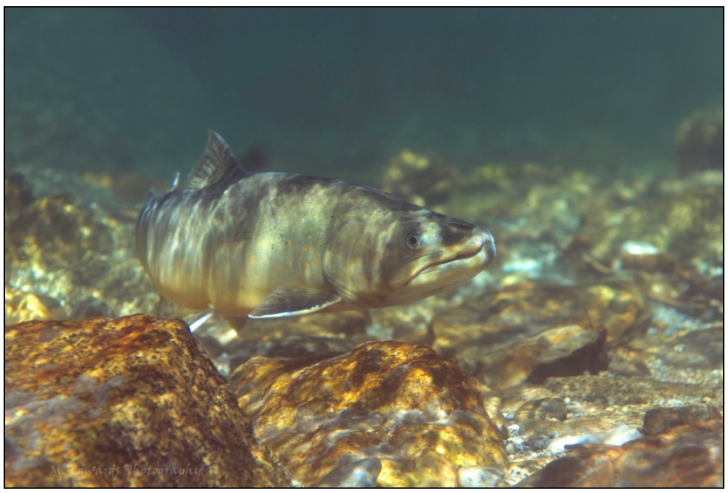
2017 Bull Trout Redd Monitoring in the Wallowa Mountains



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February 2018

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ABSTRACT

Bull trout were listed as threatened under the Endangered Species Act in 1998 due to declining populations. The U. S. Fish and Wildlife Service (Service) recommends monitoring bull trout in subbasins where little is known about the populations, including the Grande Ronde and Imnaha subbasins. Spawning survey data is important for determining relative abundance and distribution trends in bull trout populations. This report summarizes the 2017 bull trout spawning data collected in the Wallowa Mountains of northeast Oregon and compares this with past years' data. Bull trout spawning surveys have been conducted on similar index areas for selected Grande Ronde and Imnaha River streams from 1999 to 2017. These surveyed streams are located within the Wallowa River/Minam River and Imnaha River bull trout core areas. Surveys in 2017 were conducted by the Nez Perce Tribe (NPT), the Oregon Department of Fish and Wildlife (ODFW), the Service, U.S. Forest Service (USFS), Freshwater Trust, and fisheries consultants. Objectives of the survey included: (1) locate bull trout spawning areas; (2) determine redd characteristics; (3) determine bull trout timing of spawning; (4) collect spawning density data; (5) determine and compare the spatial distribution of redds along the Lostine River in 2006 through 2017; and (6) over time use all of the data to assess local bull trout population trends and the long-term recovery of bull trout. Timing of spawning, total redds, redd sizes, and redd locations are documented in the report. The local bull trout populations were relatively stable for the survey period (1999-2017). There was a decrease in redd numbers in Big Sheep Creek in 2017 compared to 2016. There was an increase in redd numbers on the Imnaha River, the Lostine River, and Bear/Goat Creek in 2017 compared to 2016. The increases were not significant for the Imnaha, the redd numbers were still low compared to 2014 and previous years. However, the increases were significant for the Lostine and Bear/Goat Creek. The Imnaha population is one of the strongholds within the Imnaha Subbasin. Big Sheep Creek and Little Sheep Creek populations within the Imnaha River core area are of concern for long-term viability due to issues with stream flows, fish passage, and connectivity. The Lostine River and Bear Creek contain brook trout and hybridization is likely occurring. In 2010 and 2012, bull trout and brook trout were documented paired up for spawning on the Lostine River.

ACKNOWLEDGMENTS

For the past fourteen years, the Service has provided staff time necessary for the coordination, implementation, and analysis and report summarization of this project. This project would not have been possible without the dedication, hard work, funding, and assistance provided by all the partners. Oregon Watershed Enhancement Board (OWEB) funding from 2007-2017 allowed the use of Del Sol Wilderness Adventures (2008-2017) for a horse/mule packer to pack our gear in and out of the Upper Imnaha to conduct our annual spawning survey in that drainage. I would like to thank the partners in 2017 which included the NPT, ODFW, the USFS, OWEB, GRMW, the Service, Freshwater Trust, and two fisheries consultants. Special thanks to the people who walked the streams, helped with scheduling surveys and surveyors, provided access to private property, packed us into remote areas to survey, assisted with the OWEB grants, produced maps with the GIS data, or summarized the data. These included: Gary Miller, Justin Martens, and Marisa Meyer (the Service); Sarah Brandy (USFS), Barry and Shirley Cox, Paul Arentsen, and crew (Del Sol Wilderness Adventures Horse/Mule Packers and Winding Waters River Expeditions); Jeff Oveson, and Mary Estes (Grande Ronde Model Watershed); Lynne Price and Jocelyn Hatch (consultants); Shane Vatland, Gus Johnson, Ryan Rumelhart, Lynne Price, Aaron Maxwell, Tyler Stright and Jim Harbeck (NPT); Kyle Bratcher (ODFW); Jessica Humphreys (Freshwater Trust) and private property landowners on the Lostine River.

1. INTRODUCTION

Bull trout were listed as threatened under the Endangered Species Act in 1998 due to declining populations. The Service recommends monitoring bull trout in subbasins where little is known about populations, including the Grande Ronde and Imnaha subbasins (USFWS 2002). The final bull trout recovery plan states that monitoring may include assessing distribution, population status, life history, migratory movements, and genetic characteristics of bull trout in each recovery unit (USFWS 2015). The Service's Mid-Columbia Bull Trout Recovery Unit Implementation Plan recommends continuing to monitor bull trout in the Imnaha Core Area, providing information on distribution and abundance for recovery. It also recommends development of a long term monitoring program to assess distribution, status and trend of bull trout in the Wallowa/Minam Core Area (USFWS 2015). Refer to Figure 1 (below) for location of these bull trout core areas within the larger Mid-Columbia Bull Trout Recovery Unit.

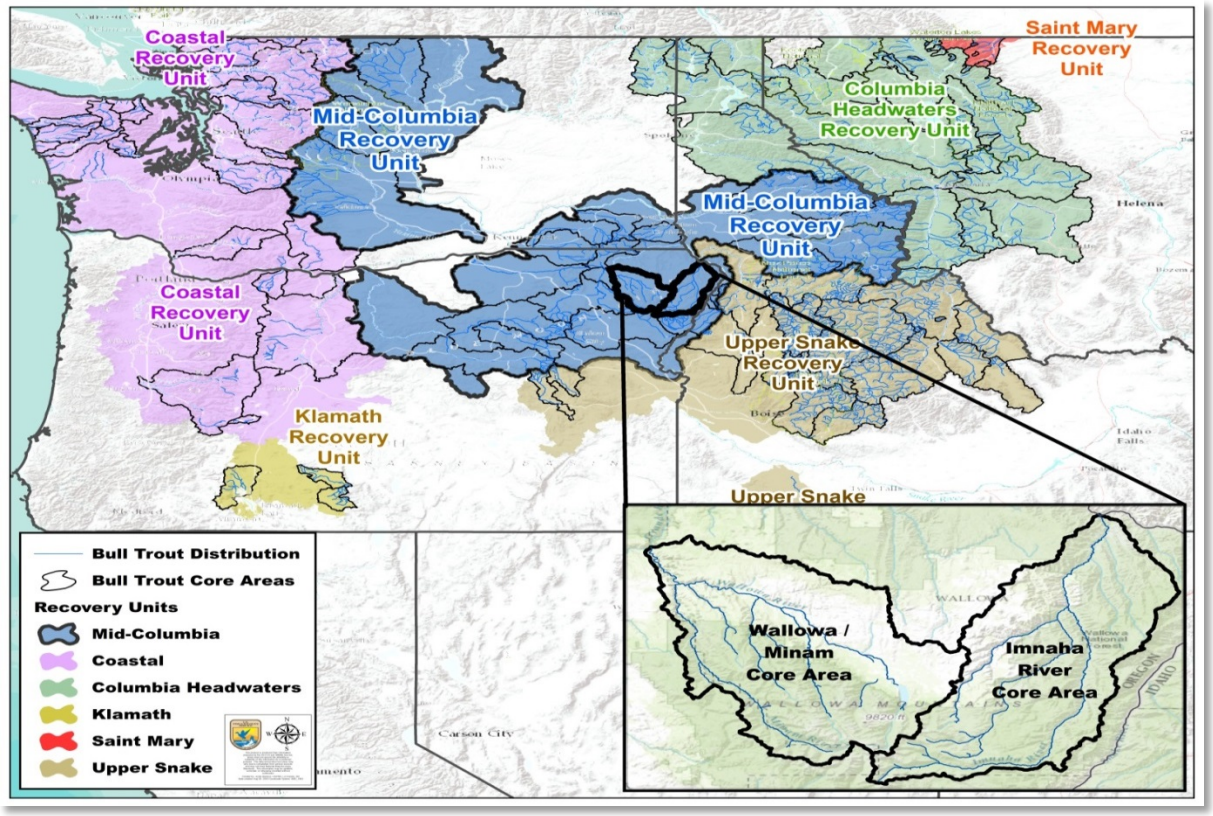

Figure 1. Map of Wallowa/Minam and Imnaha River Core Areas within the Mid-Columbia Bull Trout Recovery Unit

Securing adequate funding in order to fund a sufficient number of experienced bull trout surveyors, packers for surveys in the back-country, and to obtain adequate supplies to get the work accomplished has been difficult. OWEB funding for the project supported the continued survey of bull trout spawning areas in years 2007 through 2017 in the Wallowa Mountains of northeast Oregon. Bull Trout redd counts (spawning surveys) have been conducted annually on the Wallowa Valley, Hells Canyon National Recreation Areas (HCNRA), and Eagle Cap districts of the USFS and along some sections of private property of the Lostine River by the Service, NPT, ODFW, USFS, consultants, volunteers and others for the past 17 to 19 years.

Objectives of the bull trout spawning surveys include:

- Locate bull trout spawning areas.
- Determine redd (spawning nest) characteristics.
- Determine bull trout timing of spawning.
- Collect spawning density data.
- Map the location of the bull trout spawning reaches.
- Determine and compare the spatial distribution of redds along the Lostine River in 2005 through 2017. Collect UTM spatial redd data on Big Sheep, Lick Creek, and Middle Imnaha to compare at a later date.
- Assess population trends for local bull trout populations.
- Use this information for helping assess the long-term recovery of bull trout.

1.1 LOCATION

The Service, and multiple partners, conducted bull trout spawning surveys in 2017 on selected streams in the Grande Ronde and Imnaha Subbasins. These streams are located within the Wallowa River/Minam River and Imnaha River bull trout core areas. Stream systems surveyed in 2017 for bull trout redds included the Lostine River, Bear and Goat Creeks, the Imnaha River, Big Sheep Creek and Lick Creek (Figure 2). In 2014 and 2015, exploratory surveys were conducted on tributary streams to the Wallowa River upstream of Wallowa Lake, the West Fork and East Fork Wallowa Rivers commencing at Wallowa Lake and surveying to the upstream waterfall on the West Fork Wallowa River, and surveying the East Fork Wallowa River from the confluence with the West Fork Wallowa River upstream to the first waterfall. The Service was not granted access to private property along the East Fork Wallowa River in 2016; therefore, this survey was not conducted. PacifiCorp Energy collected data on the East Fork Wallowa River in 2017 for their Wallowa Falls Relicense Project (PacifiCorp 2017). In 2017, Deer Creek was surveyed from Road 8270 upstream 0.8 miles.

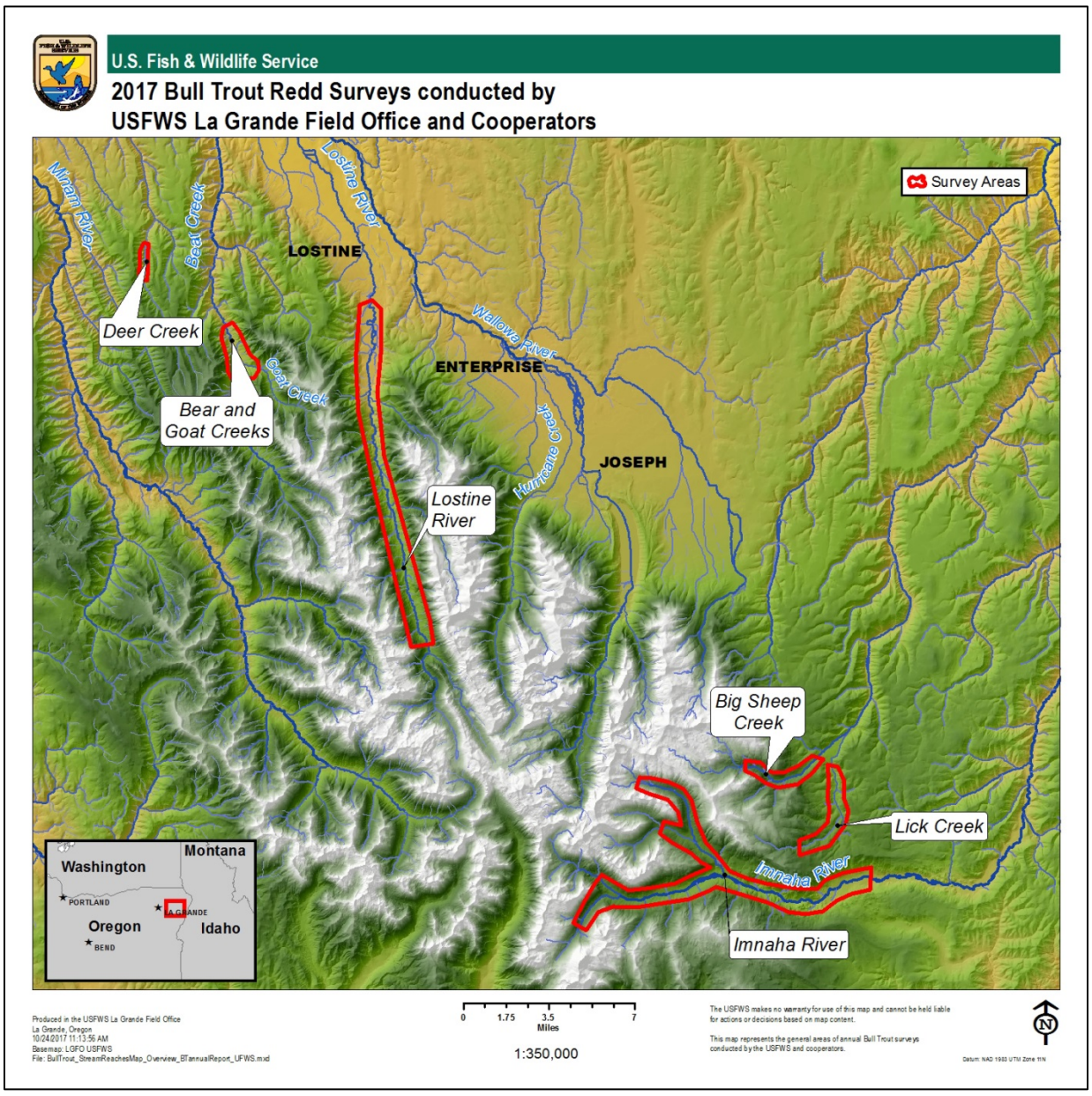

Figure 2. Wallowa Mountain Bull Trout Redd Survey Areas.

2. METHODS

Bull trout spawning surveys on large rivers require as many as ten to twelve people in one day to complete the surveys. Surveyors walk the rivers through the selected "index areas" to locate bull trout redds. Index areas in this report refer to known bull trout spawning reaches that have been surveyed in the same consistent locations on an annual basis.

This project is part of a larger effort in NE Oregon and SE Washington that occurs during September through October, the bull trout spawning period. Due to the lack of available experienced surveyors to conduct these surveys, we have had to increase our survey days on the accessible sections of the Lostine and Imnaha Rivers to two days, conducting half of the survey length one day and the other half the following day. Surveys were conducted twice (mid and late bull trout spawning season) on the Lostine River, Middle Imnaha (Blue Hole to Indian Crossing), and Bear and Goat Creeks. One-time surveys were conducted late in the spawning season in

2017 (as in past years), on the Upper Imnaha River and tributaries, due to access and funding limitations. Due to weather, Lick and Big Sheep were surveyed once late in the spawning season. An exploratory survey was conducted on Deer Creek for approximately 0.8 stream miles. Appendix B, Table 1 compares survey data and survey frequency for 1999-2017 bull trout spawning surveys on selected Grande Ronde and Imnaha River streams. Stream miles surveyed (not including repeat surveys) for the above streams totaled 41.3 in 2007, 46.3 in 2008, 41.8 in 2009, 41.1 in 2010, 41.7 in 2011, 40.9 in 2012, 35.0 in 2013, 42.3 in 2014, and 43.3 in 2015 and 2016 and 41.1 in 2017. In 2013, there were less stream miles surveyed in the Upper Imnaha due to lack of personnel and weather conditions. Total redd numbers are all redds documented, and not necessarily comparable river miles (refer to Appendix B, Table 2a-2d for comparable reaches and redd counts for those sections).

Montana Pagano of NPT, measuring a bull trout redd on the Upper Imnaha River in 2012

The survey protocol (in addition to repeat surveys, or one-time late surveys where feasible) included; 1) visits to known bull trout redds and review of survey form prior to redd count survey, 2) experienced bull trout redd count surveyor(s) paired with inexperienced surveyor (on the job training), 3) bull trout redds measured, data recorded, and redds flagged during survey, and 4) all stream flagging removed post-surveys.

Data recorded during the bull trout spawning surveys include: 1) date of survey; 2) stream location; 3) size of redds; 4) visibility of redds; 5) number of redds; and 6) approximate number and sizes of bull trout observed during surveys. In past years, reach locations (upstream and downstream boundary UTM coordinates) were documented. In 2009 through 2017, in addition to the above information, bull trout redd UTM locations on the Lostine River, Big Sheep Creek, Lick Creek, and Middle Imnaha within the “index areas” also were collected. Information collected during the bull trout spawning surveys is compiled and stored by the Service’s La Grande Field Office and made available to other agencies (i.e., this report).

Jessica Humphreys (Freshwater Trust) surveying
SF Imnaha River in 2017
bull trout fluvial size redd in photo
Photo by Kyle Bratcher, ODFW

3. RESULTS

3.1 Location of Bull Trout Spawning Habitat Areas Surveyed

Bull trout spawning surveys have been conducted on similar index areas for selected Grande Ronde and Imnaha River streams from 1999 to 2017. These surveyed streams are located within the Wallowa River/Minam River and Imnaha River bull trout core areas. During these years, bull trout spawning areas have been established for these streams, in particular, the Lostine and Imnaha Rivers. Redd characteristics have also been measured on these streams. The Middle Imnaha, consisting of the Imnaha River from the fish weir below Gumboot confluence to Indian Crossing, was not surveyed in 2005 through 2017, but this area was surveyed from 1999 to 2004 and is considered bull trout spawning habitat. This portion of known bull trout spawning habitat on the Imnaha was not surveyed for the past twelve years because of limited funding, a minimal number of redds documented in this area in past years, and the fact that this area is used extensively by spring chinook spawners and distinguishing between the two when looking at large bull trout redds or smaller chinook redds can be challenging. Bear Creek and Goat Creek were surveyed as in past years but the survey area of Bear Creek and Goat Creek increased from 1.9-3.8 total miles between 1999-2006 to 7.2 in 2007, and the survey frequency increased from generally once during the years 1999-2006 and twice in 2007. Although the survey area increased in 2007, the redd numbers did not increase substantially, especially in the lowermost survey reaches. In 2008 through 2014, and 2017, the surveys were conducted twice in the

spawning season and an additional 1.4 miles of Bear Creek was surveyed upstream of the comparable reach for a total of 3.2 miles. In 2015 and 2016, one additional reach was surveyed on Bear Creek, from the Boundary Campground Trail Bridge to 1.0 miles downstream at the Forest Rd 8250 bridge on Bear Creek, for a total of 4.2 miles. In 2014 and 2015, a survey for approximately 1.3 miles of stream was conducted on West Fork Wallowa River and approximately 0.7 miles of stream was surveyed on the East Fork Wallowa River. These are tributaries to the Wallowa River located upstream of Wallowa Lake. This survey was not conducted in 2016, as the Service was not granted access to private property along the East Fork Wallowa River. In 2017, the East Fork Wallowa River was surveyed as part of PacifiCorp Energy's Wallowa Falls Hydroelectric Relicense Project (PacifiCorp 2017). Deer Creek was surveyed in 2017, from Road 8290 junction to upstream 0.8 miles.

3.2 Timing of Bull Trout Spawning

Bull trout that were radio-tagged in the Snake River began moving into the lower Imnaha River in late-April, and continued upstream through May, June, and July, with all of the fish reaching the upper river by August to escape increasing water temperatures in the lower river (Idaho Power Company 2015). By late-July/early-August, almost all fluvial bull trout have moved upstream of the Imnaha Satellite Facility (ODFW, unpubl. capture data). In 2017, the Imnaha Satellite facility had some problems passing bull trout upstream in the summer/fall. It is not clear how this might have affected upstream spawning and/or migration. After spawning, adult bull trout soon move back downstream (Ringel et al. 2014). In the Imnaha River, downstream outmigration begins in September and continues through November (Idaho Power Company 2015).

In general, timing of bull trout spawning for our surveyed streams is approximately September 1 through October 15, and as early as August 15 in the Imnaha River system. The Lostine River has been very consistent or predictable, with commencement of spawning documented in 2006 as early as the first week in September, but the Imnaha, a much larger system, has been less predictable. The above dates are based on documentation during bull trout spawning surveys and chinook surveys where bull trout were spawning.

Bull trout fluvial pair spawning in the Lostine River in 2014
Photo by Lynne Price

We are not certain when spawning commences and ends within the Upper Imnaha, which includes; the mainstem, North Fork, South Fork, and Cliff Creek (a resident tributary). There are questions as to what time of the year bull trout pass over the falls as timing is dependent on annual flows. Some years we have seen fluvial-size bull trout spawning in the South Fork Imnaha in mid-late September to early October; however, in recent years, excluding 2017, we have not. In 2013, there were a few redds not measured in the South Fork Imnaha and Imnaha River, from the Upper Falls to Lower Falls, due to the redds still in progress. ODFW observed large fluvial bull trout spawning in the South Fork Imnaha River in mid-August 2005 (B. Knox, ODFW, pers. comm., 2005). ODFW has also observed fluvial bull trout spawning as early as mid-August, during chinook surveys, below the Imnaha falls and as late as early October, during our bull trout surveys (B. Smith, ODFW, pers. comm., 2005). In 2011, Upper Imnaha had smaller-sized redds reported than in previous years. This could be an indicator of smaller fish, however, the documented fish sizes suggest fluvial fish; or perhaps due to weather and stream conditions, the fish were spawning later and these redds were incomplete. Cliff Creek, a resident bull trout tributary stream to South Fork Imnaha, had several redds that were still in progress at the time of the 2012 survey. In 2017, 100 percent of redds in Cliff Creek were unoccupied (older redds) (Ryan Rumelhart, pers. comm. NPT, 2017). In 2017, the majority (>85%) of redds on the Imnaha (Blue Hole upstream to Cliff Creek) were completed prior to the September 25-27th survey dates. Additional years of observation and data are needed to fully understand bull trout spawning and adult movement in the Imnaha Subbasin, and Big Sheep and Bear Creek Watersheds.

Fluvial bull trout spawning pair in the Middle Fork Imnaha River
Photo by NPT, 2012

3.3 Total Number of Bull Trout Redds

Lostine River

Refer to Appendix B; Table 3a and 3b for bull trout redd count summary data for 2017. In 2017, a total of 52 bull trout redds were documented on 10.1 miles of the Lostine River, including Pole Bridge to Six Mile Bridge. The Pole Bridge to Six Mile Bridge section has not been surveyed every year. The following data for the Lostine River compares consistently surveyed index areas on the Lostine River (8.5 miles) from 1999 to 2017, excluding the Pole Bridge to Six Mile section (Figure 3). The Lostine River had a low of 19 redds in 2011, and a high of 70 redds in 2003. If you disregard the 2003 redd count of 70, which appears to be an outlier, 2017 had the highest redd count on the Lostine with a total of 52 redds. The seventeen-year average from 1999 to 2017 (subtracting out 2003, which had an outlier of 70 redds) for the Lostine River is 35.8 redds. The highest bull trout redd numbers ("the bread and butter") within the Lostine River has consistently been observed and recorded in the headwaters, from Shady Campground to Bowman, at approximately River Mile (RM) 24.5 to RM 22. In 2017, both upper reaches, Shady Campground to French Camp and French Camp to Bowman had the highest redd densities, and for this year, this was the only place on the Lostine where redds were observed (27, and 25, respectively).

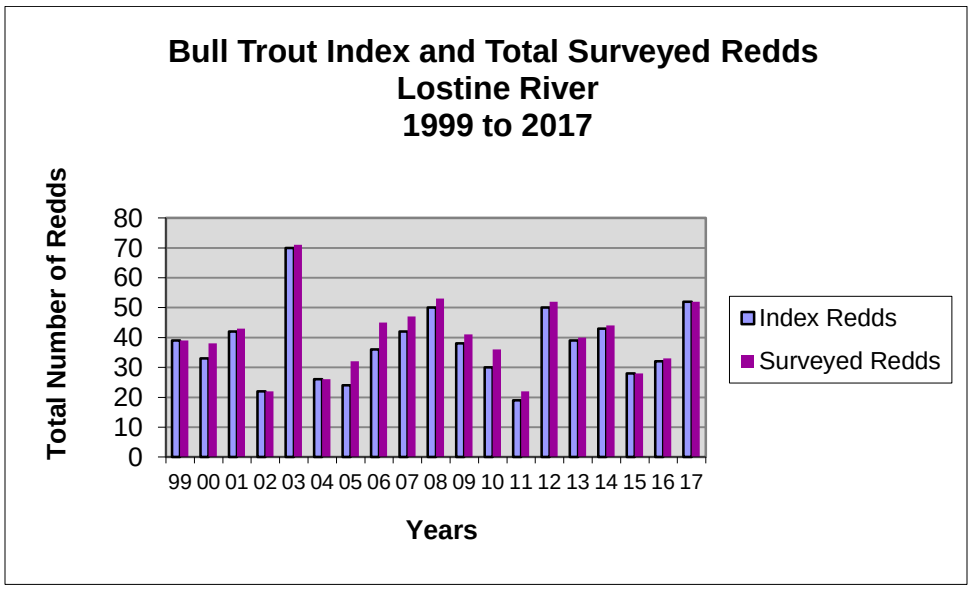

Figure 3. Comparison of bull trout surveyed redds and index redds (comparable miles) documented from 1999 to 2017 on the Lostine River.

Bear Creek

In 2017, 15 bull trout redds were documented on 3.2 miles of Bear Creek (including Goat Creek). The following data for Bear Creek compares consistently surveyed index areas on Bear Creek and Goat Creek (1.9 miles) from 1999 to 2017 (Figure 4). Redd counts on Bear Creek and Goat Creek had a low of two redds in 2015 and a high of 19 total redds in 2011, which is the highest count for the index area. The nineteen-year average from 1999 to 2017 is 10.3 redds for Bear and Goat Creeks. Bear Creek/Goat Creek spawning data collected from 1999 to 2006 is restricted in scope due to access and funding limitations, and surveys in 2007 were expanded to help identify total spawning area for bull trout in Bear and Goat Creeks. Although the survey area increased in 2007, the redd numbers did not increase substantially, especially in the lowermost survey reaches. The 2008 through 2014 and 2017 surveys were conducted twice in the spawning season and an additional 1.4 miles of Bear Creek was surveyed upstream of the comparable reach for a total of 3.2 miles. In 2015 and 2016, one additional reach was surveyed on Bear Creek, from the Boundary Campground Trail Bridge to 1.0 miles downstream at the Forest Rd 8250 bridge on Bear Creek, for a total of 4.2 miles. The highest bull trout redd counts for the survey sections on Bear/Goat Creeks have been recorded in Goat Creek, from the mouth to the waterfall, (RM 0 to RM 0.9), except in 2008, when more redds were documented in Bear Creek than in Goat Creek.

The local bull trout population in the Lostine and Bear Creek surveys appears to be relatively stable for the survey period (1999-2017). Lostine River redd numbers increased to 52 redds from lower redd numbers in years 2013-2016 (39. 43, 28, and 32 redds). Bear Creek redd numbers increased to 15 redds in 2017, compared to lower counts in 2015 and 2016 (2 and 4 redds).

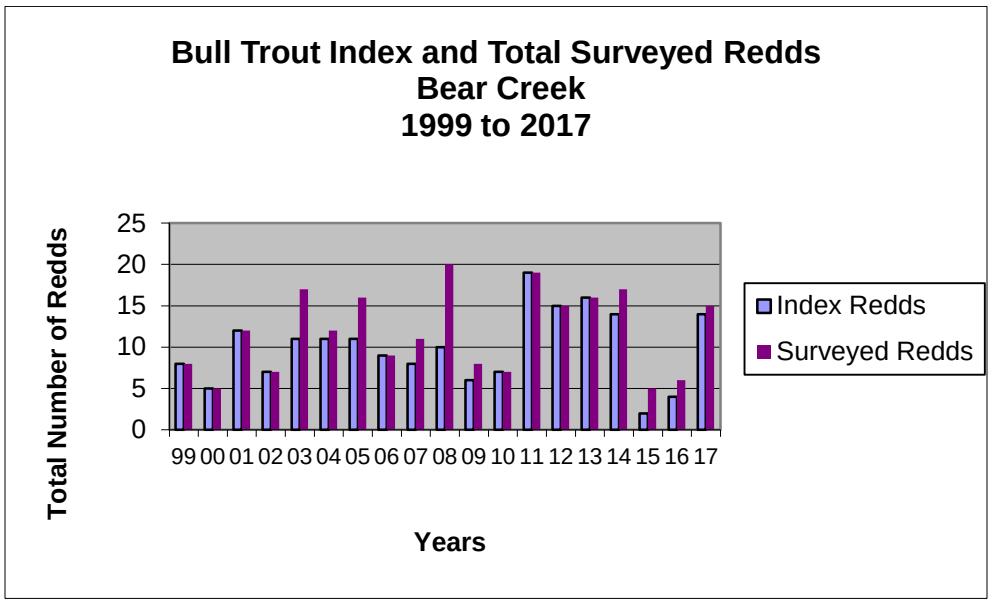

Figure 4. Comparison of bull trout surveyed redds and index redds (comparable miles) documented from 1999 to 2017 on Bear Creek, including Goat Creek.

Imnaha River

In 2017, 153 bull trout redds were documented on 19.4 miles of the Imnaha River, from Indian Crossing to Blue Hole and upstream. In 2017, Indian Crossing to Blue Hole was surveyed twice, mid and late spawning season, and upstream areas were surveyed once, mid spawning season. The following data for the Imnaha River compares consistently surveyed index areas on the Imnaha River (17.5 miles) from 2001 to 2017 (Figure 5a). The seventeen-year average from 2001 to 2017 (excluding 2013) was 171.6 redds for the Imnaha River system. Total redd numbers on the Imnaha ranged from 101-262 within that period. The highest bull trout redd counts for the Imnaha River from 2001 to 2012 was recorded in the Upper Imnaha from Blue Hole to Cliff Creek, including Upper Imnaha tributaries. In 2006 through 2008, 2014 through 2015, and 2017, there was a significant shift in documented spawning distribution. In these years, the majority of the spawning bull trout were located from the Imnaha falls to Indian Crossing, whereas, in other years the distribution had higher numbers above the Blue Hole (located two miles upstream of Indian Crossing), as well as distribution of spawning bull trout in the upper tributary streams (South Fork and North Fork Imnaha River). In 2014, the distribution was fairly evenly distributed between all Imnaha reaches. In 2017, resident Cliff Creek had the highest redd densities, with 60 redds for 2.5 miles surveyed. South Fork Imnaha and Upper Imnaha had the next highest redd densities for 2017 with 32 and 22 redds for 4.5 and 3.3 miles surveyed. Eleven redds in the Middle Imnaha (Indian Crossing to Blue Hole) for 2 miles surveyed, and 28 redds in the North Fork Imnaha River for seven miles surveyed.

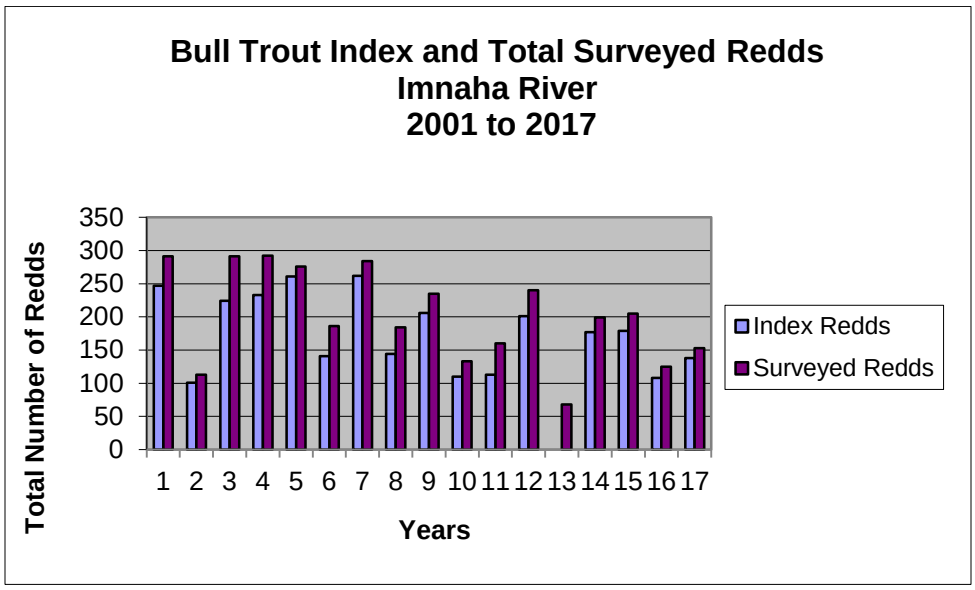

Figure 5a. Comparison of bull trout surveyed redds and index redds (comparable miles) documented from 2001 to 2017 on the Imnaha River. Index redds are not shown in 2013, since locations and miles are not comparable to past years.

In 2009, Cliff Creek, a resident bull trout tributary to South Fork Imnaha, had the greatest total number of redds at 164 redds. But in 2010, 2011, and 2012 the redd count in this stream decreased to 45, 46, and 65, respectively. This lower count in Cliff Creek created a large decrease in the total count for the Imnaha during 2010 and 2011. Sixty-nine percent of the total redds counted on the Imnaha in 2009 were from Cliff Creek and in 2010 and 2011 this percentage decreased to 34 percent. In 2012, 175 redds, (73%) of the total redds documented on the Imnaha, were fluvial and resident redds as compared to 71 redds (30%) in 2009. There was an upward trend in the Imnaha River population in 2012 with downward trend in the population in 2014 through 2016. If you subtract the resident Cliff Creek population from the Upper Imnaha redd counts, there is a substantial downward trend from 2009 through 2011. In 2017, 78 bull trout redds were documented on 16.9 miles of the Imnaha River, from Indian Crossing to Blue Hole and upstream (excluding Cliff Creek). The sixteen-year average from 2001 to 2017 (excluding 2013) was 116 redds for the Imnaha River system (excluding Cliff Creek). Within that same time period, total redd numbers (minus resident Cliff Creek) for fluvial/resident bull trout on the Imnaha ranged from 71-236. Cliff Creek and several other Upper Imnaha reaches were not surveyed in 2013 (Figure 5b).

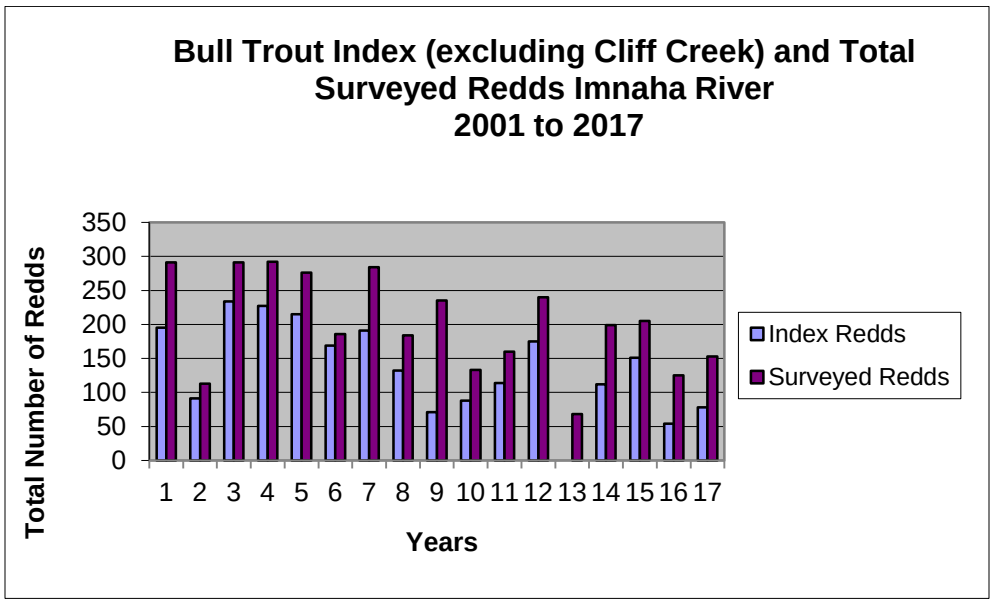

Figure 5b. Comparison of bull trout surveyed redds and index redds (comparable miles excluding Cliff Creek) documented from 2001 to 2012, and 2014-2017 on the Imnaha River. Index redds are not shown in 2013, since locations and miles are not comparable to past years and Cliff Creek not surveyed in 2013.

Big Sheep Creek/Lick Creek

In 2017, five bull trout redds were documented on 7.6 miles of Big Sheep Creek and Lick Creek. These areas were surveyed once in 2017, late spawning season. The following data for Big Sheep Creek compares consistently surveyed index areas on Big Sheep and Lick Creek (7.6 miles) from 2000 to 2016 (Figure 6). The seventeen-year average from 2000 to 2016 was 17.8 redds for the Big Sheep system. Total redd numbers within the Big Sheep system ranged from 5-38 within that period; with the highest redd count of 38 in 2011. Redd surveys for bull trout in the Big Sheep system have been limited in frequency and in miles of survey (7.6 to 14.1 miles from 2000 to 2016). Surveys in 2000, 2001, and 2017 were conducted once late season. Surveys in 2002, 2003, and 2005 through 2016 were conducted twice, mid and late season, except for lower Lick Creek survey area that was monitored only once in 2010, due to lack of surveyors. In 2004, the survey was conducted once late season for Big Sheep and twice, mid and late season for Lick Creek.

The local bull trout population, in Big Sheep and Lick Creeks appear to be relatively stable, with a possible decline for the survey period (2000-2017). There was an increase in redd numbers in Big Sheep in 2011 and a decrease in redd numbers in 2012-2017. Redd numbers were the lowest in 2017, and no redds were observed on Big Sheep Creek in 2017.

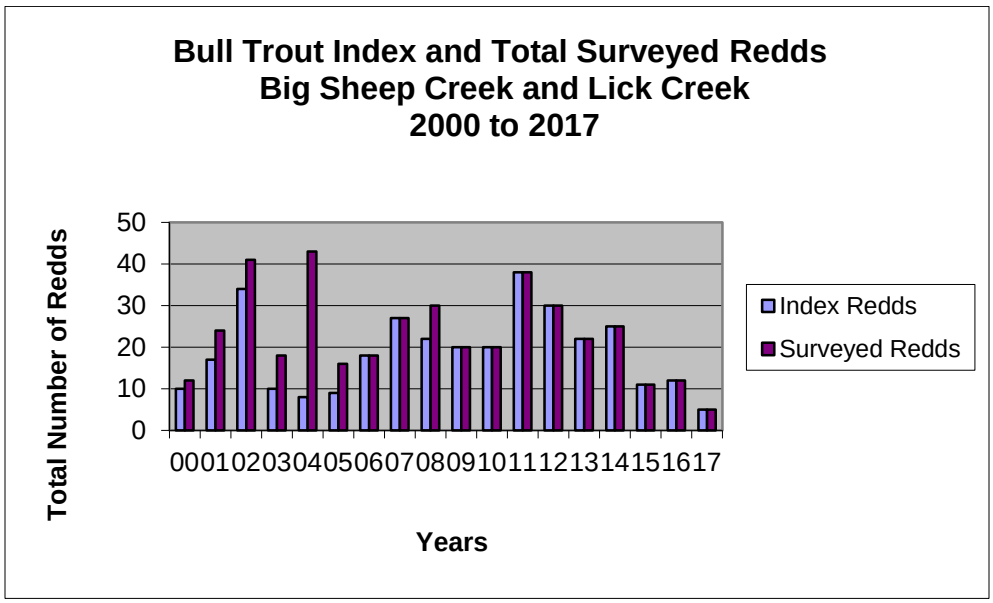

Figure 6. Comparison of bull trout surveyed redds and index redds (comparable miles) documented from 2000 to 2017 on Big Sheep and Lick Creeks.

3.4 Sizes of Bull Trout Redds

Bull trout redds were measured using the same methodology in 2004 through 2017. A comparison of bull trout redd sizes, by mean redd area (m^2), for these years is illustrated below (Figures 7 & 8). There is a relationship between the size of a female salmonid and the size of the redd; large fish make large redds (Bjornn and Reiser 1991; P. Sankovich, Service, pers. comm., 2006; Howell and Sankovich 2012). In addition, length/frequency distributions of mature resident bull trout and mature fluvial bull trout do not overlap; therefore, there is little overlap in size of redds (P. Sankovich, pers. comm., 2006).

Howell and Sankovich (2012) report that redd surveys that include estimates of redd area and spawner lengths, could be used to sort migratory versus resident forms, which are useful attributes in assessing the status of populations. Resident adult bull trout are thought to be smaller than migratory bull trout (<300 mm) and continuously reside in the same habitat where spawning and rearing occur (Mullan et al. 1992; Pratt 1992; and Nelson et al. 2002). In bull trout populations, life history forms have been classified as migratory or resident based on general migration patterns and relative body size (Rieman and McIntyre 1993). Howell et al. (2016) reported in their bull trout demographic study on Mill Creek, that although life history terminology is useful for describing broad patterns, it fails to capture the diversity and complexity within and among populations.

Bull trout redd size data is shown below for the Lostine/Bear and Imnaha systems comparing resident and migratory forms annually for these streams.

Lostine/Bear/Goat

Figure 7 compares bull trout redd sizes for the Lostine River, Bear Creek, and Goat Creek in 2004-2017. Mean redd area (m^2) ranged from 0.9-2.3 for the Lostine, 0.3-0.9 for Goat Creek, and 0.2-1.0 for Bear Creek. In 2011, the Lostine River had the largest mean redd area (m^2) of 2.3 documented for this stream to date. In 2017, the mean redd area documented was 1.0 (fluvial size redd dominant). The Bear Creek sample area was expanded in miles surveyed in 2007 and in 2015-2016 (7.2 and 4.2 miles, respectively). In past years the redd area was smaller and more

typical of resident redds, but in 2007 the redd area was larger and more typical of fluvial size bull trout redds. Bull trout redds were not observed or documented in Bear Creek within the index area in 2006, a single redd was documented in 2013, and six redds were documented in 2017 with a mean redd area of 0.8 (showing a fluvial size dominance).

Goat Creek is limited in available spawning habitat, but it appears to be the best available spawning habitat for fluvial fish in the Bear/Goat Creek system during drought years. Several miles of upper Bear Creek were dry due to low snowpack and summer drought conditions. It appears from the data in 2004-2017 that redds in Goat Creek were a combination of resident and fluvial fish, and in 2011, 2012, 2013, and 2017 dominated by more resident size redds, and in 2014-2016 dominated by fluvial size redds. Seven of the nine (78%) redds measured on Goat Creek were resident size (redd area <.32 mm). The redd sizes in both the Lostine River and Bear Creek in 2011, 2012, and 2014-2015 were dominated by fluvial size fish. In 2017, the Lostine River continued to have dominance in fluvial size redds, and Bear Creek (including Goat Creek), had 60 percent resident and 40 percent fluvial size redds. More years of data collection relative to fish and redd sizes on these streams should help us better understand the resident and fluvial life histories of bull trout in this area.

Brook trout are thought to be abundant in Bear Creek due to historical stocking in the headwater lakes. The Lostine River contains brook trout, but for most survey years, brook trout spawning with bull trout was not observed. This changed in 2008, and more recently in 2012, where they appeared to be spawning together and hybrid fish were observed. However, to date, genetic sampling for bull trout/brook trout in the Lostine and in Bear Creek has not occurred.

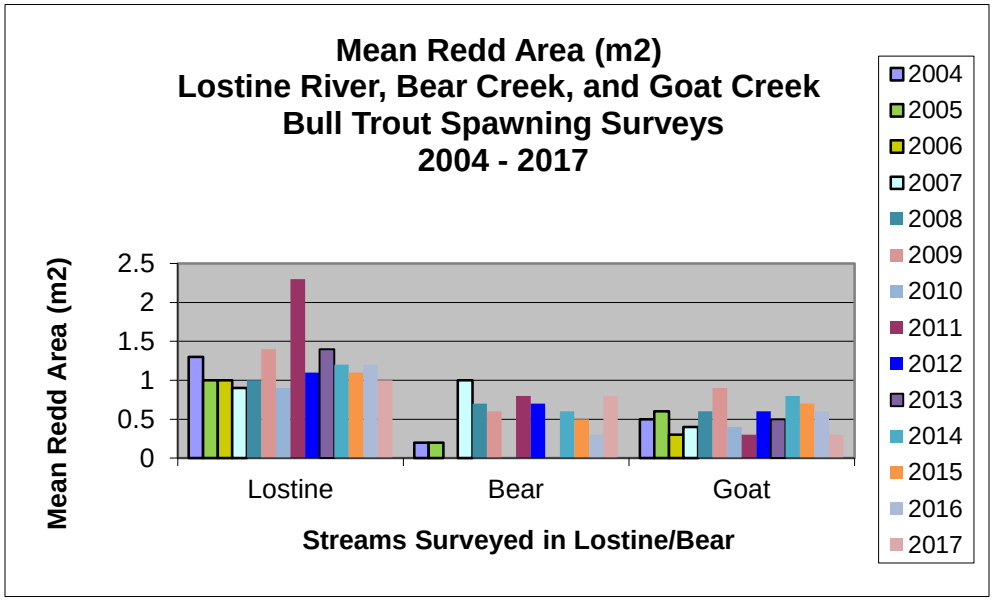

Figure 7. Comparison of bull trout redd sizes [mean redd area (m^2)] for Lostine River, Bear, and Goat Creeks sampled during bull trout spawning surveys, 2004-2017.
Footnote: Bull trout redds were not observed in the index area of Bear Creek in 2006 and one extremely large fluvial redd was observed in 2010 (not included on graph, considered an outlier).

Imnaha and Big Sheep

Figure 8 compares bull trout redd sizes for the sampled streams in the Imnaha system in years 2004 through 2017. Mean redd area (m^2) ranged from 0.3-1.0 for Lick Creek, 0.1-0.8 for Big Sheep Creek, 0.4-2.6 for Middle Imnaha, 0.8-1.8 for Upper Imnaha, 0.3-1.2 for North Fork Imnaha, 0.4-1.3 for South Fork Imnaha, and 0.1-0.4 for Cliff Creek. As shown in Figure 8, very large redds produced by large fluvial bull trout were documented on the Middle Imnaha in 2008. In 2017, the mean redd size was 1.3 (fluvial dominant) with 11 redds documented in the Middle Imnaha. Over the 14-year period (2004-2017), redd sizes have been both fluvial and resident, with a dominance towards fluvial. However, the number of redds in this 2.0 mile reach has varied through the years with 2014 (17 redds), 2015 (11 redds), and 2017 (11 redds), whereas in 2009 and 2010 redd numbers were as low as two, and four, respectively.

In some areas, overlap between bull trout and chinook redds may make it difficult to differentiate between the two species spawning nests. Although true, in Lick Creek and the Imnaha River, we have been able to rely on experienced surveyors and recognition of bull trout redds by time of year and size of substrate. In 2017, five redds were measured for Lick Creek and the redd area (m^2) was 0.2 (resident). During 2004 through 2017, approximately 64 percent of the redds have been resident-size dominant, and 36 percent of the redds have been fluvial/resident dominant, and fluvial dominant. In 2017, no redds were documented on Big Sheep Creek. By comparison, Big Sheep Creek was dominated by resident redds in most years sampled, except in 2009 with only one fluvial size and one resident redd. In 2014 and 2015, the mean redd area (m^2) for Big Sheep was 0.3 and 0.2, respectively (resident size). In 2016, the mean redd area (m^2) for Big Sheep was 0.4, 67 percent were fluvial size, and 33 percent were resident size (with 10 of the 78 bull trout observed >12 inches).

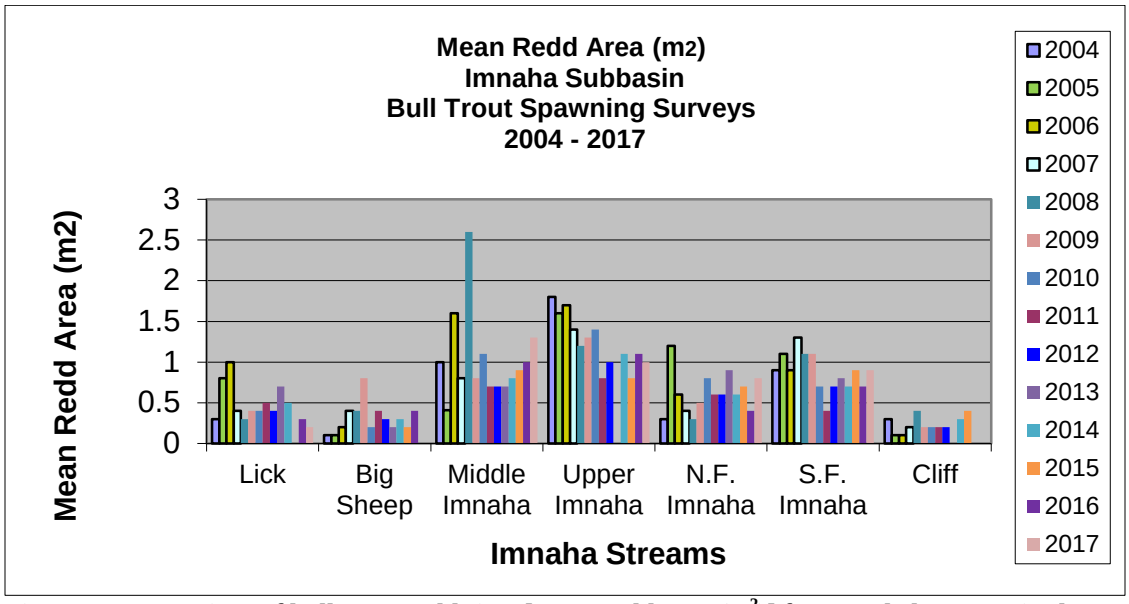

Figure 8. Comparison of bull trout redd sizes [mean redd area (m^2)] for sampled streams in the Imnaha Subbasin, 2004-2017. (In 2013, no redd size data for Upper Imnaha and Cliff Creek. NF. Imnaha missing upper reach data in 2014. Lick Creek missing 2015 due to only one redd measured). Big Sheep Creek had no redds documented for in 2017. No data for Cliff Creek in 2016 and 2017, not measured above falls due to known resident population and sufficient past data.

In 2017, Upper Imnaha and South Fork Imnaha had redds sizes with a fluvial dominance, 1.0 and 0.9 mean redd area (m^2), respectively. From 2004 through 2012, and 2014 through 2017, the Upper Imnaha and South Fork Imnaha contained a majority of fluvial redds. The Upper Imnaha

was essentially not surveyed in 2013 and South Fork Imnaha data was largely fluvial and sizes similar to 2012. In 2017, North Fork Imnaha had a redd size reflecting fluvial dominance, 0.8 mean redd area (m^2). Comparing 13 years of data on North Fork Imnaha from 2004 through 2012, and 2014 through 2017, approximately 38 percent (5 out of 13 years) the redds have been fluvial/resident size dominant, 31 percent (4 out of 13 years) the redds have been resident size dominant, and approximately 31 percent (4 out of 13 years) the redds have been fluvial size dominant.

Cliff Creek is a known resident system due to a waterfall near the mouth. In 2014, the mean redd area (m^2) for Cliff Creek was 0.3 (resident). In 2015, only two redds were measured below the falls with a mean redd area of 0.4 m^2. The survey on Cliff Creek in 2004 included a large fluvial size redd near the confluence with the South Fork Imnaha; therefore, the mean redd size was higher than in 2005 and 2006, when no fluvial redds were observed in Cliff Creek below the waterfall. The 2007 mean redd size included a few larger redds below the falls and near the mouth, which are presumed to be fluvial redds. The 2008 mean redd size was greatest above the falls, likely due to superimpositions of redds above the barrier. In 2008, all redds were measured below the falls, but not all of the redds were measured above the falls (31 of 52 total redds, 59.6%). The sample size in 2008 was large enough to get a good estimate of sizes of redds above and below the falls, and at the same time, complete the survey in a reasonable amount of time while redds were still visible during daylight. Cliff Creek was not surveyed in 2013. In 2014, 51 out of 87 (58.6 %) of redds were measured, and redds below the falls were not measured or documented as either resident or fluvial size. In 2014, as in previous years, the redd sizes above the falls included some large resident redds, likely superimposed redds, but measured as one redd. In 2015 through 2017, only redds below the falls were measured (n=2) and in 2015 they were resident size, one redd was occupied by a resident size bull trout, 6 to 12 inches in length. In 2016 and 2017, no redds were documented below the falls. Cliff Creek had several redds that were still in progress at the time of the 2012 survey and in 2017, 100 percent of redds in Cliff Creek were unoccupied (older redds), personal communication with Ryan Rumelhart, NPT, 2017. Refer to Tables 4a and 4b in Appendix B for additional information on 2017 bull trout redd characteristics.

3.5 Bull Trout Redd Distribution

Lostine River and Bear Creek

The bull trout spawning surveys on the Lostine River from 2005 through 2017 included collection of UTM coordinate data on the spatial distribution of the bull trout redds observed. Bull trout redds on the Lostine River, as well as in other surveyed streams, were often arranged in complexes (several redds located in close proximity to each other). In 2005, 2006, 2007, 2010, and 2011 through 2016, redds were primarily located in the French Camp to Shady Falls and Bowman to French Camp reaches along the Lostine River and approximately 10 miles downstream of these reaches at the Six Mile Bridge to Pole Bridge reach (except in 2015 and 2017). High site fidelity is documented by the overlapping of bull trout redds from 2005 through 2017, especially in the upper reaches of the Lostine River. In 2017, redd distribution was distributed in the upper two reaches, French Camp to Shady and Bowman to French Camp. In 2003, 2008, 2009, and 2015, a range of 6 to 13 redds were documented in the Williamson to Walla Walla Reach, in other years the range was 0 to 3 redds. In 2008, redd numbers had slightly less abundance, as compared to 2017, but an expanded distribution on the Lostine River (Figure 9). In 2017, 27 redds (52%) were observed in the French Camp to Shady reach and 25 redds (48%) in the Bowman to French Camp reach, (Figure 9).

Sections of the Lostine River were not surveyed during the survey period of years (1999-2017) due to insufficient spawning gravels, boulder and cobble being the dominant substrate, and/or difficult access. These non-surveyed areas included Bowman to Walla Walla (approximately 2.2 miles) and Williamson to Pole Bridge (approximately 3.5 miles). Additionally, downstream of Westside Ditch on the Lostine River, for approximately 9 miles, is private property that is not surveyed due to lack of bull trout spawning gravels, higher stream temperatures, and low flows associated with irrigation withdrawal.

The size and distribution of bounded alluvial valley segments on the landscape influence the distribution and abundance of bull trout spawning. Baxter and Hauer (2000), report that in northwestern Montana spawning tributary streams, the abundance of bull trout redds increased with increased area of alluvial valley segments that were longitudinally confined by geomorphic knickpoints. These bounded alluvial valley segments possessed complex patterns of hyporheic exchange and extensive upwelling zones. Bull trout used stream reaches for spawning that were strongly influenced by upwelling. However, within these reaches, bull trout redds were primarily located in transitional bedforms that possessed strong localized downwelling and high intragravel flow rates. These patterns may be occurring in the Lostine River.

Figure 10 shows survey reaches and redd locations for Bear Creek and Goat Creek in 2017. Highest abundance and distribution was primarily found in Goat Creek and Bear Creek from Goat Creek to the wilderness boundary. The reach between the wilderness boundary and the trail bridge was not surveyed in most years due to difficult access. This three mile boulder dominant confined reach was surveyed in 2007. Only one redd was located in this reach; therefore, future survey of this reach for bull trout was not deemed practical due to low redd density and access issues.

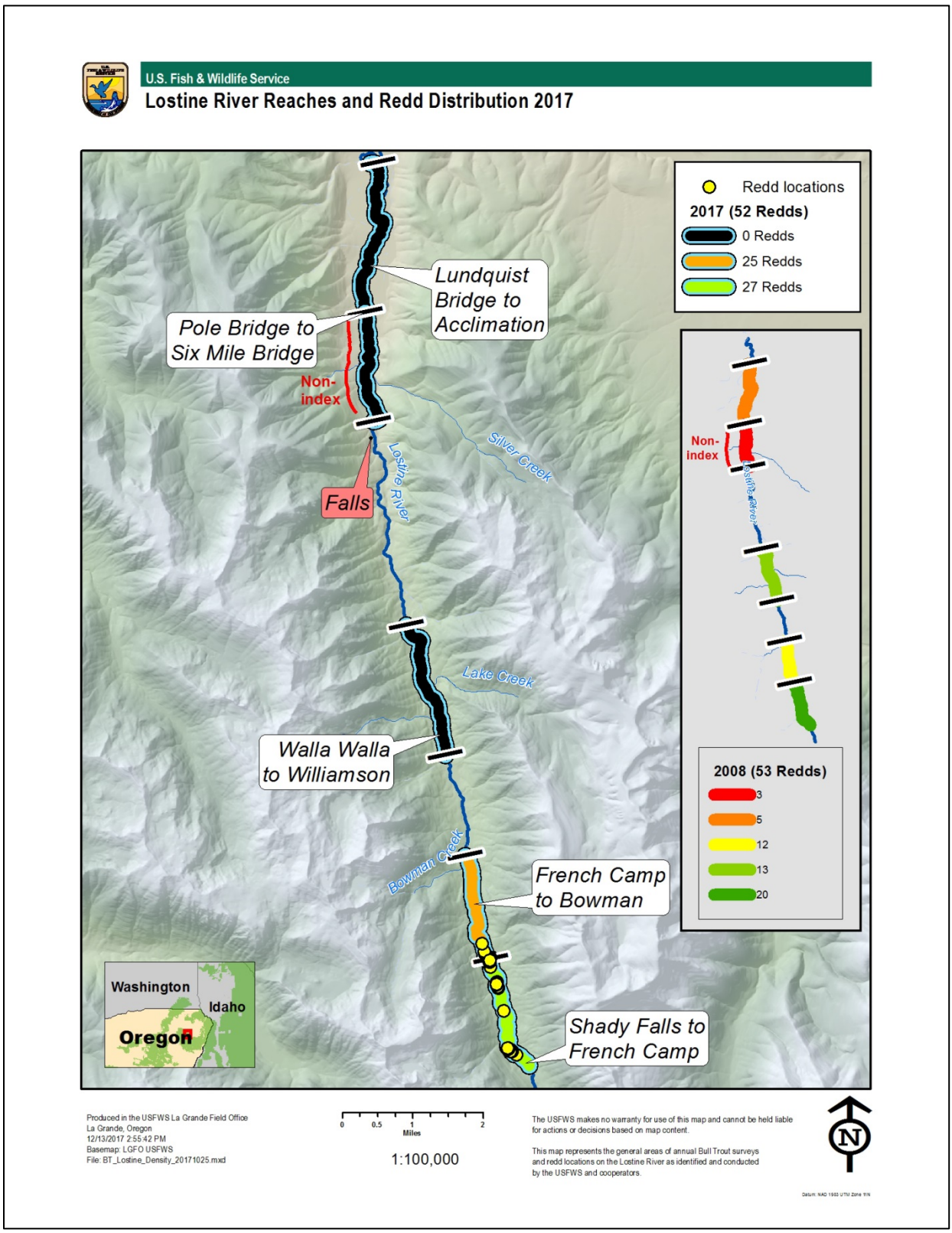

Figure 9. Map of the Lostine River showing bull trout redd survey reaches and bull trout redd locations in 2017. In 2008, redd numbers had slightly less abundance, as compared to 2017, but an expanded distribution on the Lostine River

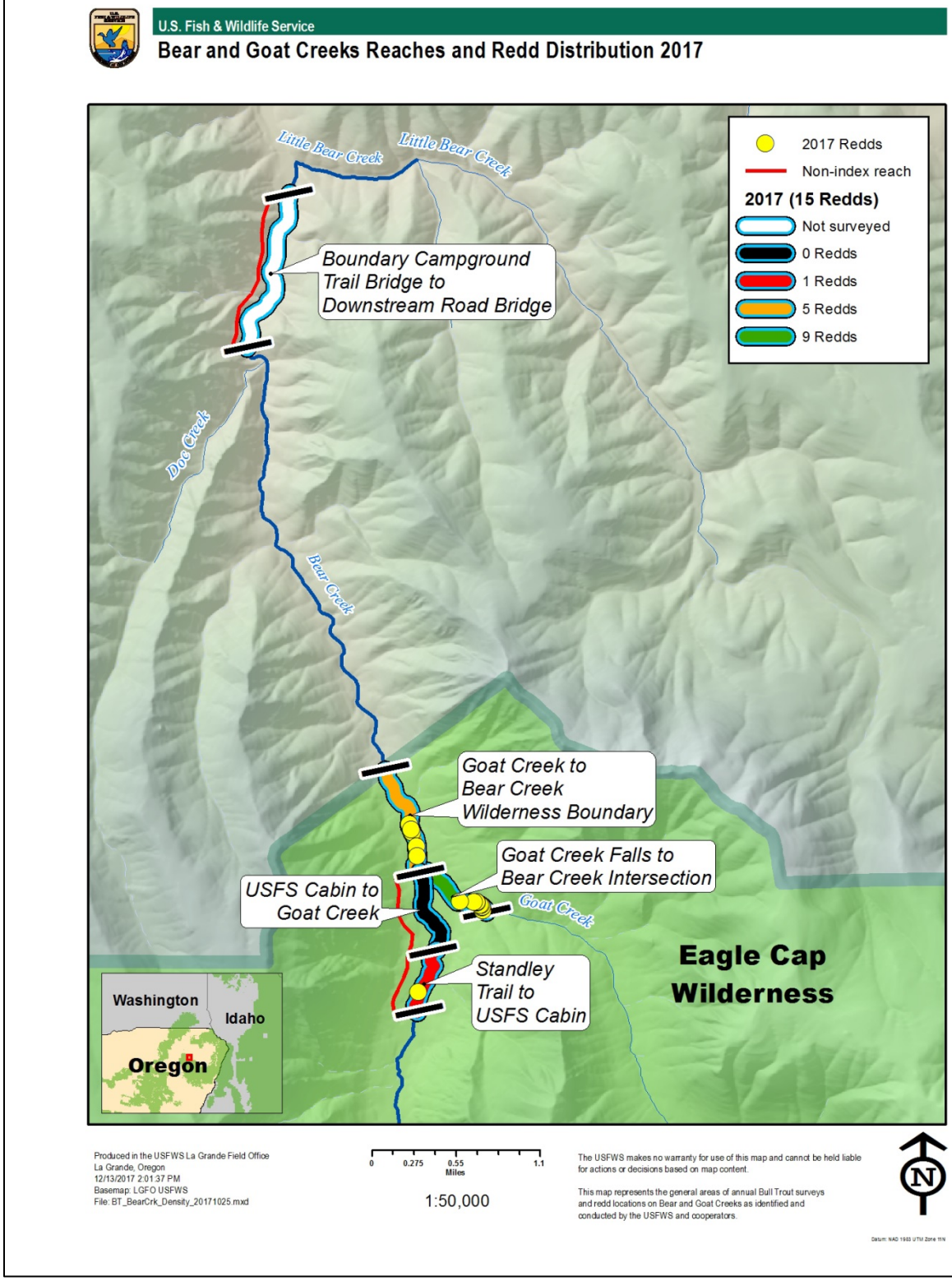

Figure 10. Map of Bear Creek and tributary stream Goat Creek showing bull trout redd survey reaches and bull trout redd locations in 2017.

Bull Trout Redd Distribution on Big Sheep Creek and the Imnaha River

Figure 11 is a map of reach and redd locations for Big Sheep and Lick Creeks in 2017. This data is compared to 2011 data when redd abundance was higher and redd distribution was expanded into the lower reach of Lick Creek. Big Sheep Creek is resident above the diversion and resident/fluvial below and no redds were documented in Big Sheep in 2017. Lick Creek is resident in the upper reach and fluvial/resident in the lower reach. In general, redd densities for both Big Sheep and Lick Creeks, excluding 2017 for Big Sheep Creek, were mostly found in the upper portion of the reach for both streams. In 2016, redd distribution was found in Big Sheep and Upper Lick Creek, with abundance documented as nine redds in Big Sheep, three redds in Upper Lick and no redds in the lower reach of Lick Creek.

Figure 12 displays reach and redd densities in 2017 for the Imnaha River and Upper Imnaha tributaries. GPS redd locations are taken for the road/trail accessible reach, the Blue Hole to Indian Crossing two mile reach, but not for the upper reaches due to limited access, survey distance, and safety concerns (returning to camp before dark). Therefore, the data displayed in Figure 12 does not display the redd locations but rather, a comparison of redd densities by reach location. Cliff Creek, a resident bull trout stream has the highest abundance, 60 redds for 2.5 miles of stream. The remaining Imnaha reaches contain fluvial/resident bull trout. The South Fork Imnaha has 32 redds for 4.6 miles of stream. The Imnaha from the confluence with the North Fork Imnaha to Indian Crossing has 33 redds for 5.3 miles of stream surveyed. The North Fork Imnaha including the Middle Fork Imnaha has 28 redds for 7 miles of stream surveyed in 2017 (Figure 12 and Table 2b). Figure 12 shows the locations with the greatest redds, black color showing no redds (Imnaha second gorge to gorge above slide) and the highest redds in the bright green (Cliff Creek).

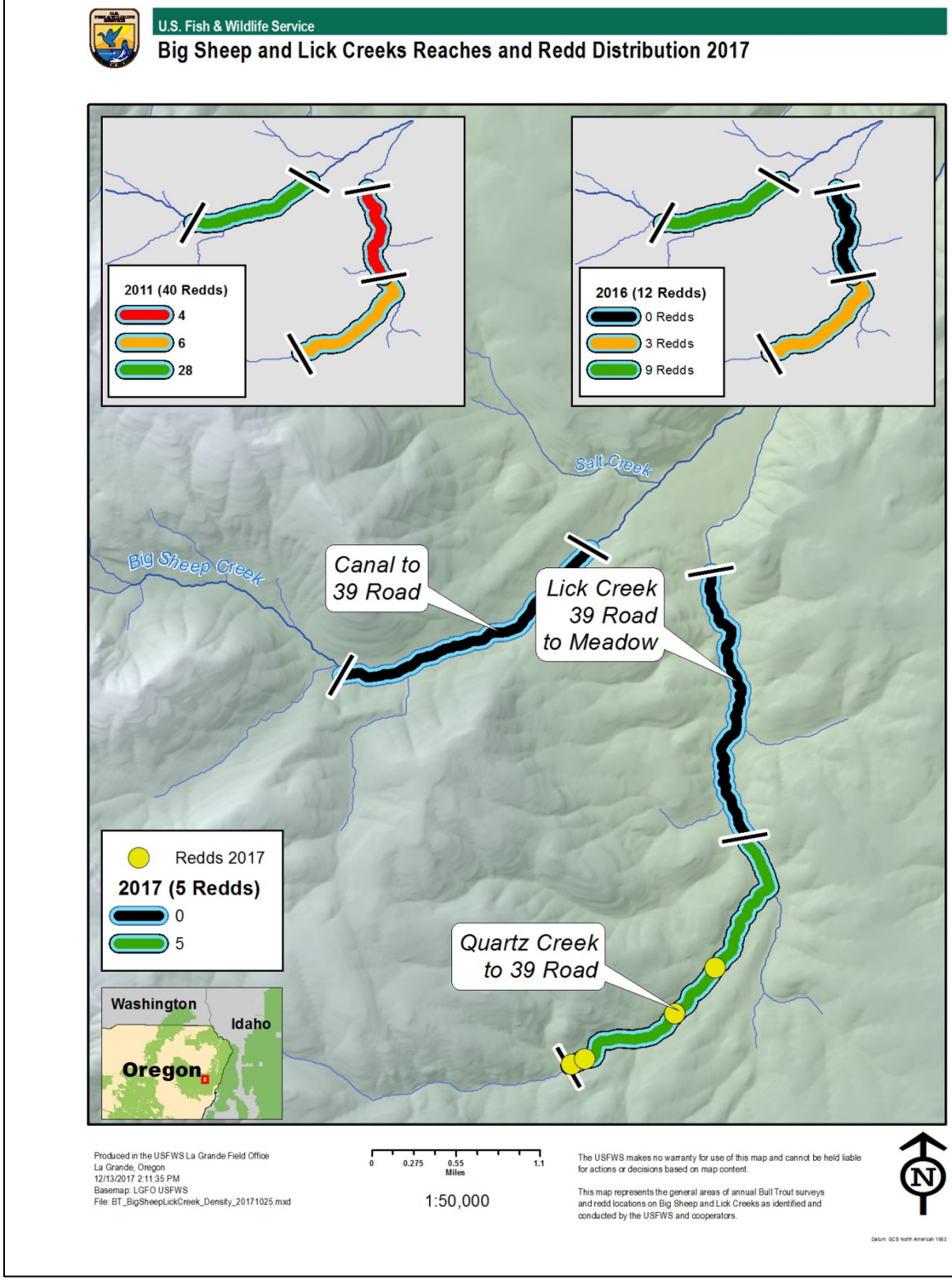

Figure 11. Map of Big Sheep Creek and Lick Creek showing bull trout redd survey reaches and bull trout redd locations in 2017 and comparing to 2011 when redd numbers higher and distribution expanded. 2016 data shows redds distribution in Big Sheep and Upper Lick Creek, more typical distribution than reported in 2017.

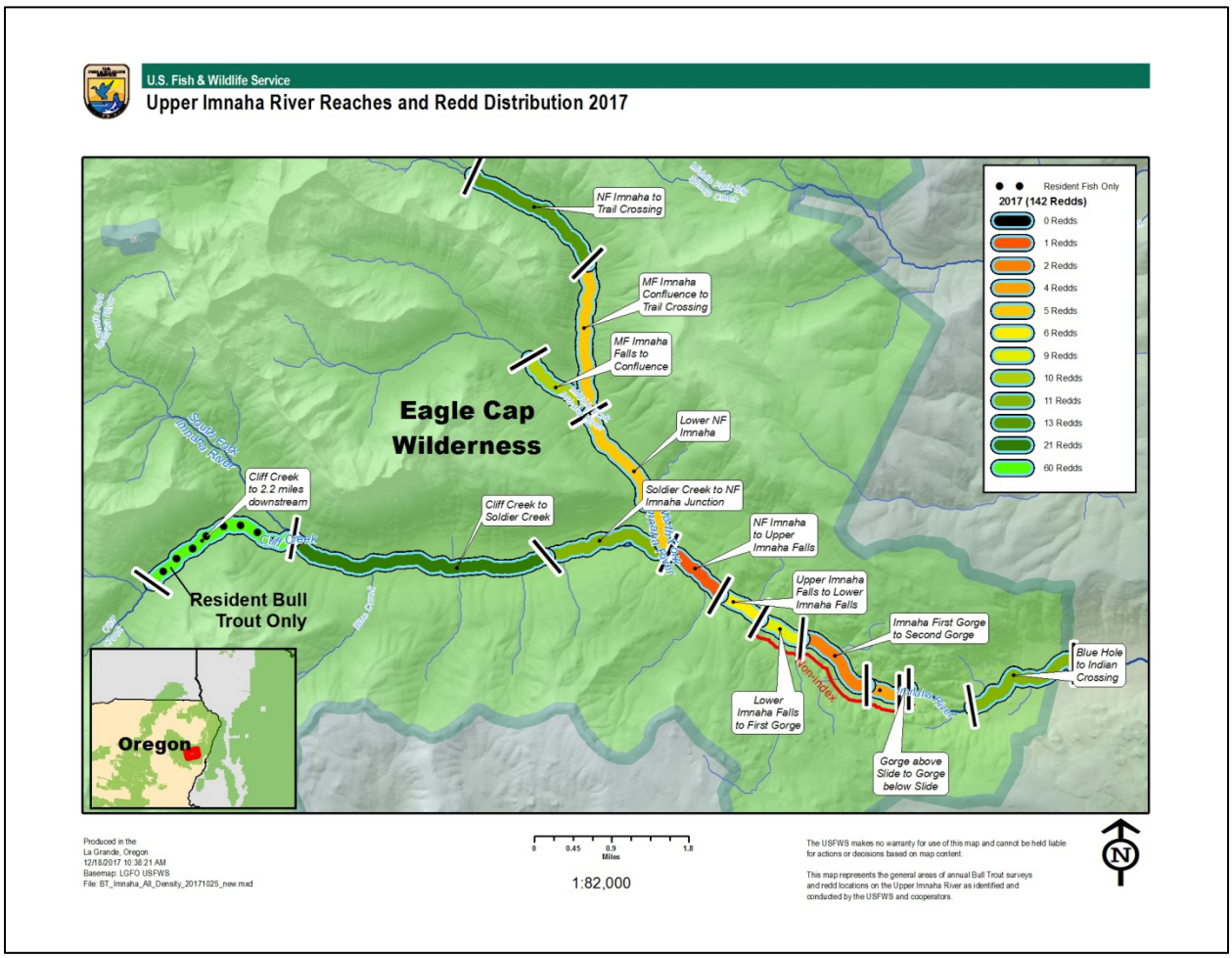

Figure 12. Map of the Upper Imnaha River showing bull trout redd survey reaches and bull trout redd densities by redd locations in 2017. Cliff Creek is a resident bull trout stream (due to waterfall near mouth) and the other reaches contain fluvial/resident bull trout.

4. DISCUSSION

4.1 Future Needs

Bull trout redd monitoring in the Wallowa Mountains was accomplished from 1999 to 2017 using skilled bull trout redd surveyors (a mix of experienced paired with inexperienced). Skilled surveyors will continue to be needed for future redd surveys. Several studies (Howell and Sankovich 2012; Dunham et al. 2001) point out the importance of using skilled surveyors to reduce measurement error. Training and retaining skilled surveyors to conduct these surveys has been a challenge, and will likely remain a challenge into the future.

Currently, there is limited bull trout redd data available for the mainstem Minam River (and tributaries, excluding the Little Minam River). Alan Miller (USFS, pers. comm. 2017), hiked into the Upper Minam from the Lostine River Two Pan Trailhead and surveyed the Upper Minam River (upstream and downstream of Elk Creek confluence and Elk Creek) in late September 2017. During this survey he documented seven fluvial redds. Alan reported that he plans to continue surveys on the Upper Minam River in the fall of 2018 (A. Miller, USFS, pers. comm. 2017).

We also recommend continued surveys of bull trout on the Oregon side of the Wenaha, with the continued help of ODFW chinook surveyors, and potentially a second, later (October) survey; if funds, surveyors, access, and weather allow.

The East Fork Wallowa River, upstream of Wallowa Lake, was surveyed by the author in 2011 for 0.8 miles of stream, to assist PacifiCorp Energy with bull trout spawning data collection as part of the relicense for Wallowa Falls Hydroelectric Project. No redds were located during this survey. PacifiCorp surveyed the East Fork Wallowa River previously in 2010 and found two fluvial bull trout paired up on one redd (PacifiCorp 2013). In 2014, the West Fork and East Fork Wallowa Rivers were surveyed from their confluences upstream to barrier falls. All redds were resident size and located in the East Fork Wallowa River. In 2015, the West Fork and East Fork Wallowa Rivers were surveyed in the same locations. One resident bull trout was observed and confirmed on the East Fork Wallowa River. The West Fork Wallowa River is more difficult to survey due to the densities of kokanee redds. Two larger (potentially fluvial size redds) were noted near the confluence with Wallowa Lake on the second October survey. The author reviewed these two redds and made the professional judgment that these were not bull trout redds but likely large kokanee redds. No bull trout were documented at the redds. The East and West Forks of the Wallowa River were not surveyed in 2016, as the Service was not given permission to access private land along the East Fork Wallowa River. PacifiCorp Energy surveyed the East Fork Wallowa River as required by the Wallowa Falls Hydroelectric Relicense Project and reported three fluvial redds and nine fluvial size bull trout in this stream in 2017. The surveys began on September 12, 2017, and continued weekly through November 1, 2017, for a total of nine redd surveys (PacifiCorp 2017). PacifiCorp Energy will survey this stream in the future as part of the Wallowa Falls Hydroelectric Relicense Project.

In the future, we recommend an exploratory survey be conducted in the headwaters of Bear Creek to obtain some baseline information on locations and densities for resident bull trout redds in this upper reach. At the same time, observations of densities of brook trout and any potential concerns for interbreeding could be initially assessed.

Overall, future needs for this project include continued funding and support from all involved parties (Service, ODFW, NPT, USFS, private land owners, volunteers, and others) for conducting and reporting bull trout redd counts in the Wallowa Mountains. OWEB Phase II Wallowa Mountains Bull Trout Redd Monitoring (2010-2011) was submitted for funding in October 2009 and received funding for 2010, 2011, and funding was extended into 2012. A Phase III Wallowa Mountains Bull Trout Redd Monitoring (2012-2013) was submitted for OWEB funding in October 2011 and was funded. This Phase III OWEB funding supported these surveys in 2012-2015. The 2016 and 2017 surveys were funded by a Phase IV OWEB funding (2016-2017), as well as 2016 Service Recovery funding, to help support Nez Perce Tribe personnel in 2016 and 2017.

To date, we have comparable bull trout redd data; 19 years completed on Lostine River and Bear Creek; 18 years completed on Big Sheep Creek; and 17 years completed on the Imnaha River. The Service and partners support continuing to build on the existing long-term bull trout spawning survey data set as these long-term data sets are limited in bull trout recovery units, including the Mid-Columbia Recovery Unit. As mentioned in the Introduction, the final bull trout recovery plan states that monitoring may include assessing distribution, population status, life history, migratory movements, and genetic characteristics of bull trout in each recovery unit (USFWS 2015). The USFWS Mid-Columbia Bull Trout Recovery Unit Implementation Plan recommends continuing to monitor bull trout in the Imnaha Core Area, providing information on

distribution and abundance for recovery. It also recommends development of a long term monitoring program to assess distribution, status and trend of bull trout in the Wallowa/Minam Core Area (USFWS 2015).

Prior to the next field season, the Service plans to meet with the local partners to strategize location and intensity of spawning surveys for the next several years in the above core areas, as well as have a larger discussion on surveys conducted in North Fork Catherine Creek and in the Upper Grande Ronde River and tributaries.

4.2 Other Riparian/Wetland Dependent Species

The Upper Imnaha survey includes many spring/wetland areas and several of these bisect the trail. At these areas, we observed much beaver (*Castor canadensis*) activity as seen in the photo below. The beavers are very persistent, the author was told that in 2016 the trail crew had drained this beaver pond, and the beavers soon after, had remade the pond (photo below). In a wetland area near the trail, not far from where the beaver pond photo was taken, an adult western toad *(Anaxyrus boreas)* hides from the author in the nearby vegetation (see photo next page). In 2016, in the South Fork Imnaha River, a river otter *(Luntra canadensis)* was documented by Lynne Price with the NPT and again in 2017, by the author. The author has observed river otters near the Imnaha weir in past years, but was surprised to hear and observe for herself that they were this high up in the Upper Imnaha River system.

Beaver pond across Imnaha trail, 2016

Adult western toad hiding from author near Imnaha trail, 2016
(the author observed this same size adult western toad in
the same location in 2017)!

5. CONCLUSION

The local bull trout populations were relatively stable for the survey period (1999-2017), with a decrease in redd numbers in Big Sheep Creek (Lick Creek) in 2017 compared to 2016. No redds were documented in Big Sheep Creek in 2017. There was an increase in redd numbers on the Imnaha River, the Lostine River, and Bear/Goat Creek in 2017 compared to 2016. The increases were not significant for the Imnaha, the redd numbers were still low compared to 2014 and previous years, but were significant for the Lostine and Bear/Goat Creek.

The Imnaha population is one of the strongholds within the Imnaha Subbasin as it has multiple age classes, contains fluvial fish, has an anadromous prey base, remains connected with the Snake River, and bull trout are distributed throughout the habitat. Primary spawning activity on the Imnaha River has been documented to occur in the headwaters which lie within wilderness. Both fluvial and resident life history forms are present. The Imnaha River is rated at low risk of extinction, and Big Sheep is rated “of special concern” (Buchanan et al. 1997). The Recovery goals are to keep the local populations viable within this entire Imnaha core area and allow the local populations to be connected (within themselves) and to one another. The Imnaha weir located downstream of the confluence with Gumboot, is a partial fish passage barrier to bull trout (USFWS 2015). Adult bull trout need to migrate upstream past the weir to access primary spawning grounds. In 2017, ODFW’s trapping data indicates that a total of 102 bull trout were trapped at the Imnaha weir. Of that 101, 61 were previously untagged, and 38 were previously tagged recaptures, and there were three mortalities (A. Gibbs and J. Yanke, ODFW, pers. comm. 2017).

Lick Creek has no barriers to passage and has a functioning resident and fluvial population. Hudson et al. 2017 reported that multiple pit-tagged bull trout individuals from Big Sheep Creek and Lick Creek were detected moving downstream as far as near the mouth of the Imnaha River. Big Sheep and Little Sheep have some issues with flows, fish passage, and connectivity and loss of fish due to the Wallowa Valley Improvement Canal (WVIC); as well as fish passage concerns

associated with two USFS culverts on Little Sheep Creek. The canal system (WVIC) in Big Sheep and Little Sheep watersheds (within the Imnaha bull trout core area) contributes to the loss of bull trout out of this core area and into the Grande Ronde and most likely to their loss, due to diversions downstream (Whitesel and Hudson, pers. comm 2013). Hudson et al. 2017 state that the data collected in their project suggests that the WVIC diversion structures may impede direct connectivity of these populations with the Imnaha River. For example, of the 85 fish from Big Sheep Creek detected moving downstream, 26 (31%) were detected moving down the canal. These fish, in addition to others tagged at Salt Creek Summit, Little Sheep Creek, Canal Creek, and Redmont Creek, were not detected moving downstream in Little Sheep Creek. Therefore, the operation of the WVIC diversion structure in Big Sheep Creek may be limiting and the diversion structure in Little Sheep Creek may be limiting/preventing downstream movement of bull trout to the Imnaha River. They also state that this may further suggest limitations to upstream movement. Hudson et al. 2017 state that providing connectivity among bull trout populations will likely ensure their persistence when faced with stochastic events that impact one or more of these populations (e.g. low water year, wildfire).

The Lostine River was considered a moderately-strong population within the Grande Ronde Subbasin (Buchanan et al. 1997). Redd numbers have increased in these locations in 2017 (52 and 15) compared to 2016. Lostine River and Bear Creek contain brook trout and the degree of hybridization is unknown; although 2010 and 2012 photos by Mary Edwards (NPT) and 2012 spawning data suggests bull trout pairing with brook trout and hybridization much more likely than past information has shown. Many of the spawning fish observed in 2012 appeared to have brook trout hybrid phenotypic characteristics, which is alarming. This was not documented in 2013 through 2017, but no underwater photos were taken during this time. Limited redd count data is available on Bear Creek and this portion of the Lostine River/Bear Creek local population has been listed as a special concern by Ratliff and Howell (1992). Future genetic analysis of bull trout and brook trout is critically needed, especially in the Lostine River to help determine the significance of this threat.

Underwater photo of a pair of fish on the Lostine River, 2012
In front, appears to be a bull trout/brook trout hybrid
and in back appears to be a pure bull trout
Photo taken by Mary Edwards Photography for the FWS LFO

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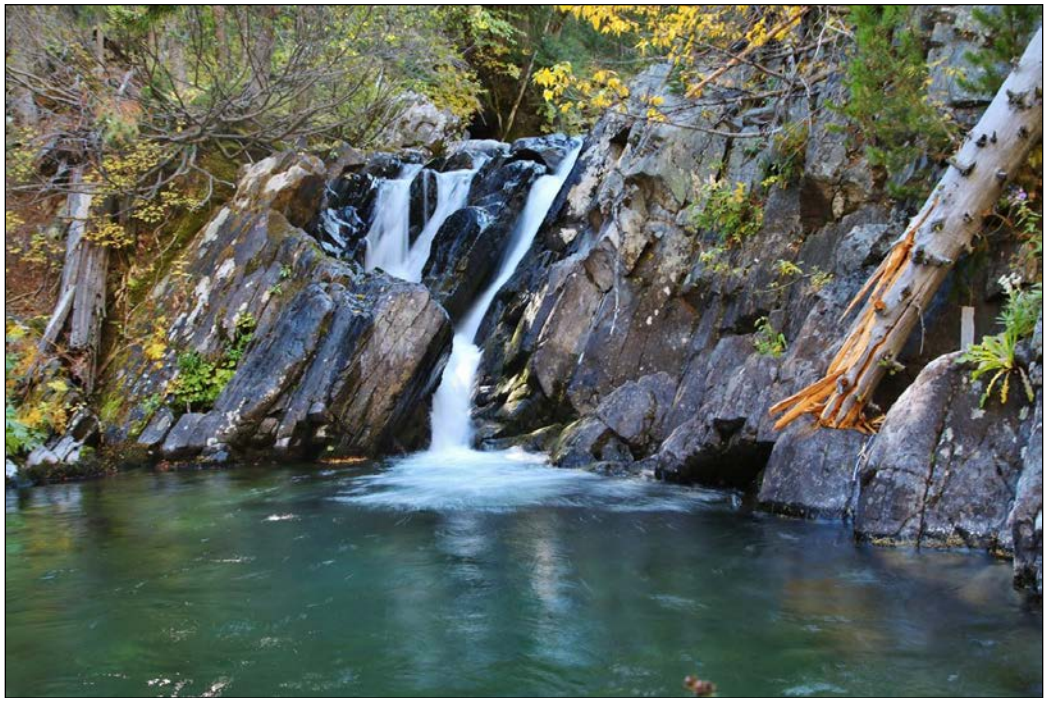
APPENDIX A – PHOTOS TAKEN AT SURVEY LOCATIONS

Upper Imnaha Crew (author taking photo) at NF Imnaha Camp, 2017
Left to right front; Sarah Brandy, Kyle Bratcher, Ryan Rumelhart, Shane Vatland. Back row, Todd Kruger, Aaron Maxwell, Jessica Humphreys, and Sam Humphreys.

Bull trout survey crew for Bear and Goat Creek, October 2017
Left to right, Aaron Maxwell, Tyler Stright, and Ryan Rumelhart (NPT), and author

Left photo, Resident spawning pair of bull trout in Cliff Creek, Photo by Devin, NPT 2016
Right photo, Fluvial pair in SF Imnaha River, Photo by Kyle Bratcher, ODFW 2017



Waterfall at Cliff Creek near mouth, Photo taken by Devin Olsen, NPT 2016

Log Jam upstream of Blue Hole
Upper Imnaha
view from trail, 2014

Log Jam at location shown above in 2017
view from trail

APPENDIX B – TABLES

Table 1 – Bull Trout Spawning Surveys and Survey Frequencies for selected Grande Ronde River and Imnaha River Streams, 1999-2017

Stream	Year	Dates	Survey Frequency	Total Redds	Total Miles	Total Redds/Mile
Lostine River	1999	9/16,9/23,10/12	3 Times	39	9.75	4.0
	2000	9/21,9/28,10/12	3 Times	38	13.74	2.8
	2001	9/17-18,10/11-12	Twice	43	14.4	3.0
	2002	9/23-24,10/7-8	Twice	22	10.7	2.1
	2003	9/23-24,10/6-7	Twice	71	10.5	6.8
	2004	9/14-15,10/5-6	Twice	26	8.5	3.1
	2005	9/15, 9/21-22, 10/3-10/4	Twice, and 3 Times in Turkey Flat and Shady Campground areas	32	10.5	3.0
	2006	9/14, 9/20-21, 10/2-10/4	Twice, and 3 Times in Turkey Flat and Shady Campground areas	45	10.5	4.3
	2007	9/19-9/20, 10/3-10/4	Twice	47	10.1	4.7
	2008	9/17, 10/1-10/2, 10/9-10/10	Twice, and 3 Times in Turkey Flat and Shady Campground	53	10.1	5.3
	2009	9/11, 9/23-24, 10/7-10/8	Twice, and 3 Times in French Camp to Bowman	41	10.1	5.2
	2010	9/22, 10/6, 10/7	Twice	36	10.1	3.6
	2011	9/21-9/22, Oct 5-6	Twice	22	10.1	2.2
	2012	9/17, 9/19, Oct 3-4	Twice	52	10.1	5.2
	2013	9/16, 9/18, 9/24, Oct 7-8	Twice	40	10.1	4.0
	2014	9/16, 9/23, Oct 6-7	Twice	44	10.1	4.4
	2015	9/22, Oct 6-7	Twice	28	10.1	2.8
	2016	9/19, Oct 6	Twice	33	10.1	3.3
	2017	9/28, Oct 4-5	Twice	52	10.1	5.2
Bear Creek	1999	9/7,9/22	Once Bear, Twice Goat	6	1.8	3.3
(including Goat Cr)	2000	10/18	Once	5	1.8	2.8
	2001	10/16	Once	12	2.3	5.2
	2002	10/15	Once	7	2.3	3.0
	2003	10/16	Once	17	3.8	4.5

Stream	Year	Dates	Survey Frequency	Total Redds	Total Miles	Total Redds/Mile
Bear Creek	2004	10/1	Once	11	2.3	4.8
	2005	10/11	Once	16	2.8	5.7
	2006	10/10	Once	9	1.9	4.7
	2007	9/17, 10/9	Twice, Exploratory (more reaches than past years)	11	7.2	1.5
	2008	9/30, 10/7	Twice	20	3.2	6.3
	2009	9/22, 10/13	Twice	8	3.2	2.5
	2010	9/16, 10/13	Twice	7	3.2	2.2
	2011	9/20, 10/11	Twice	19	3.2	5.9
	2012	9/20, 10/10	Twice	15	3.2	4.7
	2013	9/19, 10/10	Twice	16	3.2	5.0
	2014	9/18, 10/9	Twice	17	3.2	5.3
	2015	9/24, 10/14	Twice	5	4.2	1.2
	2016	9/23, 10/10	Twice	6	4.2	1.4
	2017	9/24, 10/10	Twice	15	3.2	4.7
Deer Creek	2009	10/14	Once	0	1.5	0
	2010	9/17, 10/4	Twice	12	0.8	15
	2011	9/19, 10/12	Twice	9	0.8	11.3
	2012	9/21, 10/12	Twice	1	0.8	1.0
	2013	9/23, 10/15	Twice	0	0.8	0
	2016	9/21, 10/3	Twice	2	0.8	2.5
	2017	9/21, 10/3	Twice	0	0.8	0
EF Wallowa	2011	10/9	Once	0	0.7	0
	2014	9/24, 10/14	Twice	1	0.7	1.4
	2015	9/21, 10/13	Twice	1	0.7	1.4
WF Wallowa	2014	9/24, 10/14	Twice	0	1.3	0
	2015	9/21. 10/13	Twice	0	1.3	0
Imnaha River	1999	9/20,28,10/11	Middle = Thrice	14	15.2	0.9
(excluding	2000	9/20,22,25,26,27,10/11	Upper = Once, Middle = Twice	92	29.1	3.2
Big Sheep)	2001	9/20,21,10/1,2,3,9,10	Upper = Once, Middle = Twice	291	31.3	9.3
	2002	9/25,26,9/30,10/1-2,10/10-11	Upper = Once, Middle = Twice	113	30.5	3.7
Middle=Blue Hole	2003	9/25-26,9/29-30,10/1,10/8-9	Upper = Once, Middle = Twice	291	31.3	9.3
to Indian 2005-2010	2004	9/15-9/16,9-27,28,29,10/7-8	Upper = Once, Middle = Twice	292	31.6	9.2

Stream	Year	Dates	Survey Frequency	Total Redds	Total Miles	Total Redds/Mile
Imnaha River	2005	9/26-28, 10/7	Once Upper and Middle	276	19.4	14.2
	2006	9/25-28,10/5	Upper = Once, Middle = Twice	186	19.4	9.6
	2007	9/24-27, 10/5	Upper = Once, Middle = Twice	284	19.4	14.6
	2008	9/22-25, 10/6	Upper = Once, Middle = Twice	190	19.4	9.8
	2009	9/28-30, 10/1, 10/9	Upper = Once, Middle = Twice	235	19.4	12.1
	2010	9/27-29, 9/30, 10/8	Upper = Once, Middle = Twice	133	19.4	6.9
	2011	9/26-28, 9/29, 10/7	Upper = Once, Middle = Twice	160	19.4	8.2
	2012	9/24-26, 9/27, 10/11	Upper = Once, Middle = Twice	240	19.4	12.4
	2013	10/1, 10/2, 10/3, 10/11	Once Upper and Middle	68	13.3	5.1
	2014	9/25, 9/29, 10/1, 10/10	Upper = Once, Middle = Twice	199	19.4	10.3
	2015	9/28, 9/29, 9/30, 10/9	Upper = Once, Middle = Twice	203	19.4	10.5
	2016	9/26-28, 9/29, 10/12	Upper = Once, Middle = Twice	125	19.4	6.4
	2017	9/25-9/27, 10/11	Upper = Once, Middle = Twice	152	19.4	7.8
Big Sheep	1999	9/21,29,30,10/18,19	Once	20	14.2	1.4
[(including Lick,	2000	10/13-10/16	Once	12	8.4	1.4
and Salt).	2001	10/14,10/17	Once	24	8.4	2.9
Salt Cr. not	2002	9/30,10/1,10/14-15	Twice	41	9.3	4.4
surveyed post 2003,	2003	9/22,10/14	Twice	18	9.3	1.9
and Upper Big	2004	9/20,9/28-9/29,9/30,10/4,10/19	Once Big Sheep, Twice Lick	43	14.1	3.0
Sheep exploratory	2005	9/19-20, 10/6	Twice	16	8.6	1.9
in 2004].						
	2006	9/19, 10/4	Twice	18	7.6	2.4
	2007	9/21, 10/2	Twice	27	8.6	3.1
	2008	9/29, 10/1, 10/10	Twice except once exploratory Quartz creek tributary to Lick and once Lick Creek 39 Rd to meadow	30	9.1	3.3
	2009	9/16, 10/6	Twice	20	7.6	2.6
Big Sheep	2010	9/15, 10/5	Twice except once Lick Creek 39 Rd. to Meadow	20	7.6	2.6
	2011	9/15. 10/4	Twice	38	7.6	5.0
	2012	9/11, 9/18, 10/9	Twice	30	7.6	3.9
	2013	9/10, 9/17, 10/9	Twice	22	7.6	2.9
	2014	9/17, 10/8	Twice	25	7.6	3.3

Stream	Year	Dates	Survey Frequency	Total Redds	Total Miles	Total Redds/Mile
	2015	9/23, 10/8	Twice	11	7.6	1.4
	2016	9/20, 10/11	Twice	12	7.6	1.6
	2017	10/3	Once	5	7.6	0.7

Table 2a–Bull Trout Spawning Surveys for the Lostine River Comparing 1999 to 2017 Surveys

Lostine	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	17
Reaches (miles surveyed)																			
Lundquist Bridge to OC Ranch (2.8)	1	0	2	3	3	5	0	5	4	5	0	1	1	1	1	1	0	0	0
Williamson to Walla Walla (2.2 miles)	0	2	1	0	6	1	3	0	2	13	8	2	0	3	1	7	2	0	0
Bowman to French Camp (1.6 miles)	18	19	16	11	18	3	9	9	5	12	7	6	3	18	10	14	11	17	25
French Camp to Shady Falls (1.5)	20	12.0	23	8	43	17	12	22	31	20	23	21	15	28	27	21	15	15	27
Lostine Total Redds (Comparable Reaches)	**39**	**33**	**42**	**22**	**70**	**26**	**24**	**36**	**42**	**50**	**38**	**30**	**19**	**50**	**39**	**43**	**28**	**32**	**52**
Lostine Total Miles of Comparable Stream	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Lostine Redds/Mile Comparable Stream	**4.6**	**3.9**	**4.9**	**2.6**	**8.2**	**3.1**	**2.8**	**4.2**	**5.2**	**6.2**	**4.7**	**3.7**	**2.3**	**6.2**	**4.8**	**5.3**	**3.5**	**4.0**	**6.4**
Total Redds For Year	39	38	43	22	71	26	32	45	47	53	41	36	22	52	40	44	28	33	52
Total Miles Surveyed For Year	9.8	13.7	14.4	10.7	10.5	8.5	10.5	10.5	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Total Redds/Mile For Year	**4.0**	**2.8**	**3.0**	**2.1**	**6.8**	**3.1**	**3.0**	**4.3**	**4.6**	**5.2**	**4.1**	**3.6**	**2.2**	**5.2**	**4.0**	**4.4**	**2.8**	**3.3**	**5.2**

Notes: The Lostine was surveyed three times in 1999 and 2000. Survey years 2001-2017, the Lostine was surveyed twice, (except Shady Campground and Turkey Flat areas were surveyed three times in 2005, 2006, and 2008 and Turkey Flat was surveyed three times in 2009).The Lostine River Ranch (OC Ranch) has been surveyed once (October) in recent years due to lack of access to this private land during hunting season. Dates of Lostine bull trout spawning surveys generally commenced as early as the second or third week in September and the last survey was conducted in the first or second week in October.

Table 2b – Bull Trout Spawning Surveys for Bear and Goat Creeks Comparing 1999 – 2017 Surveys

Stream																			
Bear Creek	**'99**	**'00**	**'01**	**'02**	**'03**	**'04**	**'05**	**'06**	**'07**	**'08**	**'09**	**'10**	**'11**	**'12**	**'13**	**'14**	**'15**	**'16**	**17**
Reaches (miles surveyed)																			
Bear: Goat Confluence to Wilderness Boundary (1mile)	0	2	3	1	2	3	5	0	1	6	1	1	4	3	0	2	0	1	5
Goat Creek: Mouth to Falls (0.9)	8	3	9	6	9	8	6	9	7	4	5	6	15	12	15	12	2	3	9
Bear (and Goat) Total Redds (Comparable Reaches)	**8**	**5**	**12**	**7**	**11**	**11**	**11**	**9**	**8**	**10**	**6**	**7**	**19**	**15**	**15**	**14**	**2**	**4**	**14**
Bear Creek Total Miles of Comparable Stream	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Bear Creek Redds/Mile Comparable Stream	**4.2**	**2.6**	**6.3**	**3.7**	**5.8**	**5.8**	**5.8**	**4.7**	**4.2**	**5.3**	**3.2**	**3.2**	**10**	**7.9**	**7.9**	**7.4**	**1.0**	**2.1**	**7.4**
Total Redds For Year	8	5	12	7	17	12	16	9	11	20	8	7	19	15	16	17	5	6	15
Total Miles Surveyed For Year	1.9	1.9	2.3	2.3	3.8	2.3	2.8	1.9	7.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	4.2	4.2	3.2
Total Redds/Mile For Year	4.2	2.6	5.2	3.0	4.5	5.2	5.7	4.7	1.5	6.3	2.5	2.2	5.9	4.7	5.0	5.3	1.2	1.4	4.7

Notes: These surveys were conducted once from 1999-2006, usually late in the spawning season, the first or second week in October [except in 1999, surveys were conducted in September (on 9/7 and 9/22)]. In 2007, the surveys included several additional "experimental" miles and were conducted twice in the spawning season, once in mid-September and once in early October. In 2008 – 2014, and 2017, the surveys were conducted twice in the spawning season and an additional 1.4 miles of Bear Creek was surveyed upstream of the comparable reach. In 2015 and 2016, the surveys were conducted similar to years 2008-2014, and 2017, but with a one mile reach added.

Table 2c – Bull Trout Spawning Surveys for the Imnaha River, Comparing 2001 – 2017 Surveys

Imnaha River	**'01**	**'02**	**'03**	**'04**	**'05**	**'06**	**'07**	**'08**	**'09**	**'10**	**'11**	**'12**	**'13**	**'14**	**'15**	**'16**	**'17**
Reaches (miles surveyed)																	
South Fork Imnaha and tributaries:																	
Cliff Creek, mouth to 2.5 miles (2.5 miles)	96	22	57	65	61	17	93	52	164	45	46	65	NS	87	52	54	60
South Fork Imnaha, NF to Soldier (1.5 miles)	6	7	14	12	44	9	30	6	7	2	10	28	NS	9	18	11	11
South Fork Imnaha, Soldier to Cliff (3.1 miles)	33	18	37	29	55	26	37	15	8	27	13	54	41	27	40	17	21
North Fork Imnaha:																	
North Fork, above Middle Fork (4.1 miles)	49	18	40	68	39	18	30	17	2	4	6	9	5	25	37	9	13
North Fork, below Middle Fork to mouth (2.1 miles)	2	8	15	9	21	6	7	5	3	12	2	11	6	1	1	3	5
Middle Fork, mouth to falls (0.8 miles)	12	0	12	6	24	7	17	8	7	5	2	3	3	4	11	4	10
Imnaha River:																	
Imnaha River, NF to Falls (0.6 miles)	0	3	5	1	2	3	2	1	0	0	0	6	0	0	2	2	1
Imnaha River, Falls to lower falls (0.8 miles)	41	18	35	40	13	37	28	12	13	11	25	21	7	7	7	3	6
Imnaha River, Blue Hole to Indian Crossing (2.0 miles)	8	7	9	3	2	18	18	28	2	4	9	4	6	17	11	5	11
Imnaha Total Redds (Comparable Reaches)	**247**	**101**	**224**	**233**	**261**	**141**	**262**	**144**	**206**	**110**	**113**	**201**	**n/a***	**177**	**179**	**108**	**138**
Imnaha Total Miles of Comparable Stream	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	n/a	17.5	17.5	17.5	17.5
Imnaha Redds/Mile Comparable Stream	**14.1**	**5.8**	**12.8**	**13.3**	**14.9**	**8.1**	**15.0**	**8.2**	**11.8**	**6.3**	**6.5**	**11.5**	**n/a**	**10.1**	**10.2**	**10.2**	**7.9**
Total Redds For Year	269	103	293	286	276	186	284	184	235	133	160	240	68	199	203	125	153

Total Miles Surveyed For Year	19.4	18.3	42.8	41.2	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	13.4	19.4	19.4	19.4	19.4
Total Redds/Mile For Year	13.9	5.6	6.8	6.9	14.2	9.6	14.6	9.5	12.1	6.9	8.2	12.4	5.1	10.3	10.5	6.4	7.9

Notes: All reaches except Blue Hole to Indian Crossing were surveyed once in years 2001-2017. The Blue Hole to Indian Crossing was surveyed twice in September and October from 2001-2017, except in 2005 and 2013, it was surveyed once. Due to government shut-down and furlough, and poor late season weather conditions in 2013, fewer personnel were available which caused less miles to get accomplished. S.F. Imnaha Cliff to Soldier was surveyed differently in 2013, the number of redds is for more miles than in past years. N.F to Soldier did not get surveyed in 2013. NF above MF did not get fully surveyed in 2013. Cliff Creek did not get surveyed in 2013. The gorge sections of the Upper Imnaha did not get surveyed in 2013. N/A was documented for comparable reaches, as reaches not comparable to past years. Total stream miles surveyed in 2013 (13.4) is estimated. NS=not surveyed.

Table 2d – Bull Trout Spawning Surveys for Big Sheep Creek and Lick Creek, Comparing 2001 – 2017 Surveys

Stream		**Survey Years**																
Big Sheep Creek (including Lick Creek)	**'00**	**'01**	**'02**	**'03**	**'04**	**'05**	**'06**	**'07**	**'08**	**'09**	**'10**	**'11**	**'12**	**'13**	**'14**	**'15**	**'16**	**'17**
							Redds Surveyed											
Reaches (miles surveyed)																		
Big Sheep, canal to 39 rd. (1.9 miles)	2	6	17	2	3	5	6	12	3	2	8	28	13	16	13	7	9	0
Lick Creek, Meadow to 39 rd. (1.5 miles)	0	6	3	0	1	3	5	3	4	5	7	4	4	3	5	0	0	0
Lick Creek, 39 rd. to Quartz Creek (4.2 miles)	8	5	14	8	4	1	7	12	15	13	5	6	13	3	7	4	3	5
Big Sheep Total Redds (Comparable Reaches)	**10**	**17**	**34**	**10**	**8**	**9**	**18**	**27**	**22**	**20**	**20**	**38**	**30**	**22**	**25**	**11**	**12**	**5**
Big Sheep Creek Total Miles of Comparable Stream	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Big Sheep Creek Redds/Mile Comparable Stream	**1.3**	**2.2**	**4.5**	**1.3**	**1.1**	**1.2**	**2.4**	**4.6**	**2.9**	**2.6**	**2.6**	**5**	**3.9**	**2.9**	**3.3**	**1.4**	**1.6**	**0.7**
Total Redds For Year	12	24	41	18	43	16	18	27	30	20	20	38	30	22	25	11	12	5
Total Miles Surveyed For Year	8.4	8.4	9.3	9.3	14.1	8.6	7.6	8.6	9.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Total Redds/Mile For Year	1.4	2.9	4.4	1.9	3.0	1.9	2.4	3.1	3.1	2.6	2.6	5	3.9	2.9	3.3	1.4	1.6	0.7

Notes: Survey frequency varied by year, surveys were conducted once in mid to late October in years 2000 and 2001 for both Big Sheep and Lick Creek, and surveys were conducted twice, once in September and once in October in years 2002-2016, except for Big Sheep which was surveyed once in 2004. In 2017, surveys were conducted once in October for both streams.

Bull Trout Spawning Surveys
For Some Grande Ronde Tributaries, 2017
USFWS, La Grande Field Office

Grande Ronde Basin		Kilometers	Miles		Redds				Total		Bull Trout Observed (mm)		
Stream Reach, Section	**Date(s)**	**Surveyed**	**Surveyed**	**Occ**	**Unocc**	**Total**	**Per km**	**Per Mile**	**But obs**	**<6"(150mm)**	**<12" (~300mm)**	**<18"(450mm)**	**>18"(450mm)**
Bear Creek													
Goat Cr (Mouth to Falls)	24-Sep	1.4	0.9	5.0	4.0	9.0	6.2	10.0	8.0	1.0	7.0	0.0	0.0
Goat Cr (Mouth to Falls)	10-Oct			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bear Creek (Standley Trail to USFS Cabin)	24-Sep	1.4	0.9	0.0	0.0	0.0	0.0	0.0	4.0	3.0	1.0	0.0	0.0
Bear Creek (Standley Trail to USFS Cabin)	10-Oct			1.0	0.0	1.0	0.7	0.8	1.0	0.0	1.0	0.0	0.0
Bear Creek (USFS Cabin to Goat Creek)	24-Sep	0.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bear Creek (USFS Cabin to Goat Creek)	10-Oct			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bear Creek (Goat Creek to Wilderness Boundary)	24-Sep	1.4	0.9	3.0	1.0	4.0	2.8	4.4	14.0	5.0	6.0	0.0	3.0
Bear Creek (Goat Creek to Wilderness Boundary)	10-Oct			0.0	1.0	1.0	0.7	0.8	3.0	0.0	2.0	1.0	0.0
		5.1	**3.2**	**9.0**	**6.0**	**15.0**	**2.9**	**4.7**	**30.0**	**9.0**	**17.0**	**1.0**	**3.0**
Bear Creek Total													
Lostine River													
Lundquist Bridge to OC Ranch	4-Oct	4.4	2.8	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	3.0	5.0
Pole Bridge to 6 Mile Bridge	28-Sep	3.2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pole Bridge to 6 Mile Bridge	4-Oct			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Williamson to Walla Walla	28-Sep	3.5	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Williamson to Walla Walla	5-Oct			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bowman to French Camp	28-Sep	2.6	1.6	6.0	17.0	23.0	8.8	14.4	11.0	0.0	0.0	6.0	5.0
Bowman to French Camp	5-Oct			0.0	2.0	2.0	0.8	1.3	0.0	0.0	0.0	0.0	0.0
French Camp to Shady Falls	28-Sep	2.4	1.5	4.0	6.0	10.0	4.2	6.7	10.0	1.0	4.0	5.0	0.0
French Camp to Shady Falls	5-Oct			2.0	15.0	17.0	7.1	11.3	3.0	0.0	3.0	0.0	0.0
Lostine River Total		**16.1**	**10.1**	**12.0**	**40.0**	**52.0**	**3.2**	**5.2**	**32.0**	**1.0**	**7.0**	**14.0**	**10.0**
Deer Creek													
Road 8270 Road Crossing Upstream 0.8 miles	21-Sep	1.1	0.7	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0	0
Road 8270 Road Crossing Upstream 0.8 miles	3-Oct			0	0	0.0	0.0	0.0	0.0	0	0	0	0
Deer Creek Total		**1.1**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**3.0**	**0.0**	**3.0**	**0.0**	**0.0**
Grande Ronde Basin Total													

Table 2b
Bull Trout Spawning Surveys
For the Imnaha River, 2017
USFWS, La Grande Field Office

Imnaha Basin		Kilometers	Miles		Redds				Total		Bull Trout Observed (mm)		
Stream Reach, Section	**Date(s)**	**Surveyed**	**Surveyed**	**Occ**	**Unocc**	**Total**	**Per km**	**Per Mile**	**But obs**	**<6"(150mm)**	**<12" (~300mm)**	**<18"(450mm)**	**>18"(450mm)**
Upper Imnaha System													
South Fork Tributaries													
Cliff Cr., mouth to 3.6 km*	26-Sep	4.0	2.5	0.0	60.0	**60.0**	15.0	24.0	88.0	0.0	88.0	0.0	0.0
South Fork Tributaries Total		**4.0**	**2.5**	**0.0**	**60.0**	**60.0**	**0.0**	**24.0**	**88.0**	**0.0**	**88.0**	**0.0**	**0.0**
North Fork													
Middle Fork., mouth to falls	27-Sep	1.3	0.8	4.0	6.0	10.0	7.7	12.4	8.0	0.0	6.0	2.0	0.0
N. Fk., above M. Fk. (reach 3-7)	26-Sep	6.6	4.1	1.0	12.0	13.0	2.0	3.2	1.0	0.0	1.0	0.0	0.0
N. Fk., below M. Fk. (reach 1-2)	27-Sep	3.4	2.1	2.0	3.0	5.0	1.5	**2.4**	6.0	0.0	2.0	2.0	2.0
North Fork Total		**11.3**	**7.0**	**7.0**	**21.0**	**28.0**	**2.5**	**0.4**	**15.0**	**0.0**	**9.0**	**4.0**	**2.0**
South Fork													
S. Fk., North Fork to Soldier Cr.	25-26 Sep	2.4	1.5	3.0	8.0	11.0	4.6	7.4	9.0	0.0	7.0	1.0	1.0
S. Fk., Soldier to Cliff Cr.	25-26 Sep	5.0	3.1	4.0	17.0	21.0	4.2	6.8	14.0	0.0	11.0	3.0	0.0
South Fork Total		**7.4**	**4.6**	**7.0**	**25.0**	**32.0**	**4.3**	**7.0**	**23.0**	**0.0**	**18.0**	**4.0**	**1.0**
Upper Imnaha													
Upper Imnaha Falls to North Fork	27-Sep	1.0	0.6	1.0	0.0	1.0	1.0	1.6	5.0	0.0	2.0	1.0	2.0
Upper Imnaha Falls to lower falls	27-Sep	1.3	0.8	1.0	5.0	6.0	4.6	7.4	3.0	0.0	2.0	1.0	0.0
Falls downstream .67 mi. to beg. of gorge*	27-Sep	1.1	0.7	3.0	6.0	9.0	8.2	13.2	7.0	0.0	3.0	2.0	2.0
Lower end of gorge to next gorge (.25 mi)*	27-Sep	0.4	0.2	0.0	2.0	2.0	5.0	8.0	1.0	0.0	0.0	1.0	0.0
Canyon above slide to canyon just above slide*	27-Sep	1.5	0.9	1.0	3.0	4.0	2.7	4.3	2.0	0.0	0.0	1.0	1.0
Upper Imnaha Total		**5.3**	**3.3**	**6.0**	**16.0**	**22.0**	**4.2**	**6.7**	**18.0**	**0.0**	**7.0**	**6.0**	**5.0**

Table 2b

Bull Trout Spawning Surveys
For the Imnaha River, 2017
USFWS, La Grande Field Office

Imnaha Basin	Date(s)	Kilometers	Miles		Redds				Total		Bull Trout Observed (mm)		
Stream Reach, Section		**Surveyed**	**Surveyed**	**Occ**	**Unocc**	**Total**	**Per km**	**Per Mile**	**But obs**	**<6"(150mm)**	**<12" (~300mm)**	**<18"(450mm)**	**>18"(450mm)**
Middle Imnaha													
Blue Hole to Indian Crossing	27-Sep	3.2	2.0	4.0	7.0	11.0	3.4	5.5	8.0	0.0	1.0	5.0	2.0
Blue Hole to Indian Crossing	11-Oct			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle Imnaha Total		**3.2**	**2.0**	**4.0**	**7.0**	**11.0**	**3.4**	**5.5**	**8.0**	**0.0**	**1.0**	**5.0**	**2.0**
Big Sheep System													
Big Sheep, Canal to Rd. 39	3-Oct	3.1	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lick Cr. Meadow to 39 rd.	3-Oct	2.4	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lick Cr. 39 Rd. to Quartz Cr.	3-Oct	6.8	4.2	0.0	5.0	5.0	0.7	1.2	7.0	0.0	7.0	0.0	0.0
Big Sheep System Total		**12.3**	**7.6**	**0.0**	**5.0**	**5.0**	**0.4**	**0.7**	**7.0**	**0.0**	**7.0**	**0.0**	**0.0**
Imnaha Basin Total (Page 1)		**24.0**	**17.4**	**20.0**	**100.0**	**120.0**	**5.0**	**6.9**	**144.0**	**8.0**	**122.0**	**14.0**	**8.0**
Imnaha Basin Total (Page 2)		**15.5**	**9.6**	**5.0**	**12.0**	**17.0**	**1.1**	**1.8**	**15.0**	**0.0**	**8.0**	**5.0**	**2.0**
Imnaha Basin Total Pages 1 & 2)		**39.5**	**27.0**	**25.0**	**112.0**	**137.0**	**3.5**	**5.1**	**159.0**	**8.0**	**130.0**	**19.0**	**10.0**

Table 4a –
Summary of Measured Bull Trout Redds, Grande Ronde River Basin
Lostine River and Goat Creek 2017

Stream	n*		Length (M)	Width (M)	Area (m^2)	Length/Width ratio
Lostine	50	mean	1.2	0.8	1.0	1.6
		sd	0.4	0.3	0.6	0.5
		max	2.0	2	4	3
		min	0.5	0.3	0.1	0.7
Bear	6	mean	1.0	0.7	0.8	1.6
		sd	0.5	0.4	0.7	0.3
		max	1.8	1.05	1.9	2
		min	0.25	0.15	0.04	1
Goat	9	mean	0.6	0.4	0.3	1.5
		sd	0.3	0.15	0.2	0.6
		max	1.1	0.65	0.7	2.3
		min	0.2	0.2	0.05	0.8

*n = number of redds observed and measured (sample size).

Table 4b –
Summary of Measured Bull Trout Redds, Imnaha River Basin 2017

Stream	n*1		Length (M)	Width (M)	Area (m^2)	Length/Width ratio
Lick Creek	5	mean	0.6	0.4	0.2	1.8
		sd	0.1	0.04	0.04	0.2
		max	0.8	0.4	0.3	2
		min	0.6	0.3	0.2	1.5
Middle Imnaha	11	mean	1.3	0.9	1.3	1.5
		sd	0.5	0.4	0.9	0.5
		max	2.4	1.7	2.9	2.6
		min	0.7	0.4	0.3	1.0
N.F. Imnaha	28	mean	1.1	0.6	0.8	2.0
		sd	0.5	0.4	0.5	0.7
		max	2.0	1.3	2.5	4.0
		min	0.4	0.2	0.1	0.8
S.F. Imnaha	32	mean	1.2	0.6	0.9	2.0
		sd	0.7	0.3	1.2	0.6
		max	3.5	1.6	5.6	3.8
		min	0.5	0.2	0.2	1
Upper Imnaha	22	mean	1.2	0.7	1.0	1.8
		sd	0.5	0.3	1.1	0.5
		max	3.1	1.8	5.6	2.7
		min	0.6	0.3	0.2	0.7

***n = number of redds observed and measured (sample size).**
Cliff Creek was not measured as it is a known resident population.
Big Sheep not included in table as no redds documented in 2017.