Clean Water Act Section 401 Water Quality Certification Application

Please refer to the "Clean Water Act Section 401 Water Quality Certification Application Guidance" document for assistance with completing this application.

A. Pre-Filing Meeting	
Please provide the date that a pre-filing meeting was requested from Nevada Division of Environmental Protection (NDEP) Bureau of Water Quality Planning (BWQP). *Note: If a pre-filing meeting has not been requested, please schedule a pre-filing meeting with NDEP BWQP.*	**May 5th, 2026**

B. Contact Information		
Project Proponent Information		
Company Name: Nevada Department of Wildlife		Address: 60 Youth Center Road
Applicant Name: Cody Byrne		City: Elko
Phone: 775-777-2303	Fax:	State: NV
Email: cobyrne@ndow.org		Zip Code: 89801
Agent Information		
Company Name: Anabranch Solutions LLC		Address: PO Box 8071
Agent Name: Matt Berry		City: Moscow
Phone: (530) 205-6505	Fax:	State: ID
Email: matt.berry@anabranchsolutions.com		Zip Code: 83843

C. Project General Information	
Project Location	
Project/Site Name: Jake's Fire Restoration Project	Name of receiving waterbody: South Fork Little Humbolt River (page 7 of draft concept design report)
Address: ~5 miles West of Midas, NV	Type of waterbody present at project location (*select all that apply*): ☒ Perennial River or Stream ☒ Intermittent River or Stream ☐ Ephemeral River or Stream ☐ Lake/Pond/Reservoir ☐ Wetland ☐ Other: ______________________
City: N/A	
County: Elko	
State: NV	
Zip Code: N/A	

Latitude (UTM or Dec/Deg): 41.2719 (center of proposed project area)		Longitude (UTM or Dec/Deg): -116.8743	
Township: 1) 39N 2) 40N	Range: 1) 45E 2)45E	Section: 1) 02, 03, 09, 10, 11, 14, 15, 16, 22, 23 2) 35	¼ Section:

Project Details	
Project purpose:	Mitigate/reverse the negative impacts (e.g., capture fine sediment, increase riparian vegetation) of the Jake's Fire. Improve riverscape health, specifically: 1) increase channel-floodplain connectivity, 2) reduce channel incision, 3) increase groundwater table, 4) promote the formation of multi-threaded channels, 5) recover and sustain natural habitat forming processes 6) increase habitat and overall health of Lahontan Cutthroat Trout populations
Describe current site conditions: Attachments can include, but are not limited to, relevant site data, photographs that represent current site conditions, or other relevant documentation.	The Jake's Fire in August 2025 burned the project area resulting in a loss of riparian areas and making the site more vulnerable to channel incision. Degraded conditions, and a lack of complex instream habitat are likely to negatively impact threatened Lahontan Cutthroat Trout (LCT). See attachments for site photos.
Describe the proposed activity including methodology of each project element:	The construction of 766 low-tech instream structures (BDAs and PALS) will follow the established methodology of Wheaton et al. (2019) (draft concept design pages 15 to 19) . These features are hand-built by crews using natural, native materials to mimic the function of beaver dams and natural wood jams. Woody material and sediment are harvested and transported to build instream structures that can force upstream pooling for LTC habitat, increase channel-floodplain connectivity, capture sediment, and promote incision recovery. Note that no staging will take place as a part of this project. Any materials brought to the stream will be used within 1-2 days of their delivery.
Estimate the nature, specific location, and number of discharge(s) expected to be authorized by the proposed activity:	The specific location of the proposed activities are shown in the maps provided at the end of this application. We anticipate building a maximum of 766 structures. The specific locations of individual structures will be field-fit designed. The precise location of instream structures within the ~6 mile treatment area does not exert an influence on the overall nature of the proposed work.
Provide the date(s) on which the proposed activity is planned to begin and end and the approximate date(s) when any discharge(s) may commence:	We will commence work promptly upon receiving permits. We hope to complete or at least begin this work within the 2026 calendar (September 1 to November 30) and continue in the summer and fall of 2027. Anticipated duration of implementation is 8-12 weeks.
Provide a list of the federal permit(s) or license(s) required to conduct the activity which may result in a discharge into regulated waters (see mandatory attachments):	404 permit from the US Army Corps of Engineers. We anticipate this work being permitted under Regional General Permit 16.

<table>
<tr><td>Provide a list of all other federal, state, interstate, tribal, territorial, or local agency authorizations required for the proposed activity and the current status of each authorization:</td><td colspan="2">USFWS issued a biological opinion regarding the impact of this work on Lahontan Cutthroat Trout. BLM will issue a Biological Assessment. NDEP Bureau of Water Pollution Control Permit Not Required (Appendix A)</td></tr>
<tr><td>Total area of impact to regulated waterbodies (acres):</td><td colspan="2">Stream 0.5 ac, (11.4 Ac at half a meter inundation)</td></tr>
<tr><td>Total distance of impact to regulated waterbodies (linear feet):</td><td colspan="2">2513</td></tr>
<tr><td rowspan="2">Amount excavation and/or fill discharged within regulated waters (acres, linear feet, and cubic yards):</td><td>Temporary:</td><td>Permanent:</td></tr>
<tr><td></td><td>Woody Material: 352.22 cubic yards</td></tr>
<tr><td rowspan="2">Amount of dredge material discharged within regulated waters (acres, linear feet, and cubic yards):</td><td>Temporary:</td><td>Permanent:</td></tr>
<tr><td></td><td>Sediment: 34.16 cubic yards</td></tr>
<tr><td>Describe the reason(s) why avoidance of temporary fill in regulated waters is not practicable (if applicable):</td><td colspan="2">The restoration itself requires building of instream structures that mimic natural features.</td></tr>
<tr><td>Describe the Best Management Practices (BMPs) to be implemented to avoid and/or minimize impacts to regulated waters:

Examples include sediment and erosion control measures, habitat preservation, flow diversions, dewatering, hazardous materials management, water quality monitoring, equipment or plans to treat, control, or manage discharges, etc.</td><td colspan="2">All project activities are manual and low-impact. To protect the federally threatened Lahontan Cutthroat Trout and minimize aquatic impacts, the following Best Management Practices (BMPs) will be strictly implemented: Fish Protection & Seasonal Timing: All instream work will occur during the summer and fall low-flow window (typically July 1 to Oct 31) to avoid critical spring spawning, migration, and egg incubation periods. Low-Impact Techniques: Structures (BDAs/PALS) will be installed manually using hand tools and lightweight power equipment (e.g., chainsaws, post-pounders), eliminating the need for heavy earthmoving equipment and avoiding mechanical dewatering, stream diversions, or accelerated bank erosion. Turbidity Control: Instream construction will progress systematically from downstream to upstream. This sequencing allows minor, localized turbidity plumes from manual bed disturbance to quickly settle over completed, stable structures rather than degrading pristine downstream reaches. Spill Prevention & Materials Safety: All refueling and maintenance of hand-held power equipment will occur at a designated staging area located a minimum of 100 feet away from the ordinary high-water mark (OHWM), equipped with an active spill kit. Hand-held machinery will utilize biodegradable, bio-based non-toxic hydraulic fluid. Materials Integrity: To prevent chemical leaching into regulated waters, only untreated, natural wooden posts and native vegetation will be used.</td></tr>
</table>

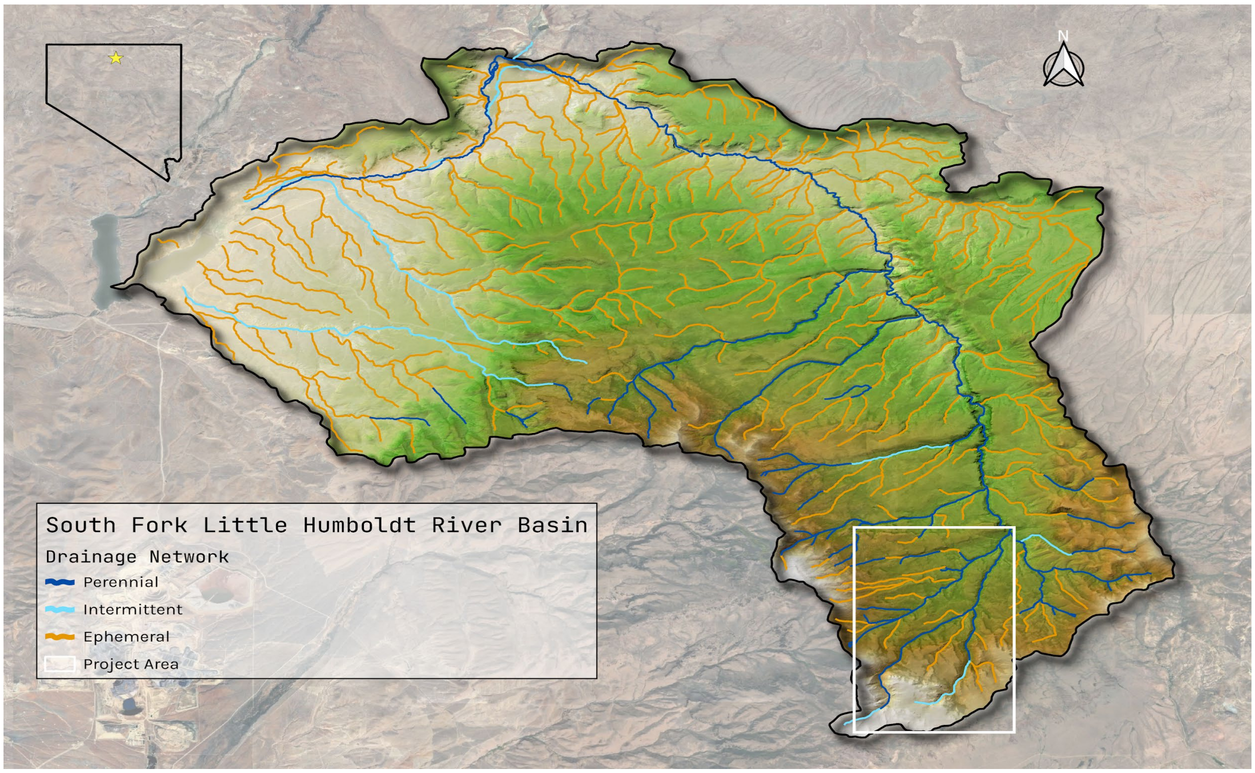
Describe how the activity has been designed to avoid and/or minimize adverse effects, both temporary and permanent, to regulated waters:	No negative impacts are expected during implementation of the restoration.
Describe any compensatory mitigation planned for this project (if applicable):	N/A

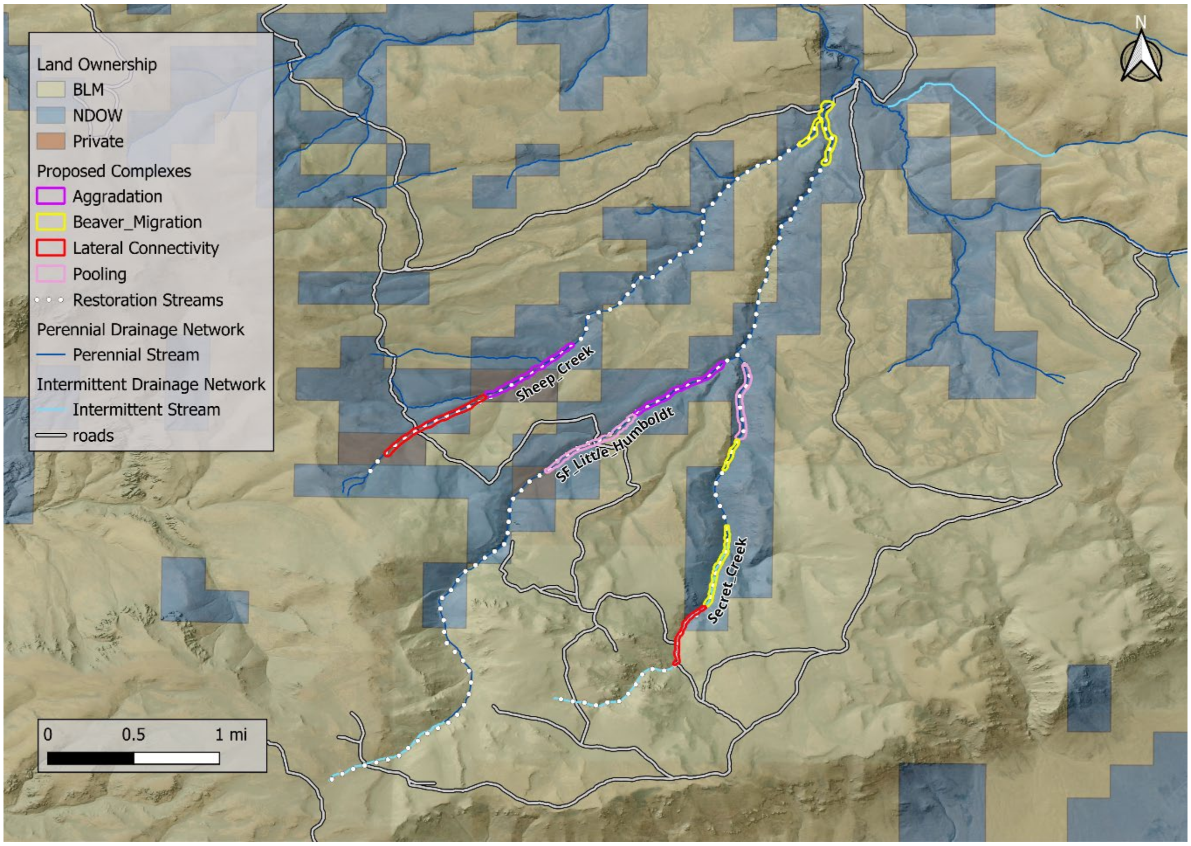
D. Signature		
Name and Title (Print): Matt Berry: California Program Manager & Meadow Ecologist	Phone Number: (530) 205-6505	Date: 4/28/2026
X Matt Berry Signature of Responsible Official		

Mandatory Attachments:

- **Federal Permit or License Identification:**
  - Project proponents seeking a federal general permit or license must include a copy of the draft federal license or permit and any readily available water quality-related materials that informed the development of the draft federal license or permit, or;
  - Project proponents seeking a federal individual permit or license must include a copy of the federal permit or license application and any readily available water quality-related materials that informed the development of the federal license or permit application.
- **Site Map** - A map or diagram of the proposed project site including project boundaries in relation to regulated waters, local streets, roads, and highways.
- **Engineered Drawings** - Engineered drawings are preferred to be submitted at the 70% design level. If only conceptual designs are available at the time of application, plans for construction should be submitted prior to the start of the project. Specific locations of the proposed activities and details of specific work elements planned for the project should be identified (e.g., staging areas, concrete washouts, perimeter controls, water diversions, or other BMPs).

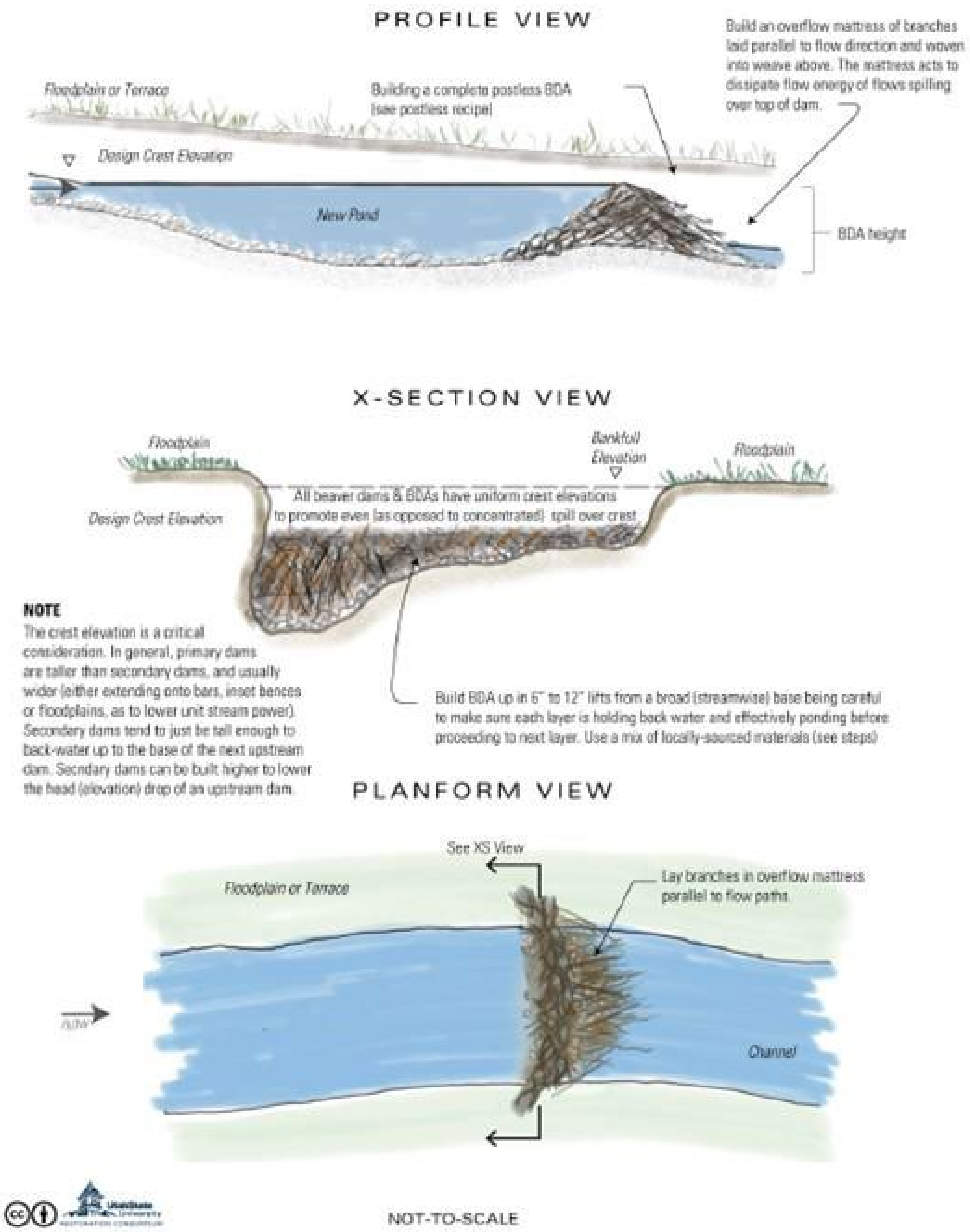
Submit the completed application materials to NDEP (ndep401@ndep.nv.gov) with the appropriate U.S. Army Corps of Engineers Regulatory Office copied on the communication (http://www.spk.usace.army.mil/Missions/Regulatory/Contacts/Contact-Your-Local-Office/).


N
South Fork Little Humboldt River Basin
Drainage Network
Perennial
Intermittent
Ephemeral
Project Area


Land Ownership
BLM
NDOW
Private
Proposed Complexes
Aggradation
Beaver_Migration
Lateral Connectivity
Pooling
Restoration Streams
Perennial Drainage Network
Perennial Stream
Intermittent Drainage Network
Intermittent Stream
roads
N
Sheep Creek
SF Little Humboldt
Secret Creek
0
0.5
1 mi

Site Photos

BDA


PROFILE VIEW
Build an overflow mattress of branches laid parallel to flow direction and woven into weave above. The mattress acts to dissipate flow energy of flows spilling over top of dam.
Floodplain or Terrace
Building a complete postless BDA (see postless recipe)
Design Crest Elevation
New Pond
BDA height
X-SECTION VIEW
Floodplain
Bankfull Elevation
Floodplain
All beaver dams & BDAs have uniform crest elevations to promote even (as opposed to concentrated) spill over crest
Design Crest Elevation
NOTE
The crest elevation is a critical consideration. In general, primary dams are taller than secondary dams, and usually wider (either extending onto bars, inset bences or floodplains, as to lower unit stream power). Secondary dams tend to just be tall enough to back-water up to the base of the next upstream dam. Secndary dams can be built higher to lower the head (elevation) drop of an upstream dam.
Build BDA up in 6" to 12" lifts from a broad (streamwise) base being careful to make sure each layer is holding back water and effectively ponding before proceeding to next layer. Use a mix of locally-sourced materials (see steps)
PLANFORM VIEW
See XS View
Floodplain or Terrace
Lay branches in overflow mattress parallel to flow paths.
FLOW
Channel
NOT-TO-SCALE


A
Post-Assisted
B
Postless
C
Postless
D
Postless
E
Post-Assisted
F
Postless
G
Postless
H
Postless

Channel Spanning PALS

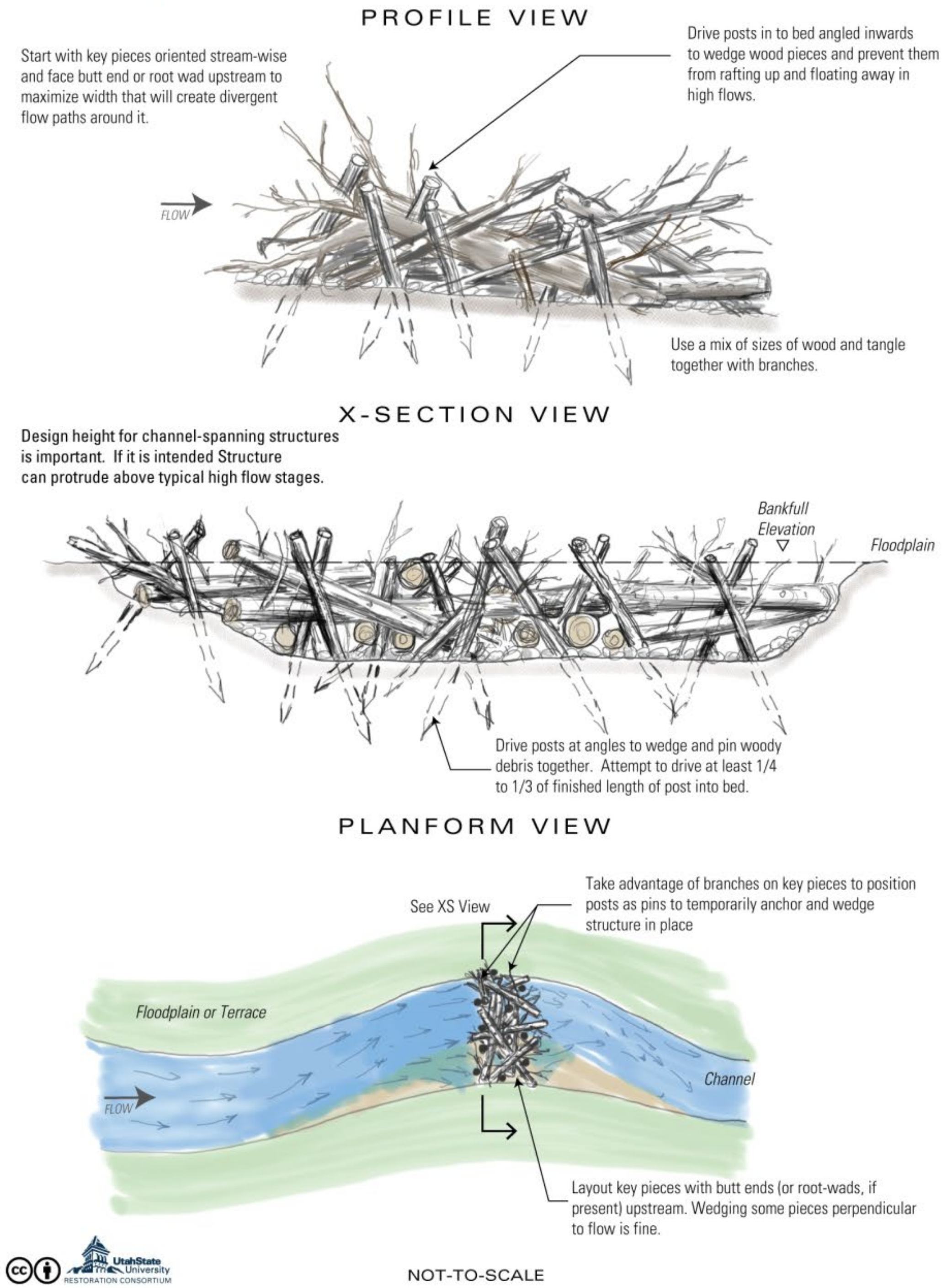


Figure 26 - Typical schematics of a channel-spanning PALS.


A
Bank-Attached
B
Mid-Channel
C
Channel-Spanning
D
Channel-Spanning
E
Mid-Channel
F
Channel-Spanning
G
Bank-Attached
H
Channel-Spanning

Notes

The fire area includes 11 HUC 12 watersheds and five HUC 10 watersheds, encompassing the full 82,217 acres. Notable HUC 12 watersheds include Headwaters South Fork Little Humboldt River (20,308 acres), Snowstorm Creek–South Fork Little Humboldt River (19,966 acres), and First Creek–South Fork Little Humboldt River (9,384 acres). The largest HUC 10 watershed is the South Fork Little Humboldt River, covering 49,660 acres. These watersheds are essential for hydrological function and aquatic habitat. Notably, 33.4 miles of streams within the area are designated as occupied habitat for Lahontan Cutthroat Trout. Lahontan cutthroat trout (LCT) habitat holds significant importance in the Bureau of Land Management's Emergency Stabilization and Rehabilitation policy due to its ecological sensitivity, legal protections, and role in broader watershed health. LCT is a federally listed threatened species under the Endangered Species Act, and its recovery is a priority for interagency conservation efforts across the Great Basin. The ESR PEA addresses SOPs to avoid impact on any special status species. The stream network includes 53 named segments totaling 46.95 miles, with Snowstorm Creek being the longest at 4.07 miles. These streams are critical for wildlife, livestock, and riparian vegetation and are assessed using Proper Functioning Condition (PFC) protocols

Appendix A

Bonnie Hartley Travis Hawks
NDEP Bureau of Water Pollution Control Permit Not Required
Tuesday, June 13, 2023 4:20:35 PM

Good Afternoon Mr. Hawks,

Per our phone conversation earlier today, the Bureau has determined that a temporary working in waters permit is not required for the Jake's Fire BDA Project as there will be no equipment in, or near, the creek. If the scope of the project changes, please let us know so we can reevaluate the need for permit coverage.

Sincerely,

Bonnie Hartley

Staff II, Associate Engineer

Permit Branch, Bureau of Water Pollution Control Nevada Division of Environmental Protection Department of Conservation and Natural Resources 901 S. Stewart Street, Suite 4001

Carson City, NV 89701 bhartley@ndep.nv.gov

(O) 775-687-9502 | (F) 775-687-4684

Good morning Cody,

The working in waters permit is only triggered if tracked and wheeled equipment, heavy machinery, and construction vehicles are used inside the defined banks of a waters of the state. Hydraulic post pounders, unless vehicle mounted, do not trigger the permit as they are considered a hand tool by the Division. Unless heavy equipment or construction machinery are working inside the defined banks, a working in waters permit will not be required for this activity.

Here is a link to our website with more information: https://ndep.nv.gov/water/water-pollution-control/permitting/temporary-permits/working-in-waters

Let me know if you have more questions.

Mitch

Mitch Cowles, P.E.
Professional Engineer | Bureau of Water Pollution Control
Nevada Division of Environmental Protection
Department of Conservation and Natural Resources
9805 Double R Blvd, Suite 200, Reno, Nevada 89521
mcowles@ndep.nv.gov
Office: 775-687-9569 | Mobile: 775-434-3938
Facebook | Instagram | LinkedIn

JAKE'S FIRE RESTORATION PROJECT DESIGN DRAFT

June 10, 2026

Prepared by:

Matt Berry, Nick Willse, Nick Bouwes

Anabranch Solutions, LLC.

Prepared for:

Nevada Department of Wildlife

Table of Contents

LIST OF FIGURES

LIST OF TABLES

DESIGN SUMMARY

This document presents a preliminary design for low-tech process-based restoration (LTPBR; Wheaton et al. 2019) within the upper headwaters of South Fork (SF) Little Humboldt River (Figure 1). The primary goal is to facilitate riverscape recovery following Jake's Fire by promoting natural fluvial processes. These efforts aim to cultivate a dynamic aquatic ecosystem that provides high-quality habitat for threatened and endangered species. Our prioritization strategy was informed by a comprehensive onsite assessment and desktop analysis of geomorphic characteristics, hydrology, vegetation trends, beaver activity, and Lahontan cutthroat trout (LCT) distribution. Special emphasis was placed on LCT-occupied reaches to ensure their protection and enhancement. We have identified three priority reaches, (Sheep Creek, SF Little Humboldt, and Secret Creek) subdivided into ten complexes based on specific ecological objectives(Figure 2). Covering approximately six miles of stream, this design includes an estimated structure count of up to 766 and phased implementation plan to allow for adaptive management. These structures utilize locally sourced, fire-killed timber, aspen, willow, and rock to slow flow, rehydrate the floodplain, and promote channel aggradation.

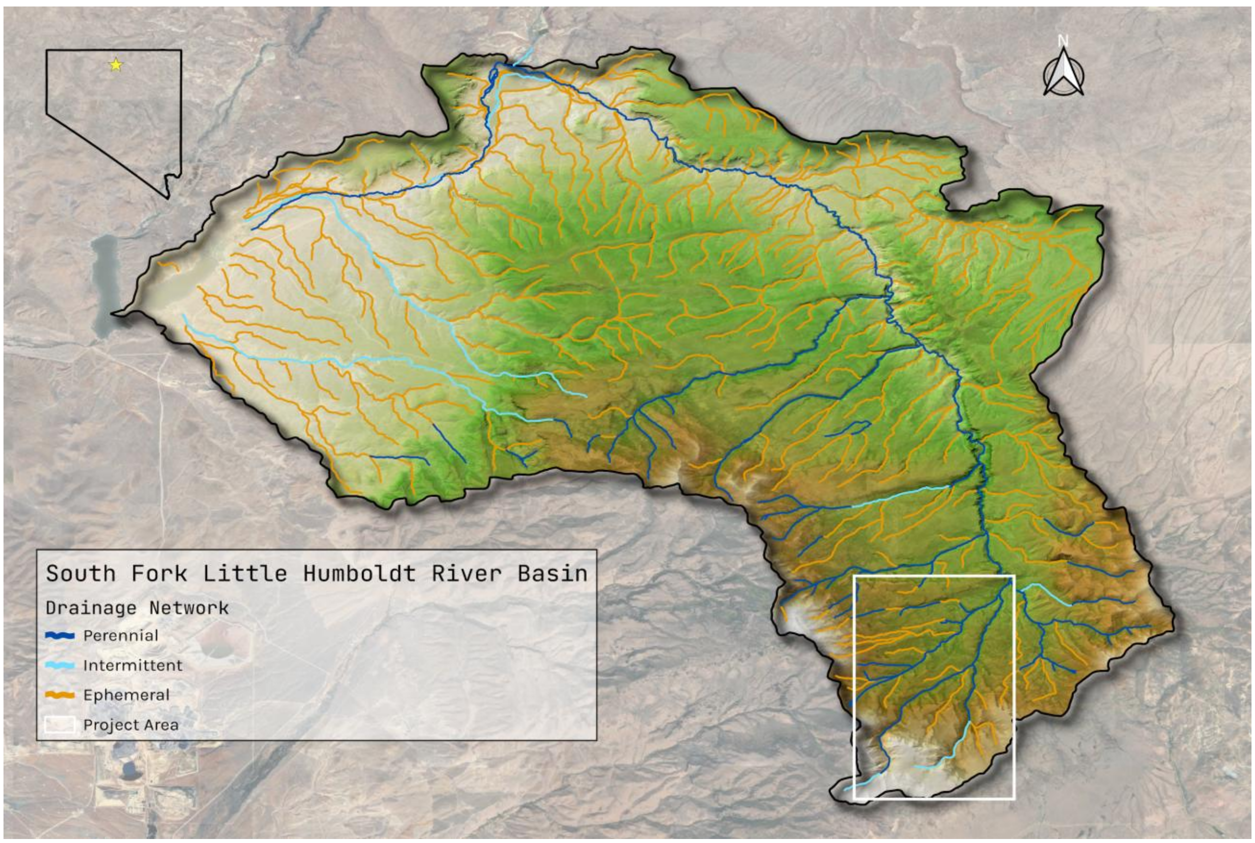


Figure 1 -- Drainage network and proposed project area within the HUC 10 South Fork Little Humboldt River Basin.

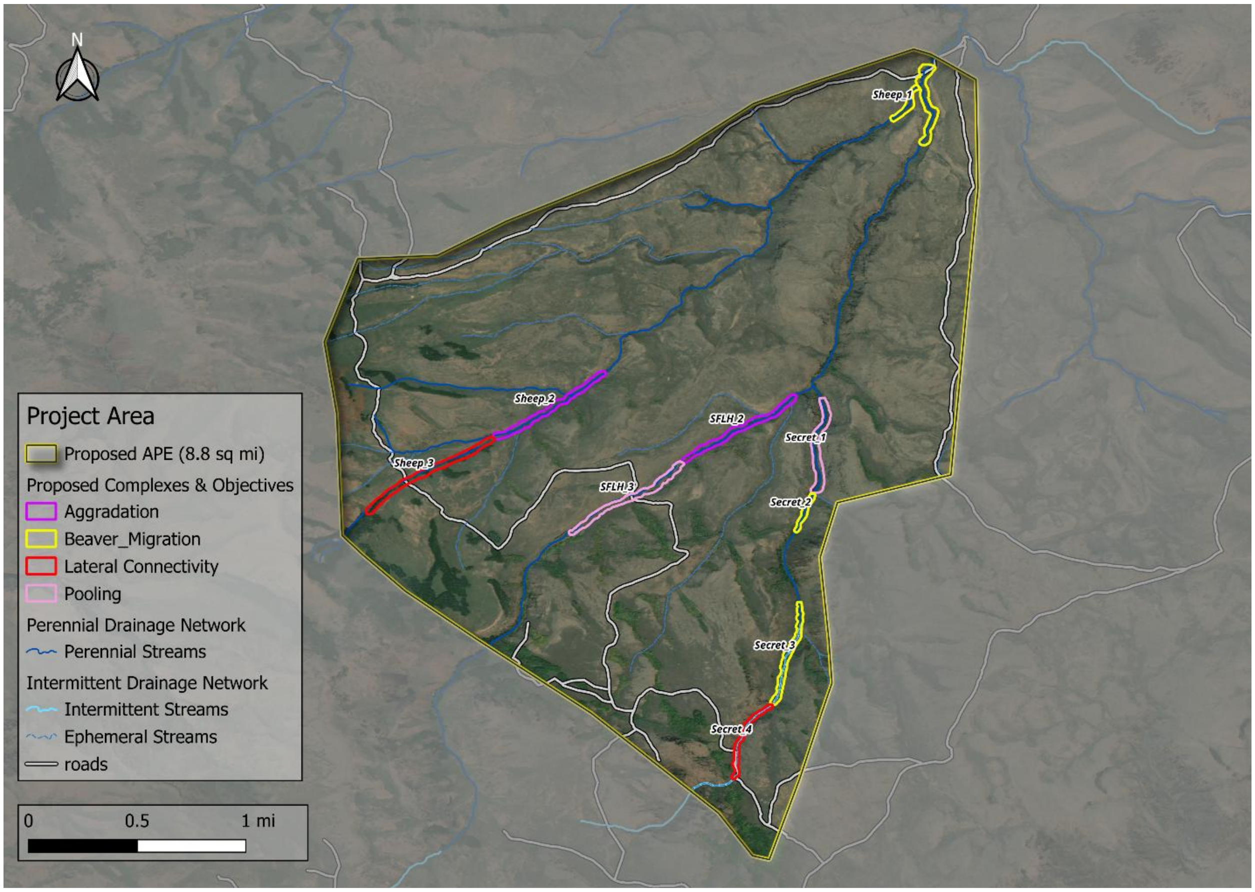


Figure 2 – Proposed Area of Potential Effect (APE) complexes and primary objectives.

PROJECT BACKGROUND AND SCOPE

During the summer of 2025 the Jakes Fire burned approximately 82,217 acres (Figure 2) in north central Nevada, approximately 5 miles west of the town Midas. Much of the area burned is within the SF Little Humboldt River Basin. Concerns about water quality along with aquatic and riparian habitat exist due to losses in canopy and groundcover and increased sediment/ash available for transport to nearby waterways during post-fire runoff events. However, burned watersheds can present opportunities to restore stream and riparian conditions that have been degraded through past climatic events and historical land management practices. Opportunities may exist to capture large quantities of sediment thereby aggrading stream reaches and laterally reactivating secondary channels and reconnecting floodplain features, increasing fines for riparian vegetation establishment, and potentially improving riparian and aquatic conditions over time.

Following the fire the Nevada Department of Wildlife contacted Anabranch Solutions to help assess the impact of the fire and to develop a design to aid in the recovery of the system with an emphasis on protecting and increasing Lahontan cutthroat trout populations. During a site visit in December of 2025, Anabranch Solutions, members of NDOW and landowners conducted a field assessment which led to the selection of three potential restoration reaches within the SF Little Humboldt River basin.

Design Goals and Objectives

The long-term, overarching goal of the Jake's Fire Restoration Project is to mitigate the impacts of the Jake's fire, as well as restore natural geomorphic, hydrologic, and biotic processes throughout the system. These processes will further help increase resiliency, ecosystem services, create a natural fire break, and improve aquatic, riparian, and floodplain habitats while simultaneously providing water and forage for adaptive management grazing strategies. More specific project goals include:

- Capture fine sediments as a result of Jake's Fire
- Increase Lahontan Cutthroat trout habitat
- Support the movement of beaver and enhance suitable habitat
- Increase health and diversity of riparian vegetation
- Increase channel-floodplain connectivity
- Mitigate and reverse channel incision

Observations and Current Conditions

Location and Setting

The Jake's Fire Restoration Project area is situated within the headwaters of the SF Little Humboldt River Basin in north-central Nevada (HUC 10-1604010902) (Figure 1). The project specifically targets a ~15.4 linear stream mile (24.8 km) network comprising the mainstem SF Little Humboldt, Sheep Creek, and Secret Creek, on NDOW and BLM land and is a tributary to the Humboldt River. The USGS StreamStats and NRCS Web Soil Surveys were used to obtain basin characteristics (Table 1), precipitation (Table 2), peak flow (Table 3), and soils information. The farthest downstream point along all tributaries was used to delineate the basin.

Table 1 -- Project site basin characteristics

USGS StreamStats Basin Characteristics	
Parameter	**South Fork Little Humboldt**
Drainage area (square miles)	15.9
Mean Elevation (feet)	7082
Annual Mean Precip.(in)	18.63
October to April Mean Precip.(in)	10.15
NOAA Atlas 24-Hr 100-yr Precip. (in)	2.5
Hydrologic Soil Group C (%)	41

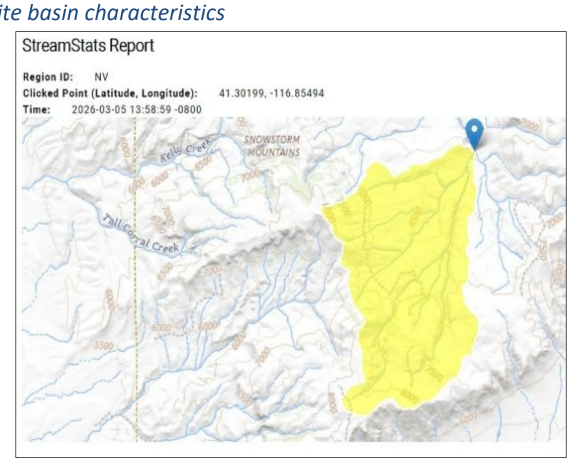


Table 2 – S.F. Little Humboldt basin precipitation

USGS StreamStats Basin Monthly Mean Precipitation (in)			
Month	**S.F. Little Humboldt**	**Month**	**SF Little Humboldt**
January	2.41	July	0.51
February	2.13	August	0.43
March	2.19	September	0.7
April	1.62	October	1.3
May	1.41	November	2.06
June	0.96	December	2.2
		Annual Mean Total	**17.92**

Geology and Soils

According to NRCS Web Soil Survey data (USDA NRCS 2026), the project area is defined by a volcanic and sedimentary landscape characteristic of the high desert Great Basin. The upland slopes are dominated by well-drained, stony loams interspersed with rock outcrops that facilitate rapid runoff during post-fire rain events. The valley bottom is comprised of hydric and organic-rich soil units that support meadow-dependent species like willow and aspen. These soils have historically functioned as a "sponge" for the watershed ; however, current channel incision has lowered local water tables, leading to a loss of soil moisture and increased vulnerability to erosion.

Post-Fire Context

The project area was significantly impacted by the summer 2025 Jake's Fire (Figure 2), which burned 82,217 acres. The loss of groundcover has made large quantities of sediment and ash available for transport. This creates a primary restoration opportunity of using LTPBR structures to capture this mobile sediment, thereby aggrading incised reaches and reconnecting the stream to its historic, soil-rich floodplain.

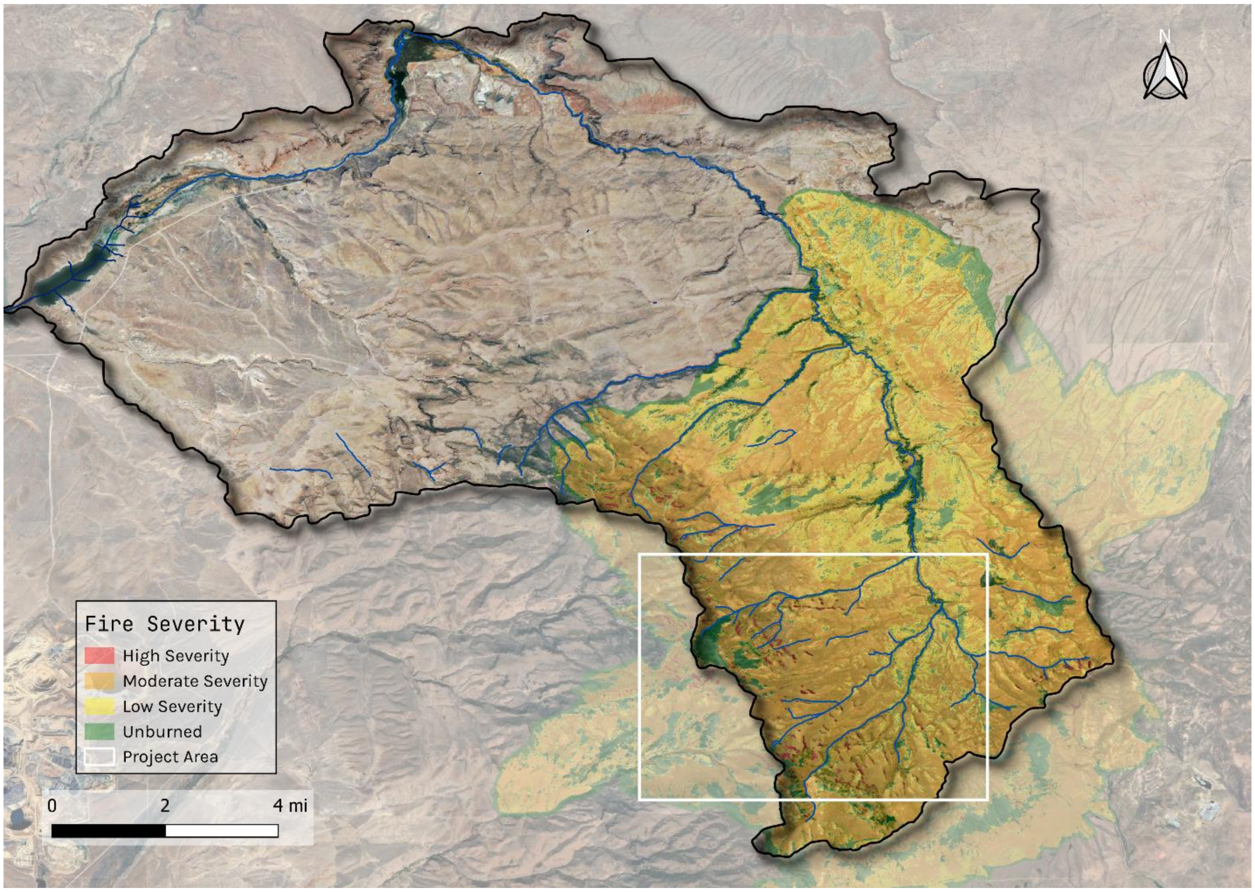


Figure 3 -- Jake's Creek Fire footprint within the SF Little Humboldt River Drainage, adapted from Monitoring Trends in Burn Severity (MTBS).

Flow Regime

While no active gauges exist onsite, StreamStats suggests a flashier hydrologic signature, with a 2-year peak (bankfull) event estimated near 0 cfs for the broad basin, and a 100-year peak of ~875 cfs.

Table 3 -- Project area basin peak flows

Recurrence Interval (years)	Basin Peak Flow (cfs)
2-Year Peak (Bankfull)	0
10-Year Peak	126
25-Year Peak	240
50-Year Peak	456
100-Year Peak	875

Desktop Analyses and Site Assessment

The section below summarizes our desktop analyses and site assessment to understand existing conditions. This information is applied in our design approach to identify structure types and locations.

Desktop Analyses

Several types of publicly available GIS data exist (e.g., 10 DEM, vegetation classifications, National Hydrography Data) that have been summarized or synthesized to provide information of the project areas to support analyses and mapping products. Since 1 meter LiDAR (light detection and ranging) data was available for the project area, we used this data in the tool *Terrain Analysis Using Digital Elevation Models* (TauDEM) in place of the publicly available 10m DEM to provide much more accurate topographic analyses. This higher resolution data was used to delineate the Zone of Influence (ZOI); which roughly represents the extent the 0.5m, 1m, and 2-meter inundation. These topographic data can be used to calculate structure quantity, spacing, fill volume estimates, etc.

Detrended Digital Elevation Model

Estimation of floodplain connectivity largely depended on the use of LiDAR topographic surfaces that have been detrended, referred to herein as a relative elevation model. Conceptually, the process of detrending topographic data consists of removing elevational changes due to the valley gradient, thereby allowing the elevation of valley bottom features (i.e., channels, floodplains, etc.) to be directly comparable. The resulting relative elevation model can provide an estimate of inundation at different heights above the channel bottom. Detrending of the project LiDAR data was implemented using the height above nearest drainage (HAND) approach and implemented within the TauDEM suite of topographic analysis tools. The HAND method starts with the identification of a drainage pathway for the channel network, the LiDAR surface is then "detrended" by differencing the elevation of each cell in the raster by the elevation if its nearest drainage cell (Liu et al. 2018).

Zone of Influence

We identify the complex valley bottom extent referred to herein as the zone of influence (ZOI), which is the area where restoration actions can influence geomorphic and hydrological processes. For example, the ZOI of wood structures and/or plug and spread options can be designed to force overbank flows within an expected lateral extent and a given increase in surface elevation. The hydrological ZOI on vegetation can extend further by increasing the water table elevations within the riparian area that roots can access below the ground surface. The ZOI can extend further yet (sometimes 100s of meters) if overbank flows propagate down the floodplain or into paleochannels.

Site Assessment

The site assessment for the Jake's Fire Restoration Project area—encompassing the SF Little Humboldt River, Sheep Creek, and Secret Creek—was conducted to characterize the current geomorphic and hydrologic conditions following Jake's Fire. This assessment combines quantitative desktop metrics with qualitative field observations to establish a baseline for restoration design.

Site Characteristics

The project area within the upper headwaters of the SF Little Humboldt River, Sheep Creek, and Secret Creek is situated in a high-elevation (6115ft to 7162ft elevation) volcanic landscape characterized by moderate to steep upland slopes that transition into varying degrees of valley bottom confinement. The site's character is defined by a historical precedent of sediment-rich flows and a snowmelt-dominated hydrologic regime, with annual mean precipitation of 17.92 inches. Current site conditions are significantly influenced by contemporary disturbances and land use, including a legacy of grazing and an established road network that intersects the channel at multiple points, acting as localized focal points for geomorphic instability. Total channel length of proposed complexes is roughly 6 miles.

Land use and ownership

The primary historical land use within the project area was intensive livestock grazing, which served as the dominant economic driver for over a century. In 1989, the Nevada Department of Wildlife (NDOW) purchased the property from the T-Lazy-S Ranch (Marvel family) to establish the Wildlife Management Area and prioritize the protection of the Lahontan cutthroat trout (Figure 3) . While active grazing management has shifted since the state's acquisition 37 years ago, the geomorphic "legacy" of that era—specifically channel incision and floodplain disconnection—remains a primary constraint on habitat function.

Currently, the NDOW-owned riparian ribbons are managed for wildlife habitat and public recreation; however, the surrounding upland watershed remains under the jurisdiction of the Bureau of Land Management (BLM) and continues to support active grazing allotments. Furthermore, an established road system continues to intersect the SF Little Humboldt River, Secret Creek, and Sheep Creek in multiple locations, occasionally serving as a focal point for localized erosion and grade instability.

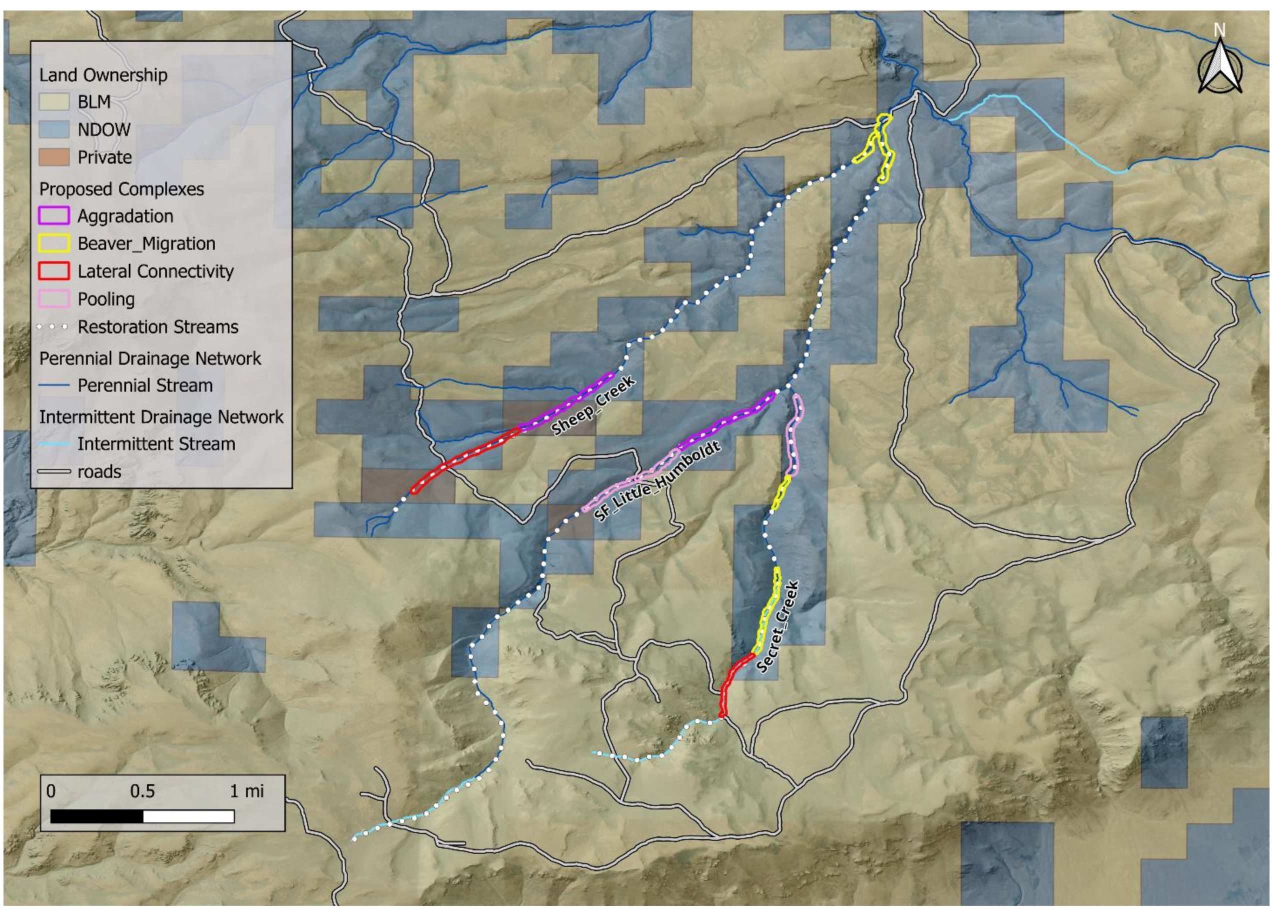


Figure 4 -- Land Ownership & proposed restoration complexes.

Vegetation

Riparian and upland vegetation communities provide the structural foundation for the project's restoration potential. The valley bottoms currently support diversity of obligate and facultative sedge, rush and grass species, and emergent vegetation, including a low-to-moderate density of willow (*Salix spp.*), which serves as critical structural material for dam building and habitat complexity. In select reaches of Sheep, S.F. Little Humboldt, and Secret Creeks, aspen (*Populus tremuloides*) persists along the margins of the riparian zone. The density of woody vegetation was mapped from both ariel imagery (drone) and onsite assessment (Figure 4). The uplands are predominantly sagebrush communities with native bunch grasses and forbs; however, the functional capacity of these vegetation types was recently altered by environmental stressors (fire), limiting their ability to catch sediment (ash and silts) eroding into the stream channel.

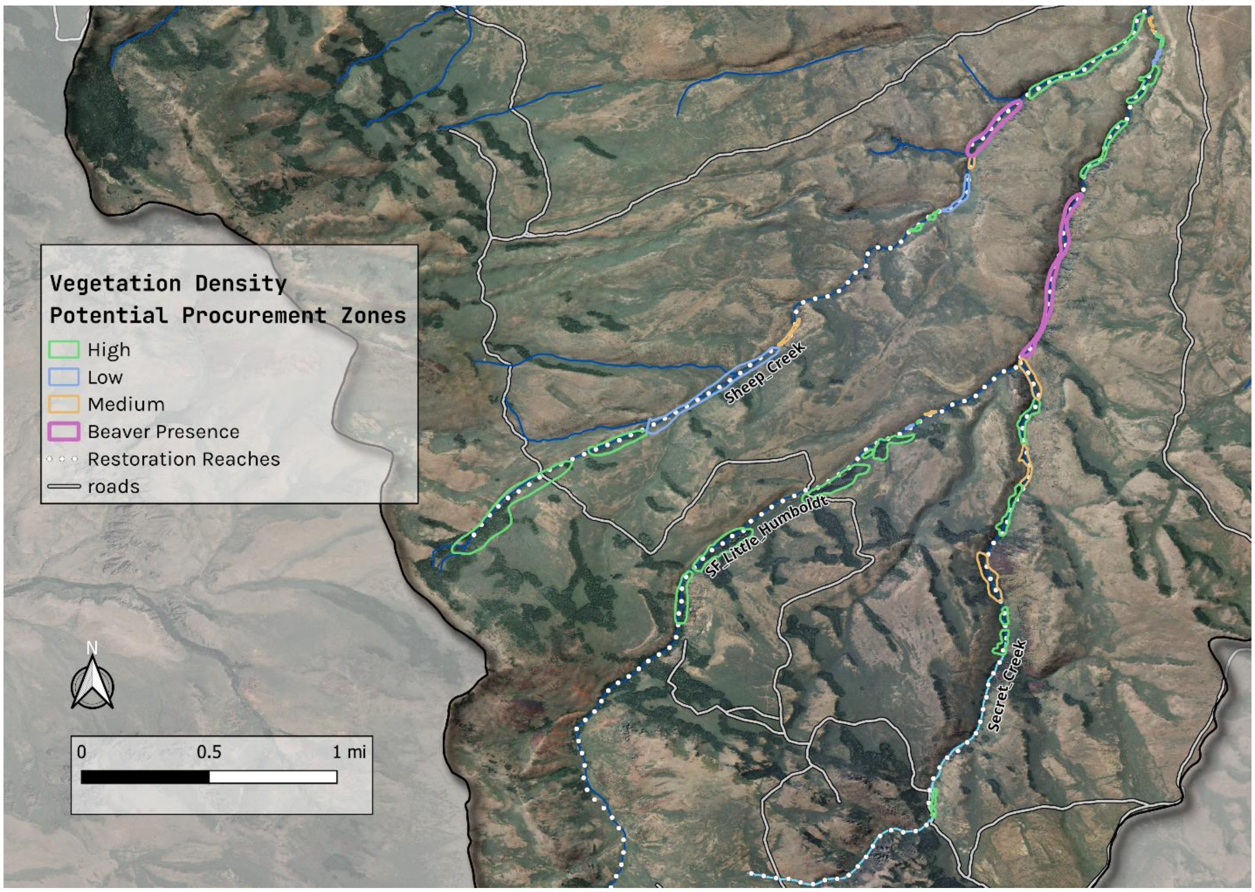


Figure 5 -- Map depicting Vegetation densities within proposed restoration reaches. Used to aid in determining complex locations based on procurement availability and ease.

Fire

The Jake's Fire (see Figure 2) represents a pivotal event in the recent history of the watershed. The fire significantly impacted upland groundcover, leaving a signature of burned sagebrush across the project area. This reduction in vegetation has altered the hydrologic response of the basin, likely increasing peak runoff rates and mobilizing a "pulse" of sediment and ash. From a restoration perspective, while the fire increased the vulnerability of the channels to vertical incision, it has also provided a unique opportunity to use LTPBR structures to capture and store these newly mobilized sediments to promote rapid aggradation.

Beaver and Wood

Beaver activity is the primary biological driver of habitat complexity within the SF Little Humboldt basin. The assessment identified a high density of beaver activity, with approximately 85 dams currently distributed across the three reaches (42 on SF Little Humboldt, 24 on Sheep, and 19 on Secret Creek) (Figure 5) . These structures range from channel-spanning to valley-bottom spanning dams. While many remain intact and continue to provide essential pool refugia for the endangered Lahontan Cutthroat Trout, several complexes appear to be hydrologically isolated. The presence of active beaver chew indicates a resident population capable of maintaining structures if the project can provide the initial structural "anchors" to reconnect the system.

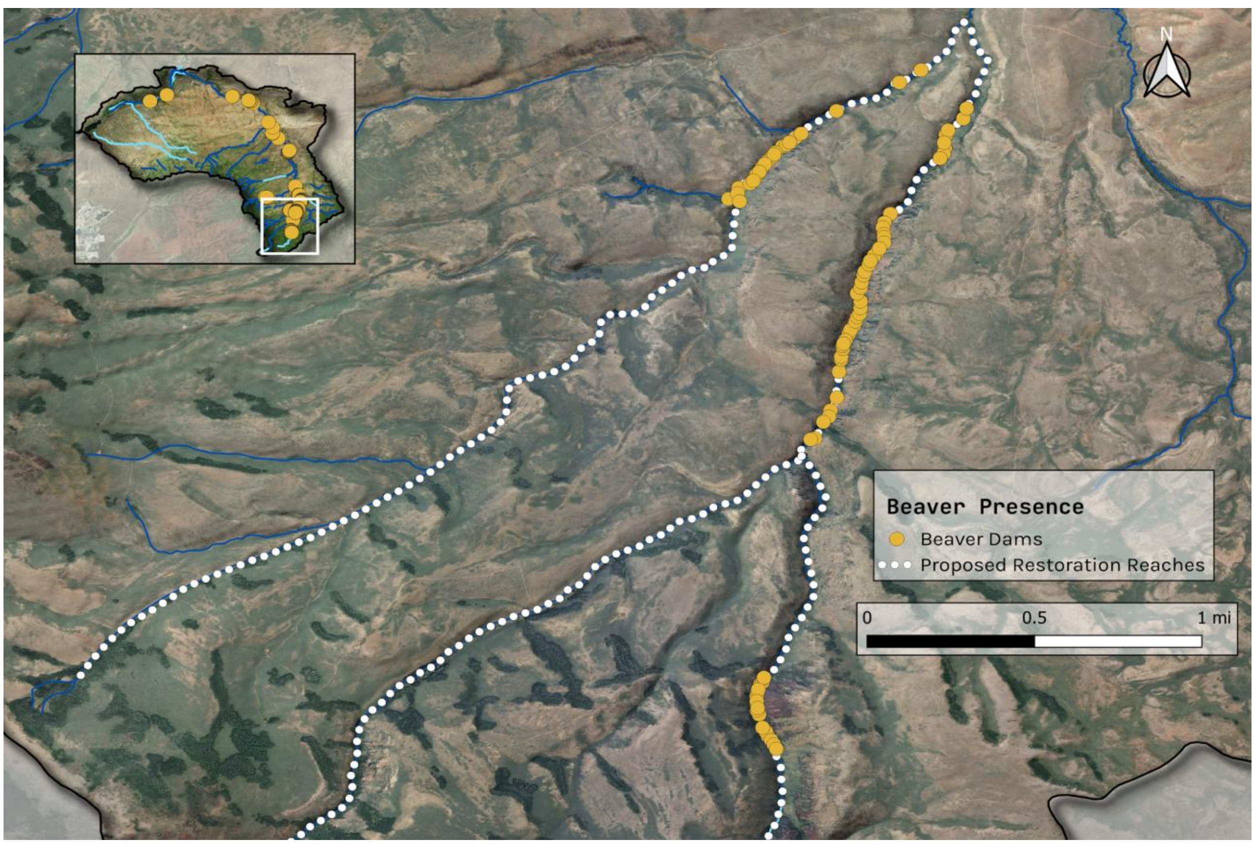


Figure 6: Beaver dams observations within the project area.

Lahontan Cutthroat Trout (*Oncorhynchus clarkii henshawi*)

A primary driver for the Jake's Fire Restoration Project is the conservation and habitat enhancement for the Lahontan cutthroat trout (LCT), a federally listed threatened species. The project area serves as a critical stronghold for LCT within the South Fork Little Humboldt River watershed. According to population data provided from the USGS Northern Rocky Mountain Science Center (Al-chokhachy et al. 2025) LCT occurrences are strongly correlated with existing beaver complexes (Figure 6).

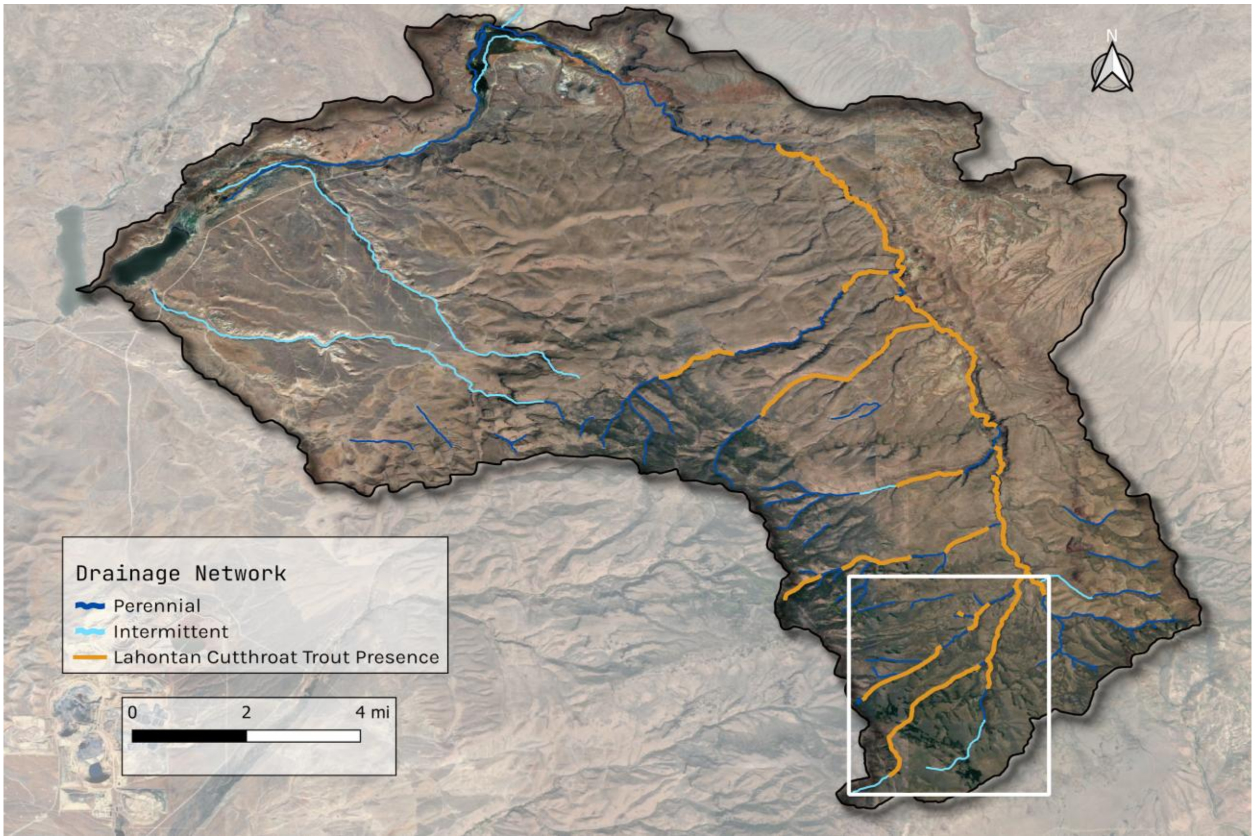


Figure 7 -- Lahontan Cutthroat Trout distribution.

Geomorphic Characteristics

Geomorphic characteristics are the physical attributes, shapes, and structural features of the riverscape. They determine how riverscapes respond to, or are changed by natural, geological forces and external forces like flowing water (i.e., geomorphic processes). Herein, we describe the geomorphic characteristics through the lens of the valley bottom because it encompasses the channel and contemporary floodplain. The valley bottom represents the maximum possible extent of channel movement and riparian areas.

The geomorphic composition of the project area ranges from confined canyon segments (6 m wide) to broader (50 m wide); unconfined meadow reaches. Gradients are moderate in the SF Little Humboldt and Sheep Creek (2.5%–2.8%) but increase significantly in Secret Creek (5.1%). The higher stream power associated with these gradients has resulted in varying degrees of incision and entrenchment. This departure from a resilient state is characterized by a loss of lateral connectivity, where flows are increasingly confined within the active channel rather than spreading across the historic floodplain. The goal of the restoration design is to reverse this trend by increasing hydraulic roughness and promoting sediment deposition across the valley bottom. Table 4 summarizes the current geomorphic condition for each reach.

Table 4 -- Summary of geomorphic conditions for each reach.

Reach Name	Valley Setting	Average Valley Width (m)	Average Channel Depth (m)	Average Channel Width (m)	Channel Gradient (%)	Length (.miles)	Dominant Bed Material	Current Geomorphic Condition
SF Little Humboldt	Partly Confined / Meadow	18.6	0.19	2.74	2.5%	6.2	Gravel / Fines	Incised/Entrenched: Disconnected from historic floodplain; high density of beaver dams in the lower section; high aggradation potential.
Sheep Creek	Partly Confined	17.5	0.21	2.70	2.8%	6.5	Gravel / Cobble	Degraded: Localized head-cutting and lateral erosion; limited riparian recruitment due to lowered water table.
Secret Creek	Confined / Steep	16.3	0.20	2.30	5.1%	2.7	Cobble / Boulder	High Energy / Incised: Vertical instability due to steep gradient; high stream power; upper section has high density of beaver dams

Restoration Approach and Design

The design was informed by previous studies, desktop analyses, field visits, and insights from personnel that have many years of experience in planning, design, and monitoring of process-based restoration projects.

Low-Tech Process-Based Restoration

Restoration of the Jake's Fire project area will rely on low-tech process-based restoration (LTPBR) techniques (Wheaton et al. 2019) to address stream impairments such as head cutting and channel incision.

LTPBR is based on an understanding of what constitutes healthy riverscapes (i.e., channel, riparian, wetland, floodplain surfaces), and how restoration actions lead to restoring riverscape health and resilience. Riverscapes are composed of channel and floodplain habitats and their associated biotic communities that are maintained by physical and biological processes that vary across spatial and temporal scales. Structural starvation (i.e., the absence of wood, beaver dams, and/or dense vegetation) in riverscapes is one of the most common impairments affecting riverscape health. Generally, a riverscape starved of structure drains too quickly, has lower lateral connectivity, is more prone to incision, and has simpler more homogenous habitat. By contrast, a riverscape system with an appropriate amount of structure provides obstructions to flow. What follows in the wake of structurally forced hydraulic diversity are more complicated geomorphic processes that result in far more diverse habitat, resilience, and a rich suite of associated ecosystem services. The specific restoration structures used (e.g., beaver dam analogues (BDAs), post-assisted log structures (PALS), and sedge plugs) are the tools used on-the-ground; however, ultimately, they are based on riverscape and restoration principles (Wheaton et al. 2019).

The LTPBR approach focuses on harnessing existing hydrological, geomorphological, and ecological processes that have been interrupted or extirpated due to anthropogenic changes. For example, historic grazing-driven channelization that shifted what was historically a depositional meadow habitat into an eroding transport reach that lacks the structure and the function of accreting and retaining the sediment that is generated both upstream of and within the meadow stream channel itself. The primary methods used include building with wood, conifer branches, sagebrush, willow, and sedge mats to simulate natural beaver dams, woody debris jams, and other in-stream structure to slow, split, and spread stream flows, promote inset floodplain development, raise water tables, and aggrade stream channels to increase floodplain connectivity (Pollock et al. 2015, Wheaton et al. 2019). The approach mimics structure that promotes processes that accelerates the evolution of the system from an incised channel to one that is highly connected to the floodplain within years-decades rather than centuries-millennia (Cluer and Thorne 2014, Pollock et al. 2014), resulting in a system that is self-sustaining (Figure--).

Additionally, because the LTPBR approach relies mainly on hand-built techniques, the habitat that is generated comes at the pace and scale of the site's delivery of flow, sediment, and natural recruitment of aquatic and riparian vegetation. The existing vegetation community that is present at the site provides the source of seed and clonal material to propagate on new surfaces, and therefore there is considerably less risk of weedy, non-native invasive vegetation to become established, and the current habitat that is supporting at-risk species will likely not only be preserved but enhanced.

The LTPBR approach can be used to reverse the degradation observed within previously grazed riparian areas. In-channel structure will slow flows, capture sediment, aggrade incised channels, and produce overbank flows, that can both lead toward a hydrological regime with increased connectivity and sheetflow, as well as one that provides instream habitat for aquatic species. Additionally, by increasing water table elevations, subsurface impacts through increases in soil moisture can help increase sedge production and eliminate encroachment of unwanted species. The dense root mats of sedges are the structure that will ultimately sustain healthy meadows and prevent incision. Subsequently, as the retention of water and sediments increase, so does resiliency to drought, floods, and fires.

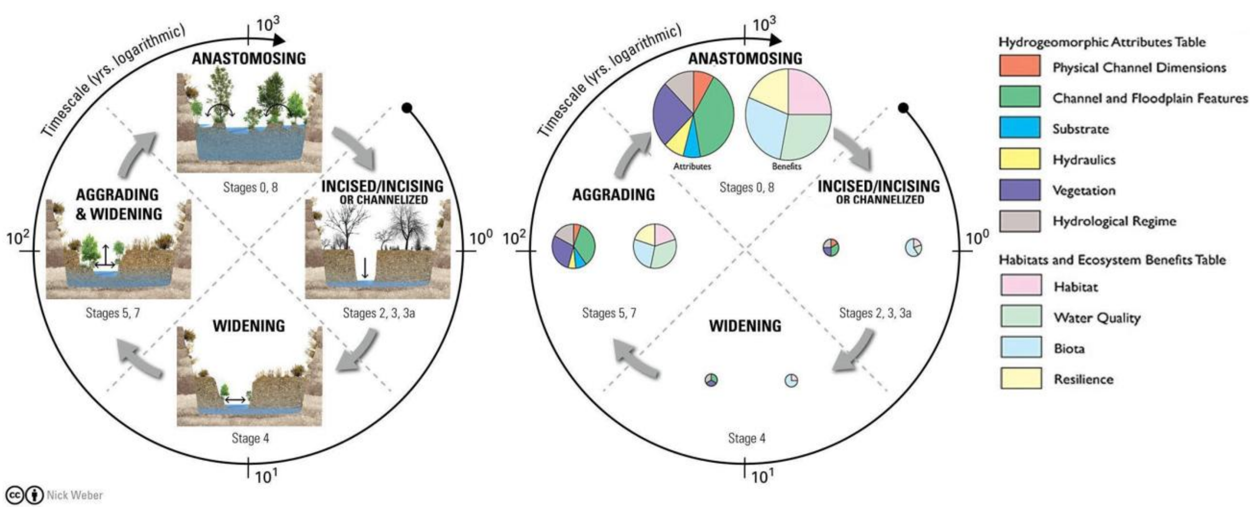


Figure 8 -- Simplified version stream evolution model (SEM) proposed by Cluer and Thorne (2014) in Wheaton et al. (2019).

Low-Tech Restoration Structures

Low-Tech Process-Based Restoration (LTPBR) frequently employs structures like beaver dam analogs (BDAs), post-assisted log structures (PALS), and large woody debris or wood jams (LWDS, WJ) to strategically mimic natural processes. These structural elements resemble beaver dams and woody debris accumulations, respectively. These structures are not intended for permanence. Their purpose is to first imitate, and then accelerate natural processes such as beaver activity, wood accumulation, and growth of riparian species.

Consequently, structures like BDAs and PALS/WJ may need ongoing maintenance or replacement until natural processes become self-sustaining. The presence of beaver activity on-site can significantly reduce maintenance needs. Furthermore, a BDA that provides secure habitat and a food source may encourage beaver to relocate to different sections. Planting willow stakes, sourced from on-site cuttings, is also a common practice when willow is abundant. This provides both a food source and a living structure that often requires less maintenance.

BDA – Beaver Dam Analog

BDAs are intended to mimic naturally occurring beaver structures, which are composed of woody materials and sediment. Materials gathered from the site are arranged mostly parallel with flow, tightly weaved and interlocked. Woody material extends beyond the crest (center and highest point of structure) to form a "mattress" designed to dissipate flows coming over the structure and prevent scour. While building up woody materials, sediment and/or sedge plugs are placed at the front of the structure to help create backwater and pooling (Figure 9). BDA's can either be posted to help secure the structure in place during high flows or can also be post-less in areas with low gradient and flow-regimes.

PALS – Post-Assisted Log Structure and Wood Jam

PALS and Wood Jams are intended to mimic naturally occurring woody structures that accumulate materials either within the channel center, the bank or span the full length of the channel or floodplain. These structures are more porous than BDAs and are intended to redirect flows, induce lateral channel migration via erosion and deposition during typical floods, as well as disperse flow across accessible floodplain surfaces (Figure 10). These structures are often secured together using untreated wooden posts driven into the streambed but similar to BDA's can be postless in certain circumstances.

Woody Debris Placement: Mimicking Natural Processes for Stream Restoration

The stream restoration design strategically incorporates Wood Jams or Large Woody Debris (LWD), particularly in aspen areas, to mimic natural processes. The main goal is to increase in-stream roughness, promote sediment accumulation (aggradation), and slow stream velocity and power.

The standard, low-impact implementation involves felling aspen trees directly into the channel, favoring naturalism and efficiency over complex, hand-built structures. This passive approach creates varied, complex aquatic habitat. However, opportunities will be taken to reinforce existing natural log jams by strategically adding heavier, structural wood pieces. This anchors the jam, increasing its longevity, maximizing its function as a sediment trap, and dissipating flow power. This balances efficient passive felling with the enhanced geomorphic stability of targeted, heavier elements.

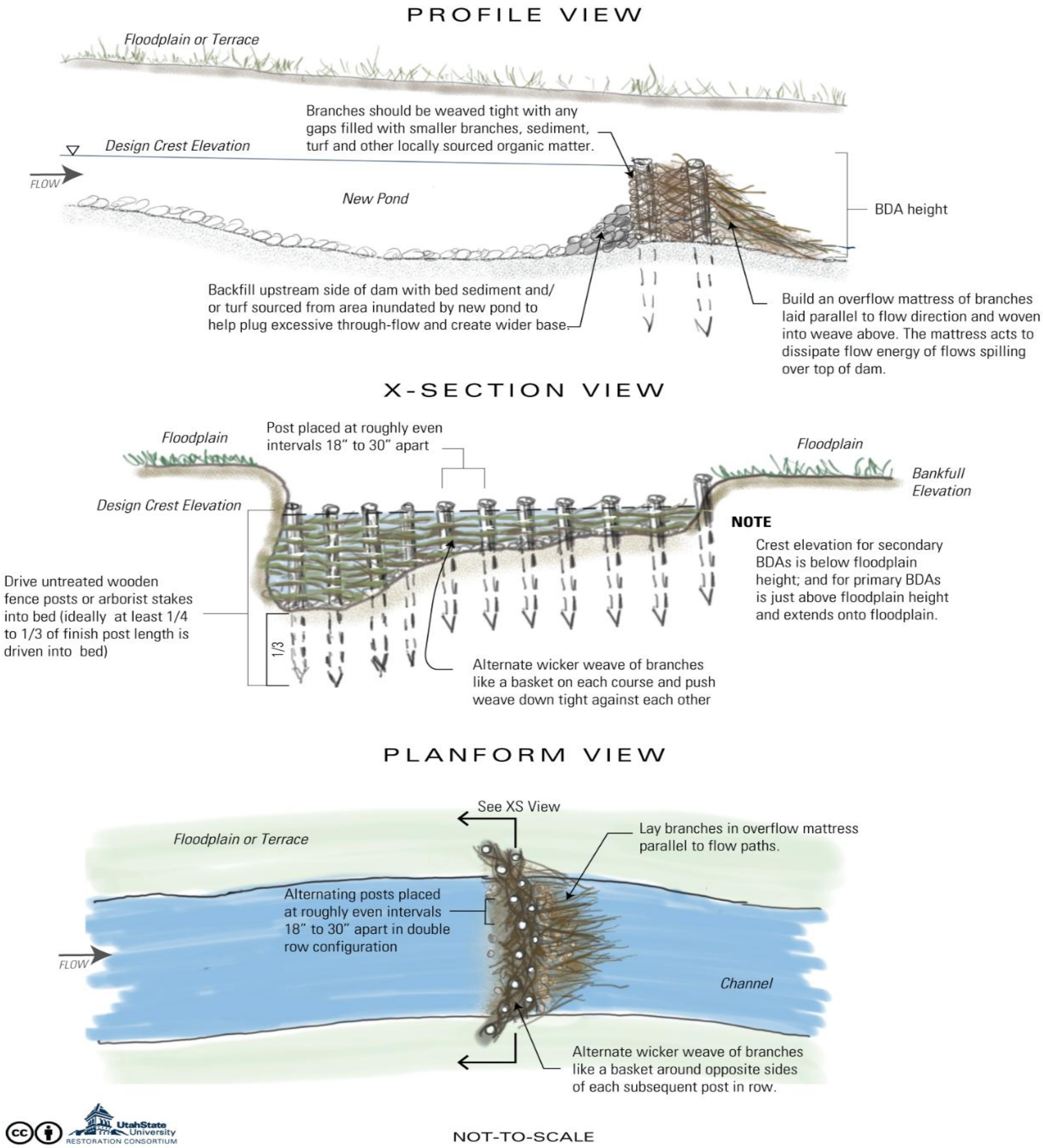


Figure 9 -- Profile, cross-sectional, and planform views of a typical BDA that uses occasional weave to compress vegetation that is incorporated to the structure in multiple directions.

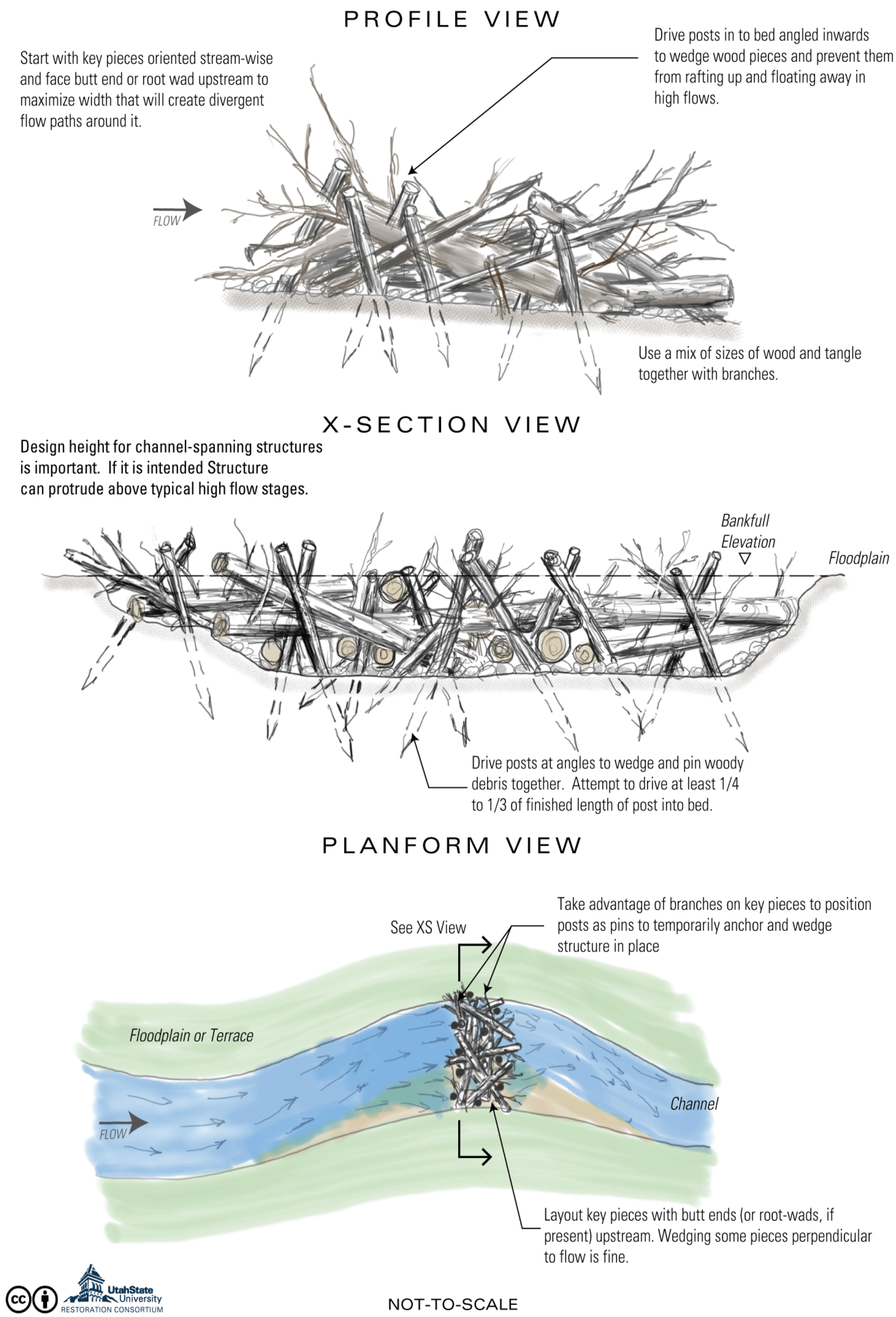


Figure 10 -- Profile, cross-sectional, and planform views of typical channel spanning Post-Assisted Log-Structure (PALS) (from Wheaton et al. 2019).

Design

The design is organized with respect to structure complexes (i.e., groups of LTPBR restoration structures), that have individual designs, objectives, and process-based response hypotheses. While the complex details and locations are provided, they should be interpreted as guidelines rather than an exact prescription. The final layout of structures occurs during implementation where subtle site-specific features are incorporated into the design taking advantage of opportunities that only become apparent as water routing responses are observed. Therefore, the design here will approximate the as-built design.

COMPLEX-SCALE OBJECTIVES

Complex-scale objectives differ from project objectives in that they specifically describe the geomorphic or hydrologic response a group of structures is designed to force. An example of a complex-scale objective is to force flows overbank to increase lateral connectivity or to aggrade the channel, both of which contribute to the larger goal of mitigating and restoring normal function following Jake's Fire. We outline the common objectives along the mainstem channel at the complex scale which include aggradation, pooling, beaver migration and increased lateral connectivity. Note that all areas are likely to benefit from structures by increased hydraulic diversity and geomorphic complexity as structures influence flow paths and the processes of erosion and deposition. As such, we do not list it as a specific reach-scale objective here.

Aggradation

Aggradation is also part of the natural cycle of recovery of incised channels. While stream evolution models generally suggest that aggradation naturally occurs after the process of widening, structures can short-circuit this cycle by immediately capturing sediment. BDAs and channel-spanning PALS are intended to capture sediment and aggrade the channel bed. In less severe cases of incision, aggradation may occur quickly enough that sustained floodplain connection can be obtained within the life of these structures. Moderate cases may require buildup of structures in multiple stages. Severe cases might initiate widening (above) before attempting aggradation. Aggradation is a key objective during post-fire mitigation to aid in the capture of fine sediments that can cause issues within the immediate stream and greater watershed.

Pooling (Lahontan Cutthroat Trout Habitat)

The primary goal of this project is to increase habitat for Lahontan Cutthroat Trout. BDAs can be used to create backwater and deep pool habitat which is suitable for LCT populations. These deep pools create areas with cooler water temperatures, coverage from predators and also refuges during low flows and drought conditions.

Increase Lateral Connectivity

In areas where the original floodplain remains accessible, or where the channel has widened and created an inset floodplain, we rely on channel-spanning structures (e.g., BDAs, channel-spanning PALS) to force connectivity to adjacent surfaces. Depending on the local channel geometry (i.e., bank height) lateral connectivity may be achieved at baseflow conditions, or only during high flow conditions. In the short term, connectivity depends on the structural forcing of flows out of the channel.

Beaver Migration

The presence of beaver can help achieve all the above goals and accelerate the overarching goal of a self- sustaining riverscape. Reinforcing inactive and active beaver dams can help strengthen existing complexes. Increasing suitable habitat by mimicking beaver dams may also encourage beaver migration throughout the system.

Table 5-- Summary of Complex characteristics

Complex ID	Reach Name	Length (m)	Avg. Channel Slope (%)	Avg. Channel Depth (m)	Avg. Channel Width (m)	Primary Impairment	Restoration Goal
Sheep_1	Sheep Creek	490	1.8%	0.14	2.85	Hydrologically isolated beaver complexes	Beaver Migration & Pooling
Sheep_2	Sheep Creek	1197	2.7%	0.28	2.40	Post-fire sediment pulse & vertical incision	Aggradation & Pooling
Sheep_3	Sheep Creek	861	5.0%	0.21	2.27	Loss of lateral connectivity & degraded riparian	Lateral Connectivity, Aggradation, & Complexity
SFLH_1	SF Little Humboldt	1000	2.5%	0.14	2.54	Channel incision & floodplain disconnection	Beaver Migration & Pooling
SFLH_2	SF Little Humboldt	1304	2.7%	0.18	2.58	Entrenched single-thread morphology	Aggradation, Widening, & Pooling
SFLH_3	SF Little Humboldt	1355	3.5%	0.19	2.60	Incised/Entrenched conditions	Pooling, Aggradation, & Complexity
Secret_1	Secret Creek	1050	3.8%	0.22	2.30	High energy vertical instability	Pooling & Aggradation
Secret_2	Secret Creek	445	4.6%	0.19	2.51	Incised channel with high stream power	Beaver Migration & Pooling
Secret_3	Secret Creek	1115	5.3%	0.14	2.12	Steep gradient vertical instability	Beaver Migration & Pooling
Secret_4	Secret Creek	885	6.8%	0.25	2.28	High energy incised state	Lateral Connectivity, Aggradation, & Complexity

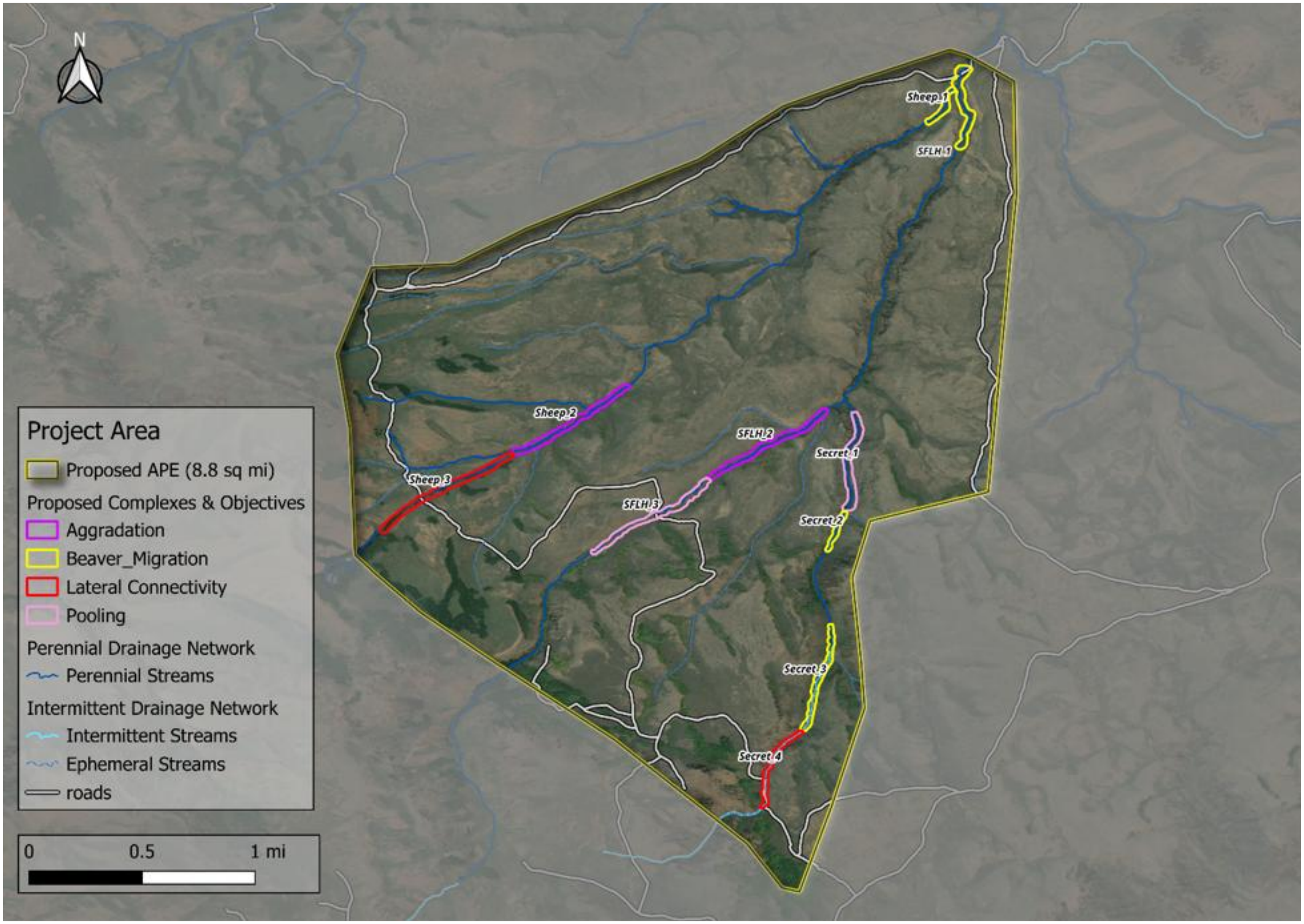


Figure 11 -- Overview of project complexes

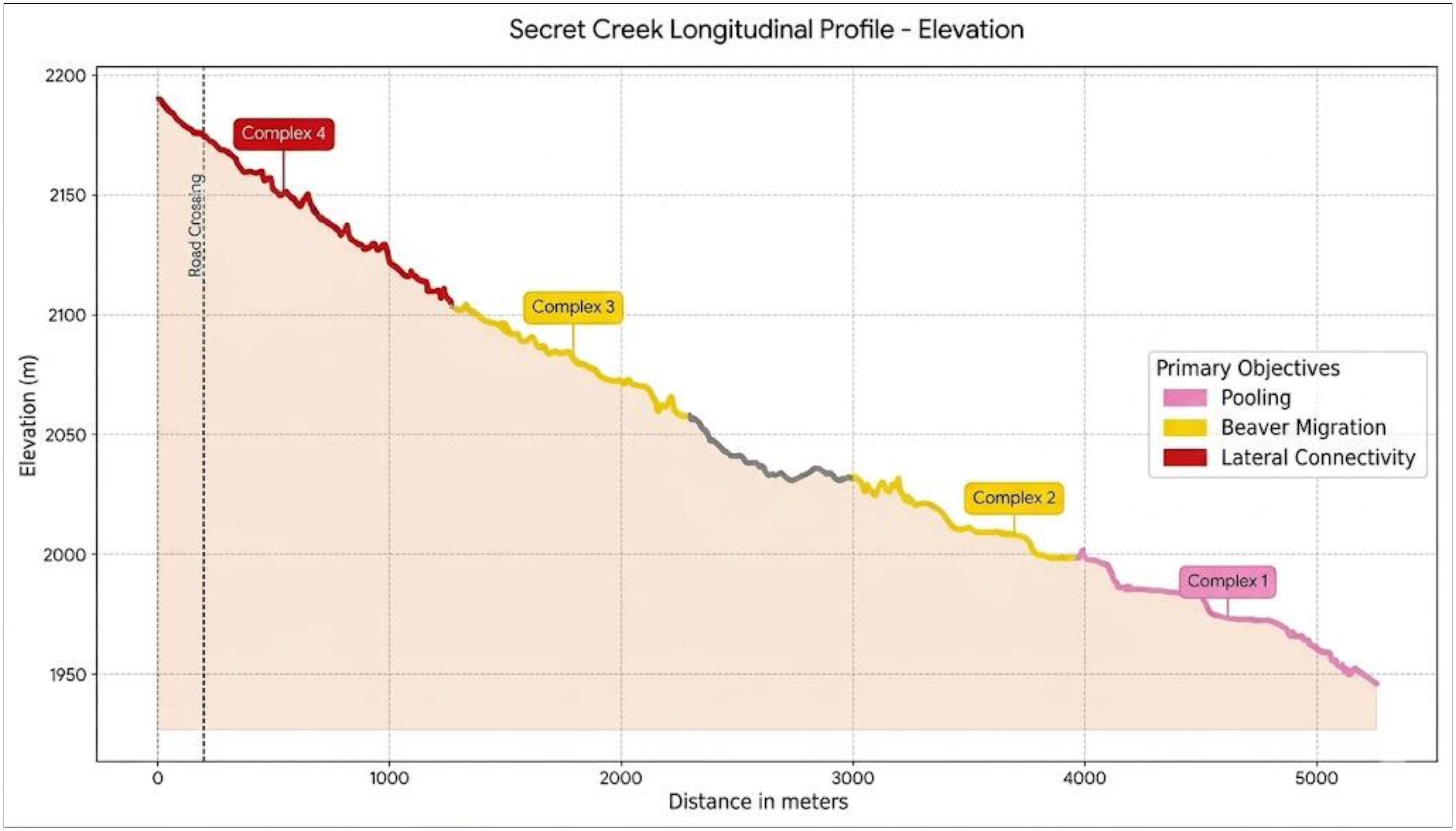


Figure 12-- Longitudinal Profile for Secret Creek with complexes, primary objectives, and roads marked

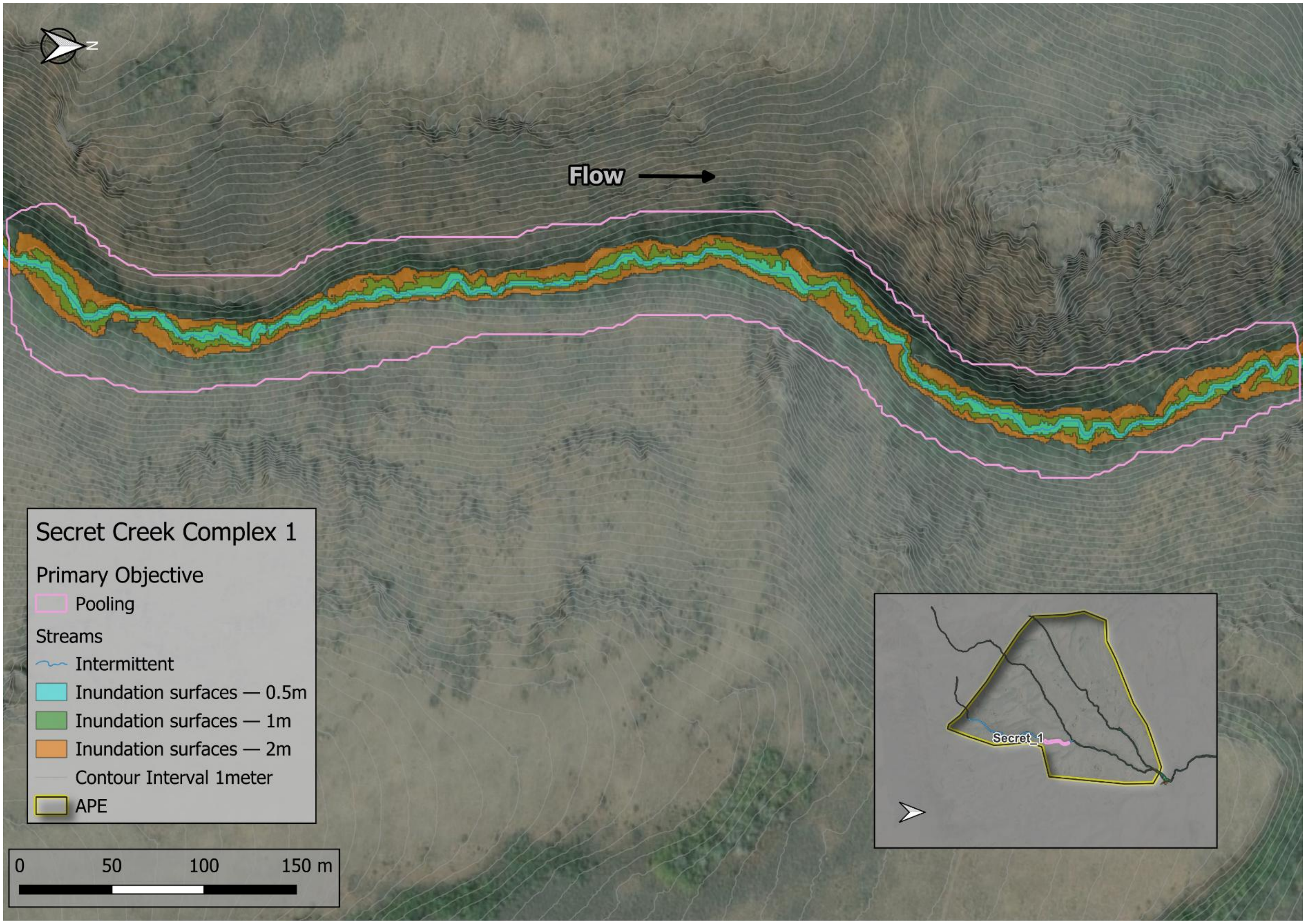


Figure 13-- Map depicting Secret Creek Complex 1. Includes primary objective and potential inundation extents.

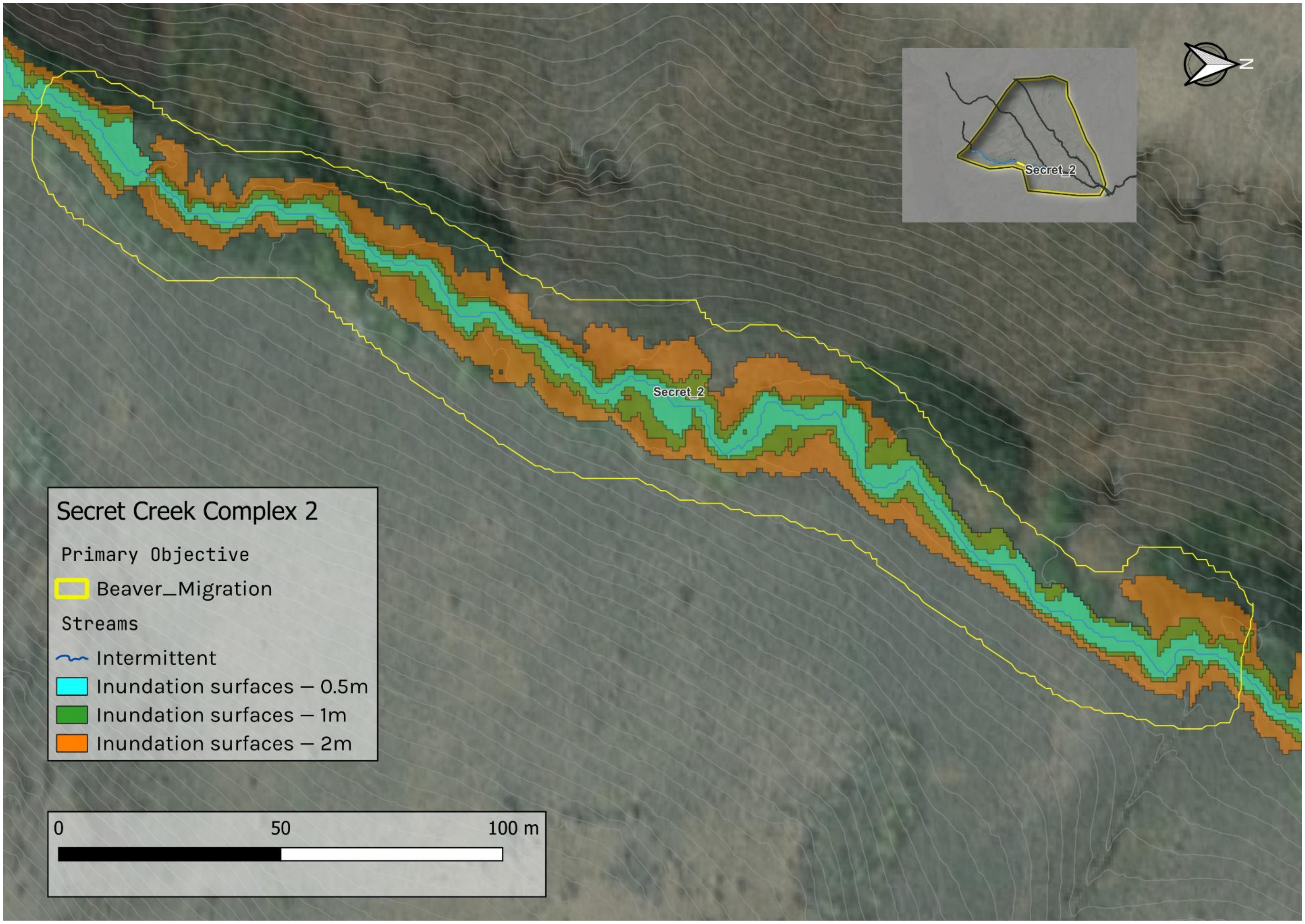


Figure 14 -- Map depicting Secret Creek Complex 2. Includes primary objective and potential inundation extents.

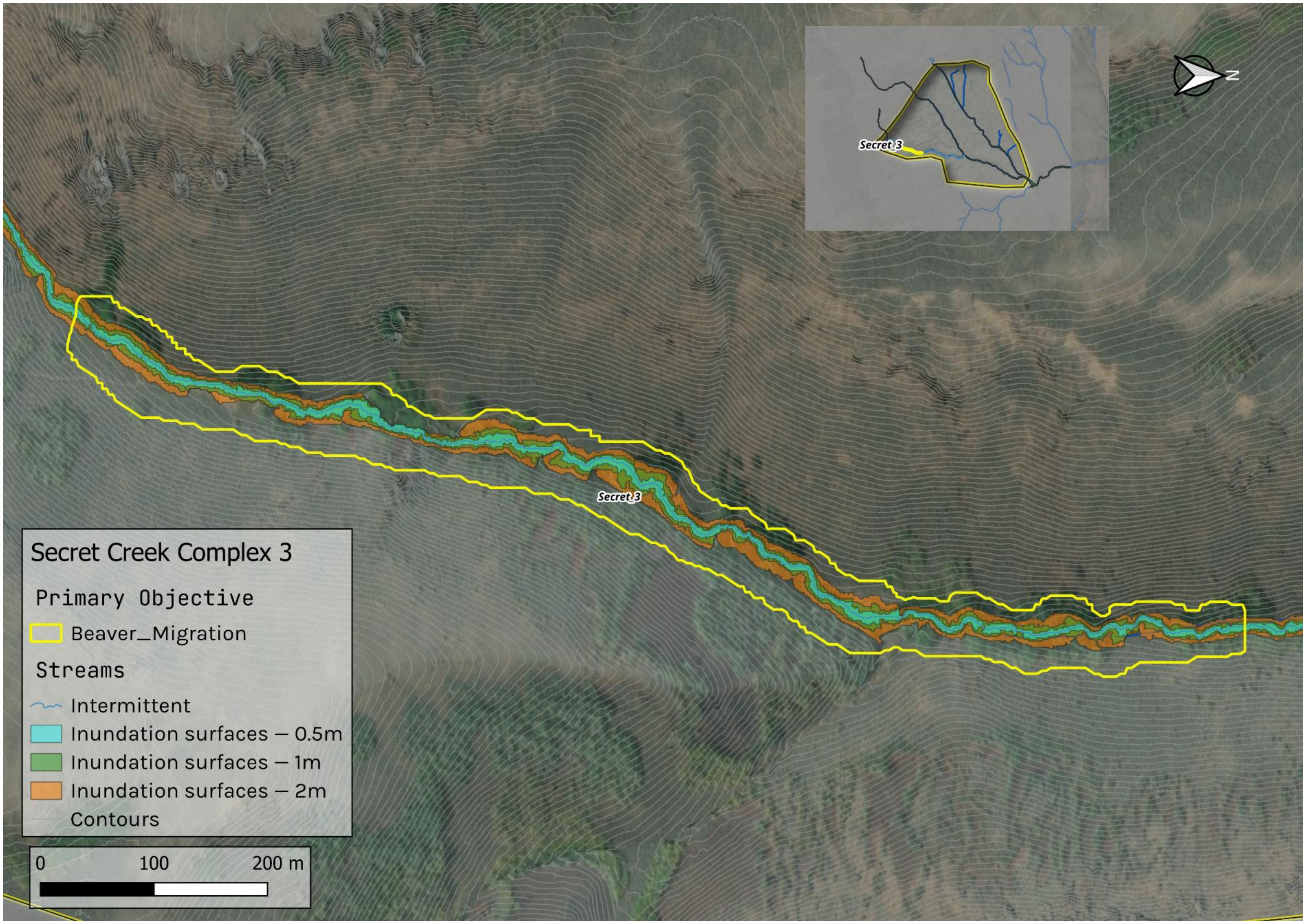


Figure 15 -- Map depicting Secret Creek Complex 3. Includes primary objective and potential inundation extents.

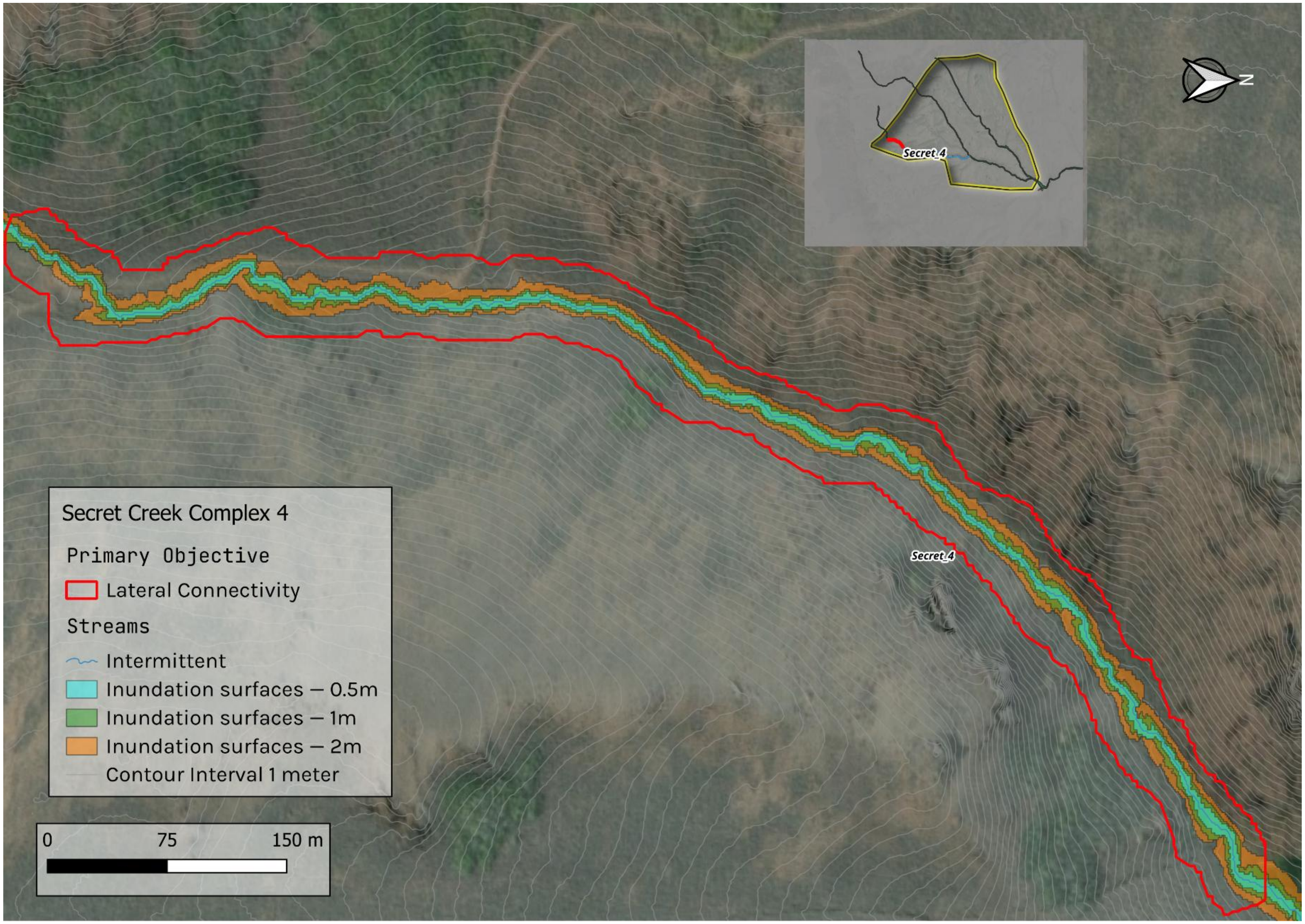


Figure 16 -- Map depicting Secret Creek Complex 4. Includes primary objective and potential inundation extents.

Figure 17-- Photos taken December 10, 2026, of Secret Creek. Top left photo: Gulling forming near road at top of complex 4 at the headwaters of Secret Creek. Photo bottom left: High severity burn area upslope of channel in complex 3. Big photo is between complex 2 and 3 in isolated area with many active beaver complexes.

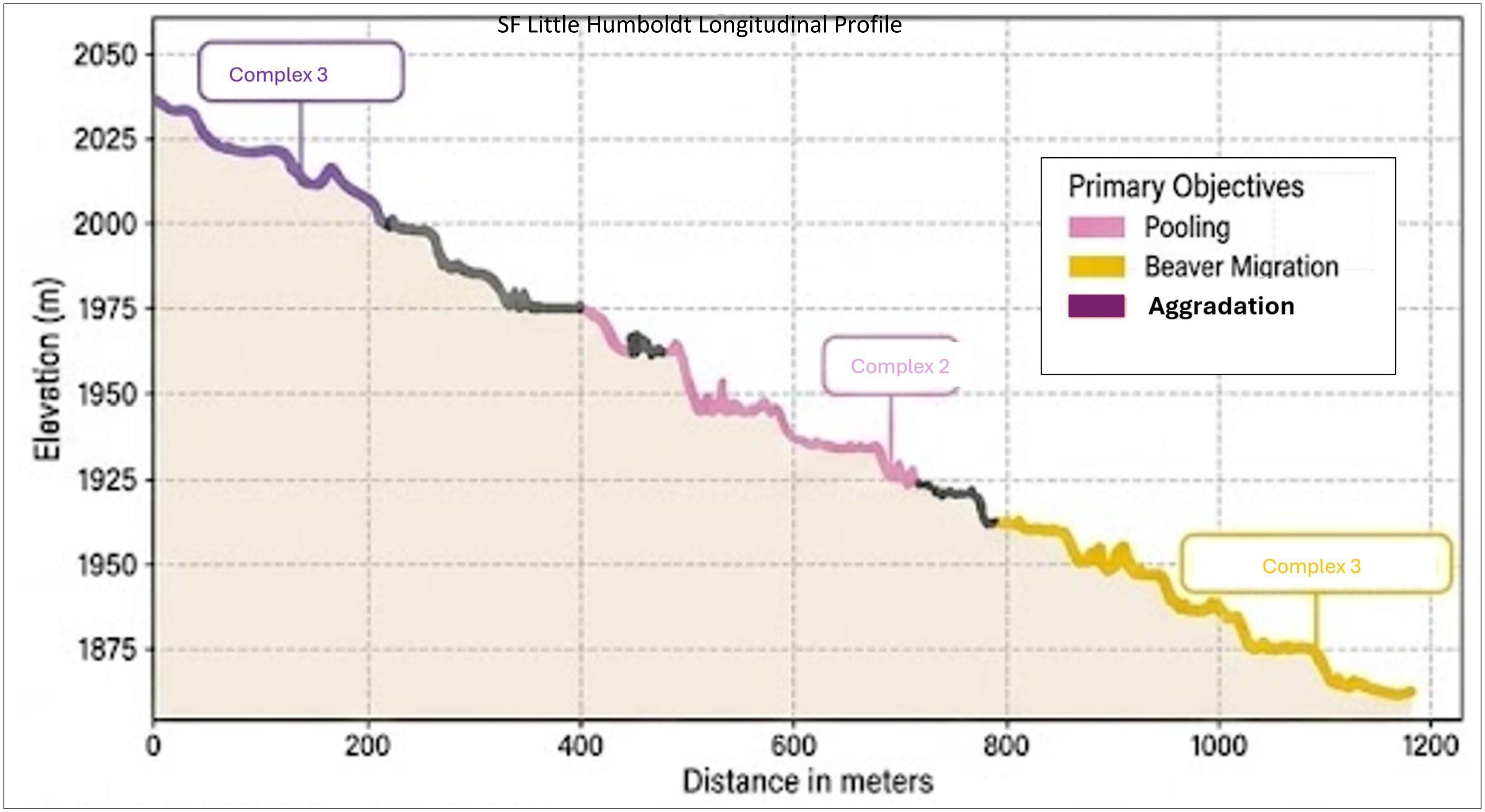


Figure 18 -- Longitudinal Profile for SF Little Humboldt River, with Complexes and primary objectives called out

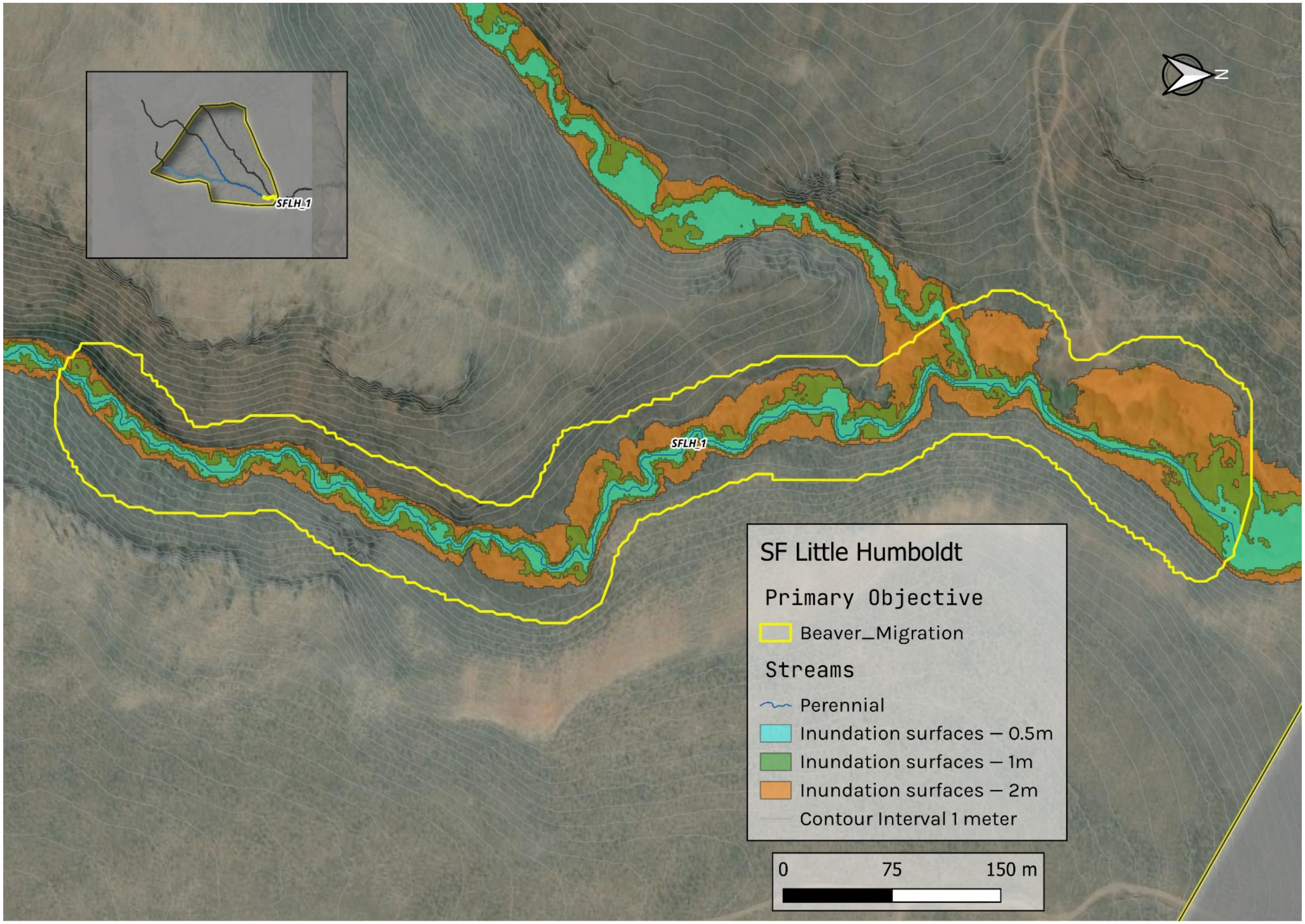


Figure 19 -- Map depicting SF Little Humboldt Complex 1. Includes primary objective and potential inundation extents.

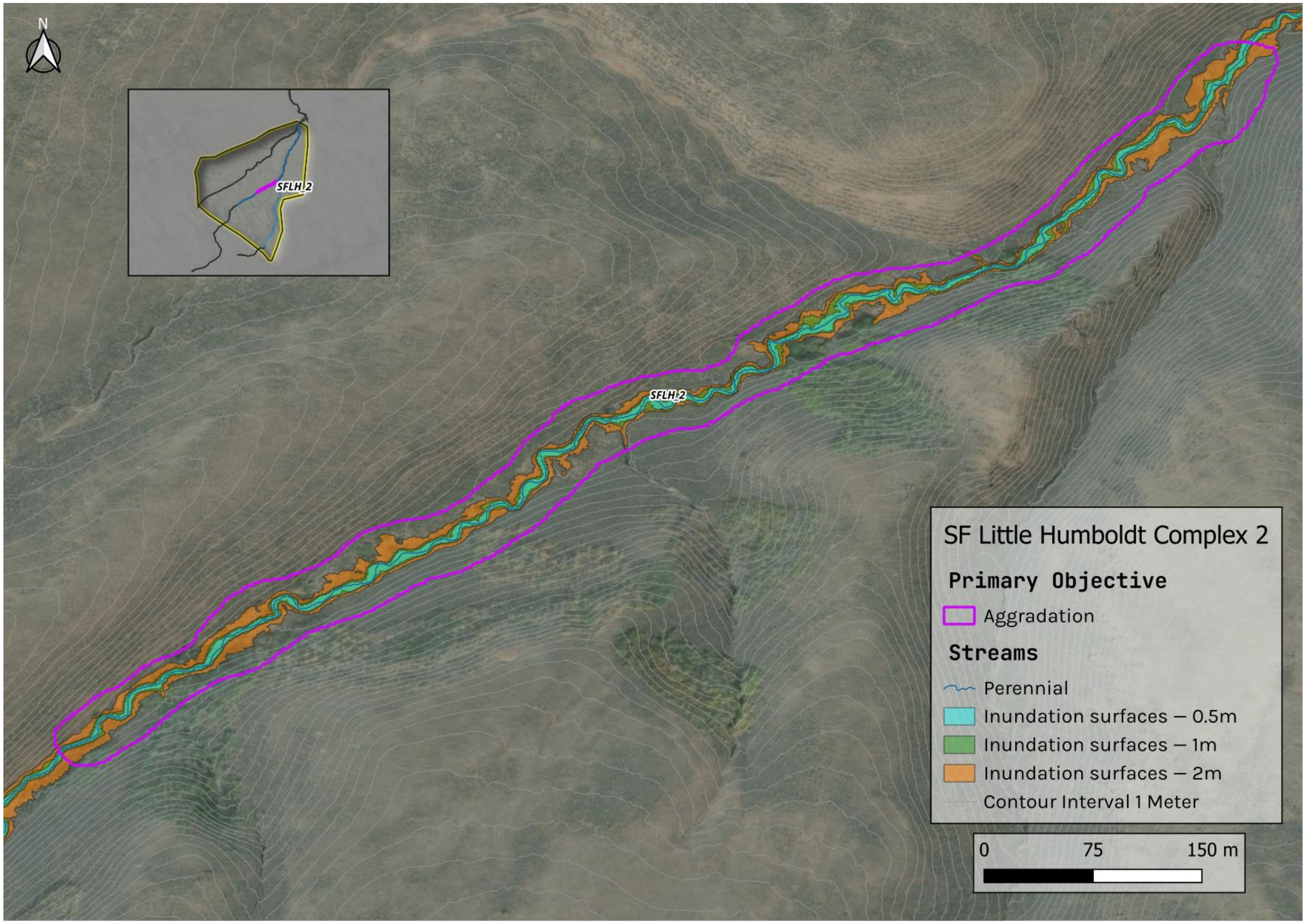


Figure 20 -- Map depicting SF Little Humboldt River Complex 2. Includes primary objective and potential inundation extents.

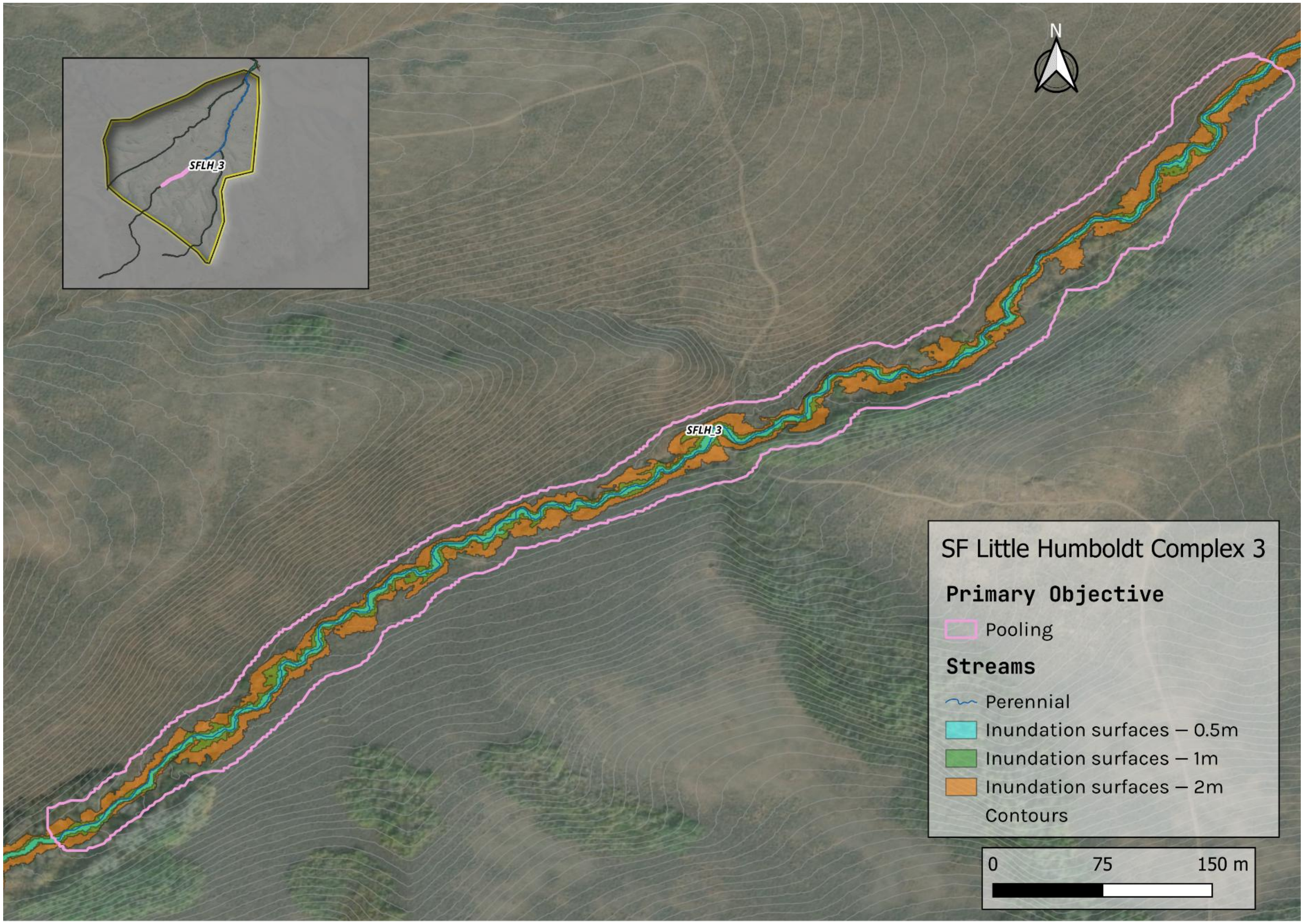


Figure 21 -- Map depicting SF Little Humboldt River Complex 3. Includes primary objective and potential inundation extents.

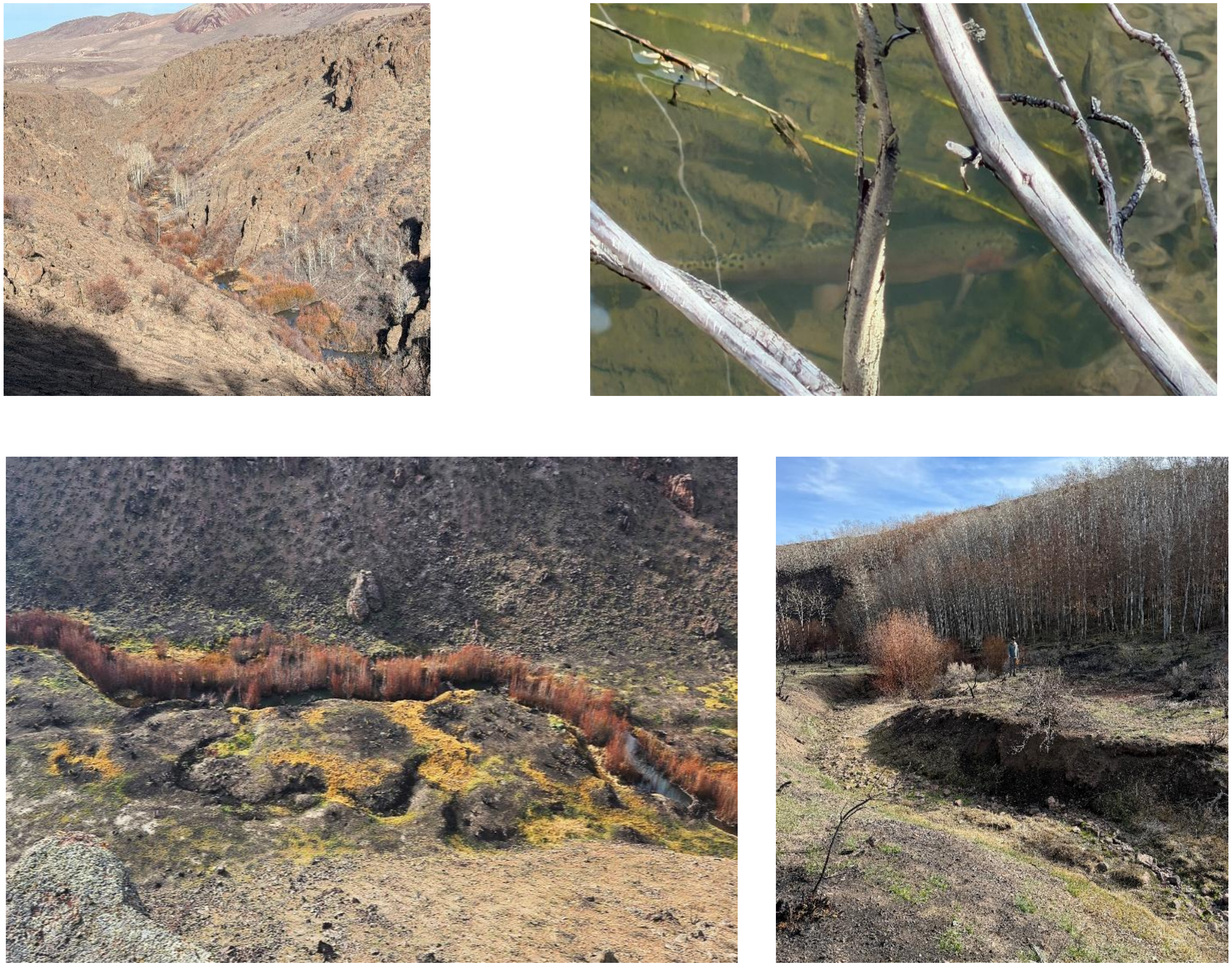


Figure 22 --Photos taken December 10, 2026, of SF Little Humboldt River. From upper left photo to lower right: Active beaver complex roughly .5 miles upstream of secret creek confluence, LTC located in beaver pond above Secret Creek confluence, burned beaver complex with willow and water in channel against toe slope.

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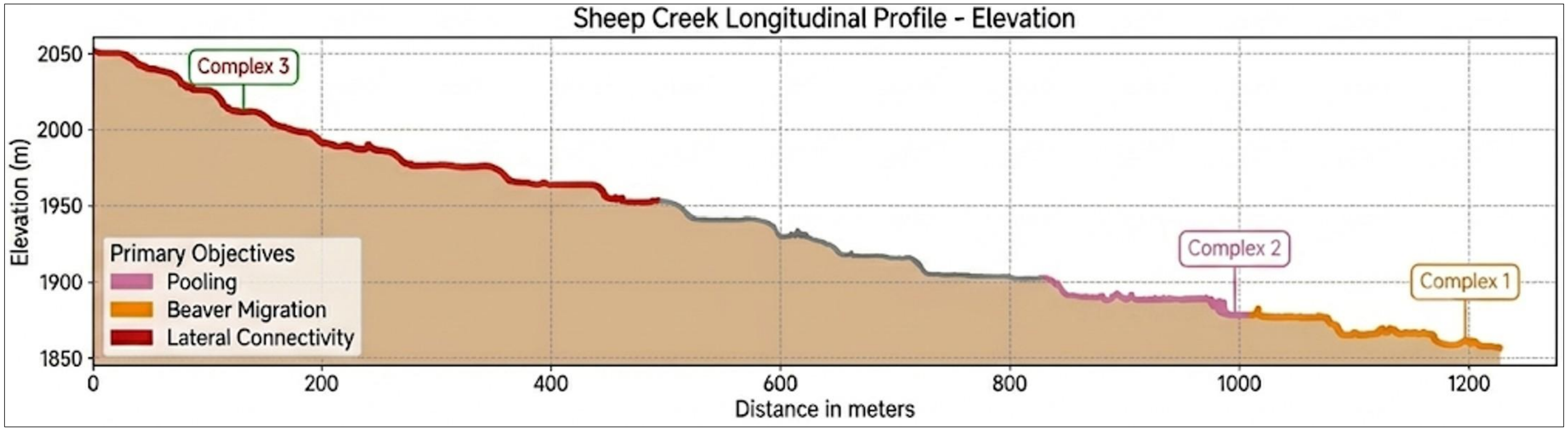

Figure 23 -- Longitudinal Profile of Sheep Creek with complexes and Primary Objectives called out

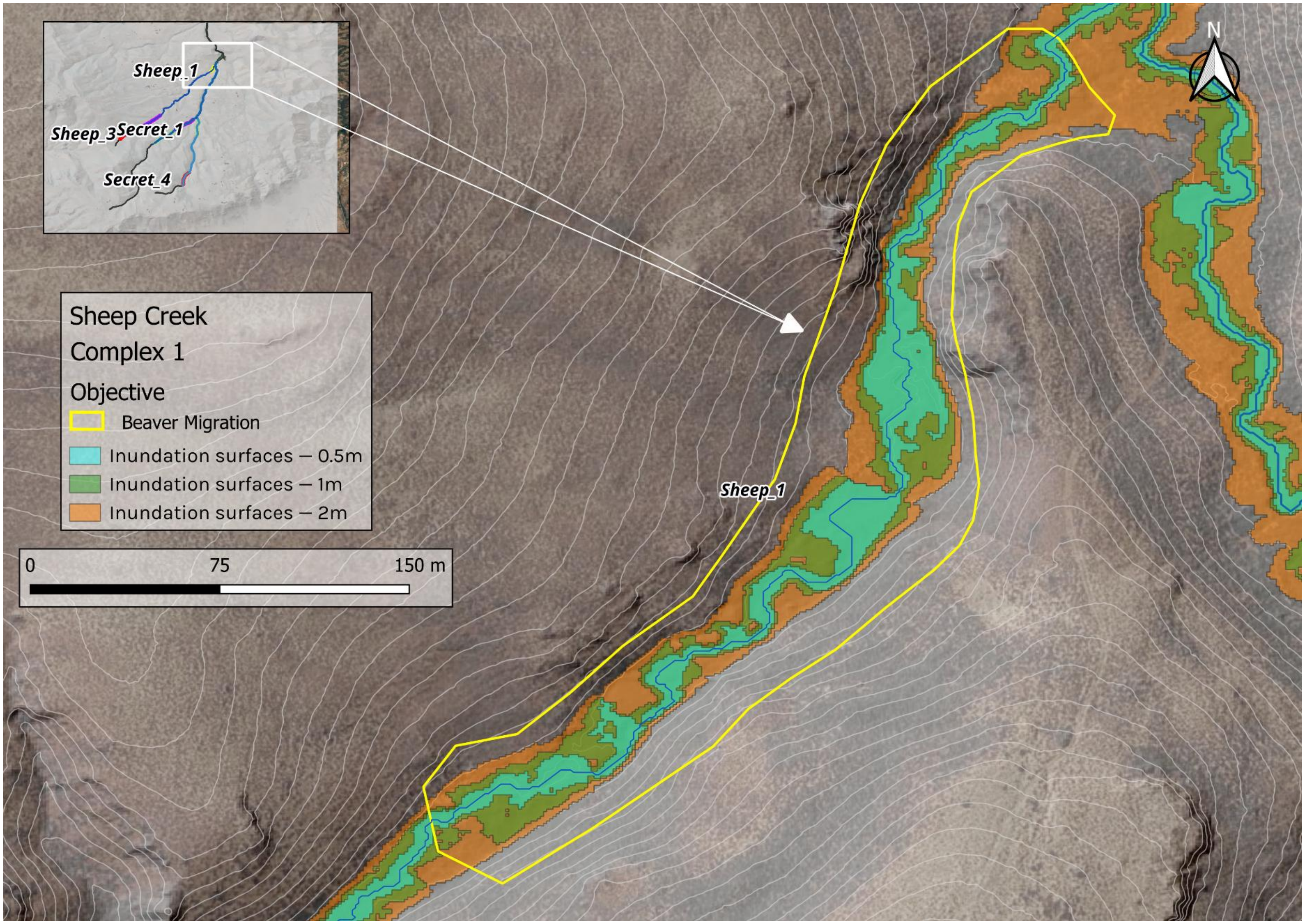

Figure 24 -- Map depicting Sheep Creek Complex 1. Includes primary objective and potential inundation extents

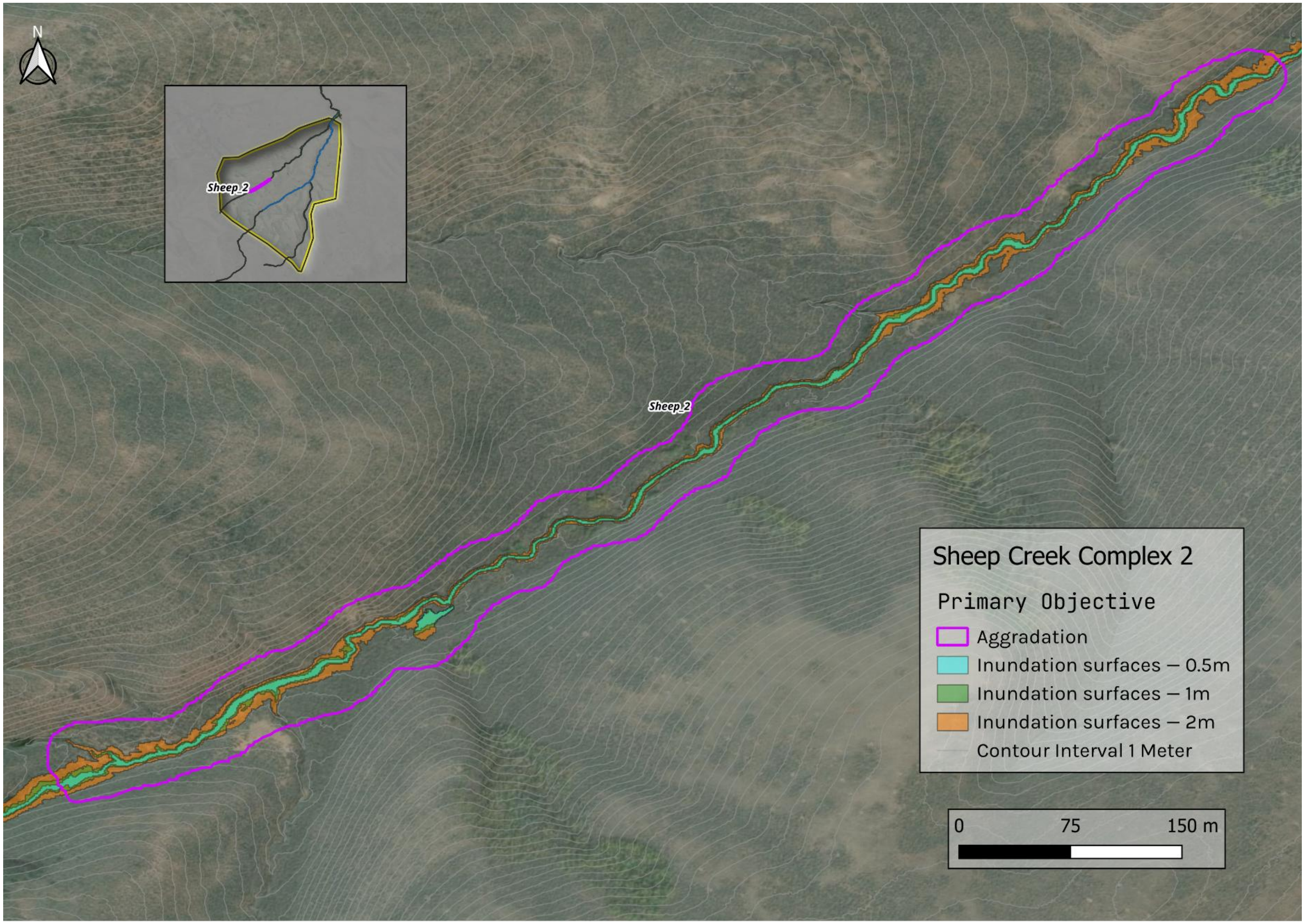

Figure 25 -- Map depicting Sheep Creek Complex 2. Includes primary objective and potential inundation extents.

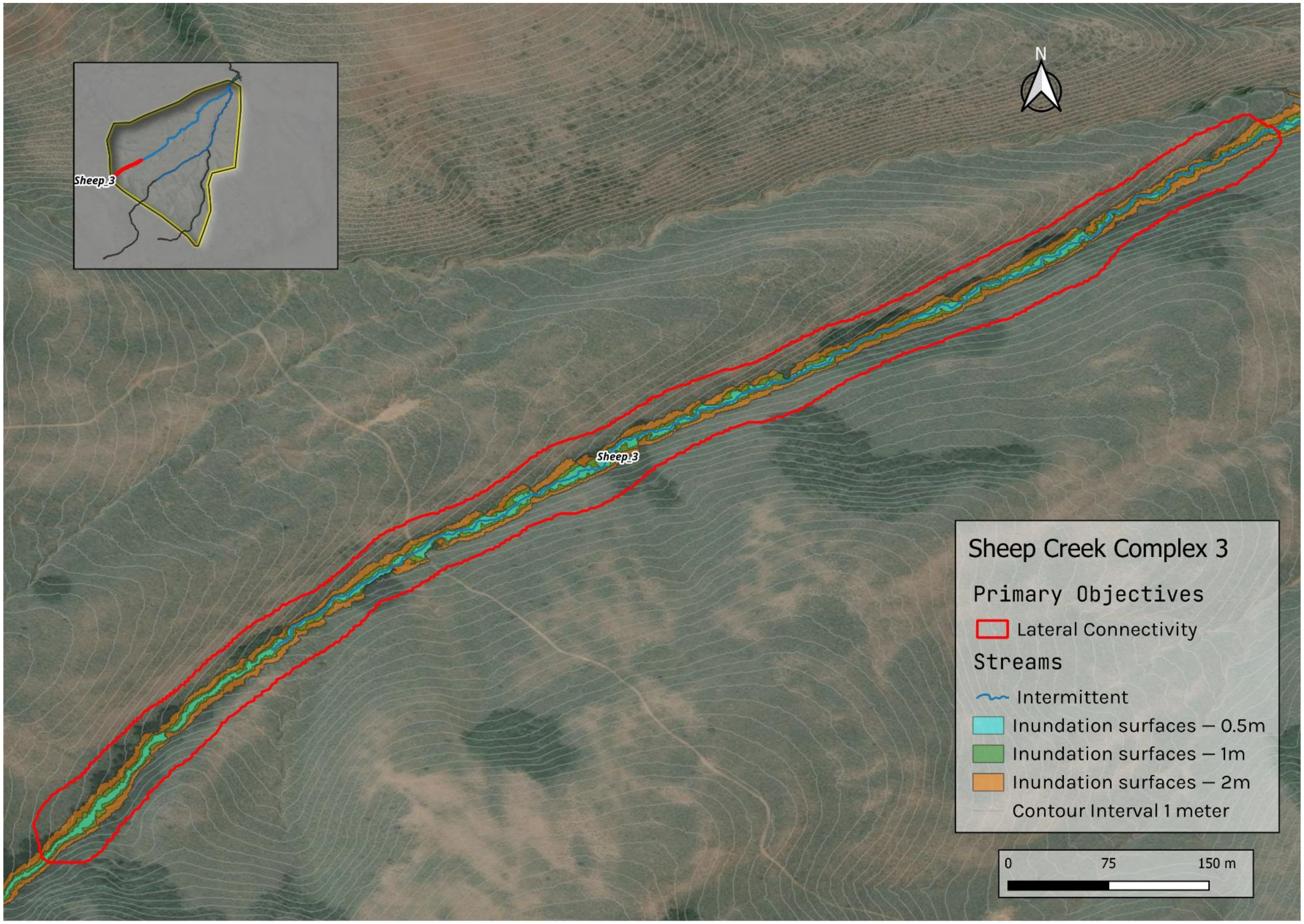

Figure 26 -- Map depicting Sheep Creek Complex 3. Includes primary objective and potential inundation extents.

Figure 27 -- Photos taken Dec 9 and Aug 19 of Sheep Creek. Top left photo: High severity burn in complex 3 below road crossing. Upper right photo: Road crossing and exposed soil from high severity burn. Lower left photo : Lower section of sheep creek with active Beaver complex. Lower right photo: Taken by NDOW in August 2025, note burned willows and aspen stands.

DESIGN TABLES

To determine the expected number of structures we use topographic data, drone imagery and field visits to obtain average depth and width of the channel for each complex. We define a generalized structure height as equivalent to the channel depth or the max structure height of 1 m, whichever is less. The structure width is equivalent to the channel width, and structure length (upstream to downstream) of 1 m at the base and 0.5 m at the top (typical of LTPBR structures). Based on the complex relief (i.e., the elevational difference between the top and the bottom of a complex), and the height of the structure, we can estimate the maximum number of structures that will lead to redundancy (i.e., where water of the downstream structure inundates to upstream structure). The number of structures for a complex is equal to the relief divided by the structure height (of structures=relief/(structure height). We always round up and assume the field fitted number will be within 30% of this estimate. The number of structures divided by the complex length gives the average spacing between structures, although this will be field fitted to deal with variations within the channel and structure specific objectives. Assuming the structure is trapezoidal in shape, volume is estimated as 1⁄2 x (1 + 0.5) x height x width of the structure. A conservative estimate of total fill was calculated as the number of structures x 30%. Structures are made of both woody material and sediment. For a BDA, we assume that 85% of the material of the structure is woody and the rest is sediment, or sod/sedge mat. For PALS, 100% of the fill is woody material. This information will be provided and includes the range of material volume that will be needed to implement the restoration design in each area permitting purposes

Table 6 -- Design Table: Complex primary and secondary objectives, total number of structures, spacing, total linear structure impact and acres.

Complex	Complex Primary Objective	Complex Secondary Objectives	Primary Structure Type	Total No. Structures	Str. Spacing (m)	Linear Structure Impact (ft)	Structure Area (acres)
Sheep_1	Beaver Migration	Pooling	BDA	24	28	79	0.017
Sheep_2	Aggradation	Pooling	BDA	85	19	279	0.050
Sheep_3	Lateral Connectivity	Aggrade; Channel Complexity	WJ	114	10	374	0.064
SFLH_1	Beaver Migration	Pooling	BDA	67	20	220	0.042
SFLH_2	Aggradation	Channel Widening; Pooling	BDA	94	19	308	0.060
SFLH_3	Pooling	Aggrade; Channel Complexity	BDA	89	20	292	0.057
Secret_1	Pooling	Aggrade	BDA	106	13	348	0.060
Secret_2	Beaver Migration	Pooling	BDA	55	11	180	0.034
Secret_3	Beaver Migration	Pooling	BDA	73	20	239	0.038
Secret_4	Lateral connectivity	Aggrade; Channel Complexity	WJ	59	20	194	0.033
	Total			**766**		**2513**	**0.5**

Table 7 – Total structures, material fill volumes, and percentage breakdowns for BDA, PALS, and WJ complexes.

Jake's Complex Fill Calculations									
Complex ID	**% Type BDA/PALS/WJ**	**Total # Structures**	**# BDA**	**# PALS**	**# WJ**	**Wood yd^3**	**Nat. Veg. yd^3**	**Soil/Sediment yd^3**	**Total Structure Fill yd^3**
Sheep_1	100 / 0 / 0	24	24	0	0	5.2	5.2	1.8	12.2
Sheep_2	51 / 16 / 33	85	43	14	28	53.2	15.9	5.6	74.7
Sheep_3	0 / 33 / 67	114	0	38	76	71.9	0.0	0.0	71.9
SFLH_1	75 / 9 / 16	67	50	6	11	17.6	9.9	3.5	30.9
SFLH_2	76 / 8 / 17	94	71	8	16	33.2	18.6	6.6	58.4
SFLH_3	51 / 17 / 34	89	45	15	30	41.0	12.2	4.3	57.5
Secret_1	50 / 17 / 33	106	53	18	35	50.6	15.1	5.3	71.0
Secret_2	75 / 9 / 16	55	41	5	9	19.5	10.9	3.9	34.3
Secret_3	75 / 8 / 16	73	55	6	12	16.1	9.0	3.2	28.3
Secret_4	0 / 34 / 66	59	0	20	39	44.0	0.0	0.0	44.0
Total	**50 / 17 / 33**	**766**	**381**	**130**	**256**	**352.2 yd^3**	**96.8 yd^3**	**34.2 yd^3**	**483.2 yd^3**

PROJECT CONSTRAINTS AND OPPORTUNITIES

Access:

Due to the remoteness of the project area and accessibility to the actual channels, work could be limited in some locations and extra time will be needed for the procurement and movement of materials as needed.

Valley Bottom Geomorphic Composition:

Many of the proposed complexes are confined, though certain areas do provide opportunities to reconnect the floodplain and valley bottom (e.g., SF Little Humboldt Complex 1). In areas where the channel and valley bottom are significantly confined, there are still opportunities to increase LTC habitat and encourage beaver migration.

Flow Regime:

Increased structural and topographic complexity should increase the duration and extent of surface flow during drought periods and provide increased refuge for LTC.

Riparian Veg and Wood Accumulation:

Impacts from the Jake's Fire have significantly impacted upland and riparian vegetation. In some areas, the proposed complexes are completely void of vegetation. Materials will need to be mobilized in these areas. These constraints may slow implementation but will allow for opportunities to capture fine sediment that can help riparian vegetation establishment. The reconnection of floodplains could also contribute to increasing riparian and vegetative health, as well as increased resiliency from future fires and droughts.

Beaver:

Beavers are already present throughout the system. The goal for several complexes is to increase suitable habitat and to encourage beaver migration throughout the system. It could also be beneficial to reinforce existing beaver dams with posts to increase resiliency of active dams.

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