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Photographic Monitoring of Channel Rehabilitation Sites on the Trinity River, California, 2007-2010

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Photographic Monitoring of Channel Rehabilitation Sites on the Trinity River, California, 2007-2010

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Abstract.—Photographic monitoring is a tool that can be used to show the evolution of riverine systems. The primary objective of this project was to supplement Trinity River monitoring projects by photographing changes through time that are caused by restoration actions, natural fluvial processes and riparian processes. The study was initiated in 2007, and as of March 2010, has collected over 3,000 photographs at 237 photographic point locations among 15 channel rehabilitation sites. These photographs show changes from mechanical restoration, coarse sediment augmentation, riparian processes and fluvial processes. Photographs can be used to support the Trinity River Restoration Program and their adaptive management framework.

INTRODUCTION

Human activities have caused fish populations and aquatic ecosystems to decline (Caruso 2006; Roni et al. 2008). This has led to increased efforts to restore and rehabilitate aquatic habitats (Beechie et al. 2008; Liermann and Roni 2008; Roni et al. 2008) with millions of dollars spent annually on restoration activities in the Pacific Northwest in an effort to increase fish populations (NRC 1996; Roni et al. 2002).

The Trinity River Division (TRD) of the Central Valley Project was completed in 1964, with Trinity and Lewiston dams blocking anadromous salmonids from reaching the upper watershed, blocking all course sediment supply from the upper watershed and the diversion of up to 80-90% of the water yield to the Sacramento Basin (USFWS and HVT 1999). The loss of high streamflows (magnitude and duration) and coarse sediment input, along with watershed management practices that led to increased fine sediment yield, resulted in severe degradation of salmonid

habitats in the mainstem Trinity River below Lewsiton Dam. In particular, changes in channel morphology occurred with the development of riparian berms and the isolation of the river from its historic floodplain. The Trinity River Restoration Program (TRRP) was established to restore the fishery resources of the Trinity River that were adversely affected by the construction and operation of the TRD through the restoration of fluvial and ecological processes on the Trinity River below Lewiston Dam.

The TRRP objectives as outlined in the Integrated Assessment Plan are to: (1) create and maintain spatially complex channel morphology; (2) increase/improve habitats for freshwater life stages of anadromous fish; (3) restore and maintain natural production of anadromous fish populations; (4) restore adult anadromous fish numbers downstream of Lewiston Dam to pre-dam levels; (5) establish and maintain riparian vegetation that supports fish and wildlife; (6) rehabilitate and protect wildlife habitats and maintain or enhance wildlife populations following implementation (TRRP and ESSA 2009). To accomplish these objectives, the TRRP is implementing a process based restoration approach that includes: (1) streamflow management to restore fluvial processes that create and maintain suitable salmonid habitat and to meet water temperatures objectives; (2) mechanical rehabilitation of the channel; (3) coarse and fine sediment management; and (4) watershed restoration (DOI 2000).

Objective, scientific evaluation of river restoration actions is crucial to learn from and improve river restoration practices in the future (Kondolf 1995). Multidisciplinary assessments that focus on water quality, habitat, fish, wildlife, geomorphic processes and riparian processes are being conducted on the Trinity River to study the effects of restoration actions. Ground-based photographic monitoring may be used to supplement quantitative assessments conducted by a variety of disciplines to show changes caused by restoration actions and natural events through time (Hall 2001; Gerstein and Kocher 2005; Shaff et al. 2007). This tool has been previously used in monitoring changes at channel rehabilitation sites on the Trinity River (McBain and Trush 2001). The primary objective of this project was to document changes of riverine habitats from restoration actions on the Trinity River and supplement other monitoring projects. These images will be available as a permanent record and sites can be revisited to evaluate changes through time as sites evolve and/or additional restoration actions are implemented.

STUDY SITES

Sven Olbertson (RKM 178.94 to 179.84)

The Sven Olbertson site consists of a left bank side channel complex (Figure 1; U.S. Bureau of Reclamation and the Trinity County Resource Conservation District 2008). The side channel was constructed with three distinct network openings to increase habitat complexity. Downstream of the side channel, a notch was cut in the cement weir that had previously ponded water. This formerly ponded area is now

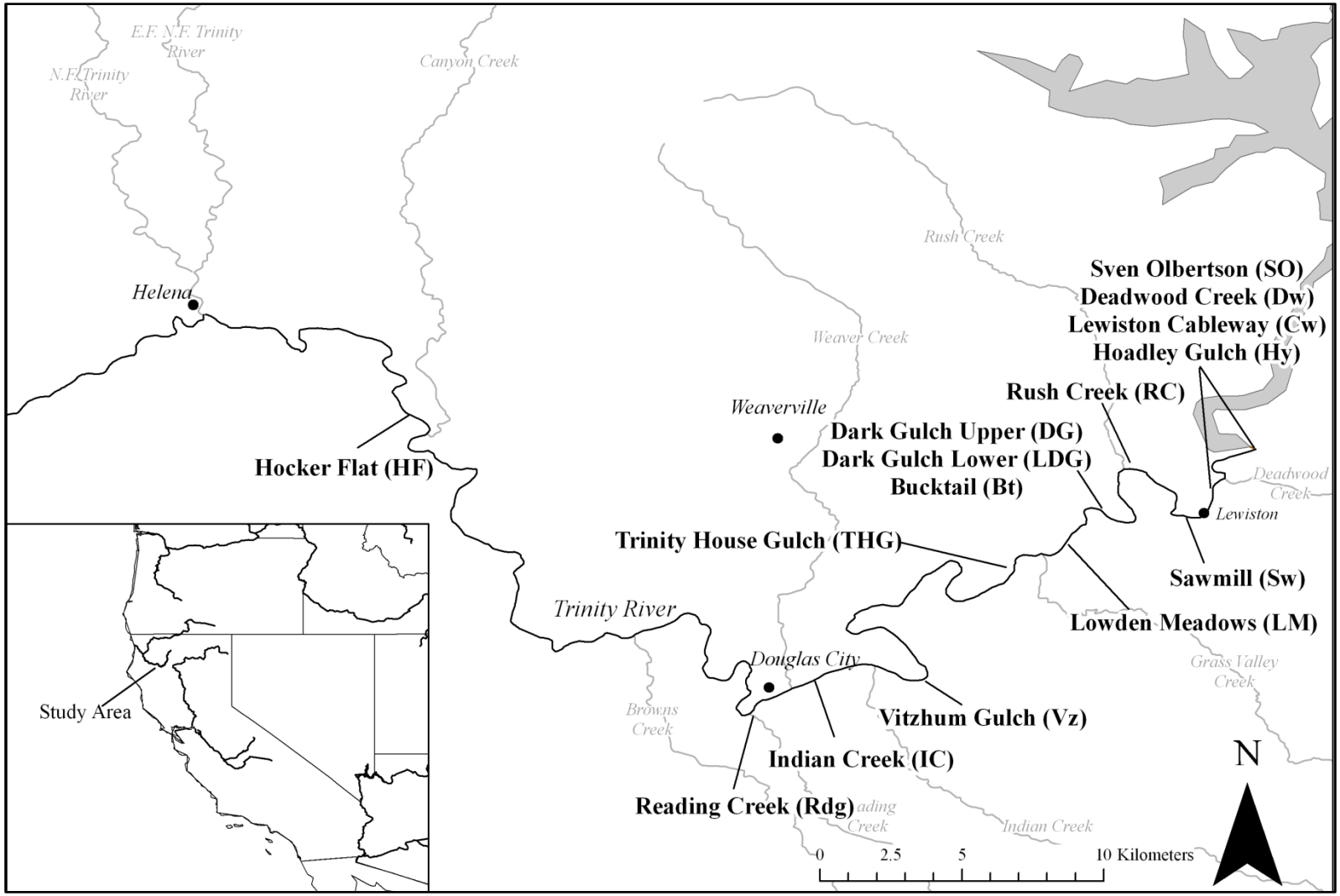


Figure 1. Bank rehabilitation sites where photographic monitoring occurred on the Trinity River.

drained during low streamflows. In addition, this site is 320 m downstream of the Lewiston Hatchery coarse sediment augmentation site.

In recent years, 2,206 metric tons (2,432 tons) of coarse sediment was added in 2006 and 5,897 (6,500) was added in 2007 (J. Faler, TRRP, personal communication). This coarse sediment is moved downstream with high streamflow events and interacts with the site. Additional restoration actions included large wood installations. Construction occurred in 2008.

Deadwood Creek (RKM 177.77 to 178.57)

Located immediately downstream of the Highway 3 Bridge, Deadwood Creek channel rehabilitation consists of a side channel construction, vegetation removal and large wood installation on the downstream left bank. Construction occurred in 2008.

Lewiston Cableway (RKM 177.32 to 177.77)

Located upstream of the Old Lewiston Bridge, the Lewiston Cableway site consists of large wood placement, a sequence of constructed gravel bars on both the left and right banks, decreasing the channel width, increasing channel confinement, adding coarse sediment to the channel, and increasing sinuosity. A side channel was also enhanced along the right bank and several in-channel rock weirs were removed or partially removed. Vegetation adjacent to the channel was also removed immediately upstream of the Old Lewiston Bridge. Construction occurred in 2008.

Hoadley Gulch (RKM 176.71 to 177.19)

Located immediately downstream of the Old Lewiston Bridge, the Hoadley Gulch site consists of a large gravel bar on the right bank of the river. A side channel with two entrances was constructed at the upstream end of the gravel bar and exits as one channel at the downstream end of the feature. Floodplain lowering, large wood placement and vegetation removal were also components of the rehabilitated site. Construction occurred in 2008.

Sawmill (RKM 175.30 to 176.50)

The Sawmill site is one of the most extensive restoration sites on the Trinity River to date. Restoration actions implemented at the Sawmill site included modifications to an existing side channel complex as well as lowering and re-contouring the floodplain (Hoopa Valley Tribe and McBain and Trush 2009; North Coast Regional Water Quality Control Board and U.S. Bureau of Reclamation 2009). Sawmill is the first site with forced meanders and a constructed log jam structure. Additional restoration actions included large wood and coarse sediment additions. Construction occurred in 2009.

Dark Gulch and Bucktail (RKM 169.74 to 172.33)

The Dark Gulch-Upper site consists of a series of existing side channel complexes on the left side of the channel. Additional side channels were constructed on the right banks of Dark Gulch-Upper, Dark Gulch-Lower and Bucktail sites. Floodplains were lowered on the Dark Gulch sites. Adjacent channel vegetation was also removed. Additional restoration actions included large wood installations. Construction occurred in 2008.

Vitzhum Gulch (RKM 154.64 to 155.84)

The Vitzhum Gulch site consists of large wood placement and a series of 13 notches excavated from the existing berm along the inside of a right bank bend in the channel with the hypothesis that the remaining berm would be removed by fluvial processes (U.S. Bureau of Reclamation and Trinity County 2007). During high streamflows, the area behind the notches was inundated. The left bank of the channel is a steep, confined grade leading directly up to Highway 299. Construction occurred in 2007.

Indian Creek (RKM 151.25 to 153.83)

The Indian Creek site extends from the confluence with Indian Creek downstream to the Highway 299 Douglas City Bridge. The most prominent design feature at this site is the long side channel constructed along the right bank. Floodplain lowering, large wood placement and vegetation removal was done upstream and adjacent to the constructed side channel. Construction occurred in 2007.

Hocker Flat (RKM 125.63 to 127.63)

Located immediately downstream of the confluence of Canyon Creek and the mainstem Trinity River, the Hocker Flat site consists of berm removal and floodplain lowering on both the left and right banks (U.S. Bureau of Reclamation and California Department of Water Resources 2004). This site was rehabilitated in 2005 and was the first site constructed since the Record of Decision (ROD; DOI 2000) was signed. After construction the channel spread out with increasing streamflow. This changed the sediment transport dynamic to facilitate coarse sediment deposition forming lateral and mid-channel bar features within the site. This rehabilitation site has had the most time to interact and evolve with the ROD releases, winter floods and riparian development.

Several sites were not constructed at the time of this report, but were monitored for pre-construction conditions. These sites include, from upstream to downstream, Rush Creek (RKM 173.80 to 173.90), Lowden Meadows (RKM 168.02 to 169.46), Trinity House Gulch (RKM 167.46 to 167.87) and Reading Creek (RKM 148.38 to 150.49).

METHODS

Photographic point locations were selected to show specific and broad scale features. Ideal locations encompassed high vantage points with minimal visual obstruction

from vegetation (Hall 2001; Gerstein and Kocher 2005). Photographic monitoring was scheduled to show visual changes and conditions at bank rehabilitation sites for pre-construction and post-construction phases in relation to streamflow (Kondolf 1995; Flosi et al. 1998; Gerstein and Kocher 2005). Pre-construction was defined as the time occurring before bank rehabilitation. Post-construction was defined as the time occurring after bank rehabilitation activities. If possible, photographic monitoring was scheduled during winter base streamflow to increase bank exposure and minimize visual obstruction caused by leafy vegetation. We attempted to schedule photographic monitoring within two weeks of the previous year's field efforts so that physical conditions such as lighting, vegetative growth and river discharge are most similar to allow for better comparisons (McBain and Trush 2001). Sites that would be constructed in the near future or recently constructed sites had the highest priority. Other factors eventually dictated when to revisit a photographic location such as the weather, location quality, streamflow level, significant changes in habitat or morphological features and the amount of time allotted for the photographic monitoring project. For example, several photographic point locations that contain ideal vantage points were opportunistically surveyed during higher river discharges and other times of the year to show sites under different hydraulic conditions.

Photographic points were established and located by utilizing geo-referenced photographic point locations, comparing previous photographs in the field and photographing in vertical panoramic form. Photographic point locations and attributes were geo-referenced with a Trimble Pro-XH GPS and tablet PC using ArcPad or Terra Sync data collection software. Photographic points were attributed with bank rehabilitation site, a unique photographic point identification number, date, photograph number, construction phase, streamflow, location description, photographer's name and general comments (Hall 2001; Gerstein and Kocher 2005). Streamflow data was calculated for each site from proximal USGS gage stations located at http://waterdata.usgs.gov (Appendix A). Photographs were usually attained with a tripod and Olympus 7.1 MP digital SLR camera. The camera was set to automatic landscape mode to decrease observer bias. Photographs were generally zoomed out, framed vertically to maximize depth of field and oriented from upstream to downstream in a horizontal panorama series. Images included a landmark or horizon when possible to facilitate photographic comparisons and revisit surveys (Gerstein and Kocher 2005). Revisit surveys were conducted by locating geo-referenced photographic point locations and framing photographs from the initial survey data. Photograph information, coordinates and associated attributes were managed in the shapefile attribute table.

RESULTS

This photographic monitoring project was initiated in 2007, and to date has collected over 3,000 photographs at 237 photographic point locations among 15 channel rehabilitation sites (Table 1; Appendix B; Appendix C). Photographic monitoring prior to and following construction phases and related to streamflow events has enabled the time sequenced documentation of changes occurring in the Trinity River. Following are some examples of photo-documentation at channel rehabilitation sites.

Sven Olbertson

The photographic series at Sven Olbertson photographic point SO4, show pre-construction conditions and post-construction conditions at multiple streamflows, (Figure 2). Pre-construction conditions were photographed in May 2008 during a high streamflow event and include riverine features such as a side channel, floodplain, mainstem backwater and established riparian vegetation separating the main channel and backwater. The post-construction conditions photographed in January 2009 show changes such as vegetation removal, floodplain and side channel re-contouring and backwater construction. The site was photographed between April and May 2009 at multiple streamflows, showing the river expanding from the low streamflow channel, connecting the side channel with the constructed backwater and inundating the re-contoured floodplain. Finally, photographs of post-construction conditions, taken in February 2010, show riparian vegetation developing on constructed surfaces.

Table 1. The number of photographic point locations at each site surveyed by year. The number of photo points surveyed at each site varies annually based on survey effort and changing site conditions.

Site (ID)	Year			
	2007	2008	2009	2010
1) Sven Olbertson (SO)	0	4	14	15
2) Deadwood Creek (Dw)	0	3	6	7
3) Lewiston Cableway (Cw)	0	13	17	18
4) Hoadley Gulch (Hy)	0	11	17	18
5) Sawmill (Sw)	0	0	0	16
6) Rush Creek (RC)	0	3	0	0
7) Dark Gulch-Upper (DG)	0	8	11	10
8) Dark Gulch-Lower (LDG)	0	14	13	16
9) Bucktail (Bt)	0	4	4	4
10) Lowden Meadows (LM)	0	0	0	24
11) Trinity House Gulch (THG)	0	0	0	15
12) Vitzhum Gulch (Vz)	9	5	9	9
13) Indian Creek (IC)	19	35	8	36
14) Reading Creek (Rdg)	0	0	4	26
15) Hocker Flat (HF)	0	0	5	0
Total	28	100	108	214

5/7/2008, Pre-construction 6,120 cfs

4/29/2009, Post-const. 2,660 cfs, backwater and side channel connection

1/15/2009, Post-const. 321 cfs, constructed side channel

5/5/2009, Post-const. 4,370 cfs, floodplain inundation

4/28/2009, Post-const. 1,590 cfs, flow ramping

2/2/2010, Post-const. 289 cfs, riparian development

Figure 2. Sven Olbertson viewed from photographic point SO4 at multiple streamflows. This photograph series show a constructed side channel complex, connection between the constructed backwater and side channel complex, floodplain inundation and riparian development on constructed surfaces. Streamflow direction is left to right.

Deadwood Creek

The photographic series at Deadwood Creek photographic point DW8 show post-construction conditions (Figure 3). Pre-construction photographs were not taken due to time constraints. The post-construction conditions photographed in January 2009 show vegetation removal and a constructed side channel that contains large wood installations. Photographs of the post-construction conditions in February 2010 show riparian vegetation development on constructed surfaces.

Lewiston Cableway

The photographic series at Lewiston Cableway photographic point OB1 show conditions before and after construction (Figure 4). The pre-construction conditions photographed in August of 2008 shows completely vegetated banks with a simple, straight channel. The post-construction photograph taken in January 2009 shows constructed gravel bars on the left and right banks, vegetation removal and a more sinuous channel.

Hoadley Gulch

The photographic series at Hoadley Gulch photographic point Hy7 show pre-construction and post-construction conditions (Figure 5.). Pre-construction conditions photographed in August 2008 show a steep and heavily vegetated bank. The post-construction photograph taken in January 2009 shows a constructed gravel bar, side channel and vegetation removal. The post-construction photograph taken in February 2010 expands the view from the pre-construction photograph. Little change was observed between 2009 and 2010 post-construction conditions.

1/16/2009, Post-construction 321 cfs 2/9/2010, Post-construction 286 cfs

Figure 3. A constructed side channel before and after a high streamflow event at Deadwood Creek viewed from photographic point Dw8. Streamflow direction is indicated with the red arrow. Riparian development is indicated with the blue arrow.

8/11/2008, Pre-construction 451 cfs 1/16/2009, Post-construction 321 cfs

Figure 4. The effects of constructed gravel bars at Lewiston Cableway viewed from photographic point OB1. Streamflow direction is indicated with a red arrow. A constructed gravel bar is identified with a blue arrow.

8/11/2008, Pre-construction 451 cfs 1/16/2009, Post-construction 321 cfs

2/3/2010, Post-construction 286 cfs

Figure 5. A constructed side channel and gravel bar at Hoadley Gulch viewed from photographic point Hy7. The photographs show vegetation removal, large gravel bar installation and a constructed side channel. Streamflow direction is indicated by the red arrow. The constructed side channel and gravel bar are identified with blue arrows.

Sawmill

The photographic example at Sawmill photographic point Sw2 shows post-construction conditions in February 2010 (Figure 6). Due to time constraints, pre-construction photographs were not taken. The photographs show a modified side channel complex, large wood installations, vegetation removal and extensive floodplain lowering and re-contouring. The large wood installation was designed to interact with high streamflow events to create geomorphic change while providing in-water escape cover, a critical component of salmonid rearing habitat.

Dark Gulch-Upper

The photographic series at Dark Gulch-Upper photographic point DG6 show pre-construction conditions and post-construction conditions at multiple streamflows (Figure 7). Pre-construction conditions photographed in August 2008 show a floodplain covered with grass and shrubs. Post-construction conditions photographed in January 2009 show floodplain lowering, re-contouring, vegetation removal, large wood installations and a constructed side channel in the distance. The post-construction conditions photographed in May 2009 show floodplain inundation at high streamflows while post-construction conditions photographed in February 2010 indicate little change after the high streamflow event.

2/3/2010, Post-construction 283 cfs

Figure 6. Post-construction conditions at Sawmill bank rehabilitation site viewed from photographic point Sw2. Photograph shows floodplain lowering and re-contouring, large wood installations, gravel additions and other treatment types. Streamflow direction is indicated with red arrows. Large wood installations are indicated with blue arrows.

8/11/2008, Pre-construction 453 cfs

1/16/2009, Post-construction 345 cfs

5/5/2009, Post-construction 4,538 cfs

2/9/2010, Post-construction 355 cfs

Figure 7. Floodplain lowering, re-contouring and inundation at Dark Gulch-Upper viewed from photographic point DG6. Streamflow direction is left to right.

Dark Gulch-Lower

The photographic series at Dark Gulch-Lower photographic point LDG9 show pre-construction conditions and post-construction conditions at multiple streamflows (Figure 8). Pre-construction conditions photographed in August 2008 show a willow dominated floodplain. Post-construction photographs in January 2009 show areas of vegetation removal, large wood installations, a constructed side channel and areas

8/12/2008, Pre-construction 455 cfs

1/26/2009, Post-construction 314 cfs

5/5/2009, Post-construction 4,538 cfs

2/17/2010, Post-construction 349 cfs

Figure 8. The effects of a floodplain lowering and re-contouring and a constructed side channel with large wood installations at Dark Gulch-Lower viewed from photographic point LDG9. Streamflow direction is indicated with a red arrow. Riparian development is indicated with a blue arrow.

where floodplain lowering and re-contouring were implemented. Photographs from May 2009 show the inundation of the constructed floodplain at high streamflows. Post-constructed conditions photographed in February 2010 show vegetation development on constructed surfaces.

Bucktail

The photographic series at Bucktail photographic point Bt4 show post-construction conditions at multiple streamflows (Figure 9). The pre-construction photograph was not in panoramic form and was not included in the example. Post-construction conditions photographed in January 2009 show a modified side channel with large wood installations. Post-construction photographs in April 2009 show wood recruitment on the large wood installation with increasing streamflow. The additional wood and/or increasing streamflows may have destabilized the large wood installation. Post-construction photographs in May 2009 show the newly recruited wood and installed wood are missing. Post-construction conditions photographed in February 2010 show recruitment of a new piece of large wood into the side channel.

Vitzhum Gulch

The photographic series at Vitzhum Gulch photographic point Vz4 show post-construction conditions at multiple streamflows (Figure 10). This study was initiated after pre-construction and is why there are no pre-construction examples. Post-construction photographs from October 2007 show a constructed notch excavated from an existing berm. This feature, in concert with high streamflow events, was intended to destabilize the riparian berm while providing salmonid rearing habitat. The photograph taken in May 2008 show the inundation of the notch and a high streamflow side channel behind the riparian berm during the high streamflow event. Post-construction conditions photographed in April 2009 and February 2010 show fine sediment deposition in the notch and riparian development, respectively.

Indian Creek

The photographic series at Indian Creek photographic point IC14 show post-construction conditions at multiple streamflows (Figure 11). Post-construction conditions photographed in November 2007 show a constructed side channel and lowered re-contoured floodplain. Post-construction conditions photographed in May 2008 show floodplain inundation and connection between the side channel and main channel during a high streamflow event. Post-construction conditions photographed in August 2008 show vegetation development on constructed surfaces (dominated by grass type vegetation) and large wood recruitment in the side channel.

1/27/2009, Post-construction 314 cfs, installed large wood

4/28/2009, Post-construction 1,627 cfs, streamflow ramping

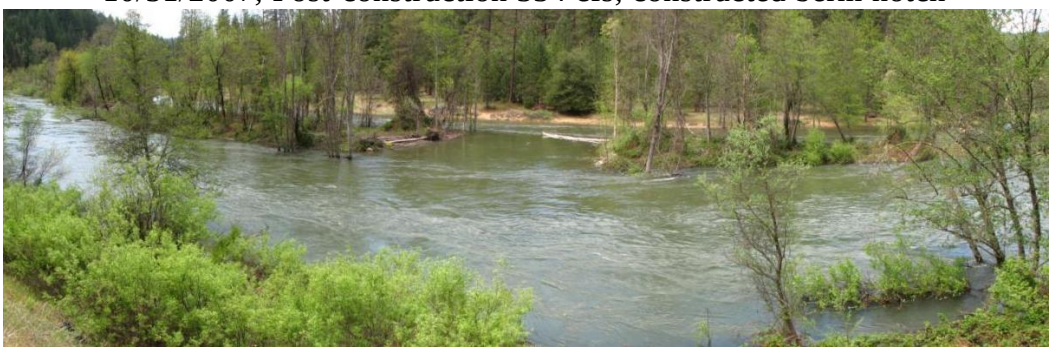
4/29/2009, Post-construction 2,690 cfs, large wood recruitment

5/5/2009, Post-construction 4,538 cfs, wood is transported downstream

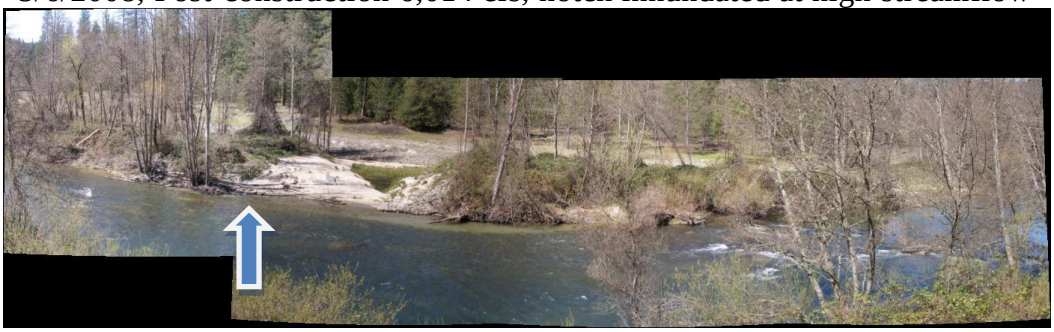
2/8/2010, Post-construction 367 cfs, wood transport and recruitment after the high streamflow event

Figure 9. Wood recruitment and transport at a constructed side channel at Bucktail bank rehabilitation site viewed from photographic point Bt4. Streamflow direction is from left to right. Wood transport processes are identified by blue arrows.

10/31/2007, Post-construction 334 cfs, constructed berm notch



5/6/2008, Post-construction 6,014 cfs, notch innundated at high streamflow



4/1/2009, Post-construction 395 cfs, fine sediment deposition in the notch

2/8/2010, Post-construction 559 cfs, riparian development

Figure 10. A berm notch is indicated by a blue arrow at Vitzhum Gulch after construction, at high streamflows and post high streamflow conditions viewed from photographic point Vz4. Streamflow direction is right to left.

11/14/2007, Post-construction 368 cfs, constructed side channel and floodplain

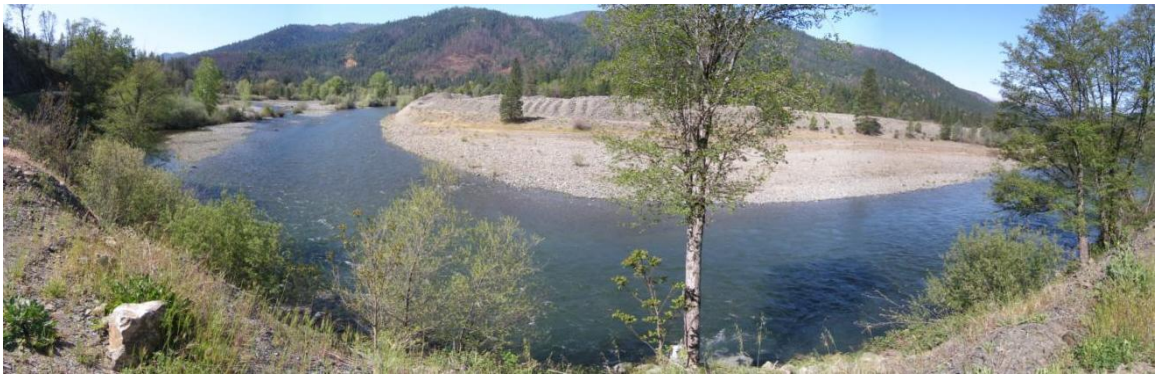
5/6/2008, Post-construction 6,068 cfs, floodplain inundation

8/14/2008, Post-construction 465 cfs, wood recruitment, riparian development

Figure 11. A constructed side channel and lowered/ re-contoured floodplain at Indian Creek photographic point IC14. Blue arrow indicates large wood recruitment and grassy riparian development. Streamflow direction is right to left.

Hocker Flat

The photograph at Hocker Flat photographic point HF1 shows post-construction conditions of a lowered floodplain during the spring high streamflow (Figure 12). No comparisons to pre-construction can be made at this time because this study was initiated after construction. Efforts will be made in the future to locate any pre-construction photographs.



4/27/2009, Post-construction 1,010cfs

Figure 12. A lowered floodplain without large wood and little grassy riparian development. Located just downstream of the Canyon Creek confluence at Hocker Flat photographic point HF1. Pre-construction occurred before this photographic monitoring project was initiated. Streamflow direction is from left to right.

DISCUSSION

It is a priority in the TRRP science framework to capture changes in the Trinity River from restoration at systemic and site specific scales (TRRP and ESSA 2009). The combination of ground-based and aerial photography is an effective way to monitor the success of restoration projects and changes at locations outside of bank rehabilitation sites through time (Shuman and Ambrose 2003). Multi-scale evaluations of restoration may be facilitated by incorporating the annual aerial photography datasets collected by the TRRP into the photographic monitoring records. Ground-based photography shows site specific features that may not be seen from aerial photography. Orthorectified aerial photography would allow broad scale features to be quantitatively digitized on maps. In the future, the TRRP may consider integrating photographic monitoring with aerial photography. This concept may be extended to other complementary remote sensing datasets collected by the TRRP such as thermal imagery and Lidar.

Long-term post-project monitoring is suggested for 10 years with revisit intervals depending on annual peak streamflows (Kondolf 1995). The Trinity Management Council recommends an annual streamflow release that causes some flooding and will most likely have annual peak streamflows every year. Figure 9, The Bucktail photographic example in the results shows large wood transport with as little as 2,690 cfs. This is important information because it proves that some changes can occur at relatively low discharges with minimal effort (ie. wood transport). In the past three years the streamflow release has ranged from 4,500 cfs to 11,000 cfs (2011), therefore every year is potentially valuable for photographic monitoring. However, long-term photographic monitoring intervals may become less frequent for each site as new sites are added each year and less time is available to revisit past photographic locations. It is important to determine if the photographic point will be useful in the future and assigning poor locations with an “inactive” status prevents

data and field efforts from continuing at these points. It is recommended to wait several years before determining whether a photographic point is inactive to allow time for the site to evolve. The TRRP should consider increasing time and effort to this photographic monitoring project as the number of restoration sites increases.

Photographic monitoring of areas outside of bank rehabilitation sites could also be useful when employing a randomized sampling and a rotating panel revisit design (CDFG et al. 2010). Randomized locations outside of bank rehabilitation sites should be incorporated into the photographic monitoring study design and will provide additional insight into changes caused by other restoration treatment types (i.e., simulated spring hydrograph, coarse sediment augmentation) and/or natural changes in the river.

Considerations for future photographic monitoring should include associating quantitative information with photographic data. Some quantitative variables that could be measured include channel or habitat features, riparian classification, and time since construction (Rosgen 1994; Castro 1997; Flosi et al. 1998; Gerstein and Kocher 2005; Simon et al. 2007). For example, a channel feature classification scheme could be associated with each photographic monitoring point. The channel features could be classified into broad geomorphic feature categories that are visible in each photographic series. Photographs could then be queried from the database based on these features as well as numerically summarized by photographic points per type. Data collection efforts for FY2011 will include presence/absence of a floodplain, berm, berm notch, island, bar, side channel, side channel top, side channel bottom, high streamflow channel, backwater, pool, riffle, run, tributary, pond, wetland, large wood installed, constructed large wood jam, bridge, and gravel injection site. These variables were selected from recommendations discussed at TRRP coordination meetings. With additional effort, previous photographs could be attributed with this information. The main purpose of the presence/absence data will be used to methodically view changes of specific features. Another example, riparian vegetation could be investigated by applying a classification scheme to each photographic point. In this example riparian vegetation could be classified by broad vegetative types (grasses, willows, alders, berries, cottonwood, etc.) and density categories (absent, sparse, dense, etc.). This could be used to track vegetation establishment and development through time. Other considerations may include an on-line map or database containing GPS locations that are linked to photographs and attributes.

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APPENDICES

Appendix A. Streamflow (cfs) data calculated for each site from proximal USGS gage stations. Sites are arranged from upriver to downriver. USGS gage station indicates the formula used to calculate streamflow for a given site.

SITE	USGS GAGE STATION
1) Sven Olbertson	TRINITY R A LEWISTON CA
2) Deadwood Creek	TRINITY R A LEWISTON CA
3) Lewiston Cableway	TRINITY R A LEWISTON CA
4) Hoadley	TRINITY R A LEWISTON CA
5) Sawmill	TRINITY R A LEWISTON CA
6) Rush Creek	TRINITY R A LEWISTON CA
7) Dark Gulch -Upper	TRINITY R A LEWISTON CA +RUSH C NR LEWISTON CA
8) Dark Gulch-Lower	TRINITY R A LEWISTON CA +RUSH C NR LEWISTON CA
9) Bucktail	TRINITY R A LEWISTON CA +RUSH C NR LEWISTON CA
10) Lowden Meadows	TRINITY R A LEWISTON CA +RUSH C NR LEWISTON CA
11) Trinity House Gulch	TRINITY R A LEWISTON CA + RUSH C NR LEWISTON CA + GRASS VALLEY C NR LEWISTON CA
12) Vitzhum Gulch	TRINITY R A LEWISTON CA +RUSH C NR LEWISTON CA + GRASS VALLEY C NR LEWISTON CA
13) Indian Creek	TRINITY R A LEWISTON CA +RUSH C NR LEWISTON CA + GRASS VALLEY C NR LEWISTON CA + INDIAN C NR DOUGLAS CITY
14) Reading Creek	TRINITY R A DOUGLAS CITY CA
15) Hocker Flat	TRINITY R A JUNCTION CITY CA

Appendix B. Photographic point identifications (ID) and coordinates in NAD 1983 State Plane, California Zone I FIPS 0401 in feet.

SITE	ID	X	Y
Sven Olbertson	SO1	6338804	2146527
	SO2	6337906	2147362
	SO3	6338276	2146503
	SO4	6338304	2146391
	SO5	6338567	2147262
	SO6	6338600	2147363
	SO7	6338526	2147496
	SO7B	6338527	2147497
	SO8	6338428	2147492
	SO9	6338338	2147465
	SO10	6338400	2147161
	SO11	6338281	2146999
	SO12	6338458	2146865
	SO13	6338900	2146705
	SO14	6338540	2146984
	SO15	6338207	2146956
	SO16	6338611	2147199
Deadwood Creek	Dw1	6339110	2145932
	Dw2	6339156	2145869
	Dw3	6339110	2145881
	Dw4	6338264	2145057
	Dw5	6338194	2144861
	Dw6	6338371	2145141
	Dw7	6337978	2144626
	Dw8	6337985	2144474
	Dw9	6337979	2144475
Cableway	Cw1	6338101	2143319
	Cw2	6338011	2142891
	Cw3	6337958	2142751
	Cw4	6337908	2142643
	Cw5	6338114	2144356
	Cw6	6338050	2144387
	Cw7	6337966	2144086
	Cw8	6338065	2143975
	Cw9	6337986	2143900
	Cw10	6337959	2143675
	Cw11	6337982	2143631
Lewiston Cableway	Cw12	6337880	2143043
	Cw13	6337889	2143322
	Cw14	6338196	2143980
	Cw15	6337765	2142888
	Cw16	6338047	2143984
	OB1	6337647	2142218
	OB3	6337685	2142200
Hoadley	OB2	6337638	2142208
	OB4	6337680	2142185
	Hy1	6337256	2141633
	Hy2	6337259	2141648
	Hy3	6337281	2141646
	Hy4	6337226	2141854
	Hy5	6337222	2141282
	Hy6	6337207	2141272
	Hy7	6337261	2141413
	Hy8	6337276	2141379
	Hy9	6337263	2141448
	Hy10	6337268	2141451
	Hy11	6337206	2141780
	Hy12	6337255	2141740
	Hy13	6337141	2141553
	Hy14	6336855	2141387
	Hy15	6336912	2141440
	Hy16	6337013	2141451
	Hy17	6337381	2141810
	Hy18	6337389	2141946
	Hy19	6337272	2141355
	Hy20	6337287	2141837
	Hy21	6337230	2141817
	Hy22	6337252	2141448
Sawmill	Sw1	6334394	2142317
	Sw2	6334411	2142342
	Sw3	6334695	2143884
	Sw4	6334733	2143317
	Sw5	6334426	2141538
	Sw6	6334512	2141513

Appendix B. Continued.

SITE	ID	X	Y
Sawmill	Sw7	6334952	2143978
	Sw8	6335165	2142965
	Sw9	6334932	2143268
	Sw10	6334849	2142164
	Sw11	6334792	2141993
	Sw12	6334624	2142080
	Sw13	6335167	2141750
	Sw14	6335161	2141597
	Sw15	6335088	2144138
	Sw16	6335119	2143424
Rush Creek	RC1	6330905	2147388
	RC2	6330927	2147388
	RC3	6330800	2147389
Dark Gulch-Upper	Un1	6330368	2143303
	Un2	6330594	2143099
	Un3	6330689	2143099
	DG1	6330688	2142703
	DG2	6331124	2142308
	DG3	6331143	2142272
	DG4	6331174	2142121
	DG5	6331250	2141571
	DG6	6330747	2141658
	DG7	6330679	2142719
	DG8	6330878	2142702
	DG9	6330872	2142583
	DG10	6330780	2142445
	DG11	6331020	2141844
	DG12	6330742	2141889
	DG13	6330769	2142048
Dark Gulch-Lower	LDG1	6329395	2141441
	LDG2	6328797	2141442
	LDG3	6328811	2141428
	LDG4	6328756	2141454
	LDG5	6328644	2141857
	LDG6	6328691	2142060
	LDG7	6328302	2142266
Dark Gulch-Lower	LDG8	6328178	2142413
	LDG9	6328347	2142427
	LDG10	6328446	2142396
	LDG11	6328551	2142296
	LDG11	6328551	2142296
	LDG12	6328057	2142576
	LDG13	6327098	2142660
	LDG14	6327211	2142699
	LDG15	6328552	2141853
	LDG16	6328244	2142383
	LDG17	6328080	2142582
	LDG18	6328475	2142373
Bucktail	Bt1	6326938	2140983
	Bt2	6326980	2140991
	Bt3	6327036	2140999
	Bt4	6326765	2141199
	Bt5	6326687	2141483
Lowden Meadows	LM1	6324595	2138123
	LM2	6324557	2138065
	LM3	6324530	2138057
	LM4	6324209	2137914
	LM5	6323803	2137549
	LM6	6323907	2137626
	LM7	6325312	2137938
	LM8	6325215	2138328
	LM9	6325476	2138833
	LM10	6325749	2138979
	LM11	6325902	2139276
	LM12	6325979	2139594
	LM13	6325519	2139050
	LM14	6325354	2138817
	LM15	6325155	2138532
	LM16	6324983	2138077
	LM17	6324792	2137756
	LM18	6324568	2137618
	LM19	6324420	2137404

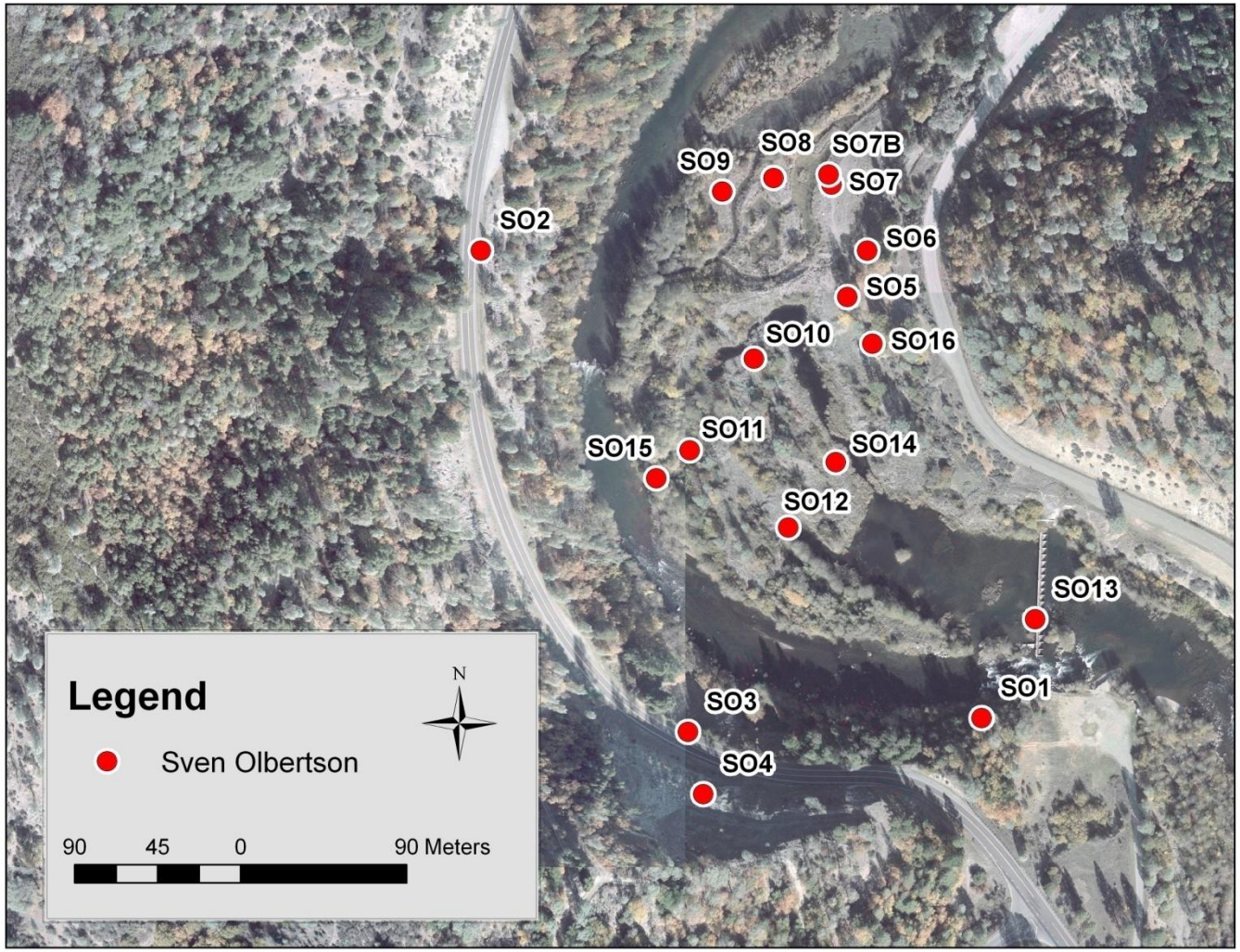
Appendix B. Continued.

SITE	ID	X	Y	SITE	ID	X	Y
Lowden Meadows	LM20	6324347	2137172	Indian Creek	IC1	6308392	2124409
	LM21	6324093	2137148		IC2	6308103	2123965
	LM22	6325626	2139681		IC3	6307739	2124260
	LM23	6325234	2139149		IC4	6303795	2123576
	LM24	6325245	2139206		IC5	6303767	2123427
Trinity House Gulch	THG1	6323081	2137458		IC6	6303552	2123266
	THG2	6322494	2137538		IC7	6303465	2123353
	THG3	6322494	2137266		IC8	6303177	2122940
	THG4	6322512	2137338		IC9	6303106	2123014
	THG5	6322281	2137521		IC10	6302800	2123130
	THG6	6322305	2137512		IC11	6301880	2122609
	THG7	6322399	2137048		IC12	6301476	2122483
	THG8	6321588	2137152		IC13	6301482	2121833
	THG9	6322732	2137439		IC14	6301189	2121839
	THG10	6321581	2137464		IC15	6300920	2121948
	THG11	6321544	2137349		IC16	6300785	2121958
	THG12	6321762	2137316		IC17	6300790	2121914
	THG13	6322093	2137240		IC18	6308283	2124285
	THG14	6321025	2137618		IC19	6301894	2122621
	THG15	6321034	2137641		IC20	6303033	2122856
Vitzhum Gulch	Vz1	6312545	2124544		IC21	6303755	2123592
	Vz2	6312575	2124435		IC22	6303919	2123648
	Vz3	6312943	2123206		IC23	6303373	2123459
	Vz4	6312645	2122776		IC24	6303121	2123269
	Vz5	6309653	2123733		IC25	6302774	2122963
	Vz6	6309468	2123772		IC26	6302487	2122757
	Vz7	6309294	2123429		IC27	6302119	2122588
	Vz8	6312465	2122676		IC28	6301867	2122696
	Vz9	6311148	2122648		IC29	6301768	2122439
	Vz9B	6311212	2122631		IC30	6301767	2122322
	Vz10	6311583	2122538		IC31	6301638	2122278
	Vz11	6311785	2122498		IC32	6301368	2122252
	Vz12	6312058	2122548		IC33	6301136	2122163
	Vz12	6312063	2122554		IC34	6301093	2122134
	Vz13	6312871	2123064		IC35	6301048	2122070

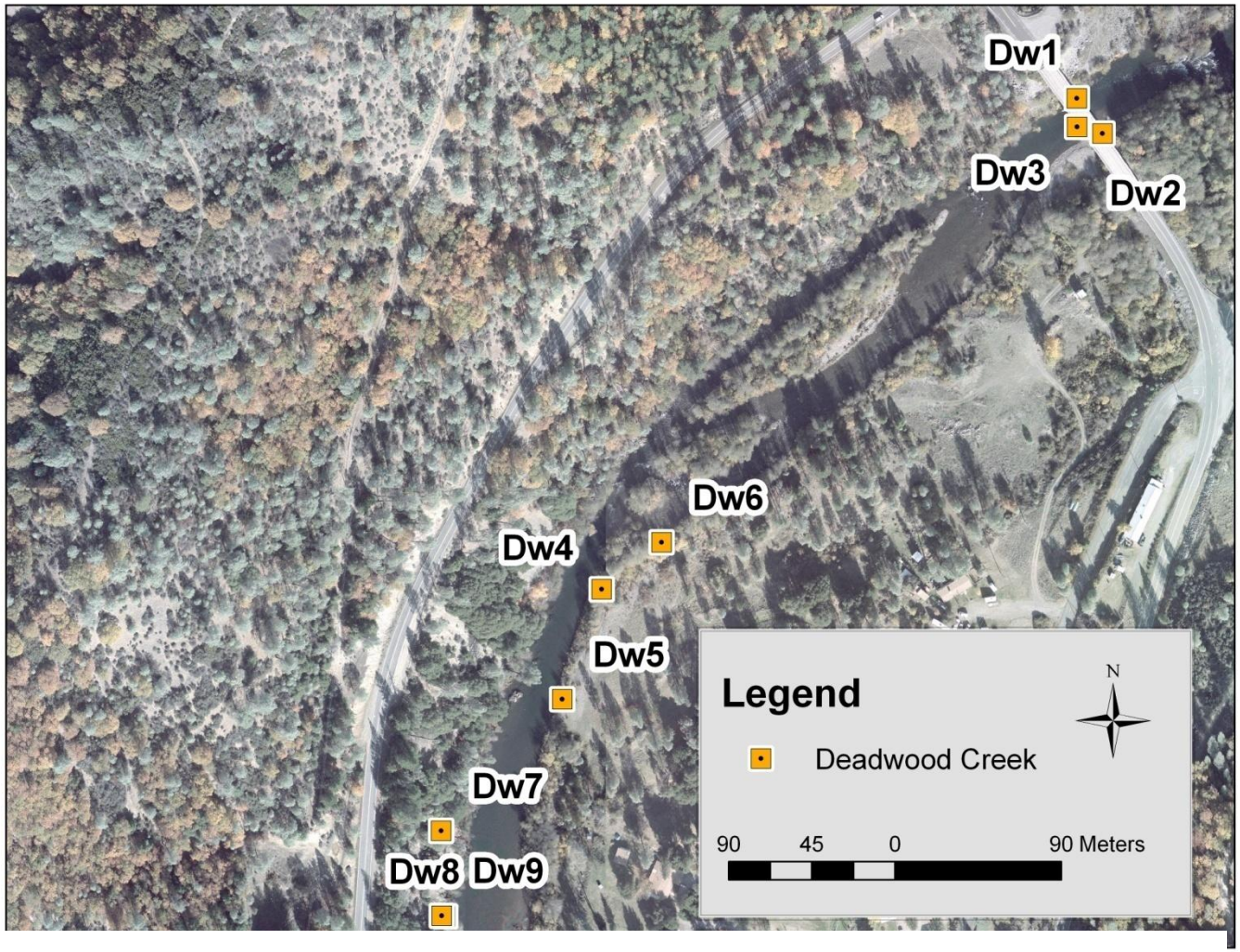
Appendix B. Continued.

SITE	ID	X	Y	SITE	ID	X	Y
Indian Creek	IC36	6300940	2122081	Reading Creek	Rdg30	6296659	2119146
	IC37	6301342	2121826		Rdg31	6296775	2119166
	IC38	6301695	2122320	Hocker Flat	HF1	6269377	2152546
	IC39	6308408	2124304		HF2	6269319	2152676
	IC40	6307676	2124541		HF3	6268869	2153269
	IC41	6302920	2123175		HF4	6269452	2151499
Reading Creek	Rdg1	6296323	2119169		HF5	6269275	2151416
	Rdg2	6296332	2119217				
	Rdg3	6296091	2119495				
	Rdg4	6296008	2119828				
	Rdg5	6297044	2119009				
	Rdg6	6296748	2118849				
	Rdg7	6296255	2118990				
	Rdg8	6297338	2119229				
	Rdg9	6297337	2119204				
	Rdg10	6297196	2119544				
	Rdg11	6297063	2119519				
	Rdg12	6296841	2119414				
	Rdg13	6296815	2119396				
	Rdg14	6296242	2119173				
	Rdg15	6296095	2119175				
	Rdg16	6296104	2119189				
	Rdg17	6296286	2120049				
	Rdg18	6296448	2120206				
	Rdg19	6296487	2120335				
	Rdg20	6296249	2120439				
	Rdg21	6296556	2120805				
	Rdg22	6296773	2121150				
	Rdg23	6297306	2121265				
	Rdg24	6297048	2121095				
	Rdg25	6297105	2120998				
	Rdg26	6297274	2121742				
	Rdg27	6297378	2121476				
	Rdg28	6296445	2119223				
	Rdg29	6296520	2119089				

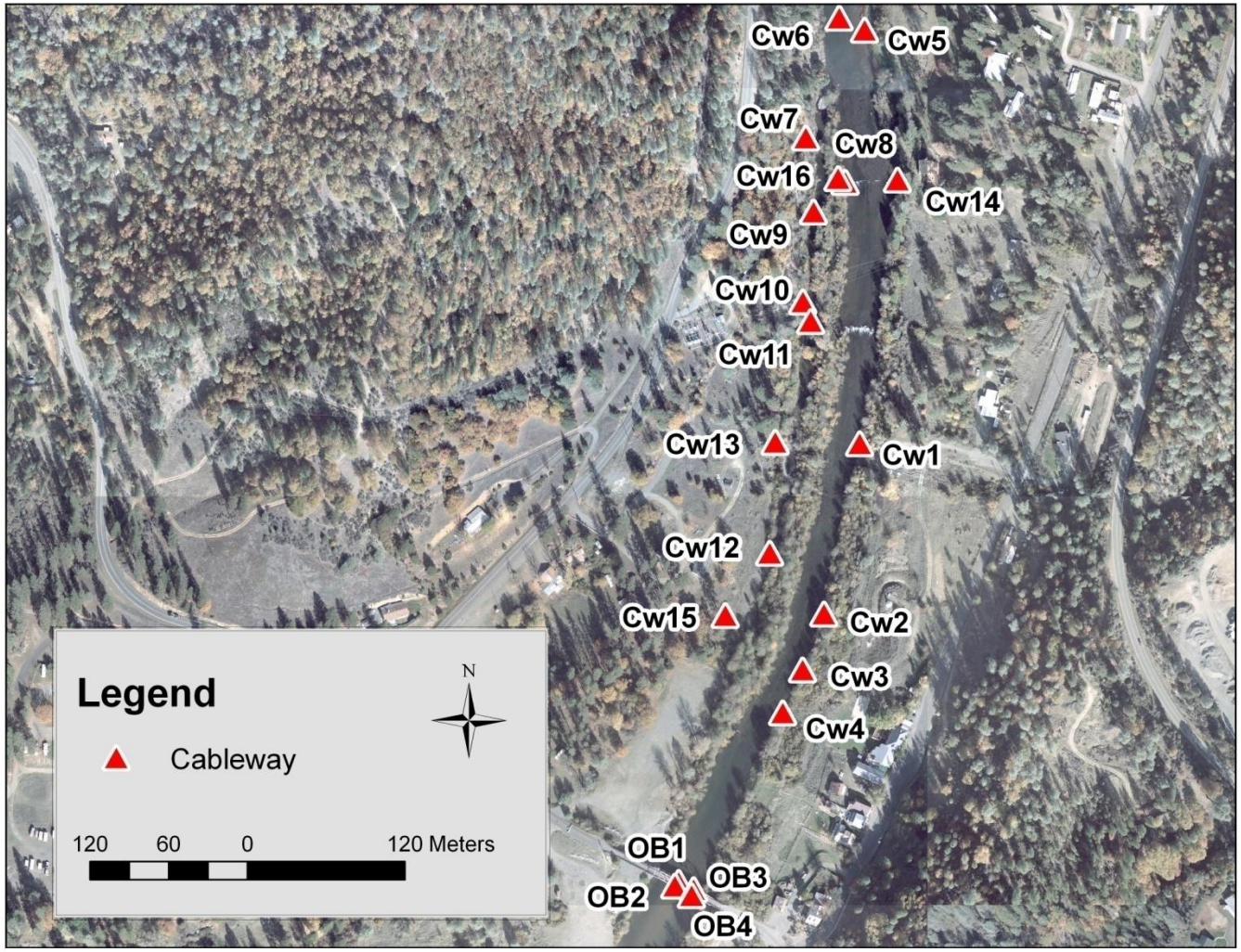
Appendix C. Locations of photographic point locations and identification numbers at channel rehabilitation sites.



Appendix C- 1. Sven Olbertson photographic point locations and identification numbers



Appendix C- 2. Deadwood Creek photographic point locations and identification numbers.



Appendix C- 3. Cableway photographic point locations and identification numbers.

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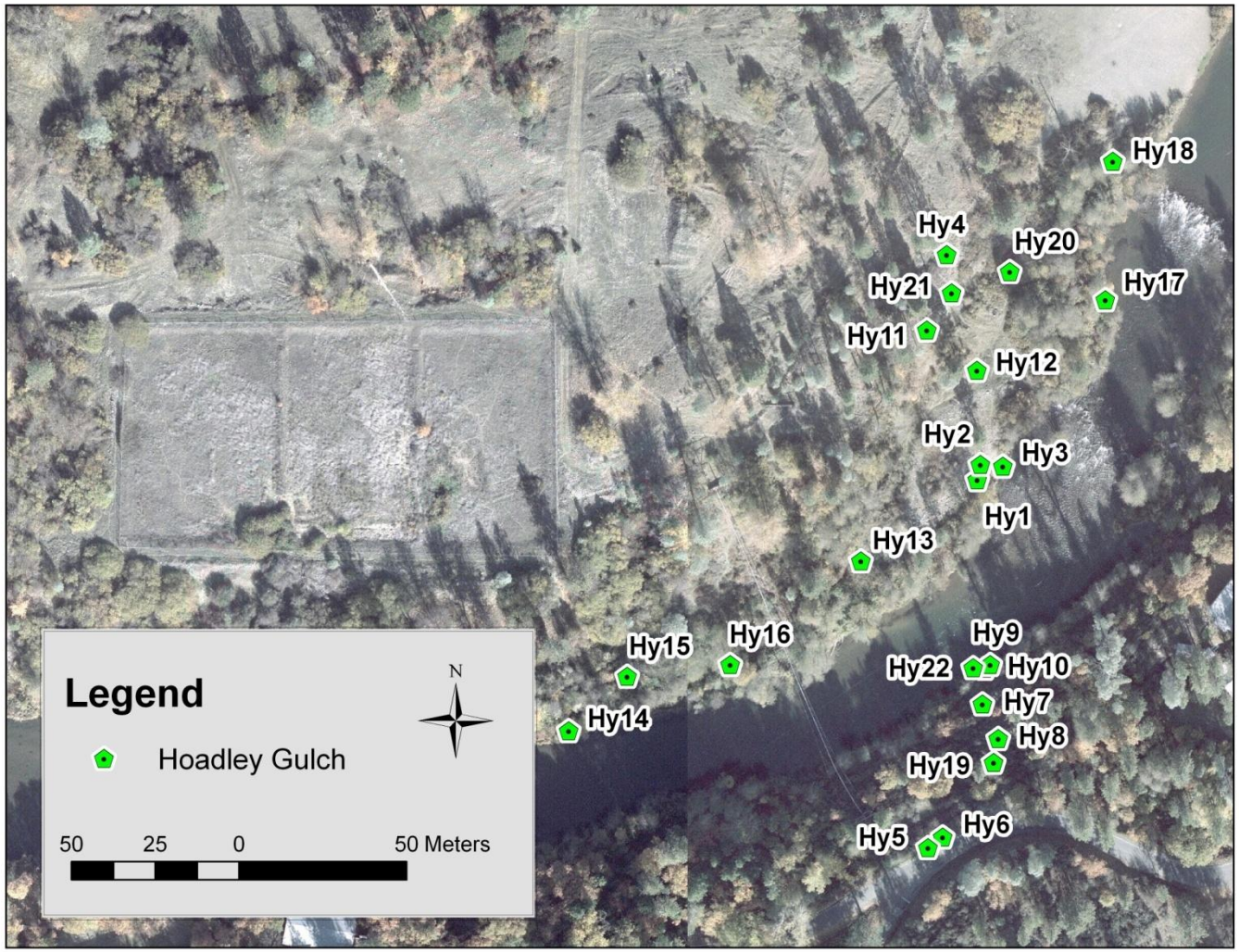
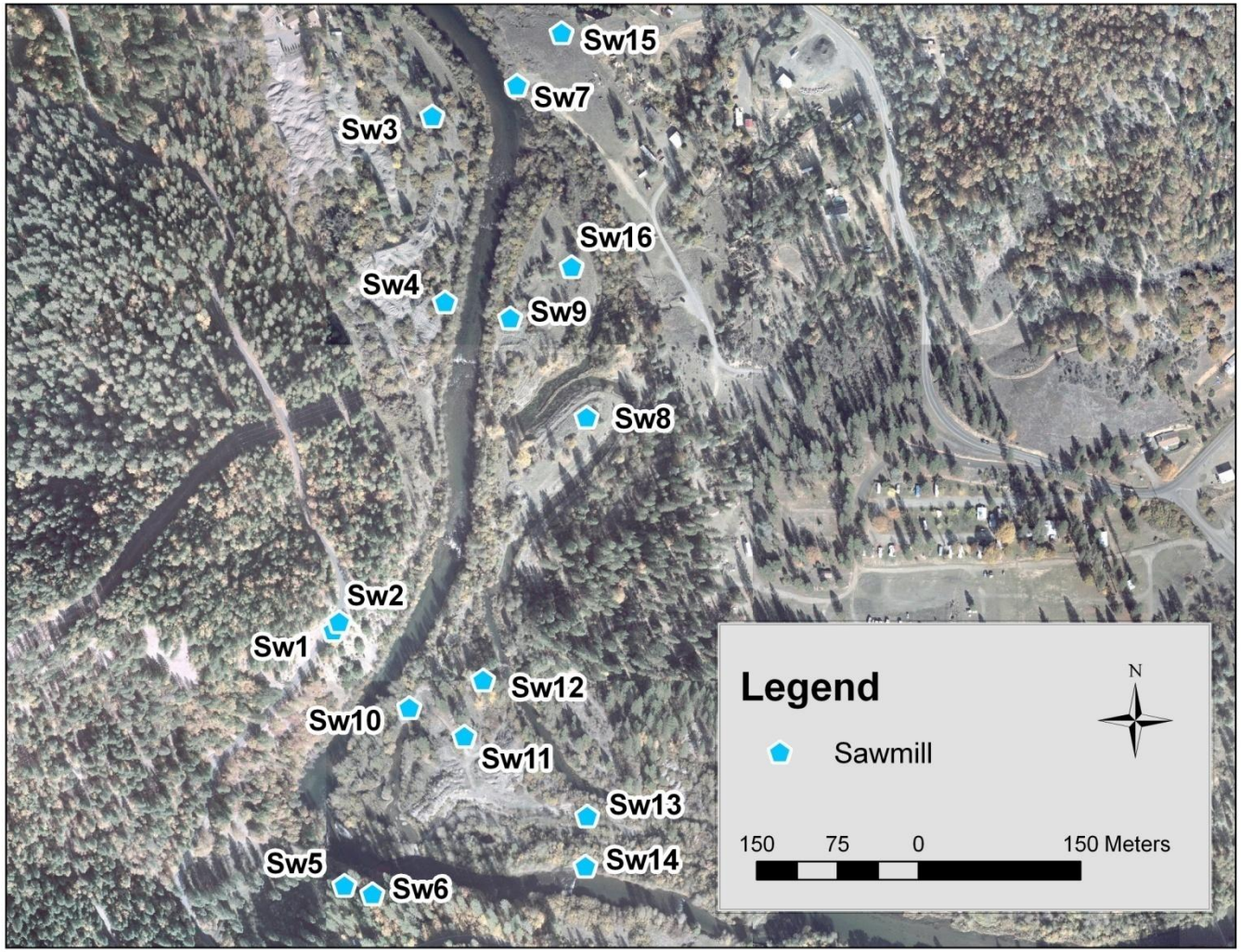
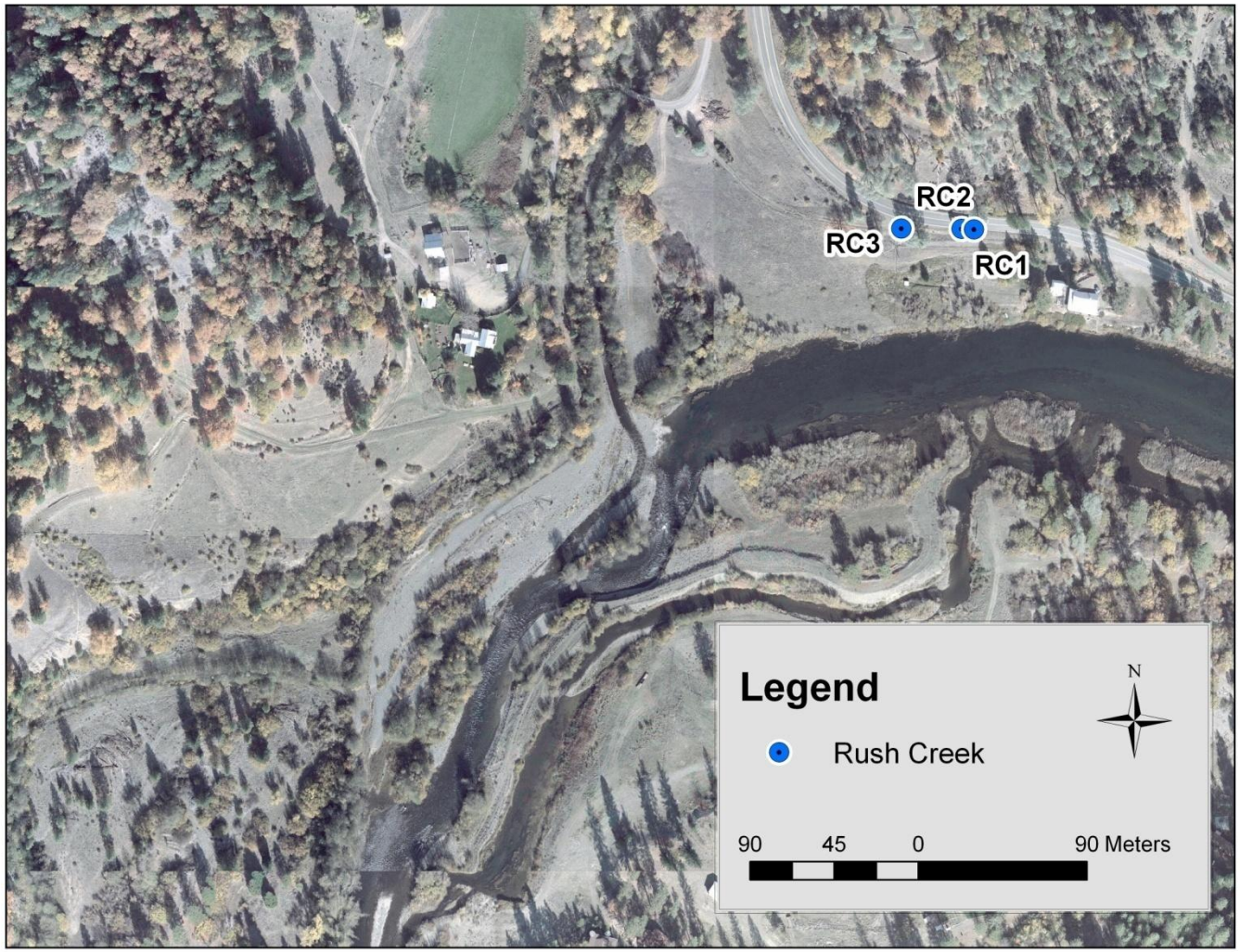


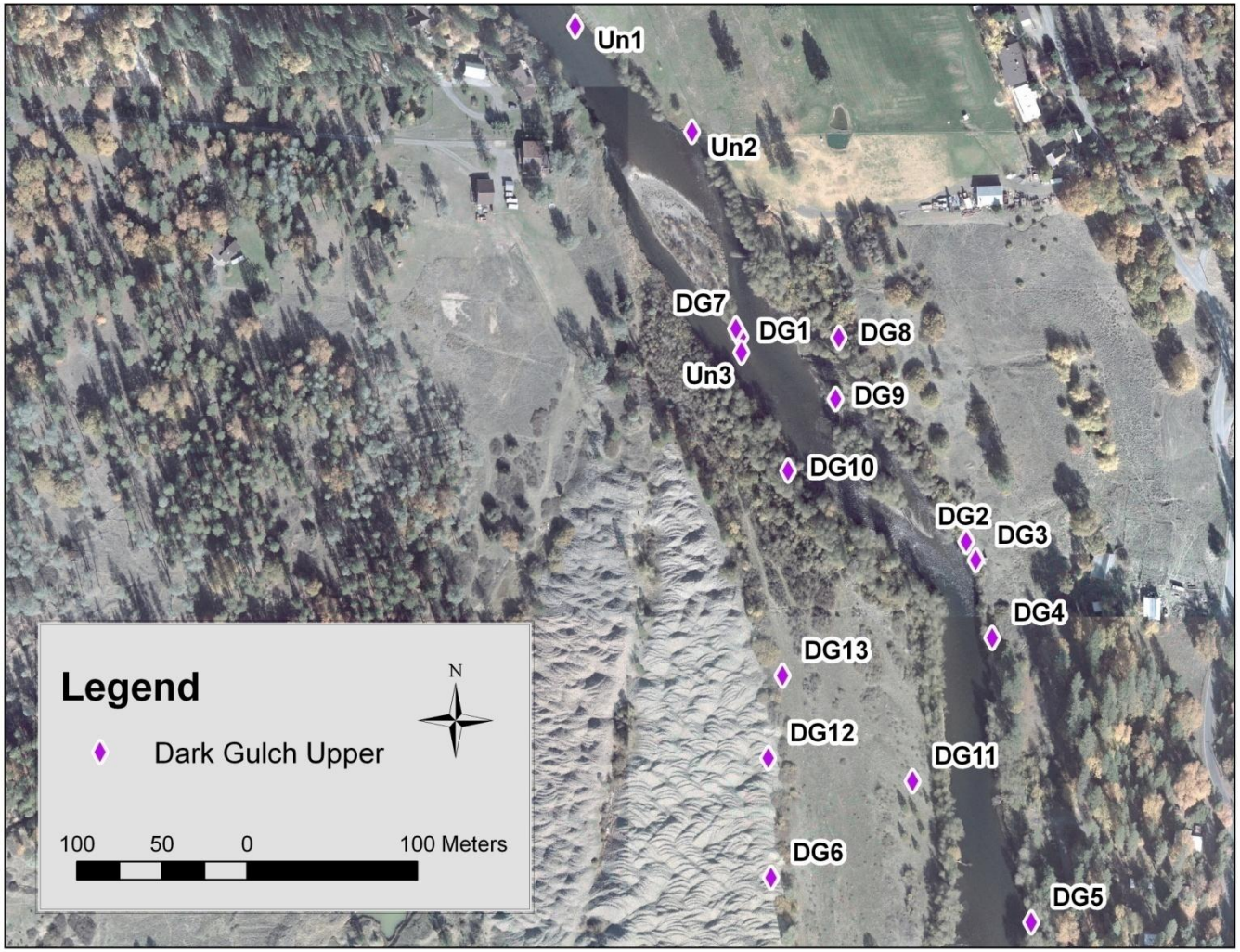
Appendix C- 4. Hoadley Gulch photographic point locations and identification numbers.



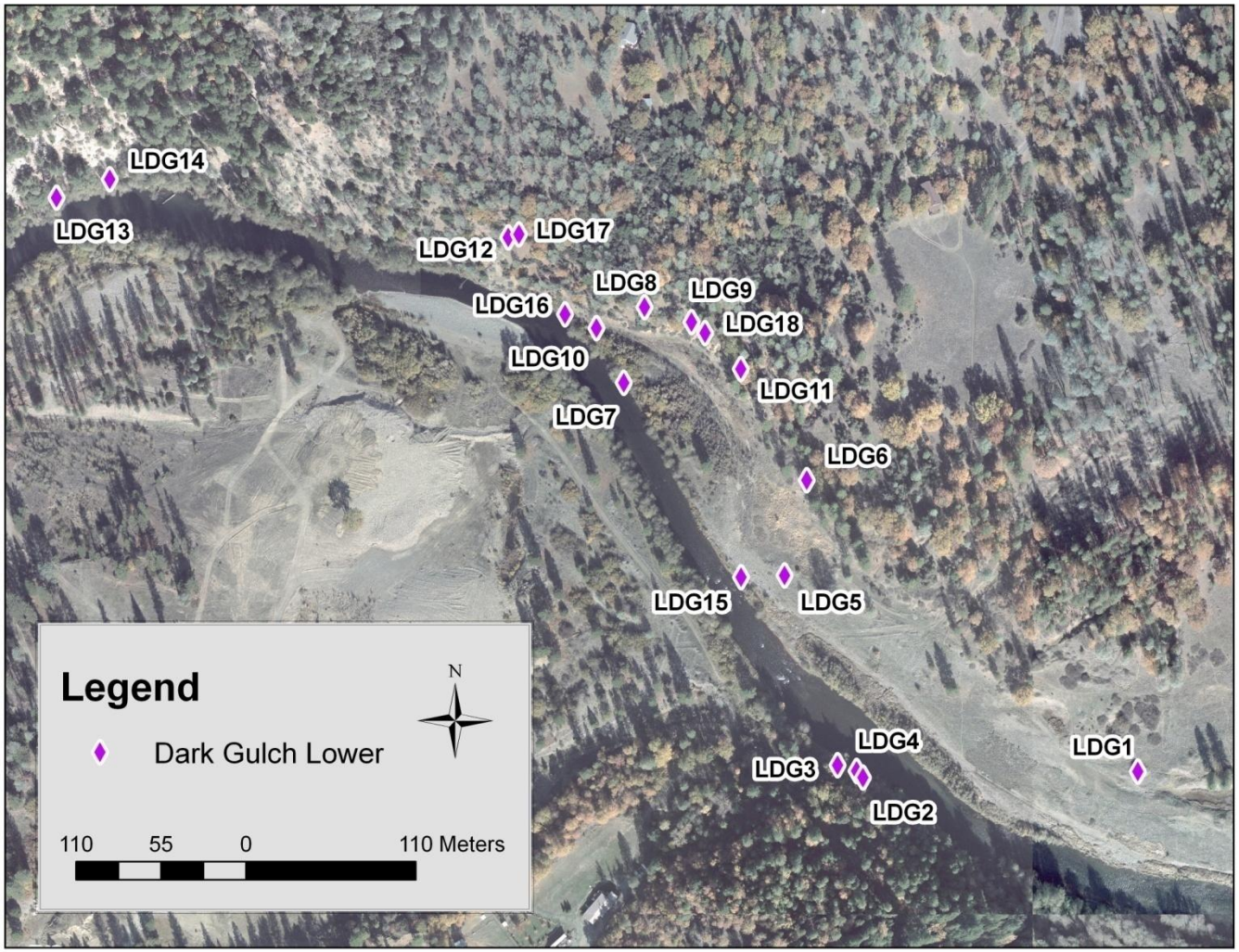
Appendix C- 5. Sawmill photographic point locations and identification numbers.



Appendix C- 6. Rush Creek photographic point locations and identification numbers.

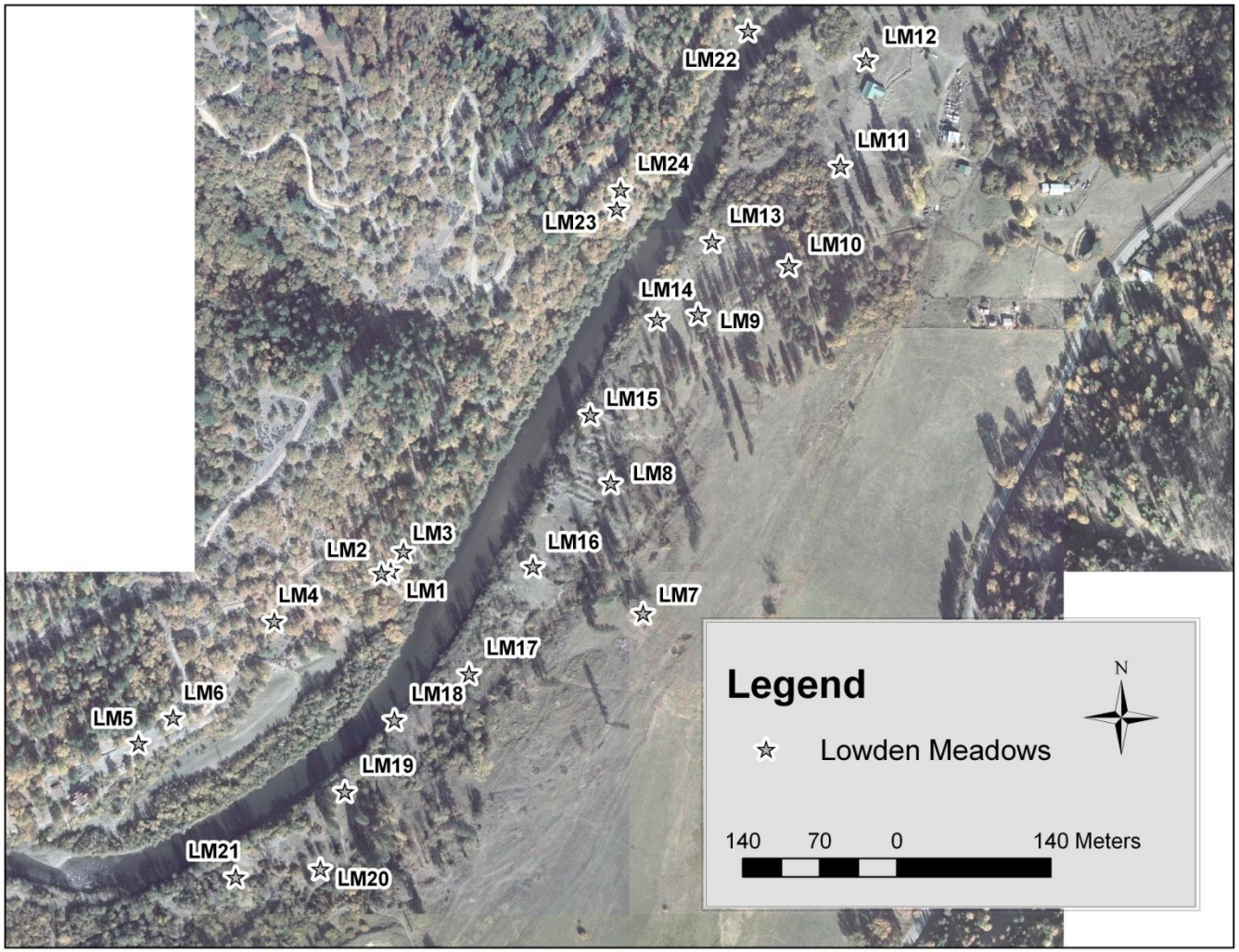


Appendix C- 7. Upper Dark Gulch photographic point locations and identification numbers.

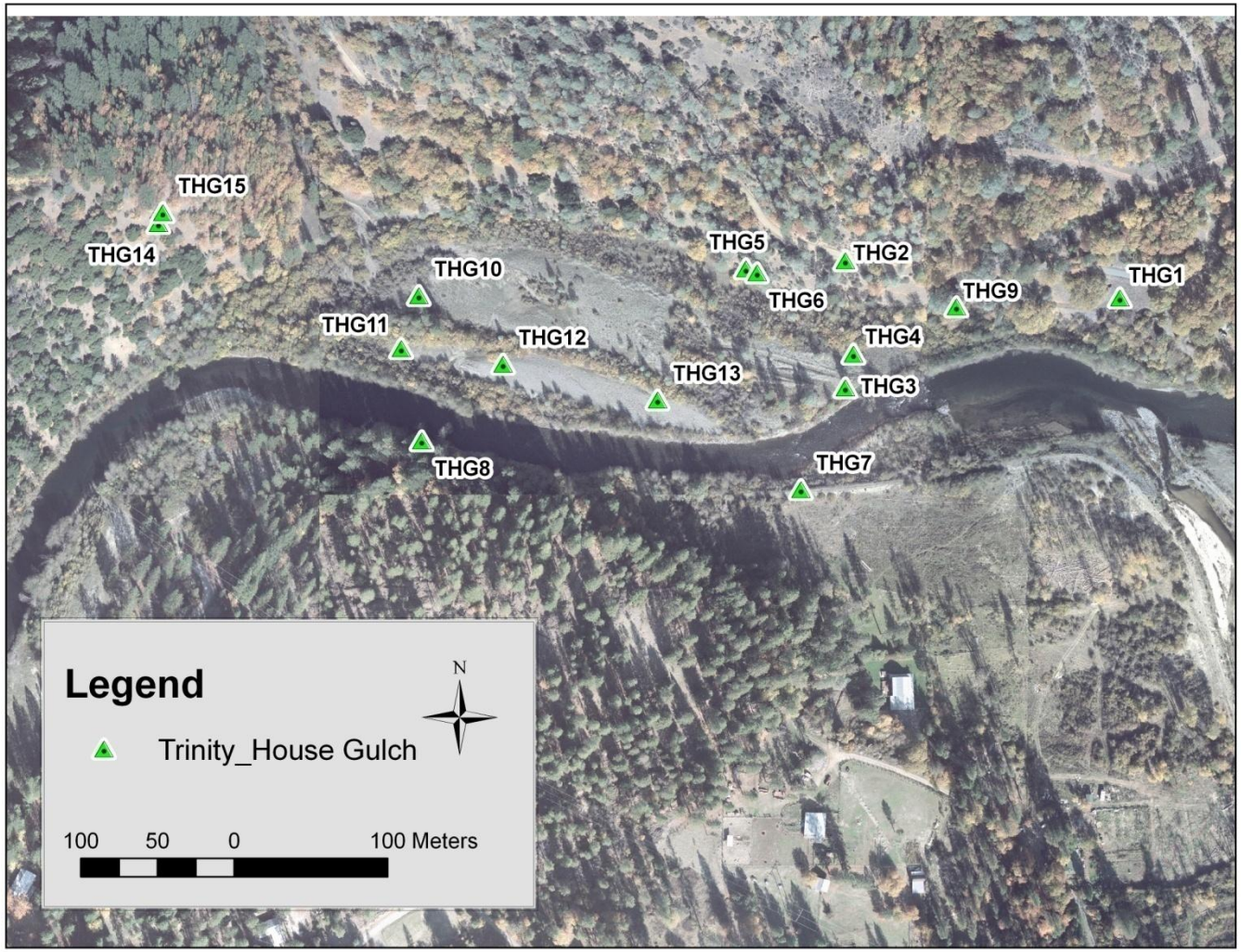


Appendix C- 8. Lower Dark Gulch photographic point locations and identification numbers.

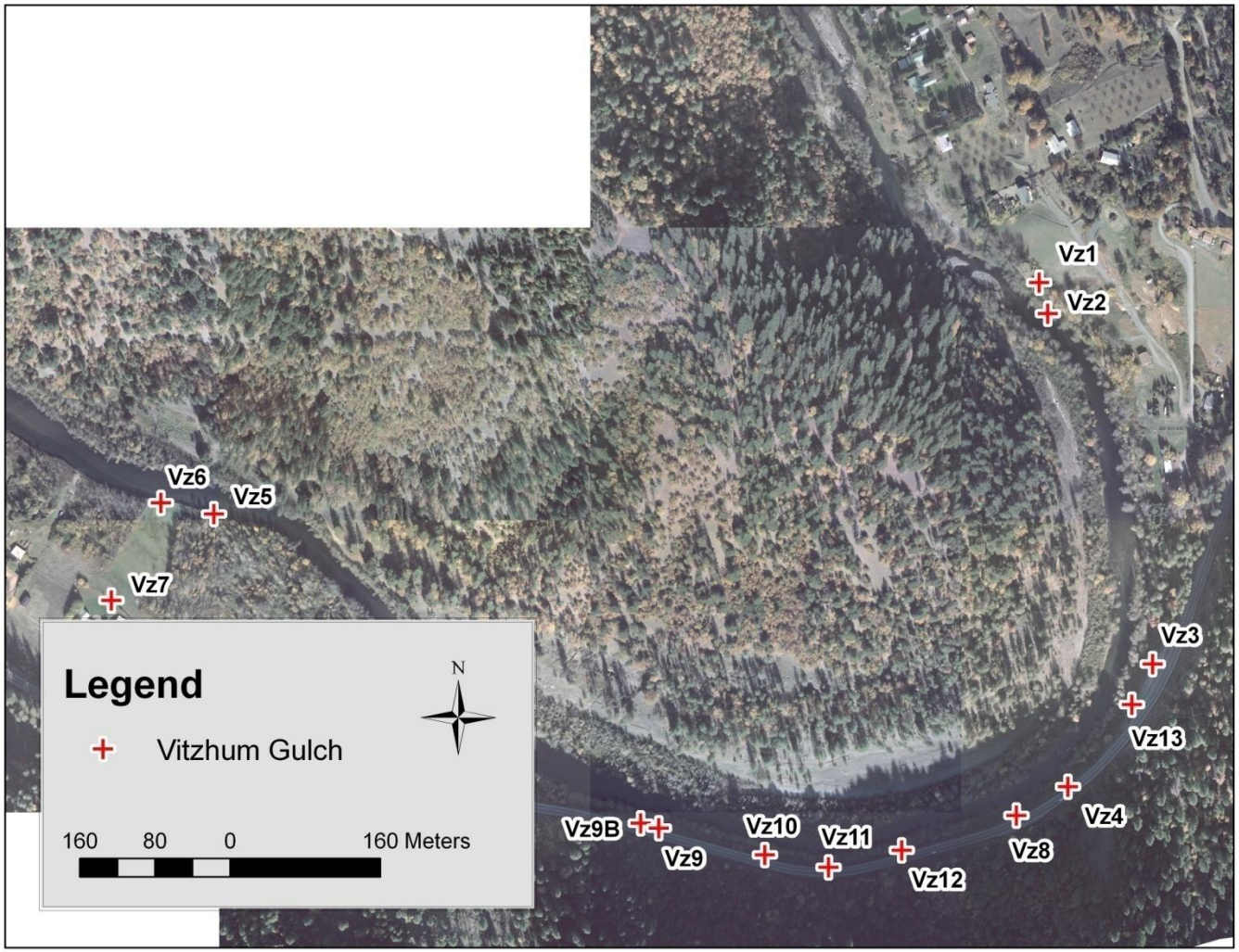
Appendix C- 9. Bucktail photographic point locations and identification numbers.



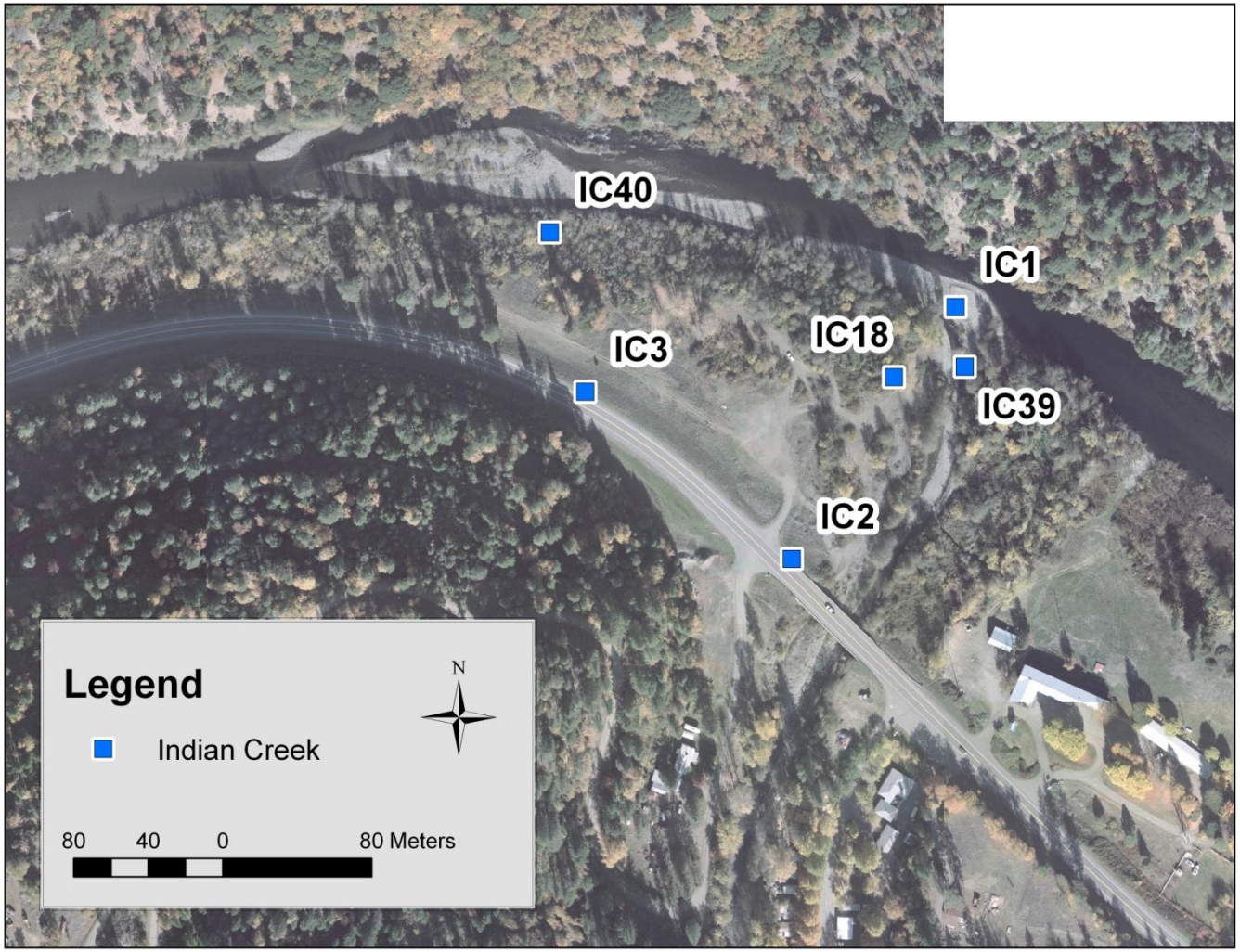
Appendix C- 10. Lowden Meadows photographic point locations and identification numbers.



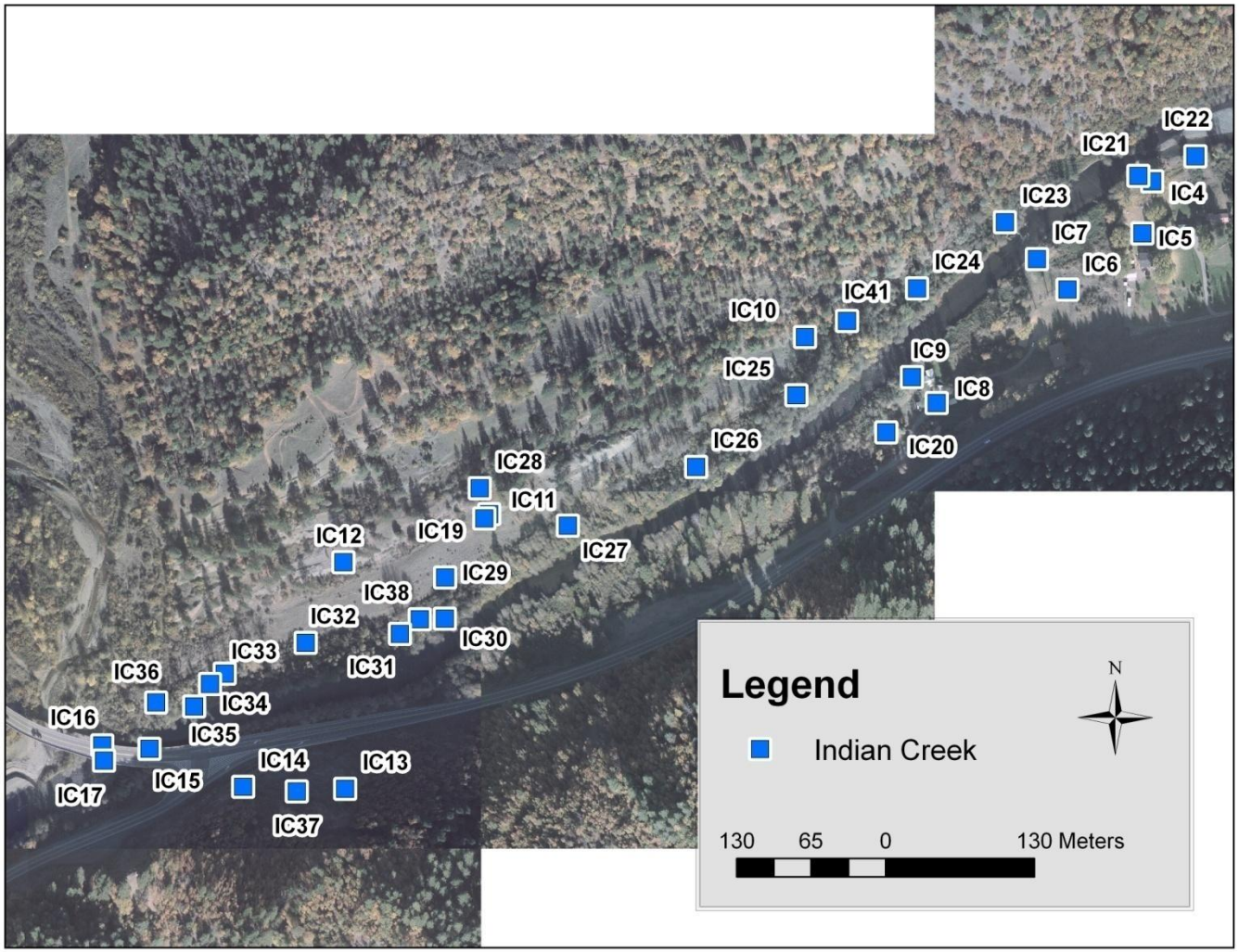
Appendix C- 11. Trinity House Gulch photographic point locations and identification numbers.



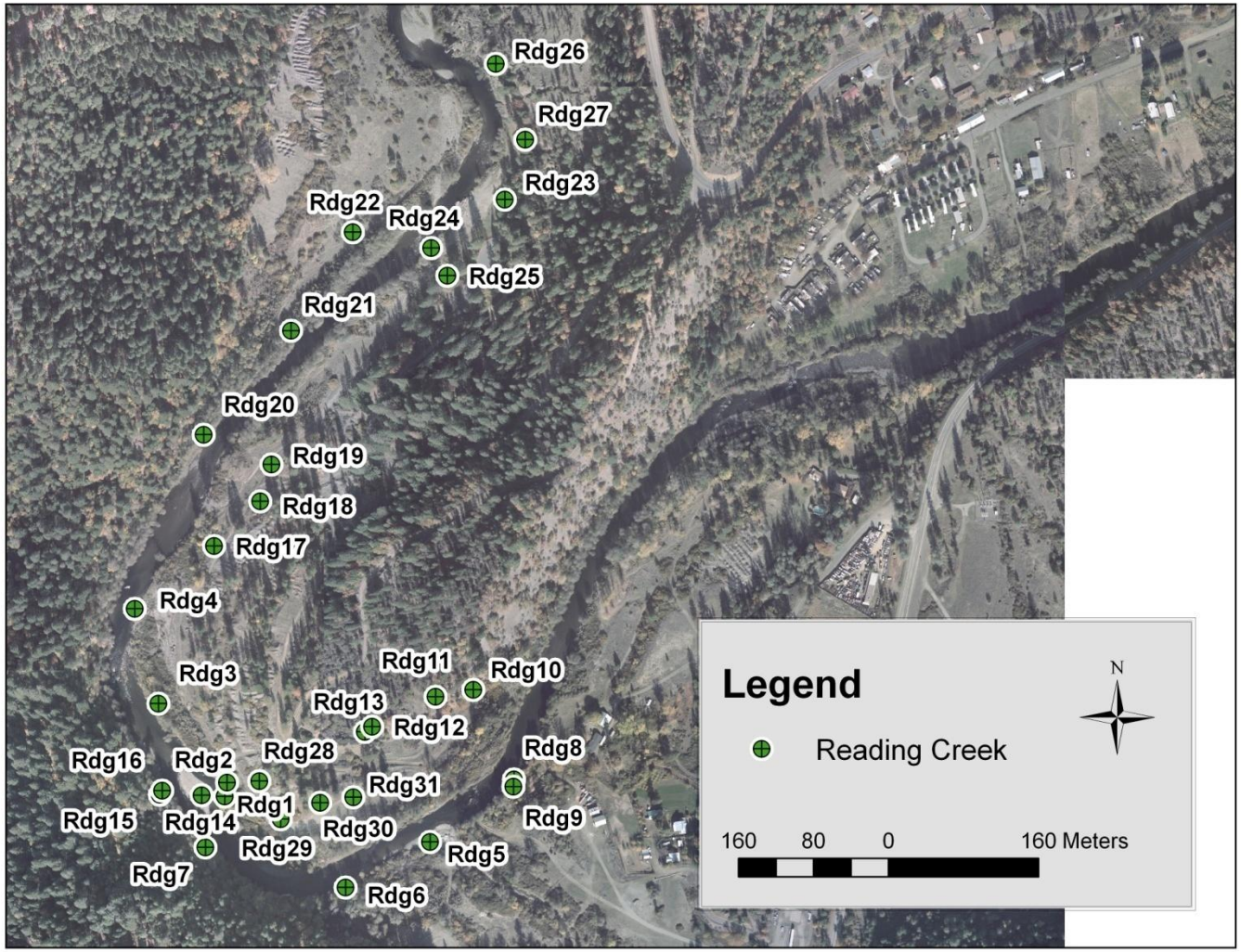
Appendix C- 12. Vitzhum Gulch photographic point locations and identification numbers.



Appendix C- 13. Upper Indian Creek photographic point locations and identification numbers.



Appendix C- 14. Lower Indian Creek photographic point locations and identification numbers.



Appendix C- 15. Reading Creek photographic point locations and identification numbers.

Appendix C- 16. Hocker Flat photographic point locations and identification numbers.