Riparian Restoration Plan for Turtle Bay East

City of Redding
Shasta County, California

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Prepared for:

City of Redding

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TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

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Acknowledgements

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EXECUTIVE SUMMARY

In 2011, River Partners received funding from the City of Redding for a riparian restoration plan and comprehensive restoration project for Turtle Bay East. Enhancement and restoration of wildlife habitat will influence approximately 42 acres. The goals of this project are to restore and develop riparian habitat, implement control measures for invasive non-native plant species, and improve the aesthetics and trails of Turtle Bay East for public use.

A detailed site evaluation examined soil texture, structure, stratification and depth to water table, as well as past land use and current conditions. Based upon site evaluation, a combination of shrub and grassland communities will be planted on the project. River Partners will implement active restoration on almost 4 acres of Turtle Bay East, and the remaining 38 acres will be enhanced by removing non-native invasive species. River Partners will create almost 42 acres of quality habitat for targeted wildlife species. The improvement of this site will contribute to the continuity of the riparian corridor, while providing a buffer between the adjacent urban community and the river.

Riparian Restoration Plan for Turtle Bay East,
City of Redding, Shasta County, California

I. INTRODUCTION

A. Project overview

Turtle Bay East has the potential to provide almost 42 acres of critical habitat for riparian dependent organisms. This restoration is part of a larger endeavor, the Sacramento River Parkway Project. The overall project enhances the current Sacramento River Parkway, which provides recreational opportunities, wildlife habitat, and environmental and cultural education along a 60 mile stretch of the river. Moreover, the project will increase the continuity of habitat along the Sacramento River riparian corridor and provide a buffer between the suburbanized community to the east and the river.

This plan will detail the development of riparian habitat, the implementation of control measures for invasive non-native plant species, and the enhancement of the aesthetics and trails of Turtle Bay East for public use. The public will enjoy a site with improved trails, picnic areas, and multi-use areas planted with native vegetation that has high wildlife value. The project will also include interpretive panels outlining specific benefits of the restoration effort.

B. Cooperative relationships

The proposed restoration activities build upon previous planning efforts for the Turtle Bay Exploration Park. In 2003, River Partners received funding from the Wildlife Conservation Board to complete the restoration of approximately 215 acres of riparian woodland, grasslands, seasonal wetlands, and valley oak groves on the McConnell Arboretum. In 2007, River Partners and the Turtle Bay Exploration Park entered into an agreement for comprehensive riparian restoration and improvement on the 76 acre Turtle Bay Bird Sanctuary. This project is the continuation of efforts by the City of Redding to improve habitat and increase the recreational opportunities in the Turtle Bay reach of the Sacramento River. A collaborative partnership between the City of Redding, River Partners, and the California Conservation Corps will bring this project to fruition.

C. Project goals and objectives

Project goals and objectives include:

- Completing a site specific riparian restoration plan,
- Creating riparian habitat along the Sacramento River,
- Eradicating non-native invasive plants,
- Expanding amenities and aesthetics at the site for public use, and
- Development of scenic overlooks.

D. Summary of Special Considerations

Special considerations include:

- Integrating concepts associated with the expansion of the existing trail system,
- Removing deteriorating wooden ramp structures to ensure public safety in the bicycle ramp park at the southern edge of the property,
- Guiding the California Conservation Corps (CCC) implementation of restoration and establishment activities, and
- Maintaining or increasing current public use and access to the site.

E. Purpose of the Restoration Plan

The purpose of the restoration plan is to:

- Identify project goals, objectives, management hypotheses and potential implementation challenges,
- Summarize the site land-use history, soils, hydrology, vegetation, and wildlife,
- Outline our current understanding of the physical and biological factors that influence site ecology (a conceptual site model),
- Describe the plant design and the rationale for its selection,
- Describe the implementation process including field preparation, planting methods, irrigation design and schedule, methods of weed control,
- Outline project monitoring, and
- Provide a timeline for project tasks.

II. SITE DESCRIPTION

A. Location

Turtle Bay East is located at the northern end of California's Great Central Valley. It is situated downstream of the headwaters of where California's largest river begins its descent from the slopes of Mount Shasta and winds south until it leaves the mountains around Redding. Turtle Bay East is located in the City of Redding, California on the east bank of the Sacramento River at River Mile 296L (Figure 1), and approximately 6 miles downstream of the Keswick Dam.

The project site is the southernmost property in an area historically called Turtle Bay. The Turtle Bay area consists of the land, channels, and gravel bars at this large bend in the river. The project lies directly adjacent to the southwest corner of the Interstate 5 corridor and Highway 44 interchange. Turtle Bay East is a high-use public area abutting a large suburban community. This plan covers restoration and enhancement activities on a 42-acre parcel within Turtle Bay East (Figure 2).

Caltrans has initiated a riparian restoration project on adjacent City-owned land as mitigation for the impacts of the Highway 44 Bridge Widening project. Under this project, the Western Shasta RCD has been engaged to complete a 15 acre restoration project. This adjoining project also includes the removal of all invasive species from the river's edge to the base of the hillside/cliff. It also involves the planting of a host of native plants consistent with its riparian setting. The only overlap between the Caltrans project and this project is that the crushed granite public access trail system will be extended throughout both restoration areas.

B. Land-use History

No known prehistoric Native American resources have been recorded in this area (Terry Hanson, personal communication), but the Native American Wintun are known to have used the surrounding area (Knudtson 1947). Due to limited site access from the Sacramento River, Turtle Bay East was largely unused until 1966, when a portion of Highway 44 was built at the northern edge of the site. The City of Redding acquired this property in 1968. During the construction of Highway 44, the California Department of Transportation likely deposited displaced materials from the highway construction, including cobble and soil, onto the site (Terry Hanson, personal communication).

Since then, the public has increasingly used the site for fishing, dog walking, picnicking, wading, jogging, and birding. In 2007, private parties constructed a series of bicycle ramps in the southernmost end of the property, pictured to the right. Additionally, the Shasta Cyclocross Race Series used the site in 2006 as a bicycle challenge course for adults and children.

Bicycle Ramps

Figure 1. Location Map, Turtle Bay East, Shasta County, California.

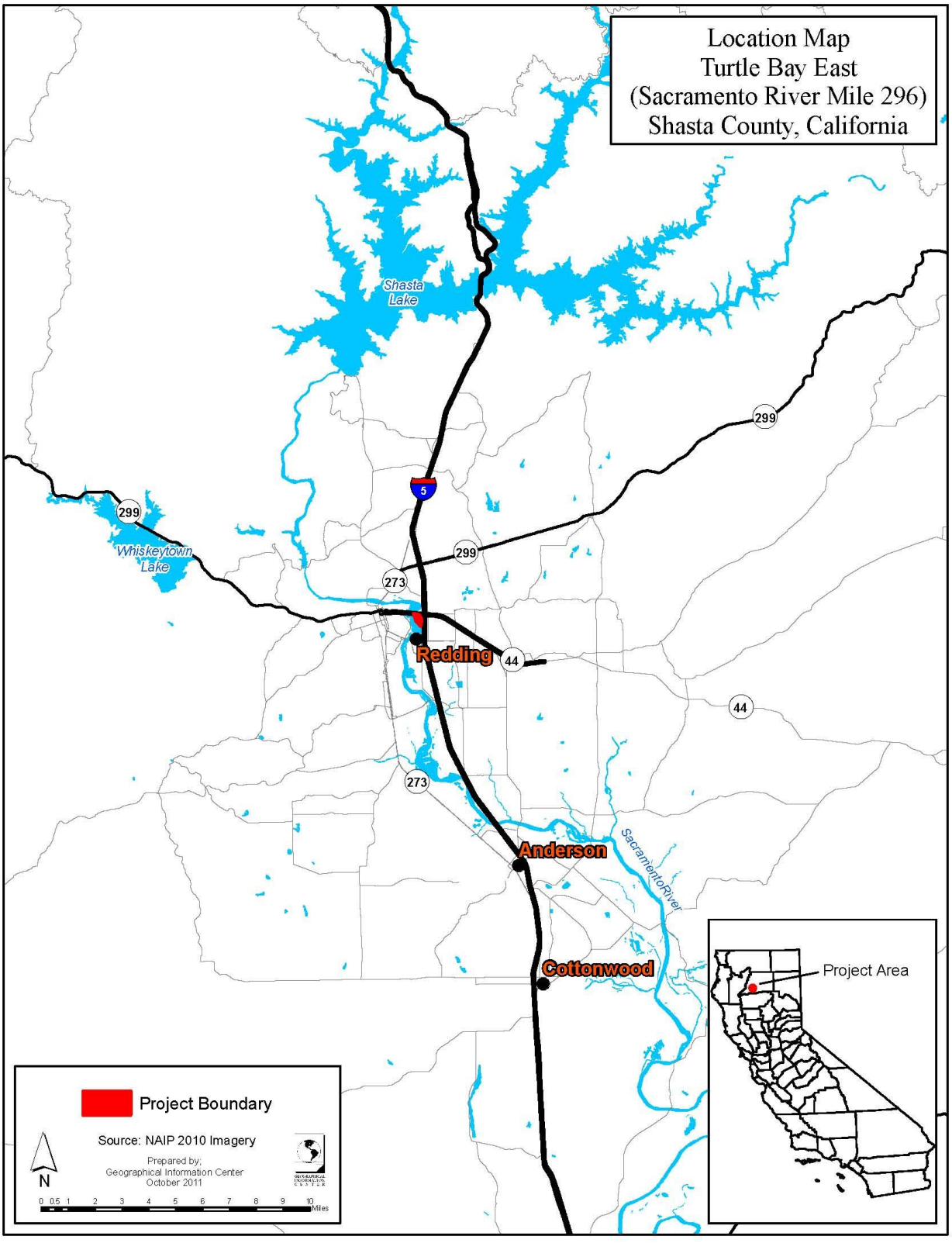


Figure 2. Project Boundary, Turtle Bay East, Shasta County, California.

C. Soils

1. General Soil Series Information

Soil texture and profile stratification greatly influence the ability of plants to survive and grow. Barriers in the soil profile, such as hardpans and sand or clay lenses, will affect plant survivorship. Knowledge of the soil profile, soil moisture, depth to water table, and root distribution influences the planting design and pattern. Accounting for these factors with an appropriate plant mix will ensure a high probability of successful plant establishment.

The Shasta County Soil Survey (Klaseen and Ellison 1974) identifies three soil series (Cobbly alluvial land, Newton gravelly loam, and Reiff fine sandy loam) for the site (Table 1 and Figure 3), but only the Reiff fine sandy loam is productive for riparian vegetation. The southern end of the site has developed a soil profile which is conducive for plant establishment and growth. The soil has a composition of over 80% cobbles, which makes planting and establishing plants across the majority of the site difficult.

Table 1. Summary of Typical Soils Conditions from the Shasta County Soil Survey (Klaseen and Ellison 1974) on soils found on Turtle Bay East, Shasta County, California.

Soil Property	Cobbly alluvial land, 1 to 5 percent slopes	Newton gravelly loam, 30 to 50 percent slopes, eroded	Reiff fine sandy loam, 0 to 3 percent slopes
Mapping unit	Ch	NeE2	RgA
Percent slope	1-5%	30-50%	0-3%
Texture	Cobbly alluvial	Gravelly loam	Fine sandy loam
Depth of soil	24 to 28 inches	60+ inches	60+ inches
Drainage	Excessive drainage and erosion/deposition are moderate	Runoff is rapid and hazard of further erosion is high	Well drained and runoff slow, hazard of erosion none to slight
Permeability	Rapid	Slow	Moderately rapid
Available water holding capacity	2 to 4 inches	9 to 11 inches	7.5 to 9 inches
Plant growth limitations	Not assigned	Not assigned	Not assigned

Figure 3. Soils Map, Turtle Bay East, Shasta County, California.

2. Soil Pit Results

In addition to the information provided by the Shasta County Soil Survey, we excavated five soil pits on September 23, 2011 within the Turtle Bay East project area (Appendix A). Observations from these samples include:

- Soil texture and structure,
- Stratification,
- Depth to water table, and
- Rooting depth of vegetation.

a) Field 1

Field 1 is shaped irregularly. Five soil pits were excavated in Field 1. These pits were spread fairly evenly across the field to capture the variability in soil composition and water table depth. There was no moisture in the pits, likely due to excessive drainage of soils at this site and the season the pits were dug. Soil texture ranged from fine sandy loams to gravelly sandy loams to gravelly silt in four out of five pits. These pits revealed soil textures which tend to support healthy vegetation, but the presence of greater than 80% cobbles in the soil will inhibit plant growth due to impaction and a lack of usable soil. Moreover, although root depth for non-native invasive species went as far as 6 feet in some areas, the soil showed no evidence of moisture to support a wide variety of native vegetation.

An additional soil pit was excavated at the southernmost field of Turtle Bay East. The pit exhibited soils consisting of sandy loam and gravelly cobbly loam. Evidence of stratified layers was observed between 1-6 feet in the pits, and a hard-packed mineral-laden soil became more consolidated at deeper levels. The cobbles became progressively smaller deeper in the pit, and organic matter was distributed throughout the pit down to 5 feet. Although the pit lacked soil horizons indicative of river influences, the soils in this pit indicated high restoration potential. However, the closed tree canopy blocked out the abundant sunlight needed for active restoration methods in this area.

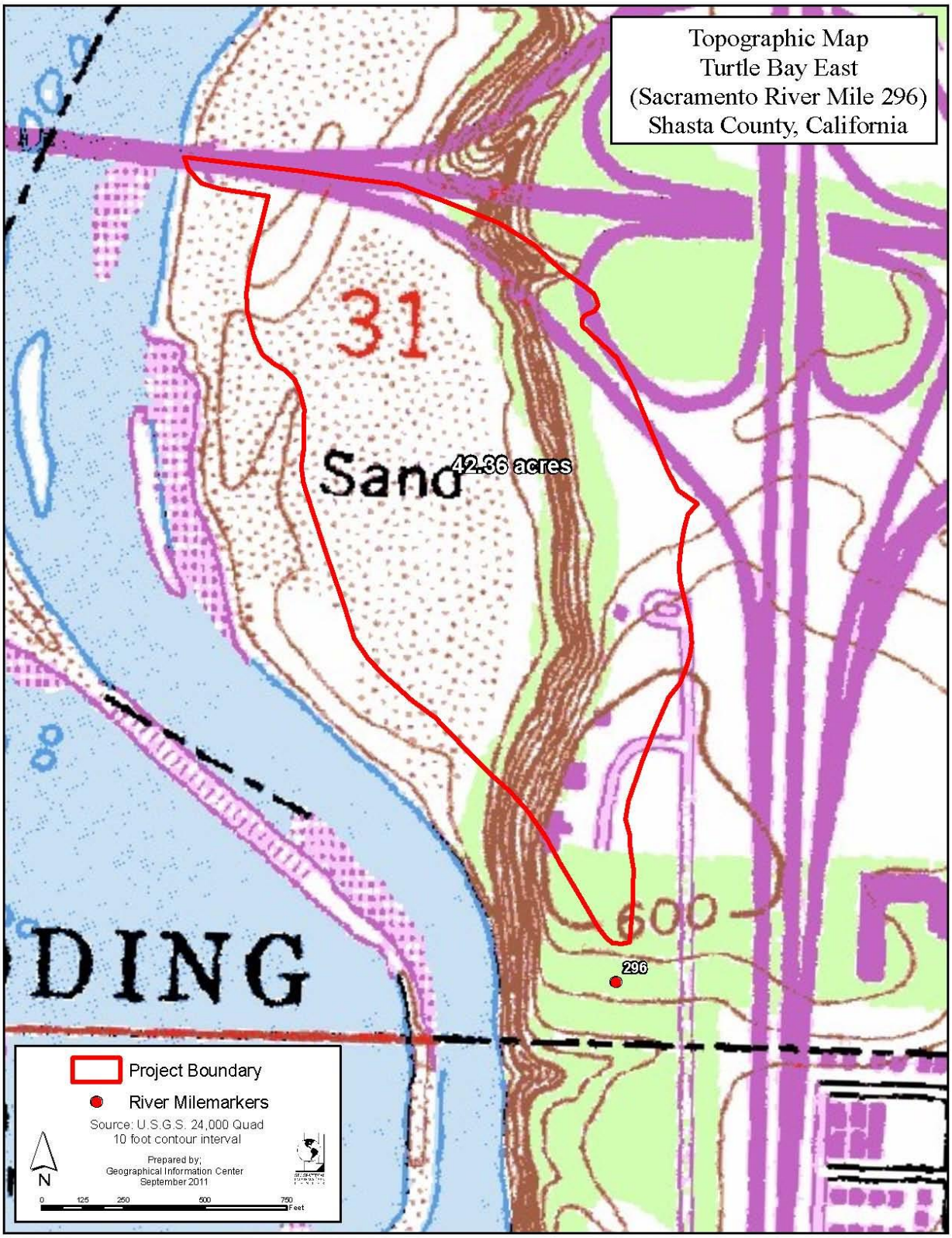
b) Field 2

One soil pit was excavated in Field 2, near the southeastern edge of the property. The pit exhibited soils consisting of silt loam with consolidated silt. Evidence of deep, rich soil was observed down to 6 feet and roots were distributed throughout. The pit lacked soil horizons indicative of river influences or moisture, but the soil composition and abundance of sunlight indicated a high potential for horticultural success.

D. Topography

The topography of the project area is mostly level, with 8-10 foot elevation drops near the riverfront on the western side of the property. The elevations across the site range from approximately 470-520 feet (Figure 4). The highest elevation on the site generally coincides with the parking lot which begins at the toe of the northeastern slope of the property. The lowest elevation is on the west end where the river creates a side channel just south of Highway 44. The topography across the site also contains numerous low elevation pits where surface runoff may pool. These lower elevation areas are likely the result of scouring during a 100-year flood event. Evidence for this conclusion is based upon the maturity of the tree stands in these depressions in the landscape.

Figure 4. Topographic Map (1969), Turtle Bay East, Shasta County, California.



E. Hydrology

The construction of the Shasta and Keswick dams, urbanization, and gravel mining operations upstream have severely altered the natural floodplain characteristics and changed riparian forest development within this reach of the river. These factors have contributed to sediment starvation immediately downstream due to sediment being trapped above the dams or sediment entering the river below the dams being transported quickly out of the area. This had led to an armored channel surface in the riverbed, which is one that lacks finer sediment and consists primarily of cobble and boulder size particles (DWR 1981). This loss of sediment created the opportunity for the land to become incised, or cut into, which increased the downward vertical expansion of the river and decreased the lateral spread of the river. This in turn has led to minimal floodplain creation and a correspondingly thin riparian corridor (Sacramento River Advisory Council 2003). Only about 20% of the project site is subject to the 100 year flood currently (Figure 5), and receives an average of 33 inches of rain annually.

When water does inundate the site, it moves north to south along the northwestern edge of the property. It rushes through with high velocity, ripping vegetation and sending cobbles and sediment into the river. The property floods when Bureau of Reclamation needs to make room for anticipated releases from Shasta Dam. These higher releases are very infrequent and of short duration. The last maximum controlled release, or 100-year flood, occurred in 1997, and was 79,000 cubic feet per second (cfs) (Terry Hanson, personal communication). The remainder of the property sits at an elevation above that of these flows.

Figure 5. 100-Year Flood Zone Map, Turtle Bay East, Shasta County, California.

F. Vegetation

1. Pre-Development Conditions

Few sources document the pre-development conditions of the vegetation in the project area. The 1950's era photograph of Turtle Bay East shows that the area was largely devoid of vegetation at that time (Figure 6), although this was after the Shasta and Keswick Dams were constructed. Furthermore, the topographic map (Figure 4) considers this area a sandbar, which explains limited vegetation recruitment of the area historically.

2. Current project area conditions

Currently, the site is a mix of native and non-native plants. The canopy is dominated by mature valley oak (*Quercus lobata*), live oak (*Quercus wislizenii*), Fremont cottonwood (*Populus fremontii*), and gray pine (*Pinus sabiniana).* The mid-story contains native plants such as Oregon ash (*Fraxinus latifolia*), sandbar willow (*Salix exigua*), arroyo willow (*Salix lasiolepis*), manzanita (*Arctostaphylos viscida*), buckbrush (*Ceanothus cuneatus*), blue elderberry (*Sambucus mexicana*), and wild grape (*Vitis californica*). Non-native trees include plum (*Prunus spp.*), black locust (*Robinia pseudoacacia)*, tree-of-heaven (*Ailanthus altissima*), black walnut (*Juglans nigra*), and mimosa (*Albizia spp)*. The understory consists primarily of Himalayan blackberry (*Rubus armeniacus*) throughout the project site, and Scotch broom (*Cytisus scoparius*) in a few clustered areas at the northwest corner of the property. The open spaces include native species such as yerba santa (*Eridictyon angustifolium*), sulfur buckwheat (*Eriogonum umbellatum*), and gumplant (*Grindelia camporum*), although a host of non-native grasses and forbs dominate, such as yellow star-thistle (*Centaurea solstitialis).*

G. Wildlife

Turtle Bay East has good wildlife potential because of its proximity to the Sacramento River. Our design approach focuses on the habitat requirements of anadromous fish, migratory birds and threatened and endangered species that occur or potentially occur (Tables 1 and 2). This includes four runs which comprise three Evolutionary Significant Units (ESUs) of Chinook salmon (*Oncorhynchus tshawytscha*) –Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley fall-run and late fall run Chinook salmon. Fish will benefit through the creation of shaded riverine habitat, which will be built by removing invasive weeds and allowing native trees to proliferate along the banks of the project site. Additional wildlife species include the Central Valley ESU steelhead (*Oncorhynchus mykiss*), green sturgeon (*Acipenser medirostris*), Valley elderberry longhorn beetle (*Desmocerus californicus diamorphus*), and western yellow-billed cuckoo (*Coccyzus americanus occidentalis*).

Wildlife sightings at this site include the northern Pacific rattlesnake (*Crotalus oreganus oreganus*), sharp-shinned hawk (*Accipiter striatus*), red-shouldered hawk (*Buteo lineatus*), red-tailed hawk (*Buteo jamaicensis*), ruby-crowned kinglet (*Regulus calendula*), bushtit (*Psaltriparus minimus*), oak titmouse (*Baeolophus inornatus*), acorn woodpecker (*Melanerpes formicivorus*), American robin (*Turdus migratorius*), spotted towhee (*Pipilo maculatus*), California towhee (*Melozone crissalis*), northern flicker (*Colaptes auratus*), western scrub jay (*Aphelocoma californica*), white-crowned sparrow (*Zonotrichia leucophrys*), golden-crowned sparrow (*Zonotrichia atricapilla*), song

sparrow (*Melospiza melodia*), turkey vulture (*Cathartes aura*), Hutton's vireo (*Vireo huttoni*), Bewick's wren (*Thryomanes bewickii*), cedar waxwing (*Bombycilla cedrorum*), black phoebe (*Sayornis nigricans*), yellow-rumped warbler (*Dendroica coronata*), California quail (*Callipepla californica*), mourning dove (*Zenaida macroura*), and house finch (*Carpodacus mexicanus*). Birds sighted along the river include the double-crested cormorant (*Phalacrocorax auritus*), American coot (*Fulica americana*), and Canada goose (Branta Canadensis).

Table 2. Federal and State-listed Endangered, Threatened, and Candidate Species occurring or potentially occurring at Turtle Bay East, Shasta County, California.

Name	Scientific Name	Status
Least Bell's Vireo (extirpated)	*Vireo bellii pusillus*	FE, CE
Bald Eagle	*Haliaeetus leucocephalus*	FT, CE
Valley Elderberry Longhorn Beetle	*Desmocerus californicus diamorphus*	FT
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	FC, CE
American Peregrine Falcon	*Falco peregrinus anatum*	FSC, CE
Willow Flycatcher	*Empidonax trailii*	FSC, CE
Bank Swallow	*Riparia riparia*	FSC, CT

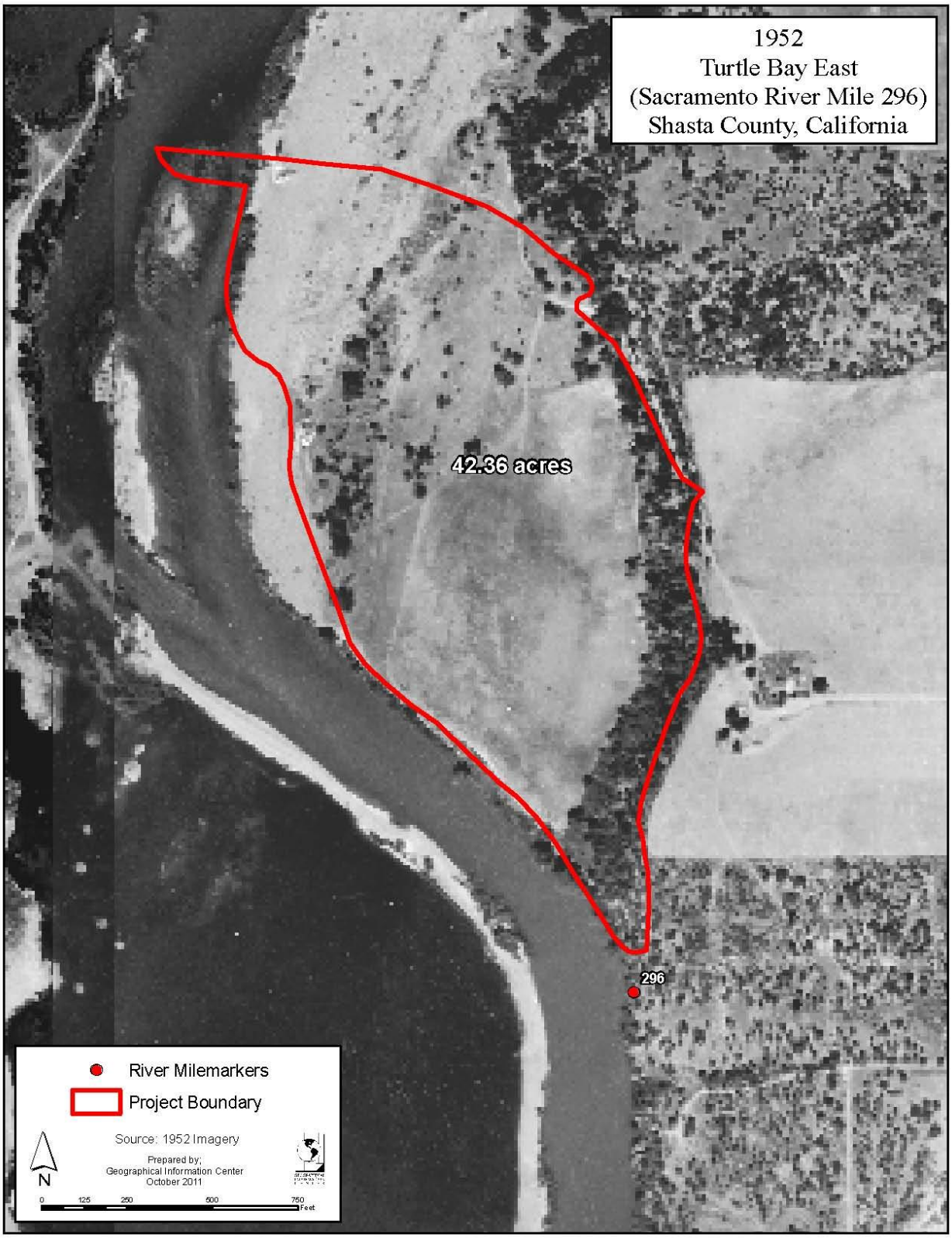
FE – Federal-listed Endangered Species
CE – California State-listed Endangered Species
FT – Federal-listed Threatened Species
CT – California State-listed Threatened Species
FC – Federal Candidate Species
FSC – Federal Species of Concern

Table 3. Other Avian Species and Their Respective Lists of Concern occurring or potentially occurring at Turtle Bay East, Shasta County, California.

Name	Scientific Name	Status
Nuttall's Woodpecker	*Picoides nuttallii*	ABC, AR, USBC, WC
Oak Titmouse	*Baeolophus inornatus*	AY
Wrentit	*Chamaea fasciata*	AY
Cooper's Hawk	*Accipiter cooperi*	CNDDB, CSC, WC
Osprey	*Pandion haliaetus*	CNDDB, CDF, CSC, WC
Yellow-breasted Chat	*Icteria virens*	CNDDB, CSC, WC

USBC – United States Bird Conservation Watch List
WC – World Conservation Union Red List
AY – Audubon Yellow List
CDF – California Department of Forestry Sensitive Species
CNDDB – California Natural Diversity Database, State Level 3
CSC – DFG California Species of Concern

Figure 6. 1952 Aerial Photograph, Turtle Bay East, Shasta County, California.



III. CONCEPTUAL SITE MODEL

This conceptual site model:

- Presents our understanding of the physical and biological factors that influence site ecology,
- Outlines our restoration strategy,
- Provides an overview of the plant design, and
- Identifies ecological benefits and targeted wildlife species.

The principles described in this section will guide the implementation of the project.

A. Past Environmental Conditions

Prior to the building of Shasta and Keswick dams, the site was inundated by large flood events common on the Sacramento River. The 1952 aerial photograph of Turtle Bay East (Figure 6) shows that the area was largely devoid of vegetation at that time, which was likely due to the fact that the site is a sandbar that has not historically promoted vegetation recruitment. Most of the project area was open space. Vegetation along the southeastern boundary was dominated by valley oaks.

B. Likely Successional Patterns without Restoration

The site will likely follow the modern trajectory of the Sacramento River downstream from the Shasta and Keswick Dams, which involves colonization by a wide array of non-native annual grasses and herbaceous plants, along with an insignificant amount of native forbs. The vegetation structure is poor and provides nesting and foraging substrate to only a small number of riparian species.

Without active restoration, the understory would continue to be dominated by non-native species, such as Himalayan blackberry and yellow star-thistle. A key consideration of damned rivers is that the processes which naturally build floodplains are disrupted. On the Sacramento, upstream sediments are now captured in reservoirs rather than distributed across the floodplains in high flow events. So, areas like Turtle Bay East, which have very thin soils due to human manipulation, have no source for new sediments. These altered conditions favor invasive species over native riparian plants.

The Himalayan blackberry is a non-native species of particular concern. Due to the amount already present on the site and its intense competition for light, moisture, and other resources few new native trees and shrubs will become established. Thus, the project area, and especially the herbaceous layer, is in danger of becoming even more non-native and single-species dominated. The site, due to the natural history of Himalayan blackberry, is also a severe fire risk to the Exploration Park and the City of Redding. Individual canes live for only 2-3 years, and then newer growth expands laterally as well as upward. This leaves an immense amount of dead canes beneath the new growth, up to 525 canes per square meter (Hoshovsky, 2001).

C. Comparison to Nearby Vegetation (Reference sites)

Although areas directly south of the Shasta and Keswick Dams have the potential to provide good reference sites for this project, soil and elevation differences between

these places and Turtle Bay East, along with high differentials in flood regimes, offer little chance for comparison. Furthermore, the adjacent urban area to the east of the project site alters the vegetation at Turtle Bay East by increasing runoff in a way that does not occur at the other potential reference locations.

The native flora that is observed near the project area will be taken into account, although it is not precisely mimicked in our restoration plant design. The plant communities and densities are designed to optimize wildlife habitat. The goal is for 100% native cover. Herbaceous understory plantings have been planned to limit weed invasion. The plant composition and installation suit to the altered hydrology of the current river system.

D. Restoration Strategies for Turtle Bay East

We recommend the following strategies for Turtle Bay East:

- **Improve site conditions by performing widespread non-native invasive species control.** Of special interest is removing and reducing the area of non-native plants such as Himalayan blackberry, tree-of-heaven, and black locust. Tree-of-heaven and black locust are trees that are prolific seed producers, and they tend to reproduce very quickly.
- **Employ active restoration techniques to establish native riparian vegetation.** Active restoration employs modern farming techniques to efficiently and rapidly establish riparian vegetation. Tasks include site preparation, native plant species propagation and planting, weed control, and supplemental irrigation.
- **Develop a plant design based on current site conditions, past environmental conditions, recreation and public use goals, and management objectives to address wildlife habitat.** The planting associations and layout are intended to provide a diversity of high quality habitat for targeted wildlife and reduce competition from invasive non-native species. The planting associations, though not based strictly on a “historical” or “climax” vegetation target, are intended to provide high quality habitat for pollinators and beneficial insects as well as targeted wildlife. The implementation of these designs must not impede upon the use of the site by the public. For example, trails and proposed picnic sites must not be overtaken by species such as wild grape that will grow rampantly into these areas and overtake them without constant care.
- **Use an adaptive management approach to the project.** River Partners uses an adaptive management approach (River Partners 2008) to provide a framework to evaluate project progress and respond to new information. River Partners has used the above strategies and achieved high plant survival rates, accelerated natural recruitment of native species (through changes in microclimate and presence of seed sources), and documented wildlife benefits in short periods of time (three years).

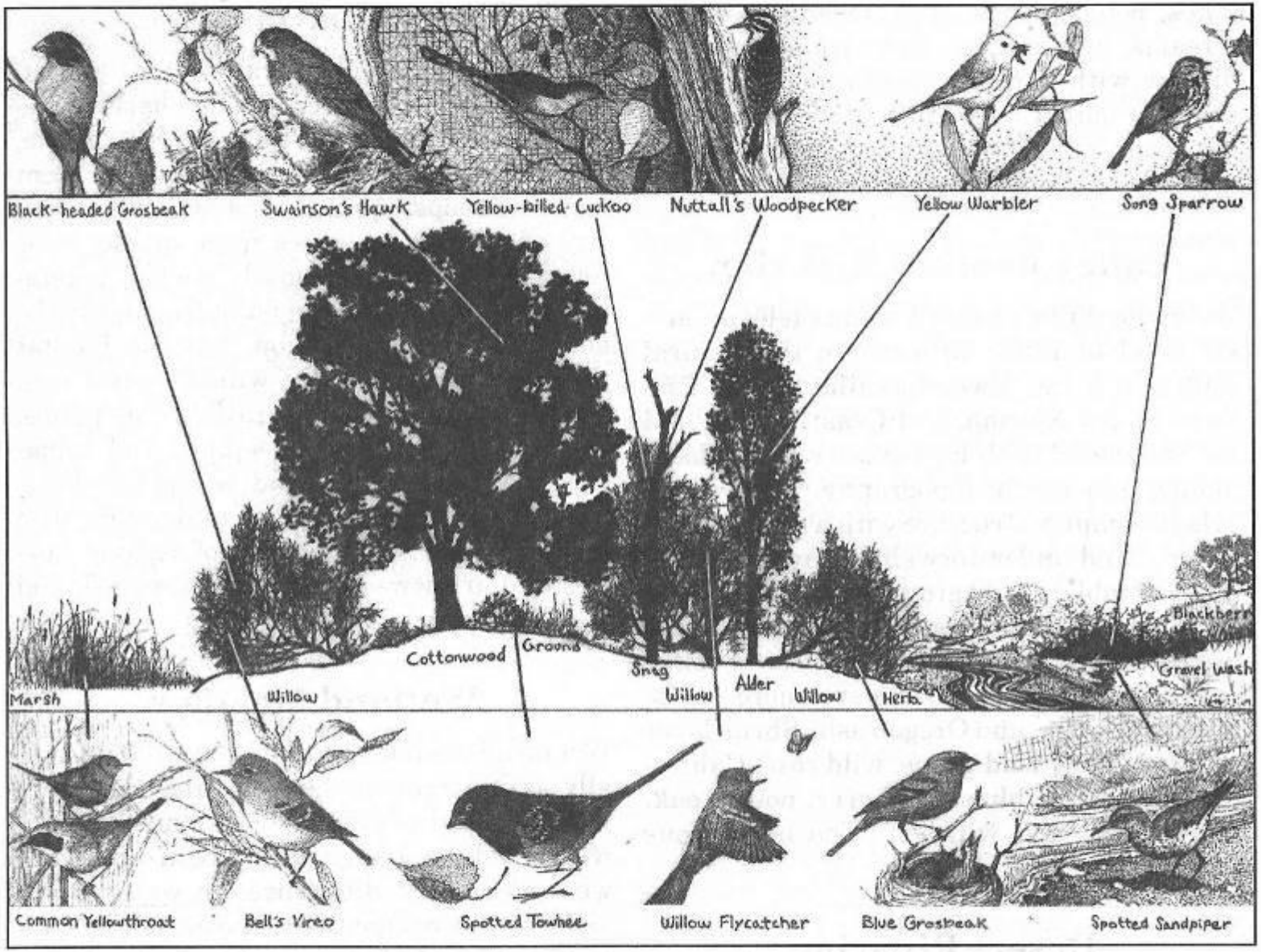
E. Identification of Ecological Benefits and Targeted Wildlife Species

Riparian floodplain restoration has proved a successful approach to restoring songbird populations along the Sacramento River (Gardali et al. 2006), and has demonstrated

positive effects on a range of other taxa including insects, pollinating bees, and small mammals (Golet et al. 2008). Continued restoration is central to restoring and maintaining biodiversity of the upper Sacramento River ecosystem. Therefore, a restored site will provide vital habitat and conditions for anadromous fish, neo-tropical migratory birds and other riparian dependent avian species (Figure 7). Riparian ecosystems harbor the most diverse bird communities in the arid and semi-arid portions of the western United States (Knopf *et al*. 1988, Dobkin 1994, Saab *et al*.1995), and may also provide the most important avian habitat in California (Manley and Davidson 1993). The Sacramento River also provides habitats for other special status anadromous fishes including, Central Valley Spring-run Chinook salmon, Central Valley Fall- and late Fall-runs of Chinook salmon, Central Valley steelhead, and green sturgeon.

The plant design additionally focuses on supporting beneficial insects and pollinators. Research shows that habitat restoration projects attract and support diverse bee communities which rival remnant habitat (Golet 2006). Native plant communities rely on pollinators (Handel 1997). Not only will the restoration site benefit from this increased pollinator and beneficial insect occurrence, but neighboring areas stand to benefit as well by increasing corridors of movement for these species (Kremen et al. 2002, 2007). This has the potential of increasing the value of the restored habitat beyond its baseline local value.

Figure 7. Habitat Value of Native Riparian Plants (RHJV 2000).



IV. PLANTING DESIGN

River Partners has developed a site-specific planting design that represents a synthesis of the available information on site conditions, using the principles of landscape ecology (Silveira *et al*. 2003, USFWS 2005), project objectives, and PRBO recommendations (Geupel *et al*. 1997).

A. Design Considerations

River Partners considered the physical factors (soils, topography and hydrology) and historical vegetation to determine what vegetation would potentially grow at the site. The design targets pollinators by incorporating shrubs and herbaceous species that will bloom and flower throughout the growing season. The design also integrates essential habitat elements to conserve, restore and enhance riparian habitat for threatened and endangered species, songbirds, waterfowl, other migratory birds, resident native wildlife and plants. Additionally, recommendations from PRBO Conservation Science (PRBO) (Geupel *et al*. 1997) are integrated into the design in order to provide quality habitat for focal bird species. Table 4 lists key considerations of the plant design for Turtle Bay East.

B. Rationale for Plant Communities

Using our knowledge of the site factors and design considerations, River Partners developed three different plant communities. Attracting pollinators is a primary consideration for the plant communities selected. Additionally, the physical layout or pattern of individual plants will also follow the recommendations from PRBO. Studies by PRBO suggest that shrub cover is the most important variable influencing nest site and there is a positive relationship between shrub richness and bird diversity (Small *et al*. 2000, Geupel *et al*. 1997).

River Partners expects at least 70% survival of its restoration plantings at the end of the three year project period. Over the years after establishment, River Partners expects some mortality based on differences of soil textures and water table depths.

Table 4. Key Plant Design Considerations of the Turtle Bay East Restoration Project, Shasta County, California.

Objective/Factor	Project Design Considerations
Provide immediate (< 3 years) habitat benefits and high probability of long-term survivorship	In the short term, relatively fast-growing species (coyote brush) will provide several generations of targeted bird species with nesting and foraging habitat. Planting a diversity of species maximizes quality habitat as the slow growing plants (manzanita, buckbrush) mature.
Provide native pollinator habitat	Use native shrubs and herbaceous species that will bloom and flower throughout the growing season.
Optimize opportunities for public access trails, picnic areas, and scenic overlooks	Consider public access trail needs by not planting across optimal new trail locations and not planting prolific species near picnic areas. Plant low-statured vegetation along river to increase scenic views.
Minimize sources of weeds, provide habitat along project	Use native plants to displace weeds in areas outside the main plantable area. When possible, we will use native grasses to outcompete non-native invasive species that currently grow.
Maintain high plant species and vegetative structural diversity	PRBO data suggests that bird diversity is highest in areas with 5-7 shrub species over a 50-m^2 area. Design considerations include varying density across the site to allow light gaps and create structural differences (grouping shrubs together will create pockets of shade and light gaps), creating vegetation patches (grouping small shrubs together will mimic larger plants and may attract desirable wildlife species faster than if they were grown apart).

C. Composition and Location of Plant Communities

We propose four plant associations on the site based on the varying hydrological and biological conditions of the site (Table 5 and Figure 8). Densities and compositions of this mix will vary due to differing soil textures across the site, species water and sunlight requirements, and opportunities to build habitat for targeted species. Three rows of native plants will be installed along the perimeter trail which will create a low-statured hedgerow that enhances but does not interfere with the view of the river, and creates food and shelter for native wildlife. Moreover, as part of a weed control scheme, three stands of native grass plugs will be planted in the dry, open areas of Field 1 to replace yellow star-thistle and annual non-native invasive grasses. A native wildflower and grass seed mix will be scattered along the constructed trail to enhance the aesthetics of the site as well as provide forage for pollinators. In addition, a native pollinator garden will be planted with a mix of shrubs, lianas, and herbaceous species in Field 2.

1. Pollinator Garden

The Pollinator Garden is approximately 1.5 acres in size, and occupies the best soils found on the site. The species to be included in this mix are shown in Table 5. This community will be planted on the higher parts of the floodplain with deeper, fine-textured soils. This mix will provide a dense habitat, which is critical to many neo-tropical migrant birds, as the density deters mammalian predators and the abundance of berry producing plants provides fledgling birds with an easy food source. Additionally, bees

and beneficial pollinators will be attracted to this area due to its varying blooming times providing a consistent food source.

The Garden will be planted on a 7'x7' grid.

2. Native -Plant Hedgerow

A hedgerow comprised of mostly native blackberry, rose and Santa Barbara sedge will be planted after weed control measures have been carried out to prevent establishment and limit the extent of the dense, aggressive Himalayan blackberry surrounding much of the perimeter of the site. This hedgerow, consisting of three rows of native blackberry and rose at a spacing of one plant spaced every 10 feet along a row and 5 foot spacing between the rows, will provide important wildlife food and cover, produce native plant seed sources, and inhibit the establishment of invasive, exotic species. Native blackberry was choses due to its partial shade tolerance since portions of the hedgerows will be planted under the existing tree canopy. Rose will be planted in full sun. The native hedgerow will remain low-statured, which will not interfere with the created scenic vistas. In areas that are in mostly shade, Santa Barbara sedge will be planted. Plants of local ecotypes will be purchased. A plant species ecotype originates from a particular ecoregion, in the case of this project, the Sacramento River floodplain. This hedgerow will consist of three rows each approximately 2,500 feet, along the constructed trail, shown in Figure 8.

3. Herbaceous Understory

To prevent establishment and limit the extent of invasions, an understory will be planted in three monoculture stands in Field 1, shown in Figure 8. Incorporation of herbaceous plants will provide important wildlife habitat, produce native plant seed sources, and inhibit the establishment of invasive, exotic species. If this understory establishes successfully, it will create edge habitat and provide forage-rich wildlife corridors across the site. We will oversee the planting of three species of drought-tolerant native grasses including blue wildrye (*Elymus glaucus*), purple needlegrass (*Nassella pulchra*), and big squirreltail (*Elymus multisetus*). Plugs will be purchased from a local native plant supplier. They will be planted by hand in clusters of 100, since the use of equipment or broadcasting to plant grass seed is unfeasible or impractical due to site conditions. This is an atypical planting strategy for restoration, as this number is very low for the acreage of the project. However, due to the poor cobbly soils and lack of consistent soil moisture in this field, the survivorship of these plots is expected to be lower than it would be on quality, loam soils. Along with the planting of native grasses, a wildflower seed mix and native grass seed will be broadcast along the trail for erosion control at 20lb per acre.

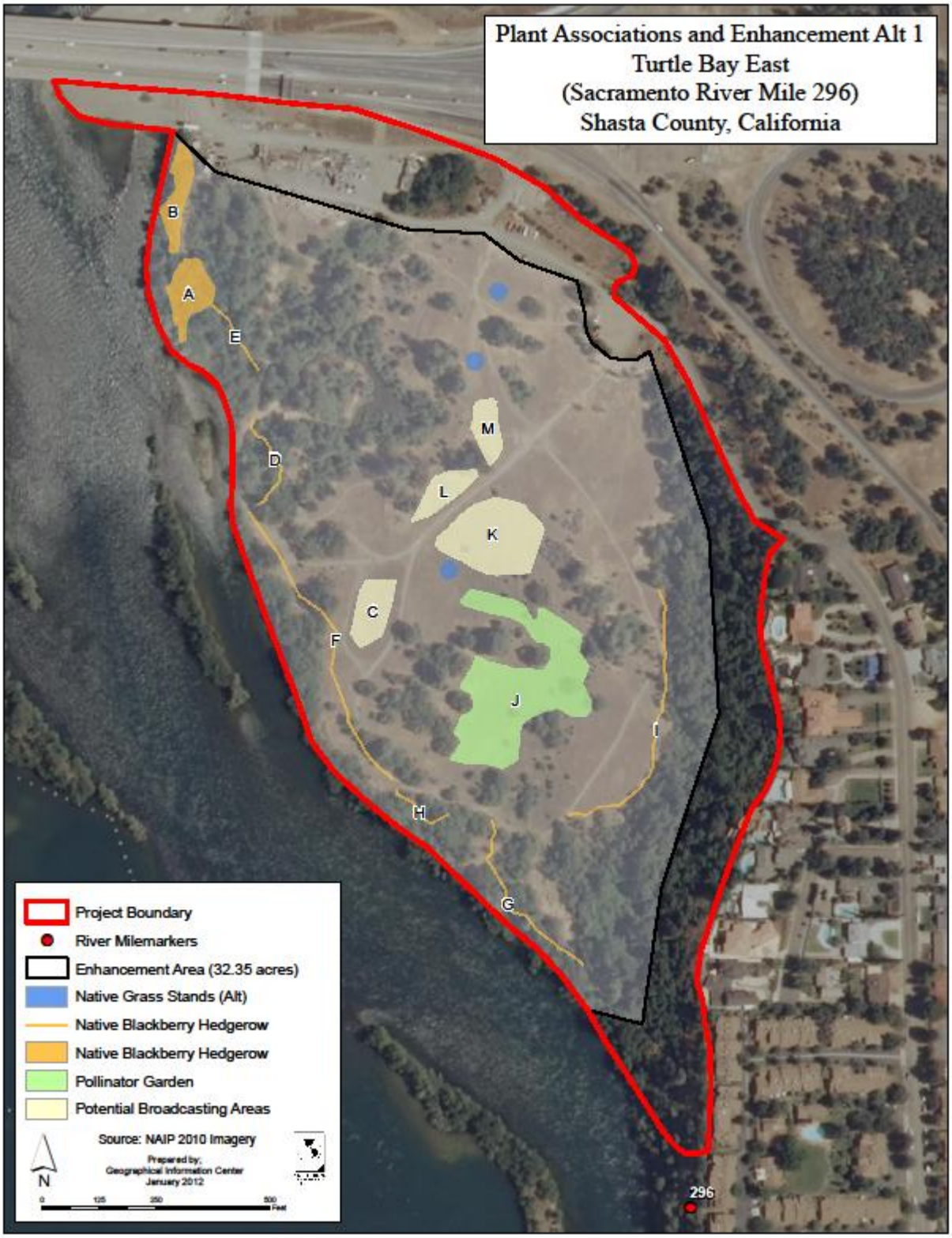
The budget will be reviewed following the initial site planting, and if more plant material can be purchased areas marked in Figure 8 as 'potential broadcast areas' will be broadcast with gumplant in Fall 2012, at a rate to be determined by the available budget.

Table 5. Summary of Proposed Plant Species at the Turtle Bay East Restoration Project, Shasta County, California.

Total Acres: 1.43

Common name	Scientific name	Species comp. (%)	Density (plants/acre)	Total Number
Pollinator Mix				
Woody Species				
Coffeeberry	*Rhamnus tomentella*	9	78	112
White-leaved manzanita	*Arctostaphylos viscida*	6	52	74
Golden currant	*Ribes aureum*	7	61	87
Coyote brush	*Baccharis pilularis*	6	52	74
Hairy honeysuckle	*Lonicera hispidula*	8	69	99
Western redbud	*Cercis occidentalis*	5	43	62
Wild rose	*Rosa californica*	14	122	174
Dutchman's pipevine	*Aristolochia californica*	5	43	62
Clematis	*Clematis ligusticifolia*	6	52	74
Total Woody Species		**66**	**529**	**756**
Herbaceous Species				
California buckwheat	*Eriogonum fasciculatum*	5	43	62
Yarrow	*Achillea millefolium*	8	69	99
California fuschia	*Zauschneria californica*	5	43	62
Deergrass	*Muhlenbergia rigens*	4	35	50
Narrow leaf milkweed	*Asclepias fascicularis*	6	52	74
Evening primrose	*Oenothera elata*	6	52	74
Total Herbaceous Species		**34**	**294**	**421**
Native Hedgerow				
California blackberry	*Rubus ursinus*	37	n/a	450
California rose	*Rosa californica*	21	n/a	250
Santa Barbara sedge	*Carex barbarae*	42	n/a	500
Total		**100**		**1,200**
Herbaceous Understory				
Blue wildrye	*Elymus glaucus*	33		100
Purple needlegrass	*Nassella pulchra*	33		100
Big squirreltail	*Elymus multisetus*	33		100
Total Herbaceous Species		**100**		**300**
Trail Mix				
Northern California Wild Flower and Grass Mix				20lb/acre

Figure 8. Planting Associations and Enhancement Area, Turtle Bay East, Shasta County, California.



V. ENHANCEMENT

Targeted species include tree-of-heaven, Scotch broom, yellow star-thistle, black locust, Scotch broom, and Himalayan blackberry (Figure 9). Enhancement activities will occur on approximately 38 acres, including much of Field 1. The primary focus of the Enhancement Area is to target non-native invasive species removal (Figure 10). Primary management methods for this area will be a combination of mowing and herbicide application of Garlon3®, Round-up®, and Goal® to all non-native species including trees, shrubs, forbs, and grasses. Following this treatment, the invasive trees and shrubs will be removed by hand or by using field equipment if site conditions permit. The equipment is owned by the City of Redding, and River Partners will consult with Terry Hanson, City of Redding, during the site preparation phase to determine the best mechanical method for extraction. Following weed removal, native blackberry will be installed to take the place of the removed vegetation.

Figure 9. Himalayan Blackberry Extent, Turtle Bay East, Shasta County, California.

Figure 10. Non-Native Exotic Species Extent, Turtle Bay East, Shasta County, California.

VI. REGULATORY COMPLIANCE

A. CEQA Compliance

The City of Redding received a Notice of Categorical Exemption for the evaluated impacts of the proposed project. General Rule exemptions do not fall within an existing exempt class, but it can be seen with certainty that there is no possibility that the activity may have a significant effect on the environment. No native trees will be removed, and no wetlands or streams will be impacted by the project. The department of Fish and Game filed a Notice of Determination on October 17, 2007, shown in Appendix B.

B. Cultural Resources

There are no known archaeological sites in the project area along the river based upon previous disturbance and the Caltrans archaeological surveys (Terry Hanson, personal communication). In the event archaeological resources are uncovered during a ground preparation activity, staff members will stop all activity within the immediate vicinity of the discovery, unless safety concerns are an issue. Staff will make an effort to protect resources or remains by flagging off the area. After activity has stopped, staff will immediately contact someone at the City of Redding via telephone and advise them to consult with a professional archaeologist who can evaluate the importance/significance of the materials in question. Written confirmation will also be turned in to the City of Redding. Activities resulting in the inadvertent discovery may resume after we receive a notice from the City of Redding.

C. Herbicide Permits

All herbicide use conditions for mixing, application and clean-up shall conform to all applicable federal, state and local regulations. Any application of herbicide shall be done under the supervision of a licensed applicator in accordance with all applicable, federal, state, local laws, and City procedures and/or guidelines. All applicators will be trained to safely handle and apply herbicides by River Partners and the Shasta County Department of Agriculture. All herbicide permits will be procured by the City of Redding.

VII. FIELD IMPLEMENTATION

This section provides field managers with information needed to implement the plant design. The subsections describe field layout and an approximate sequence of activities that will be carried out over the three-year term of the restoration project.

A. Site Preparation

A major component of the restoration is the removal of non-native invasive plant species. The site will be mowed and sprayed in the open space areas. Additionally, tree-of-heaven and black locust will be painted with Garlon 3®, and Scotch broom will be hand-pulled and sprayed with Roundup® (Glyphosate) and Goal® (Triclopyr). The site preparation phase offers the best opportunity for Himalayan blackberry control, since the widest range of tools can be used at this time and treatments can generally be more intensive. Removal will begin with a masticator, a machine which grinds through brush to clear it before smaller tools and herbicides are used. Following mastication, the CCC's will treat any remaining invasive plants with herbicide. The treatments will continue until time of planting. Herbicide applications in September through early November are most effective against blackberry because the plant is sending energy reserves downward and the herbicide is easily translocated to the roots (Bennett, 2007).

B. Plant Material Collection and Propagation

To preserve any ecotype differences and strive for restoration success, plant materials will be obtained from vegetation as near as possible to the site (USFWS 2005). River Partners will obtain plugs from a local native species distributor. Native grass plugs will be planted in Field 1 in late 2011, native wildflower seed mix will be planted in early 2012, and native shrubs and herbaceous species will be planted in Fields 1& 2 in late 2011- early 2012.

C. Plant Installation

1. Pollinator plant mix and native hedgerows

The pollinator plant mix and the native hedgerows will be planted in Fields 1& 2 in March 2012.

The pollinator garden will be subdivided into "upland" and "riparian" planting rows, with individual irrigation regimes for each. The planting locations will be flagged by the CCCs under the guidance of River Partners biologists. The "riparian" rows will be watered throughout the year, whereas the 'upland' rows will be watered as needed.

2. Herbaceous species

The non-irrigated native grass stands in Field 1 should be planted in Year 1 during late fall/early spring, concurrently with the rainy season. Each cluster should contain approximately 100 plugs planted by hand. The native wildflower seed mix will be planted in early 2012.

D. Plant Establishment

1. Plant protectors

Plant protectors (one-quart milk cartons) should be installed with about 2 inches of wood shavings applied as mulch to hold soil moisture and minimize weed growth. These help protect the plant from desiccation, herbivory, and drift from herbicide applications.

2. Weed control

Weed control is necessary for the successful establishment of native plants and improvement of habitat. The weeds of greatest concern at the site are Himalayan blackberry, yellow star-thistle, tree-of-heaven, Scotch broom, and black locust.

During the growing season, weeds along the planting rows and in the row centers should primarily be controlled by the timely spraying of Roundup® or a generic herbicide brand with glyphosate as the active ingredient. Spraying should be implemented about 10 times a year and mowing should occur about 4 times a year, during the growing season, for at least the first two years.

3. Irrigation schedule

Due to the dry summers typical of the climate in the area, irrigation will be required for plant establishment and survival of the pollinator plant mix and native hedgerows. Irrigation will be applied with the goal that plants will become self-sufficient by the end of the third growing season. Water will come from the City of Redding through a 2 inch pipe at 100 pounds per square inch (p.s.i.) and be controlled by a pressure regulator. Irrigation lines will run to the pollinator mix and the native hedgerows. The California Conservation Corps will be hand watering the wildflower mix to establish these annual plants and foster their future propagation.

The irrigation in the pollinator garden will have valves to turn individual lines on or off. This will allow for different irrigation schedules to be established for dryland and riparian species.

In the first growing season, the rapidly growing seedlings have roots only in the surface (the top 1-2 feet) of the soil profile. The rooting zone must be kept moist through the season to ensure optimum growth and survival. Due to sandy soils at the site and a deep water table, the soil moisture of the fields planted with woody species will need to be closely monitored. The intervals between irrigations are dependent upon soil texture, depth to water table, the weather conditions, and plant water stress.

The strategy for the second and third year is to train the roots to grow deep. Roots at depth (5-15 feet) will need less water and may be able to tap into the water table on the site and out-compete more shallow-rooted weeds. Less frequent, deep watering will encourage roots to grow deeper, well below the roots of the weeds, allowing the plants exclusive use of this deep moisture. As the roots grow deeper, the times between irrigations become longer; this allows the soil surface layers to dry, thereby reducing weed vigor. We anticipate that the well-drained, loamy soils, and relatively deep

groundwater present on the site, will require frequent irrigations and careful observation of water stress. These variables may dictate the frequency of watering on the site.

4. Herbivore Control

A number of measures can help control or minimize the effects of herbivores on young plants (Table 6). Cultural practices such as mowing or spraying can discourage most of these herbivores. One of the advantages of active restoration is that more plants are planted than the herbivores can eat. Some damage by herbivores is tolerable and should not impact the success of the planting.

Table 6. Summary of Herbivore Control Methods at the Turtle Bay East Project

Herbivore	Type of Damage	Comment on measure(s) or plant response
Beaver	Cut down woody species to build dams	Dismantle dams or, if damage becomes severe, herbivore removal Woody species can stump sprout
Deer	Browsing sapling Use trees to rub velvet off antlers	Install heavy-gauge metal hoops and garlic capsules or other deterrent. Saplings can resprout
Ground Squirrels (*Otospermophilus beecheyi*)	Dig up and shred plants and protectors.	Flooding can reduce populations.
Pocket Gophers (*Thomomys bottae)*	Eat root systems (probably killing more saplings than any other vertebrate pest).	Control of weed cover allows predators to hunt gophers. However, gophers can persist in an open, weed-free field. Weed mulch control or flooding reduces populations. A variety of birds will prey on gophers if given the opportunity. Raptor perches and owl boxes may increase predation.
Rabbits and Hares	Browse early spring growth.	Most seedlings resprout.
Voles (*Microtus*)	Eat bark and cambium at the base of sapling, usually girdling the entire stem.	Saplings resprout, unless vole population is high. Voles live only in dense herbaceous (weed) cover and never stop moving when in the open to avoid predators. Remove dense weed cover through herbicides or mowing.

VIII. MONITORING AND REPORTING

Monitoring and adaptive management are an integral part of this restoration. A detailed annual monitoring timeline will allow for rapid adaptation of management actions. The entire planting pattern is stored in a computerized database that will allow for future hypothesis testing of the success of this planting design relative to site factors such as soil textures and depth to water table.

River Partners has developed a science-based adaptive management program to respond to new information and changing conditions in order to "close the loop" between monitoring and project implementation (River Partners 2008). For each restoration site, River Partners staff makes weekly site visits throughout the year, and an annual quantitative survey between June and August. Towards the end of the growing season, the annual monitoring results are summarized and recommendations for changes in field management are reported in the end of season report.

During the project, monitoring results will be recorded in the following ways:

- Annual end of season report, and
- Final report.

These methods are described briefly below, and explained more fully in our monitoring program plan (River Partners 2008).

A. Weekly Monitoring and Annual Quantitative Survey

Weekly visits will be made by River Partners staff to assess field conditions and determine establishment priorities to guide weed control and field activities being conducted by the CCC's. At the end of the first growing season, River Partners will conduct a complete census of all woody species planted. The data will be used to calculate survivorship, and to determine any changes to or omissions from the planting design. During years two and three, we will sample woody species plantings to determine survivorship, growth and coverage. This allows us to document structural changes in habitat to determine whether habitat is being created for targeted species. If the budget allows, we will also sample herbaceous understory plantings.

B. End of Season Reports and Final Report

The end of season and final reports will document the monitoring data, review site activities and recommend future management actions. River Partners will also document observations related to natural processes related to flooding (erosion, sedimentation, and debris deposition) if applicable. Furthermore, we will analyze activities in terms of the restoration plan and provide long-term management suggestions in the final report. Reports will be submitted to the City of Redding for review and approval by December 1st of each year. Upon completion of the project, a final report shall be prepared and submitted to the City of Redding by December 31st of that year.

IX. SAFETY ISSUES

The health and safety of our employees are an integral part of our work. Prior to any work on the unit, River Partners staff will be briefed on safety issues associated with the site.

A. Standard Field Procedures

All employees will have a safety binder that describes safe work practices, and they will be responsible for complying with these practices. In case of injuries or illnesses while on the job, employees will:

- Call 911, or
- Call Shasta Regional Medical Center, (530) 244-5400, located at 1100 Butte Street, Redding, California 96001, and
- Contact the River Partners office at (530) 894-5401.

In addition, River Partner employees will comply with the requirements of the Drug-Free Workplace Act of 1990 (Government code Section 8350 et seq.).

B. Flood and Fire Contingencies

River Partners will remove all farm equipment from the site during the flood season (November 15 to April 15). In the event of a flood, flood debris will be cleared from the site following the flood season.

Throughout the implementation of the project, River Partners will periodically mow between rows and clusters, and along the perimeter of project areas, to reduce potential fire hazards.

X. PROJECT IMPLEMENTATION TIMELINE

The timeline for the project is shown for three years in Table 7.

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Table 7. Timeline for the Scope of Work Tasks at the Turtle Bay East Restoration Project

Task	2011	2012				2013				2014
	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Planning										
Site Preparation										
Irrigation Installation										
Field Preparation										
Planting					**(Replant woody species & plant understory)**					
Plant Establishment										
Monitoring and Reporting										

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Appendix A

Field Logs of Soil Pit Notes for Turtle Bay East

SOIL LOG AND NOTES

Date: 9/23/2011
Subunit/Area: Field 1 **Pit**
Location: Southwest out on main trail before back perimeter loop
Observers: Tom Griggs, Abby Rizzo

ID #1
GPS
Point: N 40° 34'57.6" W 122° 21'55.5"

Depth (ft.)	Texture	Color	Soil Moisture	Root Distribution	Notes
0-3ft.	Fine sandy loam	reddish brown	0	to 3 ft.	≥80% cobbles

Notes: Deep star-thistle roots

Subunit/Area: Field 2
Location: Southernmost pit; abuts the northern side of the perimeter trail
ID #2 **Pit**
GPS
Point: N 40° 34'53.3" W 122° 21'55.1"

Depth (ft.)	Texture	Color	Soil Moisture	Root Distribution	Notes
0-6ft.	Silty loam	light brown	0	to 6ft.	Consolidated silt
					Roots to 6 ft.

Notes: Oaks surrounding star-thistle patch

Subunit/Area: Field 1

Location: Southeast; north of bicycle ramps
ID #3 **Pit**
GPS
Point: N 40° 34'53.4" W 122° 21'55.1"

Depth (ft.)	Texture	Color	Soil Moisture	Root Distribution	Notes
0-1ft.	sandy loam	yellowish brown	0		Blocky, brown A horizon
1-2ft.	sandy	light brown	0		Hard-packed
2-4ft.	very sandy, gravelly cobbly loam	yellow brown	0		Lots of minerals -anaerobic soil evidence
3-5ft.	gravelly sandy loam	yellow brown	0	to 5ft.	

Notes: Three-awn grass and willow herb present; star-thistle

Subunit/Area: Field 1

Location: Pit closest to bench and parking lot
ID #4 **Pit**
GPS
Point: N 40° 35'00.6" W 122° 21'49.8"

Depth (in.)	Texture	Color	Soil Moisture	Root Distribution	Notes
0-16 in.	gravelly loam	reddish-brown	0		2 in. surface layer
16-28in.	gravelly loam	light brown	0	to 28 in.	≥80% cobbles
					Lots of 12+ in. cobbles

Notes: Star-thistle, annual grasses

Subunit/Area: Field 1

Location: West of parking lot
ID #5 **Pit**
GPS
Point: N 40° 35'04.5" W 122° 21'54.7"

Depth (in.)	Texture	Color	Soil Moisture	Root Distribution	Notes
0-15 in.	loamy	brown	0		smoothly stratified soil
15-24 in.	gravelly silt	yellow brown+carbonate	0		mineralization
25-36 in.	silt	light brown	0		≥80% cobbles
36-48 in.	sandy loam	light brown	0	to 48 in.	bush lupin, tree-of-heaven, curly dock, avena, buckwheat, star-thistle

Notes: