



## **Springs Mapping of the Upper McCloud Watershed: Inventory, Status, and Opportunities for Restoration**

Author: Rene Henery, PhD

Editor: Sandra Spelliscy

GeoPDFs and databases assembled by: Natural Resource Geospatial

Produced by: The River Exchange

---

### **Summary**

The Upper McCloud Watershed spans a more than 500 square mile region, from the upper elevations of Mt. Shasta to its southern flanks. The Upper McCloud watershed includes the smaller (USFS HUC5) Ash Creek, Upper McCloud River, and Squaw Valley Creek watersheds. Surface and groundwater in Upper McCloud watershed is dominated by precipitation and glacial-runoff. The drainage network contains numerous springs which contribute significantly to total surface flow in the region. In the last several years, a variety of factors have drawn attention to the springs in the Upper McCloud Region and the opportunity for an improved understanding of their condition and the resource they provide. Some of the most notable of these include a period of extended drought in the State of California, growing state and global water demands, the McCloud-Pit FERC relicensing process (<http://www.mccloud-pitrelicensing.com>), the status of fisheries in the greater Sacramento River watershed (<http://swr.nmfs.noaa.gov/recovery/centralvalleyplan.htm>), and increasing efforts on the part of regional resource stewardship organizations including the River Exchange, California Trout, and resource management agencies including the US Forest Service (USFS), CA Department of Fish and Game (CADFG), and the US Fish and Wildlife Service (USFWS). Ownership over the land where the springs are located is both public and private, and land use varies widely across both public and private lands and includes forest reserves, portions of the Redband Trout Refuge, timber plantations, urban developments, and recreation.

The objectives of this project were 1) to map springs in the Upper McCloud region, based on current geospatial data and historical USGS quad maps, 2) to characterize spring land ownership and status (i.e. spring condition and surrounding land use) based on aerial photographs, land owner interviews, and direct observation, and 3) based on spring status, to suggest additional investigation and restoration opportunities for specific springs. This project encompassed springs distributed across both public lands (60.1%) and private lands (39.9%). Status assessment and outreach efforts were concentrated around private lands for this project. In many cases, however, spring information, spring access, and land owner cooperation were more difficult to obtain for private lands. As a result, spring restoration recommendations are only provided for a subset of the springs on private lands including a) those where status could be assessed (to an extent) based on aerial photographs, b) those where a site visit was permitted, and c) those where the landowner provided status information.

## **Geographic scope and mapping approach**

The geographic scope of the project was the Upper McCloud Watershed. For the purposes of this project, we have defined The Upper McCloud Watershed boundary as comprising the USFS HUC5 watersheds Ash Creek, Squaw Valley Creek, and Upper McCloud River. Project GeoPDFs were initially developed with multiple layers to serve as tools for spring description, remote assessment, and spring location in the field. To create manageable file size, the project region was sectioned and a separate GeoPDF was created for each section. Eight GeoPDFs are comprised within the final product including one which provides an overview map of all subsections and associated map legend.

### **GeoPDF files include:**

- McCloudWS\_Atlas\_legend\_v20
- McCloudWS\_Atlas\_p1\_v20.geo
- McCloudWS\_Atlas\_p2\_v20.geo
- McCloudWS\_Atlas\_p3\_v20.geo
- McCloudWS\_Atlas\_p4\_v20.geo
- McCloudWS\_Atlas\_p5\_v20.geo
- McCloudWS\_Atlas\_p6\_v20.geo
- McCloudWS\_Atlas\_p7\_v20.geo

### **Spring GeoPDF specific layers include:**

- Springs
- National Hydrologic Database Point
- Water Development
- Redband Trout Refuge
- Watershed Boundaries (USFS HUC5)
- Watershed Labels
- Major Roads
- Streams
- National Wetland Inventory Sites
- USGS 7.5 Quad Sheets
- Land Ownership
- Aerial Photography (naip\_05)

Subsequent to the completion of the spring description and assessment, geo-referenced information on spring i) physical context, ii) surrounding land use, iii) status, and iii) restoration and research opportunities was incorporated into the existing GeoPDFs to produce the final GeoPDFs.

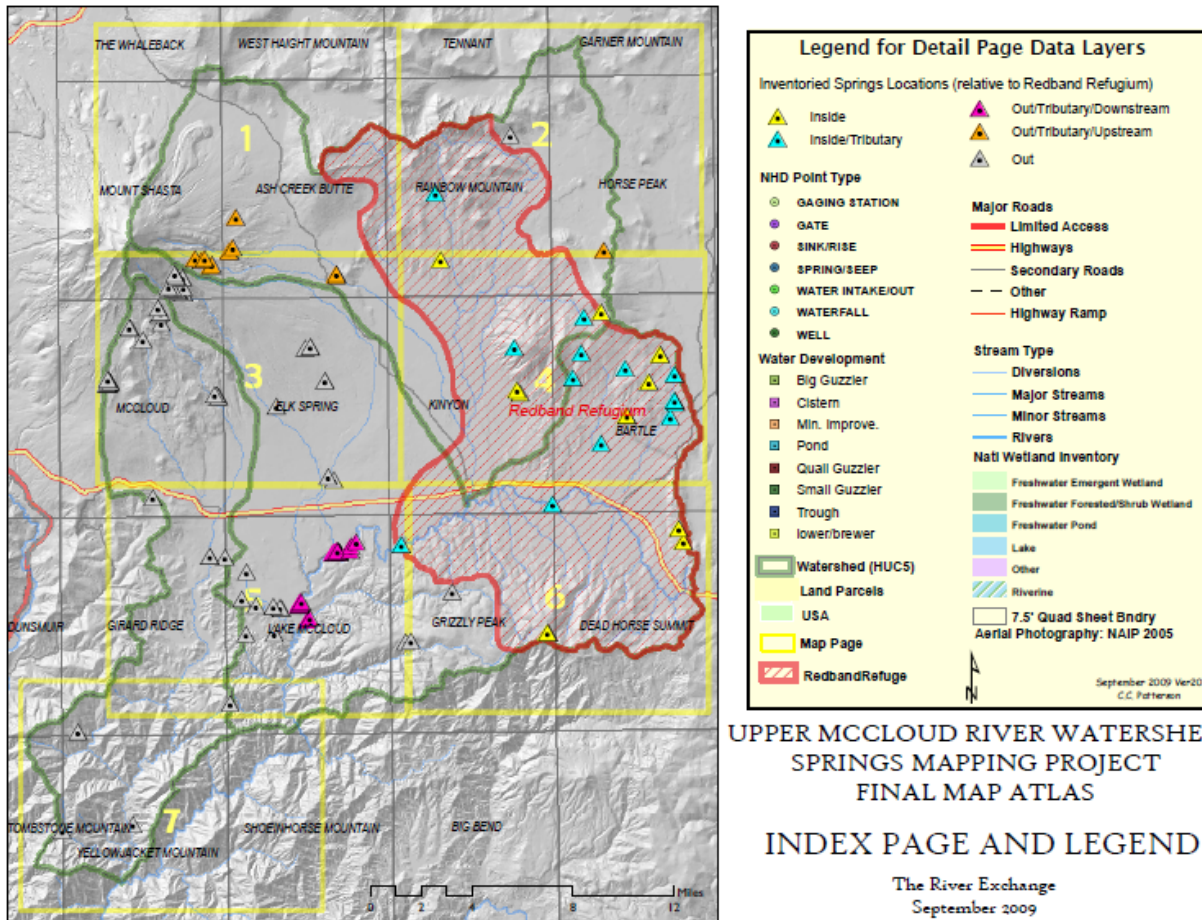


Figure 1. Overview map of project region (Upper McCloud Watershed) with individual GeoPDFs delineated, and universal legend (see also McCloudWS\_Atlas\_Legend\_v20.pdf).

## Using GeoPDFs

GeoPDFs are layered maps, constructed in GIS, and stored as layered, geo-referenced, PDF files. Complete geospatial functionality of GeoPDFs requires a free downloadable GeoPDF toolbar available from Terrago Technologies (<http://www.terragotech.com/download2.php?p=geopdftoolbar>) as well as a current version (9) of Adobe Acrobat Reader (<http://www.adobe.com/products/reader/>). There are several benefits to GeoPDFs, including:

- **Layered display:** Allows user to select what geospatial information they would like to look at, and facilitates cross dataset analysis. Layers can be displayed or hidden in different combinations to suit different inquiries or needs ([http://help.adobe.com/en\\_US/Acrobat/9.0/Standard/WS58a04a822e3e50102bd615109794195ff-7c5d.w.html](http://help.adobe.com/en_US/Acrobat/9.0/Standard/WS58a04a822e3e50102bd615109794195ff-7c5d.w.html)).
- **Widely accessible:** Does not require GIS knowledge, or any specialized software other than the free downloads described above.
- **GPS compatible:** Is GPS compatible for use in the field with GPS enabled devices, or with the addition of a USB GPS device.

## Spring identification and cataloging

All springs included in the project area have a unique ID associated with them. Existing ID's, drawn from the USFS spring geodata, range from 400-1400. Springs not represented in the USFS springs data but present on the USGS Quads have ID's greater than 2000.

All spring information is associated with a specific spring ID within the Geo-PDFs. Spring data is accessible by selecting a spring within the GeoPDFs using the object data tool ([http://help.adobe.com/en\\_US/Acrobat/9.0/Standard/WS58a04a822e3e50102bd615109794195ff-7c62.w.html](http://help.adobe.com/en_US/Acrobat/9.0/Standard/WS58a04a822e3e50102bd615109794195ff-7c62.w.html)). Once a single spring has been selected using the tool, a box with spring data will appear. In the upper portion of the box there will also appear a list of all attributes (e.g. springs) and associated ID's on that PDF. Other springs can be navigated to through this box, by 1) highlighting/ selecting the desired spring from the list, 2) right-clicking the selected item and 3) choosing the "Zoom to selection" option from the right click dropdown.

## Spring physical context

General information on springs was assembled from County and USFS data layers. Geo data was also used to compile the final spring resource GeoPDFs. Spring physical information is sub-divided into five categories:

1. **Network link:** The name, when available and applicable, of the stream or network portion that a spring drains into.
2. **Spring complex:** The spring complex name in the case where a spring is part of a complex of multiple springs that share a single name.
3. **Spring Region:** The name of the landscape subregion (e.g. Angel Meadows) in the case where a spring is located within a named subregion of the landscape.
4. **Owner Name:** The name of the landowner for the parcel on which a spring is located.
5. **Redband Refuge:** "Out" or "In" to indicate whether or not a given spring site falls within the McCloud River Redband Trout Refuge.

## Land use

Spring *Land Use* attributes describe land use surrounding spring sites in cases where that land use has the potential to impact the spring. The attributes were assigned to spring sites based on observations made using remote sensing (aerial photography, land ownership, topography). One or multiple land use attributes was assigned to each spring site as appropriate. In the case where there was no evidence of surrounding land use with the potential to impact the spring, no land use attributes were assigned. A breakdown of the land use attributes (and associated abbreviations) is included below.

- ***In/adjacent to perennial stream*** (*In/Adj to Per.Stream*) – Spring is either a component of or tributary to a perennial stream.
- ***In/adjacent to intermittent stream*** (*In/Adj to Int.Stream*) - Spring is either a component of or tributary to an intermittent stream.
- ***In/adjacent to road(s)*** (*In/Adj to Road*) – Spring site is located on or directly adjacent to a road.
- ***In/adjacent to logged area*** (*In/Adj to Logged*) - Spring site is located in or directly adjacent to an area that is either undergoing active logging or has been recently logged.

- **Minor improvement** (*Minor Improvmt*) - Spring site has been “improved” or altered in some way (e.g. boxed, piped, etc.).
- **In/adjacent to clear-cut** (*In/Adj to Clearcut*) - Spring site is located in or directly adjacent to a clear-cut.
- **In plantation** - Spring site is located in or directly adjacent to a timber plantation.
- **Off-highway vehicle use** (*OHV Use*) - Spring site is located in an area that receives off-highway vehicle use.
- **Development** - Spring site is located in a developed area or has been developed itself.
- **Meadow** - Spring site is located in or directly adjacent to a meadow.
- **Power lines** - Spring site is located under or directly adjacent to power lines.
- **Campground** - Spring site is located in or directly adjacent to a campground.
- **In/adjacent to subdivision** (*In/Adj to Subdiv*) - Spring site is located in or directly adjacent to a subdivision.

### Spring status description

Spring status describes the physical condition of the spring site itself (e.g. water, land, vegetation) as well as its tributary channel. The status of springs were identified and assigned based on direct observation by a River Exchange employee or by private land-owners. Status description information is only provided for springs where a site visit was able to occur during the project period. A breakdown of the status categories is included below.

- **Spring source boxed** – Spring source has been boxed for protection
- **Spring source undeveloped** – Spring source has not been developed or manipulated
- **Livestock within 20 ft** – Evidence of livestock access to and/ or use of spring or surrounding 20 ft, and no livestock fencing present.
- **Logging within 100 ft** – Evidence of recent or active logging within 100 ft of the spring site.
- **Sediment threat within 100 ft** – Potential sedimentation threat to the water in the spring or its tributary channel from any number of potential mechanisms (e.g. road, erosion, etc).
- **Spring water murky** – High level of turbidity in spring or its tributary pond or channel
- **Spring water is clear** – No evidence of turbidity in spring water
- **Apparent mineral content** – Presence of mineral residues in or around spring site indicating high mineral content in water and/ or surrounding environment.
- **Culvert** – Spring source or tributary culvertized near point of emergence.
- **Pond** – spring water form a pond (natural or constructed) at or immediately adjacent to emergence site.
- **Ditch/ cut banks** – Ditch leading from spring site or spring tributary channel exhibiting cut banks.
- **Vegetated within 20'** – 20ft area surrounding spring site well vegetated.
- **Devegetated within 20'** – Notable lack of vegetation within 20ft of spring site
- **Public access** – Spring site is publically accessible via maintained trail or road and is located on land where public access is common or permissible.

## Restoration and research opportunities

Based on the range in condition of the springs investigated during the project, the River Exchange developed a suite of potential research and/ or restoration opportunities. These categories were formulated in direct response to status information collected for the project. It should be noted that these categories were formed only for the purpose of guiding and prioritizing further investigation and potential action, and should not be regarded as conclusive as to the condition of a spring or its needs. In cases where no status was recorded, or where status was unambiguous and springs appeared to be in good condition, not warranting additional restoration, no restoration opportunity is listed. Additionally, there may be additional restoration or research approaches and opportunities not described here. A breakdown of the research and restoration opportunities attributed to spring sites is included below.

- ***Increase vegetation buffer*** – Indicates the potential for vegetative restoration around a spring source where it has been de-vegetated as from trampling by livestock, damage from logging, or some other mechanism.
- ***Livestock fencing*** – Indicates active use/ trampling of the spring source by livestock and the potential for remediation through the addition of fencing that excludes livestock from the spring source. In certain cases, livestock fencing could be complemented by the addition of a trough to facilitate livestock drinking without direct access to the spring, but this is not specifically indicated.
- ***Decrease sediment threat*** – Indicates the opportunity to minimize the risk of sedimentation from human use (e.g. erosion, road activity, culvertization, livestock trampling, etc.) exacerbated by the spring or conveyed in flows from the spring into adjoining streams.
- ***Channel restoration*** – Indicates channel degradation (e.g. down-cutting, bank erosion, in the area immediately downstream of a spring as a function of land use in the area) and the potential opportunity for channel restoration, by any of a number of potential approaches, based on a thorough assessment of the disturbed reach.
- ***Access support/ improvements*** – Indicates the potential for improvements to spring access either in the form increased access, or improvements to buffer the spring from the impacts of human use.
- ***Water quality investigation*** – Indicates some potential (as from livestock, pollution, sedimentation, etc.) for decreased or altered water quality parameters (nutrients, dissolved oxygen, pH, turbidity, etc) in spring outflow and the opportunity for research to investigate water quality parameters at a spring site.
- ***Wildlife use investigation*** – Indicates reason to believe that a given spring site is receiving especially heavy use by wildlife, and the need for investigation of this use prior to, or as a component of any other management of the spring site.
- ***Livestock use investigation*** - Indicates reason to believe that a given spring site is being used by livestock despite no direct observation or evidence of this, and the need for investigation of this use prior to, or as a component of any other management of the spring site.