

Stanley Geothermal Feasibility Study

Task 2 Report: Digital Geologic Maps and Linear Mapping

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1. Introduction

Phase 2 of the Stanley Geothermal study involved collecting digital data for the purposes of creating geologic maps pertinent to the study area as well as expanding on these data by mapping linear features in the hopes of identifying faults and or fractures (i.e. linear features). This data was compiled from four main sources: Idaho department of Water Resources (IDWR), United States Geologic Survey (USGS), Idaho Geologic Survey (IGS), and the Inside Idaho website.

2. Methodology/Observations

Data pertinent to this study was downloaded from the four sites listed above. Manipulation of this data to be compatible with ArcGIS was done prior to subsequent map making. An online search for geologic features including digitized geologic maps, digital elevation models (DEMs), and aerial photographs was conducted. Aerial photography was obtained from the Inside Idaho website, digital elevation models were obtained from the USGS National Elevation Dataset (NED), and geologic maps were obtained from the IGS and USGS. Other data such as well and spring information was obtained from Idaho Department of Water Resources. ArcGIS software was used to integrate all of these datasets.

As mentioned above, aerial photography was downloaded from the Inside Idaho website. These photographs are part of the United States Department of Agriculture's (USDA) National Agriculture Imagery Program (NAIP). They are 3.75 minute quarter quads, also referred to as Digital Ortho Quarter Quads (DOQQs) and have a 1 meter sampling distance, providing excellent resolution. Each USGS 7.5 minute quadrangle is split into four quadrants: NW, NE, SE, and SW. This is the format in which they are downloaded from the Inside Idaho website. In total 23 quarter quads were downloaded, they include: Stanley NE, Stanley NW, Stanley SE, Stanley SW Stanley Lake NE, Stanley Lake NW, Elk Meadow SW, Elk Meadow SE, Basin Butte SW, Basin Butte SE, East Basin Creek SW, East Basin Creek SE, Sunbeam SW, Robinson Bar NW, Robinson Bar SW, Casino Lakes SE, Casino Lakes NE, Casino Lake NW, Casino Lakes SW, Mount Cramer NW, Mount Cramer NE, Obsidian NW, and Obsidian NE. For ease of viewing in ArcGIS, the individual files were stitched together using the Mosaic tool.

The National Elevation Dataset (NED) from the USGS is a nationwide collection of digital elevation models (DEMs) available for public download. A DEM has the same spatial extent as a USGS 7.5 minute quadrangle. Within this area, the DEM is split up into a grid where each cell has the same dimensions. These grids are usually measured with units of meters when using Universal Transverse Mercator (UTM) or arc seconds when using Geographic Coordinate Systems (i.e. Degrees Minutes Seconds). The elevation of any given cell is taken to be at the center of the cell. The quality of resolution depends on the size of the individual cell. 30 meter or 1 arc second resolution was available for the Stanley area. The purpose of using a DEM in this case is to map linear features based on sudden and or irregular breaks in topography or elevation.

Linear features were recognized using Hillshade models from DEM's. This is done by telling the program which direction (i.e. N-S-E-W) and at what angle above the horizon to have the sun shine. The objective in this technique is to identify possible fault escarpments. The result of this analysis is shown in figure 3.

Digital versions of geologic maps are available from the USGS. There are several geologic maps that cover the Stanley area. On a more regional scale, the USGS's "Preliminary integrated geologic map for the United States - Western States - California, Nevada, Arizona, Washington, Oregon, Idaho, and Utah" was used for regional geologic structures and lithologies. The scale of this map is 1:500,000. A more detailed map of the Stanley area is the 1° x 2° Challis quadrangle by Fisher, McIntyre, and Johnson (1992), which can be seen in figures 4a and 4b. This map was made on a 1:250,000 scale and has a very detailed description of structures and lithologies in the Stanley area. As mentioned in Part 1 of the current study, two main trends in fault orientations exist in central Idaho and more specifically in the Stanley area, NE-SW and NW-SE. The NE-SW trending faults, including the Sawtooth Range Fault, can be attributed to stresses involved in Basin and Range extension. The NW-SE faults are related to the Trans-Challis Fault System and are most likely created in response to recent changes in the main stress orientation in central Idaho. Also as mentioned in Part 1 of the current study, the dominant rock types in the Stanley area consist of Cretaceous (~60-80 Ma) intrusive rocks of the Idaho Batholith, Eocene (~50 Ma) volcanics of the Challis Volcanic Suite, Pleistocene to Holocene (~18 Ka – Recent) unconsolidated glacial sediments. These features can be seen in figures 4 and 5.

Figure 6 shows the locations of thermal wells and springs near the Stanley area. This data comes from Idaho Department of Water Resources Information Bulletin No. 30, Part 9- "Geothermal Investigations in Idaho- Potential for Direct Heat Application of Geothermal Resources." It was subsequently digitized and made available on the IDWR's website for public use. The GIS layer covers the entire state of Idaho but the area around Stanley is of particular interest to this study. The coolest reported temperature in the Stanley area comes from a well drilled to a depth of 50 feet and has a reported temperature of 71° F. The hottest reported temperature is 170° F measured at Sunbeam Hot Springs.

Dansart et al (1994) compiled data on thermal wells and springs in the Stanley area and published data on ownership location and temperature. The location of these systems along with ownership and temperature is given in Figure 7 and Table 1. Wells near Stanley correlate with locations in Figure 6.

Spring temperatures from the Dansart report range from 76.5°C (169.7°F) for the Sunbeam Hot Spring to 35°C (95°F) for the Basin Creek Hot Spring.

This study also correlates the thermal spring locations with major structural trends of the area described earlier through previous geologic mapping and remote sensing linear mapping. An east/west trending structure called the Mormon Bend Fault lies along the northern boundary of the Stanley Basin. Several thermal springs lie along this fault including the Sunbeam Hot Springs, Slate Creek Hot Springs, Sullivan Hot Spring, Mormon Bend Hot Springs and the USFS Campground Hot Springs.

TABLE 1
Selected Hot Springs in Stanley Area (From Dansart et al, 1994)

Map #	Location	Well/ Spring	Temp (°C)	Owner/Name
37- 6	9N14E18	W	99 (37)	Rozalys Smith Well 1
37- 7	9N14E19	W	122 (50)	Rozalys Smith Well 2
37- 8	9N14E19	S	106 (41)	Rocky Mountain Ranch Spring
37- 9	10 N13E 3	S	106 (41)	Stanley Hot Springs
37-10	10N16E30	S	122 (50)	Slate Creek Hot Spring
37-11	10N16E25	S	131 (55)	No Name
37-12	11N13E36	S	136 (58)	Elk Horn Hot Spring
37-13	11N13E36	S	135 (57)	No Name
37-14	11N14E21	S	95 (35)	Basin Creek Hot Spring
37-15	11N14E22	S	134 (56.5)	USFS Campground Hot Spring
37-16	11N14E29	S	100 (38)	Mormon Bend Hot Spring
37-17	11N15E19	S	170 (76.5)	Sunbeam Hot Spring
37-18	11N15E26	S	108 (42)	E Robinson Bar Hot Spring
37-19	11N15E27	S	131 (55)	Robinson Bar Hot Spring
37-20	11N15E34	S	126 (52)	Warm Springs Creek Hot Spring
37-21	11N17E27	S	104 (40)	Sullivan Hot Springs

3. References

Dansart, W.J., Kauffman, J.D., Mink, L.L. 1994. Overview of Geothermal Investigations in Idaho, 1980-1993, Idaho Water Resources Research Institute, Moscow Idaho. Research Technical Completion Report.

Fisher, F.S., McIntyre, D.H., Johnson, K.M. 1992. Geologic map of the Challis 1x2 Quadrangle, Idaho. USGS Miscellaneous Investigations, Map I-1819. 1:250,000. <http://greenwood.cr.usgs.gov/pub/i-maps/i-1819>.

Idaho Department of Water Resources. 2001. Geothermal. Department of Commerce, Washington D.C. http://www.idwr.idaho.gov/gisdata/gis_data.htm.

Ludington, S. Moring, B.C., Miller, R.J., Flynn, A.A. 2006. Preliminary integrated geologic map databases for the United States-Western States- California, Nevada, Arizona, Washington, Oregon, Idaho, and Utah. USGS, Reston, VA. <http://pubs.usgs.gov/of/2005/1305>.

Mitchell, J., Johnson, L., Anderson, J. 1980. Geothermal Investigations in Idaho, Part 9, Potential for Direct Heat Application of Geothermal Resources. Idaho Department of Water Resources, Water Information Bulletin No. 30, Plate 1. 1:500,000.

USDA-FSA-APFO (Aerial Photography Field Office). 2010. Digital Orthoimage of the 3.75 Minute Quadrangle of: Stanley NE, Stanley NW, Stanley SE, Stanley SW Stanley Lake NE, Stanley Lake NW, Elk Meadow SW, Elk Meadow SE, Basin Butte SW, Basin Butte SE, East Basin Creek SW, East Basin Creek SE,

Sunbeam SW, Robinson Bar NW, Robinson Bar SW, Casino Lakes SE, Casino Lakes NE, Casino Lake NW, Casino Lakes SW, Mount Cramer NW, Mount Cramer NE, Obsidian NW, and Obsidian NE. USDA-FSA-APFO, Salt Lake City, UT.

USGS. 2009. 1-Arc Second National Elevation Dataset. USGS, Sioux Falls, SD. <http://nationalmap.gov>

Aerial Imagery

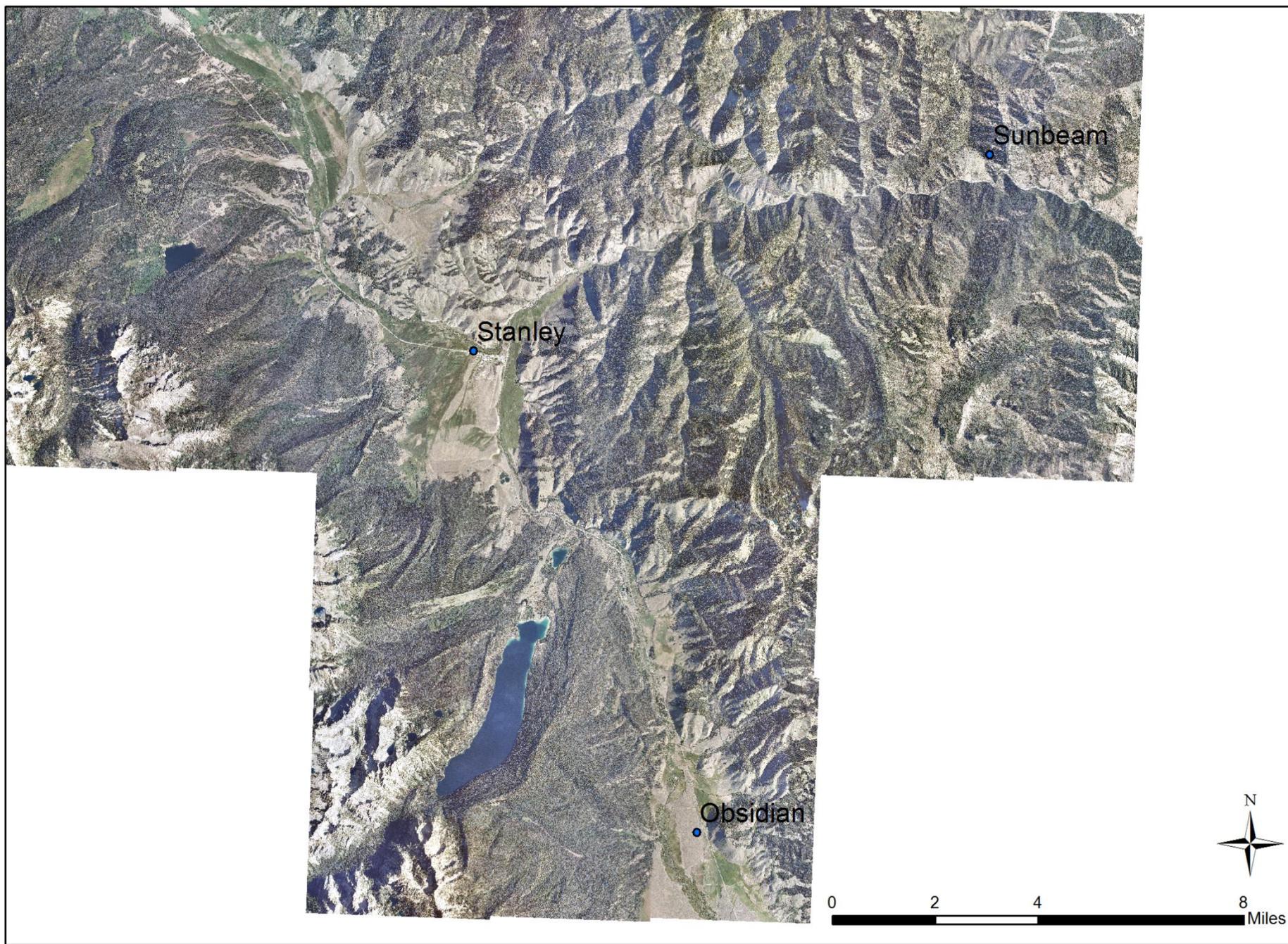


Figure 1. Mosaic image of Digital Ortho Quarter Quads (DOQQs) as described in text for the immediate area surrounding Stanley.

Stanley Digital Elevation Model

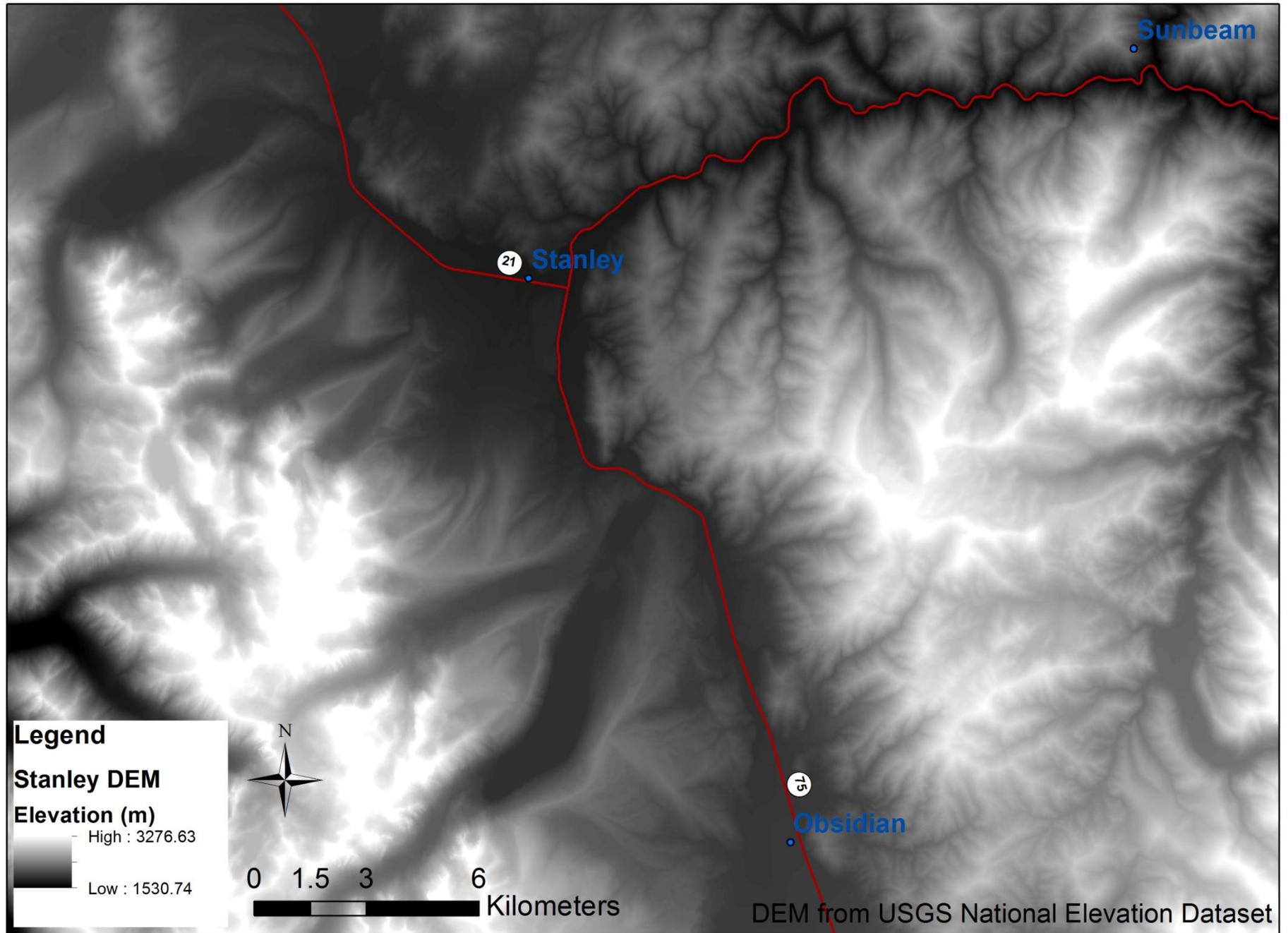
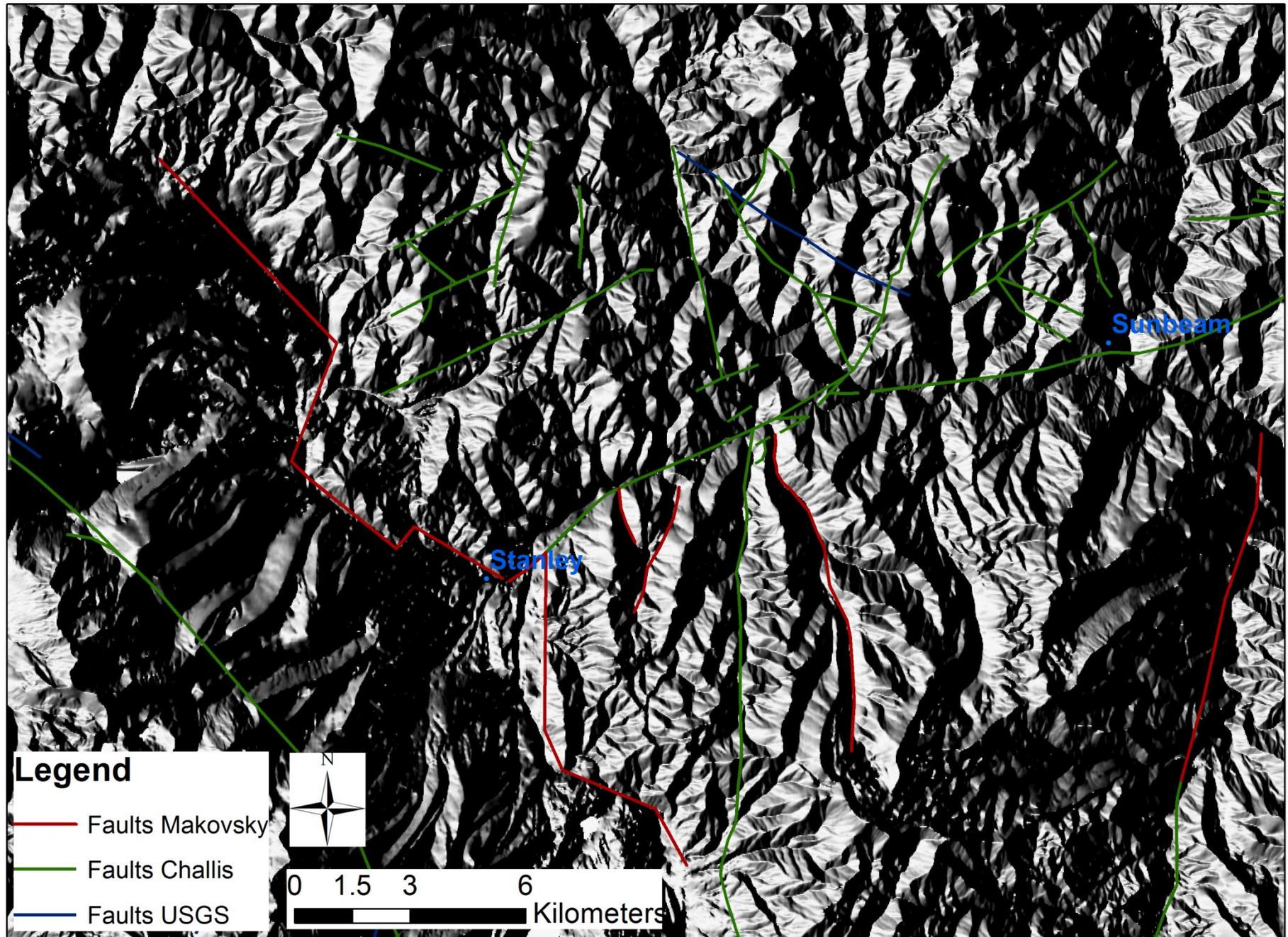


Figure 2. Map showing the Digital Elevation Model (DEM) of the Stanley area. Resolution of DEM is 30 meters.

Linear Mapping



Figures 3a & 3b. Results of linear mapping using Hillshade analysis. Detailed regional mapping from the Challis 1° x 2° quadrangle precluded the need for extensive linear mapping by authors. Red linear features are those mapped by authors. Green and blue linear features are those obtained from the Challis 1° x 2° quadrangle and USGS, respectively.

Linear Mapping

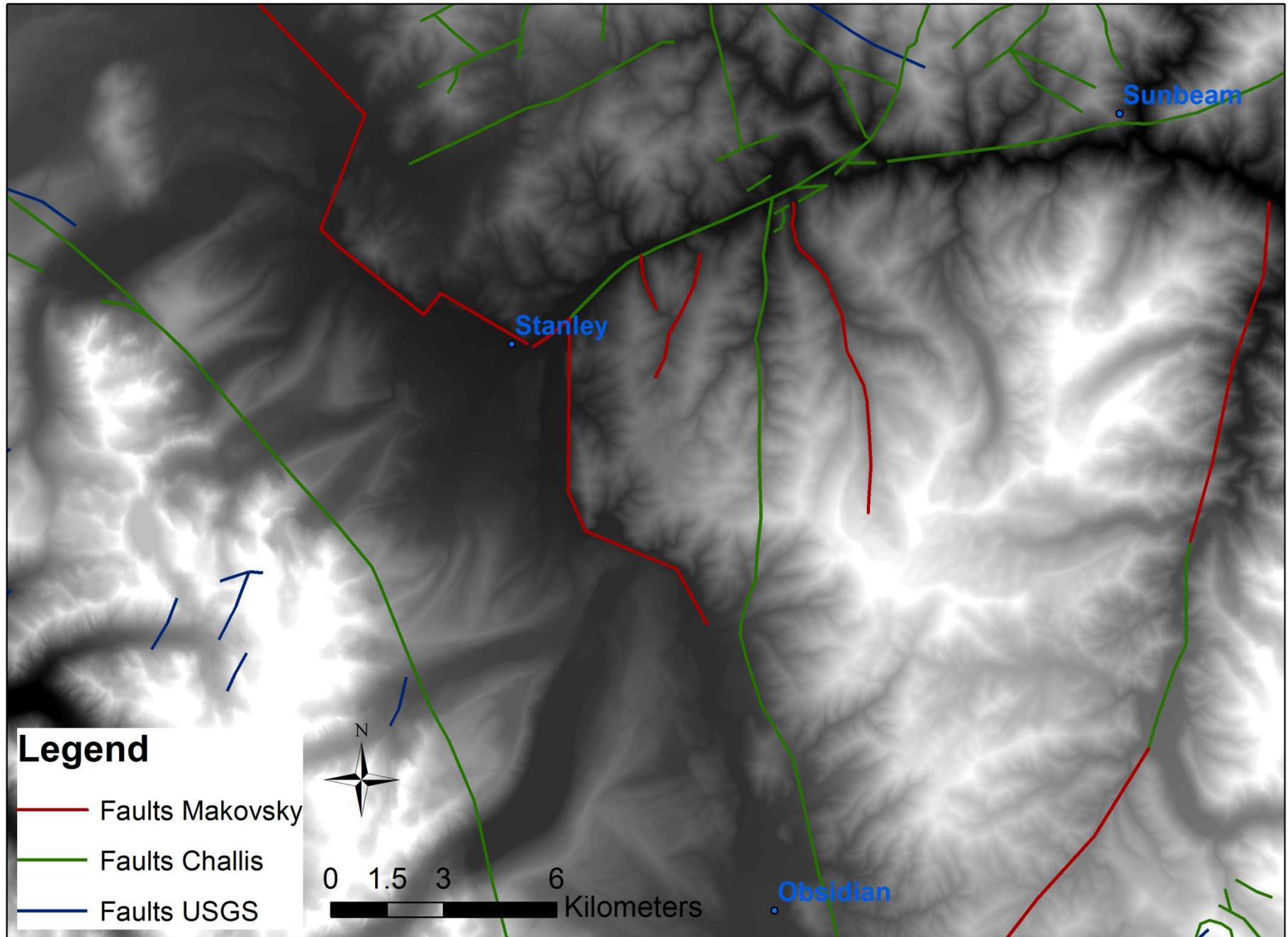
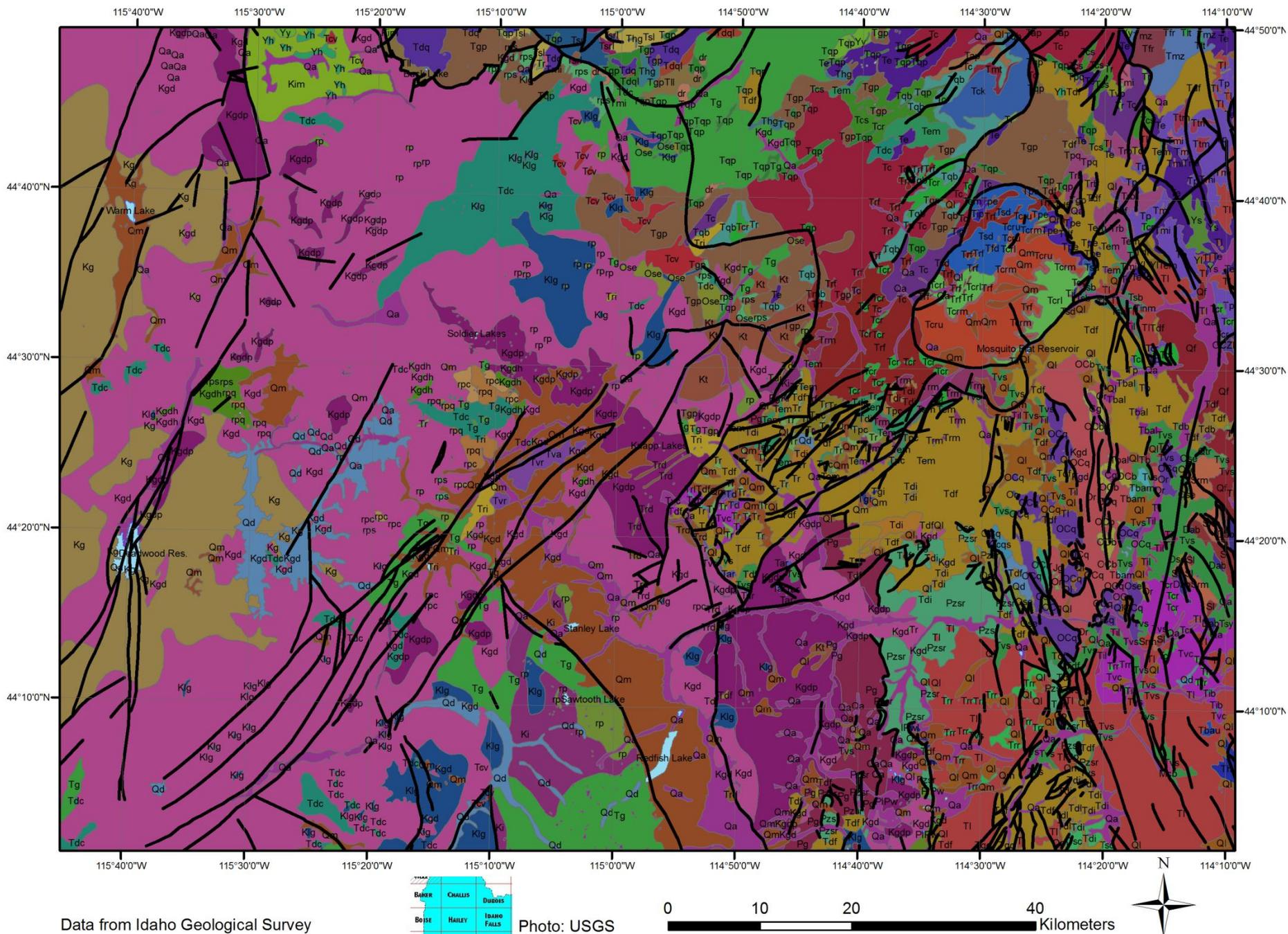


Figure 3b. Results of linear mapping using a DEM. Red linear features are those mapped by authors. Green and blue linear features are those obtained from the Challis 1° x 2° quadrangle and USGS, respectively.

Geologic Map: Challis 1x2 Quadrangle



Data from Idaho Geological Survey

Baker	Challis	Dubois
Boise	Hailey	Idaho Falls

Photo: USGS

0 10 20 40 Kilometers



Figure 4a. Challis 1° x 2° Quadrangle Geologic Map. See text for explanation of geologic units and structural trends (i.e. fault orientations).



Figure 4b. Legend for Challis 1° x 2° Geologic Map. Listed by rock type, with abbreviations found in figure 4a.

Geologic Map of Stanley

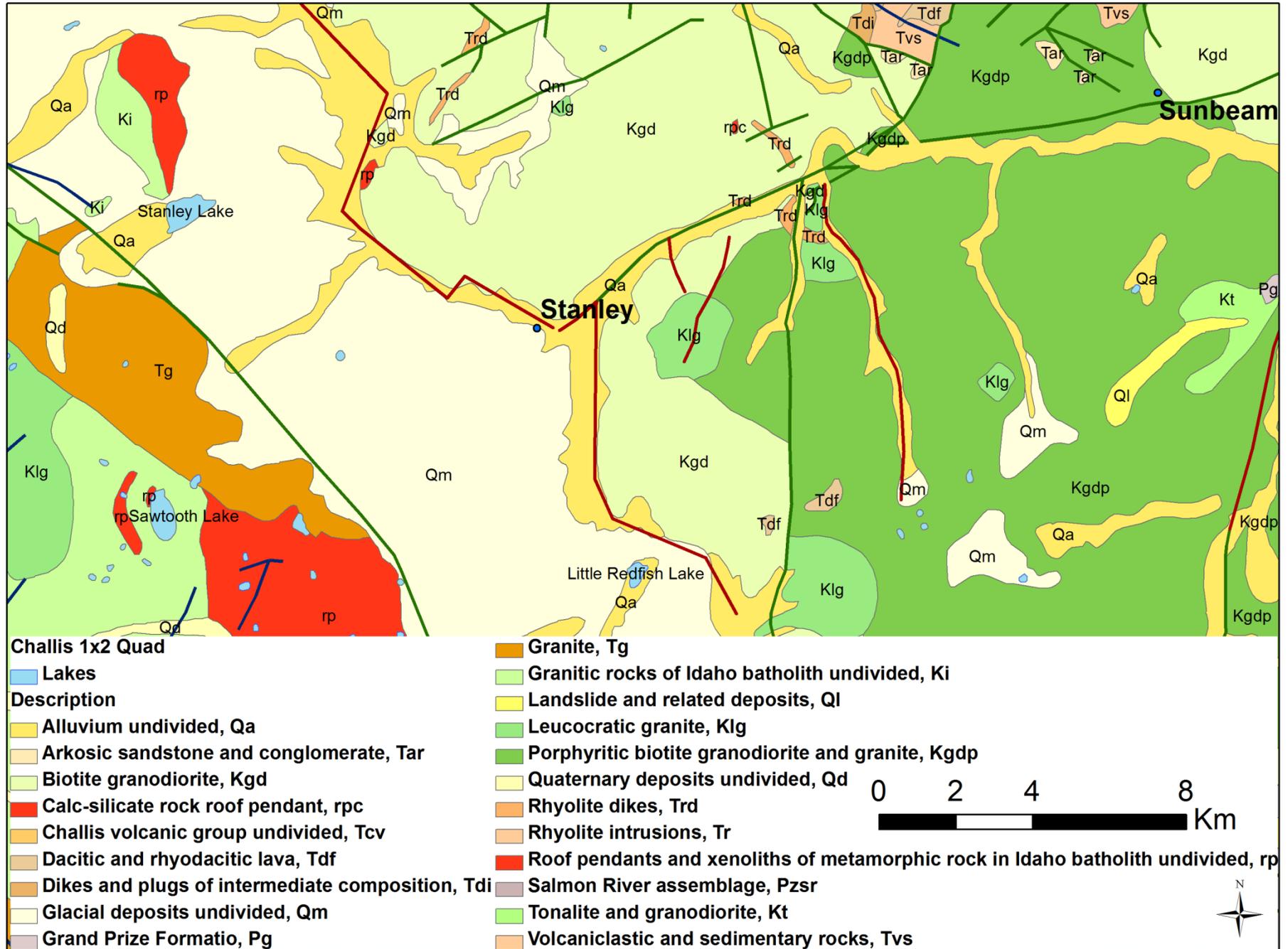


Figure 5. Geologic Map of Stanley.

Thermal Wells and Springs Near Stanley, Idaho

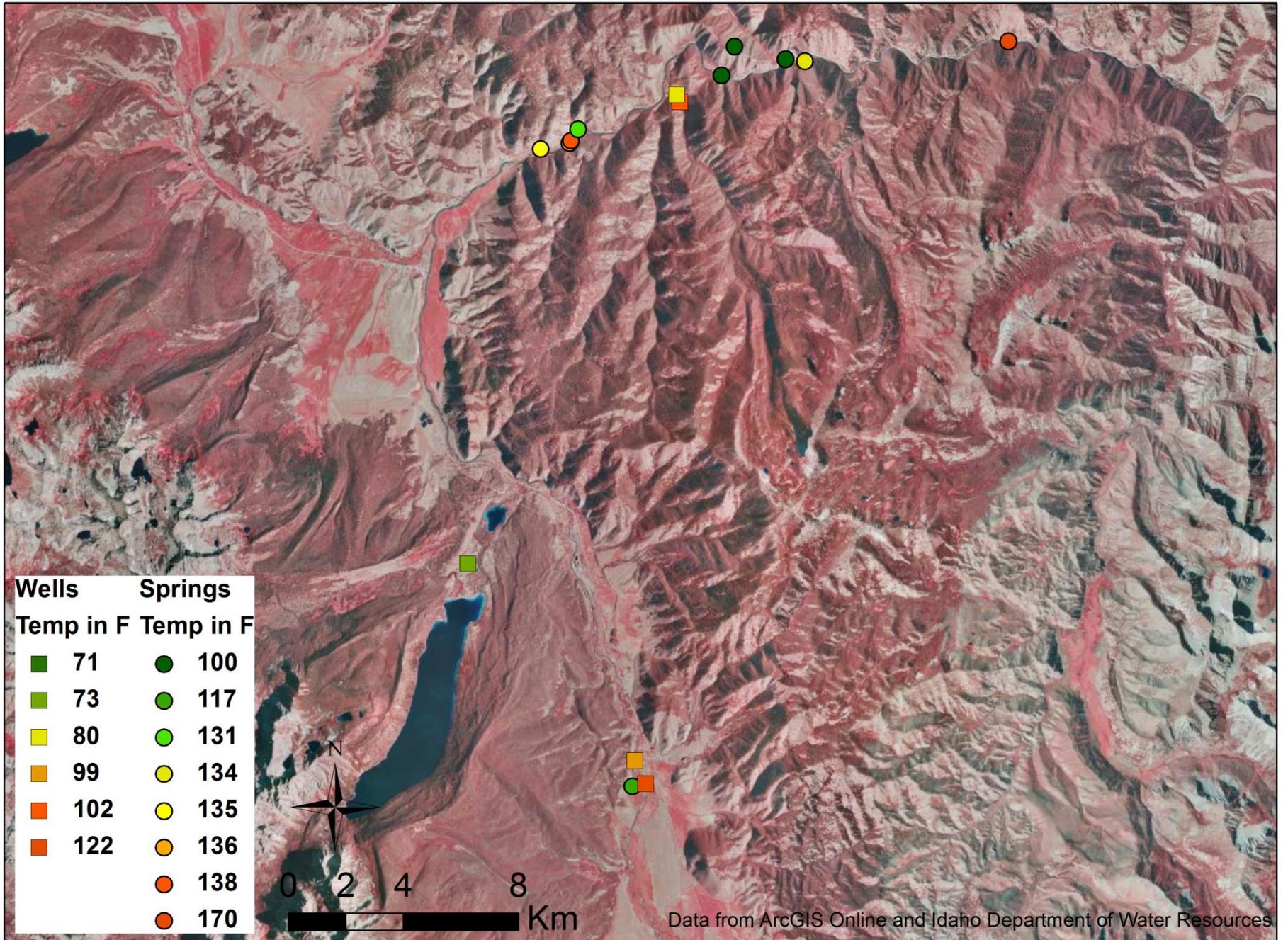


Figure 6. Thermal well and spring data for the Stanley area. See text for discussion.

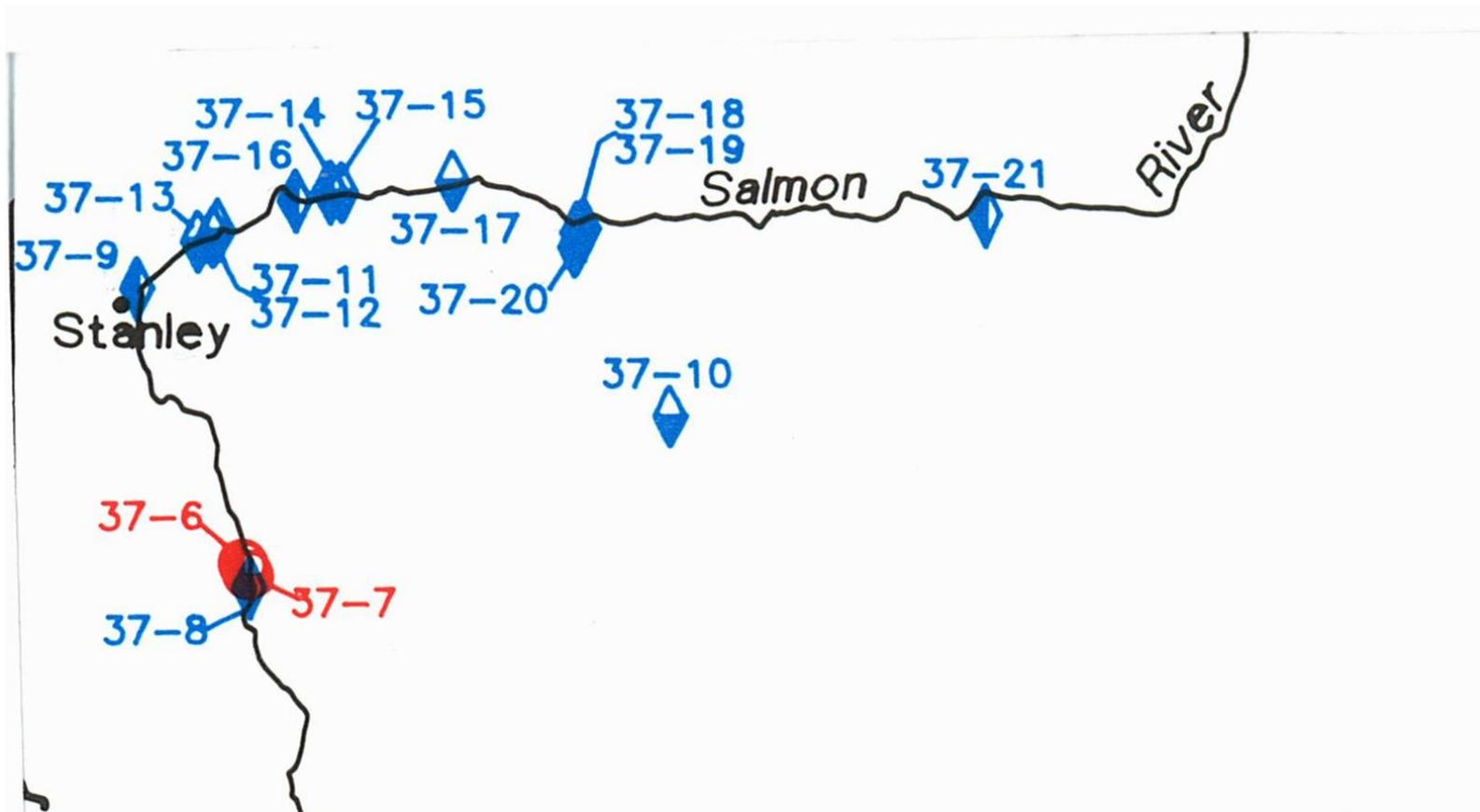


Figure 7. Locations of thermal waters outlined in Table 1.