Cascade, Idaho

From a Timber Town to a Town Focused on Recreation, Wildlife and Natural Beauty: Facilitating a Community's Transition With Geothermal-Inspired Design

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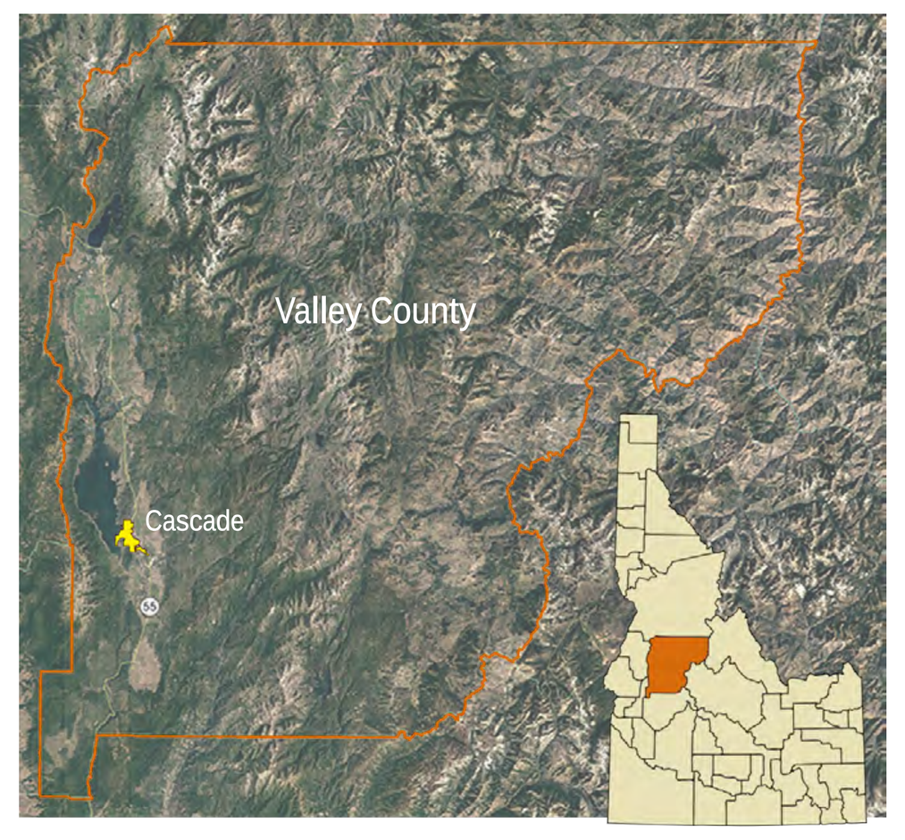
Geothermal energy is the internal heat of the earth. It is this energy that powers many of the large scale processes of the earth as the heat is redistributed from the inner core to cooler outer regions. For human utilization, geothermal energy is defined as our resource base, which is made up of all accessible and inaccessible heat. Geothermal resources are the portion of the resource base that is technologically accessible, regardless of economic viability. However, there are many regions where this resource base is readily accessible.

Cascade, Idaho, is a scenic rural city settled between the mountains of west-central Idaho in Valley County. Bordered by Cascade Lake on the west and the Payette River on the east, the city has much to offer in the way of recreation and beauty. Since the closing of the Boise Cascade lumber mill—one of the city's major employers and occupier of a large parcel of land along the Payette River—the town's economic base is in a transitional phase from a lumber town to one more focused its other abundant natural resources.



An investigation conducted in 1976 concluded that Cascade has potential for direct use applications because the area is highly faulted by the north-south trending Long Valley Fault. The predicted subsurface temperatures based on a silica geothermometer is up to 354°F. The depth of wells drilled in Cascade has thus far revealed temperatures up to approximately 103°F. Of the eight drilled wells within the town, three are in use: the Cascade School District well, the Leisure Time well, and, most recently, the Mill well. Both the School District well and the Mill well have more capacity than what is used. Untapped potential also exists in dormant wells.

In the *City of Cascade Geothermal Feasibility Report* (2015), Hand and Mink explored the potential for the expansion of a geothermal district heating system. While one scenario looked at further use of the Mill well for district heating, the rest of the potential systems used some portion of the School District system either directly from the well or from the outflow system. No other direct use applications were investigated.

The following is an exploration of direct use applications of geothermal resources through design.

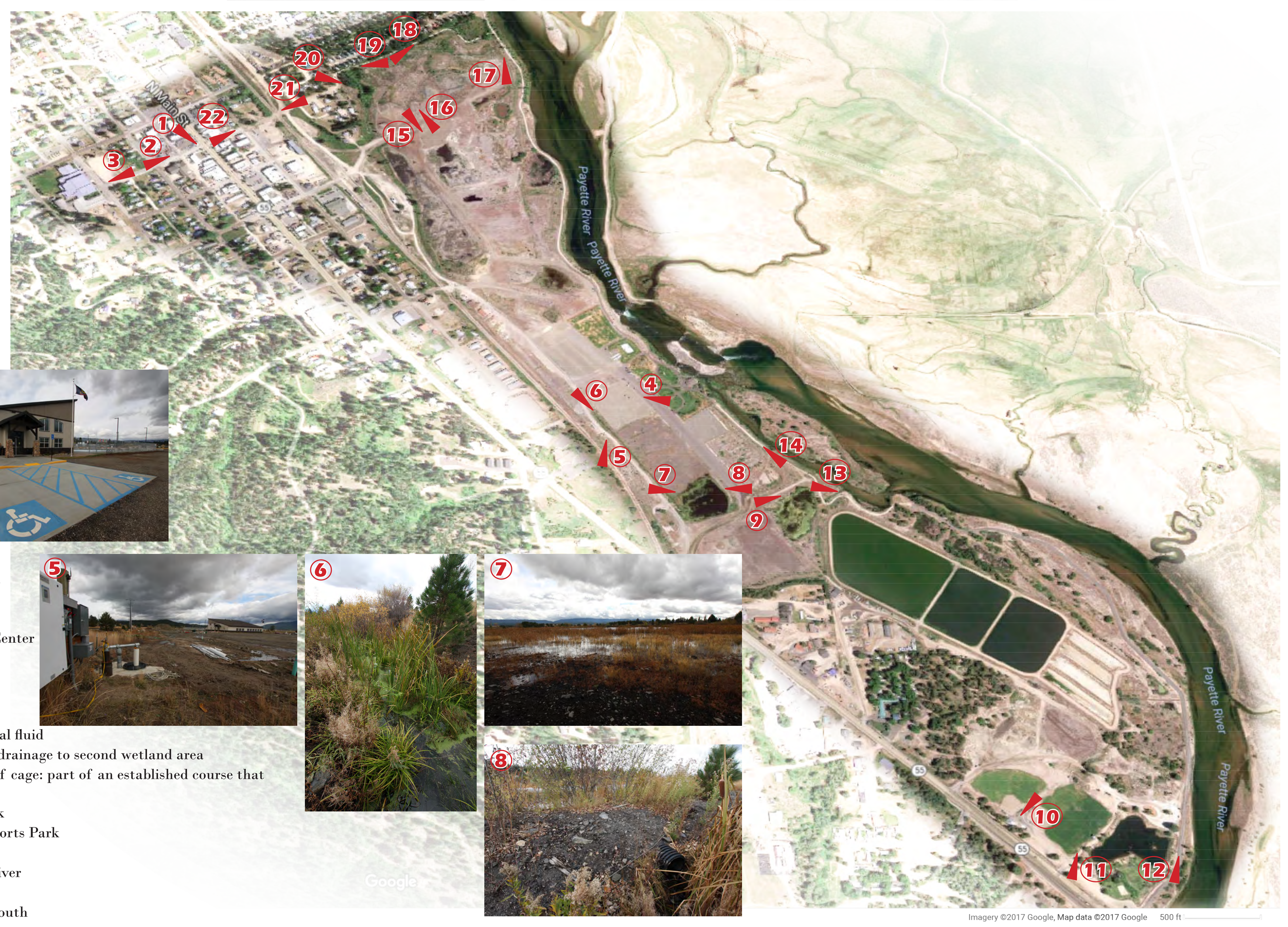
Goal:

Develop a geothermal-inspired design for the city of Cascade, Idaho, that introduces low temperature direct use resource options that enhance quality of life, protect water quality, and accommodate the goals and needs of the community.

Objectives:

1. Utilize the available geothermal resources in a way that:
   - Benefits the community
   - Considers all potential applications of low temperature resources to find the best fit for the community
   - Minimizes complexity to increase feasibility of design
2. Integrate geothermal design with current and future needs of the city, including the community transportation vision, the sports park goals, and preservation of its natural beauty and wildlife
3. Provide safe and convenient connectivity between the east and west sides of the city across Highway 55 with special consideration to school crossings
4. Protect water quality, both in regard to spent geothermal fluid disposal and stormwater runoff
5. Create further opportunity within Cascade for economic, recreational and educational growth utilizing the integration of sustainable resources and design

Pictorial Inventory of Site, Counterclockwise

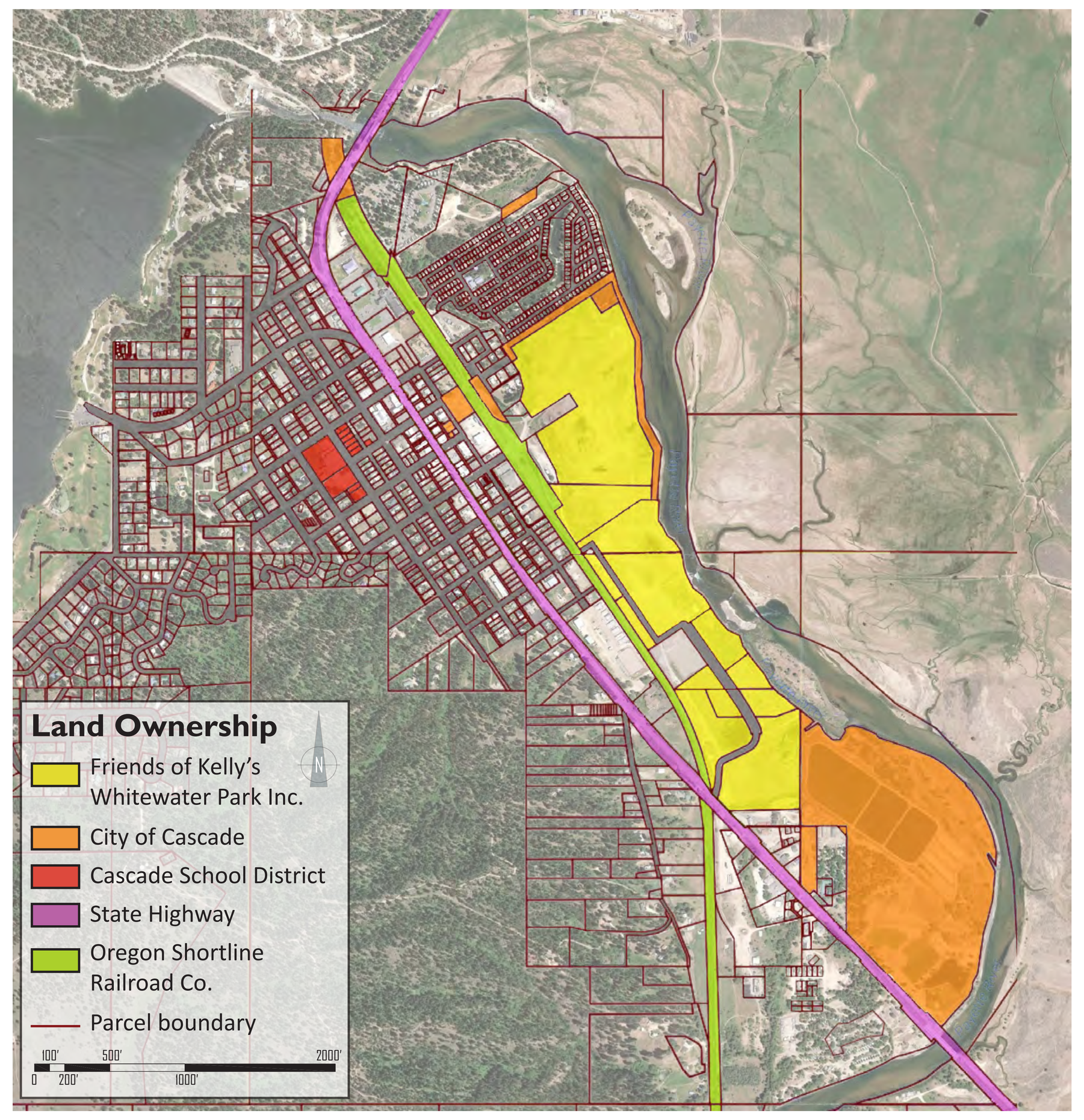


(1) Hwy 55 & Pine Street intersection
(2) W. Pine Street
(3) W. Pine Street, Cascade School
(4) Cascade Aquatic and Recreation Center
(5) Geothermal well for Rec Center, looking toward Rec Center
(6) Over ground outflow ditch for Rec center, wetland environment
(7) Wetland for stormwater/geothermal fluid
(8) Culvert for wetland area overflow drainage to second wetland area
(9) Second wetland area, note disc golf cage: part of an established course that originates in Fischer Pond Park
(10) Restroom for Cascade Sports Park
(11) Multi-purpose field at Cascade Sports Park
(12) Paved portion of Strand Trail
(13) Unpaved Strand Trail, Payette River
(14) Unpaved Strand Trail
(15) Former mill site North, looking South
(16) Former mill site North, wetland
(17) Edge of former mill property, Strand Trail
(18) City property, Strand Trail connection
(19) City property, Strand Trail connection
(20) Edge of private property overlooking former mill site
(21) E. Pine Street at railroad
(22) E. Pine Street

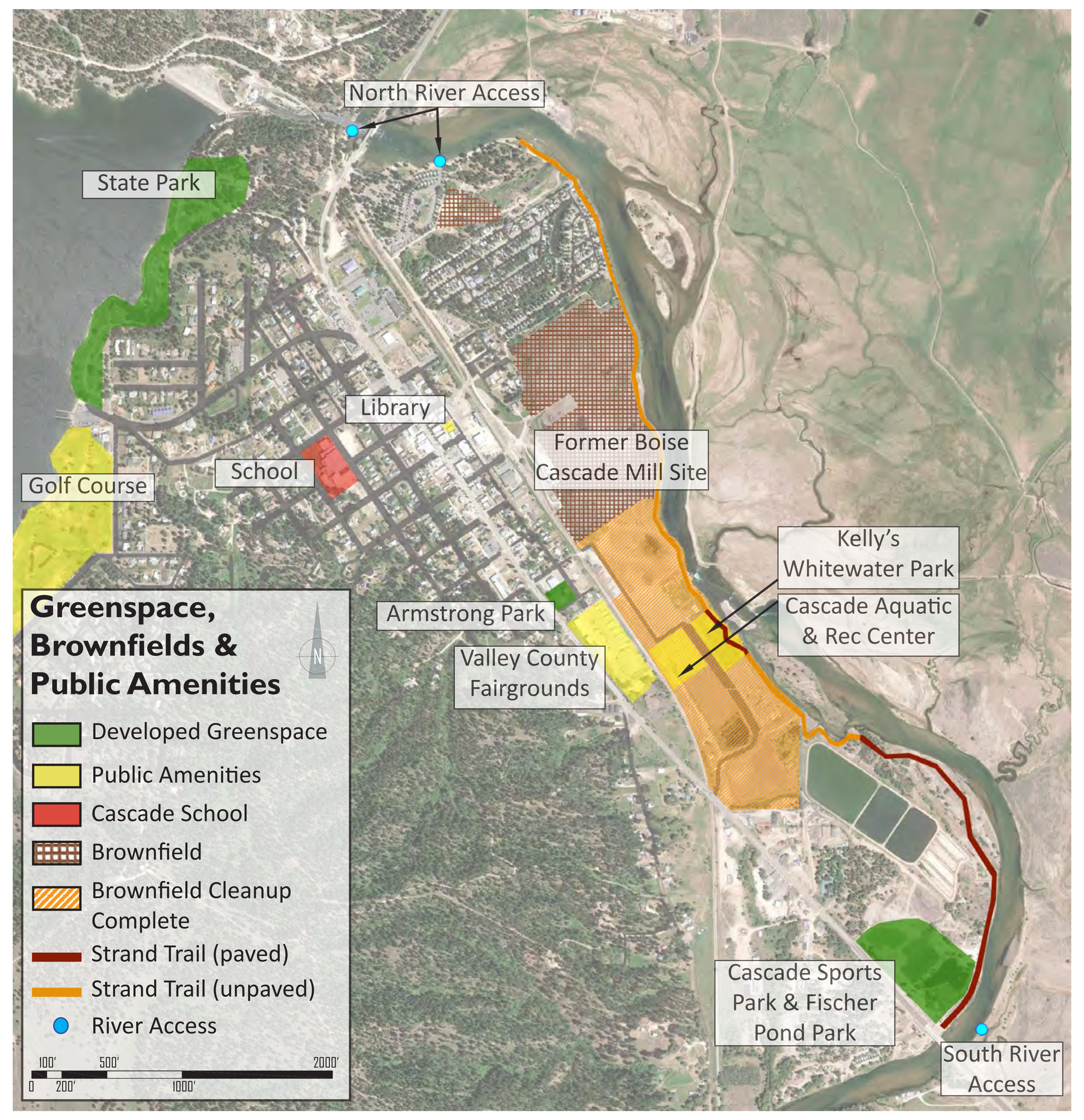
Photo credit: Sarah Roop
Pictures 3-14 taken October 2016; Pictures 1-2, 15-22 taken March 2017

Inventory:

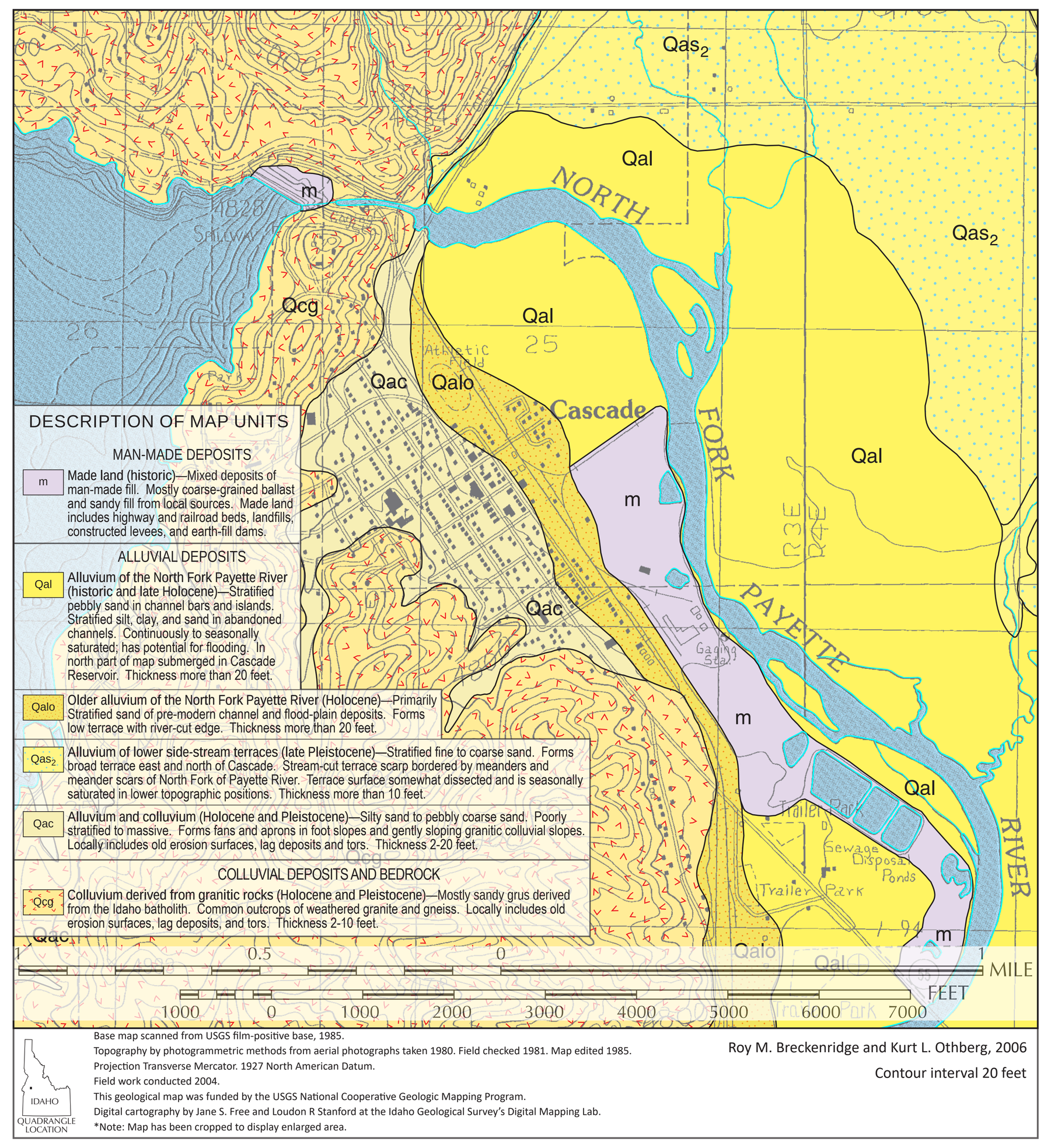
Parcel Map & Land Ownership of selected sites



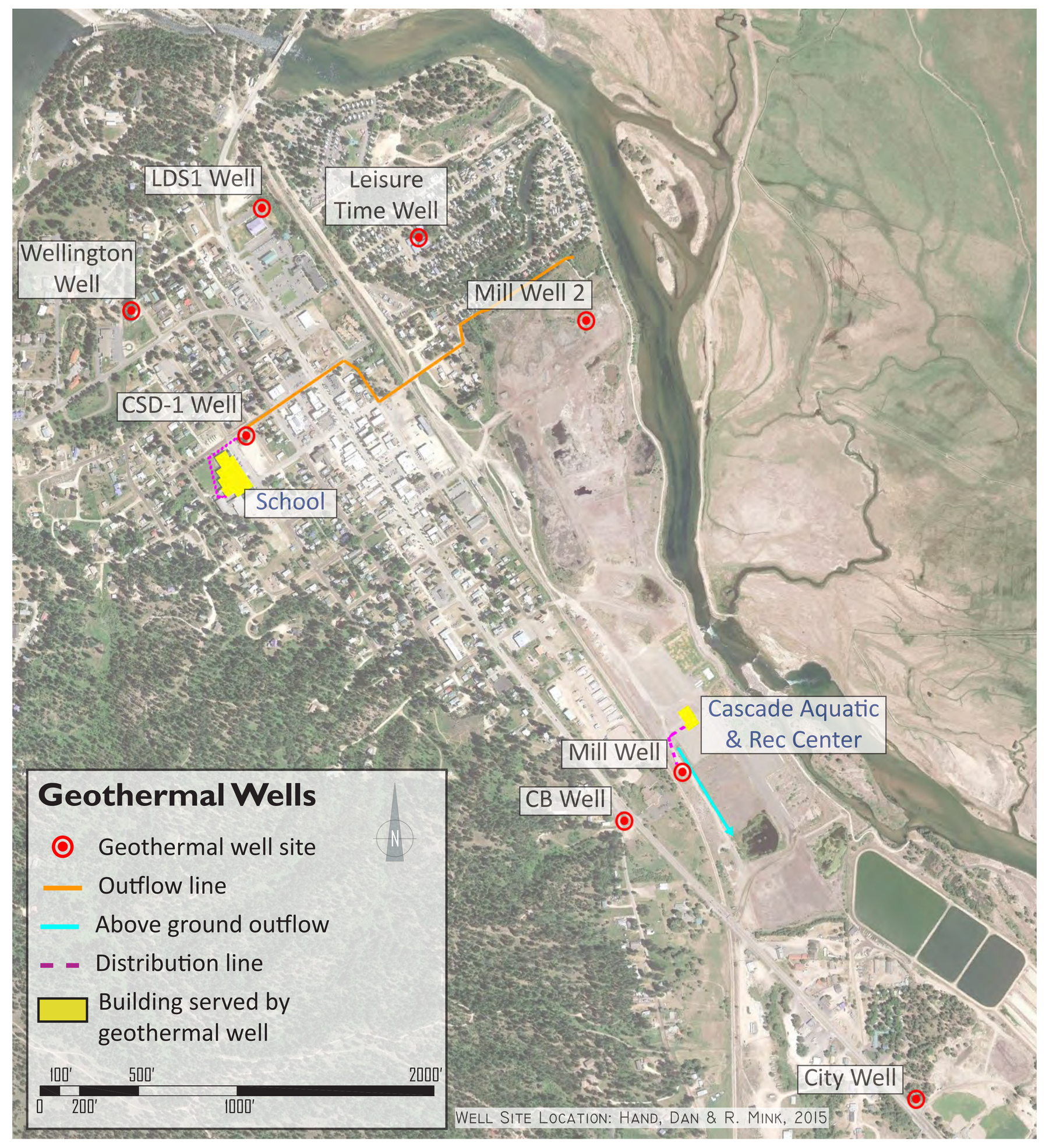
Former Mill Site and Public Amenities



Surficial Geologic Map of Cascade, Valley County, Idaho



Geothermal Well Sites within Cascade



Recent History: In 1914, the Union Pacific Railroad completed its track from Emmett to McCall, providing the area with the connection it needed to create a viable economic base to attract more residents. Logging, farming and ranching became the largest industries of the county, and the towns closest to the railroad—Cascade, Donnelly and McCall—would thrive and become the population hubs of the county. Many of the cities formed farther from the railroad would disappear.

Boise Cascade Corporation set up sawmills in both McCall and Cascade, providing employment for many of the area's residents. McCall's mill closed in 1977, but the town was able to shift to a recreation focused economy, one which thrives today. The mill in Cascade closed in 2001 and had more detrimental effects on the city's economy.

The Cascade Dam on the Payette River was completed in 1948 and created a reservoir that retains water for irrigation and flood control. Its completion flooded much of the northern valley creating Cascade Reservoir. Known today as Cascade Lake, it has become a fishery and serves as a recreation resource for the community and visitors to the area.

Economy: The closing of the Boise Cascade Mill in 2001 was a substantial economic blow to Cascade. As the then largest employer in Cascade, its closure took away 78 jobs, affecting not only individuals of the community, but the identity of the community. However, the town took the opportunity to shift focus toward new industry: tourism and recreation has since blossomed in the community and Cascade has developed amenities such as Kelly's White Water Park, Ashley Inn, Fischer Pond Park and the Cascade Sports Park, among others. The provision of supplies and services to recreational enterprises—such as backcountry excursion guides, wilderness guides, rafting guides, positions at equipment rental shops and hospitality-related jobs—provides further opportunity for employment. Additionally, ranching and logging remain major industries of the area. Whether referencing past or present economy of the city, Cascade has always relied on its natural resources and beauty for its economic livelihood. Surrounded by national forest, fertile lands and beautiful rivers and lakes, Cascade's dependence on its natural setting is well established.

Connectedness: The city of Cascade is divided east and west by Highway 55, which is also the city's Main Street. The downtown area of the corridor contains sidewalks, curb extensions, crosswalks and other aesthetic features. Several other streets are paved, but most are unimproved and do not have designated pedestrian or bike routes.

In 2015, the city of Cascade and the Cascade Mobility Team partnered with New Mobility West to develop a community transportation vision. The result was a comprehensive plan that included improvements to specific corridors and intersections as well as creating new connection trails, wayfinding signage and bike stations for the existing Strand Trail. The connection trails suggested were similar to those developed within the Cascade Pathways Master Plan in 2010. The top priority identified by the New Mobility West evaluation was improvement to pedestrian and bicycle lanes on Pine Street along with creating a safer crossing at the intersection of Pine Street and Highway 55.

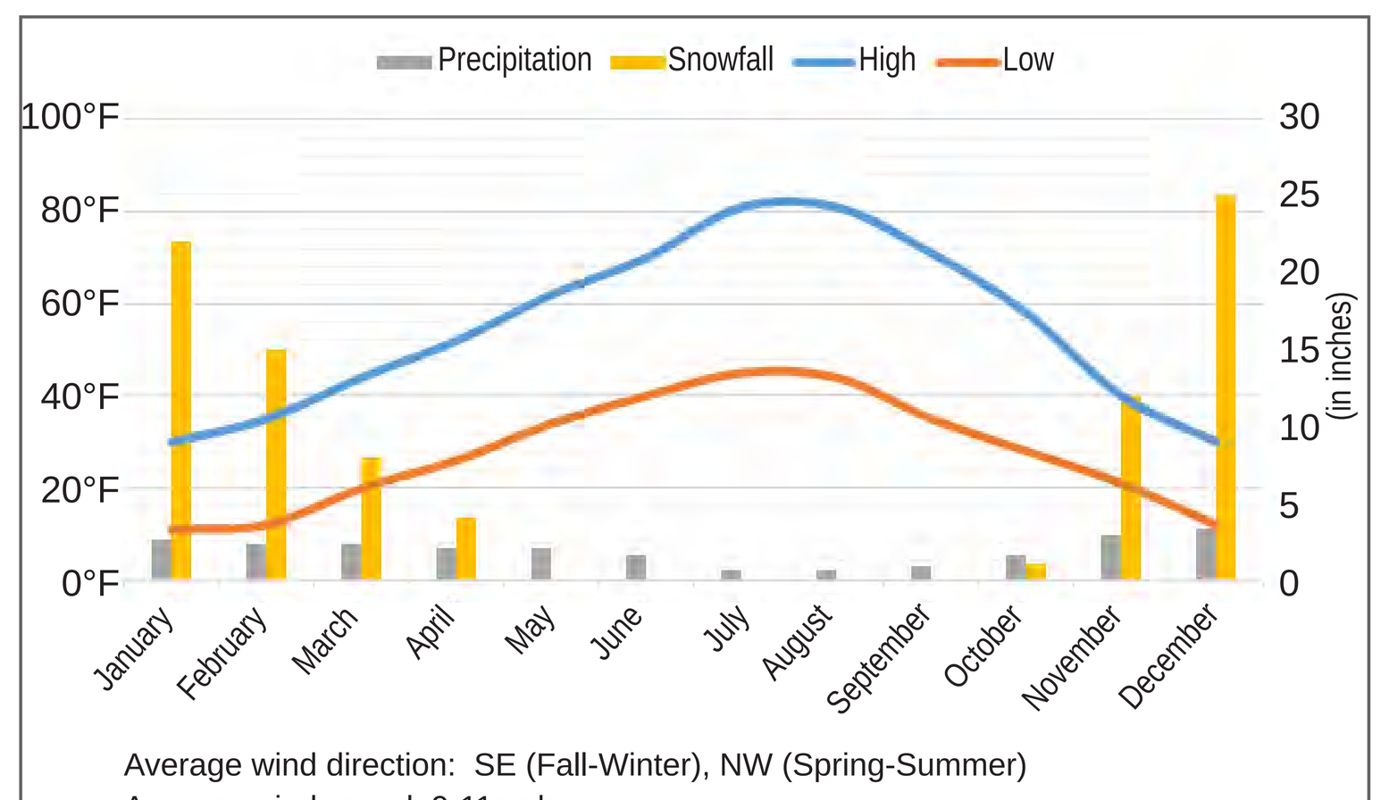
Climate: At approximately 4,750' above sea level, Cascade has a moderately cool climate with winter snowfall beginning as early as October and lasting into April. Total accumulation averages just under 100 inches per year. The cold, snowy winters are offset by moderately short but warm, dry summers. Nights are cool, even throughout the summer.

Cascade Geothermal Well Data

Data Source: Hand, Dan & R. Mink, 2015

Well Name	Flowing Temperature, °F	Bottom Hole Temperature, °F	Depth, Feet
Wellington	?	78	1085, open to 651
LSD1	63-65	?	First to 406 then deepened to 560, lost 2°F of temperature, deeper was colder
Leisure Time	78	82	1006
Mill Well	98	?	431
Mill Well #2	62	?	320
CSD-1	73	81	1120
City Well	72	?	260
Davis Cattle Well	61.7	?	300

Climate Chart



Average wind direction: SE (Fall-Winter), NW (Spring-Summer)
Average wind speed: 9-11mph
Frost-free growing season: June 19-August 29
USDA hardiness zone 4b

Cascade Development & Geothermal Resources:

Former Boise Cascade Mill Site: The site on the eastern side of the city of Cascade that formerly hosted the Boise Cascade Mill is an area rife with opportunity. The land, largely under the ownership of Friends of Kelly's Whitewater Park Inc. is a recognized asset within Cascade and by those interested in the city's development.

The brownfield designation currently hinders development on the northern half of the site while the southern half is limited to commercial and industrial uses. The southern half has seen two major developments: Kelly's Whitewater Park and the Cascade Aquatic and Rec Center.

- Kelly's Whitewater Park opened in 2010 and was made possible by the vision and direct investment of the owner along with collaboration and fundraising by the community through its involvement from 2006 to 2008 in the Idaho's Horizons program, a community leadership program sponsored by University of Idaho Extension program.
- The Cascade Aquatic and Rec Center opened in 2016 was the culmination of a project conceived over 30 years ago and made possible by the formation of the Southern Valley County Recreation District for fundraising in 1998.

Brownfield: The 120-acre property once occupied by the Boise Cascade Mill was classified as a brownfield because activities associated with the storage and handling of logs prior to processing could lead to environmental impacts. After the mill's closure, Boise Cascade officials, Valley County officials, city of Cascade officials, the DEQ and members of the public met to decide upon the future of the area. The stakeholders decided that the property should be assessed and measures for cleanup should be taken if necessary in order to redevelop the land.

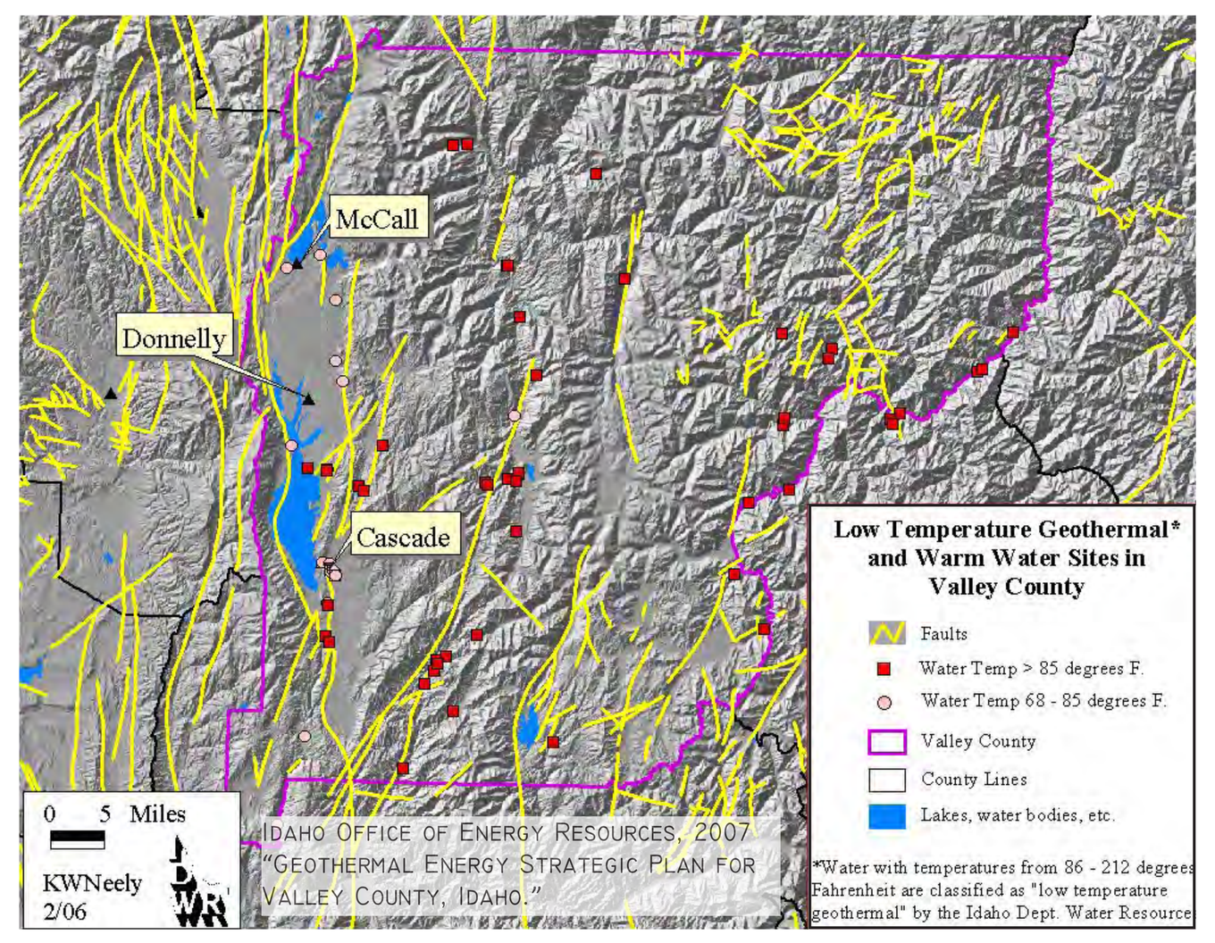
Beginning in 2004, the lumberyard was assessed, comprising 80 acres of the site. Pentachlorophenol, petroleum hydrocarbons, and arsenic found in the soils were above allowable concentrations. Pentachlorophenol is used to treat lumber for utility poles and railroad ties; petroleum hydrocarbons are made up of several hundred chemicals that come from crude oil; the presence of arsenic is possible from past mining practices. From 2004 to 2010, a Voluntary Cleanup Program was successfully implemented and completed, involving the excavation and treatment or removal of contaminated soils, groundwater monitoring, and screening and processing of log yard debris.

Currently, the 60 acres in the southern portion of the former Boise Cascade site is considered safe for commercial and industrial uses only, and has begun transformation into an area of recreational opportunities, including Kelly's Whitewater Park and the Cascade Aquatic and Recreation Center. Assessment and cleanup of the northern 60 acres may be required for further development.

Geology & Geothermal Resources: Much of the city of Cascade is built upon the alluvial deposits of sand and gravel from the North Fork of the Payette River. The remainder is colluvium derived from granite rocks or man-made fill. Granite rocks are found at shallow depths beneath the alluvial sediments throughout the city. Man-made fill occurs throughout the former mill site and south near the river. It also occurs at the zoned earthfill Cascade dam which forms Cascade Lake and controls the floodplain to essentially remove risk of flood from the area of the city that lies next to the Payette River. There are major north-south trending faults in Valley County as well as east-west trending faults. There has been recent minor seismic activity of faults in the area and the intersection of the two types of faults could provide pathways for geothermal fluids.

Several thermal springs are identified in Long Valley near Cascade. These include Carbarton Hot Springs (6 miles south of Cascade), Belvidere Hot Springs (5 miles south of Cascade), and Davis Hot Springs (2 miles east of Cascade). Several other thermal springs occur north of the city ranging in temperature from 81°F to 122°F. Overall, there are 91 geothermal water sites recorded in Valley County, 54 of which have temperatures greater than 85°F, but less than 212°F, so are classified as low temperature geothermal resources.

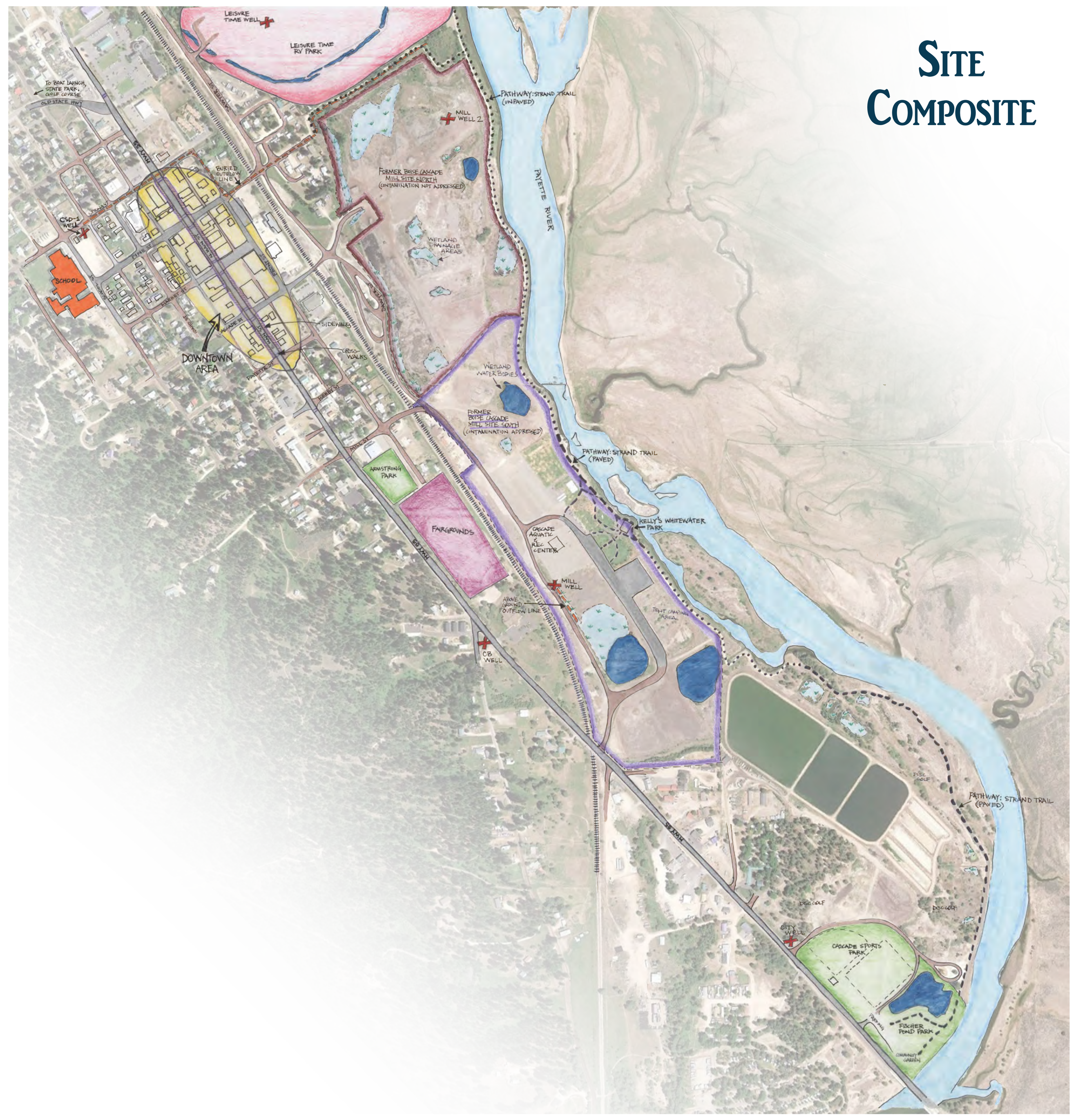
Low Temperature Geothermal Resources & Major Faults



Geothermal Spent Fluid Disposal in Cascade: There are three basic options when it comes to disposal of spent fluids in order to avoid both thermal and solid waste pollution to land and water: subsurface injection, disposal to surface waters, and/or disposal to the ground. Of these, reinjection is considered the most sustainable as it helps to maintain reservoir pressure and can replenish the reservoir. However, the high cost and complexity can be prohibitive for smaller direct use developments.

Disposal of geothermal spent fluids from all geothermal well usage in Cascade is accomplished above ground. The School District originally installed injection wells but was hampered with flooding issues related to the reinjection method. The outflow line installed in 2014 solved the flooding issue and discharges water to an area adjacent to the Payette River. Additionally, seven tees were placed along the outflow line to allow for future ease of expansion of the system. The Mill well utilizes a short outflow line and its above ground disposal follows a channel to a wetland area within the former mill site.

Site Composite



Master Plan

Geothermal Well Application

This design utilizes two existing geothermal wells in Cascade—CSD-1 well located near the school and Mill 2 Well located at the north end of the former mill property.

CSD-1 A new inflow line traverses the school lot from the current pump house to bring geothermal water to the new sidewalk along Pine Street from School Street to Main Street. The four block expanse of geothermally heated sidewalk provides a safe and year-round accessible passage from the school to downtown Cascade, along with providing a trial run for sidewalk heating application within the city.

In addition to the expanded use of the well, the outflow line is redirected from a wetland adjacent to the North Fork of the Payette River to a seasonal wetland farther inland from the river. The new drainage sight for the geothermal water then flows into a drainage creek designed to continue to eliminate any contaminants and cool the water. The creek empties into the secondary wetland adjacent to the river. Readjustment of the outflow will allow for expanded use of CSD-1 in the future without introducing thermal and other pollutants to the North Fork of the Payette River.

Mill 2 Well Currently unutilized, an inflow line brings geothermally heated water from Mill 2 Well to a newly built pump house that is a multi-use building for the track and field. The water is then directed to the track allowing for year-round usage and early season training. Additional uses of the geothermal heat could include onsite walkway heating and handicap parking space heating. The outflow line is directed to the head of the designed stream to join the water from CSD-1.

Design Elements

Streetlights While streetlights exist along Main Street, new streetlights are added to Pine Street, placed strategically along the new path to the track and field facility, and included in the track and field parking lot design.

Crosswalk A raised crosswalk with material change will increase safety at the Pine Street/ Main Street crossing. Additionally, a Rectangular Rapid Flashing Beacon (RRFB) will accompany the pedestrian crossing.

Pathways Along with a paved 10' wide path to the track and field that follows the former railroad bed, a defined path extends along Pine Street to connect to the existing city property trail that ties into Strand Trail. At the point of connection, a new trail will link to the track and field complex and continue on to Geothermal Park and Strand Trail.

Geothermal Park Designed as an educational and recreational amenity, Geothermal Park incorporates educational placards throughout the design. The park consists of a pathway system, a dispersed picnic area, a playground inspired by the history and culture of the town, and a pavilion picnic area that can serve as an eating area for participants and visitors at a sports event.

Track and Field An 8-lane, 400 meter track encircles a field that can host both football and soccer. All Idaho field events are present in the design including high jump, long jump, triple jump, pole vault, discus and shot put. Additionally there is a scoreboard, home and away bleachers, and a multi-purpose building with locker rooms, restrooms and concessions. The entire area is fenced with access from the parking lot and from Geothermal Park. The parking lot accommodates 110 vehicles plus 6 handicap spaces and bus parking. It is designed to hold and treat stormwater runoff.

Wildlife The area north of the track that is inclusive of the wetland is preserved for wildlife. Development within Geothermal Park is kept minimal to maintain a wildlife corridor along the river that maintains at least 200' spacing.

1) CSD-1 Well
2) CSD-1 outflow
3) Inflow from CSD-1 to sidewalk heating
4) Geothermally heated sidewalk
5) High visibility crosswalk
6) Paved pathway to Track and Field complex
7) Extension of Cascade Street paving to Track and Field parking lot
8) Track and Field parking lot
9) Mill 2 Well
10) Inflow from Mill 2 to Track and Field pump house
11) Mill 2 outflow
12) Track and Field complex
13) Geothermal Park
14) Redirected CSD-1 spent fluid outlet to wetland
15) Mill 2 outlet to stream
16) Stream designed as cooling channel for CSD-1 and Mill 2 spent fluid
17) Culvert from stream to existing wetland

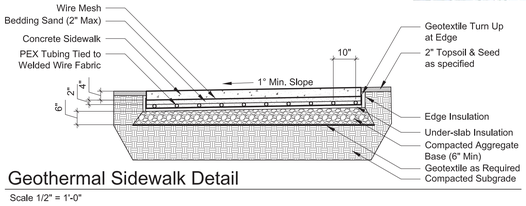
4 Sidewalk Perspective

Pine Street Snowmelt Design

The Pine Street sidewalk heating has about 6,090 ft² of snow melting surface. The required heat load varies with air temperature, wind, snowfall rate and snow accumulation. The design objective is to provide adequate performance while limiting installation and operation costs. The variables in snowmelt design are climate, available geothermal temperature and flow, tube depth, and tube spacing. The desired outcome would maintain a slab surface temperature of 38°F at 15°F air temperature with a 5mph wind speed. These conditions require 85 Btu/hr/ft². The same variables would apply to heating of the track, with consideration to the difference of a rubberized surface.

The benefits of a snowmelt system in Cascade include:

- Elimination of cost and inconvenience of snow and ice removal
- Reduced liability exposure during the winter
- Elimination of damage to sidewalks from freeze-thaw cycles
- Safe connection from the school to the downtown Cascade area
- Option of future sidewalk heating expansion



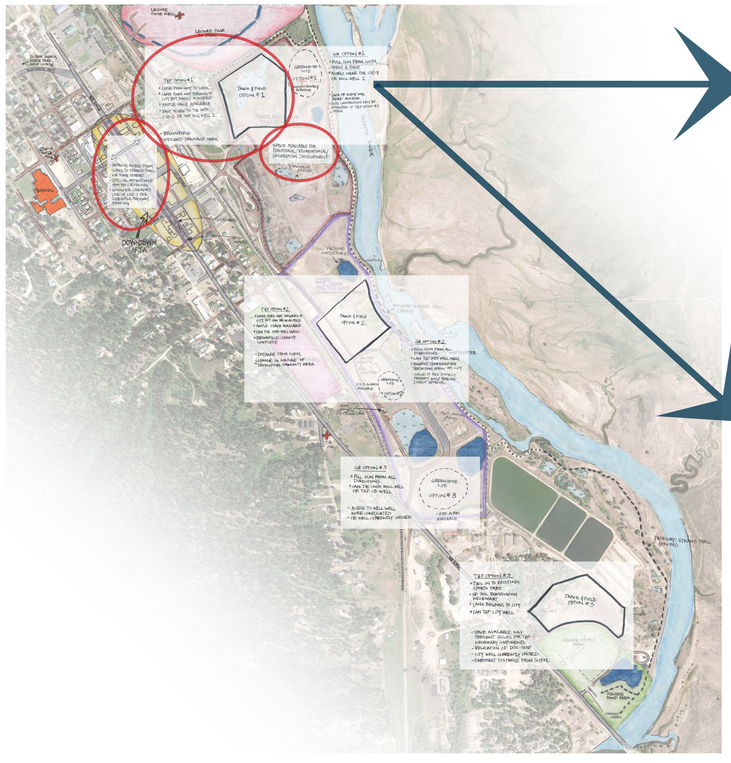
Geothermal Sidewalk Detail

Scale 1/2" = 1'-0"

5 Crosswalk Perspective

A raised pedestrian crosswalk along with RRFBs will bring additional awareness to the Pine Street/Hwy 55 crossing. The crossing will be constructed of brick laid in an alternating vertical and horizontal pattern to match the existing detail in the downtown sidewalks. The sides of the crosswalk will be painted with reflective paint. The RRFBs are solar powered to maintain the flashing beacon.

Site Analysis & Conceptual Design:

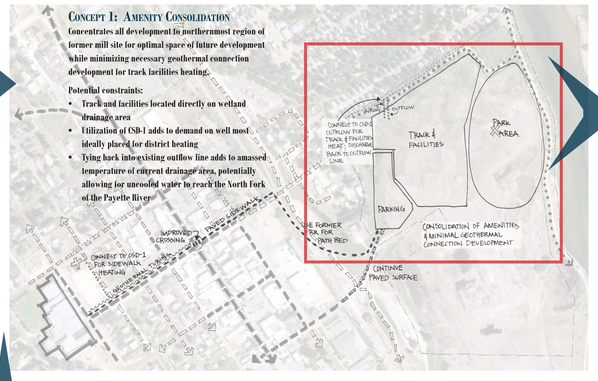


Concept 1: Amenity Consolidation

Concentrates all development to northernmost region of former mill site for optimal space of future development while minimizing necessary geothermal connection development for track facilities heating.

Potential constraints:

- **Track and facilities located directly on wetland drainage area**
- **Utilization of CSD-1 adds to demand on well most ideally placed for district heating**
- **Tying back into existing outflow line adds to amassed temperature of current drainage area, potentially allowing for uncooled water to reach the North Fork of the Payette River**



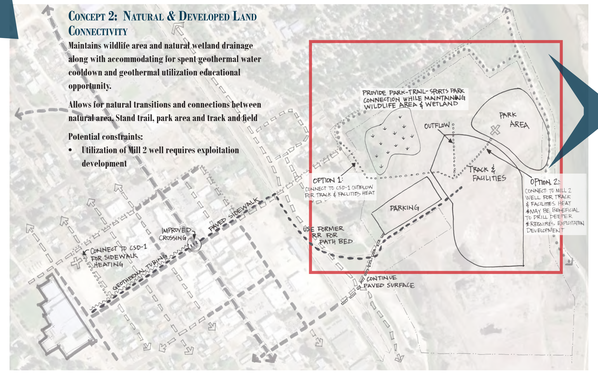
Concept 2: Natural & Developed Land Connectivity

Maintains wildlife area and natural wetland drainage along with accommodating for spent geothermal water cooldown and geothermal utilization educational opportunity.

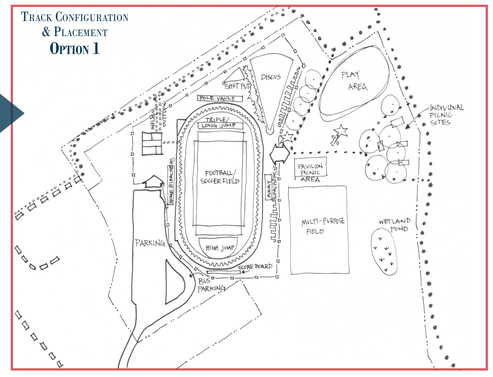
Allows for natural transitions and connections between natural area, Stand trail, park area and track and field

Potential constraints:

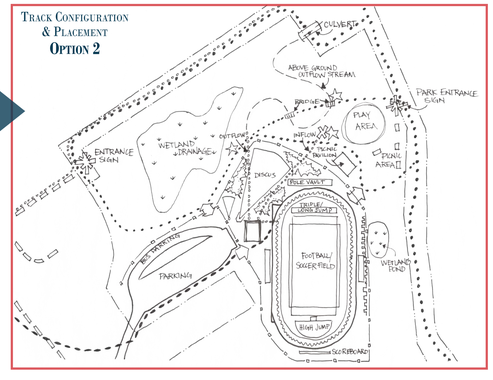
- **Utilization of Mill 2 well requires exploitation development**



Track Configuration & Placement Option 1



Track Configuration & Placement Option 2



8 Track and Field Parking Lot

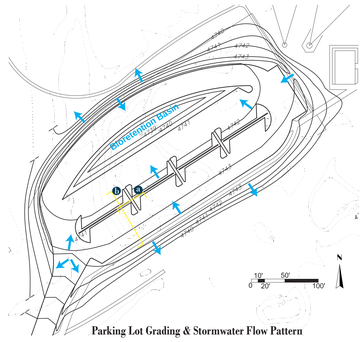
Stormwater Flow & Treatment

The goal of the parking lot design is to provide adequate parking for students, spectators and busses and allow for safe pedestrian transit, while addressing treatment for stormwater runoff. The total area dedicated to the 116-vehicle parking lot is about 1.5 acres, 1.2 of which are an impermeable surface. The remaining .3 acres consists of a long, narrow island separating rows of parking and a larger semi-circular area that separates bus parking and turnaround from the rest of the parking lot. These areas must be of sufficient size and depth to hold and treat stormwater runoff from the parking lot for a minimum of a 1" design storm, the capture of which controls roughly 90% of annual runoff.

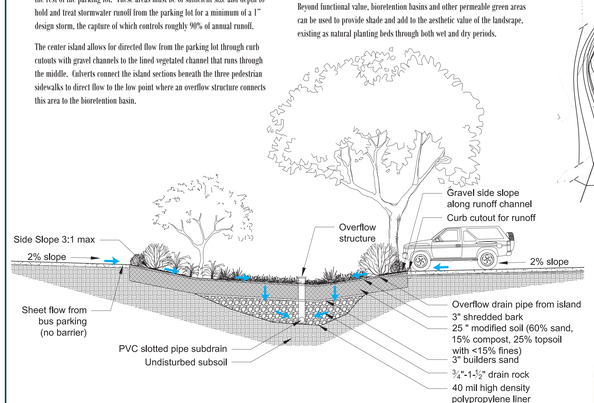
The center island allows for directed flow from the parking lot through curb cutouts with gravel channels to the lined vegetated channel that runs through the middle. Culverts connect the island sections beneath the three pedestrian sidewalks to direct flow to the low point where an overflow structure connects this area to the bioretention basin.

The bioretention basin is designed to treat all parking lot runoff in excess of a 2-year, 24-hour storm, a volume of runoff more than three times that of a 1" design storm. The lined vegetated basin is layered with filtering material to remove impurities from the runoff. A slotted pipe subdrain releases the treated stormwater back to the hydrologic system. An overflow structure allows for the release of stormwater in the event of a larger storm.

Beyond functional value, bioretention basins and other permeable green areas can be used to provide shade and add to the aesthetic value of the landscape, existing as natural planting beds through both wet and dry periods.



Parking Lot Grading & Stormwater Flow Pattern



Bioretention Basin Detail
Scale: ⅛" = 1'


a Parking Island Channel to Overflow Structure

b Pedestrian Sidewalk & Parking Island Channel Overflow Structure to Bioretention Basin

13 Geothermal Park

Design Cohesiveness

Geothermal Park is the cohesive element of the design that brings together the track and field complex, Strand Trail, and the area serving dual duty as preserved wildlife space and spent geothermal water treatment—all while giving homage to the town's history and heritage. This is accomplished with several simple elements:

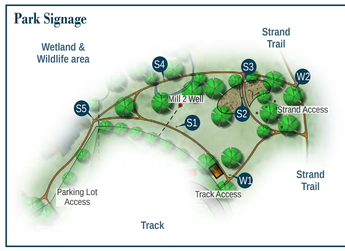
- Access: the park has entrance points from the parking lot on the west side of the track and field facility, from the east side of the track, and directly from the Strand Trail.
- Amenities: a covered pavilion accommodates both park functions as well as providing an eating area for groups of spectators and athletes at an event. The dispersed picnic area offers a resting point for those along the Strand trail and more secluded eating options away from the sports area. The playground encourages use of the Strand trail to gain access and focuses on the concept of nature play, bringing in elements from the town's culture to develop play structures.
- Signage: Interpretive signs are placed around the park describing different aspects of the natural environment, the town's history and the role of geothermal resources in Cascade. Additionally, welcome and wayfinding signs invite and explain the layout of the path system, inclusive of Strand trail.
- Natural Features: The stream created from disposal of spent geothermal water provides an element of interest along the path system of Geothermal Park, allowing for the intermingling of people and nature.
- Open Space: The park remains largely in its naturalized state without manicured appearance in order to maintain a viable corridor for wildlife along the river and into the wetland area.


http://www.bowenhobsconstruction.co.uk


http://www.naturesinstruments.com


Westmoreland Park Natural Play Area

Park Signage



W1 Welcome sign with city trail map and space for pavilion reservation information

W2 Welcome sign with city trail map

S1 Educational Sign: Mill 2 Well depth, temperature and function

S2 Educational Sign: Description of positioning of play equipment (see stacked stump structure in lower left corner) to mimic layout of the geothermal wells drilled throughout town accompanied with a map of the town and well location

S3 Educational Sign: History of the site as a lumber mill and the significance of log playground structures

S4 Educational Sign: Role of the geothermal stream for fluid cooling and treatment

S5 Educational Sign: Role of wetland in geothermal fluid treatment and its significance for wildlife


http://www.naturesinstruments.com


Westmoreland Park Natural Play Area

16 Geothermal Cooling Stream

Spent Geothermal Surface Disposal

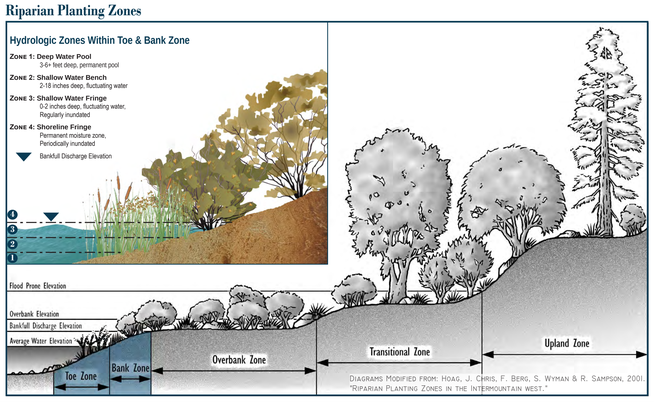
Affecting the economic feasibility of geothermal development is the disposal of spent geothermal fluids. Creating wetlands and waterways that are designed to cool waters and remove trace elements from geothermal fluids can be both an economical and environmental method of water treatment. Wetlands are self-perpetuating, aesthetically appealing, productive systems that provide valuable habitat for wildlife. An open channel can be used in conjunction with wetlands to increase heat loss efficiency from a geothermal source and further remove trace elements from the fluid. If the effluent is of sufficient quality, the channel can remain unlined.

The principle chemical present in the geothermal waters around Cascade is sodium. While current treatment involves surface disposal to a small wetland adjacent to the Payette River, expanded use of the geothermal resource may require more extensive treatment. The redirection of the existing CSB1 outflow to a seasonal wetland that connects to the formerly used wetland via a naturalized channel not only allows for adequate water treatment, but maintains and enhances the existing wildlife habitat.

The Riparian Planting Zones shown below represent species relation to the waterline. The inset diagram focuses on Zones 2 through 4 within the Toe and Bank Zones as these areas will most greatly influence treatment of geothermal waters. Selected plants should be native or naturalized to the region, have the ability to thrive in and treat sodium-rich water, and add to the functional and aesthetic qualities of the water features.

Species	Hydrologic Zone	Salinity Tolerance	Availability In Field	Commercial Availability	Wildlife Value	Notes
Herbaceous Grasses and Grass-Like Species						
Carex nebrascensis	2,3,4	Medium	Common	Seed & Plugs	Waterfowl food & cover, small mammal cover	Tolerates heat if provided with adequate moisture
Nebraska Sedge						
Deschampsia cespitosa	3,4	Medium	Common	Seed	Small mammal cover	
Tufted hairgrass						
Eleocharis palustris	2,3,4,5	Medium	Very Common	Seed & Plugs	Waterfowl food	Excellent soil stabilizer
Spikerush						
Juncus balticus	2,3,4,5,6	Medium	Very Common	Seed & Potted	Waterfowl food	Tolerates wide range of hydrolic conditions
Baltic rush						
Pascopyrum smithii	4,5,6	Medium	Common	Seed		Excellent soil stabilizer
Western wheatgrass						
P. spicata 'Alt' ripperm	3,4,5,6	Very High	Introduced	Seed		Tolerates high salinity
Newhy hybrid wheatgrass						
Puccinellia nuttalliana	3,4,5,6	High	Common	Seed & Plugs	Small mammal cover	Tolerates high salinity
Alkali grass						
Scirpus acutus	2,3,4	Medium	Very Common	Seed & Plugs	Waterfowl food & cover, small mammal cover	Excellent soil stabilizer
Hard-stem bulrush						
Scirpus maritimus	2,3,4,5	High	Common	Seed & Plugs	Waterfowl food & cover	Tolerates high salinity
Alkali bulrush						
Scirpus pungens	2,3,4	Medium	Very Common	Seed & Plugs	Waterfowl food & cover, small mammal cover	Tolerates some hydrologic drawdown
Three-square bulrush						
Spartina pectinata	2,3,4,5	Medium	Fairly Common	Seed & Plugs	Small game cover	Not palatable for livestock
Prairie cordgrass						
Typha latifolia	2,3,4	High	Very Common	Seed & Plugs	Insect & small mammal food & cover	Can be invasive
Cattail						
Native Willows						
Salix alba	4	Low	Common	Yes		Good rooting ability from cuttings
White/Golden Willow						
Salix geyeriana	2,3	Low	Very Common	Yes-limited		Good rooting ability from cuttings
Geyer willow						
Salix lemmonii	2,3	Low	Fairly Common	No		Good rooting ability from cuttings
Lemmon willow						
Salix lutea	2,3	Medium	Very Common	Yes-limited		Good rooting ability from cuttings
Yellow willow						
Salix scouleriana	3 (upland willow)	High	Fairly Common	Yes		Need to be treated with hormone
Scouler willow						
Riparian Shrubs and Trees						
Alnus sinuata	2,3	Low	Fairly Common	Yes	Big game browse & upland bird food	Poor rooting ability from cuttings
Sitka alder						
Amelanchier alnifolia	2,3	Low	Common	Yes	Big game browse & upland bird food	Poor rooting ability from cuttings
Thinleaf alder						
Betula occidentalis	2,3	Low	Fairly Common	Yes	Big game browse	Poor rooting ability from cuttings
Water birch						
Cornus sericea	2,3,4	Low	Fairly Common	Yes	Game & small mammal browse & bird food	Moderate rooting ability from cuttings
Redosier dogwood						
Crataegus douglasii	3,4	Low	Fairly Common	Yes	Browse & cover for many species	Poor rooting ability from cuttings
Black/Douglas hawthorn						
Pentaphylloides floribunda	3,4	Unknown	Very Common	Yes	Big game browse	Poor rooting ability from cuttings
Shrubby cinquefoil						
Populus tremuloides	4	Medium	Very Common	Yes	Big game browse	Poor rooting ability from cuttings
Quaking aspen						
Populus trichocarpa	4	Unknown	Very Common	Yes	Big game browse	Very good rooting ability from cuttings
Black cottonwood						
Prunus virginiana	4,5	Low-Medium	Common	Yes	Birds & small mammals eat fruit	Good rooting ability from cuttings
Chokecherry						
Ribes aureum	3,4,5	High	Common	Yes	Birds & small mammals eat fruit	Good rooting in greenhouse
Golden current						
Rosa woodsii	2,3,4,5	Low	Very Common	Yes	Rosehips eaten by many species	Good rooting in greenhouse
Wood's rose						
Sambucus cerulea	4,5	Low	Fairly Common	Yes	Fruits important for birds	Poor rooting ability from cuttings
Blue elderberry						

Riparian Planting Zones



Diagrams Modified From: Hoag, J. Chris, F. Berg, S. Wyman & R. Sampson, 2001. "Riparian Planting Zones in the Intermountain West."


Track and Field Entrance


Track access to pavilion and Geothermal Park


Geothermal Park playground, looking toward Payette River


West bridge over cooling stream

A Vision for Direct Use Geothermal Application Expansion in Cascade

The potential for expansion of direct use geothermal utilization exists in Cascade. The current applications within the city prove its viability and further opportunity analyses have confirmed the unrealized capacity of the natural resource within the city.

As Cascade transitions from its former economic ballast of timber production, the full utilization of the town's tapped geothermal resources can provide unique opportunities that go beyond the present cost savings and reduced emissions of district heating that the town currently experiences.

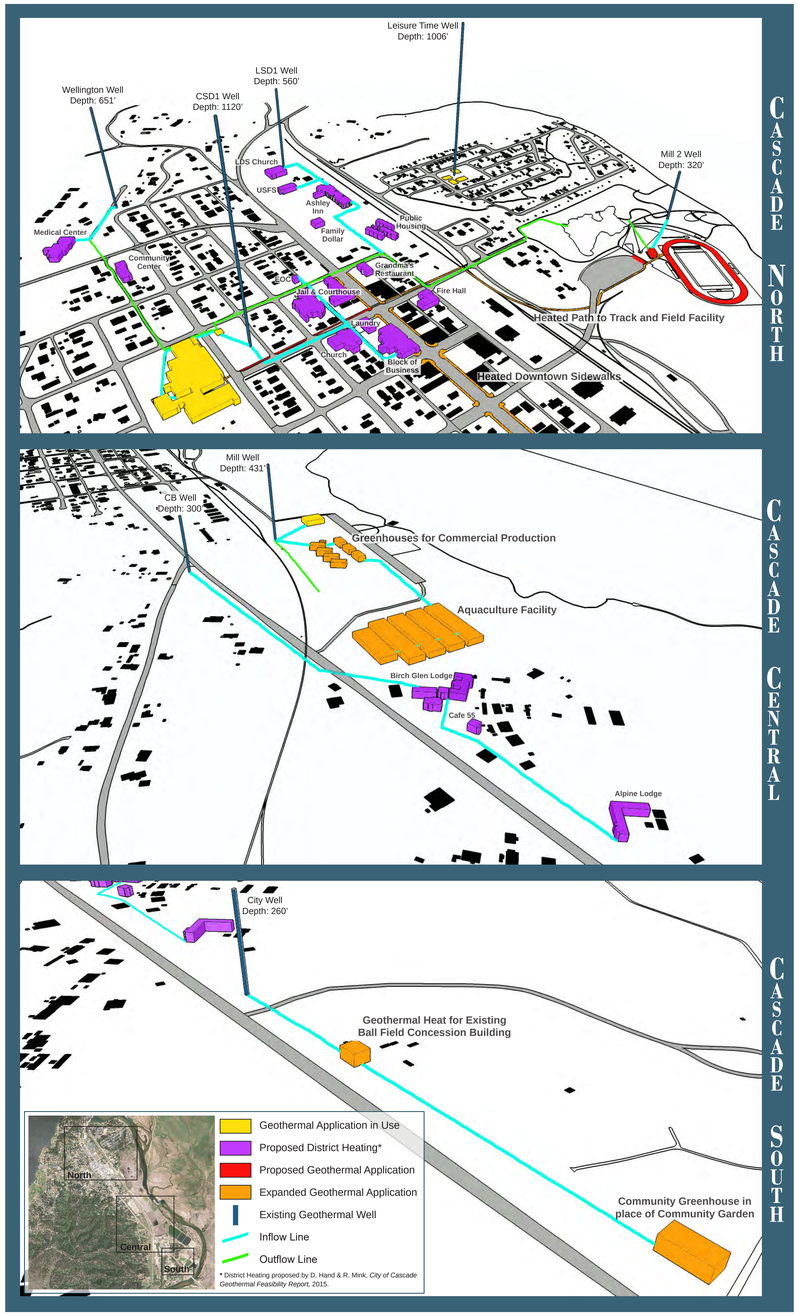
The illustration below presents a scenario of expanded geothermal use. Included is the proposal laid out in this presentation as well as the proposed expansion of the city's district heating system as detailed in the *City of Cascade Geothermal Feasibility Report*. Lastly, a plan is suggested for continued expansion of direct use applications, including expanded downtown sidewalk heating, community and commercial greenhouses, and aquaculture facilities.

Exploring the full range of direct use geothermal applications can result in unexpected benefits that radiate throughout the town. Through gains such as job creation, promotion of commercial growth, expansion of the tourist industry, improvement in quality of life, and incitement of community cohesiveness, geothermal projects can effect a high level of resiliency for the residents of Cascade as they play an active role in adapting with their changing circumstances and environment. Whether it is through agriculture, fisheries, snow melting, heating and cooling requirements or other uses, geothermal resources can not only reduce a community's carbon footprint, but transform a community environmentally, economically and socially.

Potential Benefits from Direct Use Geothermal Applications

- Energy security and price stability
- Long term environmental sustainability
- Improved agricultural productivity
- Increased food security
- Educational opportunity
- Job creation
- Promotion of commercial growth
- Expansion of tourist industry
- Stimulus for community cohesiveness
- Improved quality of life


Leo A. Geis, 2011



* District Heating proposed by D. Hand & R. Mink, *City of Cascade Geothermal Feasibility Report*, 2015.