Scott River Watershed Restoration Strategy & Schedule

Prepared by

the Scott River Watershed Council

&

Siskiyou RCD

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I. Purpose, and Objectives

Purpose Statement

The purpose of this "*Strategy & Schedule*" is to assess all existing information (both local information and peer-reviewed literature) regarding the status of the Scott River riparian corridor and previous revegetation efforts, and, where appropriate, to develop a plan for riparian protection, enhancement and restoration of the Scott River mainstem & tributaries. The intent of the "*Strategy & Schedule*" is to identify the most appropriate locations and restoration methods to enhance the river ecosystem to benefit the wildlife and aquatic health of the Scott River. Methods identified in this document are evidence-based and rely on methods proven to work in the Scott River Watershed or in other similar watersheds. In addition, this plan will outline methods to meet the intentions of the Scott River TMDL, to the fullest extent possible.

This document is intended to provide the local community with a tool to leverage funding for high priority restoration locations, as well as document the extent of riparian restoration implemented to date. An additional purpose is to identify the limitation to riparian restoration on the Scott River, given the current hydrologic, economic, and permitting restraints.

The benefits of riparian revegetation will include improved water quality, increased bank stability, increased terrestrial and aquatic habitat and food chain support for aquatic and terrestrial species. An additional benefit is increased water storage.

Objectives

The objectives of this plan are to: identify locations in the Scott River and tributaries most likely to benefit to riparian restoration measures, identify specific methods most appropriate for watershed restoration in the Scott Valley, identify reach specific design criteria, identify and prioritize project areas (including identification of willing landowners), develop a proposed schedule for restoration, and identify potential funding sources.

II. Introduction

Benefit/value of Riparian Vegetation

A riparian area is defined as the interface between land and a river or stream. The stream channel and banks are riparian areas, and the plants that grow there are called riparian vegetation. Riparian vegetation is essential for maintaining high water quality in streams, rivers, lakes, and along shorelines. Riparian zones dissipate stream energy, slow down water and prevent soil erosion. The meandering curves of a river, combined with vegetation and root systems, dissipate stream energy, which results in less soil erosion and a reduction in flood damage. Sediment is trapped, reducing suspended solids to create less turbid water, replenish soils, and build stream banks. Pollutants are filtered from surface runoff which enhances water quality via biofiltration (use of living material to capture and biologically degrade process pollutants)

The riparian zones also provide wildlife habitat, increase biodiversity, and provide wildlife corridors, enabling aquatic and riparian organisms to move along river systems avoiding isolated communities. They can provide forage for wildlife and livestock. Specific functions and benefits of riparian zones include:

- Bank stabilization and water quality protection
- Food chain support
- Thermal cover
- Fish habitat
- Wildlife habitat

Each of these benefits is described below:

- ***Bank stabilization and water quality protection***

The roots of riparian trees and shrubs help hold streambanks in place, preventing erosion. Riparian vegetation also traps sediment and pollutants, helping keep the water clean. Four specific ways vegetation can protect streambanks are (Klingeman and Bradley 1976):

I. The root system helps to hold the soil together and increases the overall bank stability by the ability of roots to hold soil particles together.

II. The exposed vegetation (stems, branches, and foliage) increases the resistance to flow and reduces the local flow velocity, causing the flow to dissipate energy against the plant parts rather than the soil.

III. The vegetation acts as a buffer against the abrasive effect of transported materials.

IV. Close-growing vegetation can induce sediment deposition by causing zones of slow velocity allowing sediments to deposit.

Vegetation is normally less expensive than most structural methods; it improves the conditions for fisheries and wildlife, improves water quality, and can protect cultural/archeological resources.

- ***Food chain support***

Salmon and trout, during the freshwater stage of their life cycle, eat mainly aquatic insects. Aquatic insects spend most of their life in water. They feed on leaves and woody material such as logs, stumps and branches that fall into the water from streambanks. Standing riparian vegetation is habitat for other insects that sometimes drop into the water, providing another food source for fish.

- ***Thermal cover***

Riparian vegetation shields streams and rivers from summer and winter temperature extremes that may be very stressful, or even fatal, to fish and other aquatic life. The cover of leaves and branches brings welcome shade, ensuring that the stream temperature remains cool in the summer and moderate in the winter.

- ***Fish habitat***

As dying or uprooted trees fall into the stream, their trunks, root wads, and branches slow the flow of water. Large snags create fish habitat by forming pools and riffles in the stream. Riffles are shallow gravelly sections of the stream where water runs faster. Many of the aquatic insects that salmon eat live in riffles. Salmon also require riffles for spawning. They use pools for resting, rearing and refuge from summer drought and winter cold.

- ***Wildlife habitat***

Riparian vegetation provides food, nesting, and hiding places for various animals and birds, including migratory birds.

Currently the tributaries to the Scott River, and portions of the Scott River Mainstem support a variety of wildlife and fisheries habitat. Deer, elk, beaver, and a variety of birds rely on these riparian areas, especially the corridor between French Creek and the mainstem Scott River. This document intends to identify a method to expand those habitats and riparian corridors.

III. Background

The Scott River and tributaries have been significantly altered in the past one hundred and fifty years. Large scale channel alterations (levying, dredging, straightening) have impacted the channel geomorphology and hydrological function of the Scott River. Extensive efforts have been undertaken in the past 20 years to attempt to restore the Scott River to a healthier riparian function. To date these efforts have been most successful in the South end of the Watershed (Siskiyou RCD 2009). Howeverin some locations of the Scott River Watershed it may be economically, hydrologically, and culturally impossible to return sections of the Scott River and tributaries to its historic potential vegetation conditions.

While the following paragraph gives a summary of the condition of the Scott River prior to European settlement, it should be recognized that many economic and legal situations exist that prevent fully returning the Scott River to its pre-European condition. In addition, any future significant flood event, such as the 1964 flood, or 1997 has the potential to remove much of the recent progress in re-vegetation. In addition to flooding, periods of extended drought impact the success of riparian revegetation projects.

Historic documents show the Scott Valley floor as having many beaver ponds, and grassy prairies. These beaver ponds would have backed up water and provided habitat for juvenile fish. The backing up of water would have stored groundwater for late season release, as well as captured sediment loads. Beginning in the 1830's, trappers began removing beaver, and records indicate that by the 1850's, beaver were nearly eliminated in the Scott River. The near elimination of beavers and consequently their dams, probably reduced channel complexity. These alterations would have impacted the riparian species as well. Although no specific documentation remains in the written record for such effects in the Scott River watershed, the ecological ramifications of beaver extirpation are well-documented for North America (see Naiman et al. 1988 for a review).

Historical channel alterations

The Scott River watershed has a history of more recent channel alterations; primarily for flood control, although gold mining played a role in the tributaries and along a six mile reach of the Scott River (Scott Tailings centered around River mile 54).

Hydraulic mining was at its peak in California by the 1880's, and many tributaries to the Scott River experienced some hydraulic mining (e.g., Miners Creek, Shackleford-Mill

Creek). The nature of hydraulic mining caused a devastating effect on the riparian environment and agricultural systems throughout California. In 1943 a large Yuba dredge began operating in the Scott River below Callahan and in several tributaries, excavating down 50-60 feet to bedrock, processing and piling millions of cubic yards of gravel and soil, and re-routing the river along the edge of the flood plain. The dredge operated through the early 1950's. Below Callahan, the tailings are piled along 6 miles of the river, and are as tall as 40 feet in places. This reach of the river channels water rapidly and does not connect with any historic flood plain.

Tributaries impacted by dredge mining include the South Fork Scott River, Miners Creek, lower Sugar Creek, and McAdams Creek, (Scott River TMDL, Appendix A).

The first channel straightening and leveeing was completed by the Army Corps of Engineers on the Scott River mainstem in the 1930’s (Western Sentinel Aug 10th, 1938). The clearing and leveeing occurred between the mouth of Etna Creek and Kidder Creek, and the lower portions of Kidder Creek. This clearing and leveeing resulted in enormous bank destabilization, channel widening, and downstream deposition of wide and deep gravel bars. Some of the leveed banks were armored again following breaching caused by the 1955 flood (Dave Black, personal communication 2011). This bank armoring has led to channel down cutting throughout the leveed reach. Currently there is an entrenched and high energy channel from approximately Hwy 3 to Eller Lane (RM 36 to RM43). The banks along this portion of the Scott River are steep and tall, resulting in an estimated 10-12 feet from the top of bank to the summer water table. Additional channel alterations and bank armoring was done by riparian landowners and the Natural Resource Conservation Service in various tributaries following the flooding in 1955, 1965, and 1997.

The result of these historic channel alterations is that the Scott River from RM 36 to RM 43 and some tributary locations are deeply entrenched and cannot access the historic flood plain. This entrenchment and subsequent depth to water table creates river banks that are not capable of sustaining as robust riparian vegetation as they previously had, although most locations support some grasses.

Historical restoration efforts

Riparian restoration efforts in the Scott River Watershed began in the 1950’s. Following the 1955 flood, bank stabilization was completed throughout the watershed in order to stop active bank erosion (Scott TMDL-Appendix I). Restoration primarily included stream bank stabilization to prevent further stream bank erosion. The oldest riparian revegetation project implemented along the Scott River was installed by Alvin Levis at River Mile 38 in the early 1990's. This vegetation has thrived and has reached mature growth. See Figure I. Aerial Overview of Alvin Lewis Planting site. In late afternoons during the summer it provides shade to the river channel (Alvin Lewis). Additionally, in 1997 approximately six miles of riparian restoration was completed from Fay Lane to French Creek. Some plantings in this reach have survived and are beginning to thrive. Some of the larger willows and cottonwoods are providing bank stabilization. (Appendix A contains documentation on these restoration efforts).

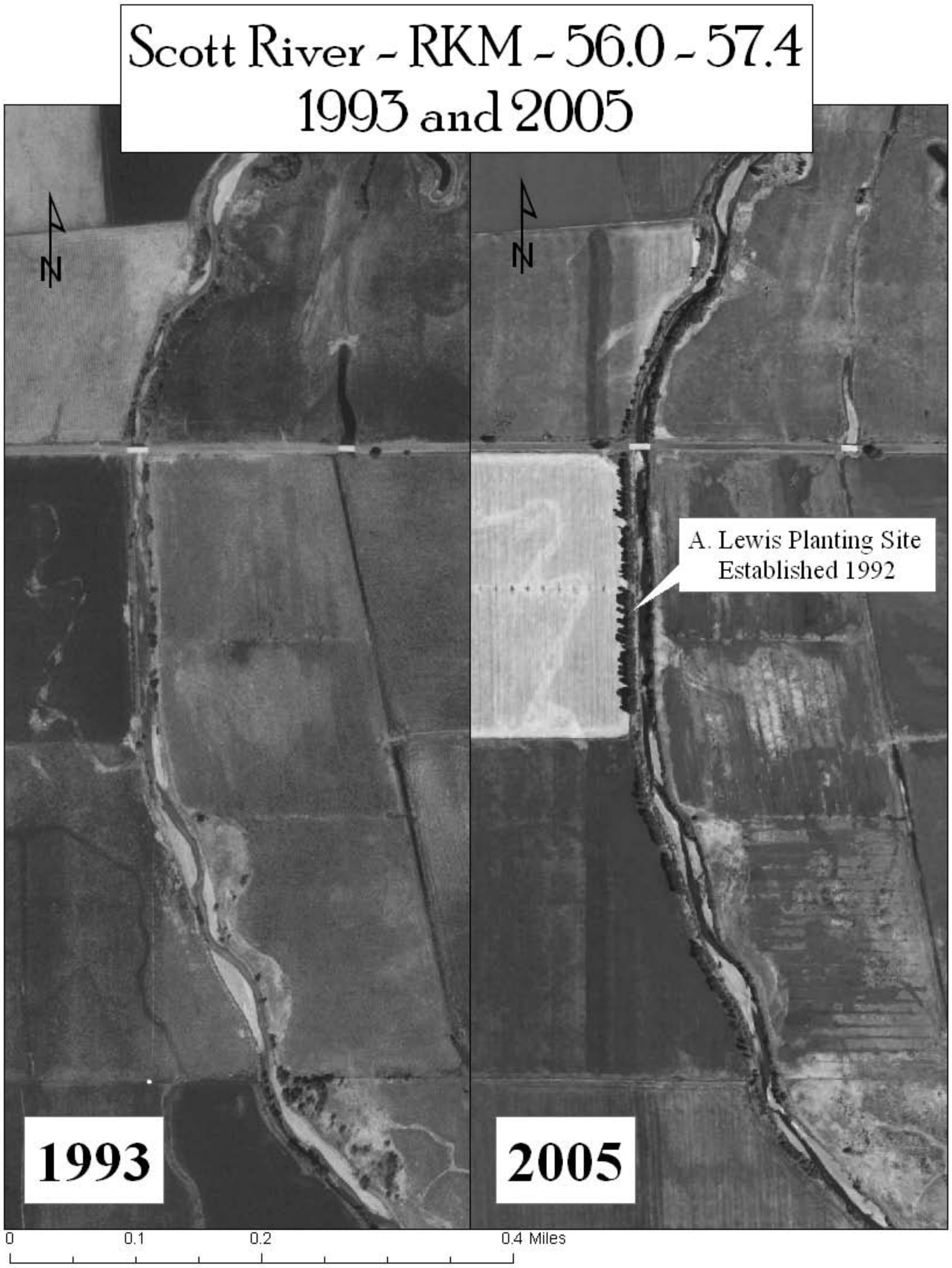


Figure 1 – Aerial photographs of planting site on the Scott River above and below Serpa Lane Bridge – 1993 and 2005. Tree growth on East Bank (left) is clear in the 2005 image.

IV. Current Riparian Restoration Efforts

Concern over fisheries habitat and water quality in the 1990's led to the implementation of riparian restoration efforts along the mainstem Scott River. In cooperation with NRCS or the RCD, or individually many landowners installed livestock exclusion fencing along the Scott River. To date more than 90% or more of lands adjacent to the Scott River which have grazing have been fenced, with additional fencing completed in 2013. Many riparian areas contain largely non-native vegetation; plants that compete and impede functional and native plants ability to derive nutrients and light from their environment. Managed Grazing can help to reestablish more functional vegetation in watersheds and to mitigate the effects of non-native vegetation (BLM 2006)

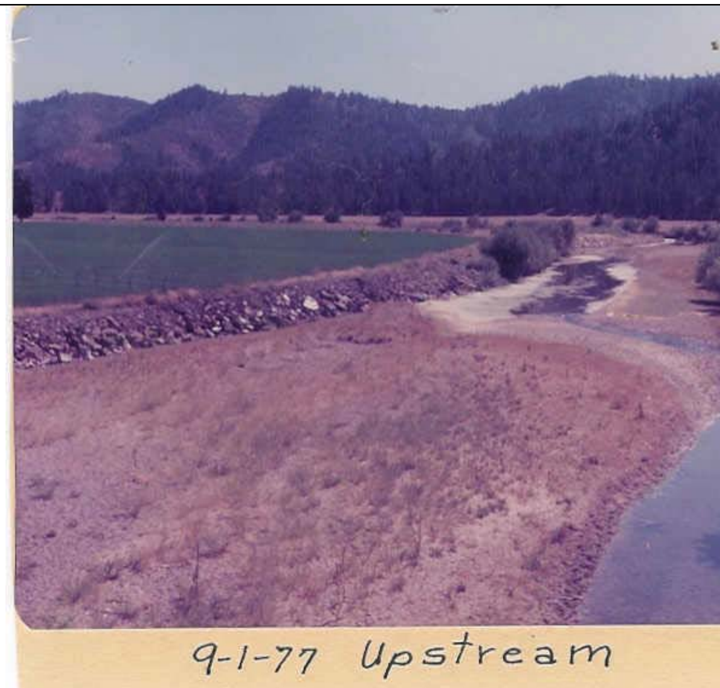
Between 1996 and 2007 the RCD implemented more than 350 acres of riparian planting along the Scott River and tributaries (Appendix A -Scott River Riparian Restoration Analysis 2007). These plantings showed mixed survival rates, but the highest survival was seen in the reach from Etna Creek to Fay Lane. Channel structure and proximity to water table played a role in this.

Efforts since 2007 have focused primarily on the tributaries, and the Scott River mainstem south of Etna Creek. These locations have shown more riparian replanting success, primarily due to channel size and structure, and the presence of a more stable water table. The most successful revegetation efforts have involved significant maintenance of the plantings, in the form of caging and seasonal irrigation (Silviera 2012, Lewis 1992).

Riparian Restoration is a long term committment

The series of photographs below show changes in riparian vegetation in the Scott River Watershed over a 30-50 year timeframe. These photos show an improvement in riparian vegetation. However, vegetative growth takes a long time in the extreme conditions that exist along the gravel bars and banks of the Scott River.

	February 1965 Looking downstream at the mouth of French Creek following the 1964 flood.
	**May 2008 Same location as above,** following extensive riparian planting and fencing beginning in the late 1990's.

	Sept 1, 1977 Scott River at Meamber Bridge looking upstream. Flows at the USGS gage (Rm 21.5) recorded at 6 cfs.
	July 28, 2004 Scott River same location as above, USGS Flows recorded at 39 cfs

Recovery takes Time

Timeline : Fay Lane Bridge

The following images were taken from the Fay Lane Bridge, looking North toward Fort Jones. Note the appearance of vegetation in the lower Right Hand corner.

Faye Lane Bridge, directly after 1964 Flood

Looking North, 1977

1989

July 2004

May 2013

V. Current Conditions

The following section describes the unique characteristics of various reaches of the Scott River and tributaries. This description includes how the reach characteristics (i.e., channel structure, depth to groundwater, bank substrate) impact restoration design and planning.

Geomorphic Reach Descriptions – Scott River Mainstem

For the purpose of this analysis, the Scott River was divided into five general reaches. Reach breaks were developed based on geomorphic survey data (channel cross-sections & longitudinal profiles), channel type data, documentation from long term DWR well data, and documentation from local revegetation efforts. Available data has shown that both the depth to low flow water table, and the available width of floodplain (i.e., riparian corridor) varies from reach to reach along the Scott River Mainstem (Siskiyou RCD 2009). For the purpose of riparian analysis and planning, the Scott River mainstem has been broken into the following four reaches based on channel characteristics. These reaches are;

Reach I. Scott River at Callahan to end of tailing piles (RM 57.1 - 52.1).

Reach II. Scott River End of tailings piles to Youngs Dam (RM 52.1 - 46.7).

Reach III. Scott River Youngs Dam to ~1.5 miles downstream of Etna Creek (RM 46.7 – 41.4).

Reach IV. Scott River ~1.5 miles downstream of Etna Creek to Oro Fino Creek (RM 41.4 - 29.3).

Reach V. Scott River at Oro Fino Creek (RM 29.3) to River Mile 21.

See Figure # 2 for a location of reach breaks.

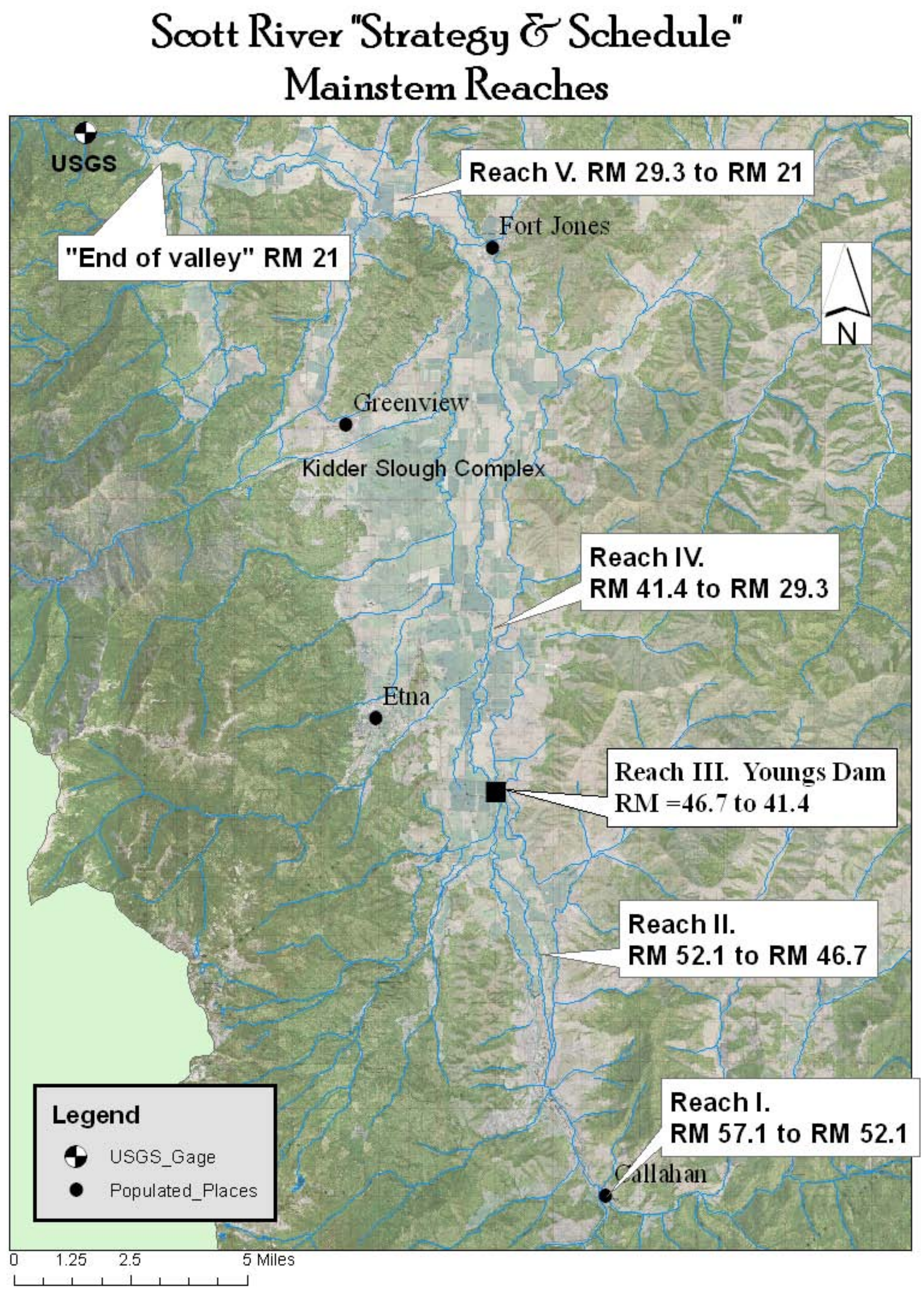


Figure - #2 – Main stem Scott River reach breaks.

Reach descriptions

Reach I. Scott River Callahan to end of tailing piles (RM 57.1 -52.1)

This reach begins at the confluence of the East and South Forks of the Scott River (RM 57.5), and is predominated by the six miles of tailing piles left by the Yuba Dredge in the 1930's. Some areas of this reach have near vertical banks of tailing piles directly adjacent to the active channel. Cross-section data collected in 2010 shows that the banks can be higher than the channel thalweg by more than 20 feet in parts of this reach. Most of the reach has limited amounts of riparian vegetation.

For the most part the river has no access to a flood plain due to the dredge piles, and little to no soil present on the dredge spoils. See **Figure 3 Aerial Imagery of Scott River Tailings.** The bottom of **Figure 3** clearly shows the dredge piles present throughout this reach.

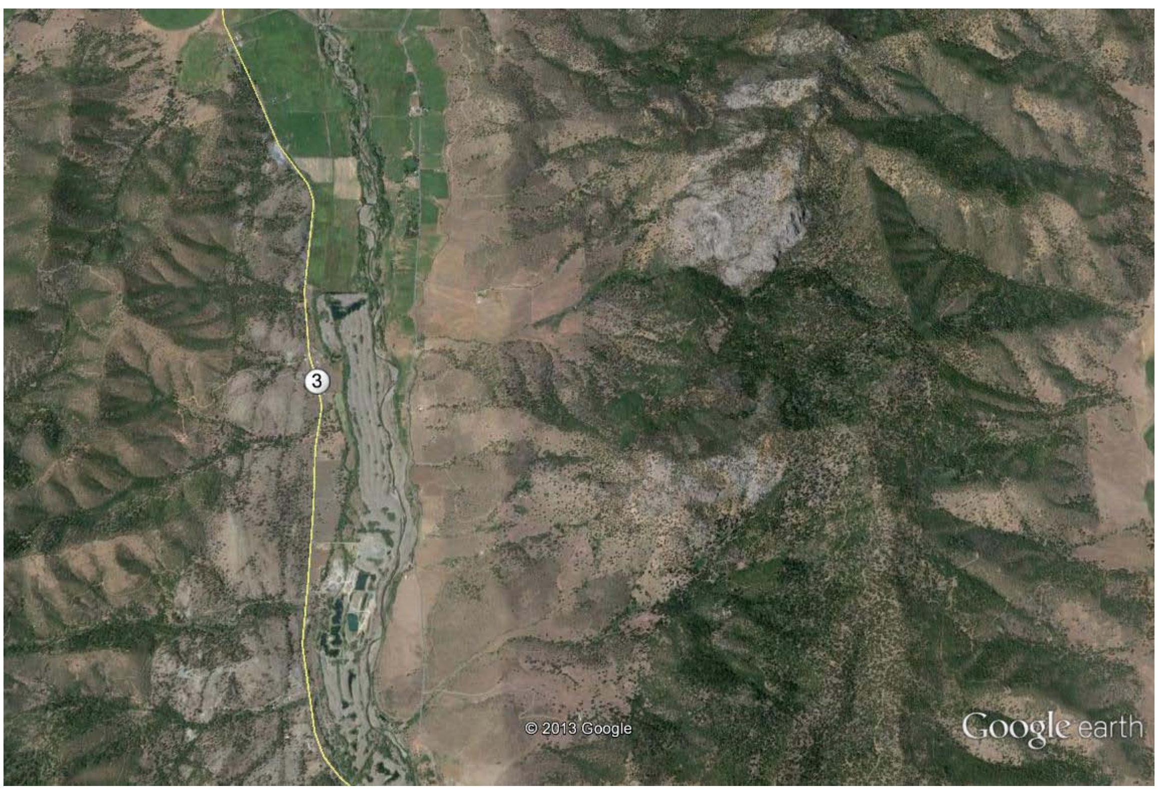


Figure 3. Image of Scott River Tailing, imagery Google Earth July 6, 2012.

Figure 4. Section of the Callahan tailings

The 2,500 foot segment shown in Figure 4. located at the downstream end of the tailing reach, was restored to a wider channel and flood plain in 2007. This reach is located where the tailings piles begin to taper off and open up to a wider channel. This lower portion of this reach has some potential to establish a riparian corridor. **See Appendix C for cross-section information.** However, the substrate in this reach is extremely large cobble with little to no fines present. The reach is very hot and dry, and the river goes subsurface at RKM 85.5 (RM 53.12). The river resurfaces a few miles downstream, and is cooled from the time spent subsurface.

Reach II. Scott River End of tailings piles to Youngs Dam (RM 52.1-46.7)

This reach is defined by a wide floodplain and riparian zone with a relatively shallow water table, compared to the rest of the Scott River. The combined width of the available riparian zone on both sides of the stream varies from 200 to 1,000 feet, with an average of 600 feet (RCD data 2010). The available riparian zone is identified as the area between riparian exclusion fencing and the stream bank. This reach has the widest fenced riparian land and flood plain on the main stem Scott River. All locations in this reach with livestock have had exclusion fencing installed for 15 years or more. Figure 3 shows aerial imagery (GoogleEarth) taken in 2012. **Figure 5** shows the aerial imagry of this reach, with French Creek entering the Scott River in the upper left corner.

This reach has braids and side channels present south of the Fay Lane bridge, and access to historic side channels floodplains north of the Fay Lane Bridge.

Beaver are present in **Reach II** and **Reach III**. Current beaver dam building activity in lower French Creek and the Scott River in the vicinity of Wolford Slough may be raising groundwater elevations and contributing to the success of the plantings in this reach. Figure 6 below shows the successful plantings established in 1996 and 1997.

Figure 5 . Reach II. French Creek is seen entering the Scott River Center left of image.

Figure 6: Scott River vicinity of French Creek (Middle left of image) and Wolford Slough(bottom left quarter of image) Lidar 2010

Planting rows visible in Figure 6 were planted in 1997 as part of the Fay Lane Project. These planting are some of the most successful in the Scott River, both in terms of vigor and survival.

In addition to the wide riparian zone, this reach has considerable surface and sub-surface influence from west side perennial streams (e.g., French Creek, and Wolford Slough.) Surface and subsurface flows from these streams likely contributes to the relatively high water table in summer. Stream channel cross-sections taken on the Scott River at Wolford Slough (,RM 48.47) indicate that ground surface elevation of the terraces adjacent to the river are 4-7 feet above the thalweg of the Scott River, which should roughly correlate with base flow water table. **See Appendix D for cross-section information.** Figure 6 depicts Wolford slough on the left, just upstream from the mouth of French Creek. The flow is from the bottom to the top of the image. In the right hand corner it is possible to see an old channel. Based on previous plantings and cross-section information, it is anticipated that all the land between the old channel and Wolford Slough would show a high survival rate for riparian replanting.

Previous riparian replanting in this reach along the west side of the Scott River, upstream from French Creek have been some of the most successful in the watershed (Scott River Riparian Restoration Analysis 2009). This planting is visible in Figure 6 above. The relatively high water table and influence of French Creek and Wolford Slough contributed to the success of these plantings. Supplemental planting was completed in this area in spring of 2013 to expand the existing riparian corridor. While livestock exclusion fencing is installed on the entire stretch of Scott River in this reach, deer, elk and beaver can severely damage young plantings.

Reach III. Scott River Youngs Dam to ~ 1.5 miles downstream of Etna Creek (RM 46.7 –RM 41.4)

The combined width of the available riparian zone on both sides of the stream in this reach varies from approximately 300 to 1,000 feet, with an average width of 350 feet. This reach has less available riparian and floodplain land on average compared to Reach II, but still maintains some meander and good riparian planting potential. Figure 7 shows aerial imagery of this reach. The existing meander bends are located upstream of the mouth of Etna Creek..

Many areas of stream bank that were actively eroding following the 1955 flood event have been stabilized with large rock rip rap. Several areas of successful riparian and non-riparian plantings were introduced by the Soil Conservation Service through this reach.

This reach is characterized by limited floodplain connectivity with the majority of the land adjacent to the active channel, and is comprised of leveed stream banks.

Figure 7. Reach III Google Earth Imagery July 2012.

Cross section data collected (2010) at Etna Creek (RM 40) shows that the low flow depth to water may be 5-7 feet in a normal water year.

Reach IV. Scott River ~ 1.5 miles downstream of Etna Creek to Oro Fino Creek (RM 41.4 – RM 29.3)

A large portion of this reach of the Scott River was "straightened, cleared and leveed" by the Army Corp of Engineers in the late 1930's. According to Wayne Elmore of the NRCS Riparian Service Team (Elmore 2004) "*Portions of this reach of the river were channelized or leveed by the U.S. Army Corps of Engineers starting in 1938. The channelization straightened, and thus shortened the length of Scott River. The shorter length causes an increase in velocity and subsequently leads to channel bed down-cutting. The down-cutting causes an overall lowering of Scott River bed elevation. The river can no longer access its historic frequent floodplain, which prevents it from dissipating energies during frequent events like 2- and 5- year events. The increased river energy has resulted in the need to rip-rap many sections of the river to prevent loss of* *adjacent agricultural areas. The vegetation along the channel is relatively sparse for the size of the Scott River. Agricultural areas have encroached on the banks of the river and leave little space for riparian vegetation. The root masses of existing riparian plants are insufficient to withstand the erosive forces of peak flow events. It is probable that cottonwood and willow composed a substantial portion of a much wider historic riparian zone. Few of these stabilizing trees and shrubs are present. Historically, a wide area of live trees and roots were intertwined with down, buried and partially buried (Large woody material) LWM that combined to dissipate stream energy*."

Elmore further states that "*A consequence of the channelization and levees is that the broad and relatively level floodplain no longer stores water for late-season release. As soon as the spring flow drops, the deeply incised channel cutting through the valley floor allows the accumulated groundwater to run into the relatively empty Scott River. The channel now acts as a drainage ditch similar to those used to drain wet areas.* ***Historically, when the river bed was higher, the hydrostatic pressure of the river and its saturated bed held back the groundwater in the valley until late in the summer and early fall.*** *Additionally, portions of the Scott Valley were historically home to large beaver colonies that created a maze of small dam complexes that stored large quantities of water. This water was gradually released during the late summer as adjacent river flows decreased. A greater amount of water was in the river longer when all the tributaries were at full potential for water storage. The fact that more water was infiltrated throughout the landscape, tributary floodplains, and valley floodplain, created a regime within which a longer period of time was required for groundwater molecules to wait their turn to exit the Scott River watershed*."

Patterson, Johnson, and Crystal Creeks enter this reach of the river from the west, and have stretches that only flow subsurface, then resurface and combine to form the Big Slough. Big Slough joins Kidder Creek to the east of Greenview and Kidder Creek joins the Scott River upstream of the confluence with Moffett Creek. The affects on the groundwater elevation from the major tributaries to the west of the Scott River in this reach is largely unknown.

Oro Fino Creek enters this reach of the Scott River from the south, downstream of Fort Jones, and Moffet Creek enters the north. These tributaries are dry during the summer months at and above their confluence with the Scott River. There is very little to no riparian vegetation along the dry reaches of the tributaries.

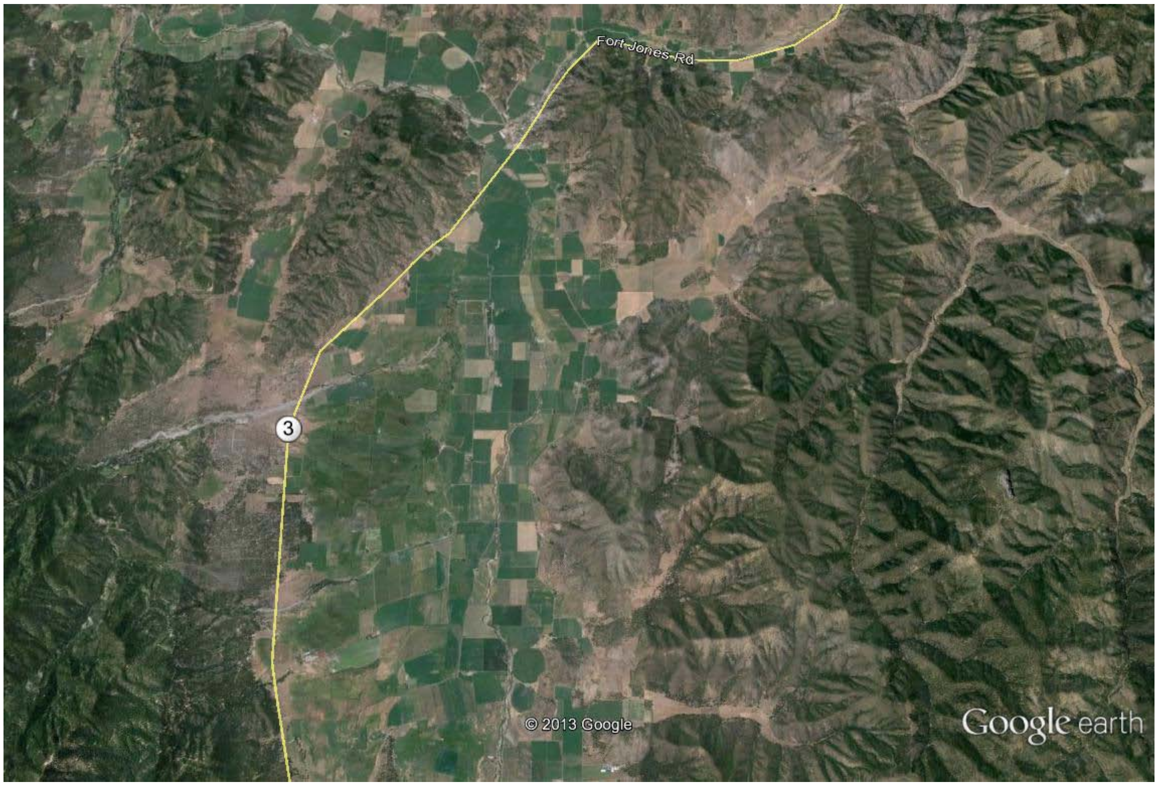


Figure 8. Reach IV. Aerial Imagery Google Earth 2012

A stretch of the Scott River in this reach, approximately 3 miles long , has an average of less than 110 ft of combined available land on both sides of the river. (See Figure 9 below). This section of the reach has the smallest average width of available land adjacent to the stream for riparian planting and potentially has the greatest distance from "riparian" landforms to the low flow surface and groundwater elevations. Based on observations recorded in planting contract final reports and observations in the field it is estimated that ground surface elevations on the adjacent terraces is between 8-11 feet above the low flow surface and groundwater elevations. The rest of the reach has an available width for riparian planting is uniform throughout the majority of the reach with only a few locations in which the combined available width is less than 300 feet.

An important feature of this reach is that it is at the point where the Scott River makes a sharp turn and flows due West. This alignment of the river channel from RM 31 to the mouth of the Scott River makes it nearly impossible for riparian vegetation to provide shade during the afternoons. However, riparian vegetation can still play a role in sediment management and groundwater recharge.

Figure 9 – Representative section of the leveed section of Reach IV around RM 34.

Reach V. Scott River at Oro Fino Creek (RM 29.3) to River Mile 21.

This reach has some similar characteristics to Reach III, but is not dominated by high elevation levees. This reach of the Scott River is dominated by gravel and cobble throughout the stream banks and adjacent floodplains, with little soils for plantings to establish. Historic planting sites varied from sandy loam to high gravel bars. The distance to groundwater in the riparian corridor is estimated to be greater than 10 feet in many locations, but no rigorous data is currently available. To date, no current channel cross-section data is available for this reach. Indian and Rattlesnake Creek enter from the North and Shackleford-Mill and Oro-Fino Creeks enter from the South. Oro-Fino, Indian and Rattlesnake Creek flow sub-surface 6-9 months out of the year. Shackleford-Mill typically goes sub-surface in late July until the first significant fall rain, which generally occurs in October or November.

Previous plantings done between the mouth Kidder Creek and Oro Fino Creek were unsuccessful. It is hypothesized that the water table recedes too fast in the summer for plantings to establish roots. However, to date planting methods in the reach have not included pole cuttings trenched down to the low flow water table. This method will be implemented in the spring of 2014.

Figure10 .Aerial Imagery of Reach V. Google Earth July 2012

Geomorphic Reach Descriptions – Tributaries

I. East Fork Scott River

The East Fork has much of the same land use patterns seen in the mainstem Scott River. The full extent of the East Fork flows perennially, with no known dry reaches. Currently little is known about the condition of the riparian corridor in this reach, other than aerial images captured during the 2003 FLIR flyover of the Scott River (Watershed Sciences 2003). A stream habitat inventory completed in 2002 (CDWR 2002) on the mainstem Scott River found the reach to be moderately entrenched with stable banks. The report recommended planting willow, alder and Doug Fir along the streambanks. Water temperatures in the tributaries are slightly elevated, due to historic land management. The East Fork has not been topographically surveyed. Visual observations indicate that it is not down cut. It is expected that this location will respond well to planting, in conjunction with livestock exclusion fencing and grazing management

II. South Fork Scott River

The South Fork Scott River flows perennially, and maintains cold water temperatures; due to topographic shading and snow-melt. The South Fork Scott River was also impacted by hydraulic mining operations in the late 1800's. This mining left many mining piles and exposed bedrock, which limits the success of riparian vegetation. However, this reach is dominated by bedrock, and snow-melt water temperatures are cold (<16 C), so it is not a priority location for temperature or sediment control.

III. Alluvial reaches of Kidder, Patterson, and Etna Creek .

Historic land use practices led to a build-up of large alluvium in the lower gradient reaches of these tributaries, primarily above and below the Hwy 3 crossings. This is typically large cobble which does not hold soil or water, and is not suitable for riparian establishment. The stream channels are very wide in these reaches, making it difficult to effectively shade the channel. These alluvial reaches go subsurface annually, even in wet water years. Outside of the alluvial reaches, these tributaries maintain adequate riparian canopy and cold water temperatures. These alluvial reaches are candidate for geomorphic analysis and instream enhancement projects prior to installation of any riparian enhancement efforts.

Figure 11. Lower alluvial reach of Etna Creek.

Figure 12. Alluvial reach of Patterson Creek upstream and downstream of Highway 3.

Figure 13. Alluvial reach of Kidder Creek.

IV. Shackleford-Mill Creek

Shackleford Creek has two alluvial reaches, the first is in the lower ½ mile at the confluence with the Scott River, and the other reach is on Quartz Valley Indian Reservation, upstream from the Quartz Valley Rd Bridge. (See Figure 14.) Other than those dry reaches, Shackleford Creek maintains perennial flows, suitable water temperatures for salmonids, and complex rearing habitat. The existing riparian condition is adequate, and many locations have undergone natural recruitment following exclusion fencing. Site specific replanting would be effective in the lower sections of Shackleford Creek. It is not clear at this time if the alluvial reaches that currently go sub-surface can be returned to perennial flow. The substrate in these reaches is large rock and cobble dominated and not likely to support riparian replanting.

Riparian vegetation in lower Shackleford Creek.

Mill Creek maintains suitable canopy cover water temperatures for approximately 2 miles upstream from the confluence with Shackleford Creek. After a ¼ mile of alluvial reach, Mill Creek again flows perennially, with adequate canopy cover. See Figure 15. No riparian replanting is recommended for this location at this time. Continued protection of the riparian corridor is strongly recommended.

Figure 14 Lower Shackleford-Mill Creek

Figure 15 Mill Creek (tributary to Shackleford Creek).

V. French Creek

Significant watershed-wide restoration has been implemented in the French Creek Watershed. French Creek has been the site of a significant amount of successful riparian replanting, as well as local efforts to reduce sediment contributions, primarily through road management (French Creek Watershed Advisory Group). French Creek maintains year-round flows, which contributes to a relatively high water table. Overall the riparian corridor is functioning with excellent canopy cover, although isolated locations are in need of site-specific planting.

Beaver play an important role in the riparian ecosystem of French Creek and the mainstem Scott in the vicinity of French Creek. The dam building in this area likely contributes significantly to an elevated groundwater table. Plantings implemented in the Scott River in the vicinity of French Creek have been some of the most successful in the watershed.

Figure 16. Scott River at the confluence with French Creek.

VI. Sugar Creek

Sugar Creek has no alluvial deposition section, and flows year-round. Sugar Creek has an active beaver population in the lower ½ mile, contributing to water storage and salmon habitat. The riparian canopy in Sugar Creek is mature, and provides sufficient shade to the creek. The combination of canopy, aspect, and snow-melt keep the water in Sugar Creek at an average of 16-18°C in the summer. At this time riparian replanting is not needed in Sugar Creek. However, some landowners have identified a need to protect key trees from beaver damage. This protection will be done on an as needed basis, with some tree caging beginning in 2013.

Figure 17. Sugar Creek.

VI. Kidder Slough

The Kidder Creek Slough is the area where Johnson Creek, Crystal Creek, and Patterson Creek come together and enter Kidder Creek. The Slough runs parallel to the Scott River and has significant surface and groundwater contributions. At this time little information is available regarding water temperatures and status of the riparian corridor.

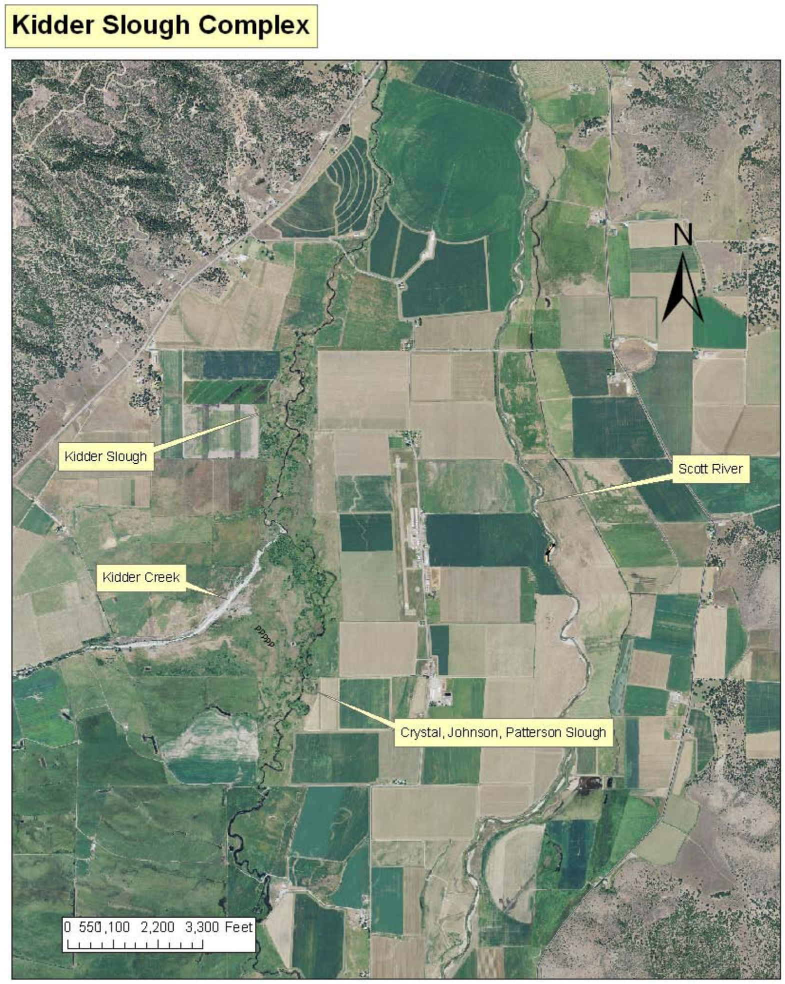


Figure 18. Kidder Slough (Crystal, Johnson, Patterson and Kidder Creek)

VI. General Restoration/Preservation Approaches

Successful work in similar watersheds

A literature search was done to evaluate which methods of riparian restoration have proven most successful in similar watersheds (i.e., similar annual air temperatures, rainfall, channel structure, etc.). Several papers have been written in the past five years which attempt to evaluate the success of riparian restoration efforts in the West. Overall, they all reach the following general conclusions.

- Active and passive riparian restoration efforts are both successful. (i.e., fencing versus replanting)
- Site assessment needs to be completed prior to the implementation of riparian restoration.
- All materials and methods should be selected on a site-specific basis.
- Maintenance needs to be part of the project design, both short term and long term.

A Master's Thesis completed at the University of Montana Missuola (Walls 2011) evaluated riparian revegetation projects completed in the Pacific Northwest. This evaluation specifically identified the following methods for locations with summer drought and course alluvium, such as many locations in the Scott River watershed.

- Planting rooted poles with most of the buds covered, which allows for root establishment without needing to support extensive above ground growth.
- Planting in excavated trenches down to water table.
- Use of a stinger (a hydraulic drill that injects water into the planting hole) in locations with large amounts of rock or rip-rap.
- These recommendations mirror observations made locally regarding successes and failures in riparian planting in the Scott River Watershed (see Appendix C).

Riparian Restoration Literature Search

The Natural Resource Conservation Service is very experienced in riparian restoration. They have published papers specific to riparian restoration in the arid climates (Hoag and Fripp 2005) such as the Scott River, and specific papers on various riparian species. In addition, in 2008, both Chris Hoag and Jon Fripp visited the Scott River Watershed and helped design a bioengineered stream bank project. This project was highly successful, and lessons learned have been incorporated into future planning efforts. Their information is incorporated into the recommendations at the end of the document and available in the bibliography.

Beaver management as a restoration tool

Throughout the United States, beaver are acknowledged as a low cost option for riparian restoration. Pollock (2003) states that "the limited available evidence suggests that key hydrologic functions of beaver dams are to: dissipate stream energy, attenuate peak flows, and increase groundwater recharge and retention, which increases summer low flows and elevates groundwater levels in stream valleys, thus expanding the extent of riparian vegetation".

The positive impacts of beaver activity that have been noted in the mainstem Scott River and tributaries, as well as the extensive national literature describing the benefits of this keystone species, has led the Scott River Watershed Council (SRWC) to identify the restoration of beaver throughout the watershed as a prime recovery strategy. The SRWC has been a participant in a multi-stake holder group seeking to lower regulatory barriers to the successful support of beaver in the watershed. In addition they have spear headed a volunteer effort to mitigate nuisance issues that occur with human beaver cohabitation such as culvert blockage and large tree damage. To date, two culvert maintenance devices ("beaver deceivers"), and a pond leveler have been installed, and a tree protection project has been accomplished, with others planned in the near future. The consideration of supporting beaver habitat, allowing natural, reintroduction of the species throughout the watershed is considered to be an important component of watershed restoration, which could provide considerable benefit in terms of raised water table, decreased sediment loads, improved fish habitat, and increased vegetation with all of its associated benefits, on a very cost effective basis.

Best Science

Scott River Mainstem

In 2004, at the request of the Scott River Watershed Council, the Natural Resource Conservation Service Riparian Service Team visited a series of sites on the Scott River and tributaries (Elmore 2004).

The NRCS Riparian Service Team made the following three key recommendations for enhancing the Scott River riparian corridor, following their field tour in 2004;

1.) Expand the riparian corridor.

2.) Determine the effects of the dredge tailings on the rivers function.

3.) Recovery of the channel bottom elevation.

Through 2007-2009 the Siskiyou RCD completed an analysis of all previous riparian planting in the Scott River, in order to determine which methods were most effective. The complete report is available in Appendix A. Key recommendations from that analysis are:

1.) Caging of trees is necessary to prevent animal browse (deer, elk, beaver, occasional stray bovine).

2.) Pole cuttings should be planted to the low flow water table depths. In locations with year-round water this may provide sufficient water.

Data Gaps

The following data gaps have been identified by the Riparian Planning committee as necessary data to fully develop an in stream restoration strategy for the Scott River:

- Geomorphic Survey and Analysis of the Scott River mainstem and Patterson Creek below Hwy 3, Moffett Creek. Analysis should include recommendations for restoring the aggraded alluvial reaches.
- East Fork Scott River
- Kidder Creek Slough Complex; this stretch should be investigated for riparian restoration need and potential, as well as quantification of contribution to the groundwater aquifer and late season flows.

- Local organizations (e.g., Siskiyou RCD and Scott River Watershed Council) should investigate the possibility of establishing "nurseries" of native cottonwood and pine to serve as sources for future planting efforts.
- Bring the National Riparian Service team back to the Scott River for another site visit.

- Develop a Beaver Management and Enhancement Plan.
  - Identity locations where land use and channel structure provide the potential for beaver to thrive without negatively impacting adjacent landowners
  - Host a workshop with Riparian experts (eg. NRCS Riparian Service Team) and beaver experts (Michael Pollock –NOAA, Mike Callahan)

VII. Recommended Methods

Restoration (e.g. selection of species, use of irrigation, cuttings vs. rooted trees, depth of planting relative to water table, streambank bioengineering, grade control structures, floodplain restoration, beaver enhancement, etc).

General restoration methods

The following restoration methods are general recommendations for any site to be treated.

Scott River Mainstem

- Utilize site evaluation form using the form in Appendix E. for prioritization & planning, and photo-documentation.
- For pole cuttings, dormant stock is the recommended planting material. If timing restraints don't allow for planting of dormant stock, overplant (2x) to allow for dieback.
- Protection and maintenance of existing natural vegetation and plantings. It was discovered that older plantings (>10 years) had suffered extensively from animal browse (beaver & elk). The animal browse is causing the cottonwoods to grow bushy rather than with one trunk A subset of these plantings need to be caged to prevent further damage, and encourage one main trunk. In the future, plantings should be visited annually, if possible, to observe for damage.
- Management of noxious weeds in riparian zones through methods such as; managed grazing, hand digging, selected spraying.
- At sites with high potential for future bank erosion, bioengineered bank stabilization techniques should be used to prevent further bank erosion and promote riparian establishment.
- The priority will be to use native vegetation (cottonwood, willow, alder) preferably found within the project site or at a minimum within the sub-drainage being treated. Some sites may be appropriate for planting non-native species such as golden willow, poplar, anderscogens, water birch, locust, etc.

- Pound large size (1-3” diameter) poles of cottonwood & willow in with hammer.
- Trenching down to anticipated low flow water table, use rooted pole cuttings or slips. It is important to plant cottonwood poles within a few hours of cutting, however soaking cottonwood poles overnight in a willow-enzyme compound may prove beneficial to establishment and should be done on a pilot basis.
  - When planting poles, ensure stem-to-soil contact.
  - Leave a depression around the stem to collect water.
  - After planting, cut back stem to about 12” tall.
- Follow-up with maintenance the following year, trim back most of growth.
- Plant cottonwoods in close proximity to willows, as the cottonwoods may benefit from the rooting hormones in the willows (if ponds are available, try to soak cuttings for several weeks).
- All cottonwood and rooted stock (pine, etc.) will be caged up to 4 feet high to prevent deer browse and beaver damage. In more barren locations, a subset of willows should be caged to help with initial survival rates.
- Other site specific maintenance, taking into account potential irrigation methods, and soil type (i.e., adding topsoil to planting holes, watering for up to three years, leaving a bowl in the planting hole to collect water.)
- If possible, utilize rooted stock plantings.
- Alder (are quick growing and suitable for barren sites. Alder seedlings should be purchase from a local nursery .
- Planting of species suitable to support beaver. Beaver will feed on willow, alder, cottonwood, and other deciduous vegetation. If trees are caged for protection, additional food supply should be established to support existing beaver populations. (This is important in Reach II and III, and the tributaries.)

Tributary Locations

The first priority for planting sites in the tributaries should focus on locations with a stable channel above the alluvial reaches, such as:

- French Creek from Miners Creek to Hwy 3.
- Mill Creek from disconnected reach to confluence with Shackleford.
- Shackleford Creek from confluence with Mill to disconnected Reach.

Identified Locations with Native vegetation

Based upon observations during the inventory of previous riparian restoration projects, as well as observations from planting projects, several locations have been identified as having sufficient existing native vegetation to serve as a source for live planting stock. See Figure 18, native vegetation locations.

Planting Stock Locations

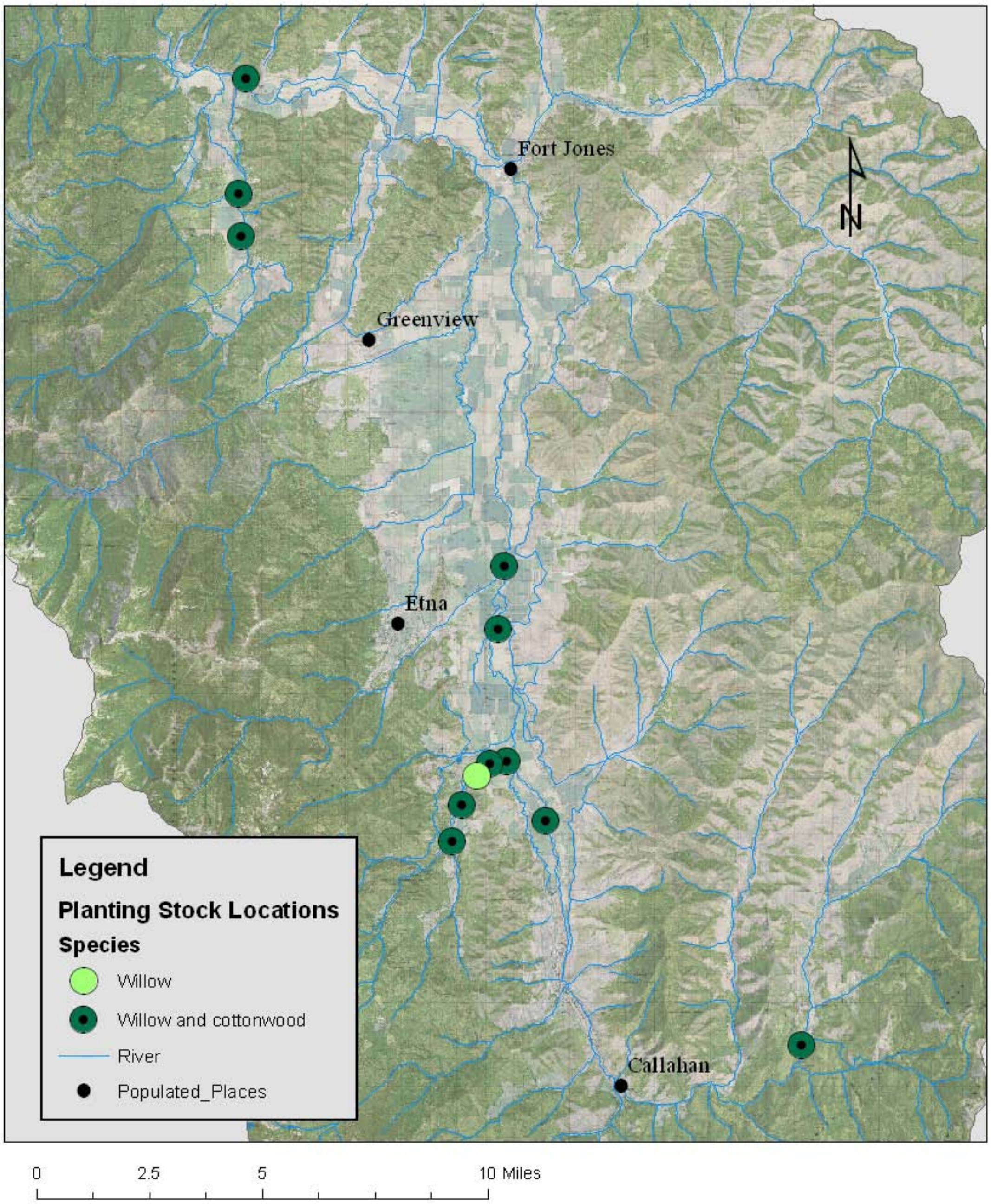


Figure 18: native vegetation locations

Reach Specific Restoration methods

Reach I: Callahan to downstream end of tailings piles

The historic geomorphic alterations to this reach have led to the banks being predominated by large cobble with little to no soil or fines present. A study needs to be done to determine the impact of the tailings on the function of the Scott River Floodplain downstream. This study should identify what treatments may be effective in improving stream function in this reach. As of 2013, a landowner group is working with the USFS and the Bureau of Reclamation to develop this study (See Appendix XX) The lower portion of this reach (RM 52.1 to ~50.7) has had treatment to remove some tailings and return the banks to a more natural alignment. This reach may have potential to benefit from riparian replanting, but is still lacking in soil and fines.

Reach II: Downstream end of tailing to SVID diversion structure

Reach II has been identified as the highest priority for riparian enhancement for the following reasons: a fully fenced riparian corridor, the width of the riparian corridor, the fact that water begins cool at top of reach as it emerges from the tailings, the estimated depth to water table, success of past plantings, existence of some riparian corridor, and proximity to existing habitat. The existing riparian corridor allows the river to follow a natural meander pattern, and is well suited to pole cuttings of broadleaf trees (i.e., alder, cottonwood, black locust, and willow). Reach II has the greatest potential for successful riparian restoration, based on known channel morphology, past revegetation success, documented distance to groundwater, the surface and subsurface contributions of Wolford Slough and French Creek, and the wide riparian corridor. In addition to the potential for success, this reach already has present many key habitat features for salmonids (cool water refugia, spawning gravels, deep pools, etc.). Increased riparian vegetation would enhance the instream features of the reach.

The following tasks have been identified by Siskiyou RCD staff for further enhancement of this reach:

1) Preservation of existing fencing and other setbacks which allows for the large fenced off riparian corridor. Much of the land was fenced in the mid-90’s through the USDA-NRCS Conservation Reserve Program. A priority for this reach will be to assist the landowners with maintaining the already dedicated setbacks and fencing in this reach.

2) Implementation of beaver management strategies. Beaver are present throughout this reach, including at the mouth of Wolford Slough and French Creek. Beaver activities can impact the operation of agricultural diversions, and threaten younger riparian plantings. However, the benefit of beaver for riparian enhancement, water storage and filtration, and providing salmon habitat is recognized. In order to further the coexistence of beaver and agriculture in this reach, the Scott River Watershed Council has identified two diversions in need of "beaver deceivers", and some riparian plantings in need of protective cages. These activities were implemented in 2012. See **Appendix C** for an extensive description of activities implemented to date.

3) Bioengineered bank stabilization at identified key sites. This reach has a well-established meander pattern, and a few locations with access to historic side channels. However, two actively eroding bank sites in the reach have been identified as needing bank stabilization to protect key fisheries habitat. The bank near the mouth of French Creek was treated in 2013 (See appendix C.) the other bank is being developed.

4) Maintenance of previously implemented plantings. Fencing of existing cottonwoods which were planted in the mid-90s, and are suffering from deer and elk browse. Re-establishment of cottonwoods is a priority along the mainstem Scott River, and in this reach. Planting of alternative species (willow, alder, black locust) will accompany this protection effort to provide a variety of species, and an alternate food source for the beaver.

5) Implementation of new planting in approximately 10 acres. Planting will be predominantly pole cuttings of willow, alder, cottonwood and black locust. Some higher elevation sites will be planted with pine or cedar.

Reach III. SVID Diversion Structure to 1.5 mile downstream of Etna Creek (RM 46.7 – 41.4)

This reach has been identified as the second highest priority reach. The upper 2+ miles of this reach has been put into a permanent conservation easement, and the remaining landowners have actively implemented restoration activities historically. The riparian corridor is wider in this location than the severely leveed section downstream in Reach IV.

The following tasks have been identified:

1.) Preservation of existing fencing and other setbacks that allow for the significant fenced off riparian corridor in the northern portion of this reach. A priority for this reach will be to assist the landowners with maintaining the already dedicated setbacks and fencing in this reach, and seeking funding to assist with fencing where it may still be needed.

2.) Bioengineered bank stabilization at identified key sites. This reach has a well established meander pattern, and only two sites in the reach have been identified as needing bank stabilization.

3.) Riparian replanting at locations identified as having potential to succeed.

Reach IV: Downstream of Etna Creek (RM 41.4) to Oro Fino (RM 29.3).

1) Bioengineered Stream Bank Enhancement – Scott River at RKM 58 (Reach III.)

This location is an actively eroding bank (800 feet) on the west side of the Scott River which is endangering the adjacent agricultural land. Bioengineered stream bank stabilization techniques will be utilized to protect the bank and establish riparian forest.

This site was selected because it is an active sediment source, and is endangering the agricultural land adjacent to the bank. Also, the location on the west bank will provide optimal shading of the river, irrigated plantings (1992) upstream from this site were successful, there is potential for irrigation, and the landowner is willing.

2) Bioengineered stream bank enhancement– Scott River at RKM 67.

This project addresses approximately 1000 feet of actively eroding stream bank, which is currently down cutting and reducing the river's ability to access the adjacent side channel. This site is on a bend in the river that will produce a significant amount of sediment, and erode agricultural land. The project site is on the west bank, which will provide for optimal stream shading.

There is a need to bring in a geomorphic expert to determine the potential for grade control structures to raise channel and increase groundwater elevations in the lower ½ of this reach. The current leveed state of this reach makes it unable to support a true riparian corridor.

Reach V. Scott River at Oro Fino Creek (RM 29.3) to River Mile 21.

This reach of the Scott River is the least studied of the mainstem Scott River. Due to the aspect (running east west), in order for any vegetation to shade the river, it will have to hang out over the river. Much of the river has existing willow vegetation (arroyo willow) which has grown into thickets. Bank beaver are also present in this reach. Suggested actions for this reach include:

1.) Selected hand thinning to thin the existing willows to allow other species to grow. This thinning will be accompanied by planting of cottonwood, alder and potentially pines/other conifer.

2.) Identification of locations that have potential to succeed for riparian planting.

VIII. Prioritization of Project Areas

Prioritization of specific project sites should follow the prioritization below

Potential to impact water quality

The following criteria are all important in developing a project:

1. Locations in Reach II. and Reach III. will be given higher priority than locations in other reaches.
2. Proximity to existing habitat and/or thermal refugia.
3. Depth to low flow water table.
4. Presence of existing vegetation, to build upon an existing riparian corridor.
5. Potential to reduce sediment contribution to the channel.
6. Past success (either at site or in adjacent location).
7. Potential to provide shade (i.e., affect water temperature).

At least two of these criteria must be present in order to continue to develop a project.

Landowner willingness

While landowner willingness is not a prioritization criteria for selection of potential project areas, it is a requirement for a project to be developed and implement.

See pre-project site evaluation form.

Pre-site Evaluation Form

Date ____________

Location description: ________________________

	Likelihood of success			Proximity to existing/restorable habitat				Potential to benefit water temperature	
Location	Depth to water table	available irrigation	in-channel	Existing Riparian	existing/potential side channel	Potential to reduce sediment'	Potential to postively impact groundwater	Exisitng cold water source	

IX. Project Scheduling

Time of year

A. Bioengineered Stream bank

   a. Permitting and wildlife considerations limit in-channel work to the low flow period of August- October, This is a challenging period to attempt riparian plantings. Greater success can be achieved through trenching to low-flow water table, and overplanting stock.

B. Off Channel.

   a. Off channel planting can be completed during the fall and winter/early spring dormant periods.

Sequence of projects

A. Schedule with identified projects

Riparian restoration schedule for Scott River- Draft October 2012

Task	**Location**	**Status**	**Timeframe**
Reach I. (Callahan to end of tailings)			
Completion of geomorphic analysis	**No recommendations until further geomorphic analysis is completed.**		
Seek funding for geomorphic analysis			as potential funding sources are identified.
Reach II. (End of tailings to SVID)			
Bioengeneered streambank	RM 48 across from French Creek	Funded	Fall 2013
Bioengeneered streambank	Merlot	In - development	Fall 2015
Maintence of previous planting (caging, etc)	Wolford Slough area (RM 48)	In progress	Fall 2012

Planting implementation	East Bank Scott Across from French Creek & south (~RM 48 miles)	In progress	Fall 2012
Planting implementation	West bank Scott at RM 48 , vicinity of Wolford Slough	In progress	Fall 2012
Maintenance	All plantings	annual	annually
Planting implemetation -10 acres	As locations are identified.	seek funding	annually
Reach III. SVID to 1.5 Miles downstream of Etna Creek			
Planting implementation	Scott at RM 40.4	Funded	Fall 2013
Maintenance	All plantings	annual	annually
Planting implemetation -10 acres	As locations are identified.	seek funding	annually
Reach IV. Etna Creek to Oro Fino Creek			
Bioengeneered streambank	Scott at RM 41	In - development	Fall 2015
Maintence of previous planting	Scott at RM 42	ongoing	ongoing by landowner
Bioengeneered streambank	Scott at RM 36	Funded	Fall 2013
Planting implementation	Scott at RM 39	Funded	Fall 2013
Planting implementation	Scott at RM 36	Funded	Fall 2013
Reach V. Oro Fino Creek to end of Valley			
Hand thinning of arroyo willow and selected planting of cottonwood and alder.	varied through reach, as landowners are identified.	in development	Fall 2013, Fall 2014
Identify potential planting locations			Annually
Planting implemetation -10 acres	As locations are identified.	seek funding	annually
Tibutaries			
Geomorpic survey and analysis of Patterson,Kidder, Etna Creek in alluvial sections.			when funding available

French Creek	As locations are identified.	seek funding	as identified & funding is available
Etna	As locations are identified.	seek funding	as identified & funding is available
Shackleford	As locations are identified.	seek funding	as identified & funding is available
Kidder	As locations are identified.	seek funding	as identified & funding is available
East Fork	As locations are identified.	seek funding	as identified & funding is available
Moffett	As locations are identified.	seek funding	as identified & funding is available

X. Permitting

The following permits will likely be needed for any ground-moving projects within the annual flood plain: California Dept. of Fish and Game 1600 permit, US Army Corps 404 permit, State Water Resources Control Board 401 Certification or Dredge and Fill Waste Discharge Requirements, and CEQA.

California Department of Fish and Game Lake and Streambed Alteration Agreement

http://www.dfg.ca.gov/habcon/1600/

California Department of Fish and Game – CEQA summary

http://www.dfg.ca.gov/habcon/ceqa/

State Water Resources Control Board 401 Water Quality Certification

http://www.waterboards.ca.gov/water_issues/programs/cwa401/

Manual hole digging, auger digging, and pounded pole cuttings can be done in the riparian corridor and adjacent flood plains without permits.

Access

Prior landowner access is an absolute requirement before any projects can be developed and implemented.

Resources for Landowners/Funding Sources

- State Water Resources Control Board

    - 319 H TMDL Implementation Annually, the California NPS Program allocates approximately $4.5 million of CWA Section 319(h) (CWA §319(h)) funding from the U.S. Environmental Protection Agency (U.S.EPA) to support implementation and planning projects that address water quality problems in surface and ground water resulting from NPS pollution. The goal of these projects is to ultimately lead to restoring the impacted beneficial uses in these water bodies. Projects are required to be located in a watershed that has an adopted/nearly adopted Total Maximum Daily Load (TMDL) for the constituent of concern and has been identified in the NPS Program Preferences. Projects focused on working toward achieving the goals of the TMDL to restore beneficial uses will be the most competitive in the selection process. http://www.swrcb.ca.gov/water_issues/programs/nps/solicitation_notice.shtml

- United States Fish and Wildlife Service-Partners for Fish and Wildlife

    - Contact Yreka Office 530-842-5763

- The California Riparian Habitat Conservation Program (CRHCP) ; Wildlife Conservation Board

  The program has a basic mission to develop coordinated conservation efforts aimed at protecting and restoring the state's riparian ecosystems. http://www.wcb.ca.gov/Riparian/

- Natural Resource Conservation Service (NRCS)

  NRCS offers voluntary programs to eligible landowners and agricultural producers to provide financial and technical assistance to help manage natural resources in a sustainable manner. Through these programs the agency approves contracts to provide financial assistance to help plan and implement conservation practices that address natural resource concerns or opportunities to help save energy, improve soil, water, plant, air, animal and related resources on

agricultural lands and non-industrial private forest land.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial

NRCS Programs

- The **Agricultural Management Assistance** (AMA) provides financial and technical assistance to agricultural producers to voluntarily address issues such as water management, water quality, and erosion control by incorporating conservation into their farming operations.

- The **Agricultural Water Enhancement Program** (AWEP) is a voluntary conservation initiative that provides financial and technical assistance to agricultural producers to implement agricultural water enhancement activities on agricultural land to conserve surface and ground water and improve water quality.

- **Conservation Innovation Grants (CIG)** is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging Federal investment in environmental enhancement and protection, in conjunction with agricultural production.

- The **Environmental Quality Incentives Program** (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length.

- The **Wildlife Habitat Incentive Program** (WHIP) is a voluntary program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land.

Monitoring

Photopoint monitoring

Photopoints will be established prior to implementation of any restoration activities to track success of the project. Ideally, photopoint locations will be GPS'd and documented on a USGS topo map or aerial photograph.

Ideally, photopoint monitoring will occur annually in the summer when vegetation is fully leafed out. The photopoint monitoring log below should be utilized for all photopoints.

SOP 4.2.1.4

PHOTO LOG FORM

Project:

Location:

Date:

Photographer

Team Members

Camera ID:

Photo #	Time	Photo Point ID	Photo pt Description & Location	Bearing to subjest	Subject Description

General Notes or Comments (weather, cloud cover, time of sunrise and sunset, other pertinent information)

Quantitative monitoring

Plant survival will be tracked to account for overall survival by site, as well as by species and planting methodology.

Adaptive management

Adaptive management is a structured, repetitive process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring.

In this way, decision making simultaneously meets one or more resource management objectives and, either passively or actively, accrues information needed to improve future management. Adaptive management is a tool which should be used not only to change a system, but also to learn about the system (Holling 1978). Because adaptive management is based on a learning process, it improves long - run management outcomes.

There are a number of scientific and social processes which are vital components of adaptive management, including:

1. Management is linked to appropriate temporal and spatial scales
2. Management retains a focus on statistical power and controls
3. Use of computer models to build synthesis and an embodied ecological consensus
4. Use of embodied ecological consensus to evaluate strategic alternatives
5. Communication of alternatives to political arena for negotiation of a selection

The achievement of these objectives requires an open management process which seeks to include past, present and future stakeholders. Adaptive management needs to at least maintain political openness, but usually aims to create it. Adaptive management must therefore be a scientific and social process. It must focus on the development of new institutions and institutional strategies in balance with scientific hypothesis and experimental frameworks (resilliance.org).

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Appendices