SHASTA RIVER RIPARIAN VEGETATION ASSESSMENT

1.0 Study Goals and Objectives

The evaluation of riparian vegetation on the entirety of the Shasta River has two principle goals:

- Characterize current riparian vegetation conditions
- Identify potential opportunities for restoring and/or enhancing the ecological functions of riparian vegetation

Specific study objectives include:

- Determine the present distribution of riparian vegetation (total vegetation canopy cover).
- Sample the species composition and structure of riparian vegetation
- Identify environmental and land use constraints affecting the distribution and condition of riparian vegetation
- Identify locations where restoration and/or enhancement of riparian vegetation may provide benefits such as increased stream shading, reduced sedimentation, and improved bank stability
- Determine canopy height, width, offset, and density of riparian vegetation for use in water temperature models

2.0 Existing Information/Literature Review

There have been several studies of riparian vegetation associated with the Shasta River and its tributaries. Included among these are studies assessing the potential for restoration, as well as modeling the benefits of riparian restoration and enhancement in moderating stream temperature (Deas et al. 1997, Deas et al. 2003, NCRWQCB 2006).

Conditions in the Shasta River watershed vary depending on location, adjacent land uses, and diversion impacts. Diverted flows, historic mining activities, and grazing have affected riparian conditions along the Shasta River. Deas et al. (1997) mapped the riparian vegetation in 1997 and classified four conditions: 1) riparian forest patches; 2) continuous linear vegetation with more than two trees per 100 feet of stream; 3) scattered linear vegetation with less than two trees per 100 feet of stream; and 4) absence of riparian vegetation. An example of that mapping is included in Appendix B. The riparian corridor is discontinuous in many places with limited remnant stands of willow and cottonwood. Some sections have virtually no riparian trees. Deas et al. (1997) identified relatively larger patches of riparian cover that still exist on point bars. Below Dwinnell Dam the riparian conditions vary from good and improving to poor depending on water availability, stream incision and agricultural impacts. Livestock exclusion fencing has been installed on several miles of stream. Riparian plantings have generally had very low survival rates.

Additional studies of riparian vegetation in relation to groundwater, soils, and potential restoration include Newlun (1983) and Watershed Sciences (2004).

Appendix A presents images displaying typical riparian conditions along the Shasta River.

3.0 Study Areas

This study plan anticipates conducting riparian assessments on all reaches of the Shasta River watershed (approximately 795 square miles) utilizing remote sensing data and limited fieldwork. During project scoping, the Shasta River was segmented into study reaches using criteria such as hydrology, length, geomorphology, and others (Normandeau Associates 2013; Figures 1 and 2). The entire Shasta River mainstem and all tributary reaches are proposed for riparian vegetation assessment.

4.0 Study Methods

4.1 Riparian Cover Mapping

The first step in the riparian vegetation assessment should be mapping the distribution of riparian vegetation in the Shasta River. Mapping should be done using the most current available aerial photographs, alternative imagery, or low-level aerial photography (NCRWQCB 2014), and standard vegetation mapping protocols. Digital color aerial imagery available from the National Agriculture Imagery Project (2012) is recommended. Additional commercially available imagery may be used to enhance the mapping. The level of resolution should distinguish mapping units of 0.25 acre. Many of the mapping units will consist of linear polygons with narrow vegetation cover. At the minimum, cover should be classified as herbaceous and/or emergent aquatic vegetation, shrub, and tree dominated. If feasible, polygons should be classified at the species level for later verification in the field. In addition to providing a comprehensive picture of the riparian vegetation, the mapping will suggest locations where connectivity can be increased through targeted restoration actions (Harris and Olson 1997; Olson and Harris 1997). Examples of mapping at the life form and plant community levels in the Shasta River watershed are shown in Appendix B.

Aerial photograph interpretation will yield at least the following general stratification in the study areas:

- Riparian vegetation absent
- Riparian vegetation consists of herbaceous vegetation, including emergent aquatic vegetation
- Riparian vegetation consists of linear strips of trees or shrubs essentially one or few canopies wide
- Riparian vegetation consists of patches several canopies wide

These data in turn can be used to derive information on the following variables (Gonzalez del Tanago and Garcia de Jalon 2006):

- Longitudinal continuity (length of riparian vegetation patches)
- Width of riparian vegetation patches
- Lifeform (herbaceous, emergent aquatic, shrub and tree dominated)

As illustrated in Appendix B, it is anticipated that the structure and composition of much of the riparian vegetation can be determined from the mapping. Aerial imagery mapping will also

identify locations where bank and floodplain conditions have been degraded by past land uses or natural events. Historic river photographs held at the Siskiyou County library should be reviewed as part of the assessment of channel and vegetation change over time. A LiDAR survey of the Shasta Valley for the Shasta Valley Resource Conservation District (TerraPoint 2008) may also contain useful information.

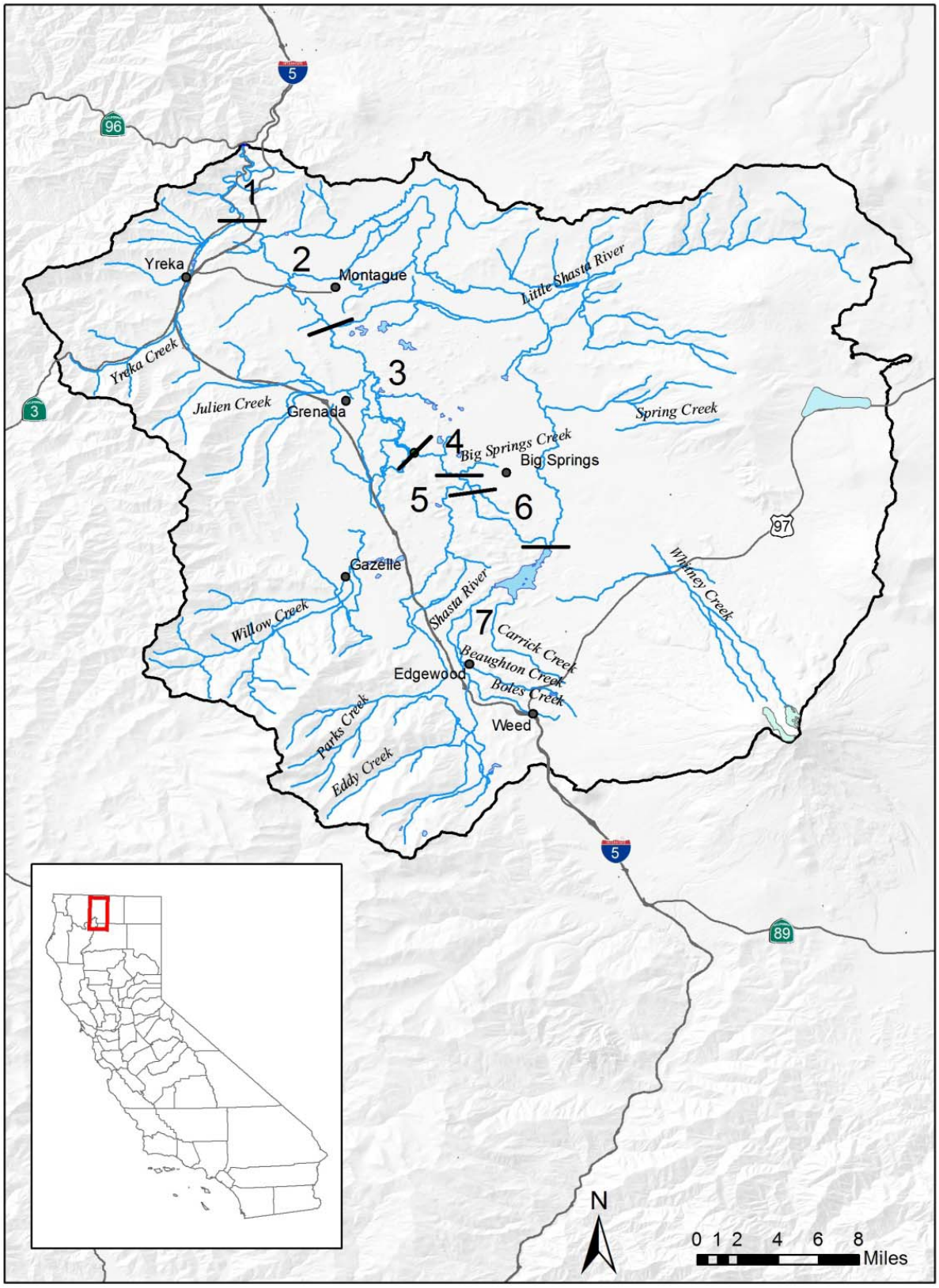

Figure 1. Shasta River Mainstem Reaches.

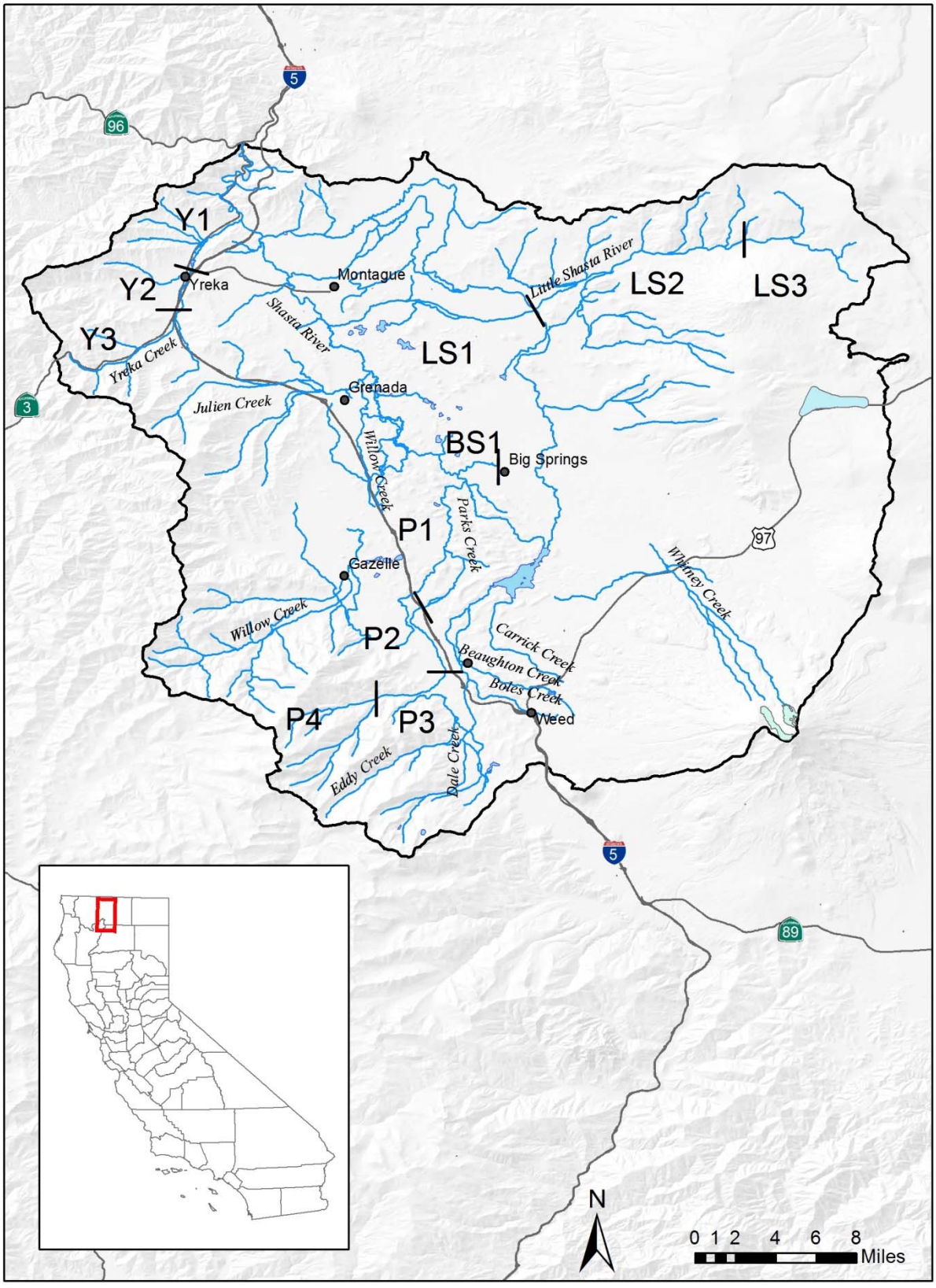

Figure 2. Shasta River Tributary Reaches. Reach BS1a (Little Springs Creek), a tributary of Big Springs Creek, is not depicted due to its short relative length (0.7 miles).

4.2 Field Sampling Plan

The majority of the Shasta River and tributary reaches are on private land and access to sampling sites will be a limiting factor. This constraint alone indicates how important a high quality aerial imagery mapping will be for documenting the area and general characteristics of riparian vegetation. Conditions in areas that are not available for sampling may need to be inferred based on conditions where sampling is permitted. In lieu of actual plot measurements, vegetation conditions will be qualitatively determined. Conditions at inaccessible sites may be estimated from accessible viewing points (Olson and Harris 1997).

Field sampling will have three principal objectives:

- Verify aerial imagery mapping results
- Augment the results of aerial imagery mapping by collecting data on species composition, density, width, offset, and canopy height.
- Collect data that cannot be obtained from aerial imagery such as presence or absence of natural regeneration, connectivity between the stream(s) and their floodplains and soil conditions insofar as they affect the potential for riparian vegetation.

On the basis of the mapping from aerial imagery, choices can be made about where to focus the necessarily limited sampling effort. Relatively greater sampling effort may be assigned to locations with existing riparian vegetation where the cover is limited to ascertain environmental or land use constraints on riparian expression. Constraints on sites with no existing riparian vegetation may be determined by qualitative observations obtained through aerial photograph interpretation supplemented by field studies.

4.3 Data Analysis

Data on the areal extent, composition and structure of riparian vegetation and hydrologic and ecological function variables should be summarized by stream reach and for each study area as a whole. Aerial imagery mapping and field sampling will yield observations on environmental and land use constraints. These may include agricultural encroachment, channel or bank instability, channel incision, lack of access to water, unfavorable soil conditions or other factors. Mechanisms of constraint should be recorded to the degree possible. Analysis should include comparisons with previous characterizations of riparian vegetation in the Shasta River watershed (e.g. Abbott 2002) where feasible.

Restoration and enhancement opportunities may exist at the stream reach and site scales. At the stream reach scale, increasing connectivity of the riparian cover by filling in gaps in the corridor can achieve several benefits including improvements in wildlife habitat and stream shading and bank stabilization. At the site scale, the ecological functions of existing riparian vegetation patches can be enhanced by encouraging changes in composition and structure e.g., introducing conifers or hardwood species that will eventually improve woody debris recruitment and/or stream shade, eradicating exotic species, etc. There are several environmental and land use conditions that will influence the feasibility of restoration at either scale. These include:

- Land use, particularly presence of grazing animals or cultivated fields. Exclusionary fencing in the Shasta River watershed is limited. Any efforts at restoration or enhancement must either control the potentially negative impacts of agriculture or be focused on locations where agriculture is not occurring.

- Landowner willingness to engage in restoration and enhancement. The local Resource Conservation District has successfully recruited landowners in the watershed to participate in riparian protection and enhancement projects. Landowner willingness does not always correlate with sites where restoration and enhancement would achieve the greatest benefits.
- Existing environmental conditions including access to water, soil type and landform. Studies of riparian restoration potential commonly evaluate associations between riparian communities, fluvial landforms, substrate and streamflow to determine potential restoration reference conditions (Harris and Olson 1997; Harris 1999). This can be inferred for portions of study reaches where features such as point bars and terraces exist and there are remnant patches of relatively intact riparian communities.

Anecdotal information indicates that efforts to establish woody riparian plants have been largely unsuccessful. Exclusion of grazing animals has benefited both riparian and aquatic vegetation. For example, in the Shasta River watershed at The Nature Conservancy Shasta Big Springs Ranch, the removal of cattle encouraged growth of aquatic vegetation that led to positive reductions in water temperature. However, planting woody vegetation in the cattle exclusion zone met with limited success.

5.0 Deliverables

The results of this study should be a quantification of existing riparian habitat structure variables (as defined above) within the Shasta River watershed, an estimate of the area of defined plant community types and a qualitative assessment of hydrologic and ecological function variables of the riparian habitat (as defined above). Both digitized maps and reports should be produced from this study.

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Appendix A

Representative Riparian Conditions on the Shasta River

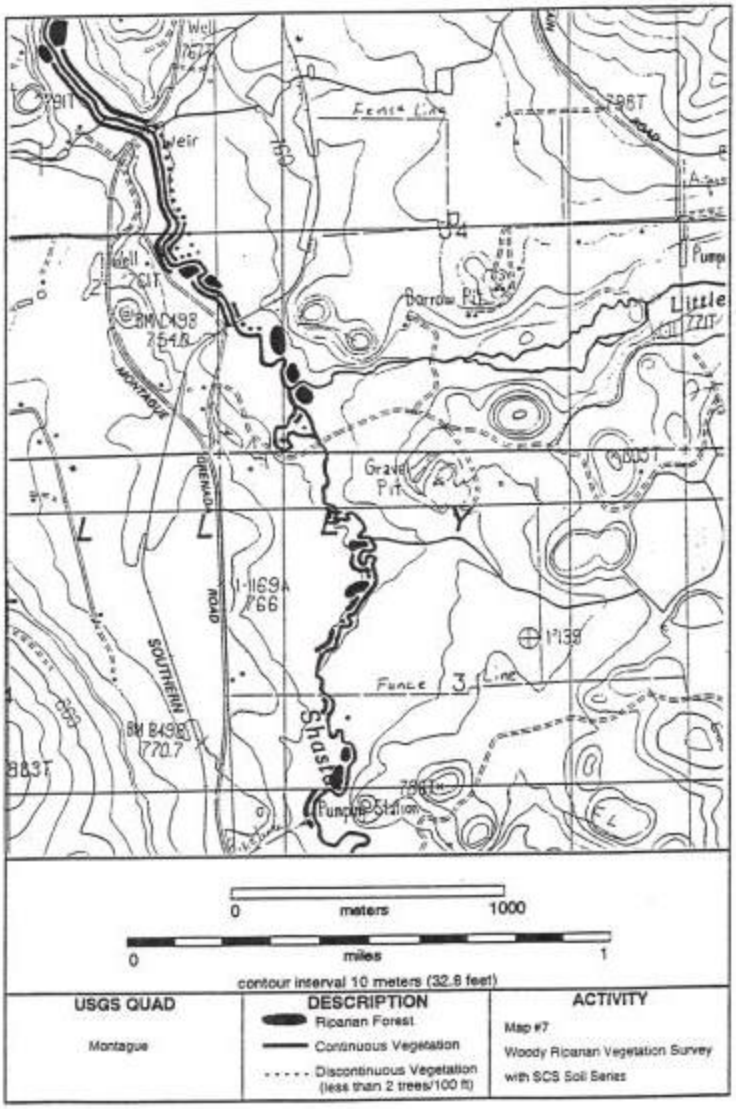


Figure 3.2 Subreach woody riparian vegetation map - Shasta River near Montague-Grenada Road Bridge, Map # 7.

Riparian Mapping for Selected Reach on Shasta River (Deas et al. 1997)

Shasta River sites illustrating common conditions of continuous and discontinuous narrow riparian corridor.

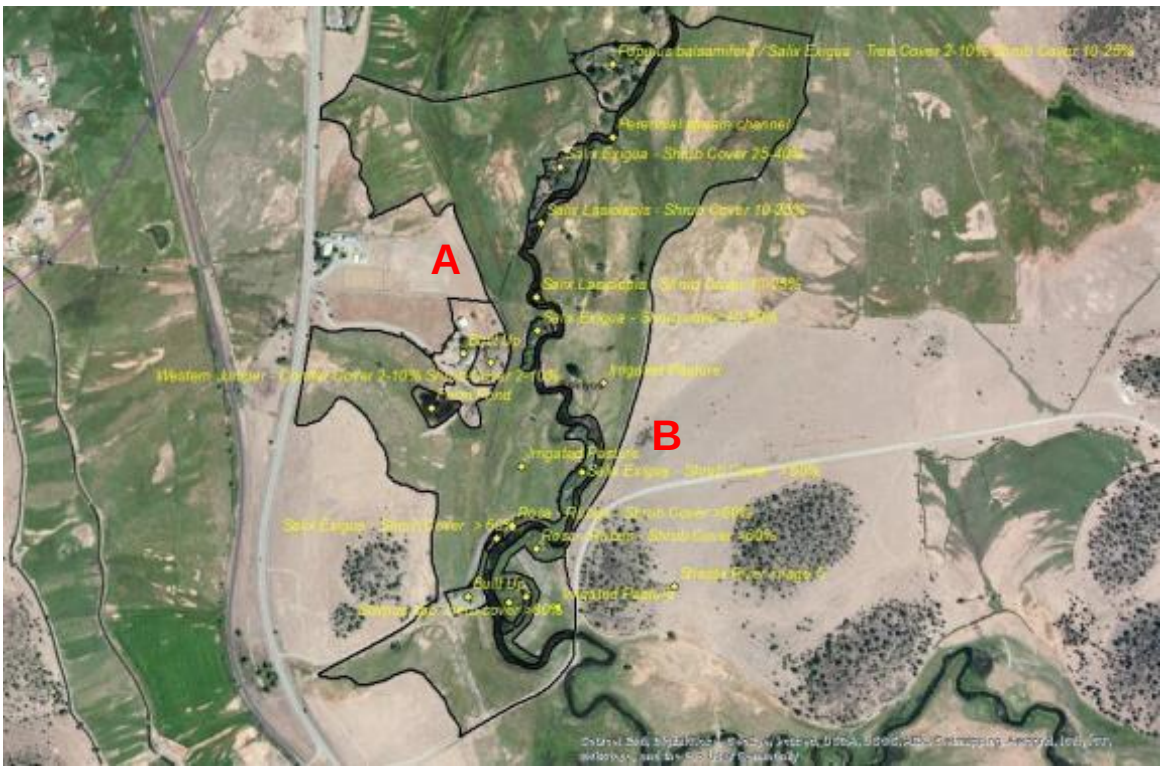
Locations where agricultural impacts have been minor still support some relatively large patches of riparian cover.

Where agricultural or other uses are directly adjacent to the stream, riparian cover may be absent or consist of relict trees.

Appendix B

Examples of Vegetation Delineation from Aerial Photography in a Test Reach of the Shasta River Basin

Vegetation delineations along a ~2/3 mile stretch of the Shasta River



Same area along the Shasta River with vegetation type assignments, stature cover estimates.

Enlargement of Area A above, showing vegetation delineations.

Enlargement of Area B above, showing vegetation delineations and attributes, including height categories.