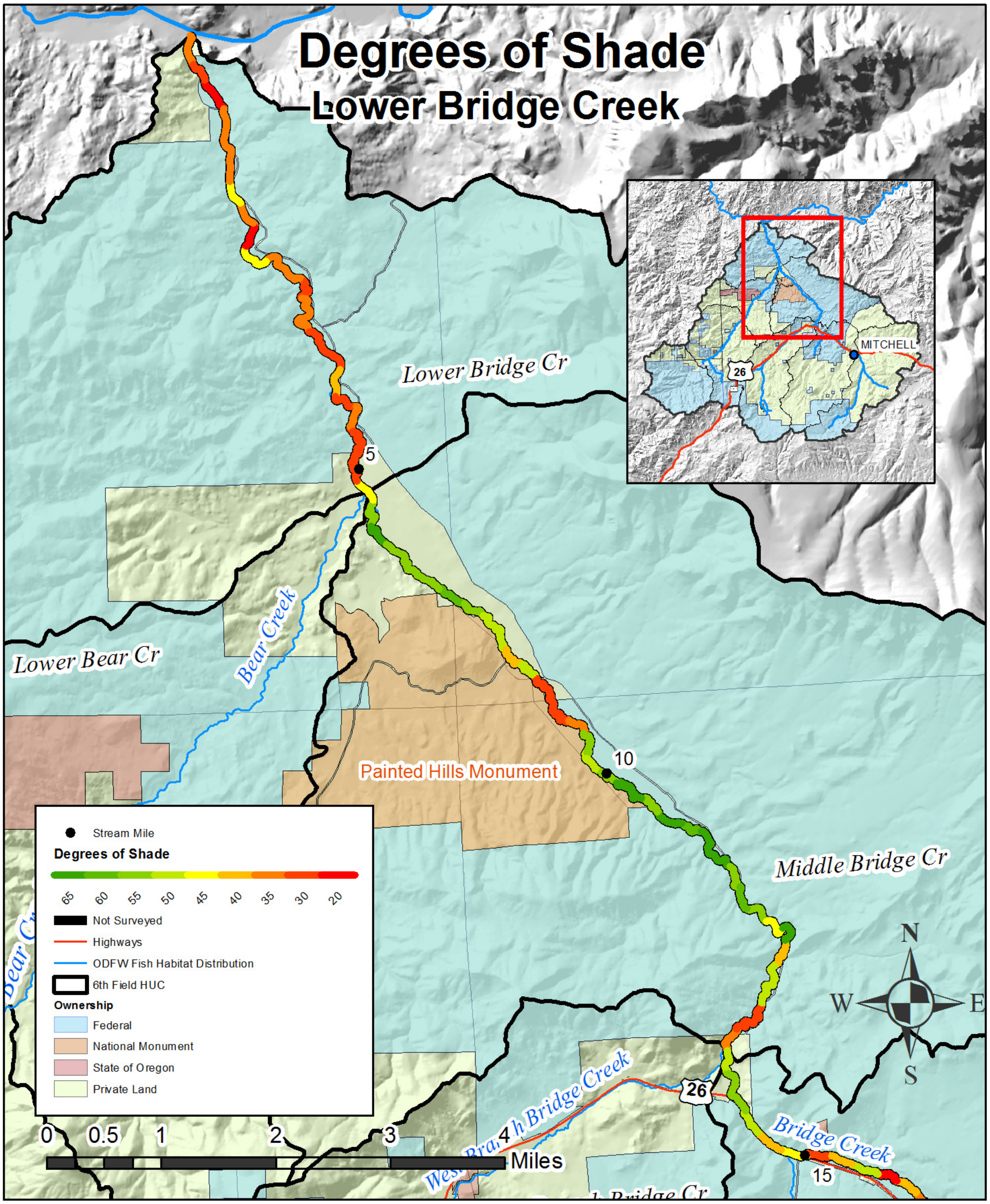

FIGURE 13 - SPATIAL DISTRIBUTION OF SHADING (LOWER WATERSHED)

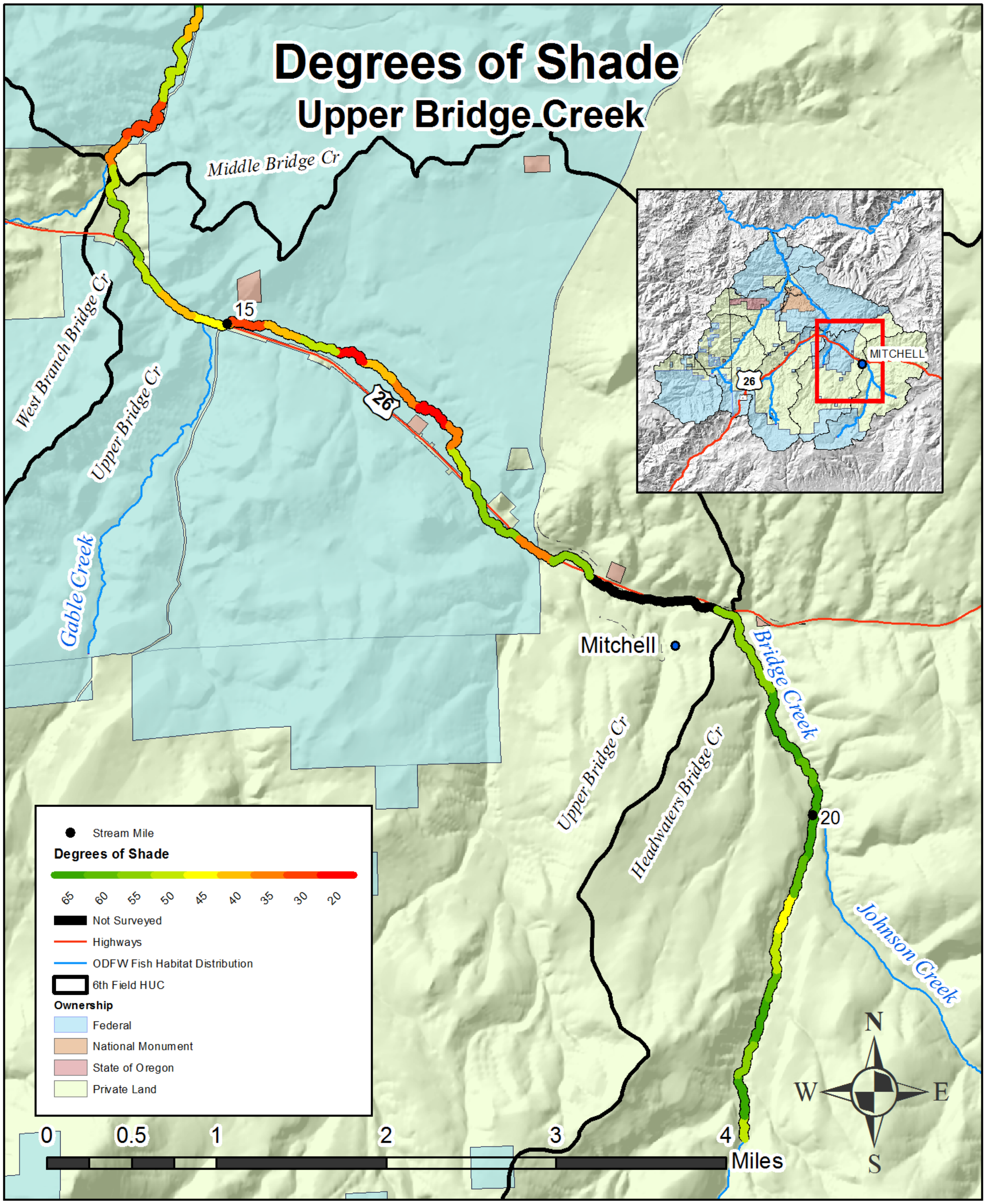

FIGURE 14 - SPATIAL DISTRIBUTION OF SHADING (UPPER WATERSHED)

HABITAT COMPLEXITY

Many different aspects are involved in assessing habitat complexity of a stream reach. Six separate metrics for habitat complexity were defined from the field survey data: average unit length, percent pool habitat, large boulder prevalence, woody debris prevalence, substrate composition, percent gravel, and percent pool habitat.

AVERAGE UNIT LENGTH

Instead of focusing on individual unit types (pool, riffle, glide, etc.), the average length of each unit was considered. By examining the frequency of change of the unit type it was possible to establish a single measure that would serve to quantify the diversity of habitat in each quarter-mile reach. More frequent unit changes (i.e. shorter unit lengths) was considered preferable to less frequent changes. The formula used for calculating the average unit length is as follows:

$$Average\ Unit\ Length = \frac{\sum_{i=1}^{n} Length_i}{n} \tag{3}$$

A histogram of the distribution of the average unit length is shown in Figure 15. The spatial distribution of average unit length is shown in Figure 16 and Figure 17. More frequent unit type changes are present in the upper watershed, which is consistent with a smaller stream channel. Normalizing the dataset according to average channel width could be incorporated into subsequent iterations to take this into account. The section with the longest distance between unit changes is the lowest 5.5 miles. There are two outliers in the lower watershed (as seen in Figure 15) which correspond to reaches at RM 0.6 and RM 1.4. Further investigation of these sites may be necessary to determine if there is a lack of overall habitat complexity, but this serves as a reasonable starting point for this investigation.

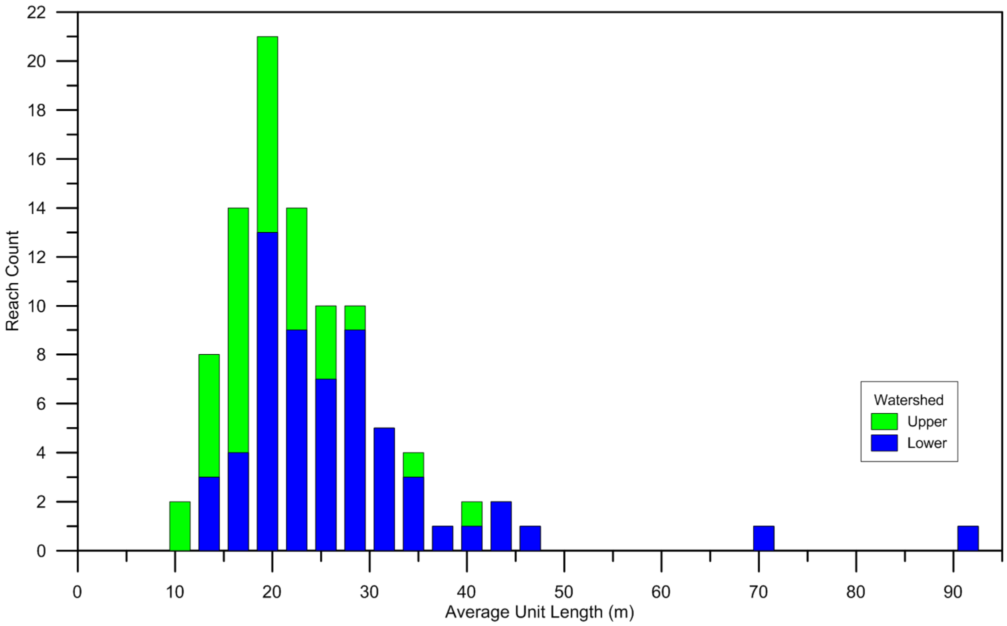

FIGURE 15 - DISTRIBUTION OF AVERAGE UNIT LENGTH