Operational Guidebook to Assessment of Riverine Waters/Wetlands Functions at the Chevron Tank Farm Facility San Luis Obispo, California

Final Report

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Table of Contents

I. Introduction…...……. I-1
A. Background……. I-1
1. Administrative Context and Need for Assessment of the Functions of Waters/Wetlands Ecosystems at the SLO Tank Farm……. I-1
2. Rationale for Selection of the Hydrogeomorphic Assessment Methodology – Operational Draft Guidebook Objectives……. I-1
B. Overview of the Hydrogeomorphic Approach to the Assessment of Functions of Waters/Wetlands…….. I-2
1. The Hydrogeomorphic Approach…….. I-2
2. Classification of Waters/Wetlands – *First Basic Element of HGM*……... I-2
3. Identification, Definition and Description of Functions – *Second Essential Element of HGM*……..…….. I-3
4. Reference Systems – *Third Essential Element of HGM*…… I-3
5. HGM Assessment Models, Protocols and Definition of Functional Indices – *Fourth Essential Element of HGM*……..……... I-7
6. Assessment Protocol…….. I-8
C. Scope of the Draft Guidebook…… I-8
1. Reference Domain – Definition and Geographic Extent……... I-8
2. Geographic Extent of Potential Reference Domain and Applicability of the Guidebook to Similar Regions……... I-8

II. Characterization of Waters/Wetlands Ecosystems at the San Luis Obispo Tank Farm…… II-1
A. Overview and Description of Project Site…….. II-1
1. Geomorphic Setting……... II-2
2. Climate……... II-3
3. Soils…… II-3
4. Vegetation Communities…… II-4
5. Fish and Wildlife Resources…….. II-5
B. Landscape Position of Riverine, Slope, and Depressional Wetland Ecosystems at the San Luis Obispo Tank Farm…….. II-7
1. Riverine Wetlands…….. II-7
2. Slope Wetlands…….. II-9
3. Depressional Wetlands……... II-10
C. Classification of Riverine, Slope and Depressional Wetlands at the Chevron San Luis Obispo Tank Farm…….. II-13

III. Waters/Wetland Functions and Assessment Models for Riverine Wetlands at the San Luis Obispo Tank Farm…….. III-1
A. Overview of the HGM Riverine Wetland Model…… III-1
B. Description of Functions Identified in Riverine Waters/Wetlands Ecosystems… III-7
1. Hydrologic Functions……. III-7
2. Biogeochemical Functions……. III-10
3. Plant Community Functions……... III-15

4. Faunal Support/Habitat Functions……. III-17
C. Detailed Description, Measurement Protocol, and Scaling of Variables for the Riverine Wetland HGM Model…… III-21

IV. Glossary…… IV-1

V. Literature Cited…….. ……. V-1

Appendices
Appendix A. San Luis Obispo Riverine HGM Reference Sampling Locations & Photographs

Appendix B. San Luis Obispo Riverine HGM Reference Site Data Sheets Used to Develop Riverine Model

Appendix C. Reference Site Data Sheets

Appendix D. San Luis Obispo Riverine HGM Guidebook Data Summary

Appendix E. Methodology Used to Collect Reference Data for the Development of the San Luis Obispo HGM Riverine Guidebook

Appendix F. GIS Maps Used to Score Variables for the San Luis Obispo Riverine HGM Reference Data

Appendix G. Variable Scores for the San Luis Obispo Riverine HGM Reference Sites

List of Figures

Figure I-1. HGM Reference System Structure..... I-5

Figure I-2. Use of HGM Subclass Profiles…… I-5

Figure I-3. Structure of an HGM model…… I-8

Figure I-4. Reference domain for the *SLO Tank Farm Riverine HGM Functional Assessment Draft Guidebook*…….. I-9

Figure I-5. Reference sampling locations for the *SLO Tank Farm Riverine HGM Functional Assessment Draft Guidebook*…… I-10

Figure II-1. SLO Tank Farm project location…… II-2

Figure II-2. Topography showing riverine waters/wetlands in a valley…… II-7

Figure II-3. Topography of a slope wetland…….. II-10

Figure II-4. Topography in a closed depressional wetland…… II-12

Figure III-1. Measurement protocol for In-channel large wood……... III-35

Figure III-2. Protocol for establishing plots within the PAA…… III-42

Figure III-3. Measurement protocol for the vegetation canopy cover variables in the Variable Assessment Area..... III-43

List of Tables

Table I-1. HGM Reference System Definitions (after Brinson *et al.* 1995)……..…... I-6

Table I-2. Reference sites for the development of the reference data set used for the development of the *SLO Tank Farm Riverine HGM Functional Assessment Operational Draft Guidebook*..... I-11

Table II-1. List of species of local concern in the San Luis Obispo area…….. II-6

Table II-2. Key to San Luis Obispo Tank farm HGM Waters/Wetland Classes and Subclasses……... II-13

Table III-1. List of Riverine Waters/Wetland Functions by Category…….. III-2

Table III-2. Riverine Wetland Variables……... III-3

Table III-3. Relationship of Variables to Functions in Riverine Wetlands……... III-5

Table III-4. Indices of Functions for Riverine Waters/Wetlands at the Chevron San Luis Obispo Tank Farm…….. III-6

Table III-5. Faunal Classes and Indicator Species for Scaling V_{ASIGN}…….. III-23

Table III-6. Indicator Species for Scaling V_{ASIGN}……...…….…….. III-23

Table. III-7. Decomposition classes for CWD…….. III-34

Table III-8. Conversion Table for Cover Class Midpoint to Cover Class Number……... III-40

List of Photographs

Photograph II-1. SLO Tank Farm. Most of the Project Site is open grassland and a mosaic of riverine, slope and depressional waters and wetlands features……... II-1

Photograph II-2. East Fork, San Luis Obispo Creek……...……..... II-8

Photograph II-3. Tank Farm Creek.……..……..….. II-8

Photograph II-4. North MarshTtank Farm Creek slope complex……. II-9

Photograph II-5. Depressional features on northern portion of the SLO Tank Farm ….. II-11

Photograph II-6. Depressional features at Reservoir 6 of the the SLO Tank Farm …… II-11

Photograph III-1. Wood rat midden at Willow Creek Reference Site……..... III-21

Photograph III-2. Row orchard in buffer at See Canyon Creek Reference Site……... III-25

Photograph III-3. Continuous unbroken buffer along the Old Creek Reference Site III-28

Photograph III-4. Hydraulic roughness features at the Willow Creek Reference Site…. III-31

Photograph III-5. Various stages of coarse woody debris decomposition below OHW were documented at the Willow Creek Reference Site……... III-33

Photograph III-6. Flood-prone area at the San Luis Obispo Creek Reference Site…….. III-37

Photograph III-7. Panicled bulrush (*Scirpus microcarpus*) in floodplain understory at the Old Creek Reference Site…….. III-39

Photograph III-8. In-channel coarse woody debris within the active channel at the Willow Creek Reference Site…….. III-44

Photograph III-9. View looking down gradient at the longitudinal profile at the Cottontail Creek Reference Site…….. III-46

Photograph III-10. Off-channel woody debris surrounds wood rate midden at Willow Creek Reference Site……... III-49

Photograph III-11. Row crops within the buffer along the See Canyon Creek Reference Site……. III-53

Photograph III-12. Primarily non-native herbaceous vegetation in herb layer, shaded by native trees and shrub species in the overstory at the Morro Creek Reference Site …….. III-57

Photograph III-13. Arroyo willow (*Salix lasiolepis*) resprouting in the understory at Morro Creek Reference Site……..... III-59

Photograph III-14. Cobble bar with fine sediments along sampling reach of Toro Creek Reference Site……... III-61

Photograph III-15. Nearly 100 percent of the stream channel is shaded at the See Canyon Creek Reference Site……. III-64

Photograph III-16. Dense shrub canopy cover by arroyo willow (*Salis lasiolepis*) along reference reach at Toro Creek……... III-66

Photograph III-17. Soil profile at the East Fork, San Luis Obispo Creek Reference Site…….. III-70

Photograph III-18. Four vegetation layers (herb, vine, shrub, and tree) at the San Luis Obispo Creek Reference Site…….. III-73

Photograph III-19. Metal pipe delivering surface water inputs to the Willow Creek Reference Site……. III-75

Photograph III-20. California walnut (*Juglans californica* var. *californica*) at the East Fork, San Luis Obispo Creek Reference Site……. III-78

Photograph E-1. Data collection at OHW cross-section, Cottontail Creek Reference Site…….. E-1

Photograph E-2. Pebble count at the San Luis Obispo Creek Reference Site..... E-3

Photograph E-3. Surface hydrologic input (metal pipe) at the Willow Creek Reference Site…….. E-3

Photograph E-4. Determination of soil color at the Willow Creek Reference Site…….. E-4

Photograph E-5. Vegetation structure at Old Creek Reference Site……. E-5

Photograph E-6. Development of the plant species list at the Dairy Creek Reference Site…….. E-6

Photograph E-7. Direct animal sign (Pacific chorus frog tadpoles) at the Old Creek Reference Site…… E-7

I. Introduction

A. Background

1. Administrative Context and Need for Assessment of the Functions of Waters/Wetlands Ecosystems at the SLO Tank Farm

The Clinton Administration's Wetland Plan (1993) expressed the need for improvement of rapid assessment techniques to allow for better consideration of the functions of waters/wetlands in the context of the Clean Water Act (CWA) Section 404 process and in other federal and state programs that focus on waters/wetlands. The Section 404 process as outlined in the 404(b) (1) Guidelines (40 CFR Part 232 and 233) and the U.S. Army Corps of Engineers (Corps) regulations (33 CFR Parts 320-330) is generally comprised of 6 steps:

(1) Establishment of geographic jurisdiction over waters of the U.S.,
(2) Determination of water dependency,
(3) Evaluation of practicable alternatives,
(4) Impact assessment,
(5) Impact minimization, and
(6) Mitigation.

The hydrogeomorphic (HGM) approach to assessment of wetland functions can be used in the 404 process (1) after waters/wetlands have been delineated on a site, and (2) after determination of water dependency and initial evaluation of practicable alternatives have been completed. Specifically, HGM can be used in comparing practicable alternatives and for impact assessment, impact minimization and mitigation (Brinson 1995, 1996). HGM can be used as an impact assessment and predictive tool that can help project proponents and permit specialists suggest and/or examine alternatives for proposed projects involving waters/wetlands. Furthermore, HGM can also be used to develop and/or condition restoration or creation project targets, and to trigger contingencies when creation or restoration project standards are in jeopardy (Brinson 1995, 1996; Brinson and Rhinehart 1996).

2. Rationale for Selection of the Hydrogeomorphic Assessment Methodology - Operational Draft Guidebook Objectives

The HGM approach to assessing the functions of waters/wetlands has been developed over the last two decades as a management tool with specific applications in land use planning, restoration design, implementation of restoration projects, permitting, and monitoring. Some common uses of the HGM approach are:

(1) Land use planning and land suitability assessment,
(2) Project impact assessment and impact minimization,
(3) Restoration design/ prioritization of restoration acquisitions and management, and

(4) Development of monitoring protocols and contingency measures for restoration projects (Brinson 1993a, Brinson *et al.* 1995).

HGM offers an objective mechanism to compare functional trade-offs of various design decisions. Additionally HGM has proven to be an effective tool for facilitating communication among individuals/groups with divergent goals for management of aquatic resources. The reference system information offered in an HGM guidebook can be used to facilitate design of restoration efforts that are customized to the stream and watershed environments of the San Luis Obispo area. That is, restoration system information can be queried to develop specifications that focus on essential elements of restoration design such as the amount and placement of refractory wood, plant species mixtures, *etc*.

B. Overview of the Hydrogeomorphic Approach to the Assessment of Functions of Waters/Wetlands

1. The Hydrogeomorphic Approach

The HGM approach to assessment of functions of waters/wetlands has four essential elements (Brinson 1993a, 1993b, 1995, 1996):

(1) Classification of waters/wetlands based upon hydrogeomorphic factors.
(2) Identification, definition, and description of the functions for the subclass of waters/wetlands under consideration.
(3) Development of a reference system that includes descriptive information about the subclass and the range of variation in structure and function observed within the subclass.
(4) Development of assessment models, associated protocols, and definition of functional indices, which establish criteria for the background information necessary to perform a functional assessment.

Each of these four elements is described in the following sections (B.2 - B.5). The inter-agency "National Hydrogeomorphic Implementation Team" recommended procedures for development of regional guidebooks, which incorporates the essential elements of HGM and synthesizes them into a standardized assessment approach for a particular subclass of waters/wetlands (*e.g.*, Brinson 1993b, Smith *et al.* 1995, Federal Register: August 16, 1996 (Vol. 61, No. 160, Pages 42593-42603); Federal Register: June 20, 1997 (Vol. 62, No. 119, Pages 33607- 33620).

2. Classification of Waters/Wetlands – First Essential Element of HGM

The first essential element of the HGM approach is the classification of waters/wetlands based upon hydrogeomorphic factors (Brinson 1993a). The purpose of the HGM classification is to provide a characterization of waters/wetlands that is based upon their position in the landscape, geomorphic setting, dominant source of water, and flow and fluctuation of the water. Such intrinsic features are sources of natural variation within each class of waters/wetlands. Classification criteria are described in greater detail in Brinson (1993a).

Seven hydrogeomorphic classes have been identified: riverine, depression, slope, mineral soil flats, organic soil flats, estuarine fringe, and lacustrine fringe. Regional subclasses of waters/wetlands can also be identified (*e.g.*, the riverine class can be subdivided into according to gradient and/or bed type). Variation within and between subclasses is often attributable to factors such as geomorphic setting, dominant water source, and hydrodynamics (Brinson 1993a). The Chevron Tank Farm HGM focuses on the riverine, slope/slope riverine proximal, and depressional wetland classes.

3. Identification, Definition and Description of Functions – Second Essential Element of HGM

The second essential element of the HGM approach is the identification, definition, and description of the functions of the waters/wetlands of concern. For the purposes of HGM, functions are defined as "processes that are necessary for the maintenance of an ecosystem, such as primary production, nutrient cycling, decomposition, *etc.*" **In the context of HGM, the term "*functions*" is used primarily as a means to highlight the distinction of ecosystem functions from socioeconomic values. The term "*values*" is associated with society's perception of ecosystem functions.** Functions occur in ecosystems regardless of whether or not they have value to society. HGM guidebook authors typically choose to group functions according to broad categories such as hydrologic, biogeochemical, plant community, and faunal support/habitat.

4. Reference Systems – Third Essential Element of HGM

The third component of the HGM approach is establishment and use of a reference system (Brinson 1995, Brinson 1996). The structure of an HGM reference system is shown in Figure I-1. To apply the use of reference systems in the context of HGM, it is important to understand the standard definitions presented in Table I-1. To the extent possible, the authors have used HGM nomenclature in this Guidebook that is known to be consistent with developing national standards. However, a national HGM nomenclature is still evolving and use of some terms may be inconsistent from region to region.

The subclass profile (Figure I-2) is the highest organizational element of the HGM reference system. Users of HGM reference systems commonly access information included in the subclass profile to establish standards for comparison among members of the subclass (*e.g.*, sites of the same subclass within the "Reference Domain" (Smith *et al.* 1995). Typically HGM users use reference systems:

(1) To apply HGM models and thus detect changes in waters/wetland ecosystem functioning,
(2) As design templates, and
(3) To set monitoring targets and specify contingency measures (Figure I-2).

Reference systems are used in the context of HGM to set a standard of comparison and create relative rather than absolute measures to increase efficiency and consistency of measurements.

Standards and details concerning development of HGM reference systems are given in the National Reference Guidebook (Smith *et al.* 1995, Smith 2001, Clairain 2002). Briefly, to develop an HGM reference system, an interdisciplinary assessment team (A-team) visits reference sites in a range of conditions (*i.e.*, relatively pristine to highly degraded) in the same biogeographic region and hydrogeomorphic subclass. At each site, the team collects data on physical, hydrologic, biogeochemical, vegetation, and faunal support/habitat community attributes.

When synthesized, interpreted, and combined with the best scientific judgment of the interdisciplinary team, these data serve to indicate the range of ecosystem conditions, functions, and responses to perturbation witnessed by the team within the subclass.

In addition to developing a subclass profile, the A-team uses best scientific judgment to determine whether each site is a "reference standard site." Reference standard sites are those that are determined by the A-team to be functioning at the highest level (*i.e.*, highest sustainable capacity) across the suite of functions exhibited within the subclass. "Reference standards" are articulated from data collected at the reference standard sites. Reference standards are those conditions exhibited by the reference standard sites that correspond to the highest level of functioning. In the HGM approach, reference standards are used to construct functional profiles of the waters/wetlands subclass, and to set the standards that allow development of HGM models.

Ideally, all of the waters/wetlands within a defined geographic region that belong to a single hydrogeomorphic subclass constitute the *reference domain*. However, practical limitations of funding, personnel, and access usually do not allow sampling of all waters/wetlands within the defined region. Therefore, the reference domain is envisioned as both the actual waters/wetlands sampled to build the reference system, and the geographic area within which reference sites for a regional waters/wetlands subclass have been sampled. Where sampling of additional reference sites could be used reasonably to expand the sampled reference domain (*e.g.*, within a single biogeographic region), one can infer a "potential reference domain." The potential reference domain thus constitutes the sampled reference domain plus the pool from which additional reference sites might be selected to expand the sampled reference domain.

Figure I-1. HGM Reference System Structure.

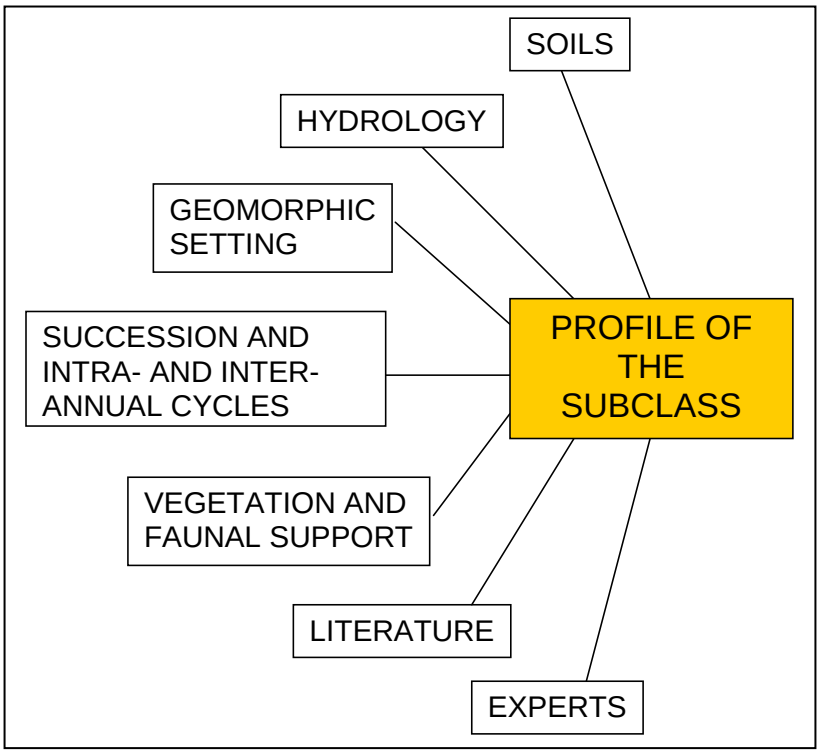


Figure I-2. Use of HGM Subclass Profiles.

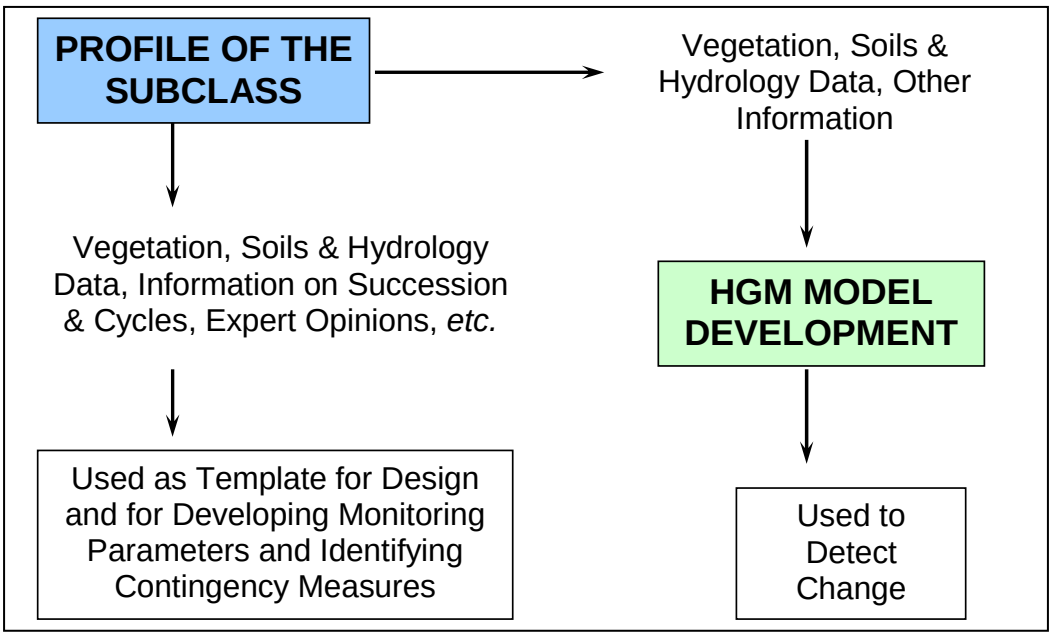


Table I-1. HGM Reference System Definitions (after Brinson *et al.* 1995).

REFERENCE TERM	DEFINITION
Reference Domain	All waters/wetlands within a defined geographic region that belong to a single hydrogeomorphic subclass.
Reference Wetland	Waters/wetland sites within the reference domain that encompass the known variation of the subclass. Reference waters/wetlands are used to establish the ranges of variation.
Reference Standard Sites	Those sites within a reference waters/wetland data set from which reference standards are developed. Among all reference waters/wetlands, reference standard sites are judged by an interdisciplinary team to have the highest level of functioning.
Reference Standards	Conditions exhibited by a group of reference waters/wetlands that correspond to the highest level of functioning (highest sustainable capacity) across the suite of functions of the subclass. By definition, reference standard functions receive an index score of “1.0”.
Site Potential	The highest level of functioning possible given local constraints of disturbance history, land use, and other factors. Site potential may be equal to or less than levels of functioning established by reference standards.
Project Target	The level of functioning identified or negotiated for a restoration or creation project. This target must be based on reference standards and site potential and be consistent with restoration or creation goals. Project targets are used to evaluate whether a project is developing toward reference standards and site potential.
Project Standards	Performance criteria and/or specifications used to guide the restoration or creation activities towards the project target. Project standards should include and specify reasonable contingency measures if the project target is not being achieved.

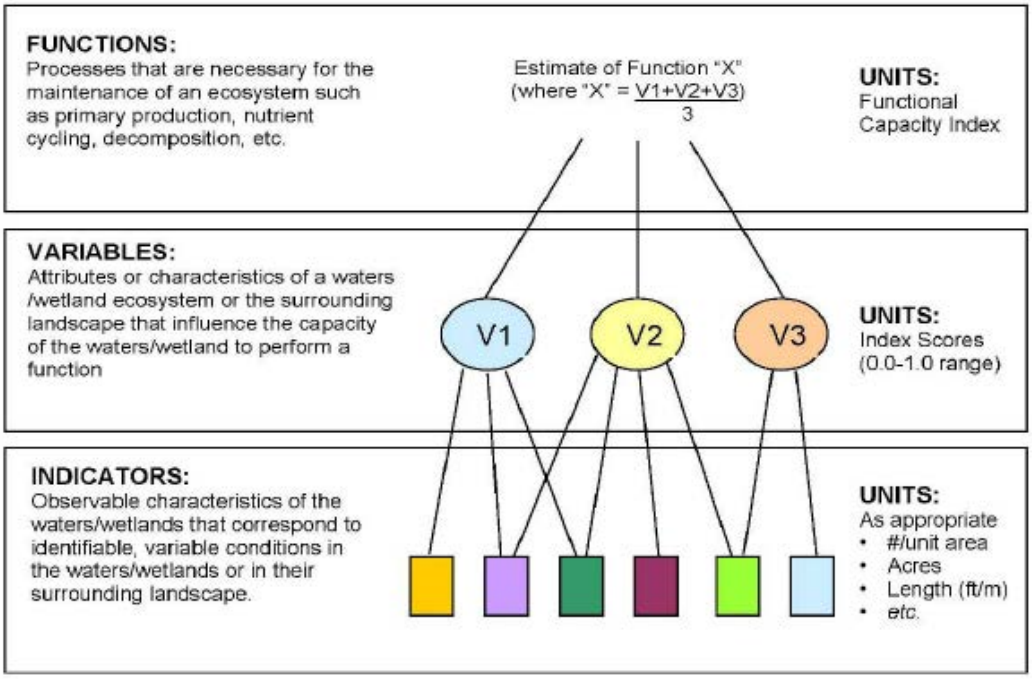
5. HGM Assessment Models, Protocols and Definition of Functional Indices – Fourth Essential Element of HGM

The fourth essential element of the HGM approach is development of assessment models for the HGM functions. After defining the ecosystem functions that waters/wetlands within a subclass perform, the assessment models and definitions of functional indices can be developed. A functional capacity index (FCI) is an estimate of the capacities of the waters/wetlands within a subclass to perform those functions (Smith *et al.* 1995). The assessment protocol is the how-to portion of the model, defining minimum information requirements and sampling techniques.

To develop assessment models for the functions associated with a regional waters/wetlands subclass, variables must be identified, defined, and scaled using data from the reference system. ***Variables* are defined as the attributes or characteristics of a waters/wetland ecosystem or the surrounding landscape that influence the capacity of a water/wetland to perform an ecosystem function or a set of functions.** For example, at San Luis Obispo Tank Farm, the condition of the Flood Prone Area affects "channel migration integrity." Whether the channel is deeply incised, constrained by culverts, levees, or rip rap, or not dramatically affects how natural channel migration processes function. At each project assessment area, a variable may be operating or expressed to a greater or lesser degree, depending upon land uses, degree of disturbance, *etc.* Hence, variables are usually observed to relate directly to the degree of anthropogenic perturbation extent on a particular site. In the field, variable conditions are either measured directly (*e.g.*, proportion of native plant species) or indirectly through the use of "field indicators" (*e.g.*, microtopographic roughness as approximated by the number and complexity of the flood plain capable of storing ponded water). Specifically, field indicators are observable characteristics of the water/wetland that correspond to identifiable variable conditions in the water/wetland or in the surrounding landscape.

Finally, variables must be combined into assessment models. **An HGM model for a particular function is usually expressed as a simple formula that combines variables in certain ways to yield an estimate of a *functional capacity index* (FCI).** In a complete guidebook, the relationships among variables that are combined to develop an FCI have been clearly established, and they are based on analyses of reference data and best professional judgment for each subclass (Figure I-3). By definition, FCI values range from 0.0 to 1.0, and reference standard sites yield FCIs of 1.0. Therefore, highly degraded waters/wetlands may yield FCIs of 0.0 (*i.e.*, unrecoverable loss of ecosystem function). Thus, an FCI is an estimate of the function performed by a water/wetland with respect to reference standard conditions.

Figure I-3. Structure of an HGM model.



6. Assessment Protocol

The final step in development of an assessment model is development of assessment protocols for users of the HGM model. The assessment protocol establishes criteria for the background information necessary to perform a functional assessment, and provides instructions for the measurement of variables in the field and subsequent calculation of FCIs. Use of assessment protocols establishes minimum requirements for valid use of models and thus helps ensure their unbiased, consistent application.

C. Scope of the Draft Guidebook

1. Reference Domain ─ Definition and Geographic Extent

The geographic reference domain for this guidebook includes the area within the Central Coast of California, from the northern limit of Monterey County to the northern limit of Santa Barbara County. Reference sites include riverine, slope and depressional waters/wetlands within this reference domain, encompassing the known variation of each subclass. Reference waters/ wetlands are used to establish the ranges of variation.

2. Geographic Extent of Potential Reference Domain and Applicability of the Guidebook to Similar Regions

This Guidebook is designed for riverine waters/wetlands within the SLO Tank Farm, but is potentially applicable in areas of similar terrain in the Central Coast of California (Figure I-4). Figure 1-5. illustrates the eleven (11) references sites throughout San Luis Obispo County that

were sampled in Spring 2008 during the development of this operational draft guidebook. Two (2) (*i.e.*, East Fork, San Luis Obispo Creek and North Marsh/Tank Farm Creek slope complex) of these reference sites are on the Project Site. Table I-2 provides precise location information for each reference sampling site.

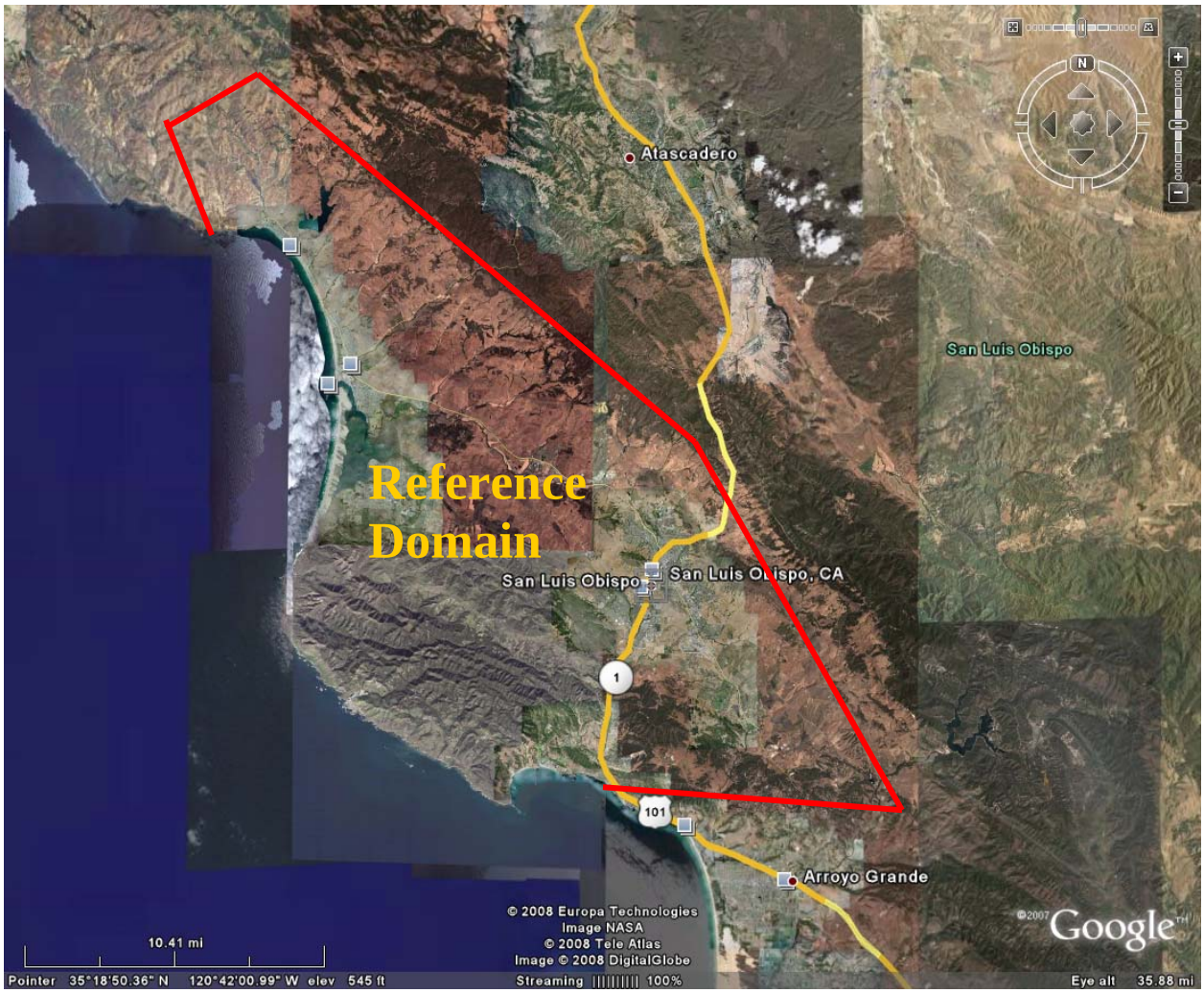


Figure I-4. Reference domain for the *SLO Tank Farm Riverine HGM Functional Assessment Draft Guidebook.*

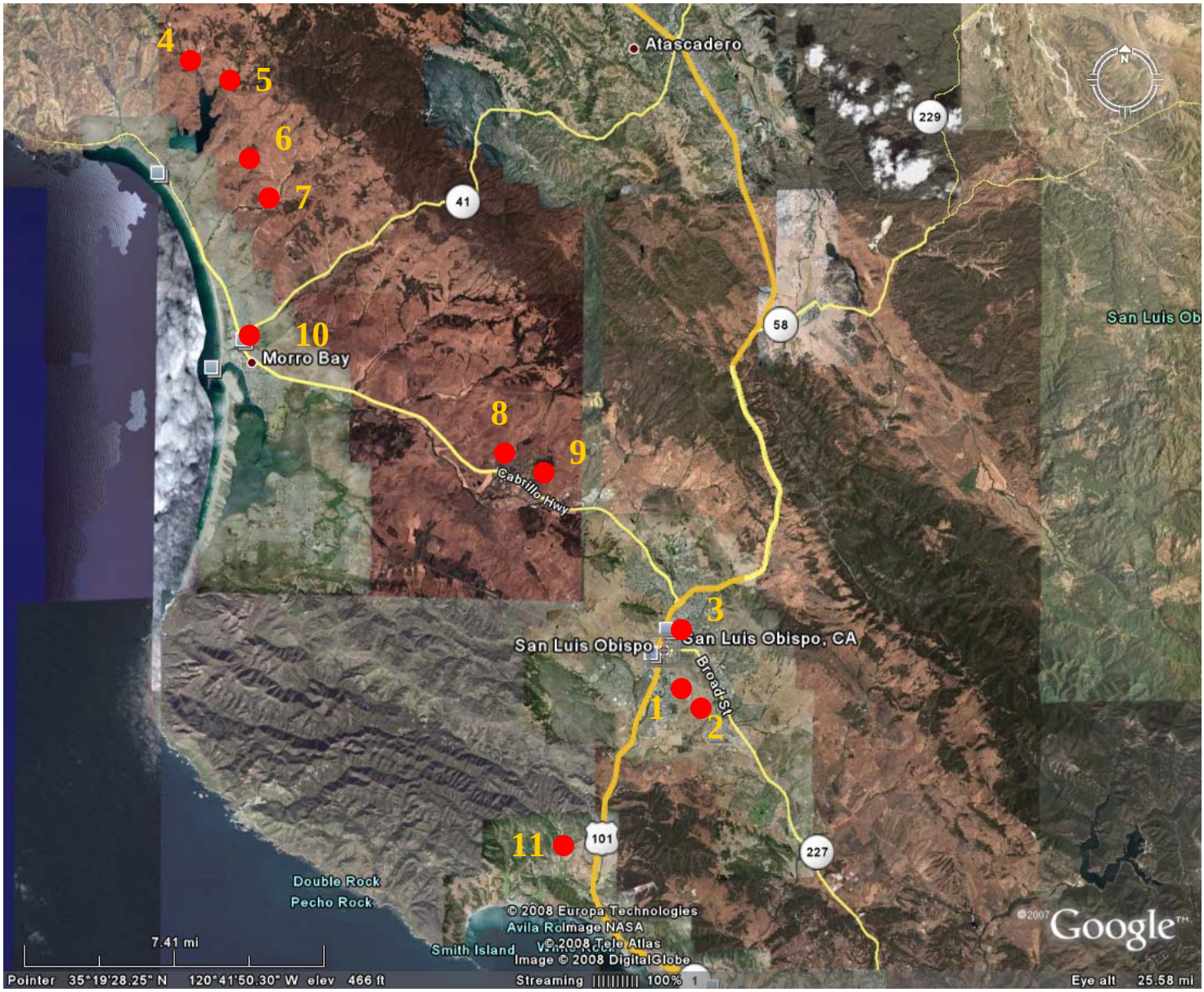


Figure I -5. Reference sampling site locations for the S*LO Tank Farm Riverine HGM Functional Assessment Operational Draft Guidebook*. Refer to Table I-2 for names and precise location information for each reference site.

Table I-2. Reference sites for the development of the reference data set used for the development of the *SLO Tank Farm Riverine HGM Functional Assessment Operational Draft Guidebook.*

Site Name	Site Number	UTM Easting	UTM Northing	Error (ft)	Site Description
North Marsh	1	5767026*	2286992*	18.81	North of Tank Farm Road; approximately 500 ft northeast of the Tank Farm Road culvert, on the north side of the marsh.
East Branch SLO Creek	2	713628	3902701	---	South of Tank Farm Road; approximately 250 ft upstream of the crossing for the San Luis Obispo Airport illuminated landing strip lights.
SLO Creek- Mission	3	712410	3906555	31	Between Chorro and Garden Streets behind Novo Restaurant within City of San Luis Obispo.
Cottontail Creek	4	692865	3927809	49.2	Approximately 0.5-mile upstream and north of Whale Rock Reservoir off of Cottontail Creek Road.
Old Creek	5	694004	3927488	36.5	Approximately 0.25-mile upstream and east of Whale Rock Reservoir off of Cottontail Creek Road.
Willow Creek	6	693576	3924276	13.9	Approximately 0.25-mile upstream of the intersection of Old Creek Road and Montecito Road.
Toro Creek	7	694642	3922520	32.1	Approximately 1,500 ft downstream of the Negranti Road crossing off Old Creek Road.
Pennington Creek	8	706400	3913727	23.2	Approximately 200 ft upstream of the bridge crossing on Pennington Creek Road.
Dairy Creek	9	706583	3912699	15.5	Approximately 0.25-mile upstream of El Chorro Regional Park.
Morro Creek	10	694768	3917067	16	Approximately 300 ft downstream of the Hwy 101 bridge crossing immediately south of Highway 41.
See Canyon Creek	11	5750584*	2271905*	19.48	Approximately 300 ft upstream of the bridge crossing at 1691 See Canyon Road.

* Coordinates for this sample site were recorded in U.S. State Plane 1983, California Zone 5 (feet).

II. Characterization of Waters/Wetlands Ecosystems at the San Luis Obispo Tank Farm

A. Overview and Description of Project Site

The San Luis Obispo (SLO) Tank Farm is owned by Union Oil Company. Storage facilities and supporting infrastructure were constructed in 1910 to serve as the tidewater accumulation point for the petroleum pipeline from the San Joaquin Valley. The tank farm facility was withdrawn slowly from Union Oil operations during the later decades of the twentieth century, and by the late 1990s, it was formally decommissioned (Avocet Environmental 2007).

With the exception of a small area of office buildings that serves as the local headquarters for Chevron Environmental Management Company (CEMC) West Coast operations, the SLO Tank Farm site primarily is open space (Figure II-1; Photograph II-1). For the past several decades, tank farm lands have been leased for cattle grazing for the purposes of fire and weed control. Adjacent land uses include the San Luis Obispo County Airport to the south, and light commercial and industrial developments, agricultural and pastoral land with scattered residences, and a trailer park to the east.

At the SLO Tank Farm, topography, soils, and vegetation have been altered considerably through plowing and disking, catastrophic fire, grazing of domestic livestock, construction and removal of oil storage tanks and their surrounding berms, stream channelization, construction of water and oil management and containment systems, and several other anthropogenic alterations. Currently, most of the SLO Tank Farm is dominated by non-native species of forbs and grasses. However, some scrub/shrub and forested plant communities occur in wet depressions or within riparian corridors associated with East Fork of San Luis Obispo Creek and its tributaries. Waters of the U.S., including wetlands, in the forms of riverine, depressional, and small slope ecosystems are prominent throughout the SLO Tank Farm. Many of the waters/wetlands on the property are associated with natural features such as swales, small riverine channel systems, or depressions. However, some of the depressional and slope wetlands are associated with human-made depressions that remain after decommissioning of oil storage facilities or after various mining or domestic livestock management operations.

Photograph II-1. *SLO Tank Farm. Most of the Project Site is open grassland and a mosaic of riverine, slope and depressional waters and wetlands features.*

Vegetation at the site is primarily native grassland that have been invaded by non-native forb and grass

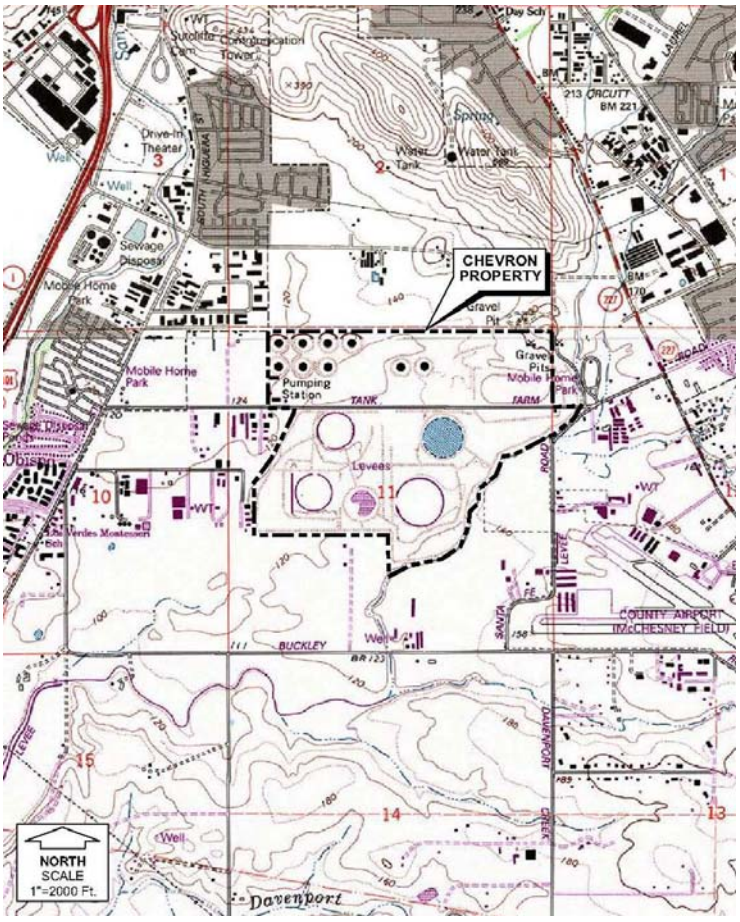
species. Waters of the U.S., including wetlands, are prominent on the tank farm. Many of the waters/wetlands at the tank farm are associated with natural features; however, some of the depressional wetlands are associated with remnant man-made depressions which remain after decommissioning of the former oil storage facility.

1. Geomorphic Setting

The SLO Tank Farm is located in a geologically complex and seismically active region. The underlying geologic structure has been formed by millions of years of folding and faulting as the Pacific plate moves north along the North American plate. Geologic structure in this landscape is oriented primarily in a northwesterly direction with the coast range.

The Project Site is located on a partially filled coastal basin composed primarily of alluvium. The northern portion of the site is characterized by a slope wetland that serves at the headwaters of a small, unnamed tributary that has been mostly disconnected from the East Fork of San Luis Obispo Creek due to anthropogenic activities. Underlying geology of this area includes a colluvial toe slope in the northern area that grades to valley alluvium which dominates the central and southern portions of the site. The valley alluvium surface is approximately 8-10,000 years old while the colluvial toe slope is a somewhat older surface. The southern portion of the site has been shaped by the wandering meanders of the East Fork of San Luis Obispo Creek as it moved back and forth across the basin.

Figure II-1. SLO Tank Farm Project Site Location (from Padre Associates, Inc. 2007).



2. Climate

The San Luis Obispo area has a mild, Mediterranean climate with warm, dry summers and wetter, cooler winters. The average maximum temperature (by month) ranges from 63° F in January to 79.5° F in September. Average minimum temperatures range between 41.6 °F in Jan and 53 degrees in August (Station No. 047851-4) (WRCC 2007). In this coastal area, the majority of precipitation comes as rainfall during the winter months (Nov. – April). Average annual precipitation is 23.45 inches (WRCC 2007).

3. Soils

The Natural Resources Conservation Service (NRCS) Soil Survey of San Luis Obispo County identifies and describes soils within the SLO Tank Farm project site as consisting of the Xererts-Xerolls-Urban land complex with 0-15 percent slopes (Soil Survey Staff 2004). These soils have some hydric inclusions. Soils at the SLO Tank Farm project site also were described by Jenesis (2003). The WSP/Padre team confirmed the presence of the NRCS mapped soils unit on the SLO Tank Farm site.

The Xererts component of the Xererts-Xerolls-Urban land unit as mapped by NRCS makes up approximately 30 percent of this map unit. Xererts formed from weathered sedimentary rocks. Xererts soils are deep and well drained, with little available water to a depth of 60 inches. The Xererts component is not flooded, or ponded, and there is no zone of water saturation within 72 inches of the soil surface. The soil does not meet the hydric criteria. The Xererts component of the Xererts-Xerolls-Urban land complex includes Cropley or Diablo soils. Cropley soils are clays that occur on alluvial fans and plains. These soils form in alluvium that weathered from sedimentary rocks and typically are very dark gray to black in the top 32 inches.

The Xerolls component makes up 30 percent of the Xererts-Xerolls-Urban land map unit. Xerolls form from alluvium and/or residual materials derived from weathered sedimentary rock. This soil type is deep and well drained, with little available water to a depth of 60 inches. The Xerolls component is not flooded or ponded, and there is no zone of water saturation within 72 inches. The soil does not meet the hydric criteria. Urban land makes up 20 percent of the Xererts-Xerolls-Urban land map unit.

On the SLO Tank Farm site, the WSP/Padre team observed that the modal soils have been disturbed extensively by historic petroleum fires, earthmoving equipment, filling, compaction by domestic livestock, and construction or demolition activities for the tank farm infrastructure. Consequently, much of the shape and physical characteristics of the soil materials have been altered. On a particular note, in areas around the old storage tank foundations is the presence of burned crude oil incorporated into many soil profiles. The soils on the SLO Tank Farm are described in greater detail in WSP (2008).

4. Vegetation Communities

Vegetation on the site has been described by EDAW (1999), Langford (2003), and Rincon Associates (2003). However, a brief summary is provided in the following text.

Plant communities along the streams of the central coast of California support a dynamic complement of native trees and other woody species, many of which can and do occur outside the riparian corridor. Perhaps the most conspicuous feature of the mature, native riparian vegetation within the southern portion of California's central coast is the dominance of large coast live oaks (*Quercus agrifolia*). Stands of live oak range in density from woodland (*i.e.*, individual tree canopies do not interdigitate) to forest (*i.e.*, tree canopies overlap). These stands occur along stream terraces in the upper and middle reaches of the moderately-sized riverine systems. The riparian overstory is mixed, with arroyo willow (*Salix lasiolepis*) dominant in many places, particularly in the downstream reaches, such as at the Chevron San Luis Obispo Tank Farm.

The understory along the East Fork, San Luis Obispo Creek has been disturbed through the reach on the Project Site, and often supports a mix of native and non-native plant species. Understory shrubs occurring on creek banks include coyote brush (*Baccharis pilularis*) and California sage (*Artemisia californica*) where the canopy is open, and blackberries (California blackberry [*Rubus ursinus*], Himalayan blackberry [*Rubus discolor*]) in both sun and shade. Herbaceous species occurring in the riparian corridor include mugwort (*Artemisia douglasiana*), poison hemlock (*Conium maculatum*), smilo grass (*Piptatherum miliaceum*), wild oats (*Avena barbata, A. fatua*), and Italian thistle (*Carduus pycnocephalus*).

In the less disturbed stream reaches in this geographic region, typically higher in the watershed than the Project Site, large oaks are joined by white alder (*Alnus rhombifolia*) and western sycamore (*Platanus racemosa*) as dominants, particularly immediately adjacent to the stream channel. In addition to these tree species, the riparian plant communities (*i.e.*, vegetation adjacent to, and influenced by, the presence of moving water), consist of a small suite of native shrubs and vines found in the understory. Poison oak (*Toxicodendron diversiloba*) is ubiquitous, as is California blackberry (*Rubus ursinus*). Less common, but still frequently occurring in the shrub layer, are several species of gooseberry (*Ribes* spp.) and honeysuckle (*Lonicera* spp.). These taxa are critically important food sources for the native fauna, providing a varied and abundant source of berries throughout much of the year. In the low elevation coastal plain, Arroyo willows are prominent in the lowland riparian ecosystems. Native oak savannah/bunch grass mosaic is the reference standard condition in upland areas along the riparian corridor.

Invasion by exotic species is a significant concern in California. Many streams in the region are now completely devoid of a native riparian ecosystem, consisting instead of a large suite of exotic Eurasian weeds (*e.g., Bromus diandrus, Carduus pycnocephalus, Melilotus officinale, Piptatherum miliaceum, Sonchus oleraceus*), ornamental escapes (*e.g., Delairea odorata, Tropaeoleum majus, Vinca major*), or a planted riparian corridor of non-native trees (*e.g., Eucalyptus globulus*).

Grassland areas within the region which are not frequently disturbed are characterized by a native perennial bunch grassland community type which has an occasional tree or shrub (e.g., elderberry [*Sambucus mexicana*]). Grassland species found in the Chevron SLO Tank Farm (EDAW 1999) include ripgut brome (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), purple needlegrass (*Nasella pulchra*), tarweed (*Deinandra congesta* ssp. *luzulifolia* and *Centromadia parryi* ssp. *congdonii*), owl's clover (*Castilleja densiflora* ssp. *obispoensis*), and fennel (*Foeniculum vulgare*). Exotics occurring in frequently disturbed areas within the uplands include yellow star-thistle (*Centaurea solstitalis*) intermixed with non-native grasses and herbaceous species such as wild oats (*Avena barbata*), soft chess (*Bromus mollis*), annual fescues (*Vulpia myuros* var. *hirsuta*), Italian ryegrass (*Lolium multiflorum*), rip-gut brome (*Bromus diandrus*), black mustard (*Brassica nigra*), wild radish (*Raphanus sativus*), and sweet fennel (*Foeniculum vulgare*).

A large slope/riverine wetland known as the North Marsh occurs on the northern portion of the SLO Tank Farm. This wetland complex resulted from the impoundment and subsequent sedimentation of an unnamed second order channel of East Fork, San Luis Obispo Creek due to the construction of Tank Farm Road. Thus, this construction transformed a riverine wetland ecosystem into a slope riverine proximal wetland type. Currently, the North Marsh is dominated by bulrush (*Schoenoplectus acutus*) with occurrences of common cattail (*Typha latifolia*).

Five special status plant species have been observed within the Project Site. These species are Congdon's tarplant (*Centromadia parryi* ssp. *congdonii*), Hoover's button-celery (*Eryngium aristatulum* var. *hooveri*), San Luis Obispo County morning glory (*Calystegia subacaulis* ssp. *subacaulis*), Obispo Indian paintbrush (*Castilleja densiflora* ssp. *obispoensis*), and San Luis Obispo serpentine dudleya (*Dudleya abramsii* ssp. *bettinae*). All five species are California Native Plant Society (CNPS) List 1B species.

5. Fish and Wildlife Resources

The region surrounding SLO Tank Farm supports numerous fish and wildlife species. Rapid growth in the area has caused habitat loss and degradation for many of these species. Species listed on the California Natural Diversity Database (CNDDB) as occurring or potentially occurring in the San Luis Obispo area are listed in Table II-1. Specifically, the SLO Tank Farm is known to contain vernal/ephemeral pool habitat which supports the federally threatened vernal pool fairy shrimp (*Brachninecta lynchi*). The East Fork of San Luis Obispo Creek and Acacia Creek are adjacent to the Project Site. San Luis Obispo Creek is known to support the federally threatened south-central California coast steelhead (*Oncorhynchus mykiss irideus*).

Table II-1. Species of concern in the San Luis Obispo area.

Scientific Name	Common Name	Status
Ambystoma californiense	California tiger salamander	Federally threatened
Taricha torosa torosa	Coast Range newt	State Species of Concern
Rana aurora draytonii	California red-legged frog	Federally threatened
Elanus leucurus	white-tailed kite	
Buteo regalis	ferruginous hawk	State Species of Concern
Coccyzus americanus occidentalis	western yellow-billed cuckoo	California Endangered Candidate species
Athene cunicularia	burrowing owl	State Species of Concern
Eremophila alpestris actia	California horned lark	State Species of Concern
Agelaius tricolor	tricolored blackbird	State Species of Concern
Oncorhynchus mykiss irideus	steelhead - south/central California coast ESU	Federally threatened
Corynorhinus townsendii	Townsend's big-eared bat	State Species of Concern
Antrozous pallidus	pallid bat	State Species of Concern
Eumops perotis californicus	western mastiff bat	State Species of Concern
Taxidea taxus	American badger	State Species of Concern
Actinemys marmorata pallida	southwestern pond turtle	State Species of Concern
Anniella pulchra pulchra	silvery legless lizard	State Species of Concern
Phrynosoma coronatum (frontale population)	coast (California) horned lizard	State Species of Concern
Branchinecta lynchi	vernal pool fairy shrimp	Federally threatened
Linderiella occidentalis	California linderiella	
Polyphylla nubila	Atascadero June beetle	
Danaus plexippus	monarch butterfly	
Pyrgulopsis taylori	San Luis Obispo pyrg	

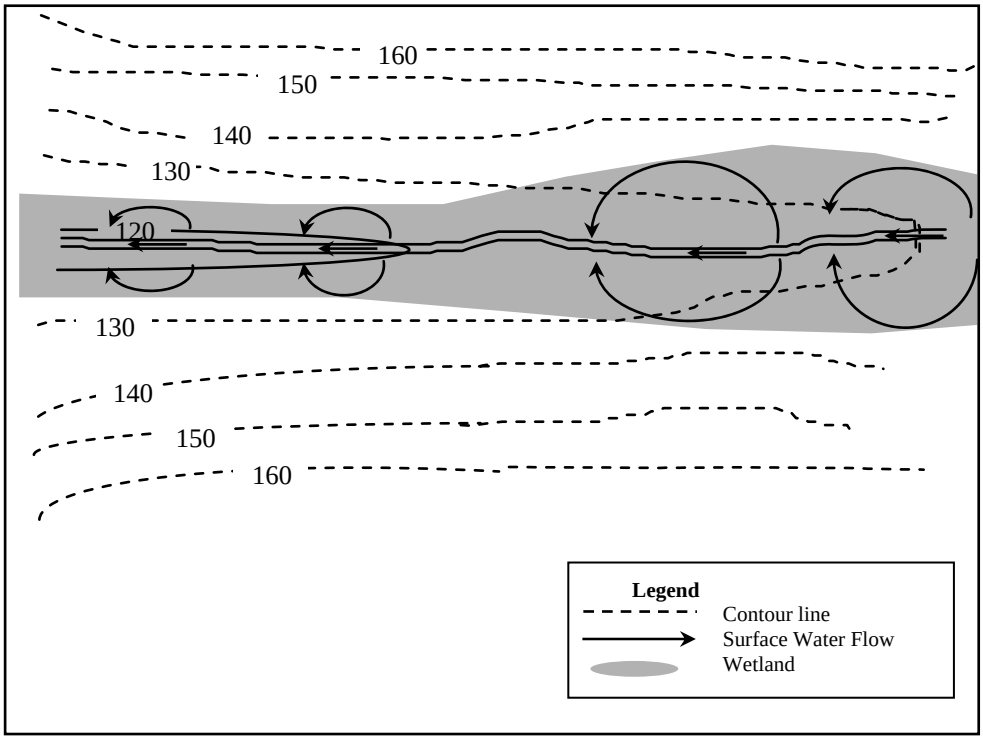
B. Landscape Position of Riverine, Slope, and Depressional Wetland Ecosystems at the Chevron San Luis Obispo Tank Farm

Three wetland classes have been identified at the Chevron Tank Farm: riverine wetlands, slope wetlands, and depressional (open and closed) wetlands. These wetland classes differ in their position within the landscape, hydrology, and plant community. Each wetland class is described in detail below. A dichotomous key is provided in Section C to assist in identifying and distinguishing between wetland classes within the SLO Tank Farm (Table II-2).

1. Riverine Wetlands

Riverine waters/wetlands occur in floodplains and riparian corridors in association with stream channels (Figure II-2). Riverine wetlands mediate flooding by detaining water during storm events and releasing it more slowly by flow through the saturated subsurface that discharges to the stream channel. Dominant water sources are overbank flow from the channel or subsurface hydraulic connections between the stream channel and wetlands. Additional water sources may be groundwater discharge from a surficial aquifer, overland flow from adjacent uplands and tributaries, and precipitation. When overbank flooding occurs, unidirectional horizontal flows dominate hydrodynamics. Streams mapped as solid or broken blue lines on U.S. Geological Survey 7.5 minute topographic maps (scale 1:24,000) usually are associated with riverine waters/wetlands.

Figure II-2. Topography showing riverine waters/wetlands in a valley.



Riverine wetlands occur within valley bottoms along the floodplain and along the riparian corridor. At their headward-most extension, riverine waters/wetlands often begin as depressional or slope wetlands where channel (bed) and bank disappear, or they may integrate with or transition from poorly drained flats or uplands.

At the SLO Tank Farm, riverine wetlands occur along low gradient streams on partially-filled alluvial surfaces. In reference system stream reaches that are not highly modified and confined vertically and laterally (*i.e.*, channelized) by anthropogenic activity, channels are expected to be highly mobile. For example, when sediment loads are high as after a recent fire, channels may aggrade, move laterally, and incorporate large woody debris. During intervals between fires and where the channel is incised initially or where it can become incised into newly deposited sediment, the channel location is relatively fixed and sediment is transported seaward. Where channels are incised, they may serve as major debris storage features. Stream channels may become aggraded for several centuries, followed by decades of sediment removal as sediment is conveyed seaward.

Two prominent riverine features, East Fork of San Luis Obispo Creek (Photograph II-2) and Tank Farm Creek (Photograph II-3), comprise most of the riverine waters/wetlands on the Project Site. However, a notable number of artificial drainage ditches have been constructed, again, as a result of site history. Tank Farm Creek, itself, is largely an artificial ditch, the result of relocation of the original creek channel to facilitate ranching and industrial uses. This is particularly true below Tank Farm Road, where the creek takes the form of several large, parallel, and intricately plumbed ditches that drain to the southwestern corner of the Project Site. Vegetation associated with this drainage network reflects primarily weedy or ubiquitous native and non-native species described previously.

The East Fork of San Luis Obispo Creek is a highly entrenched channel with members of the native riparian forest found upslope within the riparian slopes. California walnut, Fremont cottonwood (*Populus fremontii*), western sycamore, Mexican elderberry, coast live oak and arroyo willow are most common. Above ordinary high water the vegetation is primarily the annual grassland dominated by Italian ryegrass, slender wild oat, soft chess, bermuda grass (*Cynodon dactylon*), with remnant native elements, such as purple needlegrass, coyote brush, and California buttercup (*Ranunculus californicus*) also present in small populations.

Photograph II-2 (left) and II-3 (right). II-2. *East Fork, San Luis Obispo Creek.. II-3. Tank Farm Creek.*

2. Slope Wetlands

Slope wetlands occur where groundwater discharges toward the land surface. Slope wetlands occur on hillsides and on low gradient to nearly flat slopes that are incapable of depressional storage because they lack closed elevation contours (Figure II-3). Principal water sources are usually groundwater return flow, interflow from surrounding uplands, and precipitation. Hydrodynamics are dominated by down slope unidirectional water flow. Slope wetlands can occur in nearly flat landscapes if groundwater discharge is a dominant source to the wetland surface. Slope wetlands lose water primarily by subsurface saturation and surface flows and by evapotranspiration. Slope wetlands may develop channels, but the channels serve only to convey water away from the slope wetland. Seeps and fens are common examples of slope wetlands.

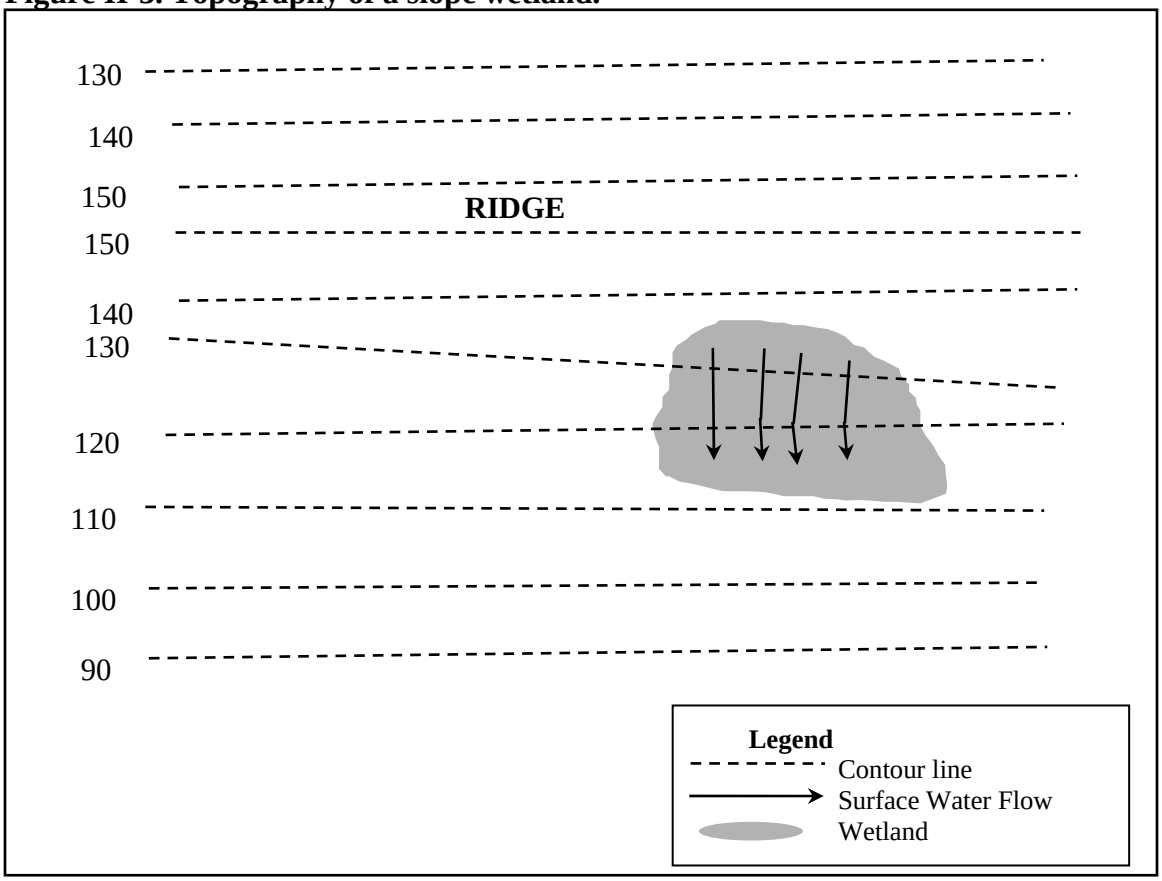
Slope wetlands occur where groundwater discharges toward the land surface. Typically, groundwater reaches the surface when soil layers have different permeability causing a perched water table and when a change in gradient brings the water to the surface. These commonly saturated areas are typically referred to as seeps. Slope wetlands provide a connection between uplands and wetlands. Therefore, maintenance of longitudinal connections and landscape connectivity for slope waters/wetlands is fundamental to maintaining their function. Within the landscape in SLO Tank Farm, slope wetlands occur in proximity and at the upward extent of streams. Few slope wetlands per se are found on the SLO Tank Farm site. Those present are primarily the result of the ditching, diking and berming from both ranching and industrial activities.

However, a large slope/riverine wetland known as North Marsh/Tank Farm Creek (Photograph II-4) occurs on the northern portion of the SLO Tank Farm. This wetland complex resulted from the impoundment and subsequent sedimentation of an unnamed second order channel of East Fork, San Luis Obispo Creek due to the construction of Tank Farm Road. This construction transformed a riverine wetland ecosystem into a slope riverine proximal wetland type. Currently, the North Marsh is dominated by bulrush, spikerush (*Eleocharis macrostachya*) and common cattail. Curly dock (*Rumex crispus*), chain speedwell (*Veronica catenata*), cocklebur (*Xanthium strumarium*), and the rare Congdon's tarplant are also present, sometimes locally abundant.

Where Tank Farm Creek flows upgradient of the North Marsh, vegetation within the channel is dominated by widespread palustrine persistent and non-persistent emergent species. These include common cattail and water plantain (*Alisma plantago-aquatica*), as well as the common curly dock, chain speedwell, among others. Several isolated arroyo willows occur along the banks, particularly within the upper reach of Tank Farm Creek on the SLO Tank Farm site.

Photograph II-4. *North Marsh/Tank Farm Creek slope complex.*

Figure II-3. Topography of a slope wetland.



3. Depressional Wetlands

Depressional waters/wetlands occur in topographic depressions. Dominant water sources are precipitation, groundwater discharge, and surface flow and interflow from adjacent uplands. The direction of flow is normally from the surrounding uplands toward the center (low point) of the depression. Elevation contours are closed, thus allowing the accumulation of surface water. Depressional waters/wetlands may have any combination of inlets and outlets or lack them completely. Dominant hydrodynamics are vertical fluctuations, primarily seasonal. Depressional waters/wetlands may lose water through intermittent or perennial discharge from an outlet, by evapotranspiration, and, if they are not receiving groundwater discharge, may slowly contribute to groundwater. Peat deposits may develop in depressional waters/wetlands. Prairie potholes are a common example of depressional waters/wetlands.

Depressional wetlands occur in two geomorphic positions within the Chevron San Luis Obispo Tank Farm, specifically, in:

(1) Natural depressions (Photograph II-5) and
(2) Remnant depressions from past industrial uses (*i.e.*, berms around tanks) (Photograph II-6).

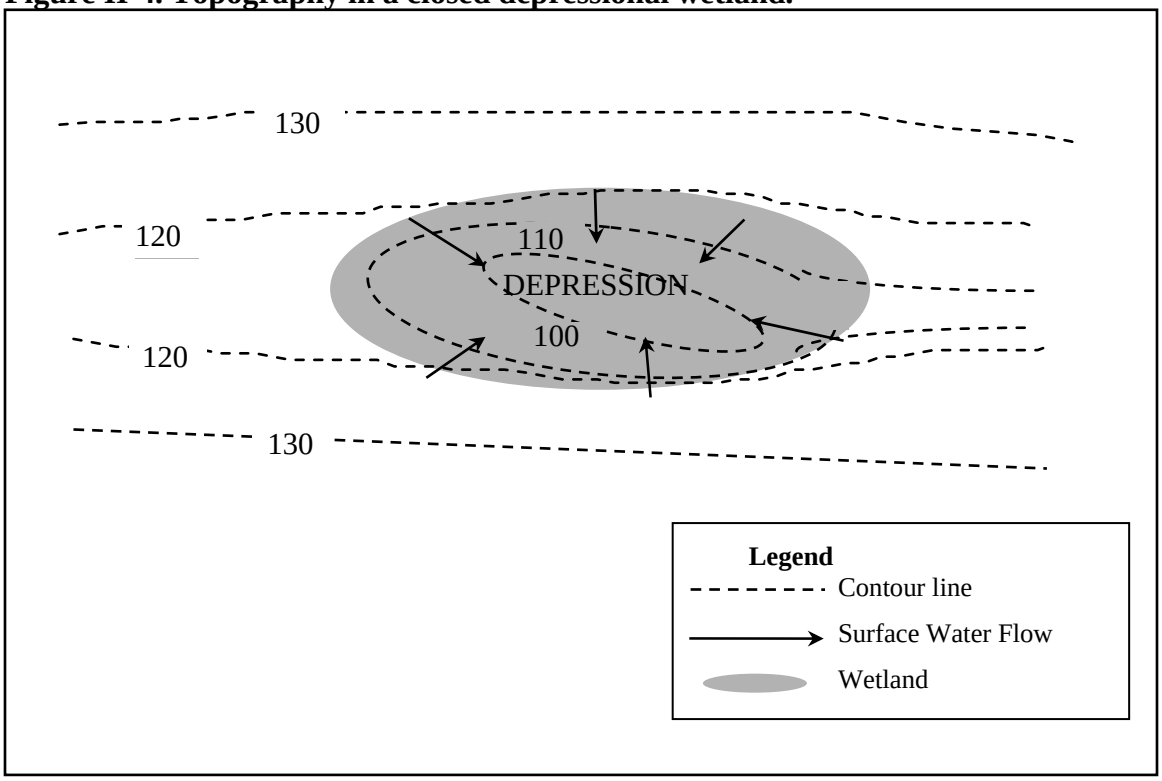
Depressional wetlands can be closed depressions which lack a surface outlet or open, flow-through depressions. This terminology refers to the mechanisms of water loss. In closed depressions, water is lost only through evapotranspiration. Open depressions have some surface connection to downstream waters, as illustrated in Figure II-4.

Photograph II-5. *Depressional features on northern portion of the SLO Tank Farm.*

Most if not all of the depressional waters/wetlands on the SLO Tank Farm Project Site are not natural features of the landscape. Depressional waters/wetlands have formed as a result of site activities, specifically, they are found in the bottom of the old storage tanks, at the base of human made berms surrounding the tanks, and as isolated depresssions resulting from the site's long history of ranching and industrial use. While many of the depressions support no vegetation for all or a portion of the year, some of them support large populations of rare plant species, including Congdon's tarplant and Hoover's button-celery. Other species commonly present include foxtail fescue (*Vulpia myuros*), rabbit's foot grass (*Polypogon monspeliensis*), dwarf wooly marbles (*Psilocarphus brevissimus*), popcorn flower (*Plagiobothry undulatus*), spikerush, bird's foot trefoil (*Lotus corniculatus*), and various native and widespread rushes (*Juncus bufonius* var. *bufonius, J. phaeocephalus, J. tenuis, J. xiphioides*).

Photograph II-6. *Depressional features at Reservoir 6 of the SLO Tank Farm.*

Figure II-4. Topography in a closed depressional wetland.



C. Classification of Riverine, Slope and Depressional Wetlands at the Chevron San Luis Obispo Tank Farm

The first step to any HGM assessment is to determine the wetland class(es) and subclass(es) in which you are working. The following page provides a key that can be used to identify and distinguish between wetland classes and subclasses within the SLO Tank Farm (Table II-2). Three different but related HGM assessment models have been developed to correspond with the three wetland classes in SLO Tank Farm (*i.e.*, riverine, slope and depression models). In addition, models to assess open and closed depressions vary slightly.

Table II-2. Key to San Luis Obispo Tank Farm HGM Waters/Wetland Classes and Subclasses.

1a. The project assessment area does not support and/or is not adjacent or contiguous with a jurisdictional water/wetland .....**Project assessment area is not a wetland, or adjacent to, or contiguous with a water/ wetland. Guidebook is not applicable.**

1b. The assessment area is adjacent to and/or contiguous with a water/wetland.....**2**

2a. Water/wetland is associated with a stream channel or channel system and/or an active floodplain.....**Riverine Wetland Class**

2b. Water/wetland is not associated with a stream channel or channel system and/or active floodplain.....**3**

3a. Water/wetland is located on a hillslope or, if it exists on nearly level terrain, the water/wetland exhibits sloped surface water or shallow subsurface (groundwater) profile.....**Slope Wetland Class**

3b. Water/wetland is located in a topographic depression. Water/Wetland is not located on a hillslope or, if it exists on nearly level terrain, the water/wetland does not exhibit a sloped surface water or shallow subsurface (groundwater) profile….....**4 (Depressional Wetland Class)**

4a. Depression is closed and does not have a permanent or seasonal surface or shallow subsurface drainage outlet.....**Closed Depression**

4b. Depression is open and has one or more permanent and/or seasonal surface or shallow subsurface drainage outlet.....**Open Depression**

III. Waters/Wetland Functions and Assessment Models for Riverine Wetlands at the San Luis Obispo Tank Farm

A. Overview of the HGM Riverine Wetland Model

We identified 13 functions performed by riverine waters/wetland ecosystems located on SLO Tank Farm. Consistent with guidance provided in the National Riverine Guidebook (Brinson *et al.* 1995), these functions fall into four groups: hydrology, biogeochemistry, plant community, and faunal support/habitat (Table III-1). All of these functions are performed at some level at all sites within the reference domain.

We use a total of 23 variables to describe the 13 riverine ecosystem functions presented and discussed in this *Guidebook* (Table III-2). Variables which we used to represent a given function sometimes differ among the riverine subclasses identified in this *Guidebook.*

Thirteen ecosystem functions and 23 variables are fully described in the following sections. Table III-3 identifies the relationship between variables and functions. Table III-4 illustrates the formulas for each function. Descriptions of the 13 functions include the following information (Section III.B):

(1) Definition
(2) Rationale for describing or recognizing the function for riverine ecosystems
(3) Listing of variables used to assess the function
(4) The formulae used to estimate the functional capacity indices

Descriptions of the 23 variables include the following information (Section III.C):

(1) Definition
(2) Rationale for selection of the variable
(3) Definition of the Variable Assessment Area (VAA)
(4) Protocol for measuring the variable in the field
(5) Scaling between 0 and 1

Please note that in describing functions or variables, we have used some terminology that allows us to address the Project Site to be assessed using HGM. The “Project Assessment Area” (PAA) refers to the waters, wetlands and their buffers which may be affected by the proposed project. The area that one needs to examine in the field to collect data necessary to score a variable is the “Variable Assessment Area” (VAA). Both PAA and VAA are defined in the **Glossary**. In addition, several of the figures that support presentation of variables illustrate graphically the extent of either PAA or VAA. All variables were scaled using best professional judgment based on a combination of many years of field experience, scientific literature and site observations.

Table III-1. List of Riverine Waters/Wetland Functions by Category.

FUNCTION	DESCRIPTION
Hydrology	
1. Energy Dissipation	The transformation and/or reduction of the kinetic energy of water as a function of the roughness of the landscape and channel morphology, and vegetation.
2. Surface and Subsurface Water Storage and Exchange	The presence of soil and/or geologic materials within the creek ecosystem, including the hyporheic zone, that have physical characteristics suitable for detention, retention, and transmission of water.
3. Landscape Hydrologic Connections	The maintenance of the natural hydraulic connectivity among source areas of surface and subsurface flow to riverine waters/wetlands and other down gradient waters/wetlands.
Biogeochemistry	
4. Cycling of Elements and Compounds	Short- and long-term transformation of elements and compounds through abiotic and biotic processes that convert chemical species (*e.g.*, nutrients and metals) from one form, or valence, to another.
5. Removal of Imported Elements and Compounds	The removal of imported nutrients, contaminants, and other elements and compounds in surface and groundwater.
6. Particulate Detention	The deposition and retention of inorganic and organic particulates (>0.45⌈m) from the water column, primarily through physical processes.
7. Organic Matter Transport	The export of dissolved and particulate organic carbon from a wetland. Mechanisms include leaching, flushing, displacement, and erosion.
Plant Community	
8. Plant Community	The physical characteristics and ecological processes that maintain the indigenous living plant biomass.
9. Detrital System	The process of production, accumulation, and dispersal of dead plant biomass of all sizes.
Faunal/Habitat Support	
10. Spatial Structure of Habitats	The capacity of waters/wetlands to support animal populations and guilds through the heterogeneity of structure of vegetative communities.
11. Interspersion and Connectivity of Habitats	The capacity of waters/wetlands to permit aquatic, semi-aquatic, and terrestrial organisms to enter and leave a riverine ecosystem via large, contiguous plant communities to meet life history requirements.
12. Distribution & Abundance of Invertebrates	The capacity of waters/wetlands to maintain characteristic density and spatial distribution of invertebrates (aquatic, semi-aquatic and terrestrial).
13. Distribution & Abundance of Vertebrates	The capacity of waters/wetlands to maintain the density and spatial distribution of invertebrates (aquatic, semi-aquatic and terrestrial).

Table III-2. Riverine Wetland Variables.

	Variable	Description	Variable Definition
1.	V_{ASIGN}	Animal Sign	The number of direct (*e.g.*, visual observation of animals) or indirect (*e.g.*, tracks, bedding, scat) observations of animal species presence in, or utilization of, the VAA.
2.	$V_{BUFFCOND}$	Buffer Condition	Describes the predominant (>50% areal extent) land use or condition within the designated riparian stream buffer
3.	$V_{BUFFCONT}$	Buffer Contiguity	The linear extent of the vegetated buffer on both sides of the stream channel, parallel to the channel.
4.	$V_{CHANROUGH}$	Channel Roughness	An indicator of the hydraulic resistance produced by natural or anthropogenic immobile features of the channel system below ordinary high water (OHW).
5.	V_{DECOMP}	Decomposition	A measure of the most frequently occurring decomposition class (mode) and the average number of decomposition classes of coarse woody debris (CWD) below ordinary high water (OHW) and within the active channel.
6.	V_{FPAXS}	Flood Prone Area Cross-section	The condition of the channel and its adjacent floodplain, which are required to carry and discharge moderate frequency, moderate magnitude flood flows.
7.	V_{HERB}	Herbaceous Cover	The percent cover of herbaceous vegetation, including graminoids, forbs, ferns, and fern allies within the VAA.
8.	V_{INCWD}	In-Channel Coarse Woody Debris	The volume of down and dead trees and/or limbs (> 3” diameter) within the active channel and below OHW.
9.	$V_{LONGPROF}$	Longitudinal Profile	The integrity of the natural longitudinal profile of the channel within and/or upstream and downstream from the main channel cross section.
10.	V_{OFFCWD}	Out of Channel Coarse Woody Debris	The volume of down and dead trees and/or limbs (> 3” diameter) above OHW and within the VAA.
11.	$V_{PATCHAREA}$	Patch Area	Relative area of habitat patches within a 250 ft radius VAA.
12.	$V_{PATCHLATCON}$	Patch Lateral Contiguity	Lateral (*i.e.*, perpendicular to the general valley trend of channel) contiguity of habitat patches within the 1,000 ft radius VAA.
13.	$V_{PATCHLONGCON}$	Patch Longitudinal Contiguity	Longitudinal (*i.e.*, along the channel) contiguity of habitat patches within the 1,000 ft radius VAA.
14.	V_{RATIO}	Ratio of Native to Non-Native Plant Species	The ratio of the dominant plant taxa within the VAA that are native to the San Luis Obispo region to those that have been introduced to the region.

Table III-2 (cont'd) Riverine Wetland Variables.

	Variable	Description	Variable Definition
15.	V_{REGEN}	Regeneration	The reestablishment of plants from seedlings, saplings, and clonal shoots.
16.	V_{SED}	Sediment Deposition	The sources and amount of sediment delivery and deposition to waters/wetlands from upgradient landscape positions.
17.	V_{SHADE}	Shade Over the Stream Channel	Tree, shrub and undergrowth vegetation canopy cover overhanging the active stream channel.
18.	$V_{SHRUBCC}$	Shrub Canopy Cover	The percent canopy cover of shrubs (multiple stemmed woody species) within the VAA.
19.	V_{SNAG}	Snags	The basal area of standing dead trees (snags) > 3" DBH.
20.	$V_{SOILINT}$	Soil Profile Integrity	A measure of the presence and condition of representative soil profiles (soil horizons) within the VAA.
21.	V_{STRATA}	Vegetative Strata	The number of distinct vegetation layers present within the VAA. Vegetation strata were defined as follows: trees (single stem woody species with > 3" DBH and > 10 ft tall); shrubs (multiple stem woody species); vines or lianas (woody vines); and herbs, including forbs, graminoids, ferns, and fern allies.
22.	V_{SURFIN}	Surface Water In	The hydrologic connections into the VAA from the adjacent landscape.
23.	V_{TREECC}	Tree Canopy Cover	The percent canopy cover of trees (single stem woody species with > 3" DBH and > 10 ft tall).

Table III-3. Relationship of Variables to Functions in Riverine Wetlands.

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										X		**T**	**T**
2.	$V_{BUFFCOND}$	X		X	X	X	X	X			X		**O**	**O**
3.	$V_{BUFFCONT}$	X		X	X	X	X	X			X			
4.	$V_{CHANROUGH}$	X					X						**B**	**B**
5.	V_{DECOMP}				X			X		X			**E**	**E**
6.	V_{FPAXS}		X	X								X		
7.	V_{HERB}	X			X	X	X	X	X				**D**	**D**
8.	V_{INCWD}	X			X			X		X			**E**	**E**
9.	$V_{LONGPROF}$			X		X		X					**T**	**T**
10.	V_{OFFCWD}				X					X			**E**	**E**
11.	$V_{PATCHAREA}$											X	**R**	**R**
12.	$V_{PATCHLATCON}$											X	**M**	**M**
13.	$V_{PATCHLONGCON}$											X	**I**	**I**
14.	V_{RATIO}								X				**N**	**N**
15.	V_{REGEN}								X				**E**	**E**
16.	V_{SED}		X		X	X	X						**D**	**D**
17.	V_{SHADE}										X			
18.	$V_{SHRUBCC}$	X			X	X	X	X	X					
19.	V_{SNAG}									X	X			
20.	$V_{SOILINT}$		X	X	X	X								
21.	V_{STRATA}								X		X			
22.	V_{SURFIN}			X										
23.	V_{TREECC}	X			X	X	X	X	X					

Table III-4. Indices of Functions for Riverine Waters/Wetlands at the San Luis Obispo Tank Farm.

FUNCTION	FORMULAE
Hydrology	
1. Energy Dissipation	$[V_{INCWD} + (V_{HERB} + V_{SHRUBCC} + V_{TREECC})/3 + (V_{BUFFCONT} + V_{BUFFCOND})/2 + V_{CHANROUGH}]/4$
2. Surface and Subsurface Water Storage and Exchange	$(V_{SED} + V_{SOILINT} + V_{FPAXS})/3$
3. Landscape Hydrologic Connections	$[V_{LONGPROF} + V_{FPAXS} + V_{SOILINT} + V_{SURFIN} + (V_{BUFFCONT} + V_{BUFFCOND})/2]/5$
Biogeochemistry	
4. Cycling of Elements and Compounds	$[(V_{SOILINT} + V_{SED})/2 + (V_{INCWD} + V_{OFFCWD})/2 + (V_{HERB} + V_{SHRUBCC} + V_{TREECC})/3 + (V_{BUFFCONT} + V_{BUFFCOND})/2 + (V_{DECOMP})]/5$
5. Removal of Imported Elements and Compounds	$[(V_{HERB} + V_{SHRUBCC} + V_{TREECC})/3 + (V_{BUFFCONT} + V_{BUFFCOND})/2 + (V_{SOILINT} + V_{SED})/2 + V_{LONGPROF}]/4$
6. Particulate Retention and Detention	$[(V_{HERB} + V_{SHRUBCC} + V_{TREECC})/3 + (V_{BUFFCONT} + V_{BUFFCOND})/2 + V_{CHANROUGH} + V_{SED}]/4$
7. Organic Carbon Export	$[V_{INCWD} + V_{DECOMP} + (V_{HERB} + V_{SHRUBCC} + V_{TREECC})/3 + (V_{BUFFCONT} + V_{BUFFCOND})/2 + V_{LONGPROF}]/5$
Plant Community	
8. Plant Community	$[(V_{TREECC} + V_{SHRUBCC} + V_{HERB} + V_{REGEN})/4 + V_{RATIO} + V_{STRATA}]/3$
9. Detrital System	$[V_{SNAG} + (V_{OFFCWD} + V_{INCWD})/2 + V_{DECOMP}]/3$
Faunal/Habitat Support	
10. Spatial Structure of Habitats	$[(V_{ASIGN} + V_{CHANROUGH} + (V_{BUFFCOND} + V_{BUFFCONT})/2 + (V_{SHADE} + V_{SNAG} + V_{STRATA})/3]/4$
11. Interspersion and Connectivity of Habitats	$[V_{PATCHAREA} + (V_{PATCHLATCON} + V_{PATCHLATCON})/2 + V_{FPAXS}]/3$
12. Distribution & Abundance of Vertebrate Taxa	To Be Determined
13. Distribution & Abundance of Invertebrate Taxa	To Be Determined

B. Description of Functions Identified in Riverine Waters/Wetlands Ecosystems

1. Hydrologic Functions

A) Energy Dissipation

1) Definition

Energy Dissipation is the transformation and/or reduction of the kinetic energy of water as a function of the roughness of the landscape and channel morphology, and vegetation.

2) Rationale for the Function

This function not only pertains to rate of flow through wetlands, but is also related to how energy is expressed in the water flowing into, through, and out of stream channels. Energy dissipation results in the allocation of potential energy to other forms of kinetic energy as water moves into, through, or out of a water/wetland. Riverine waters/wetlands derive potential energy from precipitation that falls throughout the watershed. This potential energy is converted to kinetic energy as water is moved through stream systems under the force of gravity. The primary forms of kinetic energy are water flow, sediment mobilization and transport, heat, and sound. Energy dissipation occurs as a function of resistance (*i.e.*, roughness). Thus, channel morphology, bed materials, and vegetation are critical components of this function. In some low gradient systems, connectivity to secondary channels and off channel depressions can dissipate hydrologic energy by providing additional area over which high flows can spread. Dissipated energy expressed as scour holes and sediment deposition may also enhance dynamic and long term surface water storage by creating topographic relief and surface roughness. An offsite hydrologic expression of the energy dissipation function is the reduction in flood peak, flood wave celerity, and improved water quality *(i.e.*, less sediment). Channelized streams are designed to increase flow velocity and minimize overbank flow. The resultant channel flow, unless artificially stabilized, will undercut banks and the channel will begin a meandering process to dissipate the energy. In high-energy streams, common in mountainous regions, large woody debris and boulders are moved in the channel and onto floodplains. As a result of energy dissipation within the channel and associated wetlands, hydraulic work on channel bed and banks is lessened and the system is more stable. For example, a recently cleared riparian area will have few trees in place for woody debris to lodge against. Energy that would otherwise be dissipated in riparian vegetation will be transferred to channel scour, and movement/ deposition of sediment. Similar hydrologic processes occur in lower energy systems with less obvious expressions, but no less important to the functioning of waters/wetlands.

3) Variables Used to Assess Energy Dissipation

The following variables all represent ecosystem components that act to dissipate energy by providing roughness to the channel system.

a. Channel Roughness ($V_{CHANROUGH}$)
b. In-Channel Coarse Woody Debris (V_{INCWD})

c. Buffer Condition ($V_{BUFFCOND}$)
d. Buffer Contiguity ($V_{BUFFCONT}$)
e. Herbaceous Cover (V_{HERB})
f. Shrub Canopy Cover (V_{SHRUB})
g. Tree Canopy Cover (V_{TREECC})

4) Index of Function

Index = $[V_{INCWD} + (V_{HERB} + V_{SHRUBCC} + V_{TREECC})/3 + (V_{BUFFCONT} + V_{BUFFCOND})/2 + V_{CHANROUGH}]/4$

B) Surface and Subsurface Water Storage and Exchange

1) Definition

The Surface and Ground Water Storage and Exchange function pertains to the retention and/or circulation of surface and ground water in the river network. This function includes the presence of soil and/or geologic materials within the creek ecosystem, including the hyporheic zone, which have physical characteristics suitable for detention, retention, and transmission of water.

2) Rationale for the Function

At SLO Tank Farm, the surface and ground water storage and exchange function is dependent upon surface and shallow subsurface connectivity among surface water in the flood prone area, shallow ground water in alluvial deposits, and deeper ground water in regional ground water systems. Riverine ecosystems are one part of this integrated surface and ground water system. Water may be stored as and exchanged among surface water in the flood prone area, soil moisture in the unsaturated zone, water within the capillary fringe, and ground water in the saturated zone. Surface water flowing within a specific reach is addressed in Surface Water Flow and Storage; however, deeper ground water in regional ground water systems cannot be adequately assessed by a rapid assessment procedure. Thus, focusing on the physical characteristics of the flood prone area cross-section and alluvial deposits within a specific reach provides an indirect assessment of Surface and Ground Water Storage and Exchange.

3) Variables Used to Assess Surface and Subsurface Water Storage and Exchange

The following variables represent abiotic ecosystem components that can transmit, store, and exchange water between surface and subsurface environments.

a. Flood Prone Area Cross-Section (V_{FPAXS})
b. Soil Profile Integrity ($V_{SOILINT}$)
c. Sediment Deposition (V_{SED})

4) Index of Function

Index = $(V_{SED} + V_{SOILINT} + V_{FPAXS})/3$

C) Landscape Hydrologic Connections

1) Definition

Landscape Hydrologic Connections refers to the maintenance of the natural hydraulic connectivity among source areas of surface and subsurface flow to riverine waters/wetlands and other down gradient waters/wetlands.

2) Rationale for the Function

Riverine wetlands usually form along low-gradient reaches of streams, resulting in relatively low rates of subsurface flow through the wetland. Subsurface flows, both unsaturated and saturated (groundwater), are important linkages between uplands, wetlands, and streams (see for example Roulet 1990 and O'Brian 1980). Landscape hydrologic connections are the hydrologic connectivity of contributing areas, to riverine waters/wetlands, to other down gradient waters/wetlands. The low-order ephemeral streams have land-dominated hydrographs so the timing, duration, and amount of water delivered to the channel is dependent upon the condition of the watershed and the buffer. The high-order seasonal streams have land- and channel-dominated hydrographs so the timing, duration, and amount of water delivered to the channel is dependent upon the condition of the watershed and the buffer as well as the condition of the upgradient channels. The high-order seasonal and perennial streams depend upon intact connections from the upper portions of the watershed to maintain flow and sediment transport characteristics.

3) Variables Used to Assess Landscape Hydrologic Connections

The following variables represents abiotic and biotic ecosystem components that are involved in the timing, duration, and amounts of water delivered to the channel and the connectivity to down gradient waters/wetlands.

a. Soil Profile Integrity ($V_{SOILINT}$)
b. Surface Water In (V_{SURFIN})
c. Channel Longitudinal Profile ($V_{LONGPROF}$)
d. Flood Prone Area Cross-Section (V_{FPAXS})
e. Buffer Condition ($V_{BUFFCOND}$)
f. Buffer Contiguity ($V_{BUFFCONT}$)

4) Index of Function

Index = $[V_{LONGPROF} + V_{FPAXS} + V_{SOILINT} + V_{SURFIN} + (V_{BUFFCONT} + V_{BUFFCOND})/2]/5$

2. Biogeochemical Functions

A) Cycling of Elements and Compounds

1) Definition

This function includes abiotic and biotic processes that change elements and convert compounds (*e.g.*, nutrients and metals) from one form or valence to another.

2) Rationale for the Function

Cycling of elements and compounds includes fundamental ecosystem processes mediated by both biotic and abiotic components of the environment. The biotic components of elemental cycling are net primary productivity, in which nutrients are taken up by plants, and detritus turnover, in which nutrients are released for renewed uptake by plants and microbes. Abiotic components are linked inextricably to the microbially mediated (biogeochemical) processes that drive the oxidation-reduction reactions that alter elements and compounds. Sources of these abiotic components are the soil profile, eolian processes that input nutrients and particulates, and hydrologic processes that input nutrients and particulates to the system. Net effects of elemental cycling are balanced between gains through import processes and losses through hydrologic export, efflux to the atmosphere, and long-term retention in soil, sediment, and persistent biomass. Retention/detention of elements and compounds onsite decreases the probability of their export to down-gradient aquatic ecosystems and diminishes nutrient loading. Elements and compounds detained onsite also contribute to water quality in waters/wetlands adjacent to and down gradient from the HGM project assessment area. This recycling of nutrients is critical to maintaining low concentrations of elements and nutrients in flowing water (Elder 1985).

3) Variables Used to Assess Cycling of Elements and Compounds

The following variables represent biotic and abiotic components of the ecosystem that are involved in biological and geochemical processes. The biotic components of riverine ecosystems cycle elements and nutrients through (1) uptake of nutrients from soil and water, (2) biomass accumulation, and (3) litter production. Abiotic cycling occurs in soil horizons and stream sediments.

a. In-Channel Coarse Woody Debris (V_{INCWD})
b. Out of Channel Coarse Woody Debris (V_{OFFCWD})
c. Herbaceous Cover (V_{HERB})
d. Shrub Canopy Cover ($V_{SHRUBCC}$)
e. Tree Canopy Cover (V_{TREECC})
f. Buffer Condition ($V_{BUFFCOND}$)
g. Buffer Contiguity ($V_{BUFFCONT}$)
h. In-Channel Woody Decomposition (V_{DECOMP})
i. Soil Profile Integrity ($V_{SOILINT}$)
j. Sediment Deposition (V_{SED})

4) Index of Function

Index = $[(V_{SOILINT} + V_{SED})/2 + (V_{INCWD} + V_{OFFCWD})/2 + (V_{HERB} + V_{SHRUBCC} + V_{TREECC})/3 + (V_{BUFFCONT} + V_{BUFFCOND})/2 + V_{DECOMP}]/5$

B) Retention and Detention of Imported Elements and Compounds

1) Definition

Retention and detention of imported elements and compounds includes processes which delay, retard, or prevent movement of imported nutrients, contaminants, and other elements or compounds into, through, and out of the riverine ecosystem.

2) Rationale for the Function

The functioning of riverine waters/wetlands as interceptors of nonpoint source pollution is well documented (Peterjohn and Correll 1984). Studies have shown that wetland/riparian systems serve as sinks for nutrients and contaminants from upland sources (*e.g.*, Lowrance *et al.* 1984). Riverine waters/wetlands, particularly those in headwater positions, are strategically located to intercept nutrients and contaminants before they reach streams (Brinson 1988). The detention of imported elements and compounds is a function of (a) the timing, duration, and amount of water delivered to the riverine ecosystem, (b) the development and integrity of the soil profile, and (c) the development and integrity of the vegetation communities within the flood prone area (Mayer *et al.* 2007). We use the term "detention" to imply the long-term accumulation, but not permanent loss of, elements and compounds from incoming water sources. Retention refers to uptake and incorporation into long-lasting woody and long-lived perennial herbaceous biomass. This function takes a very broad approach to both the elements and compounds of interest and the mechanisms by which they are removed. This is in contrast to most research on the topic, which is conducted on one element or mechanism at a time and often includes expensive and time-consuming methodologies that quantify the elements or compounds of interest. Elements herein include macronutrients essential to plant growth (nitrogen, phosphorus, potassium, *etc.*) as well as other elements such as heavy metals (zinc, chromium, *etc.*) that can be toxic at high concentrations. Compounds include herbicides, pesticides, and other imported materials. Soil, sediments, and vegetation are the main components of the function. Mechanisms of retention, removal, and detention include sorption, sedimentation, denitrification, burial, decomposition to inactive forms, microbial transformation, uptake and incorporation into vegetative biomass, and similar processes. The biotic components of riverine ecosystems detain elements and compounds through (a) uptake from soil and water, (b) biomass accumulation, and (c) and partitioning into soil organic matter. Physical processes which lead to detention and retention of elements and compounds influence the residence time available for biogeochemical processes to occur at a given site.

3) Variables Used to Assess Detention of Imported Elements and Compounds

The following variables represent biotic and abiotic components of the ecosystem that are involved in biological and geochemical processes. The removal of imported elements and compounds is a function of (1) the timing, duration, and amount of water delivered to the riverine ecosystem, (2) the development or integrity of the soil profile, and (3) the development and integrity of the vegetation communities within the stream buffer. The biotic components of riverine ecosystems remove elements and compounds through (1) uptake from soil and water, (2) biomass accumulation, and (3) and partitioning into soil organic matter.

a. Herbaceous Cover (V_{HERB})
b. Shrub Canopy Cover ($V_{SHRUBCC}$)
c. Tree Canopy Cover (V_{TREECC})
d. Buffer Condition ($V_{BUFFCOND}$)
e. Buffer Contiguity ($V_{BUFFCONT}$)
f. Soil Profile Integrity ($V_{SOILINT}$)
g. Sediment Deposition (V_{SED})
h. Stream Longitudinal Profile ($V_{LONGPROF}$)

4) Index of Function

$$\textbf{Index} = [(V_{HERB} + V_{SHRUBCC} + V_{TREECC})/3 + (V_{BUFFCONT} + V_{BUFFCOND})/2 + (V_{SOILINT} + V_{SED})/2 + V_{LONGPROF}]/4$$

C) Retention and Detention of Particulates

1) Definition

Retention and detention of particulates includes delay, retardation, and removal of inorganic and organic particulates (>0.45 µm) from the water column, primarily through physical processes.

2) Rationale for the Function

Flooding is the major source of inorganic particulates for floodplains and riparian areas. Floodplains of smaller streams also receive sediments due to overland flow from adjacent uplands. Once waterborne sediment has been transported to a floodplain, velocity reduction normally occurs due to surface roughness and increasing cross-sectional area of discharge (Nutter and Gaskin 1989). This leads to a reduction in the capacity of water to transport suspended sediments, so particulates settle. Detention applies to particulates arising from both onsite and offsite sources, but excludes *in situ* production of organic matter. The Retention and Detention of Particulates function requires physical processes (*e.g.*, sedimentation and particulate removal) while the Cycling of Elements and Compounds and Retention/Detention of Imported Elements and Compounds primarily relies on chemical transformation. Sediment detention/ retention occurs through burial and chemical precipitation (*e.g.*, removal of phosphorus by Fe^{+3}). Dissolved forms may be transported as particles after undergoing sorption or chelation (*i.e.*, metals mobilized with organic compounds).

3) Variables Used to Assess Retention and Detention of Particulates

The following variables are involved in physical and biological processes facilitating the detention of organic and inorganic particulates. The detention of organic and inorganic particulates from the water column is essentially a physical process. Detention of particulates is a function of the:

(1) Timing, duration, and amount of water delivered
(2) Roughness elements within the riverine ecosystem
(3) Development and integrity of the vegetation communities within the stream buffer.

The biotic components of riverine ecosystems contribute to the deposition and detention of organic and inorganic particulates by contributing properties of roughness to (1) the stream channel, (2) channel riparian areas, and (3) the associated floodplain. Abiotic components of riverine ecosystems contribute to the deposition and detention of organic and inorganic particulates by contributing physical properties of roughness to the stream channel and channel riparian areas.

a. Herbaceous Cover (V_{HERB})
b. Shrub Canopy Cover ($V_{SHRUBCC}$)
c. Tree Canopy Cover (V_{TREECC})
d. Buffer Condition ($V_{BUFFCOND}$)
e. Buffer Contiguity ($V_{BUFFCONT}$)
f. In-channel Coarse Woody debris (V_{INCWD})
g. Sediment Deposition (V_{SED})
h. Channel Roughness ($V_{CHANROUGH}$)

4) Index of Function

$$\textbf{Index} = [(V_{HERB} + V_{SHRUBCC} + V_{TREECC})/3 + (V_{BUFFCONT} + V_{BUFFCOND})/2 + V_{CHANROUGH} + V_{SED}]/4$$

D) Organic Carbon Export

1) Definition

Organic carbon export assesses leaching, flushing, displacement, and/or erosion of dissolved and particulate organic carbon from the waters/wetlands.

2) Rationale for the Function

Waters/wetlands export organic carbon at higher rates per unit area than terrestrial ecosystems (Mitsch and Gosselink 2000) in part because surface water has long contact time with organic matter in litter and surface soil. Organic carbon is exported from waters/wetlands in dissolved (≤

0.45 μm) and particulate forms. Mechanisms of organic carbon export include leaching, displacement, and erosion. Sources of organic carbon include herbaceous vegetation in the water/wetland and in the buffer, as well as organic matter incorporated into the soil profile. Export of organic carbon from riverine waters/wetlands is dependent upon the condition of the hydrologic connection to down gradient waters/wetlands. While the molecular structure of most organic matter is not well known because of its chemical complexity (Stumm and Morgan 1981, Paul and Clark 1989), organic matter nevertheless plays important roles in geochemical and food web dynamics. For example, organic carbon can complex with a number of relatively immobile metal ions, which in turn facilitates their transport in soil (Schiff *et al.* 1990). Organic carbon is a primary source of energy for microbial food webs (Edwards and Meyer 1986) that form the base of the detrital food web in aquatic ecosystems. These factors, in combination with the close proximity of wetlands to aquatic ecosystems, make wetlands critical sites for supplying both dissolved and particulate organic carbon.

3) Variables Used to Assess Organic Carbon Export

The following variables represent biotic and abiotic components of the ecosystem that are involved in the biological and physical processes that export organic carbon:

a. In-Channel Coarse Woody Debris (V_{INCWD})
b. Herbaceous Canopy (V_{HERB})
c. Shrub Canopy Cover ($V_{SHRUBCC}$)
d. Tree Canopy Cover (V_{TREECC})
e. Buffer Condition ($V_{BUFFCOND}$))
f. Buffer Contiguity ($V_{BUFFCONT}$)
g. Woody Decomposition (V_{DECOMP})
h. Longitudinal Profile ($V_{LONGPROF}$)

4) Index of Function

$$\textbf{Index} = [V_{INCWD} + V_{DECOMP} + (V_{HERB} + V_{SHRUBCC} + V_{TREECC})/3 + (V_{BUFFCONT} + V_{BUFFCOND})/2 + V_{LONGPROF}]/5$$

3. Plant Community Functions

A) Plant Community

1) Definition

The Plant Community function assesses the physical characteristics and ecological processes that maintain indigenous living plant biomass.

2) Rationale for the Function

Living plant biomass converts solar radiation and carbon dioxide into complex organic molecules that support organisms at all trophic levels. In addition to energy, plant species and assemblages of plants provide (a) compositional and structural diversity within the ecosystem, (b) corridors for migration and movement of faunal species among habitats, and (c) feeding, resting, hiding, thermal, and escape cover for migratory and resident animals. Finally, plants provide seeds and other propagules for regeneration and succession following catastrophic events such as fire, floods, and debris flows. Vegetation accounts for most of the biomass of riverine wetlands, and the physical characteristics of living and dead plants are closely related to ecosystem functions associated with hydrology, nutrient cycling, and the abundance and diversity of animal species, as mentioned above (Gregory *et al.* 1991). Removal or severe disturbance of riparian vegetation can lead to a change in the structure of macroinvertebrate communities (Hawkins *et al.* 1982), a decrease in the species diversity of stream ecosystems, a decline in the local and/or regional diversity of animals associated with riparian corridors, a deterioration of downstream water quality, and significant changes in river/stream hydrology (Gosselink *et al.* 1990). The Plant Community function considers the amount and type of vegetation present in the project site relative to reference standard conditions.

3) Variables Used to Assess Plant Community

The following variables are involved in assessing plant community maintenance:

a. Herbaceous Cover (V_{HERB})
b. Shrub Canopy Cover ($V_{SHRUBCC}$)
c. Tree Canopy Cover (V_{TREECC})
d. Ratio of Natives to Non-natives (V_{RATIO})
e. Regeneration (V_{REGEN})
f. Strata (V_{STRATA})

Percent cover class values for the three strata and the regeneration variable are averaged to provide a single measure of cover. This numeric value is then added to the variables for ratio of native to nonnative species tree basal area. These three values are considered equally important as three independent measures of plant community structure and function. The average of the measures is the single functional capacity index (FCI) for the plant community maintenance function.

4) Index of Function

Index = $[(V_{TREECC} + V_{SHRUBCC} + V_{HERB} + V_{REGEN})/4 + V_{RATIO} + V_{STRATA}]/3$

B) Detrital System

1) Definition

Detrital system assesses the process of production, accumulation, and dispersal of dead plant biomass of all sizes.

2) Rationale for the Function

Detrital matter contributes to the functioning of riverine ecosystems in multiple ways (Fontaine and Bartell 1983). For example, accumulations of detrital matter help to reduce soil erosion and can add significant amounts of organic carbon to soils (McPhee and Stone 1966). Decomposing detritus provides wildlife habitat and stores nutrients and water for use by both plants and animals (Franklin, Shugart, and Harmon 1987; Harmon *et al.*1986; Stouder *et al.* 1997). In the riverine waters/wetlands, woody debris is a major source of energy for decomposers and other heterotrophs (Harmon *et al.* 1986; Seastedt *et al.* 1989). Throughout the watershed, detrital material (especially coarse woody debris and debris dams) plays an important role by influencing the development and persistence of floodplain surfaces and the plant communities that develop in flood prone areas and in other hydrologically active areas (Bilby 1981, Smock *et al.* 1989). The approach to assessing detrital functions in the riverine ecosystems requires evaluations of the amounts and distributions of detrital material (litter and woody debris) within a PAA.

3) Variables Used to Assess Detrital Biomass

The following variables are used to assess the detrital system function:

a. Basal area of standing dead trees (snags) (V_{SNAG})
b. In channel coarse woody debris (V_{INCWD})
c. Off channel coarse woody debris (V_{OFFCWD})
d. Decay class (V_{DECOMP})

4) Index of Function

Index = $[V_{SNAG} + (V_{OFFCWD} + V_{INCWD})/2 + V_{DECOMP}]/3$

4. Faunal Support/Habitat Functions

A) Spatial Structure of Habitats

1) Definition

This function refers to the capacity of waters/wetlands to support animal populations within the habitat structure provided by hydrologic conditions, micro- and macro-topographic features, and living plant and detrital communities.

2) Rationale for the Function

The spatial structure of habitats function is used to assess the suitability of hydrologic conditions, micro- and macro-topography, and living plant and detrital communities for sustaining characteristic animal populations in riverine ecosystems. While all ecosystem attributes are important for the maintenance of faunal habitat integrity, the horizontal and vertical structural complexity of plant communities that exist within the flood prone area largely determines habitat quality for resident and nonresidential animals. Generally, habitats with greater vegetative heterogeneity and structural complexity support more diverse faunal communities (Harris 1984, Findlay and Bourdages 2000, Gibbs 2000, Jones *et al.* 2000). Contiguous habitat structure provides opportunities for movement of migratory animals or resident faunal species with large range requirements into and out of waters/wetlands.

Vegetation of mature, intact riverine ecosystems reflects the constraints imposed by environmental conditions (climate, hydrologic regime, geomorphology, *etc.*), as well as the competitive interactions among plant populations. Plant communities have been shown to be relatively reliable indicators of current and past disturbances within riverine ecosystems (*i.e.*, past and ongoing anthropogenic alterations in hydrogeomorphic conditions). The goal of assessing the spatial structure of habitats for the HGM approach is to evaluate the structural complexity of dominant hydrologic, micro- and macro-topographic and vegetation conditions within a riverine ecosystem. This function is meant to be used as part of a rapid assessment technique for waters/wetland functions. It is not intended to replace more detailed procedures or long-term habitat studies.

3) Variables Used to Assess Spatial Structure of Habitat

a. Channel Roughness ($V_{CHANROUGH}$)
b. Buffer Contiguity ($V_{BUFFCONT}$)
c. Buffer Condition ($V_{BUFFCOND}$)
d. Shade (V_{SHADE})
e. Strata (V_{STRATA})
f. Snag (V_{SNAG})

4) Index of Function

Index = $[(V_{CHANROUGH} + (V_{BUFFCOND} + V_{BUFFCONT})/2 + (V_{SHADE} + V_{RESIDPOOL} + V_{SNAG} + V_{STRATA})/4]/3$

B) Interspersion and Connectivity of Habitats

1) Definition

This function refers to the capacity of the riverine waters/wetlands to allow aquatic, semi-aquatic, terrestrial, and avian organisms to access and utilize habitats via contiguous patches.

2) Rationale for the Function

Wetland ecosystems are used extensively by aquatic, semi-aquatic, terrestrial, and avian organisms to complete portions of their life cycles including reproduction, feeding, and growth. Adequate habitat corridors are required for connecting riverine ecosystems to other portions of the landscape (Forman and Godron 1986). Smaller, less mobile faunal species frequently require juxtaposition of habitat components or resources on scales consistent with their smaller home ranges (Opdam 1990). Studies of habitat fragmentation show reduced faunal species richness as patch sizes decrease (Harris 1984). Connections between habitats help maintain higher animal and plant diversity across the landscape (Brinson *et al.* 1995). Habitat Interspersion and Connectivity characterizes the spatial distribution of waters/wetlands within their landscape settings.

3) Variables Used to Assess Interspersion and Connectivity of Habitats

We used the following variables to assess the habitat interspersion and connectivity function:

a. Flood Prone Area Cross-Section (V_{FPAXS})
b. Patch Area ($V_{PATCHAREA}$)
c. Patch Lateral Contiguity ($V_{PATCHLATCONTIG}$)
d. Patch Longitudinal Contiguity ($V_{PATCHLONGCONTIG}$)

4) Index of Function

Index = $[V_{PATCHAREA} + (V_{PATCHLATCON} + V_{PATCHLATCON})/2 + V_{FPAXS}]/3$

C) Distribution and Abundance of Invertebrates

1) Definition

This function refers to the capacity of waters/wetlands to maintain characteristic density and spatial distribution of invertebrates (aquatic, semi-aquatic, and terrestrial).

2) Rationale for the Function

Invertebrates exploit almost every microhabitat available in waters/wetlands and may reach densities of thousands of individuals per square meter. Because invertebrates are so pervasive and partition habitats so finely, they are excellent indicators of ecosystem function (Karr 1991, Karr and Kerans 1992).

3) Status of the Function in this *Draft Final Operational Guidebook*

At this stage of development of the San Luis Obispo Tank Farm *Guidebook*, we are unable to provide reliable variables that would allow calculation of an index of function for invertebrates. This situation is due to the combination of a lack of reference data, lack of invertebrate expertise on the field/author team, and a limited scope and budget for this project. However, the invertebrate function has been included as a placeholder to signify (a) our recognition of the importance of invertebrate taxa in stream ecosystems, and (b) the potential to expand upon current efforts.

D) Distribution and Abundance of Vertebrates

1) Definition

The capacity of waters/wetlands to maintain characteristic density and spatial distribution of vertebrates (aquatic, semi-aquatic and terrestrial).

2) Rationale for the Function

Vertebrate distribution and abundance in any riverine ecosystem is extremely variable, and can change rapidly in space and time. For example, large mammalian species (e.g. mountain lions) require vast tracts of land in order to sustain a population. Therefore, in any given riparian system, especially in the lower gradient positions, the level of use by these large mammals in an assessment area is episodic. In urbanizing environments, large vertebrates are uncommon. Typically, many vertebrates are conspicuous users of waters/wetlands, and can have a strong influence on the dynamics of a riverine ecosystem. The goal in assessing this function is to compare reference and assessment site functions with respect to species composition and structure of vertebrate species associated with a water/wetland and the presence of necessary habitats to support common (or rare) vertebrate faunal populations. Rapid, direct measurements of vertebrates are difficult to perform in the field. Direct sightings or indirect indicators of animal use can be used to assess this function. The following are suggestions, given the expertise and scope of work, to measure this function accurately: (a) Perform complete surveys by vertebrate specialists and compare to reference standard conditions using similar indices, (b) Reference local species lists for mammals, birds, fish, amphibians, and reptiles, and (c) Compare to reference standard conditions using similar indices.

3) Status of the Function in this *Draft Operational Guidebook*

At this stage of development of the San Luis Obispo Tank Farm *Guidebook*, and with other guidebooks developed within the last two decades, we are unable to provide reliable variables that would allow calculation of an index of function for vertebrates. This situation is due to the combination of a lack of reference data, lack of vertebrate expertise on the field/author team, and a limited scope and budget for this project. However, the vertebrate function has been included as a placeholder to signify (a) our recognition of the importance of vertebrate taxa in stream ecosystems, and (b) the potential to expand upon current efforts.

C. Detailed Description, Measurement Protocol, and Scaling of Variables for the Riverine Wetland HGM Model

The following 23 variables are used in the model to assess level of functioning for the 13 ecosystem functions listed in the previous section.

1. Animal Sign (V_{ASIGN})

A) Definition

Animal Sign is the number of direct (*e.g.*, visual observation of animals) or indirect (*e.g.*, tracks, bedding, scat) observations of animal species presence in, or utilization of, the VAA.

B) Rationale for Selection of Variable

It is very difficult to complete a reliable rapid assessment of habitat use by a range of faunal species in highly perturbed or densely populated areas. Nevertheless, rapid assessments have been shown to be necessary and useful scoping tools for various planning or regulatory purposes. Most people understand that if more detailed information is required regarding use of sites by faunal species, formal observation and/or trapping programs need to be completed.

Information commonly used to complete rapid assessments of faunal habitat functioning in riverine ecosystems include both (a) direct observation of animal use of a site, and (b) indirect indicators of animal use (*e.g.* tracks, scat, bedding areas, *etc.*) (Brinson *et al.* 1995). Specifically, in urbanizing areas, and within suburban to rural to agricultural transition zones, animal presence and use of habitat is not necessarily indicative of either (a) overall habitat suitability for several classes of animals, or (b) the preference of a given class of animals for a particular type of habitat (Thomas 1979). Data from several studies show that many classes of faunal species in developed environments adapt to habitat quality and patch sizes of last resort (Harris 1984). Unfortunately, the amount of evidence for animal use at any given site is usually controlled by a number of site specific and landscape scale factors combined with large temporal variation (*e.g.*, time of day, season, or even year of the site assessment).

Photograph III-1. Wood rat midden at Willow Creek Reference Site

Some investigators will argue that the presence or use of riverine waters/wetlands by several classes of faunal "indicator" species or guild leaders can be used as a good indication of *in situ* habitat structural complexity as well as habitat contiguity with the landscape (HEP Manuals, Gosselink and Lee 1989). This line of reasoning represents acceptance of the facts that rapid assessment of faunal functioning in waters/wetland ecosystems has limited

application, and that intact structure will likely beget function.

C) Definition of VAA

The VAA for V_{ASIGN} consists of two transects: one upstream and one downstream. Theses transects originate at the main study area cross section. Their length is seven times the OHW cross section width. Thus, you will travel a total distance of fourteen times the OHW cross section width to look for Animal Sign (*i.e*., 7 widths upstream and 7 widths downstream). The width of the transects (*i.e*., the zone where you will look for Animal Sign) is from 50 feet outward from either Ordinary High Water (OHW) mark or from the wetland boundary on stream left to 50 feet outward from either Ordinary High Water (OHW) mark or from the wetland boundary on stream right. Be sure to look in the air for birds, bats, etc. as your VAA for Animal Sign is a three dimensional zone.

D) Measurement Protocol

Start looking for direct and indirect indicators of animal use of the PAA immediately upon entering the PAA vicinity. Know that your presence may cause escape, hiding, or defense movement, alarm calls, etc. Continue actively looking and listening for, and recording animal observations during the set-up and execution of all other variable measurements. Work so as to allow for maximum time for observation of animal activities, then score the Animal Sign variable as one of the last things that you do during your time in the field.

During your walk, count the number of animal sightings (direct indicators) as well as other (indirect) indicators of animal use of the VAA (*e.g.*, calls, scat, browsing, scrapes or rubs, nests or nest cavities, bedding areas, trails, hair, feathers, *etc.*). Identify the type of sign and, if possible, the responsible animal species. Record your results.

Please note that for the purposes of V_{ASIGN} scaling, direct and indirect animal sightings have been grouped into the following five categories: mammals, birds, amphibians, reptiles, and fish. To qualify for use in scaling of V_{ASIGN}, direct or indirect observations of animal use have to be recognizable as a clear sign of use of the VAA by one of the categories of animals.

Due to the fact that the actual sighting of animals is dependent upon many factors, scaling of V_{ASIGN} also relies upon the use of the PAA by "indicator species." Table III-5 is a list of classes of animals; animal species commonly observed in this region is included in Appendix D. Table III-6 lists indicator species for V_{ASIGN}. Before scoring this variable, scan your list of direct and indirect evidence of animal use and star (*) any indicator species. Count the starred indicator species and record the total number of indicator species.

Table III-5. Faunal Classes

FAUNAL CLASS	Examples
Mammals	Mule deer, coyote, dusky-footed woodrat, Botta's pocket gopher, raccoon, striped skunk, opossum, California vole, etc.
Birds	Western scrub jay, black phoebe, song sparrow, red-winged blackbird, oak titmouse, bushtit, Bewick's wren, etc.
Raptors	Red-tailed hawk, red-shouldered hawk, American kestrel, northern harrier, turkey vulture, etc.
Amphibians	Calif. red-legged frog, Pacific chorus frog, western toad, etc.
Reptiles	Western fence lizard, southern alligator lizard, striped racer, gopher snake, common garter snake, southwestern pond turtle, etc.
Fish	Steelhead trout, three-spined stickleback, speckled dace, prickly sculpin, mosquitofish, etc.
Invertebrates	Mayfly (Order Ephemeroptera) damselfly (Order Odonata), water boatman, common water striders, Monarch butterfly, etc.

Table III-6. Indicator Species for Scaling V_{ASIGN}

INDICATOR SPECIES COMMON NAME	GENUS/SPECIES
Grey fox	*Urocyon cinereoargenteus*
Bobcat	*Lynx rufus*
American badger	*Taxidea taxus*
Yellow warbler	*Dendroica petachia*
Loggerhead shrike	*Lanius ludovicianus*
Golden eagle, Cooper's hawk, white-tailed kite, etc.	Various
Two-striped garter snake	*Thamnophis hammondii*
Southwestern pond turtle	*Emys (=Clemmys) marmorata pallida*
Calif. red-legged frog	*Rana aurora draytonii*
Arroyo toad	*Bufo microscaphus californicus*
Coast range newt	*Taricha torosa torosa*
Steelhead trout	*Oncorhynchus mykiss*
Vernal pool fairy shrimp	*Branchinecta lynchi*

E) Scaling

Measurement or Condition for V_{ASIGN}	**Index**
a. > or = 4 classes of animals or animals signs **or** > or = 2 indicator species (animals or animal signs) **and** b. No evidence of human alteration (*e.g.*, clearing of vegetation, agriculture, cattle grazing, roads, *etc.*) of the VAA within the last 50 years	1.00
a. > or = 4 classes of animals or animal signs **or** > or = 2 indicator species (animals or animal signs) **and** b. Evidence of human alteration (*e.g.*, clearing of vegetation, agriculture, cattle grazing, roads, *etc.*) of the VAA within the last 50 years.	0.75
a. > or = 3 classes of animals or animal signs **or** > or = 1 indicator species (animals or animal signs) **and** b. Evidence of human alteration (*e.g.*, clearing of vegetation, agriculture, cattle grazing, roads, *etc.*) of the VAA within the last 50 years.	0.50
a. 2 classes of animals or animal signs	0.25
a. < 2 classes of animals or animal signs **and** b. Variable **is** recoverable and sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. < 2 classes of animals **and** b. Variable is **not** recoverable and not sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

2. Buffer Condition ($V_{BUFFCOND}$)

A) Definition

Buffer Condition describes the predominant (> 50% areal extent) land use or condition within a stream buffer. The stream buffer for the purpose of this assessment extends 50 feet outward on each bank from either the first break in slope above Ordinary High Water (OHW) mark or from the boundary of any adjacent wetland.

Photograph III-2. Row orchard in buffer at See Canyon Creek Reference Site

B) Rationale for Selection of Variable

Maintenance of riparian buffers in or near the Reference Standard condition is an important consideration that, in conjunction with $V_{BUFFCONT}$, provides (a) the basis for development of channel and floodplain structure, (b) suitable substrates and soil conditions for biogeochemical processing, and (c) suitable habitat for establishment and maintenance of native plant and animal communities. Buffers in or near Reference Standard conditions also provide opportunities for movement and cover for faunal species.

Intact plant communities within buffers increase channel bank shear strength through the production and maintenance of underground fine root biomass. Specifically, intact roots provide (a) structural support necessary to help maintain channel geometry, and (b) substrates and energy sources for microbial activity that are vital in maintaining biogeochemical functions. In addition, intact vegetated communities provide roughness within riverine ecosystems. Roughness has direct, indirect, and cumulative effects on the spatial and temporal flow conditions, or hydrologic complexity of a stream. Roughness allows for complex contacts between water and soil at several flow conditions. This contact helps facilitate the filtering of particulates and thus the removal of sorbed or chelated nutrients, organic matter, and contaminants (Peterjohn and Correll 1984).

C) Definition of VAA

The VAA for $V_{BUFFCOND}$ consists of two transects: one upstream and one downstream. These transects originate at the main cross section. Their length is seven times the OHW cross section width. Thus, you will travel a total distance of fourteen times the OHW cross section to look for dominant land use conditions within the buffer (*i.e.* 7 OHW widths upstream and 7 OHW widths downstream). The width of the VAA for $V_{BUFFCOND}$ (*i.e.*, the zone wherein you will look for buffer land use conditions) extends 50 feet on either side of the stream outward from the OHW or if a wetland exists adjacent to the stream the buffer extends 50 feet from the wetland boundary.

D) Measurement Protocol

Walk upstream and downstream within and next to the VAA. Use aerial photographs, maps, and other remote sensing tools to assist you in developing an estimate of dominant (*i.e.*, > 50%) land use within the buffer (*e.g.*, 50 feet). Work within four zones; (1) upstream left, (2) upstream right, (3) downstream left, and (4) downstream right. Develop your overall estimate for the VAA using an average of the four zones.

In (relatively rare) cases where there is an equal partitioning of land use conditions within the buffer (*e.g*. 50% mixed savannah/grassland, 50% road), develop and document a clear and defensible logic as to why you assume that one buffer condition is dominant over another.

E) Scaling

Measurement or Condition for $V_{BUFFCOND}$	**Index**
Dominant land use / condition within buffer (*i.e.*, within 50 feet of stream/ wetland edge) is unaltered by human activity.	1.00
Dominant land use / condition within buffer (*i.e.*, within 50 feet of stream/ wetland edge) is minimally altered by human activity (*e.g.*, infrequently grazed, logged or cleared in distant past, some invasive species present, minor incursions such as small trails or informal paths).	0.75
a. Dominant land use / condition within buffer (*i.e.*, within 50 feet of stream/ wetland edge) is moderately altered by human activity (*e.g.*, infrequently to moderately grazed, logged or cleared, moderate invasive species cover, recreational paths, *etc*.) **and** b. < 50% of the VAA has been cleared of native vegetation.	0.50
a. Dominant land use / condition within buffer (*i.e*., within 50 feet of stream/ wetland edge) is extensively altered by human activity or fragmented by roads (*e.g.*, lawn , non-hardened flood control structures, formal paths, trails or roads, heavily grazed, hardened flood control structures, housing or commercial in adjacent landscape, *etc.*) **and/or** b. > 50% but < 80% of the VAA has been cleared of native vegetation.	0.25
a. Dominant land use / condition within buffer (i.e., within 50 feet of stream/ wetland edge) is extensively altered and/or continuously cleared by human activity (*e.g.*, paved roads, parking lots, hardened flood control structures, housing, commercial development, *etc.*), **and** b. > 80% of the VAA has been cleared of native vegetation, **and** c. Variable **is** recoverable to reference standard conditions and sustainable through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10

a. Dominant land use / condition within buffer (i.e., within 50 feet of stream/ wetland edge) is extensively altered and/or continuously cleared by human activity (*e.g.*, paved roads, parking lots, hardened flood control structures, housing, commercial development, *etc.*), **and/or** b. > 80% of the VAA has been cleared of native vegetation, **and** c. Variable is **not** recoverable to reference standard conditions nor sustainable through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

3. Buffer Continuity ($V_{BUFFCONT}$)

A) Definition

Photograph III-3. Continuous unbroken buffer along the Old Creek Reference Site

Buffer Continuity is the linear extent of the intact buffer on both sides of the stream channel, parallel to the channel. The stream buffer for the purpose of this assessment extends 50 feet outward on each bank from either the first break in slope above Ordinary High Water mark or from the boundary of any adjacent wetland. ***Please Note:*** To exist for the purposes of scaling the $V_{BUFFCONT}$ variable, in order to be considered intact, the buffer must be:

(a) Vegetated; that is, dominated by either native or non-native trees, shrubs, or undergrowth species rooted in soil. For example, orchards or perennial row crops of nearly level to moderate (<15%) slopes, lawns, ornamental planting, *etc*. are OK; any annual agricultural or viticultural crops, orchards or perennial row crops on slopes >15% are specifically excluded.

and

(b) At least 15 feet wide adjacent to the stream channel.

B) Rationale for the Selection of the Variable

Maintenance of the riparian buffers in or near the Reference Standard conditions of continuity is an important consideration that, in conjunction with $V_{BUFFCOND}$ provide (a) the basis for development of channel and floodplain structure, (b) suitable substrates and soil conditions for biogeochemical processing, and (c) suitable habitat for establishment and maintenance of native plant and animal communities. Continuity of the buffer also provides movement opportunities and cover for faunal species. Channel development and floodplain structure is influenced by the continuity of the plant communities in the buffer. Specifically, intact plant communities within the buffer increase bank shear strength through the production and maintenance of underground fine root biomass. Intact fine roots provide structural support of the channel banks which, in turn, helps to maintain channel geometry. In addition, continuous vegetative communities within the buffer provide horizontal and vertical structure and complexity for faunal habitat and/or cover (*e.g.*, layers or strata of vegetation within the riparian zone*;* resting, hiding, escape, reproductive, and thermal cover). Buffer continuity is also important in providing hydraulic roughness within the riparian zone. Roughness slows surface water flows, and provides habitat and/or cover for

aquatic and semi-aquatic vertebrates and invertebrates. In addition, roughness creates hydraulic complexity at the contact among water, soil and roots. Complex contact facilitates the filtering of particulates and thus the removal of sorbed or chelated nutrients, organic matter, and contaminants (Peterjohn & Correll 1984).

C) Definition of VAA

The VAA for $V_{BUFFCONT}$ consists of two transects: one upstream and one downstream. These transects originate at the PAA cross section. As with $V_{BUFFCOND}$, their length is seven times the OHW cross section width. Thus an observer travels a total distance of fourteen times the OHW cross section width to look for and record breaks in the continuity of the buffer (*i.e.*, 7 OHW widths upstream and 7 OHW widths downstream).

D) Measurement Protocol

Using the guidance above, count the number of times that the riparian buffer is "broken", and/or interrupted by man-made structures and/or human activities. Be sure to include activities that result in a narrowing of the buffer to less than the minimum width stipulated above. Examples of man-made structures and/or human activities that may cause breaks or interruptions in the buffer are dirt or paved roads, bridges, power line rights-of-way, annual crops, orchards, hiking and/or biking trails, lawns and/or ornamental gardens, parking lots, flood control structures, *etc.* Record your results.

E) Scaling

MEASUREMENT CONDITION FOR $V_{BUFFCONT}$	**Index**
Riparian buffer within 50 feet of Ordinary High Water (OHW) or edge of wetland is intact continuously on both sides of the stream channel.	1.00
Riparian buffer within 50 feet of Ordinary High Water (OHW) or edge of wetland is essentially intact but may be broken at one point but is not continuously impacted by human activities on either side of the stream channel (*e.g.*, road or power line intersects at one point, logging/clearing of trees, cattle grazing, annual agriculture crops, trail intersection at one point, viticulture, *etc.*).	0.75
a. Riparian buffer is broken by human activities once, but not continuously on each side of the stream channel **or** b. Twice, but not continuously on one side of the channel within the VAA (*e.g.*, roads, power lines, logging/clearing of trees, cattle grazing, annual agriculture crops, trail intersection at one point, bridge crossing, viticulture, *etc.*).	0.50
a. Riparian buffer is broken by human activities repetitively (> three times) on either or both sides of the stream channel within the VAA (*e.g.*, roads, power lines, annual agriculture, logged/cleared, cattle grazing, trails, lawn, *etc.*).	0.25

a. Intact buffer does not exist on either or both sides of the stream channel, within the VAA **and** b. Variable is recoverable and sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied (*e.g.* recovering/restored annual row crop field; abandoned dirt road, etc.).	0.10
a. Intact buffer does not exist on either or both sides of the stream channel, within the VAA **and** b. Variable is **not** recoverable and not sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied (*e.g.*, parking lot, concrete channel, commercial and/or residential buildings, *etc.*).	0.00

4. Channel Roughness ($V_{CHANROUGH}$)

A) Definition

Channel roughness is an indicator of the hydraulic resistance produced by natural or anthropogenic immobile features of the channel system below ordinary high water (OHW).

B) Rationale for Selection of the Variable

Channel roughness affects both temporal and spatial flow conditions (*e.g.*, turbulence, velocity of water, flow paths, *etc.*) in riverine ecosystems. Channel roughness also influences the kinetic energy of water flowing in the channel, and thus has direct effects on sediment mobilization, transport, deposition, and storage processes. Channel roughness can contribute to improved water quality by providing increased contact of water with diverse channel surfaces. Turbulence, created by channel roughness, increases the dissolved oxygen content of stream waters. Channel roughness also contributes to aquatic habitat diversity by providing a variety of hydraulic conditions in a given channel reach. Hydraulic complexity provides resting, hiding, feeding, thermal, and escape cover for a wide array of aquatic and semi-aquatic vertebrates and invertebrates.

Depending upon the type and timing of natural events, as well as land uses, channel roughness can vary widely within and among subclasses. Examples of features that produce resistance to flow in channels include (a) boulders transported to the site by episodic large events such as debris flows, (b) large, buried, and fixed coarse woody debris, (c) rip-rap, (d) bridge abutments, (e) bedrock, *etc.* Channel roughness is expressed as percent of the channel cross sectional area below OHW occupied by roughness elements that are relatively immobile during flood events.

C) Definition of VAA

The VAA for $V_{CHANROUGH}$ is defined as the cross-sectional area of the PAA channel cross section below OHW.

D) Measurement Protocol

To measure $V_{CHANROUGH}$, stand 25 ft downstream from the PAA cross section and imagine a vertical plane (*i.e.*, a curtain) extending from the cross section tape at the OHW level down to the channel bed. Identify natural and anthropogenic features in the cross section (*i.e.*, features that intersect the PAA cross section below OHW) that will not move during annual flood events and which contribute to channel roughness. Natural immobile features in a stream channel are generally the largest 15% of the observed channel bed material. For

Photograph III-4. Hydraulic roughness features at the Willow Creek Reference Site

example, in a high gradient stream, a Guidebook user could expect an embedded boulder not to move during an annual flooding event. However, it is important to note that immobile materials can move through other hydrologic processes such as winnowing. Anthropogenic immobile features include riprap, debris, engineered structures, *etc.* Use aerial photos or field surveys to estimate the percentage of the channel cross section occupied by roughness elements. Record your results.

An alternative, and more accurate, protocol for measurement of channel roughness is to actually measure the area of all the roughness elements within the channel cross section below OHW. Sum these measurements to develop an estimate of the total area (ft^2) of roughness elements. Divide the estimate of the roughness elements by the total area of the channel cross section below OHW and multiply by 100 to express the result as percent (%) of the main channel cross section occupied by roughness elements.

E) Scaling

MEASUREMENT CONDITION FOR $V_{CHANROUGH}$	**Index**
a. > 10 % of the channel cross sectional area is occupied by natural roughness elements such as boulders, embedded logs, clumps of vegetation, *etc.*, **and** b. There is no evidence of historic human disturbance of channel roughness	1.00
a. > 10 % of the channel cross sectional area is occupied by natural channel roughness elements such as boulders, embedded logs, clumps of vegetation, *etc.* **and** b. Evidence of historic human disturbance of channel roughness is present	0.75
> 5 % and < 10 % of the channel cross sectional area is occupied by roughness elements **that may include** both natural and anthropogenic materials (*e.g.*, concrete fragments and/or structures, rip rap, dimensional lumber, *etc.*)	0.50
> 0 % and < 5 % of the channel cross sectional area is **dominated** by anthropogenic roughness elements that by their placement or construction provide roughness (*e.g.* pipe and wire structures, rip-rap walls, revetment, concrete fragments and/or structures, dimensional lumber, *etc.*)	0.25
a. Channel cross section is smooth and rip-rap lined **or** straightened **and** b. Variable **is** recoverable to reference standard conditions and sustainable through natural processes if the existing land use is discontinued and no restoration measures are applied (*e.g.* "dirty" rip rap or revetment hardening of 1/2 channel cross section; post and wire confinement of the channel on one side of the channel)	0.10
a. Channel cross section is smooth and concrete on both sides **or** straightened, **and** b. Variable is **not** recoverable to reference standard conditions and sustainable through natural processes if the existing land use is discontinued and no restoration measures are applied, *e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*	0.00

5. In-Channel Coarse Wood Decomposition (V_{DECOMP})

A) Definition

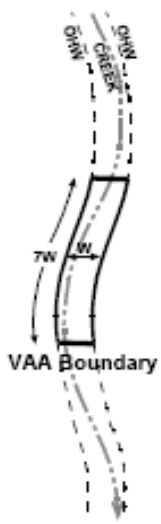
In-Channel Coarse Wood Decomposition is a measure of the most frequently occurring decomposition class (mode) and the average number of decomposition classes of coarse woody debris (CWD) below ordinary high water (OHW) and within the active channel.

Photograph III-5. Various stages of coarse woody debris decomposition below OHW were documented at the Willow Creek Reference Site.

B) Rationale for Selection of the Variable

Multiple decomposition classes within a channel reach are often good indicators of the production of detritus and thus, organic carbon. Organic carbon serves as an energy source that provides the basis for numerous ecosystem processes (*e.g.*, decomposition, nutrient cycling, energy transfer, *etc.*). The most frequently occurring (*i.e.*, modal) decomposition classes can be used as an indicator of the stage of detritus and organic carbon production within a stream ecosystem (Brinson *et al.* 1995). Human activities can have significant effects on the number of pieces and/or volume of CWD within a channel reach. For example, the removal of in-channel CWD for flood control purposes directly reduces rates and/or amounts of decomposition, nutrient cycling, energy transfer, *etc.*

C) Definition of VAA



The VAA for V_{DECOMP} consists of a channel reach length that is seven (7) times the OHW width of the main PAA cross section. The VAA is "centered" on the main PAA cross section, so that 3.5 OHW Channel widths are upstream, and 3.5 OHW channel widths are downstream from the main PAA cross section.

D) Measurement Protocol

Walk the VAA stream reach and identify all pieces of CWD (*e.g.*, down trees, branches, logs, dimensional lumber, *etc.*, >3" diameter) below OHW. Include any piece of CWD >3" diameter that intersects the OHW line but extends above OHW (See Figure III-1). Record a decomposition class for each piece of CWD using the summary of decomposition classes as outlined in Table III-6. Determine the most frequently reported decomposition class (mode), as well as the range (number) of different classes identified within the active channel reach.

Table III-7. Decomposition classes for CWD.

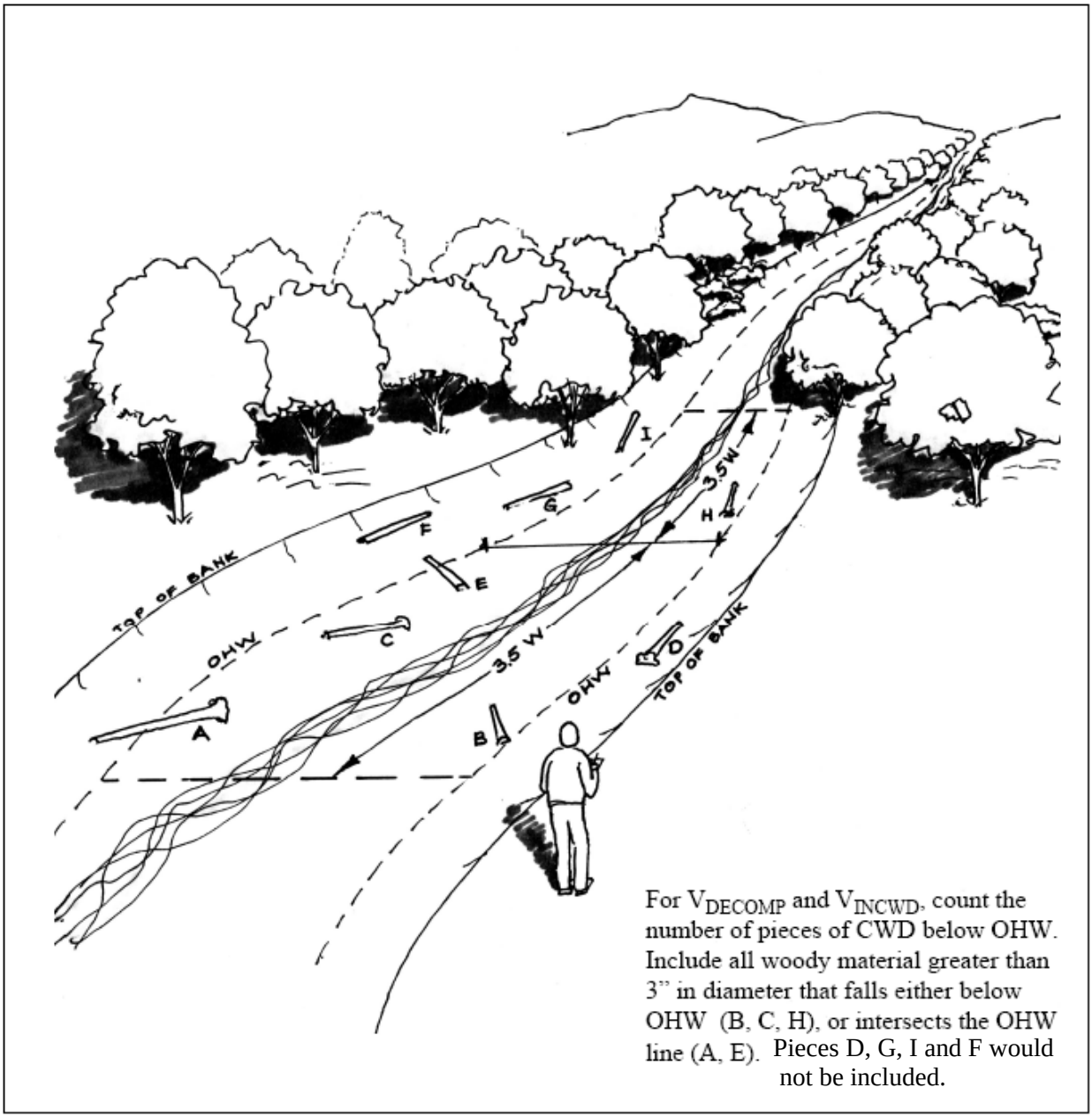
Decomposition Class	Description
1	CWD recently fallen, bark attached, leaves and fine twigs present
2	CWD with loose bark, no leaves and/or fine twigs, fungi present
3	CWD without bark, few branches present, fungi present
4	CWD without bark, and branches, heartwood in advanced state of decay
5	CWD decayed into organic material on ground

Note: If no CWD is found in the VAA reach, then no decomposition class is assigned.

E) Scaling

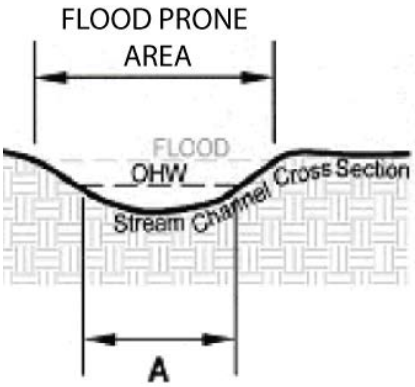
MEASUREMENT CONDITION FOR V_{DECOMP}	Index
a. Total number of decomposition classes below OHW is 4, **and** b. Mode (most frequent occurrence) of decomposition class is > 3	1.00
a. Total number of decomposition classes below OHW is 3, **and** b. Mode (most frequent occurrence) of decomposition class is > 1 and < 3.	0.75
a Total number of decomposition classes below OHW is 2, and b. Mode (most frequent occurrence) of decomposition class is < or = 3.	0.50
a. Total number of decomposition classes below OHW is 1, **and** b. Mode (most frequent occurrence) of decomposition class is > 1 and < 3.	0.25
a. There is no CWD within the VAA, **and** b. Variable **is** recoverable to reference standard conditions and sustainable through natural processes if the existing land use is discontinued and restoration measures are applied.	0.10
a. There is no CWD within the VAA, **and** b. Variable is **not** recoverable to reference standard conditions and sustainable through natural processes if the existing land use is discontinued and restoration measures are applied.	0.00

Figure III-1. Measurement protocol for In-channel large wood (V_{INCWD} and V_{DECOMP}).



6. Flood Prone Area Cross-Section (V_{FPAXS})

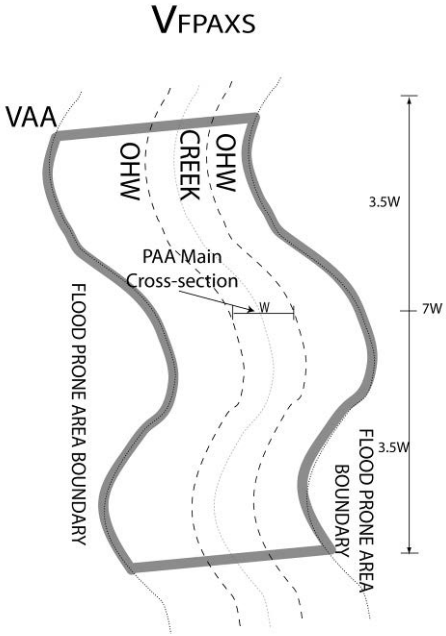
A) Definition



Flood Prone Area Cross-Section refers to the condition of the channel and those parts of the floodplain adjoining the channel, which are required to carry and discharge moderate frequency, moderate magnitude flood flows.

B) Rationale for the Selection of the Variable

Stream ecosystems can convey large amounts of water and sediment, especially during episodic events. However, human activities and alterations to watersheds result in impacts on sources and/or the timing, rate, and amount of water delivery to riverine ecosystems. Channels that have been disconnected from their former floodplains by roads, culverts, bridges, and development are unable to dissipate flow volumes and energy on their floodplains. Human induced changes in the water delivery dynamics of riverine ecosystems usually have negative impacts on all classes of ecosystem functions (*i.e.*, hydrologic, geochemical, plant community and faunal support/habitat functions) (Ward and Stanford 1979). Too much or too little water in contact with the flood prone area and associated riverine ecosystems can have large effects on the productivity and diversity of *in situ* faunal communities and on downstream faunal communities that depend on maintenance of the integrity of upstream habitats and food webs (Platts and Megahan 1975, Bestcha and Platts 1986).



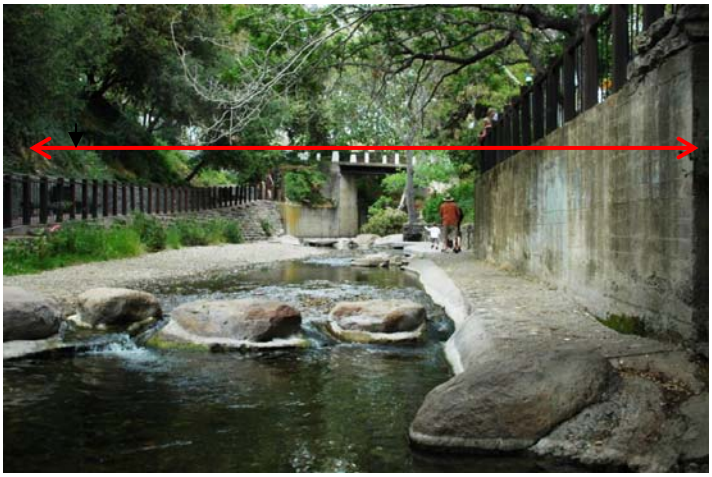
C) Definition of VAA

The VAA for V_{FPAXS} is defined laterally and longitudinally at the main PAA cross-section. Laterally, the VAA is defined as the flood prone area width (*i.e.*, the active channel and those parts of the floodplain adjoining the channel that are engaged during **moderate** frequency, **moderate** magnitude flood flows). Longitudinally, the VAA is defined as **7 times the OHW channel width** centered at the main cross-section (*i.e.*, 3.5 channel widths upstream and downstream from the main cross-section).

D) Measurement Protocol

The measurement protocol for V_{FPAXS} is to walk the VAA (the channel for a length 7 times the OHW width), making note of the condition of the channel and flood prone area, as described in the next paragraph. If visibility is poor, add lateral transects as needed to ensure that the entire VAA is considered for the purposes of scaling V_{FPAXS}.

To scale V_{FPAXS}, consider both direct and indirect impacts to the topography and structure of the flood prone area. Direct impacts to the channel/flood prone area include, but are not limited to development, placement of fill, rip-rap, levees, cultivation, roads, culverts, bridges, *etc.* Indirect impacts to the channel/flood prone area can be more subtle, and include channel incision/entrenchment, rapid lateral migration, in-channel aggradation, *etc.* It is important to observe evidence of out-of-bank flow, including sand splay features, wrack lines, and secondary channels/chutes. These indicators can provide some context of the magnitude, frequency, and duration of floodplain inundation within the VAA.



Photograph III-6. Flood-prone area of the San Luis Obispo Creek Reference Site.

E) Scaling

MEASURMENT CONDITION for V_{FPAXS}	**Index**
The flood prone area is **not** laterally constrained at any point within the VAA by anthropogenic activities (*e.g.*, culturally-accelerated entrenchment, levees, rip-rap, roads, large accumulations of fill or debris).	1.00
At some point within the VAA the flood prone area **is** laterally constrained on **one** side **or** at **one** cross-section by anthropogenic activities (*e.g.*, levees, rip-rap, roads, large accumulations of fill or debris).	0.75
a. Flood prone area is constrained on **both** sides **or** at more than one cross-section by anthropogenic activities (*e.g.*, culturally-accelerated entrenchment, levees, rip-rap, large accumulations of fill or debris, heavy grazing). b. **However**, flood prone area is still able to convey large flood flows as evidenced by large width and complex micro- and macrotopographic relief (*e.g.*, meanders, depositional bars, secondary channels, and floodplains, wide bridge crossings).	0.50
a. Flood prone area is constrained on **both** sides by anthropogenic activities (*e.g.*, culturally accelerated entrenchment, levees, rip-rap, large accumulations of fill or debris), **and** b. Flood prone area is **not** able to convey large flood flows, as evidenced by narrow width and/or relatively homogeneous surfaces that lack micro- and macrotopographic relief *e.g*, channel has been straightened and/or smoothed).	0.25
a. Flood prone area is constrained on **both** sides by anthropogenic activities (*e.g.*, culturally accelerated entrenchment, levees, large accumulations of fill or debris) **and** b. Flood prone area is hardened in places via placement of rip-rap, gabions, concrete, *etc.*, **and** c. Variable **is** recoverable and sustainable through natural processes if the existing land use is discontinued and restoration measures are applied.	0.10

a. Flood prone area is constrained on **both** sides by anthropogenic activities (*e.g.*, culturally accelerated entrenchment, levees, large accumulations of fill or debris) **and** b. Flood prone area is completely filled or hardened with concrete/asphalt, *etc;* **and** c. Variable condition is **not** recoverable or sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

7. Herbaceous Cover (V_{HERB})

A) Definition

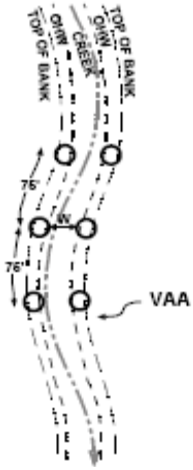
Herbaceous Cover is the percent cover of herbaceous vegetation, including graminoids, forbs, ferns, and fern allies within the VAA.

B) Rationale for Selection of Variable

Cover of herbaceous vegetation typical of reference standard conditions indicates the presence and maintenance of native plant communities.

Photograph III-7. Panicled bulrush (*Scirpus microcarpus*) in floodplain understory at the Old Creek Reference Site.

C) Definition of VAA



The VAA for V_{HERB} consists of six 0.01-acre circular plots (radius = 11.8 feet) established along two vegetation transects, located on stream right and stream left (Figure III-2 and Figure III-3).

D) Measurement Protocol

To establish the six 0.01-acre circular plots that are required to scale V_{HERB}, two vegetation transects need to be established parallel to the PAA stream reach on stream right and stream left. To establish each vegetation sampling transect, begin at the PAA cross section. Visually extend the PAA cross section 25 feet upgradient on river right and river left. Identify the midpoints of the riparian zone between this point and the ordinary high water (OHW) mark on stream right and stream left. Mark these midpoints with plastic flagging. These midpoints will act as the plot center for two of the six vegetative sampling plots, and the midpoint for both vegetation transects. From both midpoints, extend the vegetative transects 75 feet upstream and downstream parallel to the PAA stream reach on stream right and stream left. Establish the four additional plot centers at the midpoints of the riparian zone between the TOB and the OHW mark, 75 feet upstream and downstream from the PAA cross section midpoints on stream right and stream left.

If the vegetation transects cannot be established according to the articulated HGM protocol because of extremely steep terrain, a narrow riparian zone, or extensive poison oak, then locate the six vegetation in accessible, but representative portions of the riparian zone. If the establishment of six plots is not possible at all, given hazardous or unsafe conditions, then the data required for the vegetation variables should be estimated from a remote location (*e.g.*, from the creek bed).

At each of the six plot centers, define a 0.01-acre (radius=11.8) feet) circular plot. This is best accomplished by stretching a tape from the plot center to the targeted radius, and walking slowly in a circle around the plot center. Within each of the six circular plots, make ocular estimates of the percent canopy cover for the herbaceous stratum (graminoids, forbs, ferns, and fern allies) using mid-points of standard canopy-cover classes. Record your results and average the six measurements of canopy cover to calculate the final estimate of herbaceous cover for the VAA.

After determining the average cover class value for all herbaceous cover, determine the single most dominant herbaceous species within the VAA. This can be determined logically through observations from the first set of measurements, or you may have to take an additional walk through the VAA. Another alternative is to collect the necessary data to scale V_{HERB}, and then use these data to determine the dominant herbaceous species. Record the percent cover for the dominant herb species using midpoints of standard canopy cover classes.

Table III-8. Conversion Table for Percent Cover to Cover Class Midpoint

Percent (%) Cover	Midpoint
<1	0
1-5	3
6-15	10.5
16-25	20.5
26-50	38
51-75	63
76-95	85.5
96-100	98

E) Scaling

MEASUREMENT CONDITION FOR V_{HERB}	Index
a. Average herbaceous cover by native species is > 5% and < or = 50% **and** b. Vegetation within VAA is unaltered by human activities.	1.00
a. Average herbaceous cover by native species > 5% and < or = 50% **and** b. Vegetation within VAA is altered by human activities (*e.g.*, partial clearing of the vegetation by grazing of domestic livestock or clearing for crop production, parks, urban/suburban development, flood control access, *etc.*).	0.75
a. Average herbaceous cover by native species < or = 5% or > 50% **and** b. Vegetation within VAA is altered by moderately or chronically human activities (*e.g.*, partial clearing of the vegetation by grazing of domestic livestock or clearing for crop production, parks, urban/suburban development, flood control access, *etc.*).	0.50
a. Average herbaceous cover by native species < 5% **and** b. Cover class midpoint for the dominant herb species < or = 3% **and**	0.25

c. Vegetation within VAA is recently (within the last 5 years) or severely altered by human activities.	
a. Average herbaceous cover is 0% or 100% a**nd** b. Variable **is** recoverable and sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. Average herbaceous cover is 0% or 100% **and** b. Variable is **not** recoverable and not sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

Figure III-2. Protocol for establishing plots within the PAA.

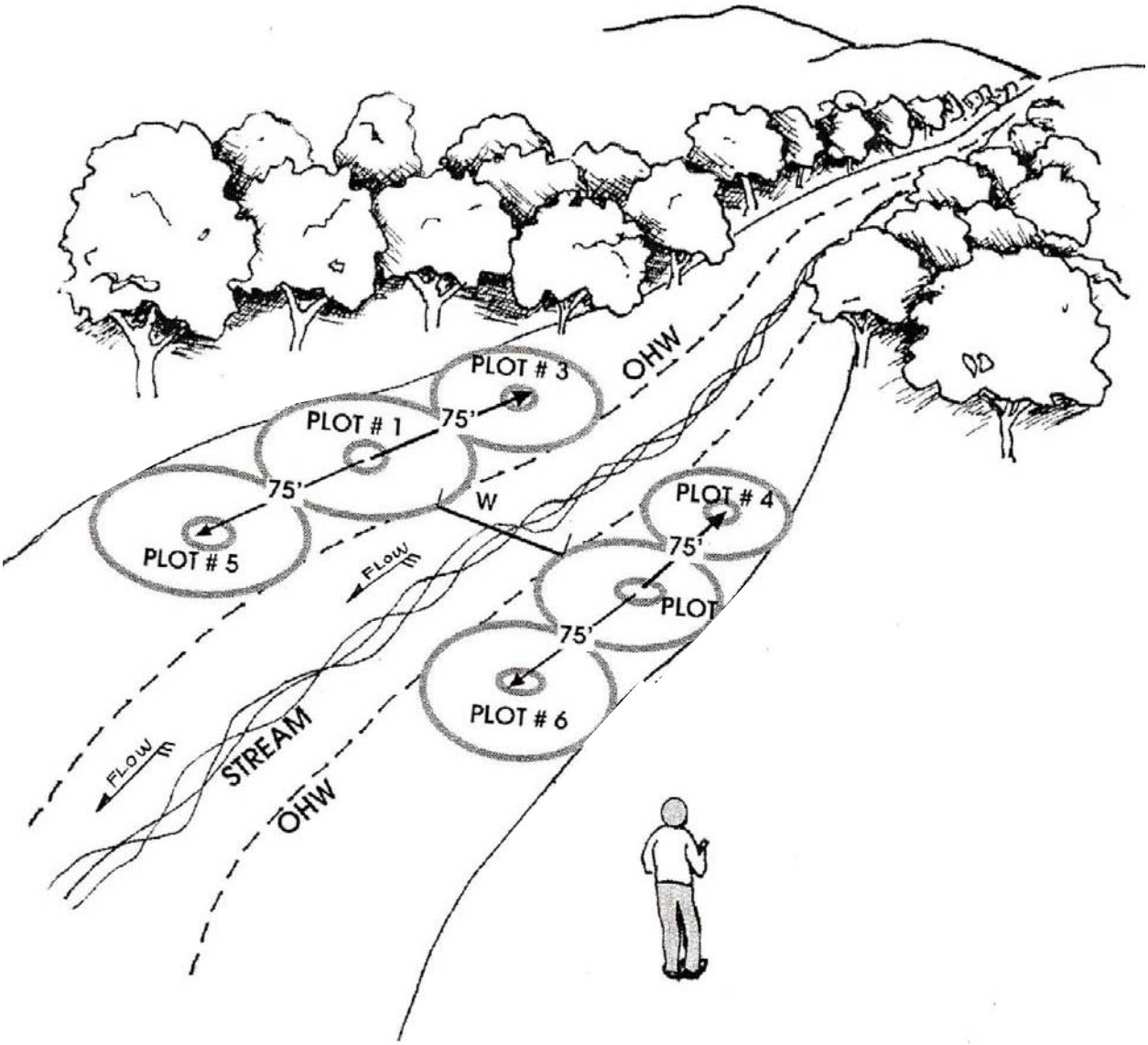
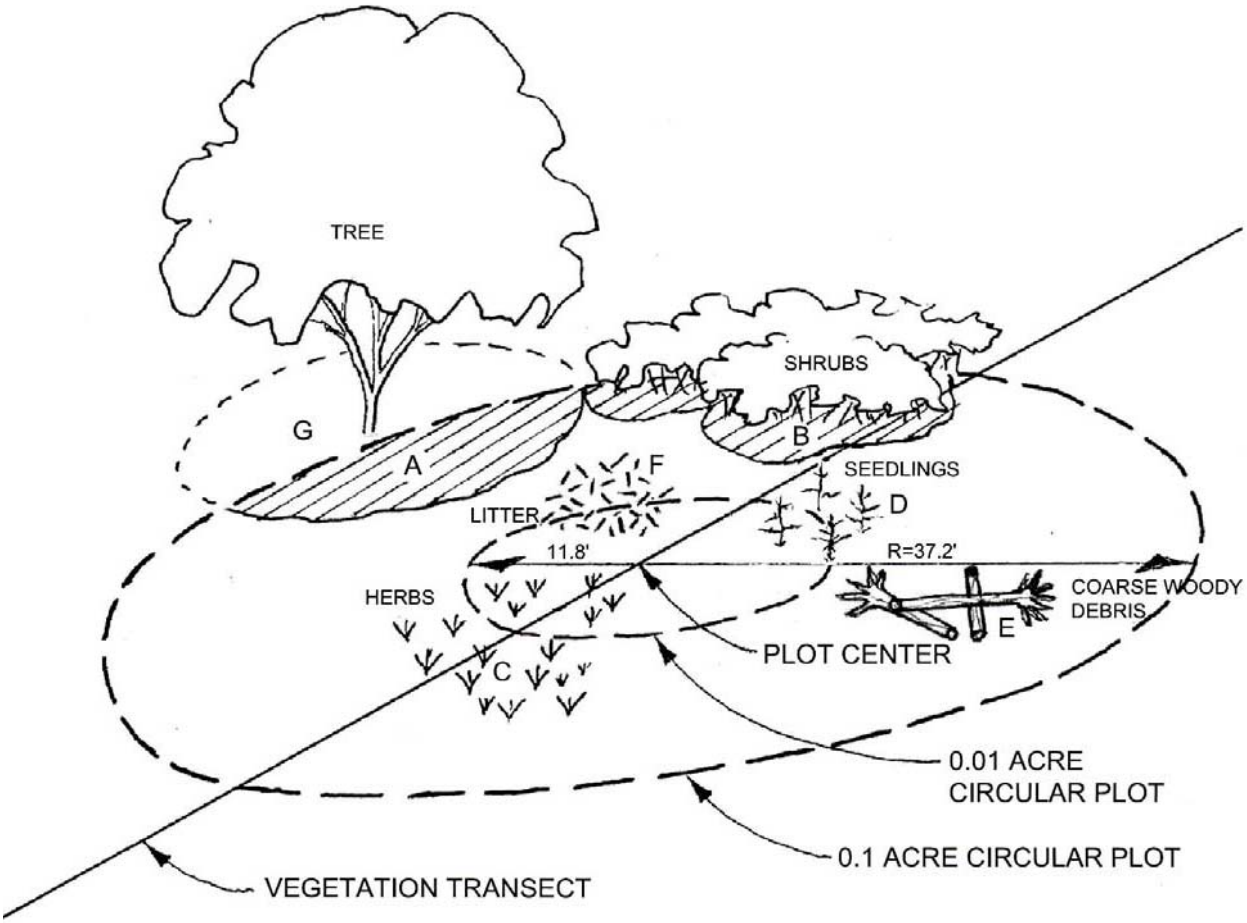


Figure III-3. Measurement protocol for the vegetation canopy cover variables in the Variable Assessment Area.



Percentage of tree canopy cover = A/0.1 acres
Percentage of shrub canopy cover = B/0.1 acres
Percentage of herb canopy cover = C/0.01 acres
Percentage of seedlings/sapling canopy cover = D/0.01 acres
Percentage of coarse woody debris cover = E/0.1 acres
Percentage of litter cover = F/0.01 acres

NOTE: Do not estimate canopy coverage for vegetation outside of circular plot (i.e. G).

8. In-Channel Coarse Woody Debris (V_{INCWD})

A) Definition

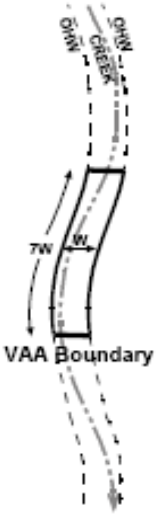
In-Channel Coarse Woody Debris is the volume of down and dead trees and/or limbs (>3” diameter) within the active channel and below OHW.

Photograph III-8. In-channel coarse woody debris within the active channel at the Willow Creek Reference Site

B) Rationale for Selection of Variable

In-channel coarse woody debris (CWD) provides resistance to flow (*i.e.*, roughness) and hydraulic complexity in the channel reach. Movement of water over, under, or around CWD dissipates hydraulic energy and can reduce the average flow velocities within the channel, and increase the complexity of the flow regime or flow pathways (*e.g.*, turbulence, low velocity eddies)(Swanson and Lienkaemper 1978, Keller and Swanson 1979, Frear 1982, Bestcha 1983, Harmon *et. al.* 1986, Sedell *et. al.* 1988, Van Sickle and Gregory 1990, and Nakamura and Swanson 1993). During moderate to high flow conditions, CWD can become mobilized and form CWD jams, which further increase the hydraulic resistance to flow and hydraulic complexity. In both relatively undisturbed and degraded channel systems, CWD jams effect the development and maintenance of cross sectional and longitudinal channel geometry. CWD also provides important animal habitat and/or cover within the riparian ecosystem. Additionally, CWD in various states of decomposition contributes organic carbon (detritus) to terrestrial and aquatic ecosystems. This organic carbon serves as an energy source that provides the basis for numerous ecosystem processes (*e.g.*, decomposition, nutrient cycling, energy transfer, *etc.*).

C) Definition of VAA



The VAA for V_{INCWD} consists of a channel reach length that is seven (7) times the OHW width of the main PAA cross section. The VAA is centered on the PAA cross section, so that 3.5 OHW channel widths are upstream, and 3.5 OHW channel widths are downstream from the PAA cross section.

D) Measurement Protocol

To develop a measurement of V_{INCWD}, start at the PAA cross section. Walk upstream 3.5 OHW channel widths and downstream 3.5 OHW channel widths. During these walks, count the number of pieces of CWD (*e.g.*, down trees, branches, logs, dimensional lumber, *etc.* > 3” diameter) below OHW. Measure the overall length and midpoint diameter of each piece counted. If any piece > 3" diameter of CWD intersects the OHW line but extends above OHW, count it and

measure its length and midpoint diameter as well. Note whether cut wood (*e.g.*, dimension lumber or sawn logs or stumps) is a substantial proportion of the in channel coarse woody debris. Convert each measurement of CWD length and diameter to volume (expressed in ft^3). As indicated on the same sheet, sum the volumes of all CWD counted within the channel below OHW to develop a measure of total CWD volume (ft^3) in the VAA. Record your results.

E) Scaling

MEASUREMENT CONDITION FOR V_{INCWD}	**Index**
a. Total CWD volume below OHW and within the VAA is > or = 75 ft^3 **and** b. VAA has been unaltered by human activities.	1.00
a. Total CWD volume below OHW and within the VAA is > or = 75 ft^3 **and** b. CWD volume within the channel has been altered by human activities.	0.75
a. Total CWD volume below OHW and within the VAA is > or = 50 ft^3 and < 75 ft^3 **or** b. > or = 100 ft3 due to artificial (human) augmentation via dumping of slash material, *etc*.	0.50
a. Total CWD volume below OHW and within the VAA is > or = 25 ft^3 and < 50 ft^3 **and** b. CWD volume within the channel has been altered by human activities (*i.e.* flood control removal).	0.25
a Total CWD volume below OHW and within the VAA is < 25 ft^3 **and** b. Variable is recoverable to reference standard conditions and sustainable through natural processes if the existing land use is discontinued and restoration measures are applied.	0.10
a. Total CWD volume below OHW and within the VAA is < 25 ft^3 **and** b. Variable is not recoverable to reference standard conditions and sustainable through natural processes if the existing land use is discontinued and restoration measures are applied.	0.00

9. Longitudinal Profile ($V_{LONGPROF}$)

A) Definition

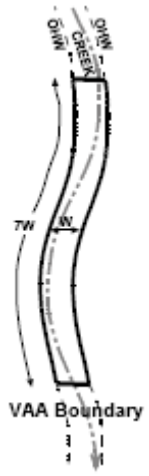
Longitudinal Profile is the integrity of the natural longitudinal profile of the channel within and/or upstream and downstream from the main channel cross section.

Photograph III-9. View looking down gradient at the longitudinal profile of the Cottontail Creek Reference Site.

B) Rationale for Selection of Variable

Maintenance of the integrity of the natural longitudinal profile of channel systems is a fundamental physical feature that, when combined with features such as channel width, depth, water volume, and bedload materials, defines the ability of the channel system to perform work (Leopold 1994, Dunne and Leopold 1978). Manipulation of the longitudinal profile of channel systems (*e.g.*, installation of in-channel dams or diversion structures, water bars, bridges, culverts, *etc.*) leads to adjustments in the ability of the channel system to allocate kinetic energy.

Thus, changes in channel slope will lead to changes in cross sectional and longitudinal channel geometry (*e.g.*, width, depth, degree of entrenchment, sinuosity, *etc.*) These responses have important direct and collateral effects on the ability of the riverine ecosystem to maintain characteristic hydrologic processes through all phases of the hydrograph, and thus to support characteristic geochemical, plant community, a faunal support/habitat functions. For example, manipulation of channel slopes can have immediate effects on water residence times, sediment transport, and the degree to which water can contact floodplain surfaces. Plant community and faunal support/habitat functions in riverine ecosystems are directly influenced by channel slope, because water residence time, water turnover (flux/storage), and the characteristics of the channel cross section and sediment dynamics are all largely controlled by longitudinal slope and variations in slope. The longitudinal gradient is delicately adjusted in a natural channel to most efficiently transport sediment in a natural channel. Any change causes readjustment through deposition or erosion of the bed and banks.



C) Definition of VAA

The VAA for $V_{LONGPROF}$ consists of a channel reach length that is seven times (7x) the OHW channel width at the main PAA cross section. The VAA is centered on the PAA cross section, so that 3.5 OHW channel widths are upstream, and 3.5 OHW channel widths are downstream from the PAA cross section.

D) Measurement Protocol

To develop a measurement for $V_{LONGPROF}$, first examine remote sensing information (*e.g.*, aerial photographs and other imagery, maps, *etc.*) to familiarize yourself with the VAA study reach. Then, walk the VAA study reach (7 OHW channel widths upstream and downstream from the PAA cross section).

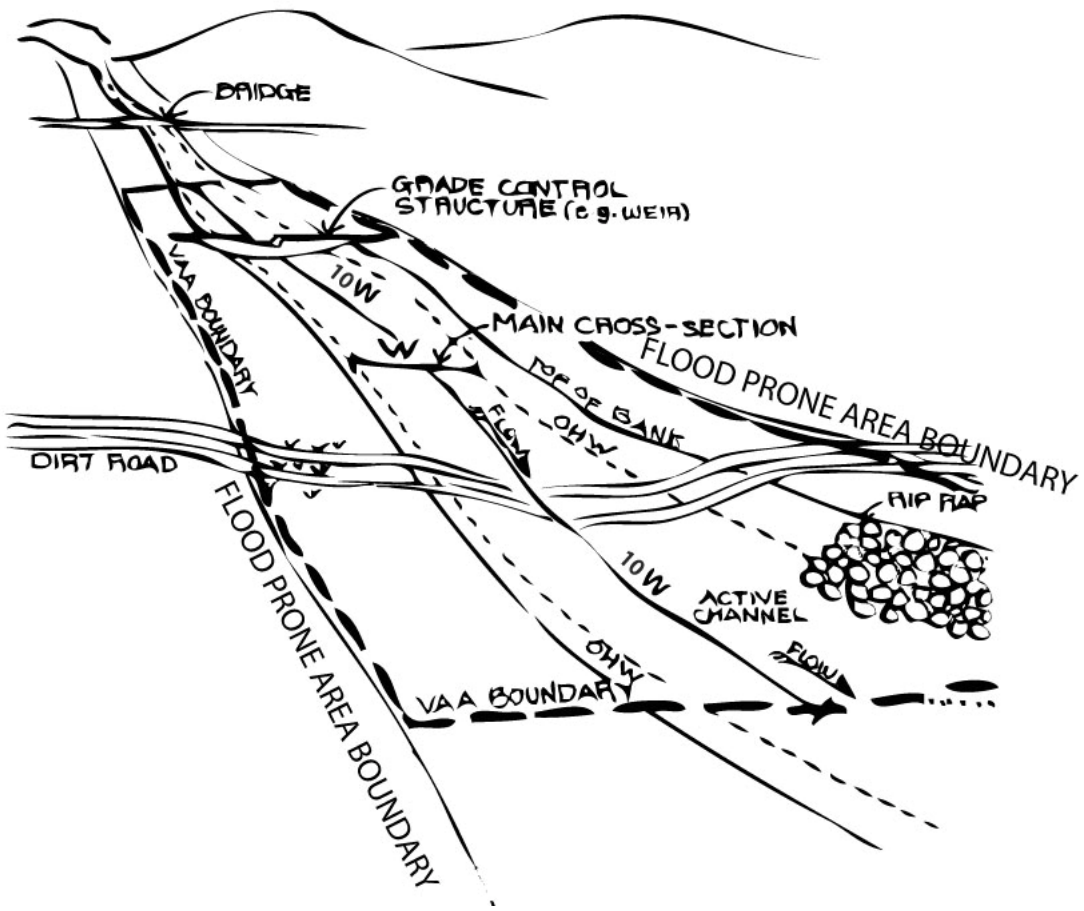
Record all human activities below OHW that are currently impacting the longitudinal channel slope within the VAA. Examples of anthropogenic sources of disturbance that may impact longitudinal channel slope are clearing of vegetation, grading and/or dredging of the channel bed, grade control structures, trails and/or dirt roads, ditches, culverts, construction activities, filling in the channel bed, installation of impervious surfaces, *etc.* In addition, refer to available remote sensing materials (*e.g.*, aerial photographs) to determine if an engineered hardened structure (*e.g.*, a debris basin) exists in up-gradient reaches of the stream. This includes debris basins located in tributaries, as well as within the main channel reach. Record your results.

E) Scaling

MEASUREMENT CONDITION FOR $V_{LONGPROF}$	**Index**
The longitudinal channel slope within the VAA study reach (*i.e.*, upstream or downstream seven times the OHW channel width from the main cross section) **or** upstream **or** downstream from the PAA study reach is unaffected by human activities.	1.00
Human Activities: a. **Have not** occurred within the VAA study reach (*i.e.*, upstream or downstream seven times the OHW channel width from the main cross section), **or** b. **Have** occurred upstream or downstream of the VAA boundary, however, these activities **have not** resulted in development of hardened, engineered structures in the channel (*e.g.* clearing of vegetation, temporary road or foot trail crossings, culverts without hardened concrete drop-ins, limited, temporary construction activities, *etc.*)	0.75
Human Activities: a. **Have** occurred upstream or downstream of the VAA boundary and have resulted in development of hardened, engineered structures in the channel (*e.g.*, permanent road, foot or off-road vehicle trail crossings, culverts with hardened/concrete drop-ins, construction activities, *etc.*), or agradation of bottom elevation due to sedimentation from human activities (*e.g.*, cattle grazing).	0.50
Longitudinal channel slope upstream **or** downstream from the VAA has been altered by In-channel grading (*e.g.*, to control vegetation) or dredging **and/or** by the placement of non-permanent control structures (*e.g.*, temporary water diversions or bank stabilization efforts, bank stabilization structures, *etc.*), and/or agradation of bottom elevation due to sedimentation from human activities (*e.g.*, cattle grazing).	0.25

a. Longitudinal channel slope within the VAA (*i.e.*, upstream or downstream seven times the OHW channel width from the main cross section) has been altered by engineered and hardened grade control or other structure(s) (*e.g.* dirty or grouted riprap channel banks and toe slopes, hardened grade control structures, *etc.*) grade control activities (*e.g.* dredging, grading, installation of hardened engineered structures) upstream **and** downstream of the VAA, or aggradation of bottom elevation due to sedimentation from human activities (*e.g.*, cattle grazing), **and** b. Variable **is** recoverable and sustainable through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. Longitudinal channel slope within the VAA (*i.e.* upstream or downstream seven times the OHW channel width from the main cross section) and/or upstream or downstream of the VAA has been permanently altered by filling the channel bed with impervious materials (*e.g.*, concrete trapezoids, concrete weirs and ramps, grouted rip rap *etc.*). b. The variable is **not** recoverable or sustainable through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

Figure III-4. Measurement protocol for Longitudinal Profile Variable.



10. Off-Channel Large Wood (V_{OFFCWD})

A) Definition

Off-Channel Coarse Woody Debris is the volume of down and dead trees and/or limbs (>3" diameter) above OHW and within the VAA.

B) Rationale for Selection of Variable

Photograph III-10. Off-channel woody debris surrounds wood rat midden at Willow Creek Reference Site

Coarse woody debris (CWD) that occurs above OHW has direct effects on hydrologic, geochemical, plant community, and faunal support/habitat functioning in areas both outside and within the influence of the active stream channel. During moderate to high flow conditions, wind storms, *etc.*, off-channel CWD can become mobilized and transported into the channel below OHW. Off-channel CWD inputs below OHW increase the hydraulic complexity of the channel, floodplain and channel roughness, *etc.* within the PAA. During moderate to high flow conditions, mobile CWD also has the potential to form many different types of debris jams. These jams can have direct and indirect effects on the development and maintenance of cross sectional and longitudinal channel geometry, diversity of on and off channel habitat conditions, *etc.* In and of itself, off channel CWD provides important plant and animal habitat and/or cover within riparian ecosystems. Additionally, off channel CWD in various states of decomposition contributes organic carbon (detritus) to terrestrial and aquatic ecosystems. This organic carbon serves as an energy source that provides the basis for numerous ecosystem processes (*e.g.*, decomposition, nutrient cycling, energy transfer, *etc.*).

C) Definition of VAA

The VAA for V_{OFFCWD} consists of six 0.1-acre circular plots (radius = 37.3 feet) established along the two vegetation transects, located on stream right and stream left.

D) Measurement Protocol

To measure V_{OFFCWD}, utilize the six plot centers on the two vegetative transects, stream right and stream left, to define 0.1-acre (radius 37.3 feet) circular plots. This is best accomplished by stretching a tape from the plot center to the targeted radius, and walking slowly in a circle around

the plot center. Within each of the six circular plots, record the length and midpoint diameter of all off channel CWD (*e.g.*, down trees, branches, logs, dimensional lumber, *etc.* >3" diameter) that falls within the plots. All pieces of CWD that intersect sample plot perimeters should be recorded. If a piece of off channel CWD > 3" diameter is found in a circular plot and it extends beyond the plot boundary and into the active channel (*i.e.*, below OHW), then include length and diameter measurements for this piece in both the in and off channel CWD data. Record your measurements and convert all measurements of off channel CWD length and diameter to volume (expressed in cubic ft). As indicated on the same sheet, sum the volumes of all CWD obtained and divide by six to develop a measure of the average off-channel CWD volume (cubic ft) per 0.1 acre.

E) Scaling

MEASUREMENT CONDITION FOR V_{OFFCWD}	**Index**
a. Total CWD volume above OHW and within the VAA is > or = 75 ft^3 **and** b. VAA has been unaltered by human activities.	1.00
a. Total CWD volume above OHW and within the VAA is > 50 ft^3 **and** b. CWD volume within the channel has been altered by human activities.	0.75
a. Total CWD volume above OHW and within the VAA is > 25 ft^3 and < or = 50 ft^3 **or** b. Total CWD volume above OHW and within the VAA is > 125 ft^3 due to artificial (human) activities, including augmentation via dumping of slash material, *etc.*	0.50
a. Total CWD volume above OHW and within the VAA is > 10 ft^3 and < or = 25 ft^3 **and** b. CWD volume within the channel has been altered by human activities (*e.g.*, flood control removal).	0.25
a. Total CWD volume above OHW and within the VAA is < or = 10 ft^3 **and** b. Variable **is** recoverable to reference standard conditions and sustainable through natural processes if the existing land use is discontinued and restoration measures are applied.	0.10
a. Total CWD volume above OHW and within the VAA is < 10 ft^3 **and** b. Variable is **not** recoverable to reference standard conditions and sustainable through natural processes if the existing land use is discontinued and restoration measures are applied.	0.00

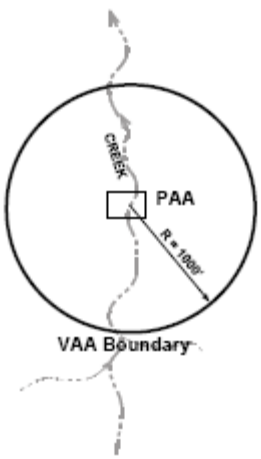
11. Patch Area ($V_{PATCHAREA}$)

A) Definition

Patch area is the percent of the area covered by habitat patches within the 1000 ft radius VAA.

B) Rationale for Selection of the Variable

The relative area (measured as a percentage of the 2,000 ft diameter VAA ring) of patches is an indicator of the site's capacity to function as habitat for faunal communities. The relative area, in combination with a measure of the total number of patches (*i.e.*, $V_{PATCHNUMBER}$), is an indicator of the number and size distribution of the habitat patches available for utilization by faunal communities. Large habitat patches have low edge-to-interior ratios and thus a diversity of interior niches that are critical for resting, hiding, escape, thermal, and feeding dynamics. For aquatic dependent species with both large and small home ranges, large intact habitat patches are critical for completion of their lifecycles. In addition, habitat patch size affects the maintenance of native vegetation communities through factors such as seed dispersal, light, and temperature regulation, *etc.*



C) Definition of the VAA

The variable assessment area (VAA) for $V_{PATCHAREA}$ is the 1,000 ft radius VAA ring centered on the project area (*i.e.* area where development is planned to occur).

D) Measurement Protocol

In the field or on a map, visually extend a circle with a radius of 1,000 feet. If using GIS, display or print an area map showing the watershed that contains the PAA of interest. Using a ruler and compass, or an equivalent technique in the GIS, plot a circle with a 100 ft radius around the centroid of the project area.

To score this variable, three habitat conditions have been identified:

<u>Habitat Types and Examples</u>

1) **Excellent**: native oak savannah/chaparral/perennial bunch grass mosaic, riparian forest, *etc*. having apparent vertical structure,
2) **Good**: annual grasslands no vertical structure except occasional tree or shrub (*e.g.*, elderberry), and
3) **Poor**: any and all developed areas including buildings, roads, asphalt and concrete, *etc*.

Using a 1:24,000 mapping scale grid, or an equivalent GIS technique (*e.g.* "Tabulate Area" in Arc/Info Spatial Analyst), measure the relative areas of the habitat patches that are within the 1,000 ft VAA ring. Habitat patches that extend beyond the 1,000 ft VAA ring should be

truncated and only the area within the 1,000 ft VAA ring should be included in the area measurement in order to produce a relative area measurement. If a patch has a width less than 35 feet, include this area with the adjacent habitat type.

Using these calculations, sum the patch areas to calculate the total patch area for Excellent and Good condition habitat within the 1,000 ft VAA ring. Divide the patch areas by the area of the 100 ft VAA ring (*i.e.*, 100 ft x100 ft x 3.14) and multiply by 100 to calculate the relative percentage of the 100 ft VAA ring in each habitat patch class. If necessary, convert the habitat patch areas from m^2 to ft^2 to maintain consistency of units. Use the relative area of the habitat patches in the 100 ft VAA ring to scale the $V_{PATCHAREA}$ variable. Print and/or include an electronic copy of the map used for the calculation.

E) Scaling

Habitat Types

1) **Excellent**: native oak savannah/chaparral/perennial bunch grass mosaic, riparian forest, *etc*. having apparent vertical structure,
2) **Good**: annual grasslands no vertical structure except occasional tree or shrub (*e.g.*, elderberry), and
3) **Poor**: any and all developed areas including buildings, roads, asphalt and concrete, *etc*.

MEASUREMENT CONDITION FOR $V_{PATCHAREA}$	**Index**
95 -100% of the VAA is covered by excellent habitat	1.00
95 - 100% of the VAA is covered by excellent or good habitat	0.75
50 to 94% of the VAA is covered by excellent or good habitat	0.50
10 to 49% of the VAA is covered by excellent or good habitat	0.25
a. 0 to < 10 % of the VAA is covered by excellent or good habitat, **and** b. The variable **is** recoverable or sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. 0 to < 10 % of the VAA is covered by excellent or good habitat, **and** b. The variable is **not** recoverable or sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

12. Habitat Patch Lateral Contiguity ($V_{PATCHLATCON}$)

A) Definition

The lateral contiguity (*i.e.*, perpendicular to the general valley trend of channel) of habitat patches within the 1,000 ft VAA.

B) Rationale for Selection of the Variable

The lateral contiguity of habitat patches within the VAA is an indicator of the site's capacity to function as habitat for faunal communities. Less disturbed riparian ecosystems are connected laterally through a contiguous landscape with native vegetation. Lateral connectivity decreases with human disturbance (roads, urbanization, agriculture, grazing, land clearing, *etc.*) and thus influences the ability of faunal communities to locate access, utilize, and disperse from a variety of habitat types.

C) Definition of the VAA

The variable assessment area (VAA) for $V_{PATCHLATCON}$ is a 2,000 ft diameter transect that crosses the centroid of the project area (PAA; *i.e.*, area where site activity will occur) and that is oriented perpendicular to the primary gradient of the slope.

D) Measurement Protocol

Using GIS, display or print a map showing the watershed that contains the PAA of interest. From the centroid (approximate center) of Project Area, draw a line 1,000 ft in each direction (2,000 ft total) that is perpendicular to the primary gradient of the slope. Count and record the number of habitat changes crossed by this line. Count a habitat class change only if some portion of the new habitat class is visible on either side of Transect. Record your results. Print and include an electronic copy of the map used for the calculation.

Photograph III-11. Row crops within the buffer along the See Canyon Creek Reference Site.

E) Scaling

MEASUREMENT CONDITION FOR $V_{PATCHLATCON}$	**Index**
a. The Habitat type within the VAA is entirely Excellent habitat, **and** b. There are 0 habitat class changes	1.00
a. 0- 3 habitat class changes within the VAA, **and** b. Excellent habitat is present within the VAA.	0.75
a. 4 - 6 habitat class changes within the VAA, **and** b. Excellent habitat is present within the VAA.	0.50
a. 7 – 9 habitat class changes within the VAA, **and** b. Excellent habitat is present within the VAA.	0.25
a. There is no Excellent habitat within the VAA, **or** b. 0 (*e.g.*, extensively urbanized or under crop production) or ≥ 10 habitat class changes in the VAA, **and** c. Variable **is** recoverable or sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. There is no Excellent habitat within the VAA, **or** b. 0 (*e.g.*, extensively urbanized or under crop production) or ≥ 10 habitat class changes in the VAA, **and** c. Variable is **not** recoverable or sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

13. Habitat Patch Longitudinal Contiguity ($V_{PATCHLONGCON}$)

A) Definition

The longitudinal contiguity (*i.e.*, along the channel) of habitat patches within the 1,000 ft radius VAA.

B) Rationale for Selection of the Variable

The longitudinal contiguity of habitat patches within the VAA is an indicator of the site's capacity to function as habitat for faunal communities. Longitudinal contiguity decreases (*i.e.*, increasing number of habitat class changes) with increasing human disturbance (*i.e.* grazing, land clearing, roads, urbanization, agriculture *etc.*) and thus influences the ability of faunal communities to locate, access, utilize, and disperse from a variety of habitat types.

C) Definition of the VAA

The variable assessment area (VAA) for $V_{PATCHLATCON}$ is a 2,000 ft diameter transect that crosses the centroid of the project area (PAA; *i.e.*, area where site activity will occur).

D) Measurement Protocol

In the field visually extend a plot, or using GIS, display and print project site map at 1:24,000 scale showing the PAA of interest. Plot the location of the project site on the map and generate a 250 ft VAA ring centered on the PAA). Identify the dominant (*i.e.*, drains the largest area) stream channel (average and draw on the map if multiple channels are present), along the 1:24,000 stream network, that passes through the 250 ft VAA.

Start from the up-gradient most point on the stream channel (*i.e.*, where the channel intersects or enters the 250 ft VAA ring) and count the number of habitat class changes that occur along the stream channel until you reach the down-gradient point where the channel exits the 1,000 ft radius VAA ring. Use the number of habitat class changes that occur along the stream channel in the VAA to score the $V_{PATCHLONGCON}$ variable.

Count habitat class changes when the stream channel (arc/line) enters or touches a new habitat type. Count a habitat class change only if some portion of the new type is visible on either side of the stream channel (arc/line). Where the stream channel (arc/line) evenly splits pixels of two different habitat types than the class you are currently in, switch habitat classes to a) the first class encountered, or b) when both are encountered at the same point, switch to the larger of the two patches encountered. Record your results and print and/or include an electronic copy of the map used for this calculation.

E) Scaling

MEASUREMENT CONDITION FOR $V_{PATCHLONGCON}$	**Index**
a. Habitat type within the VAA is entirely Excellent habitat; there are 0 habitat class changes, **and** b. There is **no** evidence of anthropogenic disturbance within the VAA.	1.00
a. 0 to 5 habitat class changes within the VAA, **and** b. Excellent habitat is present within the VAA, **and** c. There is **SOME** evidence of anthropogenic disturbance within the VAA.	0.75
a. 6 to 8 habitat class changes within the VAA, **and** b. Excellent habitat is present within the VAA.	0.50
a. > 8 habitat class changes within the VAA, **and** b. Excellent habitat is present within the VAA.	0.25
a. No Excellent habitat is present within the VAA, **but** b. The variable **is** recoverable or sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. No Excellent or Good habitat is present within the VAA, **and** b. Variable is **not** recoverable or sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

14. Ratio of Native to Non-Native Plant Species (V_{RATIO})

A) Definition

The Ratio of Native to Non-Native Plant Species is the ratio of the dominant plant taxa within the VAA that are native to the San Luis Obispo region to those that have been introduced to the region.

B) Rationale for Selection of the Variable

Native plant species dominate reference standard conditions. This is true for any plant community or ecosystem that has not been disturbed by humans. Anthropogenic disturbance provides opportunities for non-native weedy taxa to enter and subsequently, to become established within the disturbed portions of the community. However, it has been suggested that most nonnative species have little or no effect on species in the invaded community (Simberloff 1981). Some non-native species can and do interact with native species in ways that may be detrimental to the native species. Non-native taxa may hybridize with closely related species (Thompson 1991, Abbot 1992), outcompete natives (see Parker and Reichard 1998 for a review), and alter ecosystem processes such as nitrogen fixation (Vitousek *et al.* 1987), site water balance (Carman and Brotherson 1982), and mycorrhizal interactions (Goodwin 1992). Non-native taxa also may negatively affect the use of the native communities by wildlife (Neill 1983, Olson and Knopf 1986). Therefore, the ratio of native to non-native plant species in an assessment area is a general measure of the degree to which native plant communities have departed from reference standard conditions as a result of anthropogenic activities.

C) Definition of the VAA

The VAA for V_{RATIO} consists of a channel reach length that is fourteen times (14X) the OHW channel width at the PAA cross section. The VAA is centered on the main PAA cross section, so that 7 OHW channel widths are upstream, and 7 OHW channel widths are downstream from the main PAA cross section. The width of the VAA spans from edge of the intact vegetative buffer on stream right to the edge of the intact vegetative buffer on stream left.

Photograph III-12. Primarily non-native herbaceous vegetation in herb layer, shaded by native tree and shrub species in the overstory at the Morro Creek Reference Site.

D) Measurement Protocol

To develop a measurement for V_{RATIO}, start at the PAA cross section. Walk thoroughly through the VAA (upstream 7 OHW channel widths and downstream 7 OHW channel widths). During this walk of the VAA, determine the three dominant species for each of the four strata (*i.e.*, tree, shrub, vine, and herbs) and record your results. If three species are not present

within a stratum, list all that are present. For instance if only *Sambucus mexicana* and *Rhamnus californica* occur in the shrub stratum within the VAA, then only record these two species. If you encounter problems in determining the dominant species within the VAA for a particular stratum, then begin by assigning a cover class midpoint value for all species that occur in that stratum within the VAA. Then select the three species from that stratum with the highest cover class values.

For all dominant species, identify their indigenous status using either *The Jepson Manual* (Hickman 1993). Group all species by their status (native or non-native) across strata and calculate a single ratio of native to non-native species for the VAA.

E) Scaling

MEASUREMENT CONDITION FOR V_{RATIO}	**Index**
Average ratio of native to non-native dominant plant species combined from four strata (tree, shrub, vine, herb) > or = 7:1.	1.00
Average ratio of native to non-native dominant plant species combined from four strata (tree, shrub, vine, herb) > or = 4:1 and < 7:1.	0.75
Average ratio of native to non-native dominant plant species combined from four strata (tree, shrub, vine, herb) > or = 2:1 and < 4:1.	0.50
Average ratio of native to non-native dominant plant species combined from four strata (tree, shrub, vine, herb) > or = 0.5:1< 2:1.	0.25
a. Average ratio of native to non-native dominant plant species combined from four strata (tree, shrub, vine, herb) is < 0.5:1 **and** b. Variable **is** recoverable and sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. Average ratio of native to non-native dominant plant species combined from four strata (tree, shrub, vine, herb) is < 0.5:1 **and** b. Variable is **not** recoverable and not sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

15. Regeneration (V_{REGEN})

A) Definition

Regeneration is the reestablishment of plants from seedlings, saplings, and clonal shoots.

Photograph III-13. Arroyo willow (Salix lasiolepis) resprouting in understory at Morro Creek Reference Site.

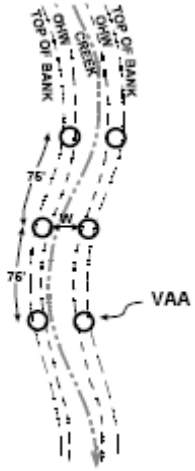
B) Rationale for the Selection of the Variable

Population processes such as the births and deaths of individuals occur in every community, and they emerge as a fundamental property of communities and higher levels of organization (*e.g.*, ecosystem). A population maintains itself when the rate of births (ultimately recruitment) is balanced by the rate of deaths (mortality). Therefore, maintenance of population function and structure, and by extension, community diversity is a fundamental process of a natural ecosystem.

The understory of a riparian ecosystem characteristically will contain seedling/saplings of species that occur in the overstory. Seedlings/ saplings persist in the understory until an opportunity (*e.g.*, tree fall) to replace canopy trees occurs. When an opportunity such a tree fall or lightening strike does occur, seedlings/saplings in the understory will grow up to the canopy layer (Hubbell & Foster 1986).

In addition, seedlings/saplings of understory species (*i.e.*, shrubs, herbs, and vines) are found in the lower strata. These understory species by definition never reach the upper or emergent canopy layer, but instead, occupy recruitment sites (often in the long term) that are not available for canopy species recruitment unless a catastrophic disturbance (*e.g.*, fire, debris flow, flood) occurs. Thus, the presence and composition of seedling/saplings in the understory of a riparian ecosystem is generally useful to predict the future composition and structure of a plant community.

C) Definition of VAA



The VAA for V_{REGEN} consists of six 0.01 acre circular plots (radius = 11.8 feet) established along the two vegetation transects, located on stream right and stream left (Figure III-2 and Figure III-3).

D) Measurement Protocol

To measure V_{REGEN}, utilize the six plot centers on the two vegetative transects, stream right and stream left, to define 0.01-acre plots. This is best accomplished by stretching a tape from the plot center to the targeted radius,

and working slowly in a circle around the plot center. Within each of the six circular plots, make ocular estimates of the percent canopy cover for all seedlings, saplings, and clonal shoots using midpoints of standard canopy cover classes. Record these estimates of percent cover and average the six measurements of canopy cover to calculate the final estimate of regeneration.

E) Scaling

MEASUREMENT CONDITION FOR V_{REGEN}	**Index**
Average seedling/sapling percent cover class > 30%	1.00
Average seedling/sapling percent cover class > 20.5% but < 30%	0.75
Average seedling/sapling percent cover class > 10.5 % but < 20.5%	0.50
Average seedling/sapling percent cover class > 2 % but < 10.5%	0.25
a. Average seedling/sapling percent cover class is < 2%, **and** b. Variable **is** recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, site cleared through heavy grazing of domestic livestock, developed park, and crop production) is discontinued and no restoration measures are applied.	0.10
a. Average seedling/sapling percent cover class is < 2%, **and** b. Variable is **not** recoverable or sustainable to reference standard conditions through natural processes if the existing land use (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) is discontinued and no restoration measures are applied.	0.00

16. Sediment Deposition (V_{SED})

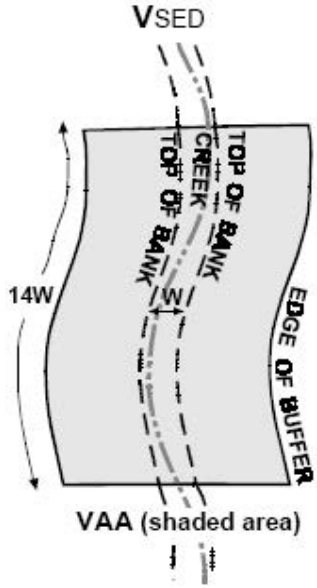
A) Definition

Sediment Deposition refers to the sources and amount of sediment delivery and deposition to waters/wetlands from upgradient landscape positions.

Photograph III-14. Cobble bar with fine sediments along sampling reach of Toro Creek Reference Site.

B) Rationale for Selection of Variable

Stream ecosystems characteristically convey large amounts of sediment. However, human activities often result in impacts on the sources and/or the timing, rate, and amount of sediment delivery and deposition to riverine waters/ wetlands (*i.e.*, significant increases or decreases over reference standard conditions). Human induced changes in the sediment dynamics of riverine ecosystems usually have negative impacts on all classes of ecosystem functions (*i.e.*, hydrologic, geochemical, plant community and faunal support/habitat functions) (Ward & Standford 1979). For example, alteration of channel geometry and hydraulic roughness due to either accelerated rates of sediment deposition, or elimination of sediment (*e.g.*, installation of debris basins) can inhibit or enhance conveyance of flood flows. Similarly, sediment accumulations from upgradient, developed source areas (*e.g.*, avocado production areas on steep unvegetated slopes, "can yards" for the cut flower industry) can be the mechanism by which riverine ecosystems and downstream ecosystems (*e.g.*, estuaries and beaches) are chronically loaded with nutrients, organic matter, or contaminants. Too much or too little sediment moving through riverine ecosystems can have large effects on the productivity and diversity of *in situ* faunal communities (Platts & Megahan 1975, Bestcha & Platts 1986) and on downstream faunal communities that depend on maintenance of the integrity of upstream habitats and food webs.



C) Definition of VAA

The VAA for V_{SED} consists of two transects: one upstream and one downstream. These transects originate at the PAA cross section. Their length is seven times the OHW cross section width. Thus, you will walk a total distance of fourteen times the OHW cross section width. The width of the VAA for V_{SED} (*i.e.*, the zone wherein you will look for V_{SED} field indicators) is from the outer edge of the wetland buffer or setback on stream left, to the outer edge of the wetland buffer or setback on stream right.

D) Measurement Protocol

To develop a measurement for V_{SED}, walk upstream and downstream within the VAA. During this walk, identify and count the number and type of natural and/or anthropogenic sources of sediment delivery or accumulation within the VAA. Note especially, direct input, accumulation, or movement of sediment to or through the stream channel system below OHW, or (b) direct input, accumulation, or movement of sediment to or through wetland "setback" or buffer.

Examples of anthropogenic sources of disturbance that may impact sediment inputs into the stream channel and/or buffer areas are clearing of vegetation, grading and/or dredging of the channel bed, recreational trails and/or dirt roads, public roads and other impervious surfaces such as parking lots, agriculture, construction activities without the proper sediment and erosion control measures, *etc.*

E) Scaling

MEASUREMENT CONDITION FOR V_{SED}	**Index**
Sources and/or amount of sediment delivery and deposition into waters/wetlands and into associated buffers within the VAA is unaltered by human activities.	1.00
Sources and/or amount of sediment delivery and deposition into waters/wetlands and into associated buffers within the VAA is currently unaltered by limited human activities (*e.g.*, light livestock grazing; very low density housing, small, paved roads, *etc.*).	0.75
Sources and/or amount of sediment delivery and deposition into waters/wetlands and into associated buffers within the VAA is altered by human activities (*e.g.* clearing of vegetation, well managed grazing; viticulture with "best management practices" in place and maintained; hiking trails; low density housing).	0.50
a. Direct observation of **input** of sediment to water/wetland portions of the VAA from up gradient sources, **or** b. Sources and/or amount of sediment delivery and deposition into waters/wetlands and into associated buffers within the VAA are significantly altered by human activities (*e.g.*, extensive clearing of vegetation; high intensity and poorly managed grazing; viticulture with no "best management practices" in place; irrigation gates; construction activities; grading or dredging; unpaved roads; suburban housing densities at 1 house/acre, *etc.*).	0.25
a. Direct observation of **accumulation** of sediment in the water/wetland portions of the VAA from up gradient sources, **or** b. Sources and/or amount of sediment delivery and deposition into waters/wetlands and into associated buffers within the VAA are significantly altered by either: 1. Filling of the channel bed and/or bank with engineered, hardened, impervious materials (*e.g.* concrete trapezoids, weirs, grade control structures, housing densities of 4 houses/acre, *etc.*)**, or** 2. Prevention of sediment movement to the VAA (*e.g.*, sediment accumulation)	0.10

through the use of structures, **and** c. The variable **is** recoverable to reference standard conditions and sustainable through natural processes, if the existing land use is discontinued and no restoration measures are applied.	
a. Sources and/or the amount of sediment delivery and deposition into waters/wetlands within the VAA are significantly altered due to the presence of hardened engineered structures (within the VAA and/or up or down gradient) that are specifically designed and maintained to alter and permanently control the amount and rate of sediment delivery to or through the VAA**, and** b. Variable is **not** recoverable to reference standard conditions and not sustainable through natural processes, if the existing land use is discontinued and no restoration measures are applied.	0.00

17. Shade over the Stream Channel (V_{SHADE})

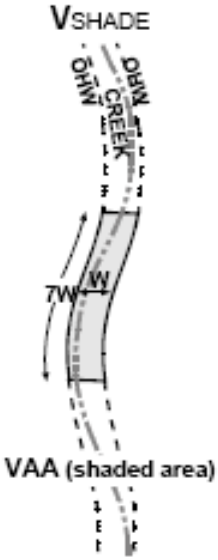
A) Definition

Shade Over the Stream Channel refers to tree, shrub and undergrowth vegetation canopy cover overhanging the active stream channel.

B) Rationale for Selection of Variable

Trees, shrubs, and undergrowth vegetation that overhangs the stream channel and casts shade below OHW have been shown to have important influences on a wide range of riparian ecosystem processes. The presence or absence of riparian shade has particularly important influences on: (1) stream water temperatures, (2) the quality and quantity of food and cover resources available for vertebrate and invertebrate faunal species, and (3) riparian microclimatic conditions (Gregory *et al*. 1991). For example, regulation of stream water temperatures by riparian tree, shrub and undergrowth canopy shade is important to the maintenance of dissolved oxygen in stream water, and thus to maintenance of aquatic and semi-aquatic vertebrate and invertebrate faunal assemblages. Specifically, it has been shown that dramatic fluctuations in diurnal water temperature (and thus dissolved oxygen content) can have deleterious short and long term effects on essential components of a aquatic and semi-aquatic species' life cycles (incubation of eggs and/or larvae). Vegetation that overhangs stream channels provides direct inputs of organic matter to the stream ecosystem, and thus to aquatic food webs (Bestcha & Platts 1986, Gregory *et al.* 1991). The presence or absence of riparian shade can have significant influences on (a) the movement of faunal species within or to and from riparian zones, and/or (b) species use of riparian habitat for feeding, escape, reproductive, and thermal cover.

C) Definition of VAA



The VAA for V_{SHADE} consists of a channel reach length that is seven times (7X) the OHW channel width at the PAA cross section. The VAA is centered on the PAA cross section so that 3.5 OHW channel widths are upstream, and 3.5 OHW channel widths are downstream from the main PAA cross section. The width of the VAA extends from OHW on stream right to OHW on stream left.

Photograph III-15. Nearly 100 percent of the stream channel is shaded at the See Canyon Creek Reference Site.

D) Measurement Protocol

To develop a measure for V_{SHADE}, begin at the PAA cross section. Look upstream on stream right a total distance of 3.5 times the OHW channel width. Identify the OHW mark along this reach. Make an ocular estimate of the average percent canopy cover of trees and shrubs that are overhanging the channel below OHW using the standard canopy midpoint cover classes. Record the canopy cover estimate. The same set of measurements should be made for (a) upstream stream left, (b) downstream stream left, and (c) downstream stream right. You will thus have a total of four sets of measurements. Using these four sets of measurements, calculate the average canopy cover over the active channel along the average overhang distance.

E) Scaling

MEASUREMENT CONDITION FOR V_{SHADE}	**Index**
Shade cover is > 85%.	1.00
Shade cover is > 70% and < or = 85%.	0.75
Shade cover is > 50% and < or = 70%.	0.50
Shade cover is > 25% and < or = 50%.	0.25
a. Shade cover is < or = 15% and > or = 25 **and** b. Variable **is** recoverable and sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. Shade cover is < 15% and > or = 25 **and** b. Variable is **not** recoverable or sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

18. Shrub Canopy Cover ($V_{SHRUBCC}$)

A) Definition

Shrub Canopy Cover is the percent canopy cover of shrubs (multiple stemmed woody species) within the VAA.

Photograph III-16. Dense shrub canopy cover by arroyo willow (*Salix lasiolepis*) along reference reach at Toro Creek.

B) Rationale for Selection of Variable

Shrub canopy coverage is one measure of vegetation that indicates maintenance of native plant community structure and function. As such, shrub canopy cover can be used along with other measures of vegetation cover to indicate the potential for a site to support characteristic ecosystem processes, such as maintenance of native and nonnative plant communities, faunal communities and faunal support/habitat, *etc.* The presence of shrubs along with that of trees, contributes to roughness and topographic variation on floodplain and channel sites. Roughness provides a mechanism to slow water flows and thus provides static and dynamic storage of flood flows as well as cover for aquatic and terrestrial fauna. Shrubs, along with trees, maintain channel morphology by increasing bank shear strength through the production and maintenance of fine root biomass. Shrubs also function as structural elements that limit and/or control development and maintenance of channel geometry.

Shrubs provide allochotonous inputs of labile and refractory organic carbon to riverine ecosystems. In addition, the shrub canopies alter micro-climatic conditions in riparian areas (*e.g.*, moisture, nutrients, light, temperature, wind speed *etc.*). Microclimatic alterations caused by the presence of shrubs is important in maintaining several ecosystem functions, such as biomass production, maintenance of site water balance, nutrient conservation, habitat structure, *etc.* Furthermore, shrubs, along with trees, are instrumental in soil genesis, elemental cycling, and successional processes (Hooper and Vitousek 1997). These successional processes include the dispersal and establishment of plant propagules, which support plant and animal species diversity and turnover (Tilman 1982, Huston and Smith 1987, Cohen and Levin 1991, Tilman and Pacala 1993).

C) Definition of the VAA

The VAA for $V_{SHRUBCC}$ consists of six 0.1 acre circular plots (radius 37.3 ft) established along the two vegetation transects, located on stream right and stream left (Figure III-2 and Figure III-3).

D) Measurement Protocol

To measure $V_{SHRUBCC}$, utilize the six plot centers on the two vegetative transects, stream right and stream left, to define the 0.1 acre circular plots. This is best accomplished by stretching a tape from the plot center to the targeted radius, and walking slowly in a circle around the plot

center. Within each of the six circular plots, make ocular estimates of the percent canopy cover for the shrub stratum using midpoints of standard canopy cover classes. Record these estimates of percent cover and average the six measurements of shrub canopy cover to calculate the final estimate of shrub cover.

E) Scaling

MEASUREMENT CONDITION FOR $V_{SHRUBCC}$	**Index**
a. Average shrub canopy cover is between 30% and 90%, **and** b. Vegetation within the VAA is unaltered by human activities.	1.00
a. Average shrub canopy cover is between 30% and 90%, **and** b. Vegetation within the VAA is in some way altered by human activities (*e.g.*, partial clearing/degradation/trampling of the vegetation by grazing of domestic livestock, parks, urban/suburban development, flood control access, *etc.*).	0.75
a. Average shrub canopy cover is between 15 % and 30 %, **and** b. Vegetation within the VAA is altered by human activities (*e.g.*, partial clearing/degradation/trampling of the vegetation by grazing of domestic livestock, parks, urban/suburban development, flood control access, *etc.*), **or** c. Average shrub canopy cover > 90%.	0.50
a. Average shrub canopy cover is between 5 % and 29 %, **and** b. Vegetation within the VAA is recently (within the last 5 years) or severely (e.g., cleared) altered by human activities.	0.25
a. Average shrub canopy cover is < 5% due to human modifications that prevent the establishment of vegetation (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*), **and** b. Variable **is** recoverable and sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. Average shrub canopy cover is < 5% due to human modifications that prevent the establishment of vegetation (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) **and** b. Variable is **not** recoverable or sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

19. SNAGS (V_{SNAG})

A) Definition

Snags refers to the basal area of standing dead trees (snags) > 3” DBH.

B) Rationale for Selection of the Variable

Snags provide habitat structure for birds, small mammals, herpetofauna, and several other classes of terrestrial and aquatic invertebrates and vertebrates. Additionally, snags contribute refractory organic carbon (detritus) to terrestrial and aquatic ecosystems. This carbon serves as an energy source that provides the basis for several ecosystem processes, (*e.g.*, decomposition, nutrient cycling, energy transfer, *etc.*).

Within active primary and secondary channels and on flood plains, snags are important sources of wood that contribute to the development of channel and flood plain structure, hydraulic complexity, and bank stability.

C) Definition of the VAA

The VAA for V_{SNAG} is the area surrounding the plot centers for the circular vegetative sample plots proximate to the PAA cross section of stream right and stream left.

D) Measurement Protocol

To develop a measure for V_{SNAG}, begin at the plot center for the circular vegetative sample plots. At each of the plot centers, use a standard plotless cruise with a basal area factor (BAF) 10 prism or angle gauge to determine estimates for the average snag basal area per acre. Remember that a snag has been defined herein as dead, single-stemmed woody vegetation that is greater than 3” DBH and upright to an angle of 45° or greater. Protocols for BAF 10 plotless cruises are summarized in (Avery 1967). Average the basal area estimates for the two basal area plots to yield an estimate of snag basal area and express snag basal area on a per acre basis. Record results.

In the absence of a BAF 10 prism or angle gauge, establish a fixed area plot (*e.g.*, 1/10 acre circular plot - radius 37.23 ft) and measure the DBH of each snag within the sample plot. Convert all DBH measurements to basal area using the equation for the area of a circle. Sum all basal area estimates to develop an estimate of total snag basal area, and then convert the snag basal area measurement to a per acre basis using the following formula.

E) Scaling

MEASUREMENT CONDITION FOR V_{SNAG}	**Index**
a. Snag basal area > 30 but < or = 60 ft^2/acre **and** b. Tree mortality resulting in snag formation is not due to human activities.	1.00
a. Snag basal area > 30 but < or = 60 ft^2/acre **and** b. Tree mortality resulting in snag formation is not due to human activities.	0.75
a. Snag basal area > 10 but < 30 ft^2/acre **or** > 100 ft^2/acre **and** b. Tree mortality resulting in snag formation is due to human activities (*e.g.*, groundwater extraction, herbicide drift, water impoundments, girdling, site preparation for crop production/development, *etc.*)	0.50
a. Snag basal area > 0 ft^2/acre but < 10 **or** > 300 ft^2/acre **and** b. Tree mortality resulting in snag formation is due to human activities (*e.g.*, groundwater extraction, water impoundments, girdling, site preparation for crop production/development, *etc.*)	0.25
a. Snag basal area is 0 ft^2/acre **and** b. Variable **is** recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, golf course, orchard, park, *etc.*) is discontinued and no restoration measures are applied.	0.10
a. Snag basal area is 0 ft^2/acre **and** b. Variable is **not** recoverable or sustainable to reference standard conditions through natural processes if the existing land use (*e.g.*, water impoundment, concrete structures, roads, parking lots, *etc.*) is discontinued and no restoration measures are applied.	0.00

20. Soil Profile Integrity ($V_{SOILINT}$)

Photograph III-17. Soil profile at the East Fork, San Luis Obispo Creek Reference Site.

A) Definition

Soil Profile Integrity is a measure of the presence and condition of representative soil profiles (soil horizons) within the VAA.

B) Rationale for Selection of the Variable

The integrity of the soil profile, through linkages with site hydrology, exerts strong control on the ecosystem functions. These functions include biogeochemical processes affecting nutrient cycles and storage, and the establishment and maintenance of plant communities. In particular, finer textured soils that occur within the Low gradient subclass are rare, given past and current land uses. Where they occur, they exhibit increased profile development, structure, and organic carbon accumulation. Thus, when compared to the sandy skeletal soils that are characteristic of the High and Moderate gradient streams, the finer textured soils in Low gradient landscape positions have higher cation exchange and assimilative capacities.

Maintenance of intact soils in Low gradient riverine waters/wetland is especially important, because water movement through Low gradient sites exhibits lower kinetic energy and longer residence time when compared to higher gradient streams (*i.e.* diminished infiltration rates and hydraulic conductivities). Increased time of contact of water with soil mineral particles and organic matter, plant roots, microbes, *etc.*, facilitates retention and transformation of nutrients, organic matter and contaminants. These soil processes are critically important to the maintenance of water quality.

C) Definition of the VAA

The VAA for $V_{SOILINT}$ consists of a transect that runs from the outer edge of the riparian buffer or setback on stream left to the outer edge of the required buffer or setback on stream right.

D) Measurement Protocol

To develop a measure for $V_{SOILINT}$, excavate a series of soil pits along the VAA transect. The objective of your sampling is to examine the structure and condition of soils that are *representative* of the riparian ecosystem (a) in the channel area and (b) above OHW and within 50 feet of OHW. Therefore, at a minimum, excavate pits or exploratory holes in these three areas.

In each pit, look for evidence of fill activities, earthwork, hardening, mechanical damage (*e.g.*, compaction), etc. Pay particular attention to present and potential interactions of VAA soils with water at (a) observed flow conditions, (b) base flow conditions, and (c) storm flow conditions. Integrate your observations of soil conditions within the VAA to develop a view of

representative soil conditions in the riparian zone. Excavate soil pits to a depth of approximately 3 ft or to the depth of impenetrable debris (*e.g.*, boulders, stones, cobbles) or excess water, whichever is encountered first. A closed-bucket or Dutch auger may be useful below approximately 2 ft. If available, examine relatively undisturbed portions of road cuts, cutbanks associated with stream channels, excavations, *etc.* to augment soil pit information. Identification, nomenclature, and description of soil horizons should be consistent with guidance provided by the USDA Natural Resource Conservation Service (SCS 1962; NRCS 1998). All soil depths are measured from the soil surface (usually an A) horizon, excluding any litter or duff layers that may have accumulated on the soil surface. Live vascular and non-vascular plant materials are **not** included in measurements of soil depths. Determine Soil colors consistent with a Munsell Soil Color Chart (Munsell 1992).

E) Scaling

MEASUREMENT OR CONDITION FOR $V_{SOILINT}$	**Index**
a. Representative VAA soil profile is weakly to strongly developed (*i.e.* different horizons are discernable), entirely intact and entirely undisturbed by human activities (*e.g.* roads, construction, agriculture).	1.00
a. Representative VAA soil profile is entirely intact and currently undisturbed by human activities, **but** b. Disturbances have occurred in the VAA, which at some point in time may affect the integrity of the soil profile (*i.e.*, may diminish organic carbon content, soil surface structure, infiltration, structural integrity of the channel bank, or lead to erosion).	0.75
Representative VAA soil profile is: a. Present but perturbed by human activities (*e.g.*, diminished structure, thickness, infiltration, and/or organic carbon content) **and** b. Soil horizons are generally intact (*i.e.*, soil horizons can still be distinguished; no horizons are completely removed).	0.50
a. Representative VAA soil profile is no longer entirely present (intact) and is disturbed by human activities. The surface horizon is removed or buried by human activities **and** b. Subsurface horizons are either buried or exposed (*e.g.*, disturbance by roads, construction, agriculture) and are subject to continued deterioration as a result of human activities.	0.25
Representative VAA soil profile is no longer entirely present or intact: a. The surface horizon has been removed by human activities and the subsurface horizon(s) are exposed, highly eroded, and subject to failure or continued erosion and deterioration as a result of human activities (*e.g.*, disturbance by roads, construction, or agriculture), **and** b. The soil profile **is** recoverable and sustainable through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10

a. Representative VAA soil profile is no longer present (*i.e.*, is unrecognizable) as a result of human activities and disturbances. The surface and subsurface horizons are generally absent due to removal **or** burial as a result of human activities (*e.g.*, the placement of fill, roads, rip-rap, revetments, concrete weirs or trapezoids) **and** b. Soil profile is **not** recoverable or sustainable through natural processes, if the existing land use is discontinued and no restoration measures are applied.	0.00

21. Vegetative Strata (V_{STRATA})

A) Definition

Vegetative Strata is the number of distinct vegetation layers present within the VAA. Vegetation strata were defined as follows: trees (single stem woody species with > 3" DBH and > 10 ft tall); shrubs (multiple stem woody species); vines or lianas (woody vines); and herbs, including forbs, graminoids, ferns, and fern allies.

Photograph III-18. Four vegetation layers (herb vine, shrub, and tree) at the San Luis Obispo Creek Reference Site.

B) Rationale for Selection of the Variable

Multiple vegetation strata (*e.g.*, tree and shrub layers) often are good indicators of the development and maintenance of plant communities, habitat structure, and channel bank stability (Tilman 1994). For example, the number of strata can be correlated with the habitat structure and complexity necessary to support characteristic faunal assemblages, *e.g.*, those typical of the region surrounding and including the SLO Tank Farm. Similarly, the number and types of vegetation strata combine to provide the diversity of faunal habitat, as well as the types and quantity of food and cover resources available.

C) Definition of the VAA

The VAA for V_{STRATA} consists of a 100-foot reach of the two vegetative transects on stream right and stream left. The 100-foot transects should be centered at the identified midpoints proximate to the PAA cross section.

D) Measurement Protocol

To develop a measure for V_{STRATA}, begin 40 feet downstream from the midpoint of the vegetative traansects on stream right. Begin walking upstream along the transect, stopping at every 10 foot interval. At each 10-foot interval, look for vegetation on the ground as well as directly above the stopping point. Record the total number of strata (*i.e.*, herb, vine, shrub, and tree) that intersects the transect at each stopping point. For example, an HGM user identifies the presence of only the herb stratum at a given sampling point. They would therefore record one stratum as present. Make this measurement at 10 points along the vegetation transect, and then repeat this process on stream left. Be sure to record all results. Using the 20 observations, calculate the average number of vegetation strata for the VAA. Round this average to the nearest whole number.

E) Scaling

MEASUREMENT CONDITION FOR V_{STRATA}	**Index**
a. Average number of strata > or = 2.0 **and** b. Vegetation within stream buffer (i.e., within 50 ft of first break in slope above OHW) is unaltered by human activities.	1.00
a. Average number of strata > or = 2.0 **and** b. Vegetation within stream buffer (i.e., within 50 ft of first break in slope above OHW) has been altered by human activities (*e.g.*, partial clearing of the vegetation by grazing of domestic livestock, or by clearing for crop production, undeveloped parks, urban/suburban development, flood control access, *etc*.)	0.75
a. Average number of strata is < 2.0 but > or = 1 **and** b. Vegetation within 25 ft of OHW is moderately altered by human activities (*e.g.*, partial clearing of the vegetation by grazing of domestic livestock, crop production, undeveloped parks, urban/ suburban development, flood control access, *etc*.).	0.50
a. Average number of strata is < 2.0 but > or = 1 **and** b. Vegetation within 25 ft of OHW is extensively altered by human activities (*e.g.*, extensive clearing of the vegetation by grazing of domestic livestock, crop production, developed parks, urban/suburban development, flood control access, highway right of way and maintenance, *etc*.)	0.25
a. Average number of strata < 1.0. b. Variable **is** recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, site cleared through heavy grazing of domestic livestock, developed park, and crop production) is discontinued and no restoration measures are applied.	0.10
a. Average number of strata < 1.0. b. Variable is **not** recoverable or sustainable to reference standard conditions through natural processes if the existing land use (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) is discontinued and no restoration measures are applied.	0.00

22. Surface Water In (V_{SURFIN})

A) Definition

Surface Water In refers to the hydrologic connections into the VAA from the adjacent landscape.

B) Rationale for Selection of the Variable

Photograph III-19. Metal pipe delivering surface water inputs to the Willow Creek Reference Site.

The type and number of surface water connections between riverine ecosystems and their surrounding landscape are good field indicators of the potential for the riverine ecosystem to maintain intact hydrologic, geochemical, plant community, and faunal support/habitat functions (Brinson *et al* 1995). For example, intact surface water connections facilitate surface water runoff from surrounding landscapes. Such runoff is necessary to maintain main channel sediment processes and characteristic cross sectional and longitudinal channel geometries. Similarly, surface water connections are vital in allowing biogeochemical processes associated with particulate retention, elemental cycling, and organic carbon export (both dissolved and particulate) to occur.

Intact surface water connections help to maintain diverse native plant communities in riparian ecosystems. They provide relatively moist microsites that are transitional habitats among (relatively wet) main channel/riparian and (relatively dry) upland habitats. The relatively moist transitional sites associated with surface water connections (a) support complex tree canopies and understory structure, (b) contribute significantly to plant species diversity in riparian ecosystems, and (c) act as corridors for dispersal of plant propagules within the between components of the riparian ecosystem.

Intact surface water connections within the relatively undisturbed riparian ecosystems also provide important links between aquatic and terrestrial habitats for a wide range of aquatic and semi-aquatic faunal species. Specifically, intact surface water connections allow riparian dependent animals (*e.g.*, Steelhead trout, salamanders, and newts) to move within riparian ecosystems, and thus to complete life cycle requirements. Surface water connections also provide escape, hiding, resting and reproductive cover for aquatic and terrestrial animals that use all or parts of riparian ecosystems as habitat.

C) Definition of the VAA

The VAA for V_{SURFIN} consists of two transects: one upstream and one downstream. These transects originate at the PAA cross section. Their length is seven times the OHW cross section width. Thus you will travel a total distance of fourteen times the OHW cross section width (*i.e.*,

7 OHW cross section widths upstream and 7 OHW cross section widths downstream). The width of the VAA is the channel system width below OHW.

D) Measurement Protocol

To develop measurements for V_{SURFIN}, examine air photos and maps that will offer information pertaining to the condition of the source areas for surface water connections to the VAA. Then, start at the main cross section. Walk the upstream and downstream legs of the VAA and identify the number and type of all permanent, seasonal, and ephemeral surface water connections that run across the OHW level and into the stream channel from surrounding landscape position. Characterize the condition of the source area landscape as being relatively natural/undisturbed, low, moderate or high density housing, malls, parking lots, industrial, etc. Examples of surface water connections into stream channels range from being natural tributaries to agricultural ditches to constructed stormwater inputs to highly engineered and hardened water diversion structures. Record your results.

E) Scaling

MEASUREMENT CONDITION FOR V_{SURFIN}	**Index**
Surface hydraulic connections into the VAA from the adjacent landscape are unaltered by human activities. No manipulations of the surface hydraulic connections leading to, or within the VAA are present.	1.00
Limited alteration of the natural surface hydraulic connections evident (*e.g.*, fire and farm road crossings; agricultural or very low density (1 house/100 acres) residential runoff directed to natural, ungraded tributaries via light grading).	0.75
Surface hydraulic connections into the VAA from the adjacent landscape have been: 1. Altered by human activity (*e.g.*, low gradient slope agricultural ditches or swales; inputs from low (1 house/10 acres) to moderate (1 house/5 acres) density residential areas or open space parks or urban inputs), **and** 2. Achieved through a combination of natural tributaries and non-hardened engineered structures (*e.g.*, through unlined ditches or swales with or without culvert outfalls), and/or via engineered structures delivering treated stormwater.	0.50
Surface hydraulic connections into the VAA are: 1. Altered by moderate to intense human activity, **and** 2. Achieved primarily through hardened engineered structures (*e.g.*, culverts with headwalls, buried pipes, lined ditches, sheet flow over concrete or asphalt) that convey flow from areas of moderate density residential (*i.e.*, 1 house/5 acres), service industry installations (*e.g.*, commercial property, parking lots, *etc.*) and/or high intensity agriculture (*e.g.*, grazing or viticulture on steep slopes).	0.25
a. Surface hydraulic connections into the VAA from the adjacent landscape have been: 1. Significantly altered by human activity such as high density suburban, urban or industrial inputs, or high intensity agricultural *(e.g.*, grazing or viticulture on steep slopes) **and**	0.10

2. Achieved through hardened engineered structures that drain runoff from urban, large industrial, or high intensity agricultural portions of the landscape proximate to the VAA; **and** b. Variable **is** recoverable to reference standard conditions and sustainable through natural processes, if the existing land use is discontinued and no restoration measures are applied.	
a. Surface hydraulic connections into the VAA from adjacent portions of the landscape have been: 1. Significantly altered by human activity (*e.g.*, agricultural, high density urban or industrial inputs); **and** 2. Achieved through hardened engineered structures that drain runoff from urban or large industrial, or high intensity agricultural (*e.g.*, grazing, viticulture on steep slopes) portions of the landscape proximate to the VAA. These structures could not be removed without extensive re-engineering to address substantial threats to public safety, **therefore** b. Variable is **not** recoverable to reference standard conditions and not sustainable through natural processes, if the existing land use is discontinued and no restoration measures are applied.	0.00

23. Tree Canopy Cover (V_{TREECC})

Photograph III-20. California walnut (*Juglans californica *var.* californica*) at the East Fork, San Luis Obispo Creek Reference Site.

A) Definition

Tree Canopy Cover is the percent canopy cover of trees (single stem woody species with >3" DBH and > 10 ft tall).

B) Rationale for Selection of the Variable

Tree canopy coverage is traditionally used as a measure of species distribution and biomass (Clements 1916; Avery 1967; Mueller-Dombois and Ellenberg 1974). As such, canopy cover can indicate the potential for a site to support characteristic ecosystem processes such as maintenance of native and nonnative plant communities and faunal habitat. Trees contribute to roughness and topographic variation on floodplain and channel sites. Roughness provides a mechanism that slows water flows and thus provides static and dynamic storage of flood flows and cover for aquatic and terrestrial fauna. Trees maintain channel morphology by increasing bank shear strength through the production and maintenance of fine root biomass. Trees also function as structural elements that limit and/or control development and maintenance of channel geometry.

Trees provide allochotonous inputs of labile and refractory organic carbon to riverine ecosystems. In addition, the presence of tree boles and canopies alter micro-climatic conditions in riparian areas (*e.g.*, moisture, nutrients, light, temperature, wind speed *etc.*). Microclimatic alterations caused by the presence of trees is important in maintaining several ecosystem functions such as biomass production, maintenance of site water balance, nutrient conservation, habitat structure *etc.* Furthermore, trees are instrumental in soil genesis, elemental cycling, and successional processes (Hooper and Vitousek 1997). These successional processes include the dispersal and establishment of plant propagules, support plant and animal species diversity and turnover (Tilman 1982, Huston and Smith 1987, Cohen and Levin 1991, and Tilman and Pacala 1993).

C) Definition of the VAA

The VAA for V_{TREECC} consists of six 0.1-acre circular plots (radius = 37.3 feet) established along the two vegetation transects, located on stream right and stream left (Figure III-2 and Figure III-3).

D) Measurement Protocol

To measure V_{TREECC}, utilize the six plot centers on the two vegetative transects, stream right and stream left, to define 0.1 acre (radius 37.3 feet) circular plots. This is best accomplished by stretching a tape from the plot center to the targeted radius, and walking slowly in a circle around the plot center. Within each of the six circular plots, make ocular estimates of the percent cover for the tree stratum using midpoints of standard canopy cover classes. Record these estimates of

percent cover and average the six measurements to produce a final estimate of percent canopy cover for the tree stratum.

E) Scaling

MEASUREMENT CONDITION FOR V_{TREECC}	**Index**
a. Average tree canopy cover > 90 % **and** b. Vegetation within the VAA is unaltered.	1.00
a. Average tree canopy cover > or = 30 % and < 90 % **and** b. Vegetation within the VAA is unaltered by human activities.	0.75
a. Average tree canopy cover > 30 % but < 90 % **and** b. Vegetation within the VAA is altered by human activities (*e.g.*, partial clearing/degradation/trampling of vegetation by grazing of domestic livestock, crop production, parks, urban/suburban development, flood control access, *etc.*).	0.50
Average tree canopy cover < or = 30 % and > 5 %.	0.25
a. Average tree canopy cover < or = 5 % **and** b. Variable **is** recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, site cleared/degraded/trampled through heavy grazing of domestic livestock, developed park, crop production) is discontinued and no restoration measures are applied. c.	0.10
a. Average tree canopy cover < or = 5 % **and** b. Variable is **not** recoverable or sustainable to reference standard conditions through natural processes if the existing land use (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) is discontinued and no restoration measures are applied.	0.00

IV. Glossary

assessment area (AA): The area in or adjacent to waters/wetlands, which will be assessed with HGM models.

assessment team (A - team): An interdisciplinary group of regional and local scientists responsible for classification of wetlands within a region, identification of reference wetlands, construction of assessment models, definition of reference standards, and calibration of assessment models.

best professional judgment: The process of making decisions based on personal experience and knowledge when better information is not available.

biogeochemical: The interaction and integration of biological and geochemical cycles and processes.

biogeochemistry: Of or relating to the partitioning and cycling of chemical elements and compounds between the living and nonliving parts of an ecosystem.

buffer: A zone of a defined width that borders waters/wetlands and that is designed to protect the waters/wetlands from impacts.

centroid: The point in character space, the coordinates of which are the mean values of each character over a given cluster of OTUs (operational taxonomic unit).

channel: An open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water.

channel cross-section geometry: The dimensions and morphology of a section of stream channel, taken perpendicular to the linear centerline of the stream from the floodplain surface on one side of the channel, to the floodplain surface on the opposite side.

Clean Water Act of 1977 (33 U.S. c.1344): Section 404 of this law that directs the Secretary of the Army, acting through the Chief of Engineers to issue permits, after notice and opportunity for public hearing, for the discharge of dredge or fill material into waters of the United States at specified locations. The object of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (33 U.S. C.1344, Section 101(a)).

flood prone area: The channel and those parts of the floodplain adjoining the channel, which are required to carry and discharge moderate frequency, moderate magnitude flood flows.

flow-through wetlands: Wetlands that recharge the groundwater system and receive groundwater discharge.

function (ecosystem): Processes which are necessary for the self-maintenance of an ecosystem such as primary production, nutrient cycling, decomposition, *etc.* The term is used primarily as a distinction from values. The term 'values' is associated with society's perception of ecosystem functions. Functions occur in ecosystems regardless of whether or not they have values.

function context area (FCA): The area that influences, or is influenced by, a wetland function. The function context area can include aquatic and upland systems adjacent to the wetland.

functional assessment: The process by which the capacity of a wetland to perform a function is measured. This approach measures capacity using an assessment model to determine a functional capacity index.

functional capacity: The rate or magnitude at which a wetland ecosystem performs a function. Functional capacity is dictated by characteristics of the wetland ecosystem and the surrounding landscape, and interaction between the two.

functional capacity index (FCI): An index of the capacity of wetland to perform a function relative to other wetlands from a regional wetland subclass in a reference domain. Functional capacity indices are by definition scaled from 0.0 to 1.0. An index of 1.0 indicates that the wetland performs a function at the highest sustainable functional capacity, the level equivalent to a wetland under reference standard conditions in a reference domain. An index of 0.0 indicates the wetland does not perform the function at a measurable level, and will not recover the capacity to perform the function through natural processes.

functional capacity unit (FCU): The value derived by multiplying the functional capacity index for a wetland area by the size of the wetland area.

functional profile:

A. Qualitative and quantitative descriptive depictions of wetlands that, in the caseof the hydrogeomorphic classification, emphasize the physical characteristics such as geomorphic setting, water source, and hydrodynamics. Profiles also may include the biotic components.

B. Narrative or quantitative description of significant factors such as water source, hydrodynamics, vegetation, and soils that affect how a wetland functions.

geomorphic setting: The location of a landscape with respect to landforms, such as stream headwater locations, valley bottom depression, and coastal position.

geomorphology: The study of the classification, description, origin, nature, and development of landforms and their relationship to underlying structures and geologic processes.

Geographical Information System (GIS): An integrated system of computer hardware, software and trained personnel linking topographic, demographic, utility, facility, image and other resource data that is geographically referenced.

Global Positioning System (GPS): An instrument that determines (by triangulation) the location of features, using data from orbiting satellites.

ground water:

A. Water occurring in the subsurface voids, pore spaces, or fissures of the earth, as opposed to water occurring above the surface in streams, ponds, lakes, and oceans.

B. The water contained in the interconnected pores located below the water table in an unconfined aquifer or located in a confined aquifer.

ground water discharge: The movement of groundwater from an aquifer to the surface.

Headwaters:

A. Streams with average annual discharge less than 5 cfs (US Army Corps of Engineers 404 Regulatory Program definition).

B. The upper most reaches of stream networks.

herb: Forbs, ferns, fern allies, and graminoids.

herbaceous: Vegetation layer consisting of herbs.

histosol: Organic soils *i.e.*, soils that contain variable amounts of organic materials (12- 20% organic carbon by weight) to specific depth and thickness requirements.

homogeneous: Of the same or a similar kind or nature, with uniform structure or composition throughout.

horizon, soil: A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the master diagnostic horizons. Lower case subscripts represent subordinate designations.

hydrogeomorphic unit: Hydrogeomorphic units are areas within a wetland assessment area that are relatively homogenous with respect to ecosystem scale characteristics such as microtopography, soil types, vegetative communities, or other factors that influence function. Hydrogeomorphic units may be the result of natural or anthropogenic processes.

hydrologic unit: A distinct hydrologic feature delineated by the Office of Water Data Coordination on the State Hydrologic Unit Maps. Each hydrological unit is identified by a unique eight-digit number.

hydrology: The science that deals with water, its properties, circulation, and distribution on and under the earth's surface and in the atmosphere.

jurisdictional wetland: Wetlands which meet the hydrologic, soil, and vegetation parameter defined in the 'Corps of Engineers Wetlands Delineation Manual', or its successor.

microtopography: Surface features and roughness imparted by natural processes such as hummocks and down wood.

modal soil profile: A soil profile that represents the average or general soil type that is typical for the area or location of interest.

national wetland inventory (NWI): A Fish and Wildlife Service program designed to map and inventory wetlands of the United States.

native: Indigenous status as listed in the *Flora of the Pacific Northwest* (Hitchcock and Cronquist 1990).

nonpoint source: Nutrients or contaminants that enter wetland and aquatic ecosystems from diffuse, unconfined sources over a greater area, in contrast to a point source from a defined, discrete location. Common non-point sources are agricultural and urban landscapes.

ordinary high water mark (OHW): ". . . that line on the shore established by the fluctuation of water and indicated by physical characteristics such as clear natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding area" (33 CFR Part 328, Section 328.3 (a)(7)(e)).

project area: The area that encompasses all activities related to an ongoing or proposed project.

project assessment area (PAA): The waters/wetland area within the geographic extent of the reference domain to be assessed for impacts.

PAA main cross section: Transect set along a representative reach within the project assessment area (PAA) from which variable assessment areas (VAA) to measure the requisite variables will be established.

percent (%) cover: Relative area covered by a particular strata (*i.e.*, herb, shrub, tree). The total sums to 100% cover.

project standards: Performance criteria and/or specifications used to guide the restoration or creation activities towards the project target. Project standards should include and specify reasonable contingency measures if the project target is not being achieved.

project target: The level of functioning identified or negotiated for a restoration or creation project. The targets must be based on reference standards and/or site potential and consistent with restoration or creation goals. They are used to evaluate whether a project is developing toward reference standards and/or site potential.

reference: The term reference in the context of functional assessment is used as a basis for comparing two or more wetlands of the same subclass. The principle of reference is useful because (1) everyone uses the same standard of comparison, and (2) relative rather than absolute measures allow better resolution, efficiency in time, and consistency in measurements.

reference domain: The area within a defined geographic region from which reference wetlands that belong to a single hydrogeomorphic subclass are sampled. The reference domain may coincide with the geographic region or be a subset of the region.

reference standards: Conditions exhibited by a group of reference wetlands that correspond to the highest level of functioning (highest sustainable capacity) across the suite of functions of the subclass. By definition, highest levels of functioning are assigned an index of 1.0.

reference wetlands: Wetland sites within the reference domain that encompass the known variation of the subclass. They are used to establish the ranges of functions.

restoration: Includes the following:

A. Returning a modified ecosystem to its pre-modified condition. For example, restoring a tidal connection to a salt marsh isolated by road construction.

B. Taking a former wetland area that had performed wetland functions or is now performing diminished functions, and altering conditions such that the wetland now performs most of its natural (*i.e.*, pre-disturbance) functions.

river left: The left side of a river or stream as one faces down steam.

river right: The right side of a river or stream as one faces down steam.

riverine: Of or pertaining to rivers; HGM class - one of seven geomorphic classes identified in the HGM methodology. The others are lacustrine fringe, estuarine fringe, depressional, organic flats, mineral flats, and slopes.

riverine wetland: Riverine wetlands are long linear features that contain a river bed and bank, and functionally cover the area of the 100-year floodplain. One of several classes of wetlands defined by Cowardin *et. al.* (1979) as systems that include all wetland and deepwater habitats contained within a channel with the exception that the system must not contain ocean derived

salts in excess of 0.5ppt and all excludes wetlands dominated by trees shrubs, persistent emergents, emergent mosses, or
lichens (palustrine wetlands).

site potential: The highest level of functioning possible, given local constraints of disturbance history, land use, or other factors. Site potential may be equal to or less than levels of functioning established by Reference Standards.

slope wetland: Slope wetlands grade into the flat below where the slope becomes negligible. Hillside seeps or springs are good examples of slope wetlands.

thalweg: The deepest points of a stream channel when viewed in cross-section perpendicular to the flow.

tree: Single-stem, woody vegetation with a stem diameter at breast height (DBH) >4 inches that is > 10 ft (3 m) tall.

upland: Topographically higher areas adjacent to waters/wetlands that do not meet the criteria for and are not wetlands themselves.

UTM: The Universal Transverse Mercator global coordinate system.

variable: An attribute or characteristic of a wetland ecosystem or the surrounding landscape that influences the capacity of wetland to perform a function.

variable assessment area (VAA): The survey region for measurement of each variable.

variable condition: The condition of a variable as determined through quantitative or qualitative measures.

variable index: A measure of how an assessment model variable in a wetland compares to the reference standards of a regional wetland subclass in a reference domain.

Waters of the United States: "....(a)(1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; (2) all interstate waters including interstate wetlands; (3) all other waters such as intrastate lakes, rivers, streams, (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate , or foreign commerce including such waters: (i) Which are or could be used by interstate or foreign travelers for recreational or other purposes; or (ii) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or (iii) Which are used or could be used for industrial purposes by industries in interstate commerce; (4) All impoundments of waters otherwise defined as waters of the United States under this definition. (5) Tributaries of waters identified in paragraphs 1-4 above; (6) The territorial sea: (7) Wetlands adjacent to waters (0ther than waters that are themselves wetlands) identified in paragraphs (a) (1)-(6) of this section; waste treatment

systems, including treatment ponds or lagoons designed to meet the requirements of the Clean Water Act (other than cooling ponds defined in 40 CFR Section 423.11(m) which meet the criteria of this definition) are not waters of the United states (404(b)(1) Guidelines - 40 CFR Section 230.3(s))" (33CFR Part 328, Section 328.3 (a)(1)-(6)).

watershed: The area of land from which surface water drains to a single outlet.

wetland: "... those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation, typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (Corps Regulation 33 CFR 328.3 and EPA Regulations 40 CFR 230.3). 2) "... lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface of the land is covered by shallow water"

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Appendix A
San Luis Obispo Riverine HGM Reference Sampling Site Locations & Photographs

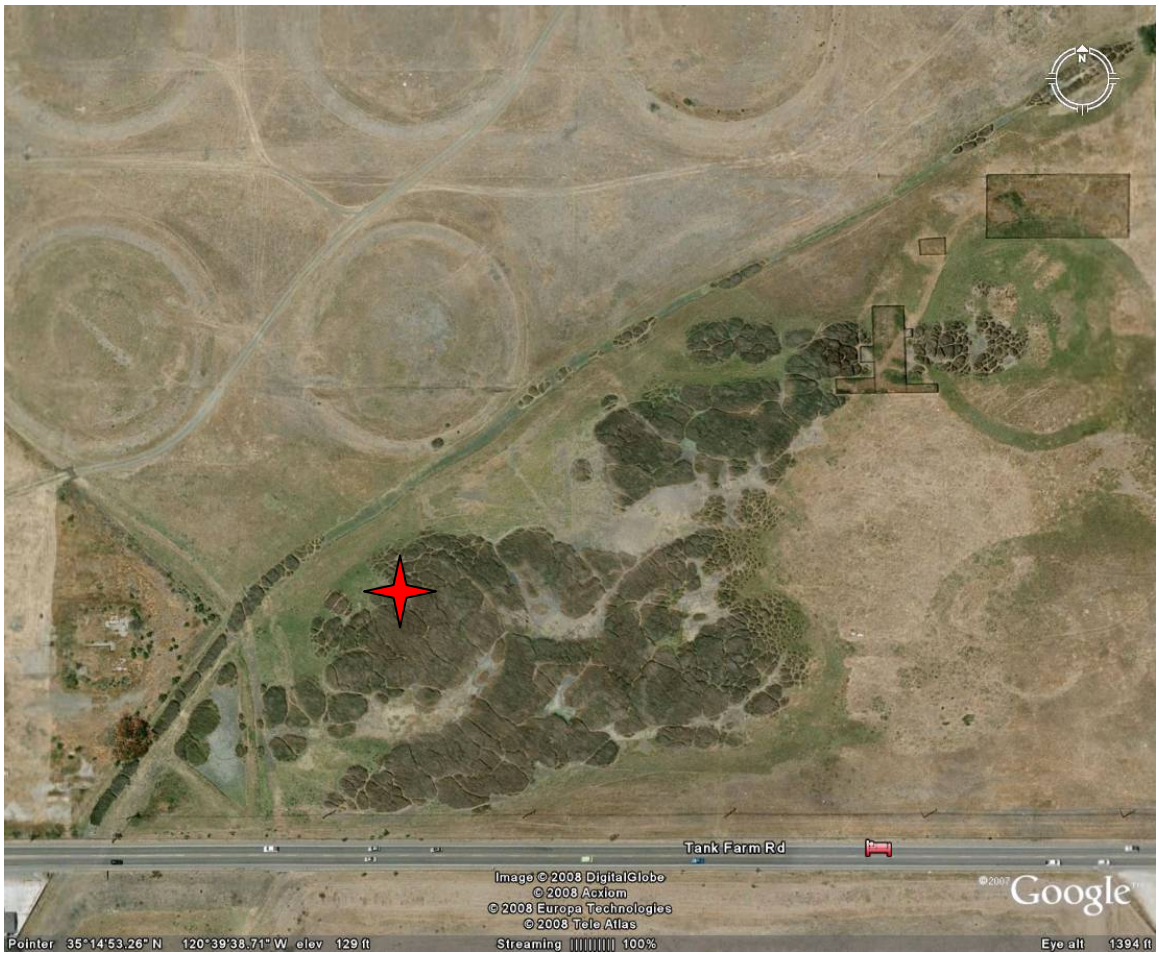


Figure I-4a. Sampling Site #1. North Marsh/Tank Farm Creek, San Luis Obispo, California (aerial view).

Figure I-4b. Sampling Site #1. North Marsh/Tank Farm Creek, San Luis Obispo, California (ground level view).

Appendix A-1

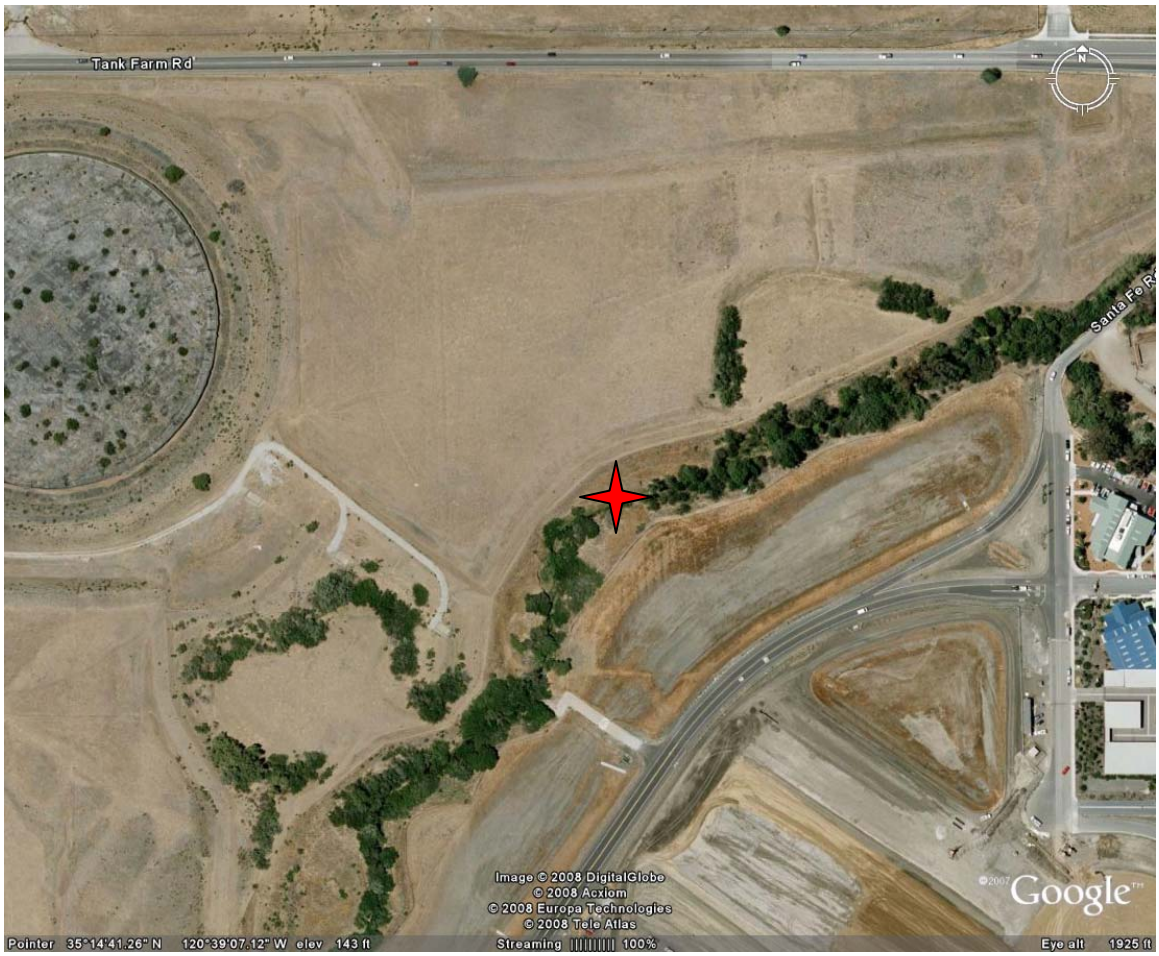


Figure I-5a. Sampling Site #2. East Branch, San Luis Obispo Creek, San Luis Obispo, California (aerial view).

Figure I-5b. Sampling Site #2. East Branch, San Luis Obispo Creek, San Luis Obispo, California (ground level view).

Appendix A-2

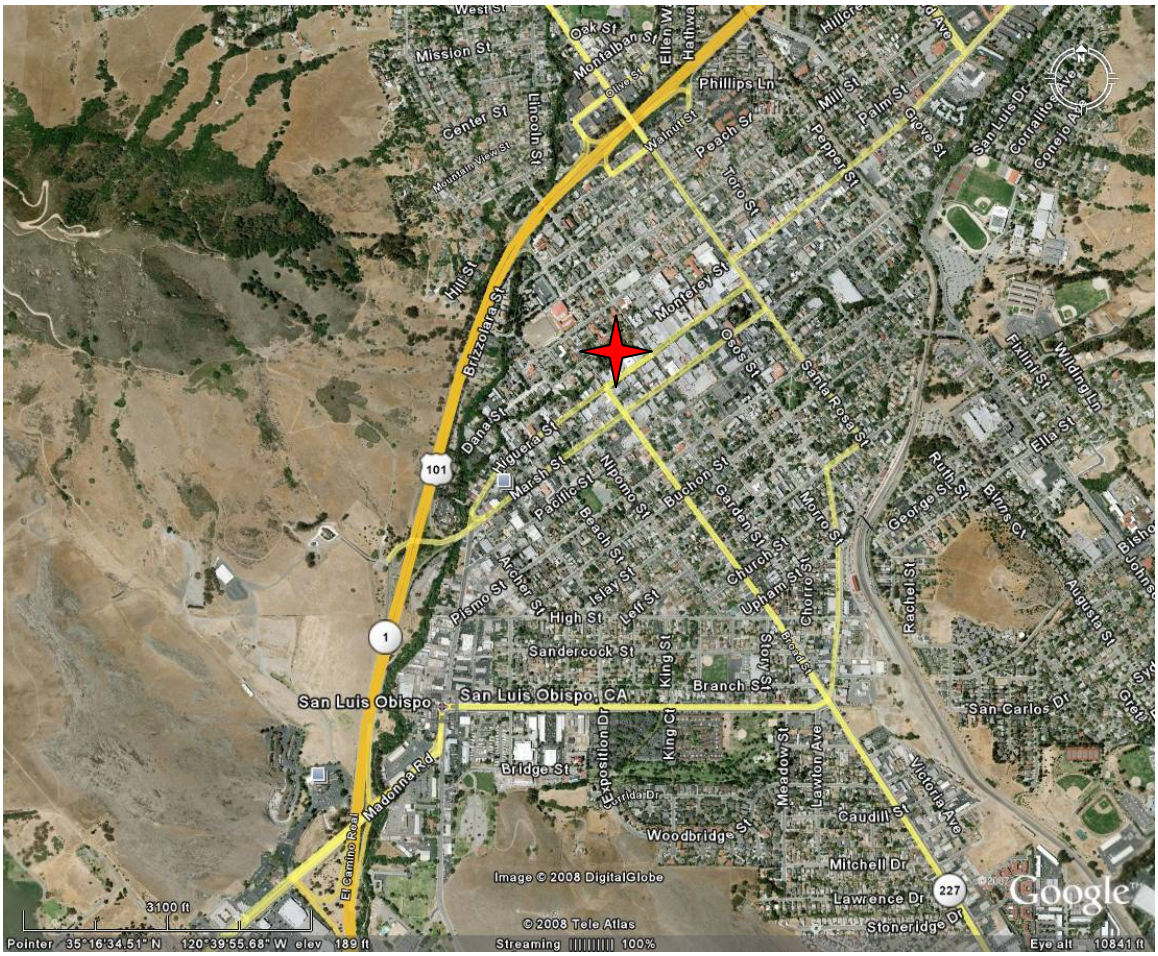


Figure I-6a. Sampling Site #3. San Luis Obispo Creek, San Luis Obispo, California (aerial view).

Figure I-6b. Sampling Site #3. San Luis Obispo Creek, San Luis Obispo, California.(ground level view).

Appendix A-3

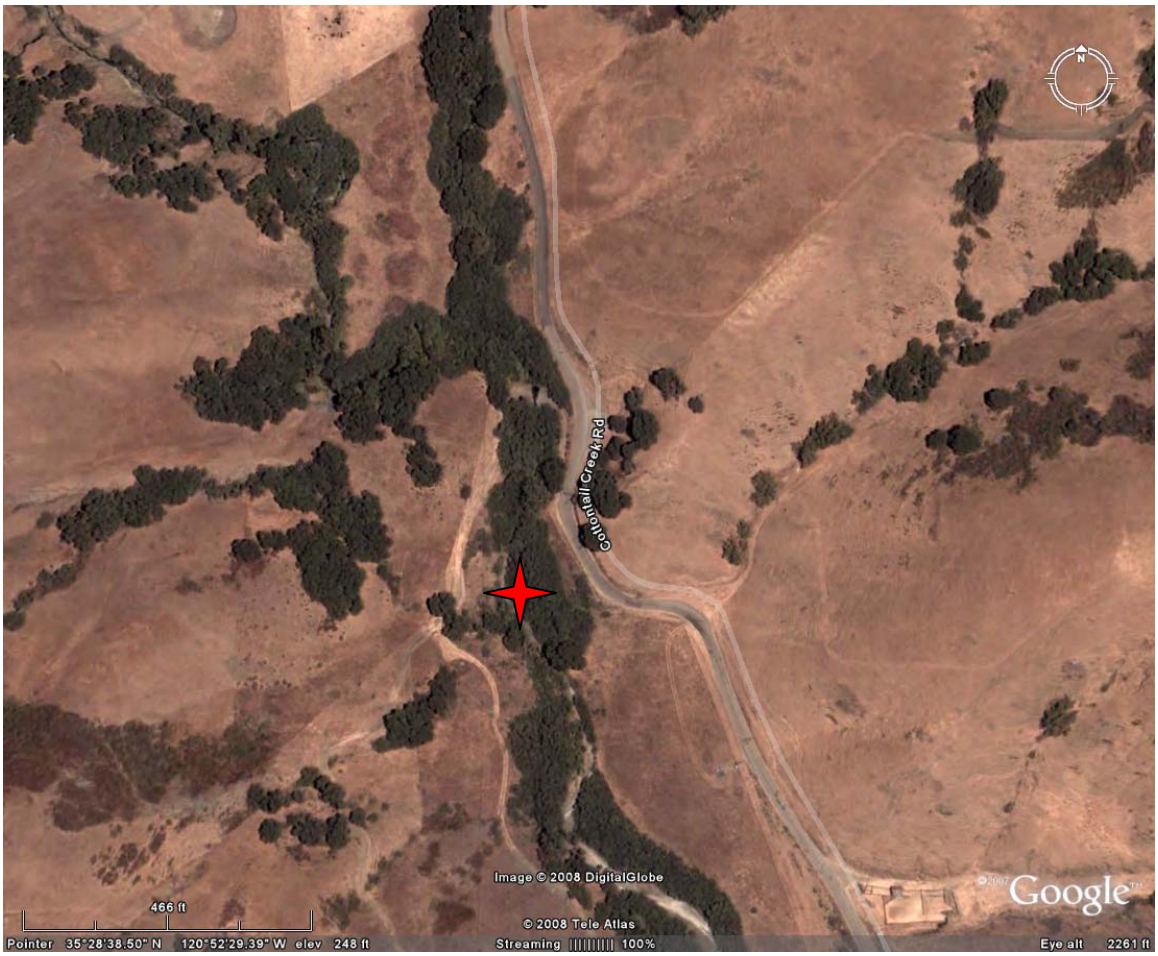


Figure I-7a. Sampling Site #4. Cottontail Creek, San Luis Obispo County, California (aerial view).

Figure I-7b. Sampling Site #4. Cottontail Creek, San Luis Obispo County, California (ground level view).

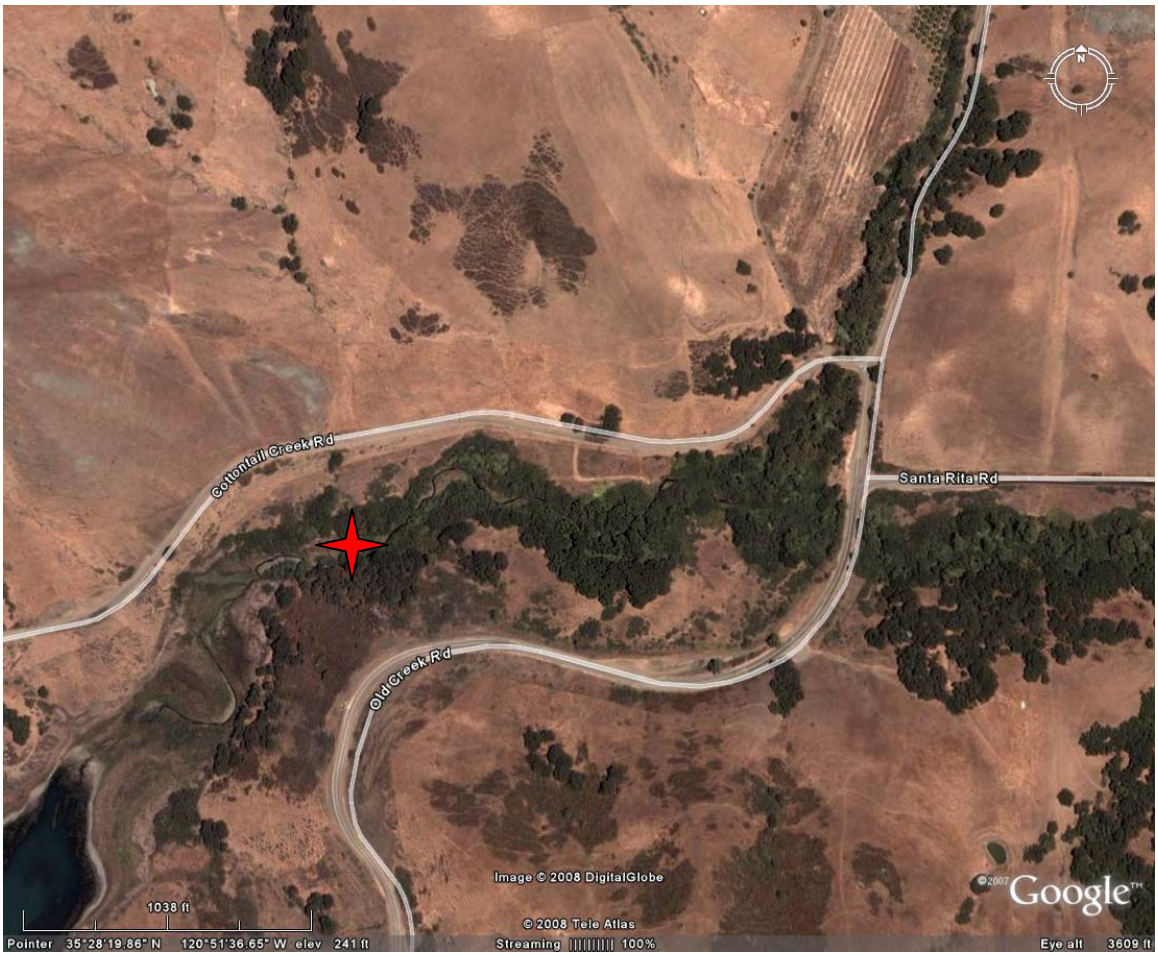


Figure I-8a. Sampling Site #5. Old Creek, San Luis Obispo County, California (aerial view).

Figure I-8b. Sampling Site #5. Old Creek, San Luis Obispo County, California (ground level view).

Appendix A-5

Figure I-9a. Sampling Site #6. Willow Creek, San Luis Obispo County, California (aerial view).

Figure I-9b. Sampling Site #6. Willow Creek, San Luis Obispo County, California (ground level view).

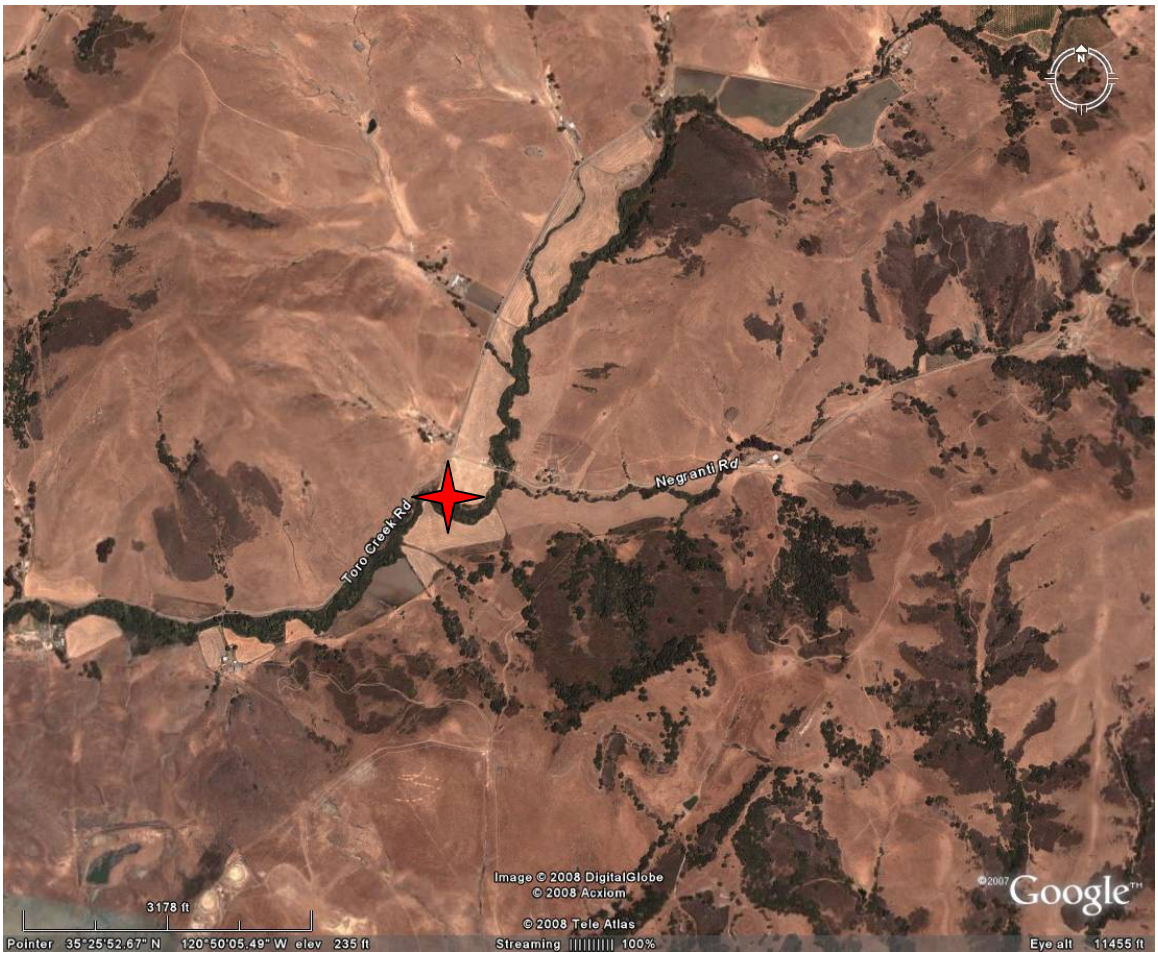


Figure I-10a. Sampling Site #7. Toro Creek, San Luis Obispo County, California (aerial view).

Figure I-10b. Sampling Site #7. Toro Creek, San Luis Obispo County, California (ground level view),

Figure I-11a. Sampling Sites #8 and #9. Pennington and Dairy Creeks, San Luis Obispo County, California (aerial view)

Figure I-11b. Sampling Sites #8 and #9. Pennington (left) and Dairy (right) Creeks, San Luis Obispo County, California (ground level view).

Figure I-12a. Sampling Site #10. Morro Creek, Morro Bay, California (aerial view).

Figure I-12b. Sampling Site #10. Morro Creek, Morro Bay, California (ground level view).

Figure I-13a. Sampling Site #11. See Canyon Creek, San Luis Obispo County, California (aerial view).

Figure I-13b. Sampling Site #11. See Canyon Creek, San Luis Obispo County, California (ground level view).

Appendix B
San Luis Obispo Riverine HGM Reference Site Data Sheets Used to Develop the Riverine Model

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 1 of 10

Site#:_____ Site Name:_____ Within Domain:_____(Yes/No) Date:_____
HGM Subclass:_____ Reference Class:_____(0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord:_____(Easting) _____(Northing) Photo Roll:_____ Photo Numbers:_____
Assessment Area Dimensions:_____(Width) _____(Length) Creek Order:_____ Team:_____

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

River Left Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1			
2			
3			
4			

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		
2		
3		
4		

Seedlings/Saplings

Quarter	Distance	Species
1		
2		
3		
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1		
2		
3		
4		

Coarse Wood (> 3' diameter at breast height)

Quarter	Distance	Length	Diameter
1			
2			
3			
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1			
2			
3			
4			

River Right Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1			
2			
3			
4			

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		
2		
3		
4		

Seedlings/Saplings

Quarter	Distance	Species
1		
2		
3		
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1		
2		
3		
4		

Coarse Wood (> 3' diameter at breast height)

Quarter	Distance	Length	Diameter
1			
2			
3			
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1			
2			
3			
4			

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	
Broadleaf Deciduous	
Needle Leaf	
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=sexual: 1=vegetative: 2=both)	
Trees	
Shrubs	
Vine	
Seedling	
Herbaceous	

Ferren, Fiedler & Leidy Classification - Palustrine

Ferren, Fiedler & Leidy Classification - Riverine

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#:_____ Site Name:_____ Team:_____ Date:_____

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem > 3" diamter at breast height)

Species	Cover Class Midpoint	Indigenous Status

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status

Vines

Species	Cover Class Midpoint	Indigenous Status

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status

Seedlings/Saplings

Species	Cover Class Midpoint	Indigenous Status

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature: 1=Agriculture: 2=Urban: 3=Other)

River Left Buffer

Sample	Width	Code	Description
1			
2			
3			
4			

River Right Buffer

Sample	Width	Code	Description
1			
2			
3			
4			

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)	1	2	3	4	5
	6	7	8	9	10

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#:_____ Site Name:_____ Within Domain:_____(Yes/No) Date:_____
HGM Subclass:_____ Reference Class:_____(0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord:_____(Easting) _____(Northing) Photo Roll:_____ Photo Numbers:_____
Assessment Area Dimensions:_____(Width) _____(Length) Creek Order:_____ Team:_____

CROSS-SECTION

Horizontal Dist (feet)	Elevation (feet)	Notes

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

Channel Width at OHW:	
Top of Bank to Top of Bank:	
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	
Assessment Area Length: (7 x OHW Width)	
Channel Depth at Thalweg: (Distance from Thalweg to OHW)	
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth)	
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	
Rosgen Classification:	

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radii: (X-Sectional Area/Wetted Perimeter)	

Notes:

Sketch Cross-Section

River Left **River Right**

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#:_____ Site Name:_____ Team:_____ Date:_____

LONGITUDINAL PROFILE

Total Length:	**Section Length:**
Channel Aspect:	**Channel Slope:**

Downstream Section - from X-Section to Downstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
+ 0.0		Channel Bed Elevation at X-Section
+		
+		
+		
+		
+		
+		

Upstream Section - from X-Section to Upstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
- 0.0		Channel Bed Elevation at X-Section
-		
-		
-		
-		
-		
-		

RESIDUAL POOLS

Sample Area: Active Channel within the Assessment Area

Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			

Total Pool Number:	**Average Pool to Pool Distance:**

Sketch the Creek Channel in Plan View

Downstream | **Cross-Section** | **Upstream**

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#:_____ Site Name:_____ Within Domain:_____(Yes/No) Date:_____
HGM Subclass:_____ Reference Class:_____(0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord:_____(Easting) _____(Northing) Photo Roll:_____ Photo Numbers:_____
Assessment Area Dimensions:_____(Width) _____(Length) Creek Order:_____ Team:_____

PEBBLE COUNT MEASUREMENTS

25																			
24																			
23																			
22																			
21																			
20																			
19																			
18																			
17																			
16																			
15																			
14																			
13																			
12																			
11																			
10																			
9																			
8																			
7																			
6																			
5																			
4																			
3																			
2																			
1																			
mm <=	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
phi	-1	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5	-7	-7.5	-8	-8.5	-9	-9.5	-10
%																			
cum.%																			

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#:_____ Site Name:_____ Team:_____ Date:_____

EMBEDDEDNESS FIGURE

IMMOBILE BED ROUGHNESS FIGURE

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#:_____ Site Name:_____ Within Domain:_____(Yes/No) Date:_____
HGM Subclass:_____ Reference Class:_____(0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord:_____(Easting) _____(Northing) Photo Roll:_____ Photo Numbers:_____
Assessment Area Dimensions:_____(Width) _____(Length) Creek Order:_____ Team:_____

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length
If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD
CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present:	Total number of FWD jams present:

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#:_____ Site Name:_____ Team:_____ Date:_____

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector

Downstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector

LAND USE WITHIN THE ASSESSMENT AREA

Adjacent Land Use (Within the Buffer)	Upstream	Downstream
(1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))		

Wetland Land Use (Below OHW Elevation)	Upstream	Downstream
(1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))		

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Average Overhang from OHW:	Average Overhang from OHW:
Average Percent Cover:	Average Percent Cover:
Describe Distribution:	Describe Distribution:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#:_____ Site Name:_____ Within Domain:_____(Yes/No) Date:_____
HGM Subclass:_____ Reference Class:_____(0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord:_____(Easting) _____(Northing) Photo Roll:_____ Photo Numbers:_____
Assessment Area Dimensions:_____(Width) _____(Length) Creek Order:_____ Team:_____

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks			
Trails (>4")			
Trails (< 4")			
Feeding Evidence			
Squirrel Middens			
Feathers			
Bird Nests			
Nesting Cavities			
Bedding			
Fur			
Scrapes, Rubs, etc.			
Browse			
Raptor Pellets			
Scat - Mammal			
Scat - Avian			
Calls - Mammal			
Calls - Avian			
Other (specify) -			

Additional Notes:

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location

Additional Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#:_____ Site Name:_____ Within Domain:_____(Yes/No) Date:_____
HGM Subclass:_____ Reference Class:_____(0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord:_____(Easting) _____(Northing) Photo Roll:_____ Photo Numbers:_____
Assessment Area Dimensions:_____(Width) _____(Length) Creek Order:_____ Team:_____

STREAM CHEMISTRY	GEOMORPHOLOGY		
Stream Temp. (F°)	Landform	Elev	Slope (RL)
Stream pH	Landfeature	Aspect	Slope (RR)
Electrical Conductivity ($uScm^{-1}$)	Position	Shape	Drainage Class

OBSERVATIONS			
Particle Size Class	Depth to Sat.(In)	Soil Temp (F°)	Area Floods?/Ponds? (circle)
Is This Soil Hydric? YES NO	Redox Depth (In)	Creek Bank and Side Slopes (%) RR	RL

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE				ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER	TEXTURE	GRAVEL (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	pH	OXIDIZED y/n	RHIZOSPH

Notes:

Appendix C
Reference Site Data Sheets

HGM Riverine Data Sheets
Site #1 – North Marsh, SLO Tank Farm
San Luis Obispo, California

Appendix C-1

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 1 of 10

Site#: 1 Site Name: North Marsh

HGM Subclass: Slope Within Domain: Yes (Yes/No) Date: 28.IV.08

UTM Cord: 10S 0471275 (Easting) 3910325 +/- 15 (Northing) Reference Class: 2 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: (Width) (Length) Photo Roll: N/A Photo Numbers: 535-546

Creek Order: N/A Team: Pulere (JP + BD), WSP

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

River Left Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1			
2			No trees
3			
4			

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		
2		No small trees
3		
4		

Seedlings/Saplings

Quarter	Distance	Species
1		
2		No saplings
3		
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1		
2		No shrubs
3		
4		

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1			
2			
3			
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1			
2			No snags
3			
4			

River Right Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1			
2			No trees
3			
4			

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		
2		No small trees
3		
4		

Seedlings/Saplings

Quarter	Distance	Species
1		
2		No seedlings/saplings
3		
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1		
2		No shrubs
3		
4		

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1			
2			None
3			
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1			
2			None
3			
4			

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	
Broadleaf Deciduous	
Needle Leaf	N/A
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=exoust: 1=vegetative: 2=both)

Trees	N/A
Shrubs	N/A
Vine	N/A
Seedling	N/A
Herbaceous	2

Ferren, Fiedler & Leidy Classification - Palustrine

Palustrine persistent emergent marsh (Bulrush Schoenoplectus acutus/californicus, Eleocharis acicularis)

Ferren, Fiedler & Leidy Classification - Riverine

N/A

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#: 1 Site Name: North Marsh Team: Jad ra (JP + BD) WSP (KK, SS, PLF) Date: 24.10.08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem ≥ 3" diameter at breast height)

Species	Cover Class Midpoint	Indigenous Status
None		

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
None		

Vines

Species	Cover Class Midpoint	Indigenous Status
None		

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Eleocharis macrostachya	90	N
Scirpus acutus	10	N
Heliotrophium curassavicum		
Distichlis spicata		
Juncus balticus	5	E
Veronica catenata	2	N
Cirsium vulgare	5	E
Plantago lanceolata	<2	E
Xanthium strumarium	2	E

Seedlings/Saplings

Species	Cover Class Midpoint	Indigenous Status
None		

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature; 1=Agriculture; 2=Urban; 3=Other)

River Left Buffer

Sample	Width	Code	Description
1	N/A		
2			
3			
4			

River Right Buffer

Sample	Width	Code	Description
1	N/A		
2			
3			
4			

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
6	7	8	9	10

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
N/A		

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
N/A		

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
N/A		

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
N/A		

Eleocharis macrostachya
Veronica catenata

* Notes: Measured OHW upstream of North Marsh - habitat area 1 elevation ~142'

OHW-OHW = 27 feet.

72' - Downstream of willow at road crossing culvert

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 1 Site Name: North Marsh Within Domain: Yes (Yes/No) Date: 4/28/08

HGM Subclass: Slope Reference Class: 2 (0=Reference Site:1=Reference Standard:2=Project Site)

UTM Cord: 10S 0712750 (Easting) 390 3025 ±15 (Northing) Photo Roll: Photo Numbers:

Assessment Area Dimensions: (Width) (Length) Creek Order: N/A Team: KK, DE, SS, BD, TP

CROSS-SECTION

Horizontal Dist (feet)	Elevation (feet)	Notes
0	0	No channel
128	0	
27	0	

94.5 CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

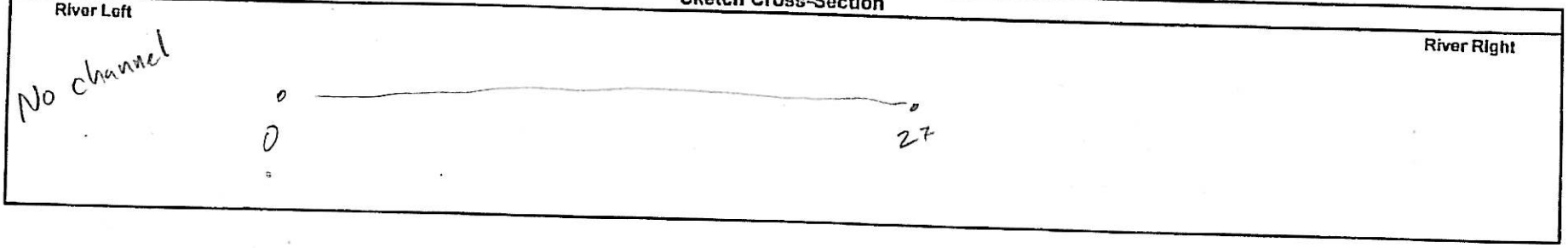
Channel Width at OHW: 27' at ohw reference ~~[illegible]~~	N/A
Top of Bank to Top of Bank:	N/A
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	
Assessment Area Length: (7 x OHW Width)	94.5'
Channel Depth at Thalweg: (Distance from Thalweg to OHW)	N/A
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth)	N/A
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	N/A
Rosgen Classification:	

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radii: (X-Sectional Area/Wetted Perimeter)	

Notes:

Sketch Cross-Section



patches of bulrush (S. acutus)

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 1 Site Name: North Marsh Team: A-team Date: 4/28/08

LONGITUDINAL PROFILE

Total Length:	Section Length:
Channel Aspect:	Channel Slope:

Downstream Section - from X-Section to Downstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
+ 0.0		Channel Bed Elevation at X-Section
+		
+	N/A	
+		
+		
+		
+		

Upstream Section - from X-Section to Upstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
- 0.0		Channel Bed Elevation at X-Section
-	N/A	
-		
-		
-		
-		
-		

RESIDUAL POOLS

NONE

Sample Area: Active Channel within the Assessment Area

Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
1			
2			
3			
4			
5			
6			
7	N/A		
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			

Total Pool Number:	Average Pool to Pool Distance:

Sketch the Creek Channel in Plan View

Downstream

N/A - no channel

Cross-Section

Upstream

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 1 Site Name: North Marsh Within Domain: Yes (Yes/No) Date: 4/28/08

HGM Subclass: slope Reference Class: 2 (0=Reference Site:1=Reference Standard:2=Project Site)

UTM Cord: 10S 0712750 (Easting) 3903025 ±15 (Northing) Photo Roll: Photo Numbers:

Assessment Area Dimensions: (Width) (Length) Creek Order: Team: A-team

PEBBLE COUNT MEASUREMENTS

25																			
24																			
23																			
22																			
21																			
20																			
19																			
18																			
17																			
16																			
15																			
14																			
13																			
12																			
11																			
10																			
9																			
8																			
7																			
6																			
5																			
4																			
3																			
2																			
1																			
mm <=	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
phi	-1	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5	-7	-7.5	-8	-8.5	-9	-9.5	-10
%	100%																		
cum.%																			

entirely silt < 2 mm

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 1 Site Name: North Marsh Team: A team Date: 4/28/08

EMBEDDEDNESS FIGURE

N/A

IMMOBILE BED ROUGHNESS FIGURE

N/A

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 1 Site Name: North Marsh
HGM Subclass: Slope Within Domain: Yes (Yes/No) Date: 4/28/08
UTM Cord: 10 S 0712750 (Easting) 3903025 ±15 (Northing) Reference Class: 2 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: Padre (JP+BD) | WSP (PLF, KK, SS)

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length

If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class
	None				None		

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD

CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class
	None				None		

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present: Ø	Total number of FWD jams present: Ø

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream
Ø	Ø

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

No coarse woody debris

No source of wood in area.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 1 Site Name: North Marsh Team: A-team Date: 4/28/08

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No 1=Yes(natural):2=Yes(artificial))	2
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	2 (CHANNEL SEDIMENTATION / ROAD CROSSING)

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	~~CULVERT~~
	- CULVERT UPSTREAM IN CHANNEL OF TANK FARM CREEK

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	N/A

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	NA

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
—	CATTLE GRAZING (HISTORIC)	- SURFACE RUN-OFF
VARIOUS	THROUGHOUT AREA	

Downstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	2
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe).2=Yes(artificial)(describe))	2 (TANK FARM ROAD CULVERTS)

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	- TANK FARM CULVERTS AND FILL MATERIAL

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NA

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	NA

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
—	CATTLE GRAZING (HISTORIC)	- SURFACE RUN-OFF
VARIOUS	THROUGHOUT AREA	

LAND USE WITHIN THE ASSESSMENT AREA

	Upstream	Downstream
Adjacent Land Use (Within the Buffer) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	4, 6	4, 6
Wetland Land Use (Below OHW Elevation) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	4, 6	4, 6

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Average Overhang from OHW: NA	Average Overhang from OHW:
Average Percent Cover:	Average Percent Cover:
Describe Distribution:	Describe Distribution:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 1 Site Name: NORTH MARSH
HGM Subclass: SLOPE Within Domain: YES (Yes/No) Date: 4/29/08
UTM Cord: 105 0712750 (Easting) 3903025 +/- 15' (Northing) Reference Class: 2 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: N/A Team: PAONE & WSP

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	YES	MULT.	DOMESTIC CATTLE / MULE DEER
Trails (>4")	YES	MULT.	" "
Trails (< 4")	YES	MULT.	MULE DEER
Feeding Evidence	YES	"	DOMESTIC CATTLE
Squirrel Middens	NO		
Feathers	NO		
Bird Nests	YES	MULT.	ACTIVE RED-WINGED BLACKBIRD NESTING @ SITE.
Nesting Cavities	NO		
Bedding	NO		
Fur	NO		
Scrapes, Rubs, etc.	NO		
Browse	NO		
Raptor Pellets	NO		
Scat - Mammal	YES	MULT.	MULE DEER / CATTLE
Scat - Avian	NO		
Calls - Mammal	NO		
Calls - Avian	YES		WESTERN MEADOWLARK / GRASSHOPPER / SONG SPARROW
Other (specify) -	—		

Additional Notes:

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
RED-WINGED BLACKBIRD	HH	BGD	W/IN ASSESSMENT AREA
BARN SWALLOW	1	BGD	"
MALLARD	1	"	"
CLIFF SWALLOW	1	"	"
EUROPEAN STARLING	1	"	"
WESTERN GULL	1	"	"
CRAYFISH (CAMBARUS SP.)	1	"	CARCASS IN ASSESSMENT AREA

Additional Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 1 Site Name: North Marsh
HGM Subclass: Within Domain: Yes (Yes/No) Date: 4/28/08
UTM Cord: 0712750 (Easting) 3903025±15 (Northing) Reference Class: (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: A - team

STREAM CHEMISTRY		GEOMORPHOLOGY			
Stream Temp. (F°)	NA	Landform	Filled flood plain	Elev	Slope (RL) —
Stream pH	NA	Landfeature	slope wetland	Aspect - Flat N/A	Slope (RR) —
Electrical Conductivity (uScm^{-1})	NA	Position	mid -	Shape - flat	Drainage Class

OBSERVATIONS					
Particle Size Class	clay	Depth to Sat.(In)	13"	Soil Temp	16°C (F°)
Is This Soil Hydric?	(YES) NO	Redox Depth (In)		Creek Bank and Side Slopes (%) RR	N/A 0 RL 0

Area Floods? (Ponds?) (circle)

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE			ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER	TEXTURE	GRAVEL (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	pH	OXIDIZED y/n	RHIZOSPH
A	0	27	10YR 2/1								0	0	0										
						1-2	2																

see OVER

Notes: 0-27 10YR 2/1 silt clay
a read of 10YR 7/6 mixed in to matrix of 10YR 2/1 clay
many fine roots to 10"
Disturbed soils - areas of 10YR 7/6 mixed in to matrix of clay 10YR 2/1
oil - black deposits appearing ~ > 10" → see reverse of page.
few small cobble < 1cm -

0-11. 10YR 2/1 many fine roots

Matrix 10YR 2/1

11-27 few ox. rhizospheres 10YR 5/6 " <2%

oil deposits ~2% concreted oil and adhered to peds

few small gravel <12 mm

HGM Riverine Data Sheets
Site #2 – East Branch, San Luis Obispo Creek
SLO Tank Farm
San Luis Obispo, California

Appendix C-13

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 1 of 10

Site#: 2 Site Name: East Branch SLO Creek
HGM Subclass: Within Domain: X (Yes/No) Date: 28.IV.08
UTM Cord: 105 0713628 (Easting) 3940270 (Northing) Reference Class: (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: NA Photo Numbers: 574 - 556
Creek Order: Team: Padre (JP + BD + WSP (KK, SS, MF)

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

River Left Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	30'	7", 11"	Juglans cal var hermsii
2	7'		Juglans cal hinzii
3	25'		Juglans cal. hinzii
4	—		none

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		none
2		
3		
4		

Seedlings/Saplings

Quarter	Distance	Species
1		none
2		
3		
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	30'	Salix lasiolepis
2		none
3	27.5'	Salix lasiolepis
4	9	Salix lasiolepis

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	—		none
2	33'	32"	4.5"
3	9'	6.2'	3.0"
4	—	—	none

Snags (Trees only)

Quarter	Distance	DBH	Height
1			none
2			none
3			none
4			none

River Right Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	27'	4	Eucalyptus globulus
2			None
3			None
4			None

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		None
2		
3		
4		

Seedlings/Saplings

Quarter	Distance	Species
1	2'	Quercus agrifolia
2		
3		
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	27'	Baccharis pilularis consim.
2	27'	Salix lasiolepis
3		None
4	10'6"	Salix lasiolepis

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	4'	30"	5"
2			None
3			None
4	29'6"	8'	4.5"

Snags (Trees only)

Quarter	Distance	DBH	Height
1			None
2			
3			
4			

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	
Broadleaf Deciduous	X
Needle Leaf	
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=sexual; 1=vegetative; 2=both)

Trees	0
Shrubs	2
Vine	0
Seedling	—
Herbaceous	0

Ferren, Fiedler & Leidy Classification - Palustrine

1) Palustrine broad-leaved deciduous forest (Salix)
2) Palustrine scrub-shrub broad-leaved deciduous shrubland (salix)

Ferren, Fiedler & Leidy Classification - Riverine

Riverine: mild perennial persistent emergent - critical - Juncus xiphioides

* Photos begin @ 514

Avena barbata
Hordeum murinum ssp leporinum
Carduus pycnocephalus

Silybum marianum

Geranium molle

<5% Geranium molle
<5% Dactylis glomerata
<5% Mentha pulegium

Plantago lanceolata <5%
Rumex crispus <5%
Xanthium strumarium <5%
Parkinsonia ursinus <5%

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#: 2 Site Name: East Broad - SLO Creek Team: Pedre (JP + BD); JOSP (SK, SS + PF) Date: 28.IV.08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem > 3" diameter at breast height)

Species	Cover Class Midpoint	Indigenous Status
Juglans californica	35	N

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis	30	40	N
Baccharis pilularis	<5	N

Vines

Species	Cover Class Midpoint	Indigenous Status
~~None~~		
Toxicodendron diversilobum	<2	N

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Artemesia douglasiana	20	N
Bromus diandrus	60	E
Avena barbata	60	E
Hordeum murinum leporinum	30	E
Phalaris aquatica	5	E
Carduus pycnocephalus	15	E
Silybum marianum	<5	E
Conium maculatum	5	E
Oxalis pes-caprae	<2	E
Brassica nigra	5	E
Typha latifolia	5	N
Lupinus succulentus	<5	N
Lotus corniculatus	<5	N
Picris echioides		

Seedlings w/Saplings

Species	Cover Class Midpoint	Indigenous Status

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Juglans californica	5	50

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
~~Eucalyptus globulus~~		
Eucalyptus globulus	0	0

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
Juglans californica	35'	32", 16.3"
		4", 12"
		9", 12.1"
		7", 4"

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
Eucalyptus globulus	30'	

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature: 1=Agriculture: 2=Urban: 3=Other)

River Left Buffer 38'

Sample	Width	Code	Description
1	6'	1	Corn field
2	20'5"	1	" "
3	20'7"	1	Corn field
4	49'	1	Corn

41'9"

River Right Buffer

Sample	Width	Code	Description
1	28'4"	1	cattle pasture
2	48'	1	" "
3	62'6"	1	" "
4	49'	1	cattle pasture

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
2 / 2	1 / 2	2 / 2	2 / 1	2 / 2
6	**7**	**8**	**9**	**10**
2 / 1	2 / 1	2 / 2	2 / 2	2 / 2

Festuca californica <2% N
Medicago polymorpha 10%
Vicia benghalensis <2%
Raphanus sativa <2% E
Melilotus officinalis (small fl.) <2%

Scirpus
Erodium cicutarium 15%
Foeniculum vulgare 2%
Sonchus asper <2%
Lolium multiflorum 25% E

Ambrosia psilostachya <2%
Bromus hordeaceus 60%
Lotus purshianus var. purshianus <2%
Juncus xiphoides 5% N
Eleocharis acicularis var. acicularis 5%

Cichorium intybus <2% E
Calystegia subacaulis episcopalis <2%
Bromus carinatus <2%

84 xer-j

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 2 Site Name: Project site SLO Creek - East Fork

HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/28/08

NAD83 UTM Cord: 10S 0713628 (Easting) 3902701 (Northing) Reference Class: 2 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers: Creek Order: Team: KK, PLF, SS, BD, JP

CROSS-SECTION

Horizontal Dist (feet)	Elevation (feet)	Notes
27	0	OHW Right bank
25	0	
23	15"	
21	20"	
16	25"	
14	30"	
13	3.9'	Edge of water
11	4.9'	
10	5.2'	Thalweg
9'	5'	
8'	4.95	
7'	5.05	
6'	5.0'	
5'	4.25	edge of water
4'	35"	
3'	19"	
0	0	OHW Left Bank

RF

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

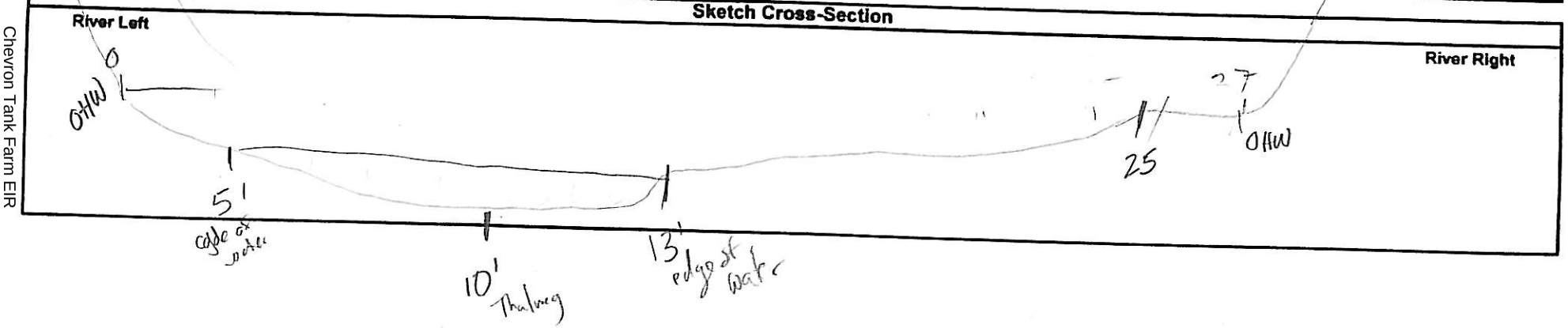
Channel Width at OHW:	27'
Top of Bank to Top of Bank:	61'
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	
Assessment Area Length: (7 x OHW Width)	168'
Channel Depth at Thalweg: (Distance from Thalweg to OHW)	1
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth)	48'
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	31.4"
Rosgen Classification:	

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radii: (X-Sectional Area/Wetted Perimeter)	

Notes: Top of bank is old oil berm. - not Natural bank

Sketch Cross-Section



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 2 Site Name: SLO Creek - East fork - Project site Team: KK, PLF, SS, BD, JP Date: 4/28/08

LONGITUDINAL PROFILE

Total Length: 225'	Section Length:
Channel Aspect:	Channel Slope:

Downstream Section - from X-Section to Downstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
0.0 1'	7.46	Channel Bed Elevation at X-Section
12'	7.13	break in slope - end of pool
32'	6.75	Middle of bulrush
55'	12.43	end of bulrush - middle of pool
75'	8.9'	
~~86~~		- could not get

Upstream Section - from X-Section to Upstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
0.0	7.46	Channel Bed Elevation at X-Section
70'	8.51	Bottom of Pool
890'	11.32	Pool-Top
126'	7.88	run above pool
150'	10.2	Pool - middle

RESIDUAL POOLS N/A

Sample Area: Active Channel within the Assessment Area

Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

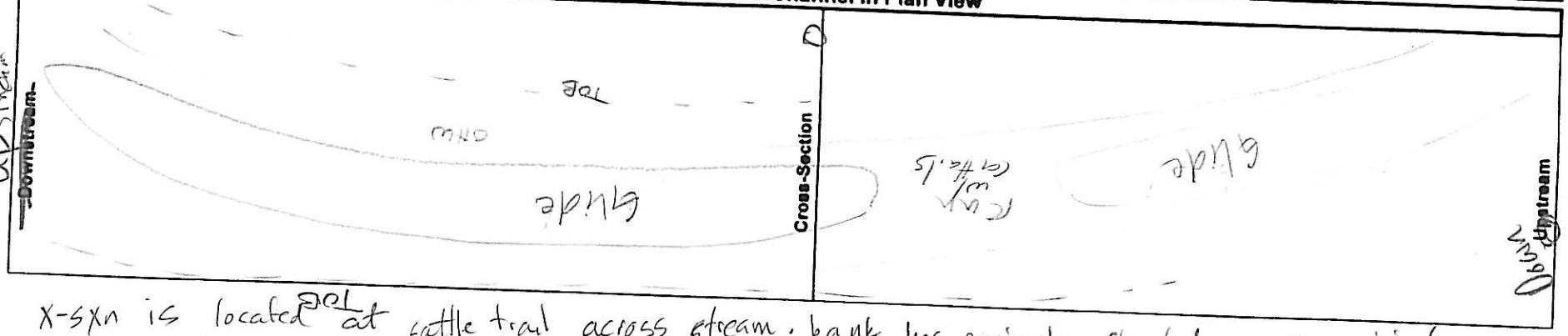
Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			

Total Pool Number: Average Pool to Pool Distance:

Sketch the Creek Channel in Plan View



X-sxn is located at cattle trail across stream. bank has previously slouched creating a high point. resulting in long profile

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 2 Site Name: SLO Creek - East fork

HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/28/08

UTM Cord: 0713628 (Easting) 3902701 (Northing) Reference Class: 2 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: (Width) (Length) Creek Order: Photo Roll: Photo Numbers:

Team: KK, JS

PEBBLE COUNT MEASUREMENTS

	mm <=	phi	%	cum.%
1	2	-1	16	16
2	3	-1.5	3	19
3	4	-2		
4	6	-2.5	6	25
5	8	-3	5	30
6	11	-3.5	12	42
7	16	-4	12	54
8	23	-4.5	20	74
9	32	-5	11	85
10	45	-5.5	11	96
11	64	-6	3	99
12	91	-6.5		
13	128	-7	1	100
14	181	-7.5		
15	256	-8		
16	362	-8.5		
17	512	-9		
18	724	-9.5		
19	1024	-10		
20				
21				
22				
23				
24				
25				

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 2 Site Name: East Fork SLO Creek Team: KK, SS, PF, JP Date: 4/28/08

EMBEDDEDNESS FIGURE

Two 16-32 mm are not embedded in sediment.

IMMOBILE BED ROUGHNESS FIGURE

No boulders

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1	16-23mm	0	
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: 0 (ft^2) Roughness % (BA/CSA):

Notes: No boulders.

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes: No boulders

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 2 Site Name: SLO Creek - East Fork

HGM Subclass: _____ Within Domain: Yes (Yes/No) Date: 4/28/08

UTM Cord: _____ (Easting) _____ (Northing) Reference Class: 2 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: _____ (Width) _____ (Length) Photo Roll: _____ Photo Numbers: _____

Creek Order: _____ Team: _____

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length

If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class
4"	11'	20'7"	2	9"	32'	32'	2

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD

CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class
Ø				10'	4'	40 sf	2
				13'	8'	104 sf	2

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present: Ø	Total number of FWD jams present: III

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream
II	II

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

- VERY FEW CWD IN CHANNEL;
- FINE WOODY DEBRIS LIMITED TO DOWNSTREAM AREA.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 2 Site Name: SLO Creek - East Fork Team: KK, SS, PLF (WSP); NP + BD (Parsons) Date: 4/28/08

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	2 - Yes
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	0 No
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	0 No

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	Possible - R/D basins @ airport across Santa Fe road discharge into SLO Creek / Need to look @ map O (A)

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	None

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
None	

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
	Cattle grazing - immediate watershed	overland flow

Downstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	2 - Yes
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	0 - No
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe).2=Yes(artificial)(describe))	No - 0

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
RL	Airport culvert

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	None

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	None

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
1	Cattle grazing - most of immediate watershed	overland flow

LAND USE WITHIN THE ASSESSMENT AREA

Adjacent Land Use (Within the Buffer) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	4	4

Wetland Land Use (Below OHW Elevation) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	4	4

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Average Overhang from OHW: No —	Average Overhang from OHW: No —
Average Percent Cover: 20%	Average Percent Cover: 50%
Describe Distribution: Concentrated in isolated or small groupings of trees (sycamores) 0 1 2 3	Describe Distribution: Scattered clumps of small willows 0 1 2 3

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 2 Site Name: SLO CREEK - EAST FORK
HGM Subclass: RIVERINE Within Domain: YES (Yes/No) Date: 4/28/09
UTM Cord: 105 071 3620 (Easting) 3902701 (NAD 83) (Northing) Reference Class: 2 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers: Creek Order: Team:

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	✓	MULT.	DOMESTIC CATTLE
Trails (>4")	✓	MULT.	" "
Trails (< 4")	✓	"	BLACK-TAILED DEER
Feeding Evidence	✓	"	BLACK-TAILED DEER / GREY FOX
Squirrel Middens	✓	MULT.	CALIF. GROUND SQUIRREL
Feathers	—		
Bird Nests	—		
Nesting Cavities	—		
Bedding	—		
Fur	✓	1	REMNANTS OF CA. GROUND SQUIRREL
Scrapes, Rubs, etc.	—		
Browse	✓	1	EVIDENCE OF DEER BROWSE ON WILLOW SAPLING
Raptor Pellets	—		
Scat - Mammal	YES ✓	1	BLACK-TAILED DEER
Scat - Avian	✓	1	GREAT-HORNED OWL
Calls - Mammal	—		
Calls - Avian	YES ✓	HH HI	MULTIPLE CALLS (SEE OBSERVATIONS)
Other (specify) -			

Additional Notes:
— APPEAR THAT GREY FOX OR OTHER SMALL CARNIVOROUS MAMMAL (i.e. BADGER) EXCAVATED NUMEROUS GROUND SQUIRREL DENS; REMAINS OF ONE SQUIRREL @ SITE OF EXCAVATION(S). (LEFT BANK / TOP).

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
KILLDEER	1	BGD	- EAST OF CREEK
HOUSE FINCH	1	"	- W/ RIPARIAN CORRIDOR
NORTHERN MOCKINGBIRD	1	"	W/IN RIPARIAN CORRIDOR
SW POND TURTLE	1	"	- IN CHANNEL
GREAT-HORNED OWL	1	"	W/IN RIPARIAN CORRIDOR
SONG SPARROW	1	"	" " "
CLIFF SWALLOW	1	"	OBSERVED IN FLIGHT OVER AREA
LESSER GOLDFINCH	1	"	- VOCALIZATION IN CREEK
RED-WINGED BLACKBIRD	1	"	- CREEK CORRIDOR
WESTERN FENCE LIZARD	1	"	- RT. BANK
3-SPINED STICKLE BACK	1	"	- IN-STREAM

Additional Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 2 Site Name: SLO Creek - East fork
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/28/08
Reference Class: 2 (0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord: 6713628 (Easting) 3902701 (Northing) Photo Roll: Photo Numbers:
Assessment Area Dimensions: (Width) (Length) Creek Order: Team: KK, SS

STREAM CHEMISTRY		GEOMORPHOLOGY			
Stream Temp. (F°)	15°C	Landform	alluvial fan	Elev ~ 115'	Slope (RL)
Stream pH	–	Landfeature	Perennial Creek	Aspect East-west bank	Slope (RR)
Electrical Conductivity (uScm^{-1})	–	Position	Mid-perennial	Shape	Drainage Class

OBSERVATIONS			
Particle Size Class	Depth to Sat.(In) >28"	Soil Temp (10") 16°C (E°)	Area Floods?/Ponds? (circle)
Is This Soil Hydric? (YES) NO	Redox Depth (In) Start ~5"	Creek Bank and Side Slopes (%) RR 42%	RL 37%

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE				ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER	TEXTURE	GRAVEL (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	PH	OXIDIZED RHIZOSPH y/n
A	0	10	10YR 4/2		ox. & conc.	1 mm	5	7.5YR 5/8		silty sand								X	X	No	X	
B	10	18.	10YR 7/6							silty clay				Strong AB						No	—	

Notes: 0-10 10YR 4/2 with few ox. rhizospheres at 7.5YR 5/8 silty sand Many fine-coarse roots and concentration
10-28" 10YR 7/6 with 7.5YR 5/8 areas - silty clay strong angular blocky, some medium roots-old. lined with reduced rhizosphere. 7.5YR 5/1

HGM Riverine Data Sheets
Site #3 – San Luis Obispo Creek at
San Luis Obispo Mission
San Luis Obispo, California

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 1 of 10

Site#: 3 Site Name: SLO Creek - Mission.
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/28/08
UTM Cord: 10S 0712410 (Easting) 3906555 ± 31 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers: 544 - 535
Creek Order: Team: A-Team

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

River Left Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1		(*)	Ulmus parvifolia
2			Juglans californica
3			Brilla ~~[illegible]~~ pendula
4			

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		Myoporum laetum
2		
3		
4		

Seedlings/Saplings

Quarter	Distance	Species
1		Juglans californica
2		
3		
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1		Berberis (common & ornamental)
2		Cotoneaster pannosa
3		~~[illegible]~~
4		

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1			
2			
3			None
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1			
2			
3			None
4			

River Right Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	14'	5"	~~Eucalyptus~~ Pinus radiata
2	14'	39" (?)	~~Populus trichocarpa~~
3	4.5'	7.5"	Ficus carica (edible) [illegible]
4	—	—	Platanus racemosa

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		
2		
3		
4		

Seedlings/Saplings

Quarter	Distance	Species
1		Ficus carica
2		Platanus racemosa
3		
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	4'	~~Heteromeles arbutifolia~~ Baccharis pilularis
2	7'	Pyracantha coccinea
3	10'	Pyracantha coccinea
4		

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1			
2			
3			None
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1			
2			
3			None
4			

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	✓ 50%
Broadleaf Deciduous	✓ 50%
Needle Leaf	
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=sexual; 1=vegetative; 2=both)	
Trees	0
Shrubs	0
Vine	2
Seedling	—
Herbaceous	0

Ferren, Fiedler & Leidy Classification - Palustrine

[illegible] N/A

Ferren, Fiedler & Leidy Classification - Riverine

~~N/A~~

Riverine upper perennial unvegetated cobble-gravel

(*) Cannot estimate date - steep bank alongside downtown restaurant.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#: 3 Site Name: SLO Creek Mission Team: Parks (LP + BD) ; WSP (SS, KK + PE) Date: 28.IV.08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem ≥ 3" diameter at breast height)

Species	Cover Class Midpoint	Indigenous Status
Quercus agrifolia	38	N
Juglans Californica	20.5	N
Betula ~~[illegible]~~ pendula	10.5	E(O)
Ficus carica	10.5	E(O)
Pinus radiata	3	N(O)
Platanus racemosa	10.5	N

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
Hypericum perforatum	3	E(O)
Berberis	3	E(O)
Cotoneaster pannosa	10.5	E(O)
Heteromeles arbutifolia	10.5	N
Myrcanthus erythrophylla	10.5	E(O)

Vines

Species	Cover Class Midpoint	Indigenous Status
Ipomea cult. purpurea	3	E(O)
Vinca major	10.5	E(O)
Hedera helix	20.5	E(O)

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Pintathemum multiaccle	3	E
Pennisetum clandestinum	10.5	E
Cyperus sp. ~~[illegible]~~	10.5	E
Mentha (Spearmint)	3	E
Acanthus	10.5	E(O)
Athyrium elatum	Ø	E(O)
Scirpus microcarpus	3	N
Hoita	3	N
Centranthus ruber	3	E(O)
Xanthium strumarium	3	E
Dietes (S Africa)	3	E(O)
? (S. Africa/Australia) like	Ø	E(O)
Oxalis pes-caprae	10.5	E

Seedlings w/Saplings

Species	Cover Class Midpoint	Indigenous Status
Quercus agrifolia	Ø	N
Platanus racemosa	3	N
Pinus sp.	Ø	N

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Quercus agrifolia	1	10
Betula duroica	2	20
Juglans Californica	3	50

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Platanus racemosa	11	20

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
Ficus carica	~~75(30)~~	
Quercus agrifolia	65	
Betula europea	60	
Juglans	45	

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
Platanus racemosa	100	
Pinus radiata	45	
Ficus carica	25(30)	

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature: 1=Agriculture: 2=Urban: 3=Other)

River Left Buffer

Sample	Width	Code	Description
1		2	Restaurant
2		2	↓
3		2	↓
4		2	↓

River Right Buffer

Sample	Width	Code	Description
1	50+41	2	City Park
2	34.5	2	↓
3	34	2	↓
4	310	2	↓

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
2 / 1	3 / 2	3 / 1	2 / 2	1 / 2

6	7	8	9	10
2 / 2	1 / 1	2 / 1	2 / 1	2 / 1

Shrubs

Genista monspeliana Ø (E)
Baccharis pilularis 3 (N)
Malva nicaea (?) Ø (E(O))
Rhamnus California 3 (N)(O)

Herbs: Malva parviflora 3 (E)
Sonchus oleraceus 3 (E)
Euphorbia peplus 3 (E)
Medicago polymorpha 3 (E)
Rorippa dicaena 10.5 (E)
Veronica anagallis-aquatica Ø (E)
Plantago major Ø (E)
Helenium puberulum Ø (N)
Tanacetum parthenium 3 (E)
Cardamine oligosperma Ø (N)
Sisyrinchium Ø (E)
Rumex ? pulcher Ø

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 3 Site Name: SLO Creek - Mission
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/28/08
UTM Cord: 0712410 (Easting) 3906555 ±31' (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: A-team

CROSS-SECTION

Horizontal Dist (feet)	Elevation (feet)	Notes
~~0~~ 0	4"	OHW
2'	4"	
4'	3.5"	- Thalweg
6'	3.8"	
8'	3.6"	
10'	~~0.25~~ 2"	
12'	2"	OHW
14'	0.5"	
16'	0.9"	
18	1"	
19	0"	

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

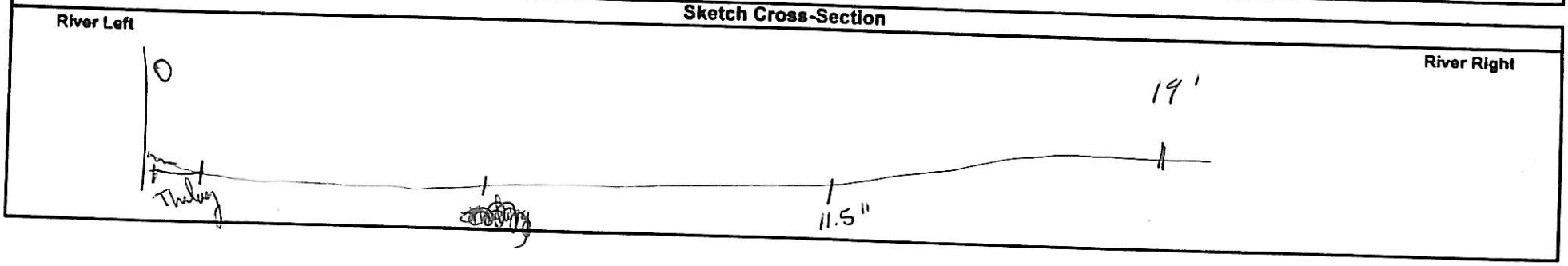
Channel Width at OHW:	19'
Top of Bank to Top of Bank:	N/A
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	
Assessment Area Length: (7 x OHW Width)	66.5 x 2 = 137'
Channel Depth at Thalweg: (Distance from Thalweg to OHW)	4"
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth) 8"	29.5'
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	19'
Rosgen Classification:	

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radii: (X-Sectional Area/Wetted Perimeter)	

Notes: Concrete channel - manufactured pools

Sketch Cross-Section



49.8
79

50
79
129

30
16
180
300
480

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 3 Site Name: SLO Creek - Mission Team: A - team Date: 4/28/08

LONGITUDINAL PROFILE

Total Length: 129	**Section Length:**
Channel Aspect: Channel → South	**Channel Slope:**

Downstream Section - from X-Section to Downstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
+ 0.0'	5.9	Channel Bed Elevation at X-Section
+ 10'	6.28	run
+ 22'	6.34	run
+ 37'	6.4	run
+ 49'	6.63	
+ 63'	6.75	behind a boulder
+ 79'	6.57	top of riffle

Upstream Section - from X-Section to Upstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
- 0.0		Channel Bed Elevation at X-Section
- 7.7'	5.91'	mid pool
- 20'	6.35'	0.85'
- 31'	7.4'	mid pool 1.92'
- 49.8	4.9	top of riffle.
-		
-		

RESIDUAL POOLS

Sample Area: Active Channel within the Assessment Area

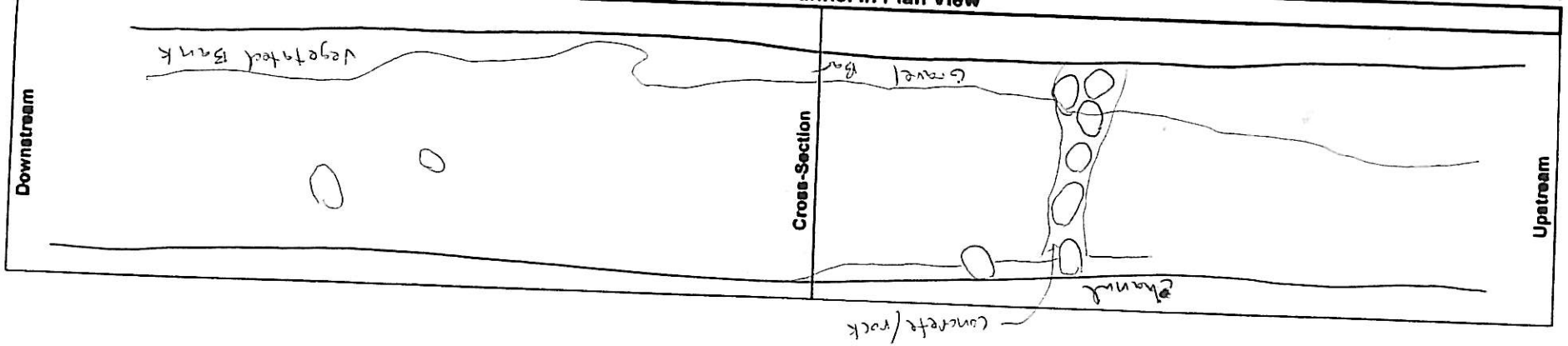
Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
1	1.92'	30 x 16 = 480	111 ft upstream
2			111 ft
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			
Total Pool Number:		Average Pool to Pool Distance:	

Sketch the Creek Channel in Plan View



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 3 Site Name: SLO Creek Mission
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/28/08
UTM Cord: 0712410 (Easting) 3906555 ± 31 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: A-team

PEBBLE COUNT MEASUREMENTS

25																			
24																			
23																			
22																			
21																			
20																			
19									X										
18									X										
17									X										
16									X										
15									X										
14									X										
13									X		X								
12									X	X	X								
11									X	X	X								
10									X	X	X								
9									X	X	X								
8								X	X	X	X	X	X						
7								X	X	X	X	X	X						
6							X	X	X	X	X	X	X						
5	X			X			X	X	X	X	X	X	X						
4	X			X			X	X	X	X	X	X	X						
3	X			X		X	X	X	X	X	X	X	X						
2	X	X		X		X	X	X	X	X	X	X	X						
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
mm <=	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
phi	-1	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5	-7	-7.5	-8	-8.5	-9	-9.5	-10
%	5	2	1	5	1	3	7	9	20	13	14	9	9	2					
cum.%	5	7	8	13	14	17	24	33	53	66	80	89	98	100					

32

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 3 Site Name: SLO Creek Team: A-team Date: 4/28/08

EMBEDDEDNESS FIGURE

Not embedded.

IMMOBILE BED ROUGHNESS FIGURE

D84 = 91 mm

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram 23-32 mm = mode

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width: 19 Channel Depth: 9.25' Ave. Channel Depth:

Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1	16" (1.3)	3" (.25)	0.33	6			
Not embedd 2	5" (.42)	3.5" (.29)	0.12	7			
3	5.5" (.46)	1.5" (.13)	0.06	8			
4	10" (.83)	5 (.42)	0.35	9			
5				10			

Cross-Section Area: (ft²) Boulder Area: (ft²) Roughness % (BA/CSA):

Notes:

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width: 19' Channel Depth: 5.5' Ave. Channel Depth:

Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1	8.5" (.71)	2.5" (.21)	0.15	6	7"	3"	21
2	5.5" (.46)	4.4" (.37)	0.17	7			
3	7" (.58)	4" (.33)	0.19	8			
4	6" (.5)	12" (1)	0.15	9			
5	8" (.67)	25" (2.08)	1.39	10			

Cross-Section Area: (ft²) Boulder Area: (ft²) Roughness % (BA/CSA):

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 3 Site Name: SLO Creek - Mission
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/28/08
UTM Cord: 0712410 (Easting) 3906555 ±31' (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: A-team

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length
If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD
CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present:	Total number of FWD jams present:

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

No wood present in channel w/in the assessment area

Appendix C-31

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 3 Site Name: SAN LUIS OBISPO CREEK – MISSION SITE Team: WSP / PASRE Date: 4/28/09

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	2
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	0

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
RL	MULTIPLE SUB-SURFACE LANDSCAPE DRAINS AND ONE CULVERT FROM ADJ. RESTAURANT.
RR	ONE SUBSURFACE DRAIN FROM LANDSCAPE (4" DRAIN)

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE KNOWN

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	N/A

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
	NONE WITHIN IMMEDIATE	
	ASSESSMENT AREA	

Downstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe).2=Yes(artificial)(describe))	

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
RR	6" CULVERT / PVC PIPE (DRAIN FROM MISSION AREA)

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE KNOWN

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	N/A

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
600 sf	PEDESTRIAN TRAIL / ERODED	– SURFACE RUN-OFF DURING STORM EVENTS

LAND USE WITHIN THE ASSESSMENT AREA

Adjacent Land Use (Within the Buffer) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	5, 6	5, 6
Wetland Land Use (Below OHW Elevation) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	6	6

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Average Overhang from OHW:	Average Overhang from OHW:
Average Percent Cover: 20%	Average Percent Cover: 50%
Describe Distribution: COMPRISED OF TVGLANS CALIFORNICA.	Describe Distribution: QUERCUS agrifolia (20%), PLATANUS (20%) ORNAMENTAL (10%)

Appendix C.32

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 3 Site Name: SAN LUIS OBISPO CREEK – MISSION SITE
HGM Subclass: _____ Within Domain: YES (Yes/No) Date: 4/29/08
UTM Cord: _____ (Easting) _____ (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: _____ (Width) _____ (Length) Photo Roll: _____ Photo Numbers: _____
Creek Order: _____ Team: _____

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	No		
Trails (>4")	No		
Trails (< 4")	No		
Feeding Evidence	No		
Squirrel Middens	No		
Feathers	No		
Bird Nests	No		
Nesting Cavities	No		
Bedding	No		
Fur	No		
Scrapes, Rubs, etc.	No		
Browse	No		
Raptor Pellets	No		
Scat - Mammal	No		
Scat - Avian	No		
Calls - Mammal	No		
Calls - Avian	III		BLACK-HEADED GROSBEAK, HOUSE FINCH, ETC. (MULTIPLE)
Other (specify) -	—		

Additional Notes:

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
ROCK DOVE	II	BGD	W/IN STREAM CHANNEL OR RIP. CANOPY
BREWER'S BLACKBIRD	III	↓	↓
ANNA'S HUMMINGBIRD	I	↓	↓
BLACK PHOEBE	I	↓	↓
STEELHEAD (YOUNG-OF-YEAR)	NUMEROUS	↓	↓
3-SPINE STICKLEBACK	II	↓	↓
HOUSE SPARROW	I	↓	↓
~~HOUSE~~ PACIFIC-SLOPE FLYCATCHER	I	↓	↓

Additional Notes:
* STEELHEAD YOUNG-OF-YEAR (YOY) PERSISTING IN POOLS & RUNS THROUGHOUT ASSESSMENT AREA (≈ 100).

Chevron San Luis Obispo Tank Farm

N/A - channelized.

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 3 Site Name: SLO Creek - Mission
HGM Subclass: Riverine Within Domain:_____(Yes/No) Date:_____
UTM Cord: 0712410 (Easting) 3906555 ±31' (Northing) Reference Class:_____(0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions:_____(Width) _____(Length) Photo Roll:_____ Photo Numbers:_____
Creek Order:_____ Team:_____

STREAM CHEMISTRY		GEOMORPHOLOGY			
Stream Temp. (F°) 15°C		Landform Dissected Alluvial Fan	Elev	Slope (RL) 90°	
Stream pH		Landfeature Stream	Aspect N-S	Slope (RR) 34°	
Electrical Conductivity (uScm^{-1})		Position	Shape	Drainage Class	

OBSERVATIONS			
Particle Size Class	Depth to Sat.(In)	Soil Temp (F°)	Area Floods?/Ponds? (circle)
Is This Soil Hydric? YES NO	Redox Depth (In)	Creek Bank and Side Slopes (%) RR	RL

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE				ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER	TEXTURE	GRAVEL (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	pH	OXIDIZED y/n	RHIZOSPH

Notes:

HGM Riverine Data Sheets
Site #4 – Cottontail Creek
San Luis Obispo County, California

Appendix C-35

080 8.31

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community

Site#: 6 Site Name: Cottontail Creek

HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/29/08

NAD83 UTM Cord: 10S 0692865 (Easting) 3927809 ±49.2' (Northing) Reference Class: O (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: 54' (Width) 378' (Length) Photo Roll: Photo Numbers: Creek Order: Team: Padre (BD, JP) WSP (KK, SS, PF)

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

River Left Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	7'	5.1"	Salix lasiolepis
2	10'	6"	Salix lasiolepis
3	3'	9"	Salix lasiolepis
4	10'	6"	Salix lasiolepis

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	—	—
2	4'	Salix lasiolepis
3	15'	Salix lasiolepis
4	—	—

Seedlings/Saplings

Quarter	Distance	Species
1	—	—
2	—	—
3	—	—
4	15'	Salix lasiolepis

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	—	—
2	—	—
3	—	—
4	—	—

None

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	6'	12'	3.25"
2	3'	3.5'	3"
3	6'	30'	6"
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1	15'	4"	15'
2	—	—	
3	—	—	
4	5'	5"	25'

River Right Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	6'	3.5"	Salix laevigata
2	25'	12"	Quercus agrifolia
3	12'	10"	Quercus agrifolia
4	None		

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	—	—
2	—	—
3	—	—
4	8'	Salix lasiolepis

Seedlings/Saplings

Quarter	Distance	Species
1	—	—
2	3'	Salix lasiolepis
3	—	—
4	—	—

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	10'	Baccharis pilularis var. consia
2	0.5'	Toxicodendron diversilobum
3	1'	Toxicodendron diversilobum
4	2'	Toxicodendron diversilobum

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	6'	45'	3.5"
2	10'	15'	3"
3	—	—	—
4	—	—	—

Snags (Trees only)

Quarter	Distance	DBH	Height
1	—	—	—
2	—	—	—
3	—	—	—
4	—	—	—

None

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	✓
Broadleaf Deciduous	✓
Needle Leaf	
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=absent; 1=vegetative; 2=both)

Trees	2
Shrubs	2
Vine	2
Seedling	2
Herbaceous	2

Ferren, Fiedler & Leidy Classification - Palustrine

(1) Palustrine, channel bank, evergreen forest (Quercus agrifolia)

(2) Palustrine, channel bank broadleaf deciduous forest (Platanus, Salix laevigata)

(3) Palustrine, channel bank broadleaf deciduous scrub-shrub (Salix lasiolepis)

Ferren, Fiedler & Leidy Classification - Riverine

(1) Riverine, upper-intermittent floating aquatic (algae)

(2) Riverine, upper intermittent rooted aquatic (mixed vascular: Rorippa, Veronica, Agrostis, Rumex)

Appendix C-36

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#: 6 Site Name: Cottontail Creek Team: Padre (JP, BD) WSP (RF, SS, KK) Date: 4/29/08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem ≥ 3" diamter at breast height)

Species	Cover Class Midpoint	Indigenous Status
Plantanus racemosa	10.5	N
Quercus agrifolia	38	N
Salix laevigata	38	N
Salix lasiolepis	10.5	N

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis	63	N
Heteromeles arbutifolia	3	N
Rubus ursinus	20.5	N
Baccharis pilularis consid.	3	N

Vines

Species	Cover Class Midpoint	Indigenous Status
Toxicodendron diversilobum	85.5	N
Rubus ursinus	20.5	N

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Rumex pulchra	3	E
Cirsium vulgare	3	E
Juncus xiphioides	10.5	N
Scirpus microcarpus	0	N
Urtica dioica	20.5	N
Scrophularia californica	3	N
Helenium puberulum	3	N
Polypodium californicum	3	N
Bromus diandrus	10.5	E
Aristis viridis	10.5	E
Symphorocarpus mollis mollis	10.5	N
Picris echioides	38	E
Eriogonum parvifolium?	3	N

Seedlings w/Saplings

Species	Cover Class Midpoint	Indigenous Status
Platanus racemosa	10.5	N
Quercus agrifolia	3	N
Salix laevigata	10.5	N

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Salix lasiolepis	||||| (6)	60

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Salix lasiolepis	II	20
Salix laevigata	I	10
Quercus agrifolia	III	30

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
Platanus racemosa	30-40'	
Salix laevigata	20-45'	

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
Quercus agrifolia	60-80'	mature
Salix laevigata	20-45'	

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature: 1=Agriculture: 2=Urban: 3=Other)

River Left Buffer

Sample	Width	Code	Description
1	50'	1	Sig. evidence of
2	↓		cattle grazing in
3	↓		riparian zone
4	↓		

River Right Buffer

Sample	Width	Code	Description
1	75'	3	term. @ road;
2	↓		steep riverbank
3	↓		
4	↓		

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
2/2	2/2	3/2	2/3	2/2
6	**7**	**8**	**9**	**10**
3/1	3/3	3/3	2/3	1/2

Leymus condensatus 3 N
Holistoma auritum var. auritum 0 N
Stachys bullata 3% N
Juncus effusus? 3% N
Eschscholzia californica 3% N
Collinsia heterophylla 3% N
Claytonia perfoliata 3% N
Sonchus oleraceus 10.5% E

Juncus patens 3 E
Sonchus asper 10.5 E
Geranium molle 0 E
Gnaphalium sp. 3 N
Carduus pycnocephalus 10.5 E
Rorippa nasturium-aquaticum 3% N
Veronica anagallis-aquatica 0 E
Euphorbia peplus 10.5% E
Solanum douglasii 20.5 N

Rumex salicifolia 3 E
Helenium 3 E
Brassica tournifii 3 E
Calyptriche 0 N
Artemisia douglasiana 10.5
Schoenoplectus californica 10.5 N
Verbena lasiostachya 3 N
Hordeum marinum gussmicanum 3 E
Brassica nigra 3 E
Conium maculatum 3 E

line w/multi sap — 3 N
Solepidaceae?

6.29
3.4

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 6 Site Name: Cottontail Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/29/08
UTM Cord: 0692863 (Easting) 3927811 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: KK-SS

CROSS-SECTION

Horizontal Dist (feet)	Elevation (feet)	Notes
0	3.4'	OHW RB
4.5	5.9'	
6.2'	6.10	→ Edge of water
7'	6.29	Thalweg
15'	6.04'	
21'	6.09'	water edge
30'	5.92'	
33'	5.46'	
37.5'	5.78'	
42.5'	5.25	Sand bar under willow
52'	4.7'	
54'	3.3'	OHW LB

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

Channel Width at OHW:	54'
Top of Bank to Top of Bank:	
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	—
Assessment Area Length: (7 x OHW Width) 189 x 2	378'
Channel Depth at Thalweg: (Distance from Thalweg to OHW) 2.2" drop.	2.8
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth)	101'
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	
Rosgen Classification:	

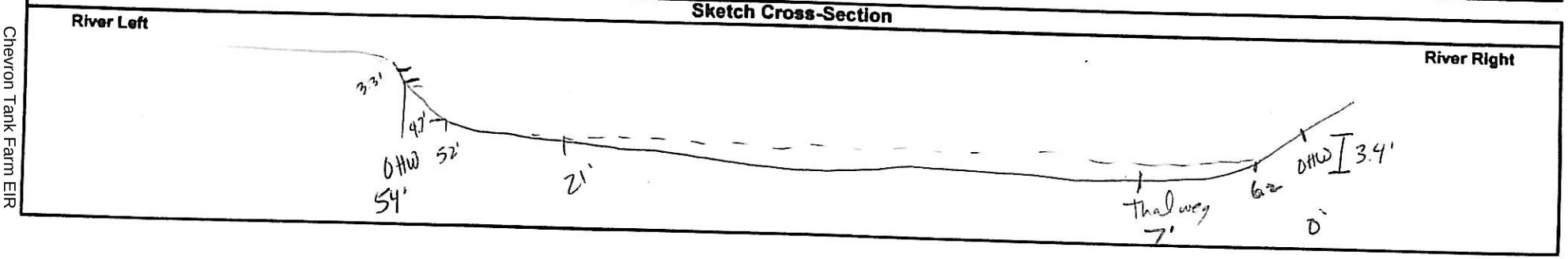
~60' calculate from cross-section

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radil: (X-Sectional Area/Wetted Perimeter)	

Notes:

Sketch Cross-Section



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 6 Site Name: Cottontail Creek Team: A-team KK-SS Date: 4/29/08

LONGITUDINAL PROFILE

Total Length: 378	Section Length:
Channel Aspect:	Channel Slope:

Downstream Section - from X-Section to Downstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
+ 0.0	6.29	Channel Bed Elevation at X-Section
+ 25'	6.6'	
+ 55'	6.65'	
+ 83'	6.67	
+ 105'	6.67	
+ 126'	7.04	
+ 150'	7.41	riffle

7.91' pool

Upstream Section - from X-Section to Upstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
- 0.0	6.29	Channel Bed Elevation at X-Section
- 35'	6.01'	glide
- 68'	5.95'	glide
- 99'	6.49	pool/glide
- 134'	6.26	pool
- 161'	6.48	pool
- 189'	6.32	

water depth 0.23'

water depth 0.69' 186'

water depth 0.29' 0.41' 0.73' 0.51 0.70 0.59

RESIDUAL POOLS

Sample Area: Active Channel within the Assessment Area

Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

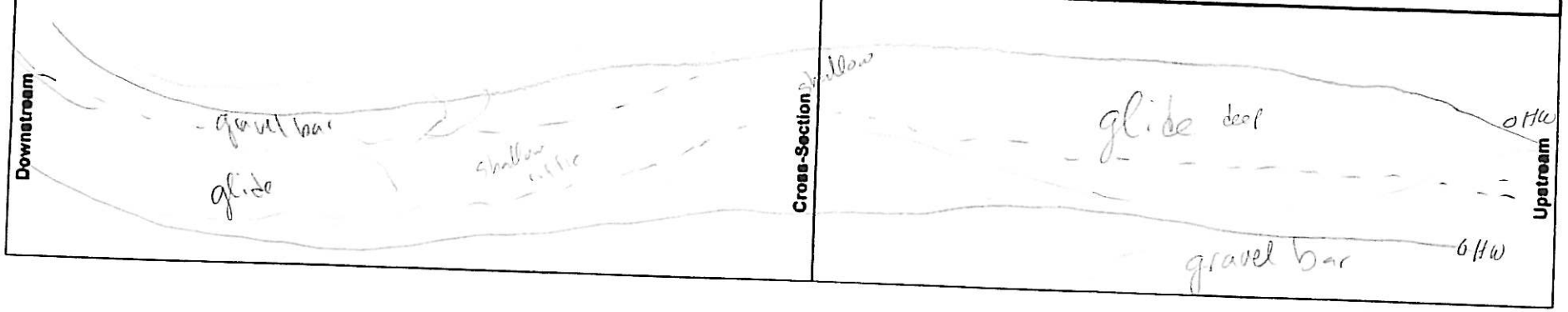
Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
1	No Pools		
2			
3	All glide and		a riffle
4	at	downstream	
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			

Total Pool Number: Average Pool to Pool Distance:

Sketch the Creek Channel in Plan View



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 6 Site Name: Cottontail Creek

HGM Subclass: Riverine Within Domain: _____ (Yes/No) Date: 4/29/08

UTM Cord: 0692863 (Easting) 3927811 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: (Width) (Length) Creek Order: Photo Roll: _____ Photo Numbers: _____

Team: A-team - SS-KK

PEBBLE COUNT MEASUREMENTS

25								X											
24								X											
23								X											
22								X											
21								X											
20								X											
19								X											
18								X											
17								X											
16								X											
15							X	X											
14							X	X		X									
13							X	X		X									
12							X	X		X									
11							X	X	X	X									
10							X	X	X	X									
9					X	X	X	X	X	X									
8					X	X	X	X	X	X									
7					X	X	X	X	X	X									
6					X	X	X	X	X	X									
5					X	X	X	X	X	X	X								
4	X				X	X	X	X	X	X	X								
3	X				X	X	X	X	X	X	X								
2	X			X	X	X	X	X	X	X	X	X	X						
1	X			X	X	X	X	X	X	X	X	X	X						
mm <=	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
phi	-1	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5	-7	-7.5	-8	-8.5	-9	-9.5	-10
%	4			2	9	9	15	26	11	14	5	3	3						
cum.%	4			6	15	24	39	65	76	90	95	98	101						

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 6 Site Name: Cottontail Creek Team: A-Kim-SS-KK Date: 4/29/08

EMBEDDEDNESS FIGURE

All mobile bed except for a few larger boulders - upstream from X-SXN

IMMOBILE BED ROUGHNESS FIGURE

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1			
2			
3			
4	All mobile bed.		
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1	NONE			6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes: No boulders here on the upstream x-sxn.

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1	0.9'	0.75'	0.68	6			
2	2.8'	1'	2.8 sq ft	7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes: 2 boulders

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 6 Site Name: Cottonwood Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 04/29/08
UTM Cord: 10S 0692863 (Easting) 3927811 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: 54' (Width) 237.4' (Length) Photo Roll: Photo Numbers:
Creek Order: Team: WSP / Roque

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length
If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class
6"	11'	11'	2	3"	27'	30'	2
				3"	21'	21'	2

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD
CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class
NONE				NONE			

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present: ~~IIII~~ III	Total number of FWD jams present: ~~IIII~~ III

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream
8	4

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:
- MINIMAL CWD IN CHANNEL

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 6 Site Name: Cottonwood Creek Team: WSP / Padre Date: 04/29/08

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

	Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	0	
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 — Connection where Rock Rds.	
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	2 — Dam @ Where Rock Rds.	

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type	RL or RR	Type
RR	Several small surface seeps		NA

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type	RL or RR	Type
	NA		NA

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type	RL or RR	Type
	None known @ Site		None known @ Site

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector	Source Area (sq. ft.)	Description of Source Area	Transport Vector
+/- 1,000 sf	Cattle trails adj. to assessment area	— Surface run-off during storm events	± 1,000 sf	Cattle trails adjacent to area	— Surface run-off during storm events

LAND USE WITHIN THE ASSESSMENT AREA

	Upstream	Downstream
Adjacent Land Use (Within the Buffer) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))	4 (cattle)	4 (cattle)
Wetland Land Use (Below OHW Elevation) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	4 (cattle)	4 (cattle)

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
~~Average Overhang from OHW:~~	~~Average Overhang from OHW:~~
Average Percent Cover: 30%	Average Percent Cover: 30%
Describe Distribution: — Salix sp. (10%), Quercus agrifolia (15%), Platanus racemosa (5%)	Describe Distribution: — Salix sp. (25%), Platanus racemosa (5%)

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 6 Site Name: COTTONTAIL CREEK
HGM Subclass: RIVERINE Within Domain: YES (Yes/No) Date: 4/29/08
UTM Cord: 10S 0692863 (Easting) 3927911 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: 54' (Width) 237.4' (Length) Photo Roll: Photo Numbers:
Creek Order: Team: WSP / PADRE

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	YES	MULT.	MULE DEER
Trails (>4")	YES	MULT.	DOMESTIC CATTLE
Trails (< 4")	YES	1	MULE DEER
Feeding Evidence	YES	1	MULE DEER REMAINS
Squirrel Middens	NO	—	
Feathers	NO	—	
Bird Nests	POSSIBLE	1	RT. BANK & LEFT BANK (GROSBEAKS)
Nesting Cavities	YES	MULT.	MULT. W/IN OAK TREES ON BANKS
Bedding	NO	—	
Fur	NO	—	
Scrapes, Rubs, etc.	NO	—	
Browse	NO	—	
Raptor Pellets	NO	—	
Scat - Mammal	YES	1	- COYOTE
Scat - Avian	NO	—	
Calls - Mammal	NO	—	
Calls - Avian	YES	III	- BLACK-HEADED GROSBEAK, SPOTTED TOWHEE, MOURNING DOVE, NUTTAL'S WOODPECKER
Other (specify) -	AVIAN-CALLS	(CONT'D)	HOUSE FINCH, ANNA'S HUMMINGBIRD, FOXY SPARROW, WESTERN GOLDFINCH
			ACORN WP, CALIF. THRASHER

Additional Notes:

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
BULLFROG (JUVENILE)	1	ALL	UPSTREAM SITE
MULE DEER	1	BGD	"
PACIFIC CHORUS FROG (TADPOLES)	MULT.	↓	THROUGHOUT STREAM
CALIF. TOWHEE	1	↓	UPSTREAM SITE
TURKEY VULTURE	11	↓	"
SCRUB JAY	1	↓	"
BLACK-HEADED GROSBEAK	IIII	↓	"
UNIDENTIFIED SMALL FISH	MULT.	↓	THROUGHOUT
PACIFIC SLOPE FLYCATCHER	1	↓	UPSTREAM
WESTERN FENCE LIZARD	III	BGD / PF	UPSTREAM
CALIF. TOWHEE	1	BGD	UPSTREAM
RAUCH-WINGED SWIFT	IIII	BGD	UPSTREAM
RED-TAILED HAWK	1	BGD	UPSTREAM
PACIFIC CHORUS FROG	1 (ADULT)	BGD	DOWNSTREAM
ASH-THROATED FLY-CATCHER	1	BGD	DOWNSTREAM

Additional Notes:

54
3.5
270
1820
189.0
189
378.

NAD83

13/8/21

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 6 Site Name: Cottontail Creek Within Domain: Yes (Yes/No) Date: 4/29/08
HGM Subclass: Riverine Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord: 10S 0692863 (Easting) 3927811 ± 49.2' (Northing) Photo Roll: Photo Numbers:
Assessment Area Dimensions: (Width) (Length) Creek Order: Team: A-team

STREAM CHEMISTRY		GEOMORPHOLOGY			
Stream Temp. (C)	16.7° C	Landform	Coast range - rivervalley	Elev	Slope (RL) 20%
Stream pH	8.31	Landfeature	river valley	Aspect 120° → Downstream	Slope (RR) 65%
Electrical Conductivity (uScm^{-1})	880 uS/cm	Position	U	Shape	Drainage Class

OBSERVATIONS					
Particle Size Class	fine sand	Depth to Sat.(In)	N/A	Soil Temp	13° C
Is This Soil Hydric?	YES (NO)	Redox Depth (In)	21	Area Floods?/Ponds? (circle)	at high flows
				Creek Bank and Side Slopes (%) RR	40% RL 5%

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE				ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER	TEXTURE	GRAVEL (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	pH	OXIDIZED RHIZOSPH y/n
A	0	21	10YR 3/3				0	—	silty	sand	0	0	0	SAB		—	few	some		N		N
B	21	30'	10YR 4/2		conc.	10-15	25%	10YR 5/6	clay	loam	0	0	0	SAB			—	—	—	N		N

Notes:
Uplands

HGM Riverine Data Sheets
Site #5 – Old Creek
San Luis Obispo County, California

31
3.5
155
93
108.5

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 1 of 10

Site#: #7 Site Name: Old Creek
HGM Subclass: _____ Within Domain: Yes (Yes/No) Date: 29.IV.08
UTM Cord: 10S 9694004 (Easting) 3927488 +/- 36.5 (Northing) Reference Class: _____ (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: _____ (Width) _____ (Length) Photo Roll: _____ Photo Numbers: Padre Canyon
Creek Order: _____ Team: _____

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

#7 plot center in old River channel 1st terrace

forest infested w/ Cape Ivy

River Left Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	12'	5.2"	Salix laevigata
2	14'	4.6"	Salix laevigata
3	16'	9.8"	Salix laevigata
4	10'	6.5"	Platanus racemosa

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	9.6'	Platanus racemosa
2	34'	Platanus racemosa
3	—	—
4	16'	Platanus racemosa

Seedlings/Saplings

Quarter	Distance	Species
1	11.5'	Platanus racemosa
2	—	—
3	—	—
4	13'	Platanus

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	—	—
2	—	—
3	—	—
4	11'	Salix lasiolepis

Coarse Wood (> 3' diameter at breast height)

Quarter	Distance	Length	Diameter
1	—	—	—
2	—	—	—
3	11'	25'	3.0"
4	15'	5.6'	3"

Snags (Trees only)

Quarter	Distance	DBH	Height
1	—	—	—
2	13'	3"	20'
3	—	—	—
4	—	—	—

River Right Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	—	—	None
2	—	—	"
3	16'	8.6"	Salix laevigata
4	17'	9"	Salix laevigata

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	—	None
2	—	"
3	13	Platanus racemosa
4	10.5	Platanus racemosa

Seedlings/Saplings

Quarter	Distance	Species
1	—	None
2	—	None
3	5.5'	Platanus racemosa
4	15'	Platanus racemosa

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	—	None
2	—	None
3	5'	Baccharis pilularis
4	11'	Baccharis pilularis

Coarse Wood (> 3' diameter at breast height)

Quarter	Distance	Length	Diameter
1	—		None
2	—		
3			"
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1	—	—	None
2	—	—	"
3	—	—	"
4	10.5'	5.8	Salix laevigata 35'

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	
Broadleaf Deciduous	✓
Needle Leaf	
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=sexual; 1=vegetative; 2=both)	
Trees	2
Shrubs	2
Vine	2
Seedling	2
Herbaceous	0

Ferren, Fiedler & Leidy Classification - Palustrine

1) Palustrine, broadleaf deciduous, River terrace forest, mixed vascular (Salix-Platanus)
2) Palustrine, broadleaf deciduous, River terrace scrub-shrub (Salix lasiolepis)

Ferren, Fiedler & Leidy Classification - Riverine

1) Riverine, upper-intermittent (vegetated) floating aquatic (algae)

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community

Site#: 7 Site Name: Old Creek Team: WSP (KK, SS, PF) Padre (JP, BD) Date: 4/29/08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem ≥ 3" diameter at breast height)

Species	Cover Class Midpoint	Indigenous Status
Platanus racemosa	20.5	N
Salix laevigata	63	N
Juglans californica	10.5	N

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis	103	N
Baccharis pilularis	10.5	N
Rubus ursinus	38	N
Cornus ~~stolonifera~~ sericea	3	N
Mimulus aurantiacus	10.5	N

Vines

Species	Cover Class Midpoint	Indigenous Status
Delairea (Senecio)		
Delarpa odorata (milkweed)	85.5	E

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Conyza canadensis	20.5	N
Gnaphalium luteo-album	20.5	E
Picris echioides	10.5	E
Cirsium vulgare	20.5	E
Medicago polymorpha	3	E
Equisetum arvense	20.5	N
Scirpus microcarpus	10.5	N
Verbena lasiostachya	20.5	N
Juncus xiphioides	10.5	E
Carium niaculatum	10.5	E
Rumex salicifolium	10.5	E
Juncus	10.5	N
Stachys bullata	10.5	N

Seedlings/Saplings

Species	Cover Class Midpoint	Indigenous Status
Platanus racemosa	10.5	N
Salix laevigata	10.5	N

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Salix laevigata	11	70
Platanus racemosa	0	0

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Salix laevigata	111	130

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
Salix laevigata	40-50'	
Platanus racemosa	25-30'	

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
Salix laevigata	40-50'	
Platanus racemosa	25-30'	

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature: 1=Agriculture: 2=Urban: 3=Other)

River Left Buffer

Sample	Width	Code	Description
1	25'	0	beyond 25'=Cape Ivy
2			infestation diff. to
3			assess accuracy of
4			riparian width

River Right Buffer

Sample	Width	Code	Description
1	75'	0	grassy shrubland
2			
3			
4			

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
2 / 2	2 / 3	2 / 2	2 / 2	2 / 1
6	**7**	**8**	**9**	**10**
3 / 3	2 / 3	2 / 3	3 / 2	2 / 2

Bromus catharticus 3 E
Schoenoplectus 3 N
Carex sp. 3 N
grass (very large) 3 N
Bromus 3 E
Arundo
Arundo donax 3 E
Brassica tournefortii 10.5 E
Sonchus asper 10.5 E
Schoenoplectus californica 10.5 N
Anagallis arvensis 3 E
Rumex pulcher 10.5 N
Cyperus eragrostis 10.5 N
Sonchus oleraceus 3 E
Isolepis (Scirpus) 0 N
Agrostis viridis 3 E
Ambrosia psilostachya 3 N
?Vicia 3 E?
? Melilotus sp. 10.5 E
Helenium puberula 10.5 N
Euphorbia lathyris 10.5 E
Equisetum telmateia 10.5 N
Geranium dissectum 3 E
Geranium molle 3 E
Plantago major 10.5 E
Solanum douglasii 10.5 N
Phalaris aquatica 10.5 E
Clematis longistylis 0 E
celery (cilantro-like) 3 E
Mimulus cardinalis 0 N
Bromus diandrus 3 E
Scrophularia californica 3 E
Brassica nigra 10.5 E
Euphorbia peplus 10.5 E
Epilobium ciliatum 10.5 E
Rorippa nasturtium-aquatica 3 N
Lolium multiflorum 3 E
Artemisia douglasiana 10.5 N
Hoita orbicularis 3 N

6.05
8.8

8.8
6.

31
15
155
310
5

108.5
108.5
217.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 7 Site Name: Old Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/29/08
105 UTM Cord: 0694004 (Easting) 3927488 ±36.5 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site) Photo Roll: Photo Numbers:
Assessment Area Dimensions: (Width) (Length) Creek Order: Team: KK, SS

CROSS-SECTION

Horizontal Dist (feet)	Elevation (feet)	Notes
0	6.11'	OHW left bank
7'	7.43	
7.2'	7.85	top of bank
8.7'	8.6'	edge of water - bottom of slope
13'	8.8'	depth water 0.22' Thalweg
17'	8.6'	edge of water R Bank - bottom of slope
19'	7.92'	Top of bank
24.8'	7.67'	break in slope ↑
26'	7.01	top of slope
31'	6.0'	OHW. Right bank

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

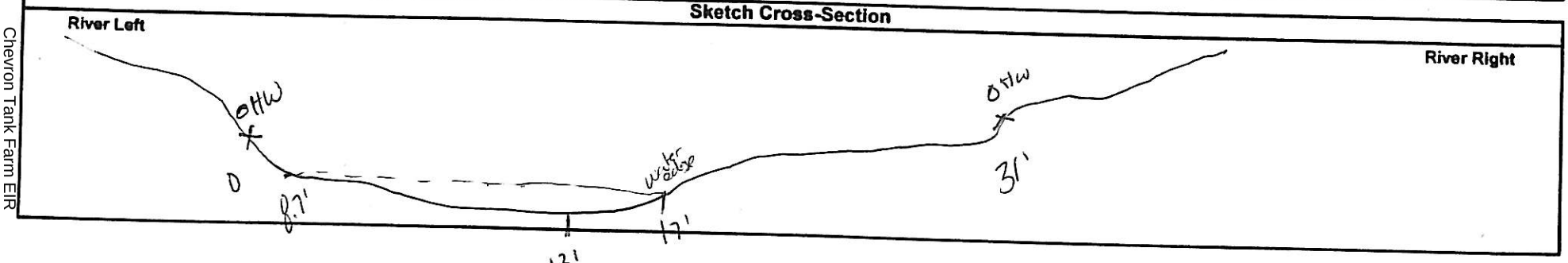
Channel Width at OHW:	31'
Top of Bank to Top of Bank:	
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	—
Assessment Area Length: (7 x OHW Width) 108.5	217
Channel Depth at Thalweg: (Distance from Thalweg to OHW)	measure (2.6') - (2.75) = subtract
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth)	67'
Wetted Perimeter: (Channel Bed Length from OHW to OHW) Calculate it	
Rosgen Classification:	

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radii: (X-Sectional Area/Wetted Perimeter)	

Notes:

Sketch Cross-Section



2.75
2

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 7 Site Name: Old Creek Team: A-team KK.SS Date: 4/29/08

LONGITUDINAL PROFILE

Total Length:	Section Length:
Channel Aspect:	Channel Slope:

Downstream Section - from X-Section to Downstream AA Boundary

Water Depth.	Dist from X-Sec (feet)	Elevation (feet)	Notes
	+ 0.0	8.8'	Channel Bed Elevation at X-Section
0.22	+ 31'	9.15'	glide
0.24'	+ 65'	9.31'	
0.20'	+ 90.5'	9.9'	
0.51'	+ 114'	9.89'	
0.38'	+		
	+		

Upstream Section - from X-Section to Upstream AA Boundary

	Dist from X-Sec (feet)	Elevation (feet)	Notes
	- 0.0	8.8'	Channel Bed Elevation at X-Section
0.22'	- 22'	8.71'	glide
0.33	- 51'	8.5'	
0.32	- 80'	8.32'	
0.3	- 107'	8.39'	
0.44	-		
	-		

RESIDUAL POOLS

Sample Area: Active Channel within the Assessment Area

Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

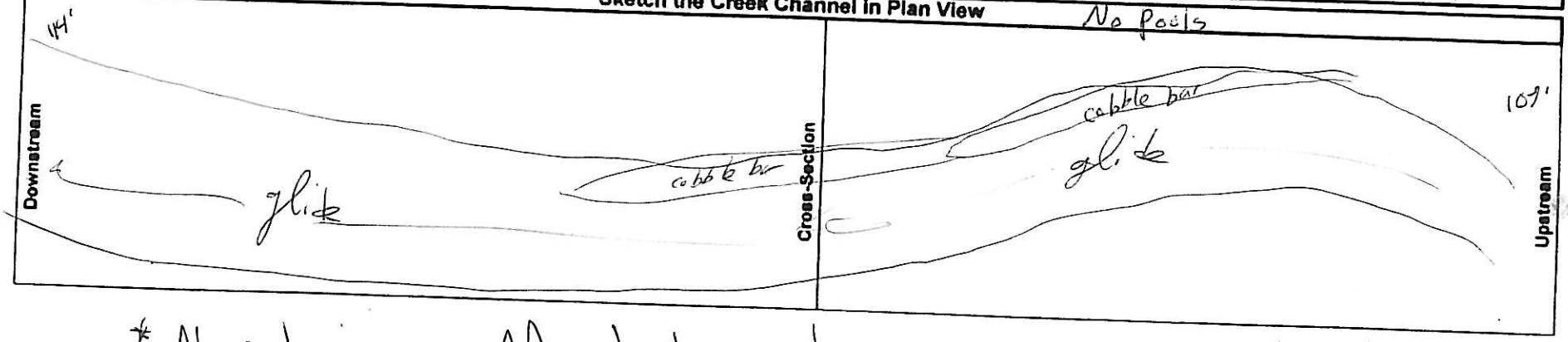
Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
1	No pools in reach - but see Note below*		
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			
Total Pool Number:		Average Pool to Pool Distance:	

Sketch the Creek Channel in Plan View

No Pools



* No pools in our AA - but upstream ≈ 110' from xsxn is bottom of a pool.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 7 Site Name: Old Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/29/08
UTM Cord: 0694004 (Easting) 3927488 I365 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Creek Order: Photo Roll: Photo Numbers:
Team: A-team - Kt-SS.

PEBBLE COUNT MEASUREMENTS

25																			
24																			
23																			
22																			
21									X										
20									X										
19									X										
18									X										
17									X										
16									X										
15									X										
14	X								X										
13	X	X					X	X	X										
12							X	X	X										
11	X						X	X	X										
10	X						X	X	X										
9	X						X	X	X		X								
8	X						X	X	X		X								
7	X						X	X	X		X	X							
6	X						X	X	X	X	X	X							
5	X				X	X	X	X	X	X	X	X							
4	X			X	X	X	X	X	X	X	X	X	X						
3	X			X	X	X	X	X	X	X	X	X	X						
2	X			X	X	X	X	X	X	X	X	X	X						
1	X	X		X	X	X	X	X	X	X	X	X	X	X					
mm <=	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
phi	-1	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5	-7	-7.5	-8	-8.5	-9	-9.5	-10
%	11	1	0	4	5	5	13	13	21	6	9	7	4	1					
cum.%	11	12	12	16	21	26	39	52	73	79	88	95	99	100					

12
11
D50
D84

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 7 Site Name: Old Creek Team: A-team KK-SS Date: 4/29/08

EMBEDDEDNESS FIGURE

All is Mobile

IMMOBILE BED ROUGHNESS FIGURE

No boulders.

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
23			
24			
25			

Blank

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 7 Site Name: OLD CREEK
HGM Subclass: RIVERINE Within Domain: Yes (Yes/No) Date: 04/29/08
UTM Cord: (Easting) (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: 31' (Width) 108.5' (Length) Photo Roll: Photo Numbers:
Creek Order: Team: WFP/PASTE

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length
If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class
3"	32'	32'	2	4"	22'	26'	2
				3"	9.3	12.8'	2

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD
CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class
NONE							

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present: IIII II	Total number of FWD jams present: IIII IIII

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream
> 50 trees	> 50 trees

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 7 Site Name: OLD CREEK Team: WSP / PADRE Date: 04/29/09

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	0
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 – CONNECTION TO WHALE ROCK
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	2 – DAM OF WHALE ROCK RES.

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
NONE	

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
NONE KNOWN	

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
NONE KNOWN	

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
NONE	SITE APPEARS STABLE	Ø CATTLE GRAZING

Downstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	0
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 – CONNECTION TO WHALE ROCK
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	2 – DAM OF WHALE ROCK RES.

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
NONE	

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
NONE KNOWN	

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
NONE KNOWN	

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
NONE	SITE APPEARS STABLE	Ø CATTLE GRAZING

LAND USE WITHIN THE ASSESSMENT AREA

Adjacent Land Use (Within the Buffer) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	1, 8 (ROADWAY)	1, 8 (WHALE ROCK RESERVOIR)
Wetland Land Use (Below OHW Elevation) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))	**Upstream**	**Downstream**
	1	1

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
~~Average Overhang from OHW:~~	~~Average Overhang from OHW:~~
Average Percent Cover: 15%	Average Percent Cover: 30%
Describe Distribution:	Describe Distribution:
SALIX SP. (12.5%), PLATANUS RACEMOSA (2.5%)	SALIX SP. (20%), PLATANUS RACEMOSA (10%)

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 7 Site Name: OLD CREEK

HGM Subclass: RIVERINE Within Domain: YES (Yes/No) Date: 04/29/08

UTM Cord: (Easting) (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: 31' (Width) 108.5' (Length) Photo Roll: Photo Numbers: Creek Order: Team: WSP/PADRE

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	YES	1	MULE DEER
Trails (>4")	YES	1	" "
Trails (< 4")	NO	—	
Feeding Evidence	NO	—	
Squirrel Middens	NO	—	
Feathers	YES	11	TURKEY VULTURE
Bird Nests	YES	MULT.	NESTING ACTIVITY OB
Nesting Cavities	YES	MULT.	
Bedding	NO	—	
Fur	NO	—	
Scrapes, Rubs, etc.	NO	—	
Browse	NO	—	PREFERRED EXISTING W/IN VICINITY
Raptor Pellets	NO	—	OF ASSESSMENT AREA; BUT NOT
Scat - Mammal	NO	—	OBSERVED DURING SURVEY.
Scat - Avian	NO	—	
Calls - Mammal	NO	—	
Calls - Avian	YES	(MULT.)	- PAC. SLOPE FLYCATCHER, LESSER GOLDFINCH SONG SPARROW, BLACK-HEADED GROSBEAK WREN-WIT.
Other (specify) -			

Additional Notes:

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
BUSHTITS	NUMEROUS	BGO	UPSTREAM AREA
ANNA'S HUMMINGBIRD	11	↓	↓
PAC. CHORUS FROG (TADPOLES)	NUMEROUS	↓	↓
SCRUB JAY	1	↓	↓
SPOTTED TOWHEE	11	↓	↓
TURKEY VULTURE	1	BGO	↓
CHESTNUT-BACKED CHICKADEE	1	↓	UPSTREAM AREA
WARBLING VIREOS	1	↓	DOWNSTREAM AREA
YELLOW WARBLER(S)	11	↓	DOWNSTREAM "
UNIDENTIFIED FISH (YOUNG-OF-YEAR)	NUMEROUS	BGO	THROUGHOUT ASSESSMENT AREA
GREAT BLUE HERON	1	BGO	UPSTREAM
PAC. CHORUS FROG (ADULT)	1	BGO	UPSTREAM
— VOCALIZATION			

Additional Notes:

sycamore, willow, carex

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 7 Site Name: Old Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/29/08
UTM Cord: 0694004 (Easting) 3927488 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: A-team - KK-SS

STREAM CHEMISTRY		GEOMORPHOLOGY			
Stream Temp. (F°)	18.9 digital 16° - Sam's not from	Landform	coastal range	Elev	Slope (RL) 30%
Stream pH	8.16	Landfeature		Aspect 220° - Downstream	Slope (RR) 18%
Electrical Conductivity (uScm⁻¹)	860 uS	Position	above man made dam	Shape	Drainage Class

OBSERVATIONS			
Particle Size Class	Depth to Sat.(In) N/A	Soil Temp 19°C (F°)	Area Floods?/Ponds? (circle) rarely
Is This Soil Hydric? YES (NO)	Redox Depth (In)	Creek Bank and Side Slopes (%) RR 18%	RL 40%

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE				ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER	TEXTURE	GRAVEL (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	PH	OXIDIZED RHIZOSPH y/n
Om	0	1																				
A	1	5	10YR 4/3					None				0	0	AB			Many	few	—	No		No
	5	18	10YR 4/3					None	silty	Sandy	10	0	0	sand			No			No		No
	18	22	10YR 3/3	wavy	(* See below			)	silt	Fine sand	0	0	0	AB			relic			No		relic

Notes:

C - * many concentrations (5YR 5/8) + many depletions (2.5Y 2.5/1)
few ox-hiz. - relic

Saw ox (?)

HGM Riverine Data Sheets
Site #6 – Willow Creek
San Luis Obispo County, California

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems; Plant Community - 1 of 10

Site#: 8 Site Name: Willow Creek @ Pat Molnar Ranch
HGM Subclass: Flow mid intermittent Within Domain: yes (Yes/No) Date: 29.IV.08
UTM Cord: 1105065 3576 (Easting) 39 24 27 +/- 13.9 ft. (Northing) Photo Roll: _____ Photo Numbers: _____
Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: _____ (Width) _____ (Length) Creek Order: _____ Team: Kirk (PD, JP) · WSP (RF, SS, KC)

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

River ~~Left~~-Buffer Right

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	15'	9"	Salix lasiolepis
2	10'	6"	Salix lasiolepis
3	8'	9"	Salix lasiolepis
4			

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		
2		
3	8'	Salix lasiolepis
4		

Seedlings/Saplings

Quarter	Distance	Species
1		
2		
3		None
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	3'	Toxicodendron diversilobum
2	3'	Toxicodendron diversilobum
3	8'	Salix lasiolepis
4		

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	0	6'	8"
2	5'	20'	3.5"
3			
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1			
2			
3	None		
4			

River ~~Right~~-Buffer Left

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1			
2	3.5'	13.5	Salix lasiolepis
3			
4	15.10'	12"	Salix lasiolepis

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		
2		
3		
4		

Seedlings/Saplings

Quarter	Distance	Species
1		
2		
3		
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1		
2	10'	Sambucus mexicana
3		
4		

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	10'	15'	6"
2	7'	3.25'	6"
3	10'	25'	8"
4	6'	7'	6"

Snags (Trees only)

Quarter	Distance	DBH	Height
1			
2			
3			
4	20'	11.3"	35'

* several wood rat nests on River left bank

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	✓ (O. agrifolia)
Broadleaf Deciduous	✓ (S. lasiolepis, S. laevigata)
Needle Leaf	
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=sauxist; 1=vegetative; 2=both)

Trees	2
Shrubs	2
Vine	0
Seedling	0
Herbaceous	0

Ferren, Fiedler & Leidy Classification - Palustrine

Palustrine Broadleaved deciduous riverbank forest (Mixed vascular (willow))
Palustrine Broadleaf Deciduous riverbank scrub shrub (Mixed vascular (willow))
Palustrine broadleaf evergreen + deciduous riverbank forest (as above)

Ferren, Fiedler & Leidy Classification - Riverine

Riverine mid intermittent vegetated floating aquatic (algae)

Appendix C:58

Appendix C: Biological Resources

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#: 8 Site Name: Willow Creek Team: Padre/JP, BD/ WSP/KK, SS, PF/ Date: 4/29/08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem > 3" diameter at breast height)

Species	Cover Class Midpoint	Indigenous Status
Quercus agrifolia	20.5	N
Salix lasiolepis	85.5	N

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
Rubus ursinus	10.5	N
Baccharis pilularis	3	N
Sambucus mexicana	20.5	N
Toxicodendron diversilobum	38	N

Vines

Species	Cover Class Midpoint	Indigenous Status
Clematis ligusticifolia	38	N
Toxicodendron diversilobum	10.5	N
Marah fabaceus	10.5	N

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Carduus pycnocephalus	10.5	E
Vicia	3	N
Bromus catharticus	10.5	E
Conium maculatum	10.5	E
Bromus diandrus	20.5	E
Lupinus succulentus	3	N
Foeniculum vulgare	3	E
Sanicula arguta	10.5	N
Scrophularia californica	3	N
Hordeum murinum leporinum	10.5	E
Sonchus oleraceus	3	E
Torilis arvense	3	E
Lolium multiflorum	10.5	E

Seedlings/Saplings

Species	Cover Class Midpoint	Indigenous Status
Quercus agrifolia	0	N

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature: 1=Agriculture: 2=Urban: 3=Other)

River Left Buffer

Sample	Width	Code	Description
1	25'	1	
2	↓		
3			
4			

River Right Buffer

Sample	Width	Code	Description
1	35'	0	open grassland
2	↓		
3			
4			

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
3 / 3	3 / 2	3 / 2	2 / 1	3 / 2
6	**7**	**8**	**9**	**10**
3 / 2	2 / end	3 / end	2 / end	2 / end

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Salix lasiolepis	1	10

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Quercus agrifolia	II	20
Salix lasiolepis	IIII	50

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
Salix lasiolepis	30'	

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
Quercus agrifolia	40-50'	
Salix lasiolepis	35'	

Rumex salicifolia 10.5 E
Agrostis viridis 10.5 E
Epilobium nasturtium aquaticum 3
Verbena lasiostachya 3 N
Agapanthus 3 E
Artemisia douglasiana 10.5 N
Osmorhiza chilensis 3 N
Cirsium vulgare 3 E
Plantago lanceolata 3 E

Medicago polymorpha 3 E
Sanicula crassicaulis 3 N
Stachys bullata 3 N
Microseris (hairy) 0 N
Melica imperfecta 3 N
Oxalis pescaprae 3 N

Helenium puberulum 3 N
Equisetum arvense 3 N

0693581
77

3924281

990 7.96
23.5

27.3
27.3
54.6

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 8 Site Name: Willow Creek at Pat Molnar
HGM Subclass: Riverine - mid Within Domain: Yes (Yes/No) Date: 4/29/08
UTM Cord: 0693581 77 (Easting) 3924280 ±17 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: A-team

CROSS-SECTION

Horizontal Dist (feet)	Elevation (feet)	Notes
0	8.16'	Right Bank OHW
1.6'	9.2'	Edge of Water RB.
2.8'	9.31'	Thalweg depth 0.15'
5.6	9.22'	Edge of Water Left Bank
7.75'	8.13	OHW - LB

1.31
8.13
1.18

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

Channel Width at OHW:	7.75
Top of Bank to Top of Bank:	—
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	—
Assessment Area Length: (7 x OHW Width) 27.3 x 2 =	54.6
Channel Depth at Thalweg: (Distance from Thalweg to OHW)	1.18'
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth)	12.2'
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	8.75'
Rosgen Classification:	

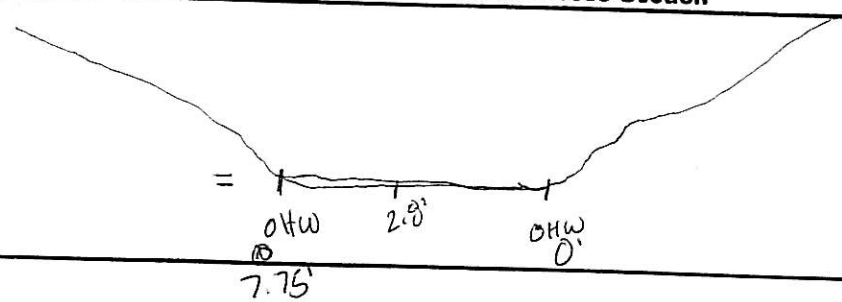
CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radil: (X-Sectional Area/Wetted Perimeter)	

Notes:

Sketch Cross-Section

River Left



River Right

38/27/65

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 8 Site Name: Willow Creek at Pat Molnar Team: A-team - SS - KK Date: 4/29/08

LONGITUDINAL PROFILE

Total Length: 65'	Section Length: 38/27
Channel Aspect: 210° DS	Channel Slope:

Downstream Section - from X-Section to Downstream AA Boundary

Depth	Dist from X-Sec (feet)	Elevation (feet)	Notes
0.15	0.0	9.31'	Channel Bed Elevation at X-Section
0.12	14'	9.46'	glide
0.16	19'	9.58'	glide
0.28	38'	9.75'	glide.

Upstream Section - from X-Section to Upstream AA Boundary

Depth	Dist from X-Sec (feet)	Elevation (feet)	Notes
0.15	0.0	9.31'	Channel Bed Elevation at X-Section - riffle
0.25	10	9.32'	bottom of pool
0.08	21'	9.02'	Top of
0.1	27'	8.99'	"riffle" bottom.
0.31	38		

RESIDUAL POOLS

Sample Area: Active Channel within the Assessment Area

Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

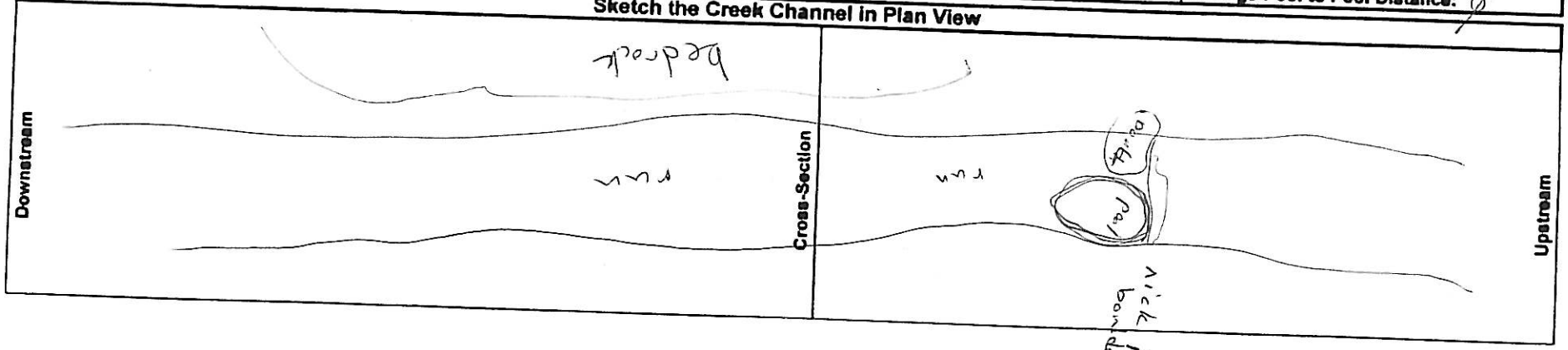
Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
1	7"	48'	Ø (ONE POOL ONLY) SEE SKETCH
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:	7"	48'	

Total Pool Number: ONE Average Pool to Pool Distance: Ø

Sketch the Creek Channel in Plan View



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 8 Site Name: Willow Creek at Pat Molnar
HGM Subclass: Riverine - mid Within Domain: Yes (Yes/No) Date: 4/29/08
UTM Cord: 0695577 (Easting) 3924280 ±17 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Creek Order: Photo Roll: Photo Numbers:
Team: KK-SS

PEBBLE COUNT MEASUREMENTS

25																			
24																			
23																			
22																			
21																			
20																			
19																			
18									X										
17									X										
16									X										
15									X										
14	X								X										
13	X								X										
12	X							X	X										
11	X							X	X	X									
10	X							X	X	X									
9	X							X	X	X									
8	X							X	X	X		X							
7	X					X	X	X	X	X		X	X						
6	X					X	X	X	X	X	X	X	X						
5	X					X	X	X	X	X	X	X	X						
4	X			X		X	X	X	X	X	X	X	X						
3	X	X		X		X	X	X	X	X	X	X	X						
2	X	X		X		X	X	X	X	X	X	X	X						
1	X	X	X	X		X	X	X	X	X	X	X	X	X	X				
mm <=	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
phi	-1	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5	-7	-7.5	-8	-8.5	-9	-9.5	-10
%	14	3	1	4	0	7	7	12	18	11	6	8							
cum.%																			

42

D86 = 91

B 86

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 8 Site Name: Willow Creek at Pat Molnar Team: KK-SS Date: 4/29/08

EMBEDDEDNESS FIGURE

IMMOBILE BED ROUGHNESS FIGURE

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1	0.75'	0.5'	<2
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators 9 1"

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1	0.4	0.2		6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes: at cross-section

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes: None - No boulders

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 8 Site Name: WILLOW CREEK (PAT MOLNAR PROPERTY) Within Domain: YES (Yes/No) Date: 04/29/08
HGM Subclass: MID - RIVERINE Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord: 10S 0693577 (Easting) 3974281 +/- 17' (Northing) Photo Roll: Photo Numbers:
Assessment Area Dimensions: 7.75' (Width) 27.3' (Length) Creek Order: Team: WSP - PADRE

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length
If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class
NONE				NONE			

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD
CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class
NONE				NONE			

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present: 2	Total number of FWD jams present: 0

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream
+/- 20 TREES/SNAGS	+/- 10 TREES, - INCLUDING WILLOWS

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

* VERY NARROW OHW/CHANNEL; NOT MUCH DEBRIS DEPOSITED; (HOWEVER UPPER BANKS HAVE LOTS OF DOWNED WOODY DEBRIS AVAILABLE FOR MIGRATION INTO CHANNEL

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 8 Site Name: WILLOW CREEK (PAT MALNAR PROPERTY) Team: WSP- PADILLE Date: 04/29/08

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section

Are there levees, dikes, etc present? (0=No:1=Yes(natural):2=Yes(artificial))	0
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 – PACIFIC OCEAN
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	0 – POSSIBLE BOX CULVERT @ HWY 1

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	NONE VISIBLE

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
500 S.F.	CATTLE TRAIL @ UPPER (RT BANK) ASSESSMENT AREA	– RUNOFF DURING STORM EVENTS

Downstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	0
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 – PAC. OCEAN
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	0 – POSS. BOX CULVERT @ HWY 1

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	NONE VISIBLE

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
300 S.F.	CATTLE TRAIL @ LOWER (RT. BANK) ASSESSMENT AREA	– RUNOFF DURING STORM EVENTS

LAND USE WITHIN THE ASSESSMENT AREA

Adjacent Land Use (Within the Buffer)	Upstream	Downstream
(1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))	4, 5	4, 5
Wetland Land Use (Below OHW Elevation)	**Upstream**	**Downstream**
(1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	4 (RIPARIAN GRAZING)	4 (RIPARIAN GRAZING)

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
~~Average Overhang from OHW:~~	~~Average Overhang from OHW:~~
Average Percent Cover: 80%	Average Percent Cover: 90%
Describe Distribution: COMPRISED ENTIRELY OF SALIX lasiolepis	Describe Distribution: 80% SAMBUCUS mexicana 10% SALIX lasiolepis

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 8 Site Name: WILLOW CREEK (PAT MULNAR PROPERTY) Within Domain: YES (Yes/No) Date: 04/29/08

HGM Subclass: MID RIVERINE Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

UTM Cord: 10S 0693577 (Easting) 3924281 +/- 17' (Northing) Photo Roll: Photo Numbers:

Assessment Area Dimensions: 7.75' (Width) 27.3' (Length) Creek Order: Team: WSP / PAORE

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	YES	MULT.	DOMESTIC CATTLE
Trails (>4")	YES	MULT.	DOMESTIC CATTLE / MULE DEER
Trails (< 4")	YES	MULT.	" / "
Feeding Evidence	YES	MULT.	DUSKY-FOOTED WOODRATS
Squirrel Middens	NO	—	
Feathers	NO	—	
Bird Nests	YES	1	SONG SPARROW NEST @ DOWNSTREAM AREA
Nesting Cavities	YES	MULT.	DEAD COAST LIVE OAK *
Bedding	NO	—	
Fur	NO	—	
Scrapes, Rubs, etc.	NO	—	
Browse	YES	MULT.	CATTLE
Raptor Pellets	NO	—	
Scat - Mammal	YES	MULT	DOMESTIC CATTLE / DUSKY-FOOTED WOODRAT
Scat - Avian	NO	—	
Calls - Mammal	YES	MULT.	DOMESTIC CATTLE
Calls - Avian	YES	MULT.	WESTERN GOLDFINCH, SONG SPARROW, ASH-THROATED FLYCATCHER
Other (specify) -			

Additional Notes:

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
PAC. CHORUS FROG	MULT.	BGO	THROUGHOUT CHANNEL
WESTERN FENCE LIZARD	1	BGO	UPSTREAM
DUSKY-FOOTED WOODRAT	III (DEN)	BGO	UPSTREAM (LT & RT. BANKS)
ASH-THROATED FLYCATCHER	1	↓	UPSTREAM
ALLIGATOR LIZARD	1	↓	UPSTREAM
SONG SPARROW	1	↓	DOWNSTREAM
AQUATIC GARTER SNAKE	1	↓	UPSTREAM
PACIFIC SLOPE FLYCATCHER	1	↓	"

Additional Notes:

* DUSKY-FOOTED WOODRAT DENS ARE LOCATED ON UPPER BANKS THROUGHOUT ASSESSMENT AREA (+/- 20 DENS total / ABOVE DRY MARK)

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 8 Site Name: Willow Creek at Pat Molnar Within Domain: Yes (Yes/No) Date: 4/29/08
HGM Subclass: Riverine - Mid Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord: 10S 0692357 7 (Easting) 3924280 ± 69 (Northing) Photo Roll: Photo Numbers:
Assessment Area Dimensions: (Width) (Length) Creek Order: Team: KK - SS

STREAM CHEMISTRY		GEOMORPHOLOGY			
Stream Temp. (F°) 23.5°C digital / 19°C same meter		Landform Dissected coastal terrace	Elev	Slope (RL) 45%	
Stream pH 7.96		Landfeature Stream canyon	Aspect	Slope (RR) 65%	
Electrical Conductivity (uScm⁻¹) 990 uS/cm		Position mid order (3rd?)	Shape	Drainage Class	

OBSERVATIONS			
Particle Size Class	Depth to Sat.(In) N/A	Soil Temp 15°C (F°)	Area Floods?/Ponds? (circle) No
Is This Soil Hydric? YES (NO)	Redox Depth (In)	Creek Bank and Side Slopes (%) RR 70% RL 80%	

SOIL DATA AND DESCRIPTION

HORIZON: Horizon	Upper (in)	Lower (in)	Color (moist) munsell	Boundary	REDOX FEATURES: Type	Size (mm)	Area (%)	Color (moist) munsell	TEXTURE: Modifier	Texture	Gravel (%)	Cobble (%)	Stones (%)	STRUCTURE: Primary	Secondary	Consist	ROOTS: Fine	Medium	Coarse	CHEM: Sulf Odor y/n	pH	Oxidized y/n	Rhizosph
A	0	5	10YR3/3	Distinct					Sandy	loam	2	0	0	AB			Some	Few	—	N		No	
	3	12	10YR5/2		O.R.	sm	1		Sandy	loam	<2%	0	0	AB-Sbl	-	-	Some	Few	—	No		No	
	12	25	10YR3/4		Conc.	10	10%	5YR3/4	Clay	loam	<2%	0	0	AB									
			10YR4/1																				

No redox sand

Notes: Pit on left bank - ~15' above thalweg

WA 3

HGM Riverine Data Sheets
Site #7 – Dairy Creek
San Luis Obispo County, California

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 1 of 10

Site#: 15 Site Name: Drain Creek @ El Chorro Reg Park
HGM Subclass: Riverine lower intermittent Within Domain: Yes (Yes/No) Date: 30.IV.08
UTM Cord: 10S 0706593 (Easting) 3919699 +/- 13.5 ft. (Northing) Photo Roll: Photo Numbers:
Assessment Area Dimensions: (Width) (Length) Creek Order: Team:
Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

River Left Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	10'	4"	Salix lasiolepis
2	15'	4	Salix lasiolepis
3	30'	8"	Salix lasiolepis
4			

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	—	—
2	—	—
3	—	—
4	15	Quercus agrifolia

Seedlings/Saplings

Quarter	Distance	Species
1	—	—
2	—	—
3	—	—
4	12'	Quercus agrifolia

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	—	—
2	7'	Mimulus aurantiacus
3	12'	Sambucus mexicana
4	13'	Rhamnus californica

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	—	—	—
2	—	—	
3	7'	25'	10"
4	—	—	—

Snags (Trees only)

Quarter	Distance	DBH	Height
1	—	—	—
2	15'	5"	25'
3		—	
4	—	—	—

River Right Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	8'	4.5"	Umbellularia californica
2	4'	10"	Quercus agrifolia
3	15'	8"	Salix lasiolepis
4	10'	4"	Salix lasiolepis

Small trees (< 3" diameter at breast height) 0

Quarter	Distance	Species
1		—
2	5'	Quercus agrifolia
3	—	—
4	—	—

Seedlings/Saplings

Quarter	Distance	Species
1	—	—
2	—	—
3	8'	Quercus agrifolia
4	—	— 0

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	—	—
2	—	—
3	—	—
4	—	—

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	—	—	—
2	—	—	—
3	—	—	—
4	—	—	—

Snags (Trees only)

Quarter	Distance	DBH	Height
1	15'	3.5'	18'
2	—	—	—
3	—	—	—
4	—	—	—

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	
Broadleaf Deciduous	
Needle Leaf	
Mixed Evergreen & Deciduous	X
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=sexual: 1=vegetative: 2=both)

Trees	2
Shrubs	
Vine	
Seedling	
Herbaceous	

Ferren, Fiedler & Leidy Classification - Palustrine

Palustrine lower intermittent broad-leaf evergreen / broadleaf deciduous riparian forest

Ferren, Fiedler & Leidy Classification - Riverine

Riverine lower intermittent unvegetated cobble / sand / boulder stream bed 0

Estimated due to high poison oak cover (mostly on RR)

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#: 15 Site Name: Dairy Creek Team: Padre (JP, BD) WSP (KK, SS, PF) Date: 30.10.08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem > 3" diameter at breast height)

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis	85.5	N
Umbellularia californica	20.5	N
Quercus agrifolia	20.5	N
Platanus racemosa	10.5	N

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
Mimulus aurantiacus	10.5	N
Sambucus mexicanus	20.5	N

Vines

Species	Cover Class Midpoint	Indigenous Status
Clematis ligusticifolia	20.5	N
Toxicodendron diversilobum	38	N
Marah fabaceus	10.5	N

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Stachys bullata	10.5	N
Oxalis pes-caprae	10.5	E
Claytonia perfoliata	3	N
Potentilla adsurgens-anserina	3	N
Sonchus oleraceus	0	E
Melica imperfecta	3	N
Hypochaeris radicata	0	E
Polypogon monspeliensis	3	N
Helenium autumnale	10.5	N
Sisyrinchium bellum	3	E
Eleutherococcus ricinifolius	10.5	E
Sanicula crassicaulis	3	N
Verbena lasiostachys	3	N

Seedlings/Saplings

Species	Cover Class Midpoint	Indigenous Status
Quercus agrifolia	3	N

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature: 1=Agriculture: 2=Urban: 3=Other)

River Left Buffer

Sample	Width	Code	Description
1	25'	3	trail in park
2			
3			
4			

River Right Buffer

Sample	Width	Code	Description
1	30'	0	in park
2			
3			
4			

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
3/3	2/2	2/2	2/3	3/2
6	**7**	**8**	**9**	**10**
3/2	1/2	2/3	3/3	3/2

Herbs: Urtica dioica 3 N
Medicago polymorpha 3 E
Bromus diandrus 3 E
Pellaea andromedifolia 3 N
Adiantum jordanii 0 N
Picris echioides 3 E
Scirpus microcarpus 3 N
Foeniculum vulgare 3 E
Athyrium felix-femina 10.5 N

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Salix lasiolepis	111	30

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Platanus racemosa	1	10
Umbellularia californica	1	16
Quercus agrifolia	1	10
Salix lasiolepis	1	10

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
Salix lasiolepis	15-50'	
Quercus agrifolia	40-45	

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
Platanus racemosa (*)	85	Ancient
Umbellularia californica	45-50'	
Salix lasiolepis	25-50'	
Quercus agrifolia	40	

(*) Very old stately specimen

7.89 - 3.2 = 4.68

12.1 - 3.2 = 8.9

5.03 - 0.90 = 4.13

5.03 + .09 = 5.93

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 15 Site Name: Dairy Creek

HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/30/08

UTM Cord: 10S 0706583 (Easting) 3912699 ±15.5' (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:

Creek Order: Team: KK-SS

CROSS-SECTION

Horizontal Dist (feet)	Elevation (feet)	Notes
0	4.69	OHW right bank 3.2 different
6.5	7.89	edge of water
9.3	8.28	Thalweg
15.6	8.54	backwater channel 4.1
20.4'	5.03	
20.6	4.13	0.9 different OHW left bank

Depth

0

1.48

0.68

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

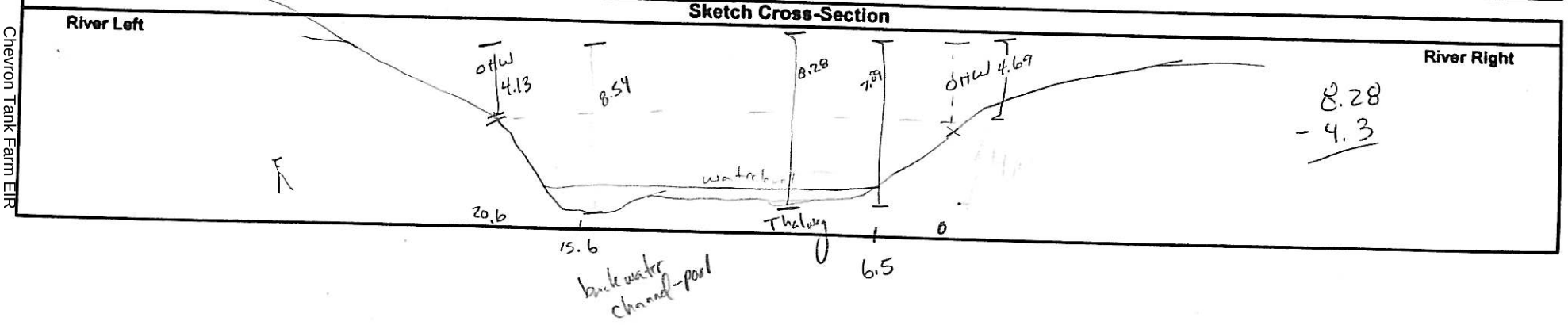
Channel Width at OHW:	20.6'
Top of Bank to Top of Bank:	
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	
Assessment Area Length: (7 x OHW Width) 72 x 2'	144'
Channel Depth at Thalweg: (Distance from Thalweg to OHW)	~4'
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth)	
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	24
Rosgen Classification:	

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radii: (X-Sectional Area/Wetted Perimeter)	

Notes:

Sketch Cross-Section



70
66
136

42
8
336

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 15 Site Name: Dairy Creek Team: KK-SS Date: 4/30/08

LONGITUDINAL PROFILE

Total Length:	136.6	Section Length:	70.5 + 66
Channel Aspect:	220° → DS	Channel Slope:	

Downstream Section - from X-Section to Downstream AA Boundary

Depth of water	Dist from X-Sec (feet)	Elevation (feet)	Notes
0.48	+ 0.0 0'	8.28'	Channel Bed Elevation at X-Section
0.78	+ 13'	8.61'	pool
0.65	+ 39.7'	8.5'	pool
0.22	+ 66'	9.14'	bottom of riffle
	+		can't go farther + bse sight
	+		
	+		

Upstream Section - from X-Section to Upstream AA Boundary

	Dist from X-Sec (feet)	Elevation (feet)	Notes
0.48	- 0.0	8.28	Channel Bed Elevation at X-Section
0.32	- 19'	8.15	Bottom of riffle
0.21	- 31.2'	7.31	Top of riffle
0.18	- 52.2	7.23	glide - above pool
0.29	- 70.5	7.08'	
	-		
	-		

RESIDUAL POOLS

Sample Area: Active Channel within the Assessment Area

Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

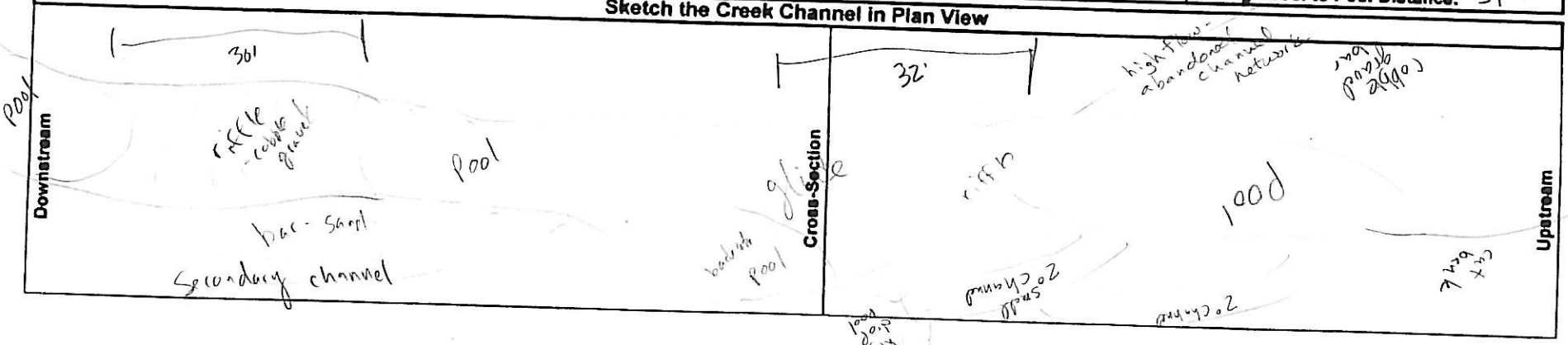
Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
1	6"	11 x 7 = 77 ft²	32'
2	18"	42 x 8 = 336'	30'
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			

Total Pool Number: 2 Average Pool to Pool Distance: 31'

Sketch the Creek Channel in Plan View



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 15 Site Name: Dairy Creek @ El Chorro Regional Park
HGM Subclass: ~~105~~ Riverine Within Domain: Yes (Yes/No) Date: 4/30/08
UTM Cord: 105 0706583 (Easting) 3912699 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Creek Order: Photo Roll: Photo Numbers:
Team: KK, SS

PEBBLE COUNT MEASUREMENTS

25																			
24																			
23																			
22																			
21																			
20																			
19																			
18																			
17																			
16																			
15											X								
14										X	X								
13										X	X	X							
12								X		X	X	X							
11								X		X	X	X	X						
10								X		X	X	X	X						
9								X		X	X	X	X						
8								X	X	X	X	X	X	X					
7								X	X	X	X	X	X	X					
6								X	X	X	X	X	X	X					
5	X							X	X	X	X	X	X	X					
4	X							X	X	X	X	X	X	X					
3	X				X		X	X	X	X	X	X	X	X	X				
2	X			X	X		X	X	X	X	X	X	X	X	X				
1	X			X	X	X	X	X	X	X	X	X	X	X	X	X			
mm <=	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
phi	-1	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5	-7	-7.5	-8	-8.5	-9	-9.5	-10
%	5			2	3	1	3	12	8	14	15	13	11	8	4	1			
cum.%	5			7	10	11	14	26	34	48	63	76	87						

D50 D84

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 15 Site Name: Dairy Creek Team: KK/SS Date: 4/30/08

EMBEDDEDNESS FIGURE

Skip.

IMMOBILE BED ROUGHNESS FIGURE

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width: 20 Channel Depth: Ave. Channel Depth:

Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1	1.8	1.6'	2.88	6			
2	0.6	1'	0.6	7			
3	0.6	0.6	0.36	8			
4	2	2.8'	5.6	9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width: 20.6 Channel Depth: Ave. Channel Depth:

Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1	1.6	2	3.2	6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

At cross-section.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 15 Site Name: DAIRY CREEK Within Domain: YES (Yes/No) Date: 4/30/08

HGM Subclass: RIVERINE Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

UTM Cord: 10S 0706583 (Easting) 3912699 (Northing) Photo Roll: Photo Numbers:

Assessment Area Dimensions: (Width) (Length) Creek Order: Team: WSP / PADREE

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length

If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class
3"	3'	9'	2	NONE			
3"	5'	5'	2				
4"	5'	10'	2				

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD

CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class
6'	10'	60 s.f.	2	5'	10'	50 s.f.	2
3'	6'	18 s.f.	2	3'	12'	36 s.f.	2

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present: ~~IIII~~ ~~IIII~~ II	Total number of FWD jams present: ~~IIII~~ ~~IIII~~

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream
+/- 50 trees	+/- 50 trees

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 15 Site Name: DAIRY CREEK Team: WSP/PADRE Date: 04/30/08

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section		Downstream AA Boundary to X-Section	
Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	0	Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 — CONNECTION TO CHORRO & MORRO BAY	Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 — SEE UPSTREAM
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	2 — POSSIBLE @ GOLF COURSE ?	Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type	RL or RR	Type
	NONE VISIBLE		NONE VISIBLE

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type	RL or RR	Type
	NONE KNOWN		NONE KNOWN

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type	RL or RR	Type
	NONE VISIBLE		NONE VISIBLE

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector	Source Area (sq. ft.)	Description of Source Area	Transport Vector
+/- 30 SF	BANK EROSION / CUT SLOPES (BOTH BANKS)	SCOUR DURING HIGH FLOW EVENTS	900 S.F.	EXPOSED SOILS ON SLOPE TO ACCESS RD. (LFT. BANK)	SCOUR DURING HIGH FLOW EVENTS
			200 S.F.	BANK EROSION / CUT SLOPE (RT. BANK)	" " " "

LAND USE WITHIN THE ASSESSMENT AREA

Adjacent Land Use (Within the Buffer) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	4 (AG & CHORRO PARK)	4 (AG & CHORRO PARK)
Wetland Land Use (Below OHW Elevation) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	**Upstream**	**Downstream**
	1	1

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
~~Average Overhang from OHW:~~	~~Average Overhang from OHW:~~
Average Percent Cover: 90%	Average Percent Cover: 75%
Describe Distribution: PLATANUS (10%), SALIX SP. (75%) UMBELLARIA (5%)	Describe Distribution: SALIX (70%) UMBELLARIA (5%)

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 15 Site Name: DAVIS CREEK Within Domain: YES (Yes/No) Date: 4/30/08
HGM Subclass: RIVERINE Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord: 10S 0706583 (Easting) 3912699 (Northing) Photo Roll: Photo Numbers:
Assessment Area Dimensions: (Width) (Length) Creek Order: Team: WSP / PADRE

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	YES	MULT.	MULE DEER
Trails (≥4")	NO	—	
Trails (< 4")	YES	—	MULE DEER
Feeding Evidence			
Squirrel Middens	NO	—	
Feathers	NO	—	
Bird Nests	NO	—	
Nesting Cavities	YES	MULT.	W/IN MASSIVE PLATANUS RACEMOSA
Bedding	NO	—	
Fur	NO	—	
Scrapes, Rubs, etc.	NO	—	
Browse	NO	—	
Raptor Pellets	NO	—	
Scat - Mammal	NO	—	
Scat - Avian	NO	—	
Calls - Mammal	NO	—	
Calls - Avian	YES	MULT.	BLACK-HEADED GROSBEAK, NUTTALL'S WOOD SCRUB JAY, PAC. SLOPE - FLYCATCHER PEWEE
Other (specify) -		—	CALIF. QUAIL, WILD TURKEY

Additional Notes:

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
* CA. RED-LEGGED FROG	1	BGD	DOWNSTREAM POOL
FEMALE WILD TURKEY	1	ALL	← ABOVE CHANNEL
DUSKY-FOOTED WOODRAT (DENS)	MULT.	BGD	UPSTREAM / DOWNSTREAM
AMERICAN CROW	11	BGD	UPSTREAM
TURKEY VULTURE	11	BGD	UPSTREAM

Additional Notes:
* GREAT HABITAT FOR CA. RED LEGGED FROGS
W/ POOLS & VARIOUS BANKS FOR COVER
* 0 SHELTERED OBSERVED (MAY BE BARRIER DOWNSTREAM)

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 15 Site Name: Dairy Creek upstream from Park
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/30/08
UTM Cord: 10S 0706583 (Easting) 3912699 ±15.5' (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: KK/SS

STREAM CHEMISTRY		GEOMORPHOLOGY			
Stream Temp. (F°)	14°C - Same as air T°	Landform	Elev	Slope (RL)	40%
Stream pH	8.3	Landfeature	Aspect 220° B.S.	Slope (RR)	20%
Electrical Conductivity (uScm^{-1})	960 uS	Position	Shape	Drainage Class	

OBSERVATIONS					
Particle Size Class		Depth to Sat.(In) NA	Soil Temp 12°C	Area Floods?/Ponds? (circle)	only at highest flows
Is This Soil Hydric? YES (NO)		Redox Depth (In) NA	Creek Bank and Side Slopes (%) RR 22%	RL 14%	

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE				ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER	TEXTURE	GRAVEL (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	PH	OXIDIZED y/n / RHIZOSPH y/n
Oa	0	1	—																			
A	1	8	10YR 3/2		None				loam		10	10	-		AB		~~Some~~ few			No		No
	8	18	10YR 3/2		None				loam		25%	5%		~~Sub~~ Sub	AB		Some	few	—	No		No
	18 →		10YR 2/2		None				loam		5%	25%					few	few		No		No

Notes: Pit on Top of bank - face.

HGM Riverine Data Sheets
Site #8 – Pennington Creek
San Luis Obispo County, California

13' orth
45.5 up/down

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 1 of 10

Site#: 14 Site Name: Pennington Creek
HGM Subclass: _____ Within Domain: Yes (Yes/No) Date: 30,
UTM Cord: 10S 0706400 (Easting) 3913727 ±23.2 (Northing) Reference Class: _____ (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: 13' (Width) 91' (Length) Photo Roll: _____ Photo Numbers: _____
Creek Order: _____ Team: _____

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

~~River Left Buffer~~ Right

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	—	—	—
2	14.6'	15"	Platanus racemosa
3	12'	15"	Quercus agrifolia
4	9'	6"	Salix lasiolepis

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	—	—
2	12.5"	Salix lasiolepis
3	3'	Quercus agrifolia
4	—	—

Seedlings/Saplings

Quarter	Distance	Species
1	6'	Quercus agrifolia
2	15'	Rhamnus californica
3	4'	Rhamnus californica
4	—	—

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	—	—
2	6'	Baccharis pilularis
3	6'	Baccharis pilularis
4	4'	Baccharis pilularis

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	—	—	—
2	—	—	—
3	—	—	—
4	5.5'	6'	3.5"

Snags (Trees only)

Quarter	Distance	DBH	Height
1	—	—	—
2	—	—	—
3	—	—	—
4	—	—	—

River Right Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	5'	8"	Salix lasiolepis
2	6'9"	7.2"	Salix lasiolepis
3	—	—	—
4	3'	6"	Salix lasiolepis

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	15'	Salix lasiolepis
2	—	—
3	—	—
4	—	—

Seedlings/Saplings

Quarter	Distance	Species
1	—	—
2	8.5'	Umbellularia californica
3	12'	Umbellularia californica
4	1.5'	Umbellularia californica

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	4.5'	Mimulus aurantiacus
2	10	Rhamnus californica
3	4'8"	Rhamnus californica
4	6'	Rhamnus californica

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	5'	6'	8"
2	5'4"	10'	8"
3	—	—	—
4	4'	8'	4"

Snags (Trees only)

Quarter	Distance	DBH	Height
1	—	—	—
2	—	—	—
3	—	—	—
4	—	—	—

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	
Broadleaf Deciduous	X
Needle Leaf	
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=absent; 1=vegetative; 2=both)

Trees	2
Shrubs	2
Vine	2
Seedling	2
Herbaceous	0

Ferren, Fiedler & Leidy Classification - Palustrine

Ferren, Fiedler & Leidy Classification - Riverine

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#: 14 Site Name: Pennington Creek Team: Padre (JP, BD) WSP/PF Date: 4/30/08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native; E=Exotic; O=Ornamental)

Trees (single stem > 3" diamter at breast height)

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis	85.5	N
Platanus racemosa	10.5	N
Quercus agrifolia	10.5	N

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
Baccharis pilularis	3	N
Heteromeles arbutifolia	3	N
Rhamnus californica	10.5	N
Mimulus aurantiacus	3	N
Salix lasiolepis	10.5	N
Salvia mellifera	3	N

Vines

Species	Cover Class Midpoint	Indigenous Status
Toxicodendron diversilobum	38	N
Rubus ursinus	38	N
Lonicera hispidula var. vacillans	10.5	N

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Helenium puberulum	3	N
Epilobium sp.	3	N
Cirsium vulgare	3	E
Eriophyllum confertiflorum	3	N
Stachys bullata	10.5	N
Artemisia douglasiana	10.5	N
Bromus diandrus	3	E
Sanicula crassicaulis	3	N
Symphoricarpos mollis	10.5	N
Mimulus guttatus	10.5	N
Melica californica	3	N
Juncus xiphioides	3	N
Conium maculatum	0	E

Seedlings/Saplings

Species	Cover Class Midpoint	Indigenous Status
Umbellularia californica	3	N

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Salix lasiolepis	~~IIIIIIIIIII~~	110

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Platanus racemosa	1	10
Quercus agrifolia	1	10
Salix lasiolepis	1	10

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
Salix lasiolepis	35'	

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
Platanus racemosa	40'	
Quercus agrifolia	45'	
Salix lasiolepis	25'	

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature; 1=Agriculture; 2=Urban; 3=Other)

River Left Buffer

Sample	Width	Code	Description
1	>25'	1	
2			
3			
4			

River Right Buffer

Sample	Width	Code	Description
1	18'	1	
2			
3			
4			

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
3 / 1	2 / 2	3 / 2	2 / 2	3 / 2
6	**7**	**8**	**9**	**10**
2 / 2	2 / 2	1 / 1	2 / 2	2 / 1

Plantago lanceolata O E
Vicia americana var. americana 3 N
Calystegia subacaulis ssp. episcopalis O N
Medicago polymorpha O E
Sonchus oleraceus O E
Scrophularia californica 3 N
Verbena lasiostachya 3 N
Carex 70.5 N

method - measure down - Not use laser.

400

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 14 Site Name: Pennington Creek

HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/30/08

UTM Cord: 10S 0706400 (Easting) 3913727 ± 23.2 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:

Creek Order: Team: KK-SS

CROSS-SECTION

Horizontal Dist (feet)	Elevation (feet)	Notes
0		Right Bank OHW
2'	0.6'	
2.2'	1.75'	Edge of water right
5	1.9'	Thalweg
7.5'	1.55	Edge of water - Left
9.5'	0.15	
11.5'	0.23'	
13'	0	

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

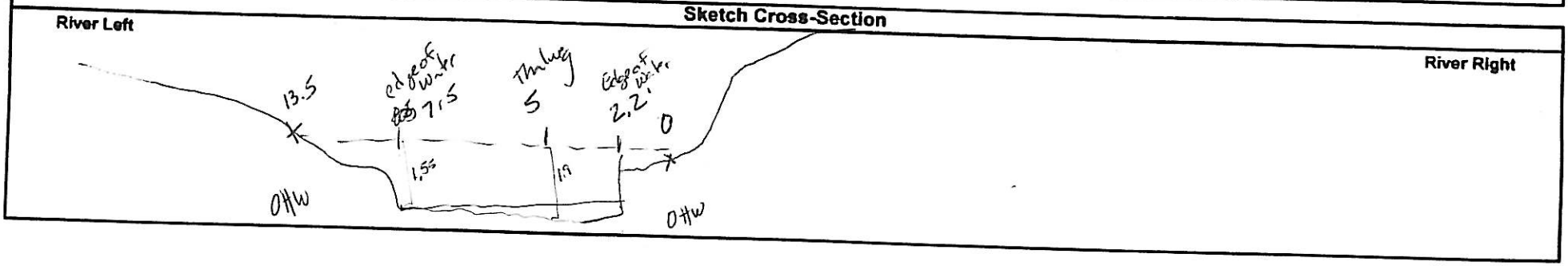
Channel Width at OHW:	13'
Top of Bank to Top of Bank: Skip	
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	
Assessment Area Length: (7 x OHW Width) 45.5x2	91'
Channel Depth at Thalweg: (Distance from Thalweg to OHW)	1.9'
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth) 3.8	23'
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	15'
Rosgen Classification: Step pools.	

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radii: (X-Sectional Area/Wetted Perimeter)	

Notes:

Sketch Cross-Section



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 14 Site Name: Pennington Creek Team: RK - SS Date: 4/30/08

LONGITUDINAL PROFILE

Total Length: 89.5	Section Length: 44+45.5
Channel Aspect:	Channel Slope:

Downstream Section - from X-Section to Downstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
0.0	7.18	Channel Bed Elevation at X-Section - top of pool
23.5'	7.38	bottom of pool / top of riffle
44'	8.09	bottom of riffle

0.30
0.52
0.25

Upstream Section - from X-Section to Upstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
0.0	7.18	Channel Bed Elevation at X-Section - top of pool - bottom of riffle.
17'	6.98	
25'	6.91	
28'	6.44	top of riffle bottom of pool (2' deep pool - water depth)
45.5'	5.68	top of riffle - nick point root across channel.

0.30
0.60
0.59
0.20
0.27

RESIDUAL POOLS

Sample Area: Active Channel within the Assessment Area

Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

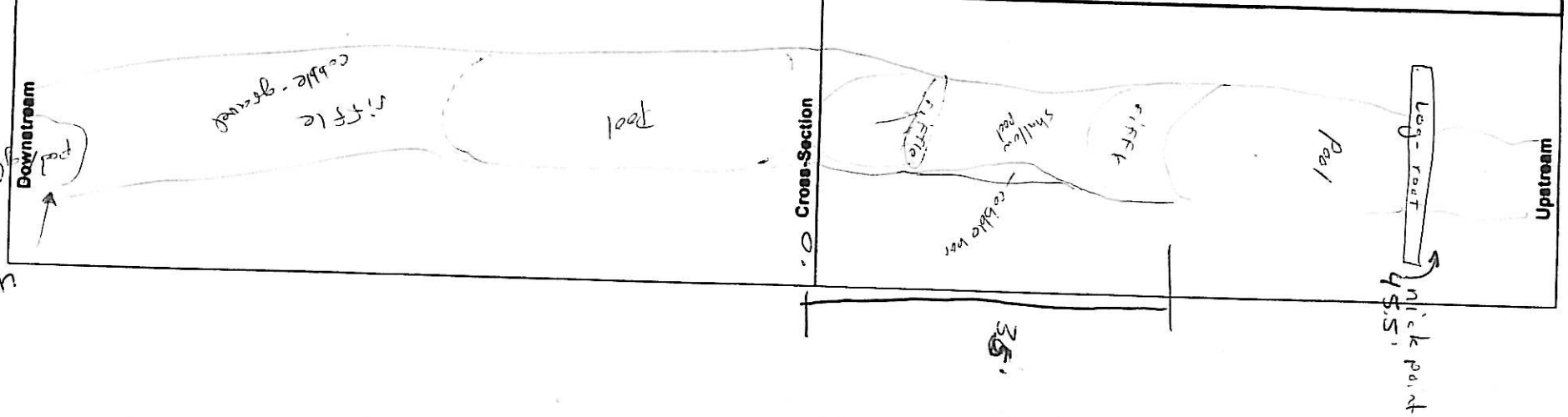
Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
1	26"	15x10 = 150 ft²	35'
2	17"	21' x 8'	> 30' out of A.A.
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			

Total Pool Number: 2 Average Pool to Pool Distance:

Sketch the Creek Channel in Plan View



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 14 Site Name: Pennington Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/30/08
UTM Cord: 10S 0706400 (Easting) 3913727 ±4023.2 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: KK - SS

PEBBLE COUNT MEASUREMENTS

	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
25																			
24																			
23																			
22																			
21																			
20																			
19																			
18																			
17								X											
16								X	X										
15								X	X										
14								X	X										
13								X	X	X									
12								X	X	X		X							
11								X	X	X		X							
10								X	X	X	X	X							
9							X	X	X	X	X	X							
8							X	X	X	X	X	X							
7							X	X	X	X	X	X	X						
6	X						X	X	X	X	X	X	X						
5	X						X	X	X	X	X	X	X						
4	X						X	X	X	X	X	X	X						
3	X				X	X	X	X	X	X	X	X	X						
2	X				X	X	X	X	X	X	X	X	X						
1	X	X			X	X	X	X	X	X	X	X	X	X					
mm <=	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
phi	-1	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5	-7	-7.5	-8	-8.5	-9	-9.5	-10
%	6	1			3	3	9	17	16	13	10	12	7	1					
cum.%	6	7			10	13	22	39	55	68	78	90	97	98					

X Bedrock
2
100

D50 D84

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 14 Site Name: Pennington Creek Team: KK - SS Date: 4/30/08

EMBEDDEDNESS FIGURE

Skip

IMMOBILE BED ROUGHNESS FIGURE

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1	.5	.5	.025	6			
2	.6	.9	.072	7			
3	.5	.3	.015	8			
4	.4	.2	.08	9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Downstream Cross-Section (1 OHW channel width from the baseline cross-section) Attaken. At 8xn.

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1	0.6	0.4	0.24	6			
2	0.4	0.2	0.08	7			
3	0.7	0.4	0.28	8			
4	0.4	0.3	0.12	9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Appendix C-85

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 14 Site Name: Pennington Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/30/08
UTM Cord: (Easting) (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: 13.2' (Width) 45.5' (Length) Photo Roll: Photo Numbers:
Creek Order: Team: BD

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length
If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class
8"	13'	50'	2	3"	12'	13'	2
4"	8'	22'	2	3"	+4'	+6'	3
3"	4'	5'	3	5"	8'	10'	2
3"	5'	5'	2				

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD
CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class
NONE				NONE			

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present: IIII	Total number of FWD jams present: IIII

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream
+/- 10 TREES	+/- 10 TREES

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

* CWD @ UPSTREAM BOUNDARY WAS CREATED NICE POOL FOR STREAMBED; ALSO NATURAL FWD JAMS CREATED GOOD HABITAT IN CHANNEL (SEE RESIDUAL POOL DISCUSSION).

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 14 Site Name: Pennington Creek Team: BD Date: 4/30/08

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	0
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 – TRIB. TO CHORRO CREEK
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	0

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE KNOWN

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	NONE KNOWN

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
	Ø	

Downstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	0
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 – TRIB. TO CHORRO CREEK
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	0

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE KNOWN

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	NONE KNOWN

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
	Ø	

LAND USE WITHIN THE ASSESSMENT AREA

Adjacent Land Use (Within the Buffer) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	4	4

Wetland Land Use (Below OHW Elevation) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	1	1

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
~~Average Overhang from OHW:~~	~~Average Overhang from OHW:~~
Average Percent Cover: 90%	Average Percent Cover: 85%
Describe Distribution:	Describe Distribution:
80% SALIX sp. & 10% TOXICODENDRON	50% PLATANUS RACEMOSA, 45% SALIX sp. & 5% TOXICODENDRON sp.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 14 Site Name: Pennington Creek Within Domain: Yes (Yes/No) Date: 4/30/08
HGM Subclass: Riverine Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord: (Easting) (Northing) Photo Roll: Photo Numbers:
Assessment Area Dimensions: 13.2' (Width) 45.5' (Length) Creek Order: Team: BD

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	No	—	
Trails (>4")	No	—	
Trails (< 4")	YES	Mult.	MULE DEER ON Rt. BANK
Feeding Evidence	No	—	
Squirrel Middens	No	—	
Feathers	No	—	
Bird Nests	No	—	
Nesting Cavities	No	—	
Bedding	No	—	
Fur	YES	1	CA. GROUND SQUIRREL CARCASS
Scrapes, Rubs, etc.			
Browse			
Raptor Pellets			
Scat - Mammal			
Scat - Avian			
Calls - Mammal	YES	1	DOMESTIC CATTLE
Calls - Avian	YES	Mult.	AM. CROW, PAC. SLOPE FLYCATCHER, CHESTNUT-BACKED CHICKADEE.
Other (specify) -			LESSER GOLDFINCH

Additional Notes:

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
STEELHEAD (SMOLTS)	+/- 5	AIL	UPSTREAM / DOWNSTREAM
CHESTNUT-BACKED CHICKADEE	1	BCO	UPSTREAM
		↓	
DUSKY-FOOTED WOODRATS (NESTS)	MULT.	↓	UPSTREAM / DOWNSTREAM
		↓	
WESTERN FENCE LIZARD	1	↓	UPSTREAM
NUTTAL'S WOODPECKER	1	↓	UPSTREAM

Additional Notes:
* GOOD SHADY POOL HABITAT BOTH UPSTREAM AND DOWNSTREAM OF ASSESSMENT AREA CROSS-SECTION

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 14 Site Name: Pennington Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/30/08
UTM Cord: 10 S 0706 400 (Easting) 3913727 ± 23.2 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers: Creek Order: Team: KK - SS

STREAM CHEMISTRY		GEOMORPHOLOGY			
Stream Temp. (F°)	12°C - Sams // 14.2° digital	Landform	Elev	Slope (RL)	20%
Stream pH	8.76	Landfeature	Aspect	Slope (RR)	cant see slope
Electrical Conductivity (uScm^{-1})	790 uS/cm	Position	Shape	Drainage Class	

~20% whole.

OBSERVATIONS					
Particle Size Class		Depth to Sat.(In)	N/A	Soil Temp 13°C (F°)	Area Floods?/Ponds? (circle)
Is This Soil Hydric? YES (NO)		Redox Depth (In)	N/A	Creek Bank and Side Slopes (%) RR 60%	RL 14%

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE				ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER	TEXTURE	GRAVEL SM. (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	pH	OXIDIZED y/n	RHIZOSPH
On	0	1																				
A.	1	6	7.5YR 3/2			None			Many	Sand	10%	0	0	Sand		—	Some	Some		No		No
	6	16	10YR 3/3			None			Many	Sand	10	40%	0	Sand			Some	Many				

Notes:

at unc Sand/ conglom.

Appendix C-89

HGM Riverine Data Sheets
Site #9 – Toro Creek
San Luis Obispo County, California

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community

NAD83

Site#: 9 Site Name: TORO CREEK

HGM Subclass: Within Domain: Yes (Yes/No) Date: 4/30/08

UTM Cord: 10S 0694642 (Easting) 3922520 ±32.1' (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: 28.8' (Width) 202' (Length) Photo Roll: Photo Numbers:

Creek Order: Team: Parker (JP, BD), WCP (PF, KE, SG)

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

River Left Buffer RIGHT

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	–	–	None
2	7'	4.6"	Populus balsamifera trichocarpa
3	8' 8"	3.1"	Populus balsamifera
4	–	–	None

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	8' 11"	Salix lasiolepis*
2	–	–
3	15'	Populus balsamifera trichocarpa
4	6' 10"	Salix lasiolepis

Seedlings/Saplings

Quarter	Distance	Species
1	20'	Salix laevigata
2	6' 6"	Populus balsamifera trichocarpa
3	13'	Salix lasiolepis
4	10'	Salix lasiolepis

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	8'	Baccharis pilularis
2	3' 4"	Eriophyllum confertiflorum
3	–	–
4	–	–

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	–	–	–
2	–	–	–
3	–	–	–
4	–	–	–

Snags (Trees only)

Quarter	Distance	DBH	Height
1	–	–	–
2	–	–	–
3	–	–	–
4	–	–	–

River Right Buffer LEFT

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	16'	8"	Salix lasiolepis
2	–	–	–
3	–	–	–
4	8' 8"	6.2"	Salix lasiolepis

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	7' 3"	Salix lasiolepis
2	–	–
3	–	–
4	6' 6"	Salix lasiolepis

Seedlings/Saplings

Quarter	Distance	Species
1	6.5'	Quercus agrifolia
2	–	–
3	–	–
4	4'	Quercus agrifolia

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	–	–
2	16'	Baccharis pilularis
3	12'	Baccharis pilularis
4		

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	–	–	–
2	–	–	–
3	–	–	–
4	–	–	–

Snags (Trees only)

Quarter	Distance	DBH	Height
1	–	–	–
2	–	–	–
3	–	–	–
4	–	–	–

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum: TREE

Broadleaf Evergreen	
Broadleaf Deciduous	X
Needle Leaf	
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=sexual; 1=vegetative; 2=both)

Trees	2
Shrubs	2
Vine	2
Seedling	Ø
Herbaceous	2

Ferren, Fiedler & Laidy Classification - Palustrine

(1) Broad leaf deciduous riparian forest (mixed vascular - (Salix spp.; Populus balsamifera trichocarpa; Platanus racemosa)

Ferren, Fiedler & Laidy Classification - Riverine

Riverine intermittent unvegetated / cobble gravel channel bed wetland / water

(4) Salix lasiolepis here is coppiced. - All trees were cut recently. Coarse wood was 100' downstream in large log jam

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#: 9 Site Name: Toro Creek Team: Padre (JP BD); RBP (CK) Date: 30.IV.08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem > 3" diameter at breast height)

Species	Cover Class Midpoint	Indigenous Status
Populus balsamifera trichocarpa	20.5	N
Salix laevigata	10.5	N
Platanus racemosa	38	N
Salix lasiolepis	89.5	N

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis	10.5	N
Baccharis pilularis	10.5	N
Mimulus aurantiacus	3	N
Eriophyllum sp	3	N
Symphoricarpos racemosa	10.5	N

Vines

Species	Cover Class Midpoint	Indigenous Status
Clematis ligusticifolia	20.5	N
Toxicodendron diversilobum	38	N
Rubus ursinus	38	N

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Equisetum telmateia	10.5	N
Rorippa nasturtium-aquaticum	10.5	N
Scirpus microcarpus	10.5	N
Hoita orbicularis	10.5	N
Helenium autumnale	3	N
Picris echioides	3	E
Juncus xiphioides	3	E
Sonchus oleraceus	3	E
Mentha sp.	0	E
Conium maculatum	10.5	E
Solanum douglasii	3	E
Stachys bullata	10.5	N
Medicago polymorpha	3	N
Cirsium vulgare	3	N

Seedlings w/Saplings

Species	Cover Class Midpoint	Indigenous Status
Platanus racemosa	3	N
Salix lasiolepis	10.5	N
Salix laevigata	3	N
Populus balsamifera trichocarpa	3	N
Alnus rhombifolia	3	N

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature: 1=Agriculture: 2=Urban: 3=Other)

River Left Buffer

Sample	Width	Code	Description
1	8' +	Then vertical zone 9' -	
2		(1)	riverbank
3			
4			

River Right Buffer

Sample	Width	Code	Description
1	> 100'	3	Road
2			
3			
4			

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
2 / 2	2 / 2	2 / 2	2 / 2	2 / 2

6	7	8	9	10
2 / 1	2 / 2	1 / 1	1 / 2	2 / 2

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Salix lasiolepis	111	46

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Populus balsamifera trichocarpa	1	10
Salix lasiolepis	1	16

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
Salix lasiolepis	75-80'	

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
Salix lasiolepis	75-80	
Platanus racemosa	60-80	

Vines
Bolaiera odorata 03 E

Herbs Vicia sp. 3 N
3 E Lathyrus odorata Rumex salicifolia (crest ssp.) 10.5 N Chenopodium ambrosioides 0 N
10.5 E Rumex pulcher Urtica dioica 3 N
3 E Sonchus asper Smilacina 3 N

method - not use laser level for cross-section

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 9 Site Name: Toro Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/30/08
UTM Cord: 10S 0694642 (Easting) 3922520 ±32.1 ft (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: A-Team ~ KK SS

CROSS-SECTION

Depth	Horizontal Dist (feet)	Elevation (feet)	Notes
	0'	0	OHW left Bank
0	6'	3.3'	edge of water
0.24	11.5'	3.34'	
0.39	17.6'	3.52'	Thalweg
0	21.9	3.16'	20.5 = Edge of water

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

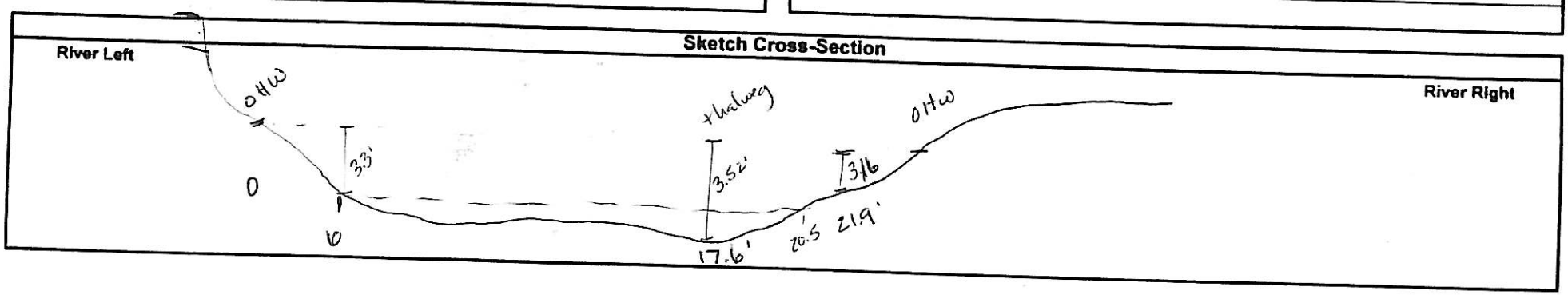
Channel Width at OHW:	28.8'
Top of Bank to Top of Bank:	
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	
Assessment Area Length: (7 x OHW Width) 28.8 x 3.5 = 101	202
Channel Depth at Thalweg: (Distance from Thalweg to OHW)	3.52'
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth) 7.04	61'
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	
Rosgen Classification:	

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radii: (X-Sectional Area/Wetted Perimeter)	

Notes:

Sketch Cross-Section



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 9 Site Name: Toro Creek Team: A-team KK-SS Date: 9/30/08

LONGITUDINAL PROFILE

Total Length: 210'	Section Length: 119' + 91' (210)
Channel Aspect: 230° - D.S.	Channel Slope:

Downstream Section - from X-Section to Downstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes	Depth of water (ft)
+ 0.0	7.09'	Channel Bed Elevation at X-Section	0.39
+ 16"	7.16	glide	0.41
+ 42'	7.30	~~top of riffle~~ glide	0.41
+ 73'	7.68	top of riffle	0.50
+ 84'	8.19	bottom of riffle	0.25
+ 91'	9.25	pool at log jam - mid pool	
+			

Upstream Section - from X-Section to Upstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes	
- 0.0	7.09	Channel Bed Elevation at X-Section	0.32
- 18'	7.12	glide.	0.45
- 31'	7.58	pool in a glide	0.90
- 45	7.42	"	0.72
- 81.5	7.20	bottom of riffle	0.50
- 96	6.75	~~mid~~ of riffle	0.20
- 119	6.65	top of riffle / bottom of pool	0.32

RESIDUAL POOLS

Sample Area: Active Channel within the Assessment Area

Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

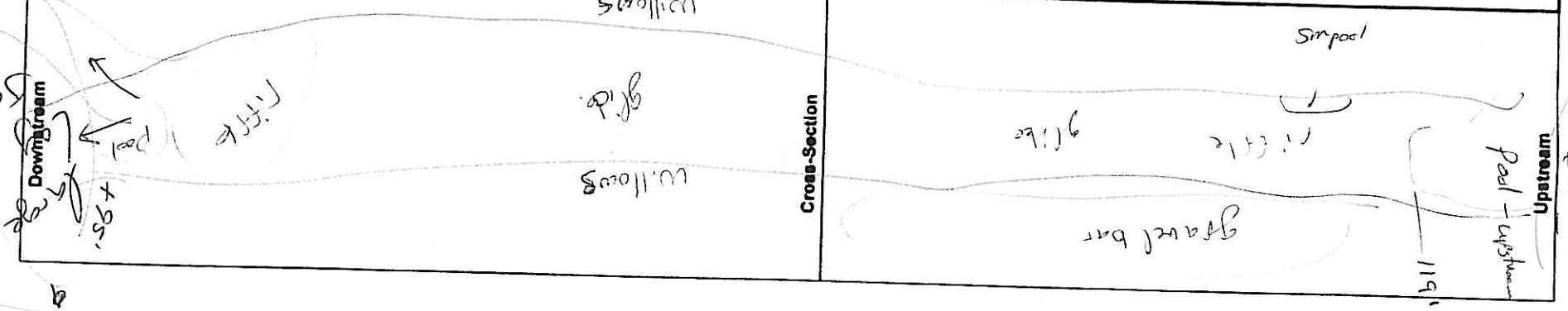
Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (≥6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
~~X~~	~~3~~	~~5 x 2' = 10 ft²~~	~~Not a pool~~
1	8"	30' x 6' = 180'	140'
3-2	Not natural pool - log jam +	channelization crest	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			
Total Pool Number:		Average Pool to Pool Distance:	

20x 20'

Sketch the Creek Channel in Plan View



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 9 Site Name: Toro Creek Within Domain: Yes (Yes/No) Date: 4/30/08
HGM Subclass: Riverine Reference Class: _____ (0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord: 0694642 (Easting) 3922520 ± 31 (Northing) Photo Roll: _____ Photo Numbers: _____
Assessment Area Dimensions: _____ (Width) _____ (Length) Creek Order: _____ Team: A-team K/K- JS

PEBBLE COUNT MEASUREMENTS

25																			
24																			
23																			
22																			
21																			
20																			
19																			
18																			
17							X												
16							X		X										
15							X		X										
14							X	X	X										
13							X	X	X										
12							X	X	X										
11							X	X	X										
10							X	X	X										
9					X		X	X	X										
8				X	X		X	X	X	X									
7				X	X		X	X	X	X									
6	X			X	X	X	X	X	X	X									
5	X			X	X	X	X	X	X	X	X	X							
4	X			X	X	X	X	X	X	X	X	X							
3	X			X	X	X	X	X	X	X	X	X	X						
2	X			X	X	X	X	X	X	X	X	X	X						
1	X		X	X	X	X	X	X	X	X	X	X	X						
mm <=	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
phi	-1	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5	-7	-7.5	-8	-8.5	-9	-9.5	-10
%	6	0	1	8	9	6	17	14	16	8	6	6	4						
cum.%	6	6	7	15	24	30	47	61	77	85	91	97	101						

D50 D84

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 9 Site Name: Toro Creek Team: KK-SS Date: 4/30/08

EMBEDDEDNESS FIGURE

All mobile

IMMOBILE BED ROUGHNESS FIGURE

All mobile

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 9 Site Name: TORO CREEK Within Domain: YES (Yes/No) Date: 04/30/08

HGM Subclass: RIVERLINE Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

UTM Cord: 10S 0694642 (Easting) 3922520 +/- 32.1' (Northing) Photo Roll: _____ Photo Numbers: _____

Assessment Area Dimensions: 28.8' (Width) 100.8' (Length) Creek Order: _____ Team: WSP / PADRE

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length

If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class
NONE				NONE			

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD

CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class
NONE				15'	54'	520 SF.	2

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present: HH	Total number of FWD jams present: +/- 25

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream
+/- 100 TREES	

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
(2)	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

* DOWNSTREAM CWD JAM CREATED BY LANDOWNER; RECENT WILLOW CLEARING IN CHANNEL WHICH WAS RESULTED IN VERY SUBSTANTIAL DAM FEATURE AND POOL HABITAT COMPLEX.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 9 Site Name: TORO CREEK Team: WSP/PADRE Date: 04/30/08

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section

Are there levees, dikes, etc present? (0=No:1=Yes(natural):2=Yes(artificial))	0
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 – DIRECT DISCHARGE to PAC-OCEAN
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	0 – NO BARRIERS

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE KNOWN

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	NONE

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
7,500 S.F.	SEVERELY UNDERCUT BANK ON RIGHT-SIDE (UNDER OAK)	- SCOUR DURING HIGH-FLOW EVENTS & SUBSEQUENT LANDSLIDES
200 S.F.	SEVERELY UNDER CUT BANK ON LEFT SIDE (UNDER OAK)	- SEE ABOVE.

Downstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	0
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	1 – DIRECT DISCHARGE to PAC. OCEAN
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	0 – NO BARRIERS

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE KNOWN

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	NONE

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
1,000 S.F.	UNDERCUT BANK ON LEFT. BANK	- SCOUR DURING HIGH-FLOW EVENTS & SUBSEQUENT LANDSLIDES

LAND USE WITHIN THE ASSESSMENT AREA

Adjacent Land Use (Within the Buffer) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	4, 5	4, 5

Wetland Land Use (Below OHW Elevation) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	1	1

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
~~Average Overhang from OHW:~~	~~Average Overhang from OHW:~~
Average Percent Cover: 80%	Average Percent Cover: 70%
Describe Distribution: COMPRISED ALMOST ENTIRELY OF SALIX SP.	Describe Distribution: – SALIX SP. DOMINANT.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 9 Site Name: TORO CREEK

HGM Subclass: RIVERINE Within Domain: YES (Yes/No) Date: 04/30/08

UTM Cord: 10S 0694642 (Easting) 3922520 +/- 32.1' (Northing) Reference Class: (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: 28.8' (Width) 100.8' (Length) Photo Roll: Photo Numbers:

Creek Order: Team: WSP / PADRE

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	No	—	
Trails (>4")	No	—	
Trails (< 4")	YES	1	MULE DEER (ON BANKS)
Feeding Evidence	No	—	
Squirrel Middens	No	—	
Feathers	No	—	
Bird Nests	No	—	NONE VISIBLE DURING SURVEY / BUT PRESUMED PRESENT
Nesting Cavities	YES	MULT.	
Bedding	NO	—	
Fur	YES	1	COYOTE CARCASS
Scrapes, Rubs, etc.	No	—	
Browse	No	—	
Raptor Pellets	No	—	
Scat - Mammal	No	—	
Scat - Avian	No	—	
Calls - Mammal	No	—	
Calls - Avian	YES	MULT.	SONG SPARROW, PAC.-SLOPE FLYCATCHER, RED-TAILED HAWK, BLACK-HEADED GROSBEAK
Other (specify) -	CONT'D	—	SCRUB JAY, SPOTTED TOWHEE

Additional Notes:

- DENSE RIPARIAN CORRIDOR W/ GOOD NESTING BIRD HABITAT

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
COYOTE	1	BGO	CARCASS / REMAINS @ DOWN-STREAM
SONG SPARROW	1	↓	@ UPSTREAM
STEELHEAD (YOUNG-OF-YEAR)	+/- 50	↓	@ UPSTREAM & DOWNSTREAM
CLIFF SWALLOW(S)	+/- 20	↓	FEEDING ABOVE CHANNEL
SCRUB JAY	1	↓	DOWNSTREAM
TADPOLES (UNID.)	MULT.	↓	@ LARGE POOL DOWNSTREAM
			↓

Additional Notes:

- LARGE WOODY DEBRIS DAMS @ DOWNSTREAM (CUT BY LANDOWNER) OF ASSESSMENT AREA HAS CREATED A LARGE POOL(S); PRESUMED GOOD HABITAT FOR CA. RED-LEGGED FROG & SW POND TURTLE.
- * GOOD/KNOWN STEELHEAD STREAM CENTRAL COAST (NO MIGRATION BARRIERS)

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 9 Site Name: Toro Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 4/30/08
UTM Cord: 0694642 (Easting) 3922520 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers: Creek Order: Team: KK - SS

STREAM CHEMISTRY		GEOMORPHOLOGY		
Stream Temp. ~~(F°)~~ Sams 11°C		Landform	Elev use map.	Slope (RL)
Stream pH 8.53		Landfeature	Aspect 230° BS	Slope (RR)
Electrical Conductivity (uScm^{-1}) 850 uS		Position	Shape	Drainage Class

OBSERVATIONS			
Particle Size Class	Depth to Sat.(In) N/A	Soil Temp 13°C (F°)	Area Floods?/Ponds? (circle)
Is This Soil Hydric? YES (NO)	Redox Depth (In) N/A	Creek Bank and Side Slopes (%) RR 25%	RL ~~[illegible]~~ 55%

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE				ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER org. matter	TEXTURE	GRAVEL (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	pH	OXIDIZED RHIZOSPH y/n
Dm	0	0.5'							~~Sandy~~	~~Sand~~				Weak	Sand							
A	0.5'	6	10YR 3/3		None				loamy	Sand	0	0	0	Sand	-weak		few	few		No		No
A1	6	18	10YR 3/3		None				loamy	sand	15	15		Sand	-weak		—			No		No
	18→		too much cobble to continue																	No		No

Notes:

HGM Riverine Data Sheets
Site #10 – Morro Creek
Morro Bay, California

* Photo series ends w/ a data sheet photo

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 1 of 10

Site#: 10 Site Name: Morro Creek

HGM Subclass: Within Domain: Yes (Yes/No) Date: 5/1/08

UTM Cord: 105 0694765 (Easting) 3917067 ± 16' (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: 39.5' (Width) 274' (Length) Photo Roll: Photo Numbers:

Creek Order: Team: WSP (KK, SS) Padre (JP)

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

* River Left Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	—	—	—
2	20'	12"	Salix lasiolepis
3	13'	3.5"	Salix lasiolepis
4	—	—	—

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	20'	Salix lasiolepis
2	15'	Salix lasiolepis
3	—	—
4	—	—

Seedlings/Saplings

Quarter	Distance	Species
1	12'	Salix lasiolepis
2	—	—
3	2'	Salix lasiolepis
4	3'	Salix lasiolepis

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	—	—
2	—	—
3	—	—
4	—	—

None

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	—	—	—
2	—	—	—
3	—	—	—
4	—	—	—

None

Snags (Trees only)

Quarter	Distance	DBH	Height
1	—	—	—
2	—	—	—
3	—	—	—
4	—	—	—

None

* River Right Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	18'	4"	Salix lasiolepis
2	3'	3.5"	Salix lasiolepis
3	20'	4.5"	Salix lasiolepis
4	—	—	—

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	—	—
2	7'	Salix lasiolepis
3	—	—
4	5'	Salix lasiolepis

Seedlings/Saplings

Quarter	Distance	Species
1	8'	Salix lasiolepis
2	—	—
3	—	—
4	—	—

* difficult to estimate due to thick cape ivy.

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	—	—
2	—	—
3	—	—
4	—	—

None

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1	—	—	—
2	—	—	—
3	—	—	—
4	—	—	—

None

Snags (Trees only)

Quarter	Distance	DBH	Height
1	—	—	—
2	—	—	—
3	—	—	—
4	—	—	—

None

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	
Broadleaf Deciduous	X (Salix lasiolepis)
Needle Leaf	
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=sexual; 1=vegetative; 2=both)

Trees	2
Shrubs	2
Vine	2
Seedling	2
Herbaceous	2

Ferren, Fiedler & Leidy Classification - Palustrine

Palustrine broadleaf deciduous forest (Salix lasiolepis)

Ferren, Fiedler & Leidy Classification - Riverine

Riverine intermittent floating vegetation (algae)

* estimated due to poison oak & thick hedges of cape ivy.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#: 10 Site Name: Morro Creek Team: NSP (KK, SS) Padre (JP) Date: 5/1/08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem ≥ 3" diameter at breast height)

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis	85.5	N
Platanus racemosa	10.5	N

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis	20.5	N

Vines

Species	Cover Class Midpoint	Indigenous Status
Dalea ornata (milkamidas) /senecio	85.5	E
Toxicodendron diversilobum	20.5	N
Rubus ursinus	38	N
Clematis ligusticifolia	10.5	E

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Urtica dioica	10.5	N
Chenopodium californica	10.5	N
Brassica nigra	20.5	E
Rumex crispus	10.5	E
Conium maculatum	20.5	E
Phalaris aquatica	3	E
Poa annua	3	E
Cirsium vulgare	10.5	E
Raphanus sativa	10.5	E
Silybum marianum	10.5	E
Mimulus guttatus	3	N
Veronica anagallis-aquatica	10.5	E
Cyperus eragrostis	10.5	N

Seedlings/Saplings

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis		N

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature: 1=Agriculture: 2=Urban: 3=Other)

River Left Buffer

Sample	Width	Code	Description
1	>50'	2	
2			
3			
4			

River Right Buffer

Sample	Width	Code	Description
1	>25'	2	park/industrial
2			
3			
4			

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
2 / 2	2 / 2	2 / 2	2 / 3	2 / 3
6	**7**	**8**	**9**	**10**
2 / 3	3 / 2	2 / 3	2 / 2	2 / 2

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Salix lasiolepis	111	30

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Salix lasiolepis		0
None		

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
Salix lasiolepis	25-40'	

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
Salix lasiolepis	25'-60'	
Platanus racemosa	30'	

Rumex salicifolia 10.5 E
Melilotus pubescens 10.5 N
Artemisia douglasiana 10.5 N
Baccharis salicifolia 3 N
Euphorbia peplus 10.5 E
Equisetum telmateia 3 N
Geranium dissectum 3 E
Rorippa nasturtium-aquaticum 3 N
Agrostis viridis 10.5 E

Avena barbata 3 E
Malva parviflora 3 E
Nasturtium 10.5 E
Foeniculum vulgare 3 E
Sonchus asper 10.5 E
Medicago polymorpha 3 E

Anagallis aquatica 10.5 E
Carduus pycnocephalus 10.5 E
Bromus diandrus 10.5 E
Brassica tournefortii 10.5 E
Erodium cicutarium 3 E
Rumex pulchra 10.5 E

Gnaphalium luteo-album 3 E
Epilobium sp. 3 N
Taraxacum officinale? 3 E
Plantago lanceolata 3 E
Vinca major 10.5 E
Lolium multiflorum 3 E

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 10 Site Name: Morro Creek
HGM Subclass: Riverine - flow Within Domain: Yes (Yes/No) Date: 5/1/08
UTM Cord: 105 0674769 (Easting) 3917068 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: KK-SS

CROSS-SECTION

	Horizontal Dist (feet)	Elevation (feet)	Notes
	0	5.39'	0
0	0.8'	7.51	edge of water (2.12) to OHW
0.34	5	8.15'	Thalweg (2.76') to OHW
0	9.2'	7.70	edge of water
	30'	6.75	break in slope.
0	39.5	5.39'	0.75'

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS

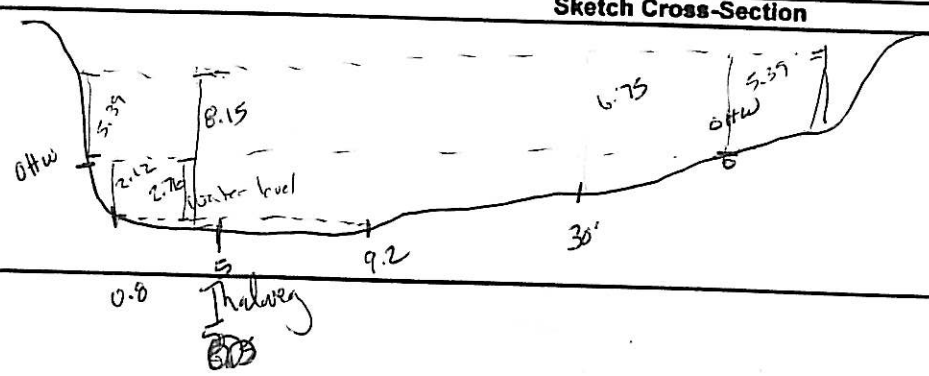
Channel Width at OHW:	39.5'
Top of Bank to Top of Bank:	50'
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	
Assessment Area Length: (7 x OHW Width) 137.25x2	
Channel Depth at Thalweg: (Distance from Thalweg to OHW)	2.76
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth)	46.5'
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	~45' calculate
Rosgen Classification:	

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS

Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radii: (X-Sectional Area/Wetted Perimeter)	

Notes:

Sketch Cross-Section



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 10 Site Name: Morro Creek Team: KK . SS Date: 5/1/08

LONGITUDINAL PROFILE

Total Length:	Section Length:
Channel Aspect:	Channel Slope:

Downstream Section - from X-Section to Downstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
0.0	8.15	Channel Bed Elevation at X-Section
55'	7.96	tail of pool / top of riffle
95'	8.75	riffle - mid deep spot.
138'	9.84	in pool at base of riffle.
		can't see tail of riffle.

0.31
0.10
0.30'
0.70

Upstream Section - from X-Section to Upstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes
0.0	8.15	Channel Bed Elevation at X-Section
25	7.6	glide
66	7.38	glide
112'	7.5	glide
137'	7.49	

0.34
0.28
0.22
0.34
0.35

RESIDUAL POOLS

Sample Area: Active Channel within the Assessment Area

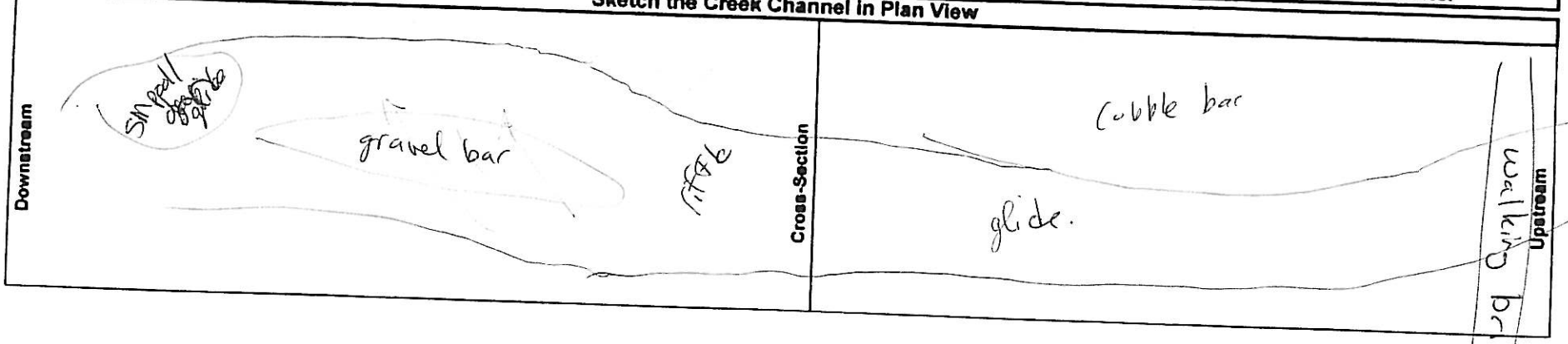
Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth ~~(Inches)~~ feet	Area (feet)	Dist to Next Pool (feet)
1			
2			
3	2.3'	33 x 5' = 165 ft²	73'
4	0.5'	10 x 3 = 30'	out of AA.
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			
Total Pool Number:		Average Pool to Pool Distance:	

Sketch the Creek Channel in Plan View



Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 10 Site Name: Morro Creek

HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 5/1/08

UTM Cord: 10S 0697768 (Easting) 3917068 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:

Creek Order: Team: KK - SS

PEBBLE COUNT MEASUREMENTS

25																			
24																			
23																			
22																			
21																			
20											X								
19											X	X							
18											X	X							
17											X	X							
16											X	X							
15											X	X							
14											X	X							
13											X	X							
12								X			X	X							
11								X			X	X							
10								X		X	X	X							
9								X		X	X	X							
8								X		X	X	X							
7							X	X		X	X	X	X						
6	X						X	X	X	X	X	X	X						
5	X						X	X	X	X	X	X	X						
4	X						X	X	X	X	X	X	X						
3	X						X	X	X	X	X	X	X						
2	X						X	X	X	X	X	X	X						
1	X	X	X		X	X	X	X	X	X	X	X	X	X					
mm <=	2	3	4	6	8	11	16	23	32	45	64	91	128	181	256	362	512	724	1024
phi	-1	-1.5	-2	-2.5	-3	-3.5	-4	-4.5	-5	-5.5	-6	-6.5	-7	-7.5	-8	-8.5	-9	-9.5	-10
%	6	7	1		1	1	8	13	7	11	21	20	9	1					
cum.%	6	7	8		9	10	18	31	38	49	70	90	99	100					

D50 D84

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 10 Site Name: Morro Creek Team: KK-SS Date: 5/1/08

EMBEDDEDNESS FIGURE

N/A

IMMOBILE BED ROUGHNESS FIGURE

All mobile

N/A

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 10 Site Name: Morro Creek Within Domain: Yes (Yes/No) Date: 5/1/08
HGM Subclass: Riverine Reference Class: _____ (0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord: 10S 669 + 768 (Easting) 39 17067 ± 16 ft (Northing) Photo Roll: _____ Photo Numbers: _____
Assessment Area Dimensions: _____ (Width) _____ (Length) Creek Order: _____ Team: KK-SS

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length
If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class
None				8	15	15	2

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD
CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class
None				None			

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present: ~~IIII~~ II	Total number of FWD jams present: ~~IIII~~ III

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream
Many	Many

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 10 Site Name: Morro Creek Team: KK - SS, JP Date: 5/1/08

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	2 bridge crossing gabions footings
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	No - 0
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	No

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
both	residential area upstream.
both	bridges - x2

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	None observed.

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	None

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
bedrock	bridges	runoff
	residential upstream.	runoff

Downstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	NO
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	No
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	No

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	None observed

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	None observed

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	None observed

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
	recreation -	
	runoff channel	stormwater

LAND USE WITHIN THE ASSESSMENT AREA

Adjacent Land Use (Within the Buffer) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	6	6

Wetland Land Use (Below OHW Elevation) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	Upstream	Downstream
	N/A	N/A

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Average Overhang from OHW: 10'	Average Overhang from OHW: 10'
Average Percent Cover: >80 %	Average Percent Cover: >80 %
Describe Distribution: Solid Salix lasiolepis +	Describe Distribution: Cape ivy

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 10 Site Name: MORRO CREEK
HGM Subclass: Within Domain: Yes (Yes/No) Date: 5/1/08
UTM Cord: 10S 0694768 (Easting) 3917067 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site) Photo Roll: Photo Numbers:
Assessment Area Dimensions: 39.5' (Width) 274' (Length) Creek Order: Team: Padre (JP) WSP (KK, SS)

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	Yes	many	domestic dog
Trails (>4")	no		
Trails (< 4")	no		
Feeding Evidence	no		
Squirrel Middens	no		
Feathers	no		
Bird Nests	Yes	1	unknown
Nesting Cavities	no		
Bedding	no		
Fur	no		
Scrapes, Rubs, etc.	no		
Browse	no		
Raptor Pellets	no		
Scat - Mammal	no		
Scat - Avian	no		
Calls - Mammal	no		
Calls - Avian	Yes		see animal observations list
Other (specify) -			

Additional Notes:

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
Anna's hummingbird	2	JP	Riparian corridor
Scrub jay	1		" "
House finch	>5		" "
Lesser goldfinch	>5		" "
Cliff swallows	>10		flying overhead
American crow	1		birdar crossing
European Starling	1		Riparian corridor
white-crowned sparrow	>5		" "
song sparrow?	>5		" "
Pacific chorus frog	1		Riparian corridor
Western fence lizard	2		Right bank
south-central coast steelhead	>5	(young of the year)	channel
domestic dog	1		channel

Additional Notes:
swallow tail butterfly
painted lady butterfly

* Animal survey less extensive than @ other sites

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 10 Site Name: Morro Creek
HGM Subclass: Riverine low elevation Within Domain: Yes (Yes/No) Date: 5/1/08
UTM Cord: 10S 0694768 (Easting) 3917067 ± 16 ft (Northing) Reference Class: _____ (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: _____ (Width) _____ (Length) Photo Roll: _____ Photo Numbers: _____
Creek Order: _____ Team: KK-SS

STREAM CHEMISTRY		GEOMORPHOLOGY		
Stream Temp. (F°) 11.5°C		Landform partially filled coastal basin	Elev	Slope (RL) 16%
Stream pH 8.6		Landfeature stream	Aspect E-W	Slope (RR) 10%
Electrical Conductivity (uScm^{-1}) 1030		Position	Shape	Drainage Class

OBSERVATIONS			
Particle Size Class	Depth to Sat.(In) —	Soil Temp 11.5°C (F°)	Area Floods?/Ponds? (circle)
Is This Soil Hydric? YES (NO)	Redox Depth (In)	Creek Bank and Side Slopes (%) RR 9%	RL vertical

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE				ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER	TEXTURE	GRAVEL (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	pH	OXIDIZED RHIZOSPH y/n
O	0	1																				
A	1	6	2.5Y 4/3		—	—	—	—	loamy	sand	—	—	—	weak sub	angular blocky		few	—	few	—		
	6	16	10YR 4/3		—	—	—	—	coarse 3-6 mm	sand	50	—	—	—	—	—	few	—	—			
	16	22	10YR 4/2		conc.	5 mm	<2%	7.5YR 4/6	sandy	loam	—	—	—	sub angular blocky		—	few	—	—		8.44	

Notes:
ped faces moist

HGM Riverine Data Sheets
Site #11 – See Canyon Creek
San Luis Obispo County, California

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 1 of 10

Site#: 18 Site Name: Sea Canyon Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 5/1/08
NAD 83 UTM Cord: 1DS 06947167 (Easting) 3917067 ± (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: 24' (Width) 168' (Length) Photo Roll: Photo Numbers: Creek Order: Team: JP, BD (Padre) KK, SS (WSP)

POINT-CENTER QUARTER PLOTS

Sample Area: In the Buffer within Assessment Area

Randomly establish plot center within the buffer on river left and river right, and perform standard PCQ measurements

River Left Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	23'	36"	Platanus racemosa
2	42'	40"	Platanus racemosa
3	6'	9.5"	Populus balsamifera trichocarpa
4			

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1	16'	Salix laevigata
2		
3	5'	Populus balsamifera trichocarpa
4		

Seedlings/Saplings

Quarter	Distance	Species
1	15'	Populus balsamifera ssp trichocarpa
2	3.5'	Salix laevigata
3		
4	2.0	Populus balsamifera trichocarpa

Shrubs (multiple woody stems)

Quarter	Distance	Species
1		
2		None
3		
4		

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1			
2			
3	6'	10'	22"
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1			
2	8'	2.5"	8'
3			
4			

River Right Buffer

Trees (single stem > 3" diameter at breast height)

Quarter	Distance	DBH	Species
1	60'	45"	Quercus agrifolia
2	18'	32"	Platanus racemosa
3	50'	4"	Platanus racemosa
4			

Small trees (< 3" diameter at breast height)

Quarter	Distance	Species
1		
2		
3		
4		

Seedlings/Saplings

Quarter	Distance	Species
1		
2		
3		
4		

Shrubs (multiple woody stems)

Quarter	Distance	Species
1	20'	Cornus sericea
2		
3		
4	20'	Salix lasiolepis

Coarse Wood (> 3" diameter at breast height)

Quarter	Distance	Length	Diameter
1			
2			
3			
4			

Snags (Trees only)

Quarter	Distance	DBH	Height
1			
2			
3			
4			

LEAF TYPE OF DOMINANT STRATUM

Dominant Stratum:	
Broadleaf Evergreen	
Broadleaf Deciduous	X
Needle Leaf	
Mixed Evergreen & Deciduous	
Herbaceous	
Other	

DOMINANT TYPE OF REGENERATION

Codes for each stratum (0=sexual; 1=vegetative; 2=both)

Trees	2
Shrubs	2
Vine	2
Seedling	2
Herbaceous	2

Ferren, Fiedler & Leidy Classification - Palustrine

Palustrine, broadleaf deciduous forest, mixed vascular, streambank forest (Platanus, Salix, Juglans, Cornus, Acer, Populus)

Ferren, Fiedler & Leidy Classification - Riverine

Riverine, lower perennial unvegetated, unconsolidated bottom (cobble-gravel) riverbed

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Plant Community - 2 of 10

Site#: 18 Site Name: Sea Canyon Creek Team: JP, BD, KK, SS Date: 5/1/08

SPECIES COMPOSITION AND INDIGENOUS STATUS

Sample Area: In the buffer, within the Assessment Area

Codes for Indigenous status in each stratum: (N=Native: E=Exotic: O=Ornamental)

Trees (single stem > 3" diamter at breast height)

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis	38	N
Platanus racemosa	85.5	N
Quercus agrifolia	10.5	N
Acer negundo	10.5	N
Juglans californica var. californica	38	N
Populus balsamifera ssp trichocarpa	38	N
Salix laevigata	10.5	N

Shrubs (multiple woody stems)

Species	Cover Class Midpoint	Indigenous Status
Cornus sericea ssp occidentalis	85.5	N
Salix laevigata	10.5	N
Salix lasiolepis	10.5	N

Vines

Species	Cover Class Midpoint	Indigenous Status
Rubus ursinus	20.5	N
Toxicodendron diversilobum	20.5	N

Forbs, Graminoids, Ferns & Fern Allies

Species	Cover Class Midpoint	Indigenous Status
Equisetum telmateia	20.5	N
Scirpus microcarpus	20.5	N
Mentha spicata var spicata	10.5	E
Epilobium sp.	3	N
Artemisia douglasiana	3	N
Symphoricarpos mollis	3	N
Medicago polymorpha	0	N

Seedlings/Saplings

Species	Cover Class Midpoint	Indigenous Status
Salix lasiolepis	3	N
Quercus agrifolia	0	N

WIDTH OF RIPARIAN VEGETATION

Sample Area: In the buffer, within the Assessment Area

Codes for reason of termination: (0=Natural feature: 1=Agriculture: 2=Urban: 3=Other)

River Left Buffer

Sample	Width	Code	Description
1	38'		
2	↓		
3	↓		
4	↓		

River Right Buffer

Sample	Width	Code	Description
1	>50'	3	Road
2	↓		
3	↓		
4	↓		

NUMBER OF STRATA PRESENT

Measure the number of strata along two 100 foot transects (RL & RR) (Read of the Toe of Boot every ten paces) (e.g. tree+shrub+herb=3)

1	2	3	4	5
3/3	2/2	3/3	2/2	3/2
6	**7**	**8**	**9**	**10**
2/2	2	3	3	2

PLOT CRUISE

Sample Area: In the buffer, within the Assessment Area

Use prism to estimate density, and basal area.

Basal Area: River Left

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Populus balsamifera	1	10
Platanus racemosa	III	40
Salix laevigata	1	10

Basal Area: River Right

Tree Species	Density (stem/acre)	Basal area (sq. ft/acre)
Quercus agrifolia	1	10
Platanus racemosa	III	30

Height & Age: River Left

Tree Species	Height (feet)	Age (Years)
Platanus racemosa	100-125'	
Populus balsamifera ssp trichocarpa	125'	
Juglans californica var. californica	85'	
*Salix lasiolepis	30-45'	

Height & Age: River Right

Tree Species	Height (feet)	Age (Years)
Acer negundo	30'	
Quercus agrifolia	45-50'	
Platanus racemosa	100-125'	

* willows have been topped along power line

Method- measure from

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 3 of 10

Site#: 18 Site Name: See Canyon Creek Within Domain: Yes (Yes/No) Date: 5/1/08
HGM Subclass: Riverine Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
UTM Cord: 0694767 (Easting) 3917067 (Northing) Photo Roll: Photo Numbers:
Assessment Area Dimensions: (Width) (Length) Creek Order: Team: KK - SS

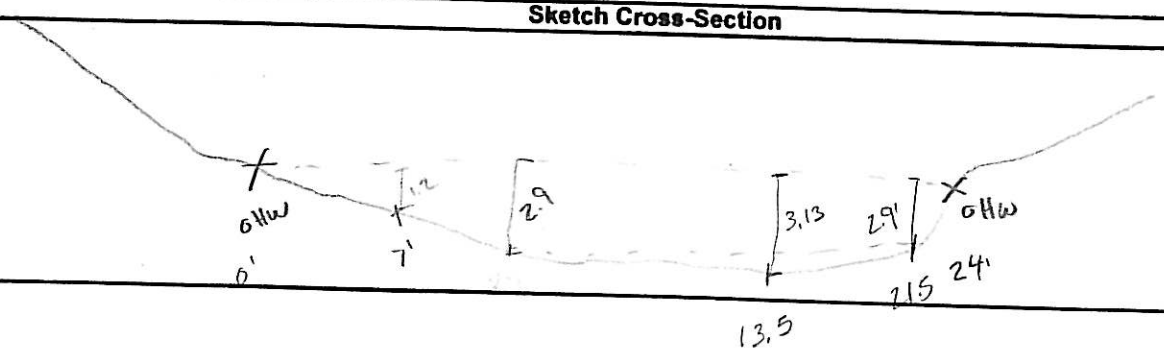
Depth	Horizontal Dist (feet)	Elevation (feet)	Notes
	0	0'	OHW - left bank
	7'	1.2'	
0	10.75'	2.9'	edge of water - LB
0.30	13.5'	3.13'	Thalweg
0	21.5'	2.90'	edge of water
	24'	0	

CHANNEL CHARACTERISTICS - FIELD MEASUREMENTS	
Channel Width at OHW:	24'
Top of Bank to Top of Bank:	
Assessment Area Width: (2 x Buffer (50' rural or 100' urban) + Top of Bank Width)	
Assessment Area Length: (7 x OHW Width) 84x2	168'
Channel Depth at Thalweg: (Distance from Thalweg to OHW) 6.2'	3.13'
Flood Prone Area Width: (Horizontal Projection at 2 x Thalweg Depth)	75'
Wetted Perimeter: (Channel Bed Length from OHW to OHW)	29'
Rosgen Classification:	

CHANNEL CHARACTERISTICS - OFFICE CALCULATIONS	
Average Channel Depth: (Distance from Channel Bed to OHW)	
OHW Width to Depth Ratio:	
OHW Cross-Sectional Area:	
Entrenchment Ratio: (Floodprone Area Width/OHW Width)	
Hydraulic Radii: (X-Sectional Area/Wetted Perimeter)	

Notes:

Sketch Cross-Section



84
79
163

27
14
13

13
26
39

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Survey - 4 of 10

Site#: 18 Site Name: See Canyon Creek Team: KK - SS Date: 5/1/08

LONGITUDINAL PROFILE

Total Length: 163	Section Length: 79+84
Channel Aspect: 180° → DS	Channel Slope:

Downstream Section - from X-Section to Downstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes	Depth of water
+ 0.0'	7.02	Channel Bed Elevation at X-Section	0.30'
+ 12	7.35	glide	0.45
+ 37'	7.40		0.42
+ 51'	7.37		0.20
+ 66'	7.75		0.40
+ 79'	7.82		0.35
+			

Upstream Section - from X-Section to Upstream AA Boundary

Dist from X-Sec (feet)	Elevation (feet)	Notes	
- 0.0'	7.02	Channel Bed Elevation at X-Section	0.30
-			0.3
- 5'	7.08	bottom of pool	0.38
- 25'	7.0	bottom of riffle → pool	0.32
- 40'	6.67	glide	0.30
- 60'	6.38		0.38
- 84'	6.32		

RESIDUAL POOLS

Sample Area: Active Channel within the Assessment Area

Identify pools by measuring the maximum depth of the pool relative to the overflow elevation

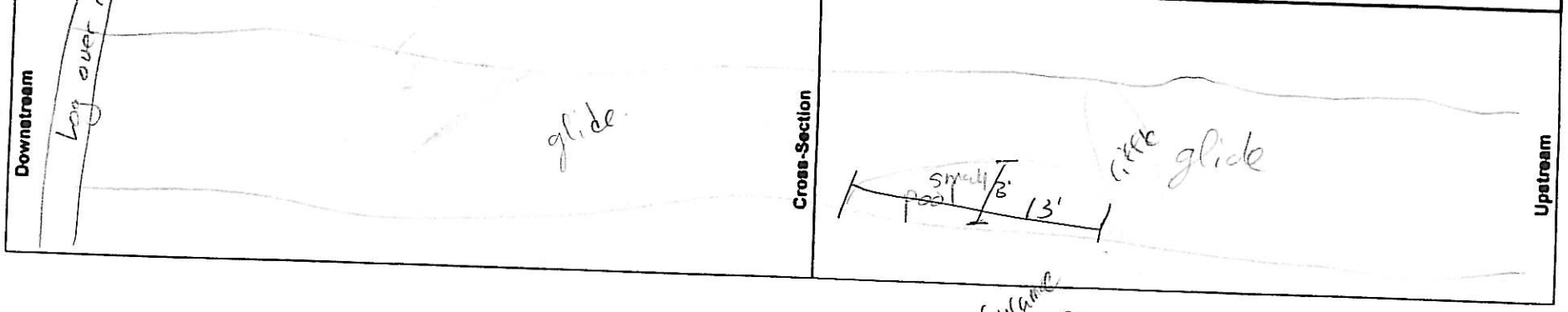
Pool Criteria: High Gradient Subclass (> 3 inches deep and > 4 square feet in size)

Medium and Low Gradient Subclasses (> 6 inches deep and > 10 square feet in size)

Pool Number	Depth (inches)	Area (feet)	Dist to Next Pool (feet)
1	8"	13' x 3' = 39	84' each direction
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Mean:			

Total Pool Number: Average Pool to Pool Distance:

Sketch the Creek Channel in Plan View



fines prominent

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 5 of 10

Site#: 18 Site Name: Slee Canyon Creek

HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 5/4/08

UTM Cord: 10S 0694767 (Easting) 3917067 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)

Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:

Creek Order: Team: KK SS

PEBBLE COUNT MEASUREMENTS

	mm <=	phi	%	cum.%
25	2	-1	4	4
24	3	-1.5	1	5
23	4	-2		
22	6	-2.5	6	11
21	8	-3	6	17
20	11	-3.5	13	30
19	16	-4	7	37
18	23	-4.5	11	48
17	32	-5	15	63
16	45	-5.5	8	71
15	64	-6	13	84
14	91	-6.5	6	90
13	128	-7	9	99
12	181	-7.5		
11	256	-8	1	100
10	362	-8.5		
9	512	-9		
8	724	-9.5		
7	1024	-10		
6				
5				
4				
3				
2				
1				

D50 D84

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Channel Bed Materials - 6 of 10

Site#: 18 Site Name: See Canyon Creek Team: KK-SS Date: 5/1/08

EMBEDDEDNESS FIGURE

N/A

IMMOBILE BED ROUGHNESS FIGURE

N/A

EMBEDDEDNESS MEASUREMENTS

Sample Area: Active Channel within the Assessment Area

Select cobble size for embed measurements by selecting the mode from the appropriate pebble count histogram

Iteration	Vertical Cobble Measurement (mm)	Vertical Embedd Measurement (mm)	Size of Fines (mm)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

IMMOBILE BED ROUGHNESS MEASUREMENTS

Sample Area: OHW Cross-Sections within the Assessment Area

Select boulder size for immobile bed roughness by selecting the D84 from the pebble count histogram and cross check with field indicators

Upstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Downstream Cross-Section (1 OHW channel width from the baseline cross-section)

OHW Channel Width:			Channel Depth:		Ave. Channel Depth:		
Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)	Sample Number	Width (feet)	Height (feet)	Area (sq. ft.)
1				6			
2				7			
3				8			
4				9			
5				10			

Cross-Section Area: (ft^2) Boulder Area: (ft^2) Roughness % (BA/CSA):

Notes:

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Woody Debris - 7 of 10

Site#: 18 Site Name: See Canyon Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 5/1/08
UTM Cord: 105 0694767 (Easting) 3917067 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: BD, KK, SS

COARSE WOODY DEBRIS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD is defined as >3" diameter & > 5' in length
If more than 16 CWD are found within the AA, then measure CWD jams

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class	Diameter (inches)	Length Below OHW (feet)	Total Length (feet)	Decomp Class
6"	2'	5'	2	9"	2'	10'	3
3"	4'	20'	2	4"	15'	15'	2
				4"	9'	11'	3

COARSE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

CWD jams are defined as > 2' width & > 5' in length, with at least 4 pieces of CWD
CWD jams do not include wracked debris above the OHW elevation

Upstream AA Boundary to X-Section				Downstream AA Boundary to X-Section			
Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class	Width (feet)	Length (feet)	Area (sq. ft.)	Decomp Class
10'	8'	80 sf.	2				
30'	5'	150 sf.	3	4'	10'	240 ft2	3

FINE WOODY DEBRIS JAMS

Sample Area: In Channel, Below OHW, within the Assessment Area

FWD jams are defined as assemblages of FWD (sticks, twigs, etc.) that are > 1 square foot in area

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
Total number of FWD jams present: 9	Total number of FWD jams present: 14

BANK SOURCE OF CWD

Total # of Trees and Snags Proximate to the Bank

Upstream	Downstream
15	20

CWD DECOMPOSITION CLASSES

1	CWD recently fallen, bark attached, leaves & fine twigs present
2	Logs with loose bark, no leaves/fine twigs, fungi present
3	Logs w/o bark, few stubs of branches, fungi present
4	Logs w/o branches/bark, heartwood in advanced state of decay
5	Logs decayed into ground

Notes:

Downstream debris jam is caught behind cottonwood trunk fallen at 5' above channel.

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Hydrology & Buffer - 8 of 10

Site#: 18 Site Name: See Canyon Creek Team: BD Date: 5/1/08

HYDROLOGIC CHARACTERISTICS

Sample Area: Length of the Channel within the Assessment Area

Answer the following questions using visual observations of the Assessment Area from the vantage of the creek channel

Upstream AA Boundary to X-Section

Are there levees, dikes, etc present? (0=No:1=Yes(natural):2=Yes(artificial))	No
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	No
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	No

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
RL	LARGE (20") CULVERT W/ CONCRETE APRON AND DROP INLET @ TOP OF BANK

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE KNOWN OR VISIBLE

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	NONE KNOWN OR VISIBLE

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
UNDETERMINED	DROP INLET AND 20" CULVERT @ UPPER ASSESSMENT AREA	SURFACE RUNOFF DURING RAIN SEASON, APPEARS TO DRAIN ENTIRE ORCHARD

Downstream AA Boundary to X-Section

Are there levees, dikes, etc. present? (0=No:1=Yes(natural):2=Yes(artificial))	No
Is there a hydrologic connection to waters/wetlands? (0=No(describe):1=Yes)	No
Are there observable downstream barriers to fish passage? (0=No:1=Yes(natural)(describe):2=Yes(artificial)(describe))	No

If there are surface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE VISIBLE

If there are subsurface water inputs to the creek channel, describe them below

RL or RR	Type
	NONE KNOWN OR VISIBLE

If there are surface water outputs from the creek channel, describe them below (e.g.diversions, pumps, etc.)

RL or RR	Type
	NONE KNOWN OR VISIBLE

If there are sediment inputs to the buffer or creek channel, describe them below

Source Area (sq. ft.)	Description of Source Area	Transport Vector
	Ø — SEE AA DISCUSSION FOR SEDIMENT IMPACTS TO CHANNEL	

LAND USE WITHIN THE ASSESSMENT AREA

	Upstream	Downstream
Adjacent Land Use (Within the Buffer) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture:5=low density housing: 6=urban:7=cleared:8=other(describe))	4 (W/ SFR)	4 (W/ SFR)
Wetland Land Use (Below OHW Elevation) (1=undisturbed:2=logged 0-5 yrs. ago: 3=logged 5+ yrs. ago:4=agriculture 5=low density housing: 6=urban:7=cleared:8=other(describe))	1	1

SHADE OVER CHANNEL

Upstream AA Boundary to X-Section	Downstream AA Boundary to X-Section
~~Average Overhang from OHW:~~	~~Average Overhang from OHW:~~
Average Percent Cover: 90%	Average Percent Cover: 90%
Describe Distribution:	Describe Distribution:
40% PLATANUS SP., 30% SALIX SP., 10% CORNUS	50% PLATANUS, POPULUS 10%, SALIX 20%, ACER 5%, CORNUS 5%

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Animal Sign - 9 of 10

Site#: 18 Site Name: See Canyon Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 5/1/08
UTM Cord: (Easting) (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Photo Roll: Photo Numbers:
Creek Order: Team: BD

ANIMAL SIGN

Sample Area: All Portions of the Assessment Area

Feature	Yes/No	Number	Species/Notes
Tracks	No	—	
Trails (>4")	No	—	
Trails (< 4")	No	—	
Feeding Evidence	No	—	
Squirrel Middens	No	—	
Feathers	Yes	Mult.	Poss. Chestnut-backed chickadee
Bird Nests	No	—	
Nesting Cavities	Yes	Mult.	w/ large sycamores in corridor
Bedding	No	—	* Excellent nesting cavities
Fur	No	✓	
Scrapes, Rubs, etc.	No	—	
Browse	No	—	
Raptor Pellets	No	—	
Scat - Mammal	No	—	
Scat - Avian	Yes		Unknown species
Calls - Mammal	No	—	
Calls - Avian	Yes	Mult.	- Black-headed grosbeak, House finch, Lesser goldfinch, Chestnut-backed chickadee
Other (specify) - Avian calls	Cont'd		Pacific slope flycatcher, Chickadee, Song sparrow, Spotted towhee
			Domestic chicken, Calif. quail, Scrub jay
			Wrentit.

Additional Notes:

ANIMAL OBSERVATIONS

Sample Area: All Portions of the Assessment Area

Species	Number	Observer	Location
Steelhead/Young-of-year	Mult.	BGD	Upstream / presumed down as well
Western fence lizard	11	KK/BGD	Upstream
Calif. towhee	1	BGD	Downstream
Calif. quail	1	BGD	11
Steller's jay	1	BGD	11
Nuttall's woodpecker	1	BGD	11
Pac. slope flycatcher	1	BGD	11

Additional Notes:
* Excellent steelhead habitat / multiple steelhead y.o.y. observed in both pools and glides of assessment area (i.e., steelhead nursery).

debris flow
alluvial fan
coastal terrace

Chevron San Luis Obispo Tank Farm

HGM Functional Assessment Data Sheet for Riverine Ecosystems: Soils, Geomorphology, and Chemistry - 10 of 10

Site#: 18 Site Name: See Canyon Creek
HGM Subclass: Riverine Within Domain: Yes (Yes/No) Date: 5/1/08
UTM Cord: 10S 0694767 (Easting) 3917067 (Northing) Reference Class: 0 (0=Reference Site:1=Reference Standard:2=Project Site)
Assessment Area Dimensions: (Width) (Length) Creek Order: Photo Roll: Photo Numbers:
Team: Kk-SS

STREAM CHEMISTRY		GEOMORPHOLOGY		
Stream Temp. (F°) 12 °C	Valley - incised in alluvial valley. uplifted coastal terrace	Landform distal end of alluvial fan.	Elev	Slope (RL)
Stream pH 8.46		Landfeature incised chanel on valley. alluvial	Aspect S	Slope (RR)
Electrical Conductivity (uScm^{-1}) 940 uS/cm		Position midway down alluvial fan.	Shape concave - channel.	Drainage Class

OBSERVATIONS			
Particle Size Class	Depth to Sat.(In) NA	Soil Temp 11 °C (F°)	Area Floods?/Ponds? (circle)
Is This Soil Hydric? YES (NO)	Redox Depth (In) NA	Creek Bank and Side Slopes (%) RR 28% RL 40%	

SOIL DATA AND DESCRIPTION

HORIZON					REDOX FEATURES				TEXTURE					STRUCTURE				ROOTS		CHEM		
HORIZON	UPPER (in)	LOWER (in)	COLOR (moist) munsell	BOUNDARY	TYPE	SIZE (mm)	AREA (%)	COLOR (moist) munsell	MODIFIER	TEXTURE	GRAVEL (%)	COBBLE (%)	STONES (%)	PRIMARY	SECONDARY	CONSIST	FINE	MEDIUM	COARSE	SULF ODOR y/n	pH	OXIDIZED RHIZOSPH y/n
O	0	5	sycamore leaf / duff																			
	5	10	10YR 3/2	—	—	—	—	—	loamy	sand	5	—	—	—	—	—		some	—	—		
	10	26	10YR 3/2		—	—	—	—	loamy	sand	—	—	—	subangular	weak		—	few	—	—		
	26	↓	10YR 3/2		—	—	—	—	loamy	sand	—	—	—	angular	blocky							

Notes:
Pit at Toe of slope ~ 5' above OHW elevation

Appendix D
San Luis Obispo Riverine HGM Guidebook
Data Summary

AppendixD

PLANT COMMUNITY DATA

Date	Site Number	RL Point Center Quarter Plots	Tree Sp.	Distance (ft)	DBH (in)	RL Point Center Quarter Plots	Small Tree Sp.	Distance	DBH	RL Point Center Quarter Plots	Seedling Sapling Sp.	Distance	DBH	RL Point Center Quarter Plots	Shrub Sp.	Distance	DBH	RL Point Center Quarter Plots	Coarse Wood Distance	Length	Diameter	Area	volume	RL Point Center Quarter Plots	Snag Distance	DBH	Height
4/28/2008	1	1.1				1.1				1.1				1.1				1.1						1.1			
		1.2				1.2				1.2				1.2				1.2						1.2			
		1.3				1.3				1.3				1.3				1.3						1.3			
		1.4				1.4				1.4				1.4				1.4						1.4			
4/28/2008	2	1.1	Juglans Californica	30	7, 11	1.1				1.1				1.1	Salix lasiolepis	30		1.1						1.1			
		1.2	Juglans Californica	7		1.2				1.2				1.2				1.2	33	32	4.5	0.11039	3.5325	1.2			
		1.3	Juglans Californica	25		1.3				1.3				1.3	Salix lasiolepis	27.5		1.3	8	6.2	3	0.04906	0.304188	1.3			
		1.4				1.4				1.4				1.4	Salix lasiolepis	9		1.4						1.4			
4/28/2008	3	1.1	Quercus agrifolia			1.1	Myoporum leetum			1.1	Juglans californica			1.1	Berberis			1.1						1.1			
		1.2	Juglans Californica			1.2				1.2				1.2	Cottoneaster pannosa			1.2						1.2			
		1.3	Betula pendula			1.3				1.3				1.3				1.3						1.3			
		1.4				1.4				1.4				1.4				1.4						1.4			
4/29/2008	4	1.1	Salix lasiolepis	7	5.1	1.1				1.1				1.1				1.1	6	12	3.25	0.11516	1.381927	1.1	15	4	15
		1.2	Salix lasiolepis	10	6	1.2	Salix lasiolepis	4		1.2				1.2				1.2	3	3.5	3	0.09813	0.343438	1.2			
		1.3	Salix lasiolepis	3	9	1.3	Salix lasiolepis	15		1.3				1.3				1.3	6	30	6	0.3925	11.775	1.3			
		1.4	Salix lasiolepis	10	6	1.4				1.4	Salix lasiolepis	15		1.4				1.4						1.4	5	5	25
4/29/2008	6	1.1	Salix lasiolepis	15	9	1.1				1.1				1.1	Toxicodendron diversilobum	3		1.1	0	6	8	0.69778	4.186667	1.1			
		1.2	Salix lasiolepis	10	6	1.2				1.2				1.2	Toxicodendron diversilobum	3		1.2	5	20	3.5	0.13356	2.671181	1.2			
		1.3	Salix lasiolepis	8	9	1.3	Salix lasiolepis	8		1.3				1.3	Salix lasiolepis	8		1.3						1.3			
		1.4				1.4				1.4				1.4				1.4						1.4			
4/29/2008	5	1.1	Salix laevigata	12	5.2	1.1	Platanus racemosa	9.6		1.1	Platanus racemosa	11.8		1.1				1.1						1.1			
		1.2	Salix laevigata	14	4.6	1.2	Platanus racemosa	34		1.2				1.2				1.2						1.2	13	3	20
		1.3	Salix laevigata	10	9.8	1.3				1.3				1.3				1.3	11	25	3.5	0.13356	3.338976	1.3			
		1.4	Platanus racemosa	10	6.5	1.4	Platanus racemosa	16		1.4	Platanus racemosa	8		1.4	Salix lasiolepis	11		1.4	15	5.6	3	0.09813	0.5495	1.4			
4/30/2008	8	1.1				1.1				1.1	Quercus agrifolia	6		1.1				1.1						1.1			
		1.2	Platanus racemosa	14.6	15	1.2	Salix lasiolepis	12.5		1.2	Rhamnas californica	15		1.2	Baccharis pilularis	6		1.2						1.2			
		1.3	Quercus agrifolia	12	15	1.3	Quercus agrifolia	3		1.3	Rhamnas californica	4		1.3	Baccharis pilularis	6		1.3						1.3			
		1.4	Salix lasiolepis	9	6	1.4				1.4				1.4	Baccharis pilularis	4		1.4	5.5	6	3.5	0.13356	0.801354	1.4			
4/30/2020	9	1.1	Salix lasiolepis	6	9	1.1				1.1				1.1				1.1						1.1			
		1.2	Salix lasiolepis	15	4	1.2				1.2				1.2	Mimulus aurantiacus	7		1.2						1.2	15	5	25
		1.3	Salix lasiolepis	30	8	1.3				1.3				1.3	Sambucus mexicana	12		1.3	7	25	6	0.3925	9.8125	1.3			
		1.4				1.4	Quercus agrifolia	15		1.4	Quercus agrifolia	12		1.4	Rhamnus californica	13		1.4						1.4			
4/30/2008	7	1.1				1.1	Salix lasiolepis	8.92		1.1	Salix lasiolepis	20		1.1	Baccharis pilularis	8		1.1						1.1			
		1.2	Populus balsam	7	4.6	1.2				1.2	Populus balsam	6.5		1.2	Eriophyllum confertiflorum	3.33		1.2						1.2			
		1.3	Populus balsam	8.67	3.1	1.3	Populus balsam	15		1.3	Salix lasiolepis	13		1.3				1.3						1.3			
		1.4				1.4	Salix lasiolepis	6.83		1.4	Salix lasiolepis	10		1.4				1.4						1.4			
5/1/2008	11	1.1	Platanus racemosa	23	36	1.1	Salix laevigata	16		1.1	Populus balsam	15		1.1				1.1						1.1			
		1.2	Platanus racemosa	42	40	1.2				1.2	Salix laevigata	3.5		1.2				1.2						1.2			
		1.3	Populus balsam	6	9.5	1.3	Populus balsam	5		1.3				1.3				1.3	6	10	22	5.27694	52.76944	1.3	8	2.5	8
		1.4				1.4				1.4	Populus balsam	2		1.4				1.4						1.4			
5/1/2008	10	1.1				1.1	Salix lasiolepis	20		1.1	Salix lasiolepis	12		1.1				1.1						1.1			
		1.2	Salix lasiolepis	20	6	1.2	Salix lasiolepis	15		1.2				1.2				1.2						1.2			
		1.3	Salix lasiolepis	13	3.5	1.3				1.3	Salix lasiolepis	2		1.3				1.3						1.3			
		1.4				1.4				1.4	Salix lasiolepis	3		1.4				1.4						1.4			

AppendixD

PLANT COMMUNITY DATA

Date	Site Number	RR Point Center Quarter Plots	Tree Sp.	Distance	DBH	RR Point Center Quarter Plots	Small Tree Sp.	Distance	DBH	RR Point Center Quarter Plots	Seedling Sapling Sp.	Distance	DBH	RR Point Center Quarter Plots	Shrub Sp.	Distance	DBH	RR Point Center Quarter Plots	Coarse Wood Distance	Length	Diameter	Area	Volume	RR Point Center Quarter Plots	Sang Distance	DBH	Height
4/28/2008	1	1.1				1.1				1.1				1.1				1.1					0	1.1			
		1.2				1.2				1.2				1.2				1.2						1.2			
		1.3				1.3				1.3				1.3				1.3						1.3			
		1.4				1.4				1.4				1.4				1.4						1.4			
4/28/2008	2	1.1	Eucalyptus globulus	27	4	1.1				1.1	Quercus agrifolia	2		1.1	Baccharis pilaris	27		1.1	4	2.5	5	0.2725694	0.681424	1.1			
		1.2				1.2				1.2				1.2	Salix lasiolepis	27		1.2					0	1.2			
		1.3				1.3				1.3				1.3				1.3					0	1.3			
		1.4				1.4				1.4				1.4	Salix lasiolepis	10.6		1.4	30	8	4.5	0.2207813	1.76625	1.4			
4/28/2008	3	1.1	Pinus radiata	17	5	1.1				1.1	Ficus carica			1.1	Grevilea rosemarinifolia	4		1.1					0	1.1			
		1.2	Platanus racemosa	4.5	7.5	1.2				1.2	Platanus racemosa			1.2	Pyracantha angustafolia	7		1.2					0	1.2			
		1.3				1.3				1.3				1.3	Pyracantha angustafolia	10		1.3					0	1.3			
		1.4				1.4				1.4				1.4				1.4					0	1.4			
4/29/2008	4	1.1	Salix laevigata	6	3.5	1.1				1.1				1.1	Baccharis pilaris var consig	10		1.1	6	4.5	3.5	0.133559	0.601016	1.1			
		1.2	Quercus agrifolia	25	12	1.2				1.2	Salix lasiolepis	3		1.2	Toxicodendron diversilobum	0.5		1.2	10	15	3	0.098125	1.471875	1.2			
		1.3	Quercus agrifolia	12	10	1.3				1.3				1.3	Toxicodendron diversilobum	1		1.3					0	1.3			
		1.4				1.4	Salix lasiolepis	8		1.4				1.4	Toxicodendron diversilobum	2		1.4					0	1.4			
4/29/2008	6	1.1				1.1				1.1				1.1				1.1	10	15	6	0.3925	5.8875	1.1			
		1.2	Salix laevigata	3.5	13.5	1.2				1.2				1.2	Sambucus mexicana	10		1.2	7	3.25	6	0.3925	1.275625	1.2			
		1.3				1.3				1.3				1.3				1.3	10	25	8	0.6977778	17.44444	1.3			
		1.4	Salix laevigata	15.1	12	1.4				1.4				1.4				1.4	6	7	6	0.3925	2.7475	1.4	20	11.3	35
4/29/2008	5	1.1				1.1				1.1				1.1				1.1					0	1.1			
		1.2				1.2				1.2				1.2				1.2					0	1.2			
		1.3	Salix laevigata	16	8.6	1.3	Platanus racemosa	13		1.3	Platanus racemosa	5.5		1.3	Baccharis pilularis	5		1.3					0	1.3			
		1.4	Salix laevigata	17	9	1.4	Platanus racemosa	10.5		1.4	Platanus racemosa	15		1.4	Baccharis pilularis	11		1.4					0	1.4	10.5	5.8	35
4/30/2008	8	1.1	Salix lasiolepis	5	8	1.1	Salix lasiolepis	15		1.1				1.1	Mimulus auranticus	4.5		1.1	5	6	8	0.6977778	4.186667	1.1			
		1.2	Salix lasiolepis	6.9	7.2	1.2				1.2	Umbeullaria californica	8.5		1.2	Rhamnas californica	10		1.2	5.33	6	8	0.6977778	4.186667	1.2			
		1.3				1.3				1.3	Umbeullaria californica	12		1.3	Rhamnas californica	4.67		1.3					0	1.3			
		1.4	Salix lasiolepis	3	6	1.4				1.4	Umbeullaria californica	1.5		1.4	Rhamnas californica	6		1.4	4	8	4	0.1744444	1.395556	1.4			
4/30/2020	9	1.1	Umbellularia californica	8	4.5	1.1				1.1				1.1				1.1					0	1.1	15	3.5'	18
		1.2	Quercus agrifolia	4	6	1.2	Quercus agrifolia	5		1.2				1.2				1.2					0	1.2			
		1.3	Salix lasiolepis	15	6	1.3				1.3	Quercus agrifolia	8		1.3				1.3					0	1.3			
		1.4	Salix lasiolepis	10	4	1.4				1.4				1.4				1.4					0	1.4			
4/30/2008	7	1.1	Salix lasiolepis	16	8	1.1	Salix lasiolepis	7.25		1.1	Quercus agrifolia	0.5		1.1				1.1					0	1.1			
		1.2				1.2				1.2				1.2	Baccharis pilularis	16		1.2					0	1.2			
		1.3				1.3				1.3				1.3	Baccharis pilularis	12		1.3					0	1.3			
		1.4	Salix lasiolepis	8.67	6.2	1.4	Salix lasiolepis	6.5		1.4	Quercus agrifolia	1		1.4				1.4					0	1.4			
5/1/2008	11	1.1	Quercus agrifolia	60	45	1.1				1.1				1.1	Cornus sericea	20		1.1					0	1.1			
		1.2	Platanus racemosa	18	32	1.2				1.2				1.2				1.2					0	1.2			
		1.3	Platanus racemosa	50	4	1.3				1.3				1.3				1.3					0	1.3			
		1.4				1.4				1.4				1.4	Salix lasiolepis	20		1.4					0	1.4			
5/1/2008	10	1.1	Salix lasiolepis	18	4	1.1				1.1	Salix lasiolepis	8		1.1				1.1					0	1.1			
		1.2	Salix lasiolepis	3	3	1.2	Salix lasiolepis	7		1.2				1.2				1.2					0	1.2			
		1.3	Salix lasiolepis	20	4.5	1.3				1.3				1.3				1.3					0	1.3			
		1.4				1.4	Salix lasiolepis	5		1.4				1.4				1.4					0	1.4			

AppendixD

PLANT COMMUNITY DATA

Date	Site Number	Leaf type - Dominant Stratum	Regeneration - Dominant (0,1,2)	Trees	Shrubs	Vine	Seedling	Herbaceous	FFL Class-Palustrine	FFL Class-Riverine
4/28/2008	1							2	1. Paulustrine persistant emergent marsh.	
4/28/2008	2	Broad leaf deciduous		0	2	0		0	1. Palustrine-BLDF 2. Palustrine scrub- BLDS	Mid perennial persistant emergent
4/28/2008	3	Broadleaf deciduous- 50% Broadleaf evergreen- 50%		0	0	2		0		Riverine upper perennial unvegetated cobble gravel
4/29/2008	4	Broadleaf evergreen Broadleaf deciduous		2	2	2	2	2	1. Channel bank evergreen forest 2. Channel bank BLDF 3. Channle bank BLDS	1. upper intermittent floating aquatic (algae) 2. upper intermittent rooted aquatic
4/29/2008	6	Broadleaf evergreen Broadleaf deciduous		2	2	0	0	0	1. riverbank BLDF 2. riverbank BLDS 3. riverbank BLEDF	1. intermittent vegetated floating aquatic (algae)
4/29/2008	5	Broadleaf deciduous		2	2	2	2	0	1. river terrace BLDF 2. river terrace BLDS	1. upper intermittent floating aquatic (algae)
4/30/2008	8	Broadleaf deciduous		2	2	2	2	0		
4/30/2020	9	Mixed evergreen & deciduous		2					1. lower intermitt BLEDF	1. lower intermittent unvegetated cobble/sand/boulder stream bed
4/30/2008	7	Broadleaved deciduous		2	2	2	0	2	1. riverbank BLDF	1. perennial unvegetated cobble, gravel channel and wetland.
5/1/2008	11	Broadleaved deciduous		2	2	2	2	2	1. BLDF, mixed vascular stream bank forest	1. lower perennial unvegetated, unconsolidated bottom (cobble-gravel)
5/1/2008	10	Broadleaved deciduous		2	2	2	2	2	BLDF	intermittent floating vegetation (algae)

BLDT- Broad leaved deciduous trees
BLDS- Broad leaved deciduous scrubland
BLDF- Broadleaved deciduous forest
BLEDF- Broadleaved evergreen and deciduous forest

AppendixD

PLANT COMMUNITY DATA

Date	Site Num	Tree Sp	Cover Class Mid-point	Ind Status*	Shrub Sp	Cover Class Mid-point	Ind Status*	Vine Sp	Cover Class Mid-point	Ind Status*	Forbs Sp	Cover Class Mid-point	Ind Status*	Seedling/Sapling	Cover Class Mid-point	Ind Status*
4/28/2008	1										Eleocharis macrostachya	10	N			
											Scheonoplectus acutus	90	N			
											Rumex crispus	5	E			
											Veronica catenata	2	E			
											Cirsium vulgare	5	E			
											Plantago major	2	E			
											Xanthium strumarium	2	E			
											Average	16.57143	29%N			
													72%E			
4/28/2008	2	Juglans californica	25	N	Salix lasiolepis	40	N	Toxicodendron diversilobum	<2	N	Bromus diandrus	60	E			
		Average	25	100%N	Baccharis pilularis	<5	N	**Average**	<2	100%N	Avena barbata	60	E			
					Average	22.5	100%N				Hordeum murinum ssp. Lepornum	30	E			
											Phalaris aquatic	5	E			
											Carduus pycnocephalus	15	E			
											Silybum marianum	5	E			
											Cicuta maculata	5	E			
											Oxalis pes-caprae	2	E			
											Brassica nigra	5	E			
											Rhaphnus sativa	27	E			
											Lolium multiforum	25	E			
											Bromus hordeaceus	60	E			
											Cichorium intybus	2	E			
											Artemesia douglasiana	20	N			
											Typha latifolia	5	N			
											Lupinus succulentus	5	N			
											Lotus corniculatus	5	N			
											Festuca californica	2	N			
											Juncus xiphioides	5	N			
											Medicago polymorpha	10	E			
											Vicia benghalensis	2	E			
											Melilotus officianalis	2	E			
											Erodium cicutarium	15	E			
											Foeniculum vulgare	2	E			
											Sonchus asper	2	E			
											Ambrosia psilostachya	2	N			
											Lotus purshianus var. pursianus	2	N			
											Eleocharis acicularis var. acicularis	5	N			
											Calystegia subacanlis episcopalis	2	N			
											Bromus carinatus	2	N			
											Geranium molle	5	E			
											Dactylis glomerata	5	E			
											Mentha pulegium	5	E			
											Plantago lanceolata	5	E			
											Rumex crispus	5	E			
											Xanthium strumarium	5	E			
											Rubus ursinus	5	N			
											Picris echiodes		E			
											Scirpus		N			
											Average	11.46	33%N			
													77%E			
4/28/2008	3	Quercus agrifolia	38	N	Myoporum laetum	3	E	Ipomoea purpurea	3	E	Piptatherum milliaceum	3	E			
		Juglans californica	20.5	N	Berberis	3	E	Vinca major	10.5	E	Pennisetum clandestinum	10.5	E	Quercus agriflolia	0	N
		Betula pendula	10.5	E	Cotoneaster parosa	10.5	E	Hedera helix	20.5	E	Cyperus sp	10.5	N	Platanus racemosa	3	N
		Ficus carica	10.5	E	Pyracantha angustifolia	10.5	E	***Average***	**11.33**	**100%E**	Mentha	3	E	Pinus sp.	0	N
		Pinus radiata	3	N	Genista monspessulana	0	E				Agapanthus	10.5	E	***Average***	**1**	**100%N**
		Plantanus racemosa	10.5	N	Malva	0	E				Centranthus rubra	3	E			
		Average	**15.5**	**67%N**	Heteromeles arbutifolia	10.5	N				Xanthium strimmer	3	E			
				33%E	Baccharis pilularis	3	N				Dietes	3	E			
					Rhamnus californica	3	N				Oxalis pes-caprae	10.5	E			
					Average	**4.83**	**67%E**				Malva parviflora	3	E			
							33%N				Sonchus oleraceus	3	E			
											Eupatoria peplus	3	E			
											Medicago polymorpha	3	E			
											Bromus diandrus	10.5	E			
											Veronica anagallis	0	E			
											Plantago major	0	E			
											Taraxacum officinale	3	E			
											Sagina	0	N			
											Rumex pulcher	0	E			
											Scirpus microcarpus	3	N			
											Hoita	3	N			
											Melenia?	0	N			
											Cardamine oligosperma	0	N			
											Average	**3.85**	**74%E**			
													26%N			
4/29/2008	4	Plantunus racemosa	10.5	N	Salix lasiolepis	63	N	Toxicodendron diversilobium	85.5	N	Rumex pulcher	3	E	Platanus racemosa	10.5	N
		Quercus agrifolia	38	N	Heteromeles arbutifolia	3	N	Rubus ursinus	20.5	N	Cirsium vulgare	3	E	Quercus agriflolia	3	N
		Salix laevigata	38	N	Rubus ursinus	20.5	N	***Average***	**53**	**100%N**	Bromus diandrus	10.5	E	Salix laevigata	10.5	N
		Salix lasiolepis	10.5	N	Baccharis pilularis	3	N				Agrostis viridis	10.5	E	***Average***	**8**	**100%N**
		Average	**24.25**	**100%N**	***Average***	**22.38**	**100%N**				Picris echiodes	38	E			
											Sonchus oleraceus	10.5	E			
			97								Juncus patens	3	N			
											Sonchus asper	10.5	E			
											Geranium molle	0	E			
											Carduus pycnocephalus	10.5	E			
											Veronica anagallis-aquatica	0	E			
											Eurphorbia peplus	10.5	E			
											Rumex salicifolia	3	E			
											Helenium	3	N			
											Brassica tournefortii	3	E			
											Hordeum murinum ssp gussonieanum	3	E			
											Brassica nigra	3	E			
											Conium maculatum	3	E			
											Juncus xiphioides	10.5	N			
											Scirpus microcarpus	0	N			
											Urtica dioca	20.5	N			
											Scrophularia californica	3	N			
											Helenium puberulum	3	N			
											Polypodium californica	3	N			
											Symphoricarpus mollis	10.5	N			
											Eriogonum parviflorum	3	N			
											Leymus condenstatus	3	N			
											Pholistoma auritum var auritium	0	N			
											Stachys bullata	3	N			
											Juncus effusus	3	N			
											Eschscholzia californica	3	N			
											Collinsia heterophylla	3	N			
											Claytonia perfoliata	3	N			
											Gnaphalium sp.	3	N			
											Rorippa nasturtium-aquaticum	3	N			
											Solanum douglasii	20.5	N			
											Cyperus sp	3	N			
											Callitriche	0	N			
											Artemesia douglasiana	10.5	N			
											Schoenoplectus californica	10.5	N			
											Verbena lasiostachya	3	N			
											Average	**6.17**	**61%N**			
													39%E			
4/29/2008	6	Quercus agrifolia	20.5	N	Rubus ursinus	10.5	N	Clematis ligusticifolia	38	N	Carduus pycnocephalus	10.5	E			
		Salix lasiolepis	85.5	N	Baccharis pilularis	3	N	Toxicodendron diversilobum	10.5	N	Bromus catharticus	10.5	E			
		Average	**53**	**100%N**	Sambucus mexicana	20.5	N	Marah fabaceae	10.5	N	Conium maculatum	10.5	E			
					Toxicodendron divers.	38	N	***Average***	**19.67**	**100%N**	Bromus diandrus	20.5	E			
					Average	**18**	**100%N**				Foeniculum vulgare	3	E			
											Hordeum murinum ssp leporinum	10.5	E			
											Sonchus oleraceus	3	E			
			106								Torilis arvensis	10.5	E			
											Lolium multiflorum	10.5	E			
											Rumex salicifolia	10.5	E			
											Agrostis viridis	10.5	E			
											Rorippa nasturtium	3	E			
											Agapanthus	3	E			
											Cirsium vulgare	3	E			
											Plantago lanceolata	3	E			
											Medicago polymorpha	3	E			
											Vicia	3	E			
											Lupinus succulentus	3	N			
											Sanicula arguta	10.5	N			
											Scrophularia californica	3	N			
											Verbena lasiostachya	3	N			
											Artemisia douglasiana	10.5	N			
											Osmorhiza chilensis	3	N			
											Sanicula crassicaulis	3	N			
											Stachys bullata	3	N			
											Melica imperfecta	3	N			
											Oxalis pes-carpe	3	E			
											Helenium puberulum	3	N			
											Equisetum arvense	3	N			
											Average	**6.19**	**38%N**			
													62%E			
4/29/2008	5	Platanus racemosa	20.5	N	Salix lasiolepis	63	N	Delairea odorata	85.5	E	Gnaphalium luteo-album	20.5	E	Platinus racemosa	10.5	N
		Salix laevigata	63	N	Baccharis pilularis	10.5	N	***Average***	**85.5**	**100%E**	Picris echiodes	10.5	E	Salix laevigata	10.5	N
		Quercus agrifolia	10.5	N	Rubus urisinus	38	N				Cirsium vulgare	20.5	E	***Average***	**10.5**	**100%N**
		Average	**31.33**	**100%N**	Cornus sericea	3	N				Medicago polymorpha	3	E			
					Mimulus aurantiacus	10.5	N				Juncus xiphoides	10.5	N			
					Average	**25**	**100%N**				Conium maculatum	10.5	E			
											Rumex salicifolius	10.5	N			
											Bromus catharticus	3	E			
			94								Bromus ?	3	E			

Date	Site Num	Tree Sp	Cover Class Mid-point	Ind Status*	Shrub Sp	Cover Class Mid-point	Ind Status*	Vine Sp	Cover Class Mid-point	Ind Status*	Forbs Sp	Cover Class Mid-point	Ind Status*	Seedling/Sapling	Cover Class Mid-point	Ind Status*
	5										Cynodon dactylon	3	E			
											Brassica tournefortii	10.5	E			
											Sonchus asper	10.5	E			
											Anagalis arvensis	3	E			
											Sonchus oleraceus	3	E			
											Argarostis viridis	3	E			
											Vicia (?)	3	E			
											Melilotus sp.	10.5	E			
											Euphorbia lathyris	10.5	E			
											Geranium dissectum	3	E			
											Geranium molle	3	E			
											Plantago major	10.5	E			
											Phalaris aquatica	10.5	E			
											Clematis longasticifolia	0	N			
											Celery (cilantro-like)	3	E - ??			
											Bromus diandrus	3	E			
											Scrophularia californica	3	N			
											Brassica nigra	10.5	E			
											Euphorbia peplus	10.5	E			
											Epilobium cilicatum	10.5	N			
											Lolium multiflorium	3	E			
											Conyza canadensis	20.5	N			
											Equisetum arvense	20.5	N			
											Scirpus microcarpus	10.5	N			
											Verbena lasiostaya	20.5	N			
											Juncus	10.5	N			
											Stachys bullata	10.5	N			
											Osmorhiza	0	N			
											Carex sp.	3	N			
											Cyperus (lg)	3	E			
											Rumex pulchra	10.5	E			
											Cyperus eragrostis	10.5	N			
											Isolepis	0	N			
											Ambrosia psilostachya	3	N			
											Helenium puberula	10.5	N			
											Equisetum telmateia	10.5	N			
											Solanum douglasii	10.5	N			
											Mimulus cardinalis	0	N			
											Rorippa nasturtium-aquaticum	3	N			
											Artemisia douglasiana	10.5	N			
											Hoita orbicularis	3	N			
											Average	**7.81**	**46%N**			
													54%E			
4/30/2008	8	Salix lasiolepis	85.5	N	Baccharis pilularis	3	N	Toxicodendron diversilibum	38	N	Cirsium m?	3	E	Umbellularia californica	3	N
		Platanus racemosa	10.5	N	Heteromeles arbutifolia	3	N	Rubus ursinus	38	N	Conium maculatum	0	E	***Average***	**3**	**100%N**
		Quercus agrifolia	10.5	N	Rhamnus californica	10.5	N	Lonicera hispidula	10.5	N	Plantago lanceolata	0	E			
		Average	**35.5**	**100%N**	Mimulus auranticus	3	N	***Average***	**28.83**	**100%N**	Medicago polymorpha	0	E			
					Salix lasiolepis	10.5	N				Sonchus oleraccus	0	E			
					Savlia mellifora	3	N				Helenium puberulum	3	N			
					Average	**5.5**	**100%N**				Epilobium sp.	3	N			
											Eriophyllum confertiflorum	3	N			
											Stachys bullata	10.5	N			
											Symphoricarpos mollis	10.5	N			
											Mimulus guttatus	10.5	N			
											Melica californica	3	N			
											Juncus xiphioides	3	N			
											Vicia americana var americana	3	N			
											Calystegia subacaulis ssp episcopalis	0	N			
											Verbena lasiostachya	3	N			
											Carex	20.5	N			
											Average	**4.47**	**71%N**			
													29%E			
4/30/2020	9	Salix lasiolepis	85.5	N	Mimulus aurantiacus	10.5	N	Clemantis ligusticfolia	20.5	N	Oxalis pres-carpae	10.5	E	Quercus agrifolia	3	N
		Umbelluaria californica	20.5	N	Sambucus mexicanus	20.5	N	Toxicodendron diversilibum	38	N	Sonchus oleraccus	0	E	***Average***	**3**	**100%N**
		Quercus agrifolia	20.5	N	***Average***	**15.5**	**100%N**	Marah fabaceus	10.5	N	Hypochaeris maculata	0	E			
		Platanus racemosa	10.5	N				***Average***	**23**	**100%N**	Euphorbia peplus	10.5	E			
		Average	**34.25**	**100%N**							Medicago polymorpha	3	E			
											Bromus diandrus	3	E			
											Picris echioides	3	E			
											Scirpus microcarpus	3	E			
											Foeniculum vulgare	3	E			
											Rorippa nasturtium-aquaticum	3	N			
											Melica imperfecta	3	N			
											Pentagramma triangularis	3	N			
											Helenium puberulum	10.5	N			
											Sanicula crassicaulis	3	N			
											Verbena lasiostachya	3	N			
											Urtica dioica	3	N			
											Pellea andromedifolia	3	N			
											Adiatum jordanii	0	N			
											Athyrium felix-feminia	10.5	N			
											Claytonia perfoliata		N			
											Average	**4.11**	**55%N**			
													45%E			
4/30/2008	7	Populus balsam	20.5	N	Salix lasiolepis	10.5	N	Clemantis ligusticfolia	20.5	N	Picris echioides	3	E			
		Salix laevigata	10.5	N	Baccharis pilularis	10.5	N	Toxicodendron diversilobum	38	N	Juncus xiphioides	3	E			
		Platanus racemosa	38	N	Mimulus aurantiacus	3	N	Rubus ursinus	38	N	Sonchus oleraccus	3	E			
		Salix lasiolepis	85.5	N	Eriophyllum sp.	3	N	Delairea odorata	63	E	Mentha sp.	0	E			
		Average	**38.63**	**100%N**	Sambucus racemosa	10.5	N	Lathyrus odorata	3	E	Conium maculatum	10.5	E			
					Vicia	3	N	Rumex pulcher	10.5	E	Solanum douglasii	3	N			
					Average	**6.75**	**100%N**	Sonchus asper	3	E	Equisetum telmateia	10.5	N			
								Average	**25.14**	**43%N**	Rorippa nasturtium-aquaticum	10.5	N			
										57%E	Scirpus sp.	10.5	N			
											Hoita orbicularis	10.5	N			
											Helenium puberulum	3	N			
											Stachys vallarta	10.5	N			
											Medicago polymorpha	3	N			
											Cirsium vulgare	3	N			
											Rumex salicifolia	10.5	N			
											Urtica dioica	3	N			
											Smilacina	3	N			
											Chenopodium californica	0	N			
											Average	**5.58**	**72%N**			
													28%E			
5/1/2008	11	Salix lasiolepis	38	N	nus sericea ssp. Occident	85.5	N	Rubus ursinus	20.5	N	Mentha spicata var. spicata	10.5	E	Salix lasiolepi	3	N
		Platanus racemosa	85.5	N	Salix laevigata	10.5	N	Toxicodendron diversilobum	20.5	N	Equisetum telmetea	20.5	N	Quercus agrifolia	0	N
		Quercus agrifolia	10.5	N	Salix lasioleopis	10.5	N	***Average***	**20.5**	**100%N**	Scirpus microcarpa	20.5	N	***Average***	**1.5**	**100%N**
		Acer negundo	10.5	N	***Average***	**35.5**	**100%N**				Epilobium sp.	3	N			
		Juglans californica var. c	38	N							Artemisia douglasiana	3	N			
		Populus balsam	38	N							Medicago polymorpha	0	N			
		Salix laevigata	10.5	N							***Average***	**9.58**	**83%N**			
		Average	**33**	**100%N**									**17%E**			
			231													
5/1/2008	10	Salix lasiolepis	85.5	N	Salix lasiolepis	20.5	N	Darilea odorata	85.5	E	Brassica nigra	20.5	E			
		Platanus racemosa	10.5	N	***Average***	**20.5**	**100%N**	Toxicodendron diversilobum	20.5	N	Rumex crispus	10.5	E			
		Average	**48**	**100%N**				Rubus ursinus	38	N	Conium maculatus	20.5	E			
								Clemantus ligustiafolia	10.5	E	Phalaris aquatica	3	E			
								Average	**38.625**	**50%N**	Poa annua	3	E			
										50%E	Cirsium vulgare	10.5	E			
											Raphnus sativa	10.5	E			
											Silybum marianum	10.5	E			
											Veronica analgallis-aquatica	10.5	E			
											Euphorbia peplus	10.5	E			
											Gernium dissectum	3	E			
											Agrostis viridis	10.5	E			
											Avena barbata	3	E			
											Malva parviflora	3	E			
											Tropaeolum sp.	10.5	E			
											Foeniculum vulgare	3	E			
											Sonchus asper	10.5	E			
											Medicago polymorpha	3	E			
											Anagallis aquatica	10.5	E			
											Carduus pycnocephalus	10.5	E			
											Bromus diandrus	10.5	E			
											Brassica tournefortii	10.5	E			
											Erodium cicutarium	3	E			
											Rumex pulchra	10.5	E			
											Gnaphalium luteo-album	3	E			
											Taraxacum officionale?	3	E			
											Plantago lanceolata	3	E			
											Vinca major	10.5	E			
											Lolium multiflorum	3	E			
											Rumex salicifolia	10.5	N			
											Urtica dioica	10.5	N			
											Chenopodium californica	10.5	N			
											Mimulus guttatus	3	N			
											Cyperus eragrostis	10.5	N			
											Helenium puberulum	10.5	N			
											Artemisia douglasiana	10.5	N			
											Baccharis salicifolia	3	N			
											Equisetum telemetea	3	N			
											Rorippa nasturium-aquaticum	3	N			
											Epilobium sp.	3	N			
											Average	**7.81**	**28%N**			
													72%E			

PLANT COMMUNITY DATA

Date	Site Number	RL Riparian Width	Width (ft)	RR Riparian Width	Width (ft)	RL Tree BA Spp	RL Tree BA (sq ft/ac)	RR Tree BA Spp	RR Tree BA (sq ft/ac)	RL Height - Spp	RLTree Height (ft)	RL Tree DBH	RR Height - Spp	RRTree Height (ft)	RR Tree DBH	RL Strata	Number	RR Strata	Number
4/28/2008	1	**1**		**1**												**1**	1	**1**	1
		2		**2**												**2**	1	**2**	1
		3		**3**												**3**	1	**3**	1
		4		**4**												**4**	1	**4**	1
		average														**5**	1	**5**	1
																6	1	**6**	1
																7	1	**7**	1
																8	1	**8**	1
																9	1	**9**	1
																10	1	**10**	1
4/28/2008	2	**1**	38.5	**1**	28.333	Juglas californica	5	Eucalyptus globulus	0	Juglas californicus	35	2, 16.3	Eucalyptus globulus	30		**1**	2	**1**	2
		2	20.4	**2**	48							1, 13				**2**	1	**2**	2
		3	20.6	**3**	62.5							9, 12.1				**3**	2	**3**	2
		4	41.8	**4**	49							7, 9				**4**	2	**4**	1
		average	***30.325***	**average**	***46.958***											**5**	2	**5**	2
																6	2	**6**	1
																7	2	**7**	1
																8	2	**8**	2
																9	2	**9**	2
																10	2	**10**	2
4/28/2008	3	**1**		**1**	41	Quercus agrifolia	10	Plantanus racemosa	20	Quercus agrifolia	65		Plantanus racemosa	60		**1**	2	**1**	1
		2		**2**	34.5	Betula ?	20			Betula ?	60		Pinus radiata	45		**2**	3	**2**	2
		3		**3**	34	Juglans californica	30			Juglans californica	45		Ficus caria	25 (30)		**3**	3	**3**	1
		4		**4**	36											**4**	2	**4**	2
		average		**average**	**36.375**											**5**	1	**5**	2
																6	2	**6**	2
																7	1	**7**	1
																8	2	**8**	1
																9	2	**9**	1
																10	2	**10**	1
4/29/2008	4	**1**	50	**1**	75	Salix lasiolepis	60	Salix lasiolepis	20	Plantus racemosa	30-40		Quercus agrifolia	60-80		**1**	2	**1**	2
		2	50	**2**	75			Salix laevigata	10	Salix laevigata	20-45		Salix laevigata	20-45		**2**	2	**2**	2
		3	50	**3**	75			Quercus agrifolia	30							**3**	2	**3**	2
		4	50	**4**	75											**4**	2	**4**	3
		average	**50**	**average**	**75**											**5**	2	**5**	2
																6	3	**6**	1
																7	3	**7**	3
																8	3	**8**	3
																9	2	**9**	3
																10	1	**10**	2
4/29/2008	6	**1**	25	**1**	35	Salix lasiolepis	10	Quercus agrifolia	20	Salix lasiolepis	30		Quercus agrifolia	40-50		**1**	3	**1**	3
		2	25	**2**	35			Salix lasiolepis	50				Salix lasiolepis	35		**2**	3	**2**	2
		3	25	**3**	35											**3**	3	**3**	2
		4	25	**4**	35											**4**	2	**4**	1
		average	**25**	**average**	**35**											**5**	3	**5**	2
																6	3	**6**	2
																7	2	**7**	
																8	3	**8**	
																9	2	**9**	
																10	2	**10**	
4/29/2008	5	**1**	25	**1**	75	Salix laevigata	70	Salix laevigata	130	Salix laevigata	40-50		Salix laevigata	40-50		**1**	2	**1**	2
		2		**2**		Platanus racemosa	0			Platanus racemosa	25-30		Platanus racemosa	25-30		**2**	2	**2**	3
		3		**3**												**3**	2	**3**	2
		4		**4**												**4**	2	**4**	2
		average	**25**	**average**	**75**											**5**	2	**5**	1
																6	3	**6**	3
																7	2	**7**	2
																8	2	**8**	2
																9	3	**9**	3
																10	2	**10**	
4/30/2008	8	**1**	>25	**1**	18	Salix lasiolepis	110	Platanus racemosa	10	Salix lasiolepis	35		Platanus racemosa	40		**1**	3	**1**	1
		2		**2**				Quercus agrifolia	10				Quercus agrifolia	45		**2**	2	**2**	2
		3		**3**				Salix lasiolepis	10				Salix lasiolepis	25		**3**	3	**3**	2
		4		**4**												**4**	2	**4**	2
		average	**>25**	**average**	**18**											**5**	3	**5**	2
																6	2	**6**	2
																7	2	**7**	2
																8	1	**8**	1
																9	2	**9**	2
																10	2	**10**	1
4/30/2020	9	**1**	25	**1**	30	Salix lasiolepis	30	Platanus racemosa	10	Salix lasiolepis	15-50		Platanus racemosa	85		**1**	3	**1**	3
		2		**2**				Umbellularia californica	10	Quercus agrifolia	40-45		Umbellularia californi	45-50		**2**	2	**2**	2
		3		**3**				Quercus agrifolia	10				Salix lasiolepis	25-50		**3**	2	**3**	2
		4		**4**				Salix lasiolepis	10				Quercus agrifolia	40		**4**	2	**4**	3
		average	**25**	**average**	**30**											**5**	3	**5**	2
																6	3	**6**	2
																7	1	**7**	2
																8	2	**8**	3
																9	3	**9**	3
																10	3	**10**	2
4/30/2008	7	**1**	8	**1**	100	Salix lasiolepis	40	Populus balsam	10	Salix lasiolepis	75-80		Salix lasiolepis	75-80		**1**	2	**1**	2
		2		**2**				Salix lasiolepis	10				Platanus racemosa	60-80		**2**	2	**2**	2
		3		**3**												**3**	2	**3**	3
		4		**4**												**4**	2	**4**	2
		average	**8**	**average**	**100**											**5**	2	**5**	2
																6	2	**6**	1
																7	2	**7**	2
																8	1	**8**	1
																9	1	**9**	2
																10	2	**10**	2
5/1/2008	11	**1**	38	**1**	50	Populus balsam	10	Quercus agrifolia	10	Platanus racemosa	100-125		Acer negundo	30		**1**	3	**1**	3
		2	38	**2**	50	Platanus racemosa	40	Platanus racemosa	30	Populus balsam		125	Quercus agrifolia	45-50		**2**	3	**2**	3
		3	38	**3**	50	Salix laevigata	10			Juglans californica		85	Platanus racemosa	100-125		**3**	3	**3**	3
		4	38	**4**	50					Salix lasiolepis	30-45					**4**	2	**4**	2
		average	**38**	**avarage**	**50**											**5**	3	**5**	2
																6	2	**6**	2
																7	2	**7**	
																8	3	**8**	
																9	3	**9**	
																10	2	**10**	
5/1/2008	10	**1**	>50	**1**	>25	Salix lasiolepis	30	Salix lasiolepis	0	Salix lasiolepis	25-40		Salix lasiolepis	25-60		**1**	2	**1**	2
		2		**2**									Platanus racemosa	30		**2**	2	**2**	2
		3		**3**												**3**	2	**3**	2
		4		**4**												**4**	2	**4**	3
		average	**>50**	**average**	**>25**											**5**	2	**5**	3
																6	2	**6**	3
																7	3	**7**	2
																8	2	**8**	3
																9	2	**9**	2
																10	2	**10**	2
																Mode	2	***Mode***	2

AppendixD

PLANT SPECIES LIST

Latin Name	Stratum	Total Obs	Site 1	Site 2	Site 3	Site 4	Site 6	Site 5	Site 8	Site 9	Site 7	Site 11	Site 10
	Trees												
Acer negundo		1										X	
Betula pendula		1			X								
Ficus carica		1			X								
Juglans californica		2			X							X	
Pinus radiata		1			X								
Plantanus racemosa		8			X	X		X	X	X	X	X	X
Populus balsamifera		2									X	X	
Quercus agrifolia		7			X	X	X	X	X	X		X	
Salix laevigata		4				X		X			X	X	
Salix lasiolepis		7				X	X		X	X	X	X	X
Salix lasiolepis		1					X						
Umbelluaria californica		1								X			
	Seedlings/Saplings												
Quercus agriflolia					X	X				X		X	
Platanus racemosa					X	X							
Pinus sp.					X								
Salix laevigata						X							
Umbellularia californica									X				
Salix lasiolepis												X	
	Shrubs												
Baccharis pilularis		1		X									
Baccharis pilularis		6			X	X	X	X	X		X		
Berberis		1			X								
Cornus sericea ssp. Occidentalis		2						X				X	
Cotoneaster parosa		1			X								
Eriophyllum sp.		1									X		
Genista monspessulana		1			X								
Heteromeles agrifolia		1							X				
Heteromeles arbutifolia		3			X	X			X				
Malva		1			X								
Mimulus aurantiacus		4						X	X	X	X		
Myoporum laetum		1			X								
Pyracantha angustifolia		1			X								
Rhamnus californica		1			X								
Rhamnus californica		1							X				
Rubus urisinus		3				X	X	X					
Salix laevigata		1										X	
Salix lasiolepis		7		X		X		X	X		X	X	X
Sambucus mexicanus		2					X			X			
Sambucus racemosa		1									X		
Savlia mellifora		1							X				
Toxicodendron diversilobum		1					X						
Vicia		1									X		
	Vines												
Clemantis ligusticfolia		4					X			X	X		X
Delairea odorata		3						X			X		X
Hedera helix		1			X								
Ipomoea purpurea		1			X								
Lathyrus odorata		1									X		
Lonicera hispidula		1							X				
Marah fabaceae		2					X			X			
Rubus ursinus		5				X			X		X	X	X
Rumex pulcher		1									X		
Sonchus asper		1									X		
Toxicodendron diversilobum		8		X		X	X		X	X	X	X	X
Vinca major		1			X								
	Forb/Graminoid/Fern												
Adiatum jordanii		1								X			
Agapanthus		2			X		X						
Agrostis viridis		3				X	X						X
Ambrosia psilostachya		2		X				X					
Anagalis arvensis		1						X					
Anagallis aquatica		1											X
Argarostis viridis		1						X					
Artemesia douglasiana		6		X		X	X	X				X	X
Athyrium felix-feminia		1								X			
Avena barbata		2		X									X
Baccharis salicifolia		1											X
Brassica nigra		3		X		X		X					

AppendixD

Latin Name	Stratum	Total Obs	Site 1	Site 2	Site 3	Site 4	Site 6	Site 5	Site 8	Site 9	Site 7	Site 11	Site 10
Brassica nigra		1											X
Brassica tournefortii		2				X		X					
Brassica tournefortii		1											X
Bromus ?		1						X					
Bromus carinatus		3		X			X	X					
Bromus diandrus		7		X	X	X	X	X		X			X
Bromus hordeaceus		1		X									
Callitriche		1				X							
Calystegia subacanlis episcopalis		2		X					X				
Cardamine oligosperma		1			X								
Carduus pycnocephalus		4		X		X	X						X
Carex		2						X	X				
Celery (cilantro-like)		1						X					
Centranthus rubra		1			X								
Chenopodium californica		2									X		X
Cichorium intybus		1		X									
Cicuta maculata		1		X									
Cirsium m?		1							X				
Cirsium vulgare		6	X			X	X	X			X		X
Claytonia perfoliata		2				X				X			
Clematis longasticifolia		1						X					
Collinsia heterophylla		1				X							
Conium maculatum		6				X	X	X	X		X		X
Conyza canadensis		1						X					
Cynodon dactylon		1						X					
Cyperus (lg)		1						X					
Cyperus eragrostis		2						X					X
Cyperus sp		2			X	X							
Dactylis glomerata		1		X									
Dietes		1			X								
Eleocharis acicularis var. acicularis		1		X									
Eleocharis arecularis		1	X										
Epilobium cilicatum		1						X					
Epilobium sp.		3							X			X	X
Equisetum arvense		2					X	X					
Equisetum telemetea		4						X			X	X	X
Eriogonum parviflorum		1				X							
Eriophyllum confertiflorum		1							X				
Erodium cicutarium		2		X									X
Eschscholzia californica		1				X							
Eupatoria peplus		1			X								
Euphorbia lathyris		1						X					
Euphorbia peplus		4				X		X		X			X
Festuca californica		1		X									
Foeniculum vulgare		4		X			X			X			X
Geranium dissectum		1						X					
Geranium molle		3		X		X		X					
Gernium dissectum		1											X
Gnaphalium luteo-album		2						X					X
Gnaphalium sp.		1				X							
Helenium		1				X							
Helenium puberulum		6				X	X	X	X	X	X		X
Hoita orbicularis		3			X			X			X		
Hordeum murinum ssp gussoneanum		1				X							
Hordeum murinum ssp. leporinum		2		X			X						
Hypochaeris maculata		1								X			
Isolepis		1						X					
Juncus		1						X					
Juncus effusus		1				X							
Juncus patens		1				X							
Juncus xiphioides		5		X		X		X	X		X		
Leymus condenstatus		1				X							
Lolium multiforum		3		X			X	X					
Lotus corniculatus		1		X									
Lotus purshianus var. pursianus		1		X									
Lupinus succulentus		3		X			X						
Malva parviflora		1			X								X
Medicago polymorpha		9		X	X		X	X	X	X	X	X	X
Melica		1			X								
Melica californica		1							X				
Melica imperfecta		2					X			X			
Melilotus officianalis		1		X									
Melilotus sp.		1						X					
Mentha pulegium		1		X									
Mentha sp.		2			X						X		
Mentha spicata var. spicata		1										X	

AppendixD

Latin Name	Stratum	Total Obs	Site 1	Site 2	Site 3	Site 4	Site 6	Site 5	Site 8	Site 9	Site 7	Site 11	Site 10
Mimulus cardinalis		1						X					
Mimulus guttatus		2							X				X
Osmorhiza chilensis		2					X	X					
Oxalis pes-caprae		4		X	X		X			X			
Pellea andromedifolia		1								X			
Pennisetum clandestinum		1			X								
Pentagramma triangularis		1								X			
Phalaris aquatic		3		X				X					X
Pholistoma auritum var auritium		1				X							
Picris echiodes		4		X		X		X		X			
Piptatherum milliaceum		1			X								
Plantago lanceolata		4		X			X		X				X
Plantago major		3	X		X			X					
Poa annua		1											X
Polypodium californica		1				X							
Raphnus sativa		1											X
Rhaphnus sativa		1		X									
Rorippa nasturtium-aquaticum		5				X	X	X		X	X		
Rubus ursinus		1		X									
Rumex crispus		3	X	X									X
Rumex pulcher		4			X	X		X					X
Rumex salicifolia		4				X	X				X		X
Sagina		1			X								
Sanicula arguta		1					X						
Sanicula crassicaulis		2					X			X			
Schoenoplectus acutus		1	X										
Schoenoplectus californica		1				X							
Scirpus		2		X							X		
Scirpus microcarpus		5			X	X		X		X		X	
Scrophularia californica		3				X	X	X					
Silybum marianum		1		X									X
Smilacina		1									X		
Solanum douglasii		3				X		X			X		
Sonchus asper		4		X		X		X					X
Sonchus oleraceus		7			X	X	X	X	X	X	X		
Stachys bullata		5				X	X	X	X		X		
Symphoricarpus mollis		2				X			X				
Taraxacum officionale?		2			X								X
Torilis arvensis		1					X						
Tropaeolum sp.		1											X
Typha latifolia		1		X									
Urtica dioica		4				X				X	X		X
Verbena lasiostachya		5				X	X	X	X	X			
Veronica anagallis-aquatica		4	X		X	X							X
Vicia		2					X	X					
Vicia americana var americana		1							X				
Vicia benghalensis		1		X									
Vinca major		1											X
Xanthium strumarium		3	X	X	X								

AppendixD

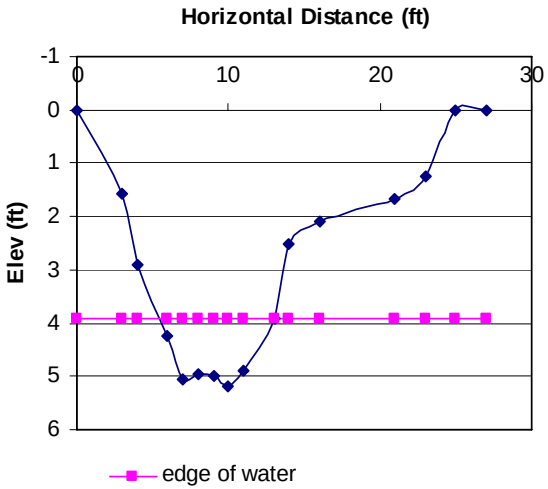
SURVEY DATA

Site Number	Channel width	Top of bank width	Assessment Area Length	Channel Depth at Thalweg	Flood Prone Area Width	Wetted Perimeter	Rosgen Class	Channel Slope	Distance measured	Avg. Channel Depth	OHW W:D	OWH X-Section Area	Entrenchment Ratio	Hydraulic Radii	Notes
1	27		94.5	NA											
2	27	61	168	1	46	31.4									Top of bank is old oil berm- not natural bank
3	19		137	4	29.5	19									Concrete channel- manufactured pools
4	54		378	2.8	101										
6	7.75		54.6	1.18	12.2	8.75									
5	31		217	2.75	67										
8	13		91	1.9	23	15									
9	20.6		144	4		25									
7	28.8		202	3.52	61										
11	24		168	3.13	75	29									
10	39.5	50	274.5	2.76	46.5	45									

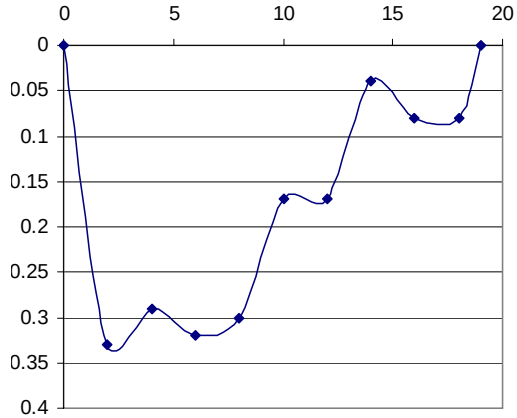
Average	26.514	55.5	175.327	2.704	51.24444	24.7357
SD	12.579	7.7782	91.7259	1.05902	27.90251	11.948
Range	7.8-54	50-61	54.6-378	1-3.52	12.2-101	8.8-45

Cross Section Profiles

Site #2



Site #3



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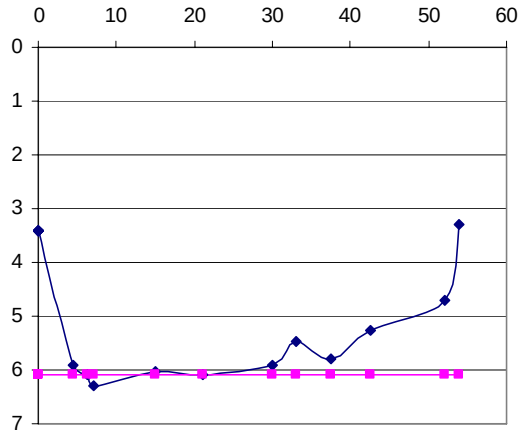

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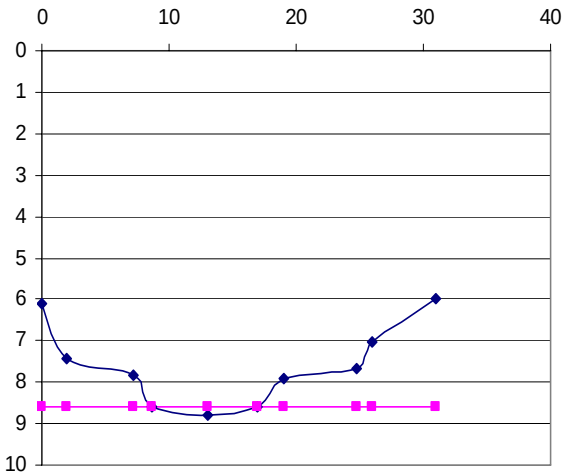

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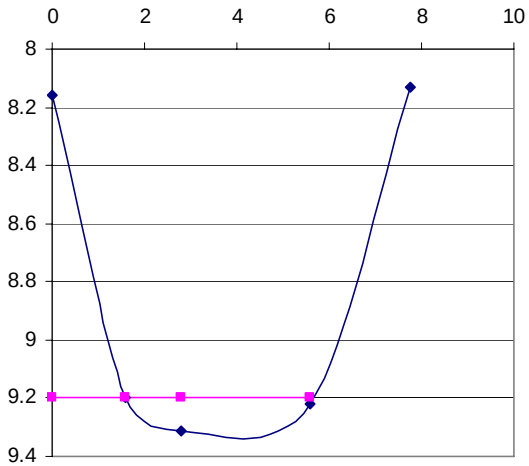
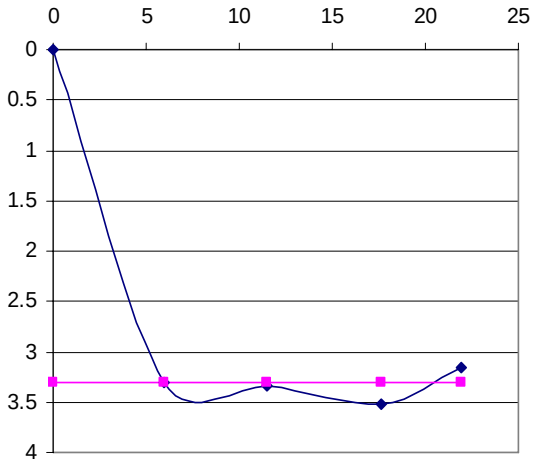
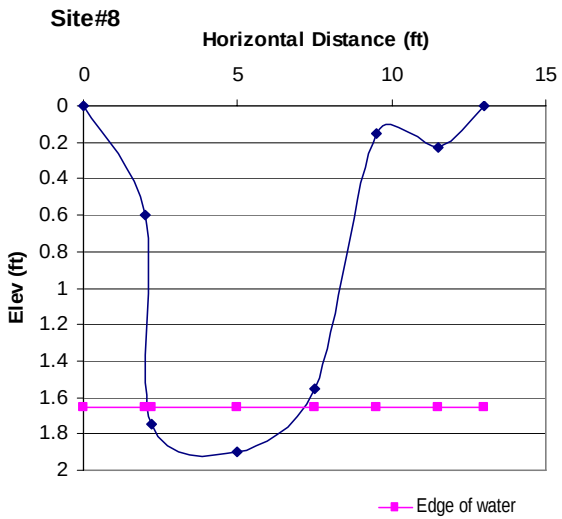
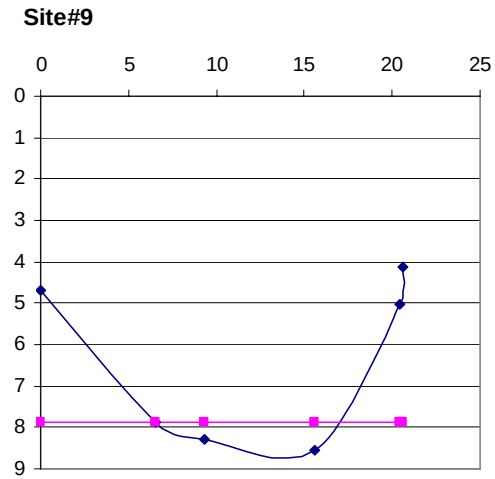


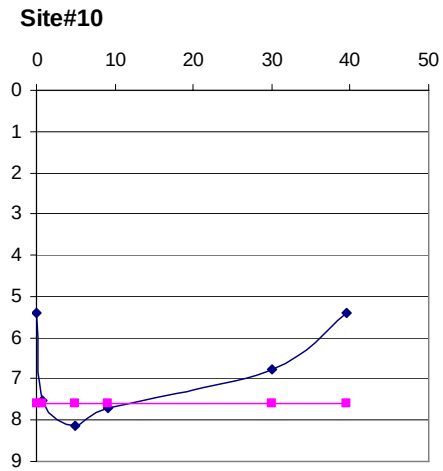
Site# 7

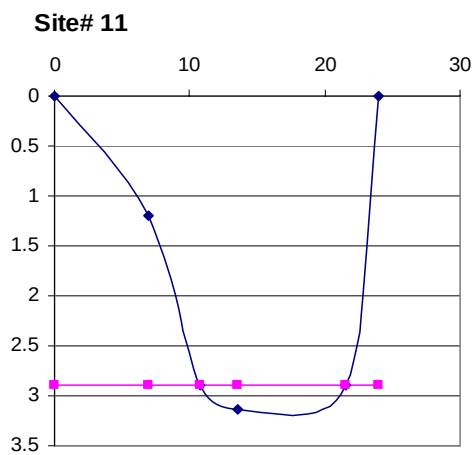


Cross Section Profiles









Longitudinal Profiles

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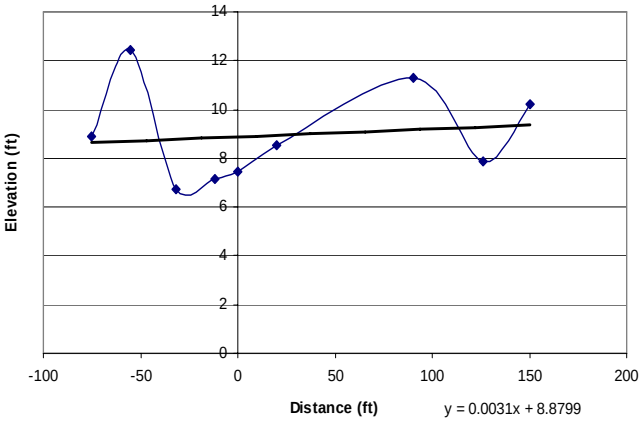
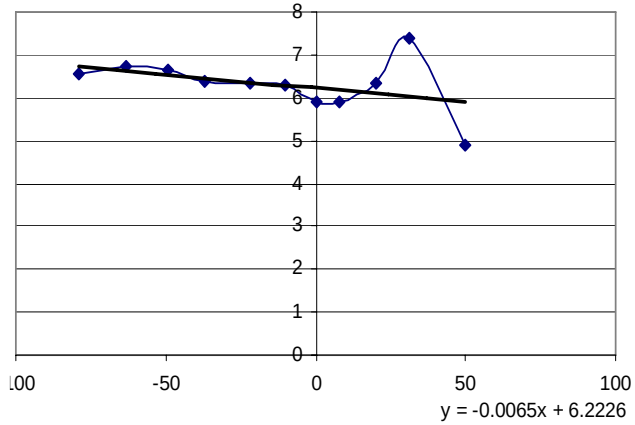


Site#3



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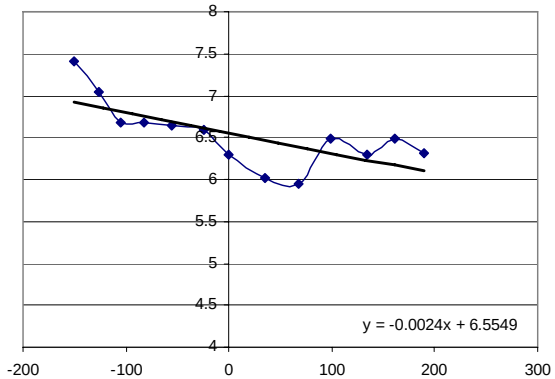

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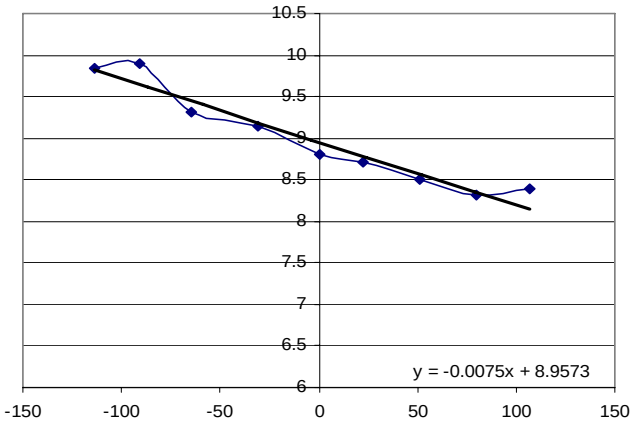

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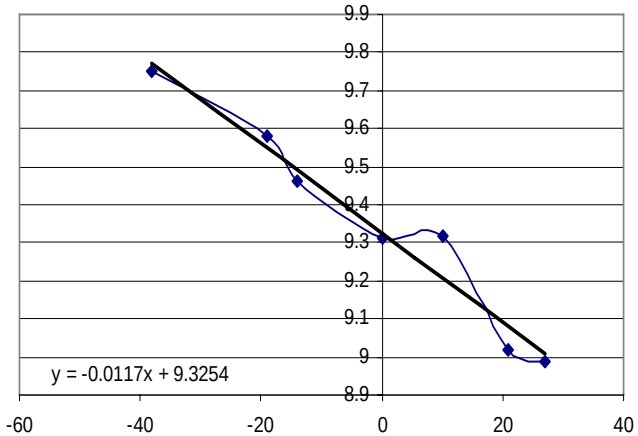
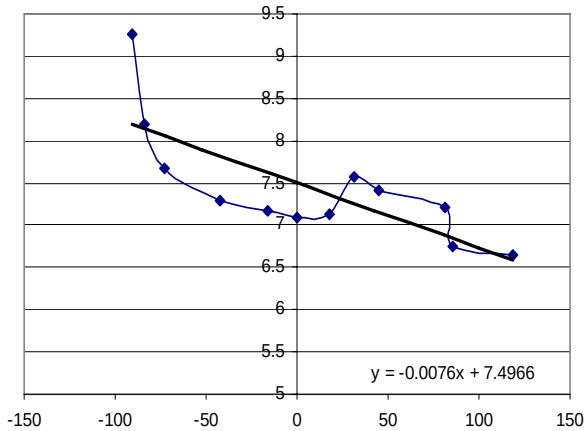
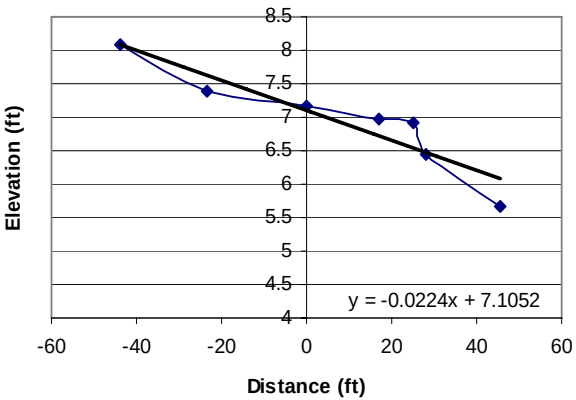


Site#7



Longitudinal Profiles

Site#8



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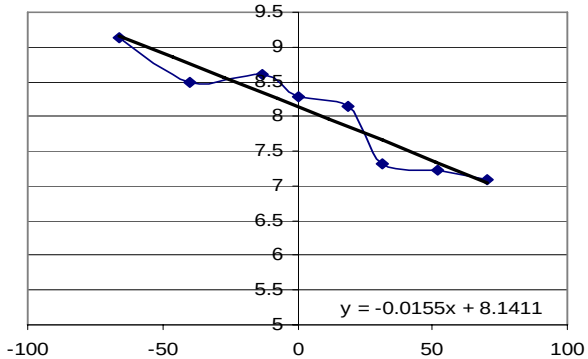

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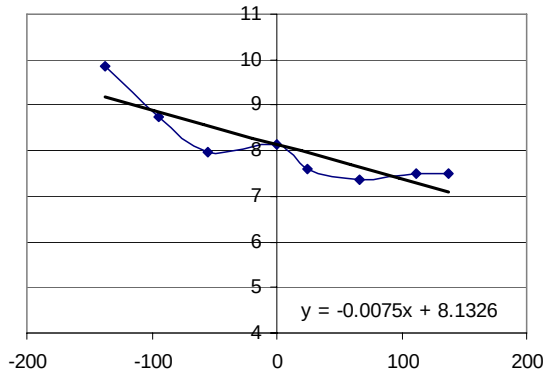

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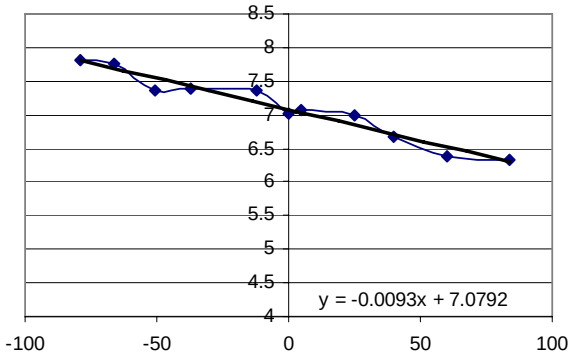


AppendixD

Date	Site Number	Residual Pools Number	RP Number	RP Area (ft)	RP Distance to Next Pool (ft)
4/28/2008	1	27			
4/28/2008	2	N/A			
4/28/2008	3	1		480	111
4/29/2008	4	NA			
4/29/2008	6	1		48	0
4/29/2008	5	0			
4/30/2008	8	2		150	35
				168	30
4/30/2020	9	2		77	32
				336	30
4/30/2008	7	1		180	140
5/1/2008	11	1		39	84
5/1/2008	10	2		165	73
				30	out of area

AppendixD

CHANNEL BED MATERIAL

Date	Site Number	D-50	D-84
4/28/2008	1	<2mm	<2mm
4/28/2008	2	16	32
4/28/2008	3	32	64
4/29/2008	4	23	45
4/29/2008	6		
4/29/2008	5	23	64
4/30/2008	8	32	91
4/30/2020	9	64	128
4/30/2008	7	23	45
5/1/2008	11	32	64
5/1/2008	10	64	91

AppendixD

CHANNEL BED MATERIAL

Date	Site Number	Embeddedness	Upstream OWH Channel Width	Upstream Channel Depth	UP Immobile Bed Sample	UP Immobile Bed Width (ft)	UP Immobile Bed Area (ft2)	Downstream OWH Channel Width	Downstream Channel Depth	Down Immobile Bed Sample	Down Immobile Bed Width (ft)	Down Immobile Bed Area (ft2)
4/28/2008	1	NA			1					1		
					2					2		
					3					3		
					4					4		
					5					5		
					6					6		
4/28/2008	2	NA			1					1		
					2					2		
					3					3		
					4					4		
					5					5		
					6					6		
4/28/2008	3	NA	16	9.25	1	1.3	0.33	19	5.5	1	0.71	0.15
					2	0.42	0.12			2	0.46	0.17
					3	0.46	0.06			3	0.58	0.19
					5	0.83	0.35			5	0.5	0.5
					6					6	0.67	1.39
					4					4		
4/29/2008	4	NA			1					1	0.9	0.68
					2					2	2.8	2.8
					3					3		
					5					5		
					6					6		
					4					4		
4/29/2008	6	NA	91		1	0.4	0.08			1		
					2					2		
					3					3		
					4					4		
					5					5		
					6					6		
4/29/2008	5	NA			1					1		
					2					2		
					3					3		
					4					4		
					5					5		
					6					6		
4/30/2008	8	NA			1	0.5	0.025			1	0.6	0.24
					2	0.6	0.072			2	0.4	0.08
					3	0.5	0.15			3	0.7	0.28
					4	0.4	0.8			4	0.4	0.12
					5					5		
					6					6		
4/30/2020	9	NA	20		1	1.8	2.88	20.6		1	1.6	3.2
					2	0.6	0.6			2		
					3	0.6	0.36			3		
					4	2	5.6			4		
					5					5		
					6					6		
4/30/2008	7	NA			1					1		
					2					2		
					3					3		
					4					4		
					5					5		
					6					6		
5/1/2008	11	NA			1					1		
					2					2		
					3					3		
					4					4		
					5					5		
					6					6		
5/1/2008	10	NA			1					1		
					2					2		
					3					3		
					4					4		
					5					5		
					6					6		

AppendixD

WOODY DEBRIS

Date	Site Number	Coarse WD Upstream - Diameter (in)	Coarse WD Upstream - Diameter (ft)	Coarse WD Upstream - Length < OHW (ft)	Area calc	Volume Coarse WD upstream	Coarse WD Upstream -Total Length (ft)	Coarse WD Upstream - Decomp Class	Coarse WD Downstream - Diameter (in)	Coarse WD Upstream - Diameter (ft)	Coarse WD Downstream - Length < OHW (ft)	Area calc	Volume Coarse WD dwnstream	Coarse WD Downstream - Total Length (ft)	Coarse WD Downstream - Decomp Class	# Coarse WD Jams Upstream	# Coarse WD Jams Downstream	# Fine WD Jams Upstream	# Fine WD Jams Downstream	Source of CWD Upstream	Source of CWD downstream	Total # FWD jams Upstream	Total # FWD jams Downstream	Total # Trees/Snags Upstream	Total # Trees/Snags Downstream
4/28/2008	1	0	0	0		0	0		0	0	0			0		0	0								
4/28/2008	2	4	0.333333	11	0.087	0.95944	20.583	2	9	0.75	32	0.44156	14.13	32	2	0	2	0	3		logs w/ loose bark			0	5
4/28/2008	3	0																							
4/29/2008	4	6	0.5	11	0.196	2.15875	11	2	3	0.25	27	0.04906	1.3247	30	2							8	8	8	4
									3	0.25	21	0.04906	1.0303	21	2										
4/29/2008	6	0																				2		±20	±10
4/29/2008	5	3	0.25	32	0.049	1.57	32	2	4	0.3333333	22	0.08722	1.9189	26	2							7	10	>80	>50
									3	0.25	9.3	0.04906	0.4563	12.8	2										
4/30/2008	8	8	0.666667	13	0.349	4.53556	50	2	3	0.25	12	0.04906	0.5888	13	2							5	5	±10	±10
		4	0.333333	8	0.087	0.69778	22	2	3	0.25	4	0.04906	0.1963	6	3										
		3	0.25	4	0.049	0.19625	5	3	5	0.4166667	8	0.13628	1.0903	10	2										
		3	0.25	5	0.049	0.24531	5	2																	
						5.6749							1.8753												
4/30/2020	9	3	0.25	3	0.049	0.14719	8	2		0						2	2					12	10	±50	±50
		3	0.25	5	0.049	0.24531	5	2		0															
		4	0.333333	5	0.087	0.43611	10	2		0															
						0.82861																			
4/30/2008	7	0	0		0	0																5	±25	±100	
5/1/2008	11	6	0.5	2	0.196	0.3925	5	2	9	0.75	2	0.44156	0.8831	10	3	2	2					9	14	15	20
		3	0.25	4	0.049	0.19625	20	2	4	0.3333333	15	0.08722	1.3083	15	2										
									4	0.3333333	9	0.08722	0.785	11	3										
						0.58875																			
5/1/2008	10	0	0		0				8	0.6666667	15	0.34889	5.2333	15	2							7	8	many	many

Notes: Decomposition classes: 1- CWO recently fallen, bark attached, leaves and fine twigs present; 2- Logs with loose bark, no leaves/fine twigs present; 3- Logs w/o bark, few stubs of branches, fungi present; 4- logs w/o branches/bark, heartwood in advanced state of decay; 5- Logs decaying into ground

AppendixD

HYRDOLOGY AND BUFFER

Date	Site Number	Upstream Levees/ dikes?	Downstream Levees/ dikes?	Upstream Hydrologic connxn	Downstream Hydrologic connxn	Upstream Fish Bariers	Downstream Fish Bariers	Surface water inputs- number Upstream	Type of surface water inputs upstream	Surface water inputs- number Downstream	type of surface water inputs Downstream	subsurface water inputs Upstream	Sediment inputs- source Upstream	subsurface water inputs downstream	Sediment inputs- source downstream	Adjacent land use within buffer	Weland land use below OHW	Shade over channel- average overhang	Average percent cover	Average of 2 banks
4/28/2008	1	2	2	1	1	2	2	Yes	Culvert upstream			none	Cattle grazing	none	cattle grazing	4, 6	4,6	0	0	0
4/28/2008	2	2	2	0	0	0	0	Yes	R/D basins	Yes	airport culvert	none	Cattle grazing	none	cattle grazing	4, 4	4, 4	0	20/50	35
4/28/2008	3	2		1		0		Yes	landscape draws, culvert, and subsurface drain	Yes	6 inch culvert/PVP pipe	none	none	none	ped trail/eroded	5, 6 & 5,6	6, 6		20/50	35
4/29/2008	4	0		1		2		Yes	surface seeps			none		none	cattle	4,4	4,4		30/30	30
4/29/2008	6	0	0	1	1	0	0	none		none		none	cattle trail	none	cattle trail	4,5 & 4,5	4,4		80/90	85
4/29/2008	5	0	1	2	0	1	2	none		none		none	stables	none	stables	1,8 & 1,8	1,1		15/30	23
4/30/2008	8	0	1	0	0	1	0	none		none		none		none		4,4	1,1		90/80	85
4/30/2020	9	0	1	2				none		none		none	bank erosion	none	exposed soils/bank erosion	4,4	1,1		90/75	82.5
4/30/2008	7	0	1	0	0	1	0	none		none		none	undercut banks	none	eroded bank	4,5 & 4,5	1,1		80/70	75
5/1/2008	11	0	0	0	0	0	0	Yes	culvert- top of bank	none		none	inlet & culvert	none		4,4	1,1		80/90	85
5/1/2008	10	2	0	0	0	0	0	Yes	residential area US, 2 bridges	none		none	bridges and residential	none	recreation, run-off channel	6,6	N/A		80/80	80
																mode= 4	mode= 1			

0 = no

1 = yes (natural)

2 = yes (artificial)

Notes:

1= undisturbed; 2= logged 0-5 years ago; 3= logged 5+ years ago; 4= agriculture; 5= low density housing; 6= urban; 7= cleared; 8= other

AppendixD

ANIMAL SIGNS

Date	Site Number	Animal signs-Tracks	Trails >4"	Trails < 4"	Feeding evidence	Squirrel middens	Feathers	Bird nest	Nesting cavities	Bedding	Fur	Scrapes/rubs	Browse	Raptor Pellets	Scat-Mammal	Scat-Avian	Calls-mammal	Calls-avian	Animal observations-number of species
4/28/2008	1	1,2	1,2	2	0	0	0	1	0	0	0	0	0	0	1,2	0	0	1	7
4/28/2008	2	1	1	2	2	2	0	0	0	0	2	0	2	0	2	2	0	2	11
4/28/2008	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8
4/29/2008	4	2	1	2	2	0	0	possible	2	0	0	0	0	0	2	0	0	2	15
4/29/2008	6	1	1,2	1,2	2	0	0	2	2	0	0	0	1	0	1,2	0	1	2	8
4/29/2008	5	2	2	0	0	0	2	2	2	0	0	0	0	0	0	0	0	2	12
4/30/2008	8	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	1	2	5
4/30/2020	9	2	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	2	5
4/30/2008	7	0	0	2	0	0	0	0	2	0	2	0	0	0	0	0	0	2	6
5/1/2008	11	0	0	0	0	0	2	0	2	0	0	0	0	0	0	2	0	2	7
5/1/2008	10	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	13 (2)

0 = no
1 = yes (domestic)
2 = yes (wildlife)

FAUNA LIST

Common Name	Total obs.	Site 1	Site 2	Site 3	Site 4	Site 6	Site 5	Site 8	Site 9	Site 7	Site 11	Site 10
Invertebrates												
crawfish	1	X										
Vertebrates												
Birds												
red winged blackbird	2	X	X									
barn swallow	1	X										
mallard	1	X										
cliff swallow	4	X	X							X		X
european starling	2	X										X
western gull	1	X										
killdeer	1		X									
house finch	2		X									X
northern mocking bird	1		X									
great-horned owl	1		X									
song sparrow	3		X							X		X
lesser goldfinch	2		X									X
rock dove	1			X								
brewer's blackbird	1			X								
anna's humingbird	3			X			X					X
house sparrow	1			X								
pacific slope flycatcher	4			X	X	X					X	
california towhee	2				X						X	
turkey vulture	3				X		X		X			
scrub jay	1				X					X		X
black-headed grospeak	1				X							
rough-wingered swift	1				X							
red-tailed hawk	1				X							
ash-throat flycatcher	2				X	X						
scrub jay	2					X	X					
spotted towhee	1						X					
chestnut-backed chickadee	2						X	X				
yellow warbler	1						X					
great blue heron	1						X					
? Woodpecker	2							X			X	
wild turkey	1								X			
american crow	2								X			X
california quail	1										X	
stellar's jay	2										X	X
white-crowned sparrow	1											
Vertebrates												
Fish												
3-spined stickelback	2		X	X								
Steelhead	5			X				X		X	X	X
Reptiles & Amphibians												
SW pono turtle	2		X								X	
western fence lizard	5		X		X	X		X				X
bullfrog	1				X							
pacific chorus frog	4				X	X	X					X
alligator lizard	1					X						
aquatic garter snake	1					X						
red-legged frog	1								X			
tadpoles- unID	1									X		
Mammals												
mule deer	2	X			X							
dusky-footed woodrat	3				X			X	X			
Coyote	1									X		
domestic dog	1											X
Insects												
swallow tail butterfly	1											X
painted lady butterfly	1											X

AppendixD

SOILS, GEOMORPHOLOGY, AND CHEMISTRY

Date	Site Number	Stream temp	Stream pH	EC	Landform	Land Feature	Position	Elevation	Aspect	Shape	Slope RL	Slope RR	Particle size class	Depth to Sat (in)	Soil Temp	Area ponds or floods	Soil Hydric (Y/N)	Redox Depth (in)	Creek bank side slope (%) RL	Creek bank side slope (%) RR
4/28/2008	**1**	NA	NA	NA					flat	flat	NA	NA	clay	13	16	Ponds			0	0
4/28/2008	**2**	15			alluvial fan	perennial creek	mid-peren.	115	eastward bank					28	16	Floods	Y	5	42	37
4/28/2008	**3**	15			dissected alluvial fan	stream			N-S		90	≥4	NA							
4/29/2008	**4**	16.7	8.31	880	coast range river valley	river valley			120-dwnstrrm.		20	65	fine sand	NA	13	Floods	N	21	40	5
4/29/2008	**6**	23.5/19	7.96	990	dissected coastal terrace	stream canyon					45	65			15	N	N		70	80
4/29/2008	**5**	18.9/16	8.16	860	coastal range		above man-made dam		220 downstrm		30	18			19	Floods	N		18	40
4/30/2008	**8**	12/14.2	8.76	790							20	≈20			13	Floods	N		30	14
4/30/2020	**9**	14	8.3	960					220- DS		40	20			12	Floods	N		22	14
4/30/2008	**7**	11	8.53	850					230-DS						13	Floods	N		25	55
5/1/2008	**11**	12	8.46	940	alluvial fan	incised channel on valley	midway down alluvial fan		S	concave channel					11	Floods	N		28	40
5/1/2008	**10**	11.5	8.6	1030	partially filled coastal basin	stream			E-W		16	10			11.5		N		9	vertical

AppendixD

SOILS, GEOMORPHOLOGY, AND CHEMISTRY

Date	Site Number	A Horizon - Upper (in)	A Horizon - Lower (in)	A Horizon Color	A Horizon Boundary	A-H Redox type	A-H Redox Feature Size	A-H Redox Feature Area (%)	A-H Modifier	A-H Texture	A-H Gravel (%)	A-H Cobble (%)	A-H Stones (%)	A-H Primary	A-H Secondary	A-H Consistnecy	A-H Roots Fine	A-H Roots Medium	A-H Coarse	Sulfuric Odor (Y/N)	A-H pH	A-H Oxidized Rhizospheres (Y/N)
4/28/2008	1	NA	NA	NA					flat	flat	NA	NA	clay	13	16	Ponds			0	0		
4/28/2008	2	0	10	10 YR 4/2			1mm	5		silty sand										N		
4/28/2008	3	NA																				
4/29/2008	4	0	21	10YR3/3				0	silty	sand	0	0	0	SAB			few	some		N		N
4/29/2008	6	0	5	10YR3/3					sandy	loam	2	0	0	AB			some	few		N		N
4/29/2008	5	1	5	10YR4/3							0	0	0	AB			many	few		N		N
4/30/2008	8	1	6	7.5YR3/2					loamy	sand	10	0	0	Sand			some	some		N		N
4/30/2020	9	1	8	10YR3/2					loamy		10	10		AB			some	few		N		N
4/30/2008	7	0.5	6	10YR3/3					loamy	sand	0	0	0	Sand						N		N
5/1/2008	11	5	10	10YR3/2					loamy	sand	5						some					
5/1/2008	10	1	6	2.5YR4/3					loamy	sand				blocky			few		few			

AppendixD

SOILS, GEOMORPHOLOGY, AND CHEMISTRY

Date	Site Number	B Horizon - Upper (in)	B Horizon - Lower (in)	B Horizon Color	B Horizon Boundary	B-H Redox type	B-H Redox Feature Size	B-H Redox Feature Area (%)	B-H Modifier	B-H Texture	B-H Gravel (%)	B-H Cobble (%)	B-H Stones (%)	B-H Primary	B-H Secondary	B-H Consistnecy	B-H Roots Fine	B-H Roots Medium	B-H Coarse	B-H Sulfuric Odor (Y/N)	B-H pH	B-H Oxidized Rhizospheres (Y/N)
4/28/2008	1	NA	NA	NA					flat	flat	NA	NA	clay	13	16	Ponds			0	0		
4/28/2008	2	10	188	10YR7/6						silty clay				strong AB						N		
4/28/2008	3	NA																				
4/29/2008	4	21	30	10YR4/2		conc.	15-Oct	25	clay	loam	0	0	0	SAB						N		N
4/29/2008	6	3	12	10YR3/2		O.R.	sm	1	sady	loam	<2	0	0	AB			Some	few		N		N
4/29/2008	5	6	18	10YR4/3					silty	sand	10	0	0	sand			no			N		N
4/30/2008	8	6	16	10YR3/3					loamy	sand	10	40	0	sand			some	many				
4/30/2020	9	8	18	10YR2/2					loamy		25	25		AB			few	few		N		N
4/30/2008	7	6	18	10YR3/3					loamy	sand	15	15		sand						N		N
5/1/2008	11	10	26	10YR3/2					loamy	sand							few					
5/1/2008	10	6	16	10YR4/3		conc.	small	<2	sandy	loam				sub angular bocky			few				8.44	

Appendix E
Methodology Used to Collect Reference Data for the Development of the San Luis Obispo HGM Riverine Guidebook

APPENDIX E

Methodology Used by the A-Team to Collect Reference Data for the Development of the San Luis Obispo Riverine HGM Guidebook

Hydrology and Coarse Wood Sampling

For each of the 1 reference sites sampled for this study, the A-team completed an examination of pertinent references, floras, published reports, plans, etc. prior to traveling to the field. Once in the field, the A-team completed a thorough reconnaissance of each candidate stream channel reach and riparian zone. The A-team also examined areas immediately upstream and downstream of the recommended location for the reference site. The A-team used current and historic air photos, U.S. Geological Survey and County maps at several scales, soil survey information, etc. to assist us in our reconnaissance. On completion of the site reconnaissance, the team conferred to review reconnaissance results and to either accept or reject the reference site for incorporation into the San Luis Obispo County (SLOC) Reference System. Grounds for rejection usually focused on safety, access permission, and redundancy with reference sites already sampled, or the appropriateness of the proposed site as belonging to the reference domain. If a reference site was accepted, the A-team then worked to identify a "representative" and relatively homogeneous stream channel reach. On selection of the sample reach, the A-team established the main stream channel cross section.

Standard methods for locating a representative reach and stream cross section were used (Dunne and Leopold 1978, Harrelson *et al*. 1994). These methods caution investigators to avoid meanders or otherwise complex portions of the channel system (*e.g.*, a cross section through a log jam) and to locate cross sections in relatively straight, homogeneous parts of the channel. For this study, and mainly for the purposes of establishing a standard reference level for measurements, the main channel cross section extended from the "Ordinary High Water" mark (OHW) on stream left (left bank, looking downstream) to OHW on stream right (right bank, looking downstream). Our definition of OHW was consistent with language offered in the Federal Regulations at 33 CFR 328.3 (e). In all three subclasses that were the main focus of this study, OHW stream left to OHW stream right delineations almost always represented the geographic extent of federal jurisdiction and our best judgment of the level of flood events that occur on an annual or near annual return frequency. The A-team used a standard non-stretch measuring tape, vice grips or clamps, and either bubble or laser levels to mark the main cross section and to ensure that our main cross section reference line was taught and level.

Photograph E-1. *Data collection at OHW cross section, Cottontail Creek Reference Site.*

From the outset, the A-team recognized that use of OHW as a reference level in the main channel cross section may be problematic, because of the erratic and highly variable nature of stream hydrographs in the SLOC region, and the degree of entrenchment or human alteration of many streams within the SLOC domain. OHW determination by the A-team in many altered and in unaltered channel reaches represent our best professional judgment regarding the stage (OHW) of the approximately 1 to 1.5 year return flow event. The A-team recognize that this field measurement technique is somewhat contrived and that it does not capture the hydrologically active portions of the channel system at very high or catastrophic flow events. For the purposes of this Draft Guidebook, the A-team considered the area from "top of bank stream left" to "top of bank stream right" to be most likely flood-prone during very high to catastrophic flow events.

Following establishment of the main channel cross section, the A-team used a Spectra Precision Laser model GL 412 laser level and rod system, and the cross section tape to complete horizontal and vertical measurements in the cross section. These included channel width and depth from OHW at several points in the cross section. From these measurements the A-team calculated cross-sectional area at the main cross section. The A-team also used the laser level system to complete measurement of the longitudinal profile of the channel for a distance 3.5 times the OHW width at the main cross section upstream and downstream from the main cross section. Thus, the longitudinal profile transect was a total length of 7 times the OHW channel width at the main cross section. To complete the series of measurements centered at the main cross section, the A-team developed sketches of both the main channel cross section and the longitudinal transect, and took representative photos.

Starting at the main cross section, the A-team measured the width of the area from "top of bank" stream left to "top of bank" stream right.

Starting at the deepest point in the main cross section (thalweg), "Flood Prone Area Width" (FPAW) was measured using the assumption that it equals the width of a horizontal projection to channel or terrace banks on stream left and right from a level two times the thalweg depth (Leopold 1994, Rosgen 1994). The A-team also measured "wetted perimeter" at the main channel cross section by laying a cloth tape over the bottom of the channel from OHW stream left to OHW stream right. A summary of these basic channel geometry measurements, and derived channel geometry statistics (*e.g.*, width:depth ratio; entrenchment ratio; hydraulic radius) are offered on the data sheets offered in Appendices C and D.

Several measurements were completed along the main channel study reach for a distance of 3.5 times the OHW channel width upstream and 3.5 the OHW channel width downstream from the main channel cross section. For example, in the entire 7x study reach, the A-team used Rosgen's (1994) system to classify the stream channel type. The A-team also walked the study reach several times to:

1. Count and measure the distance between "residual pools." By definition, residual pools that are at least 10 ft^2 in area and 0.5 ft deep at the deepest point that would exist within the channel cross section at base flow conditions.
2. Complete a standard, 100 sample pebble count (Leopold 1970).

3. Use the pebble count estimates of larger size bed material (D-84) to identify and measure the degree of embeddedness of 20 samples of larger size channel bed material in smaller size channel bed materials.
4. Count the number and measure the length and diameter of each piece of "coarse woody debris" (wood > 3 inch diameter) in the channel below OHW.
5. Count and measure the length, width, area, and decomposition class of coarse and fine woody debris jams.
6. Count the number of coarse wood pieces from channel bank sources.

Measurements of immobile bed roughness, where appropriate, were completed at OHW stream right to OHW stream left channel cross section transects located 25 ft upstream and downstream from the main channel cross section. Within these "immobile bed" transects, the area of each immobile bed feature (e.g., stones or boulders size class D-84 and larger, which are derived from pebble count data) intersecting the vertical plane of the cross section was measured (Photograph E-2). All area measurements were added, then divided by the cross sectional area at that point in the channel to derive an estimate of the proportion of the channel cross-section occupied by immobile bed features.

Photograph E-2. *Pebble count at the San Luis Obispo Creek Reference Site.*

Additional hydrology measurements included observations of hydrologic connections up- stream and downstream, surface or subsurface water inputs (Photograph E-3) and outputs, observations of sediment inputs and accumulations, and obser- vations of any levees, dikes, or barriers to fish passage.

Photograph E-3. *Surface hydrologic input (metal pipe) at Willow Creek Reference Site.*

Soils Sampling

The A-team sampled soils using undisturbed channel cutbanks and soil pits to identify and describe soil characteristics. Soil characteristics also yielded important information on site hydrology (e.g., drainage class, presence or absence of redoximorphic features). When channel cutbanks were not present, soil pits were excavated. These pits were excavated to the depth of impenetrable debris (e.g., boulders, stones, cobbles) or excess water, or to a depth of approximately 3 ft, whichever was encountered first. The upper 3 ft were excavated with a "sharpshooter" shovel. A closed-bucket or Dutch auger often was used below approxi-

mately 2 ft. The A-team described the riparian soils on stream right and stream left, and estimated the texture and particle size class of the sediment within the stream channel.

Identification, nomenclature, and description of soil horizons were consistent with guidance provided by the USDA Natural Resources Conservation Service (Schoeneberger *et al.*, 1998). Field teams measured all depths from the top of the surface horizon, usually an A horizon. Live vascular and non-vascular plant materials were **not** included in these depths. Soil colors were determined using a standard Munsell Soil Color Chart (Munsell 1992) (Photograph E-4).

Photograph E-4. *Determination of soil color at the Willow Creek Reference Site.*

Vegetation Sampling

Vegetation sampling allowed for the collection of multiple descriptive measures of the plant communities characteristic to the SLOC riverine waters/wetlands. For example, the A-team collected data on tree, shrub, vine, herb, snag, and seedling/sapling and off-channel coarse woody debris percent cover, as well as tree and snag basal area. Other data included descriptions of dominant leaf type, dominant type of regeneration, average number of strata present, and width of riparian zone of influence. A species list was compiled, with cover class values assigned to each taxon. The vegetation sampling team also evaluated the continuity of the vegetation. Classes of waters/wetlands present, according the modified Cowardin classification developed by Ferren and colleagues (Ferren 1995, 1996 a, b, c) also were described.

Point Center Quarter (PCQ) Plots

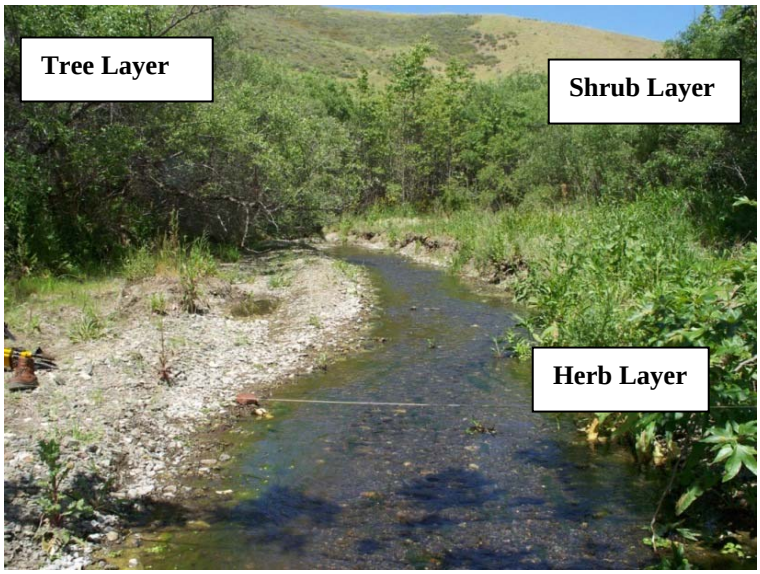
The point-center quarter plot is a standard technique in vegetation sampling used to obtain a measure of stand composition and dominance (Mueller Dombois and Ellenberg 1974). The A-team chose a plot center that would allow the sampling team to obtain a set of measurements that best characterized the riparian vegetation within the variable assessment area. Where significant constraints were encountered such as extensive growth of Poison oak (Toxicodendron diversiloba) or a slope (> 70%) so steep that the A-team could not stand upright and take measures, the team estimated the requisite measurements (i.e., inter tree distance and diameter at breast height) from outside the riparian zone, typically standing in the creek below OHW.

To use the point-centered quarter methodology, one member of the team stood at plot center, determined the four cardinal quarters of the plot (using a standard compass when needed), and held the zero end of the sampling tape for the second member of the team. The second person held the other end of the tape, and with the team recorder, determined the identity of and distance to the closest tree, shrub, vine, herb, and seedling/sapling in each of the four quarter

plots. Additionally, distances to nearest snag and off-channel coarse woody debris also were obtained. For each tree and snag within each quarter, the diameter at breast height (DBH) using a forester's diameter tape.

Number of Strata

To obtain a measure of the average number of vegetation strata within the assessment area, the vegetation team recorder held one end of the 100 ft sampling tape while the other walked the length of the tape, parallel to the stream. Generally, but not always, the center of the PCQ plot was the (50 ft) center of vegetation strata transect. When it was not possible to stretch a tape for the entire 100 ft due to the density of the understory, ten measurements were obtained at sampling points spaced at minimum 10 ft apart, but not necessarily at exactly equivalent distances.



Photograph E-5*. Vegetation structure at Old Creek Reference Site.*

At every ten ft, one team member determined the number of strata that intersected the sampling point at the toe of their boot. For example, if a tree canopy overhung a continuous vine layer, with no additional vegetation present at the sampling point, two (2) vegetation strata (tree + vine) were recorded. The A-team obtained twenty (20) measurements total, ten (10) on each side of the assessment area within the riparian zone of influence (Photograph E-5).

Width of Riparian Zone

To obtain a measure of the extent of streamside vegetation from the ordinary high water mark to its upslope extent, the A-team measured the width of the riparian zone from OHW to the first break in vegetation. A break in vegetation was defined as any noticeable, measurable change in the continuity of vegetation, such as a foot trail or road, which had the potential to affect the movement of any terrestrial animal.

Typically, four measurements of riparian width were obtained from each side of the assessment area. One member of the team stood at OHW, while the other walked to the first break in continuity of vegetation. In most instances, it was possible to correct for the influence of slope by holding the tape plumb and from OWH to the break in vegetation. This sampling protocol was repeated up to four times to capture the range of variation in width. If the width of the riparian zone was unvarying, often the result of an immediately adjacent paved road or when the creek was highly disciplined (e.g., concrete channel), then only one measurement was taken on each side of the assessment area.

Tree Density and Basal Area

To obtain a measure of tree density and basal area, the A-team used a basal area factor (BAF) 10 prism, which is a standard "plotless" technique used in forest measurement. The recorder stood at the center of the PCQ plot and using the prism, counted the number of trees that were large enough to be counted within the assessment area on one side (either left or right) of the stream. The second team member recorded the ocularly estimated height of an individual representative of each species. This protocol was repeated on the other side of the assessment area.

Species Composition and Indigenous Status

After the above measurements had been taken, the vegetation team walked the assessment area and recorded every plant species present. After the entire site had been thoroughly assessed, an ocular estimate of canopy cover was made for each species, and the cover class midpoint recorded. At the end of the sampling, the indigenous status (i.e., whether the species was native, nonnative, ornamental, or cultivated) also was recorded (Photograph E-6).

Photograph E-6. *Development of the plant species list at Dairy Creek Reference Site.*

Additional Descriptive Information

Various other data were obtained at the end of the sampling effort. The team member responsible for the species list recorded the (1) leaf type of the dominant stratum, (2) dominant type of regeneration, and (3) type of waters/wetland(s) present within the assessment area, using the Ferren et al. classification for each stratum (Ferren et al. 1995, 1996 a, b, c). For leaf type, the possible states for trees, which most often were the dominant vegetation, were broadleaf evergreen, broadleaf deciduous, needle leaf evergreen, mixed broadleaf deciduous and evergreen. When trees were not the dominant vegetation, then the dominant life form (e.g., herbs) was recorded. For dominant type of regeneration by strata, the A-team recorded either sexual exclusively, vegetative exclusively, or both the dominant taxa exhibited sexual and vegetation modes of regeneration.

The listing of waters/wetland types from the Ferren, Fiedler, Leidy classification (1995) was more problematic. This classification technique requires considerable knowledge of the classification structure as well as the vegetation. Classification of waters/wetland types at each sampling site typically was time-intensive. Therefore, the A-team recorded only the modal riverine wetland type(s) and palustrine wetland type(s) at each site.

Habitat/Faunal Support Sampling

Photograph E-7. *Direct animal sign (Pacific chorus frog tadpole) at the Old Creek Reference Site.*

At each of the 11 reference sites sampled for this study, the A-team completed a systematic look for either direct or indirect signs of animal use of the waters/wetlands or the associated riparian zone/buffer area. The area sampled extended laterally from buffer boundaries on stream left to buffer boundaries on stream right. Upstream and downstream boundaries extended at minimum 3.5 times the OHW channel width at the main cross section. Direct observations required that the team member would actually see or hear the call of an animal within the assessment area (Photograph E-7).

Indirect observations included several types of sign (*e.g.*, tracks, browse, nests, scrapes or rubs, etc.). A complete list of animal signs is included in the data sheet, provided in Chapter III.

Land Use, Buffers, and GIS Location Input

Observations were noted on the data sheet (Appendix A) regarding the dominant land use within the assessment area and the adjacent buffer. Land use was classified as either (1) undisturbed, (2) agriculture, (3) housing, (4) urban, (5) cleared, or (6) other.

The 11 HGM reference site locations were identified in the field using a GPS (Global Positioning System) unit programmed to read UTM (Universal Transverse Mercator) coordinates. The reference site locations were recorded on the appropriate datasheet in UTM and where then later translated into decimal degrees to be converted into GIS (Geographic Information System) point features in ArcView (Figure 3.2). The reference site locations were converted to a map projection useful for area calculations and consistent with the other public data in the GIS database (i.e., Albers California map projection). Data points were attributed with the appropriate reference site identification numbers. In some instances, due to steep topography and tree canopy cover in the riparian zone, a positional error of as much as 50 meters occurred. In two instances the GPS points capture did not overlay into the correction geographical position. In these instances, the points were recaptured by GPS and amended in the GIS data layer.

Remote Sensing and GIS Methodology and Applications

Generation of Variable Assessment Scales

Most landuse and vegetation GIS data were accessed on the publicly available SLO datafinder website (http://lib.calpoly.edu/collections/gis/slodatafinder/) managed by the California Polytechnic State University Library. Further, most GIS data layers offered on this site were contributed by the County of San Luis Obispo and exist in compatible coordinate systems, which minimized the need for data projection conversion. Relevant data accessed at this site included

comprehensive countywide streams and roads vector layers, county transmission lines data, and two vegetation data layers.

The Streams data layer was developed as part of the National Hydrography Dataset (NHD) and was based on 1:100,000 scale USGS Digital Line Graph hydrography data and the EPA Reach File Version 3 (RF3). The location of reference site location points was confirmed by the correct position of points along a corresponding stream reach and was cross compared to a respective location on an areal photograph. After verifying that all reference points were projected within the correct collection location, a 1000-ft radius buffer or variable assessment area (VAA) ring was created around each of the 11 reference sites.

In order to develop an appropriate land use classification system, multiple vegetation data layers were accessed and evaluated for suitability and accuracy based on field observations made at each reference site. From the SLO Datafinder website, two vegetation data layers were downloaded, including a countywide vegetation cover layer developed by the USGS Gap Analysis Program (GAP) and a more detailed vegetation type layer restricted to the San Luis Obispo Planning Area. After a close inspection of the countywide vegetation cover layer within each of the defined VAA it was determined that the data layer did not accurately reflect field observations of vegetation cover. As a result, a third more detailed vegetation layer was accessed from the California Department of Forestry Fire and Resource Assessment Program (FRAP) website (http://frap.cdf.ca.gov/). The FRAP vegetation grid layer was capture at a 100 meter resolution scale using the common California Wildlife Habitat Relationships (CWHR) classification system. A close inspection of the grid layer within each VAA identified minimal discrepancies with field observations and was therefore used to establish the land use classification system used for the HGM GIS variables. It should be noted that due to the relatively small area encompassing each VAA for the HGM analysis, the FRAP vegetation layer should have been re-sampled at a smaller resolution. Due to the limited capabilities offered by ArcView, this step was omitted for this exercise; however, the effectiveness of the original data layer was found to be adequate for a simple functional assessment analysis.

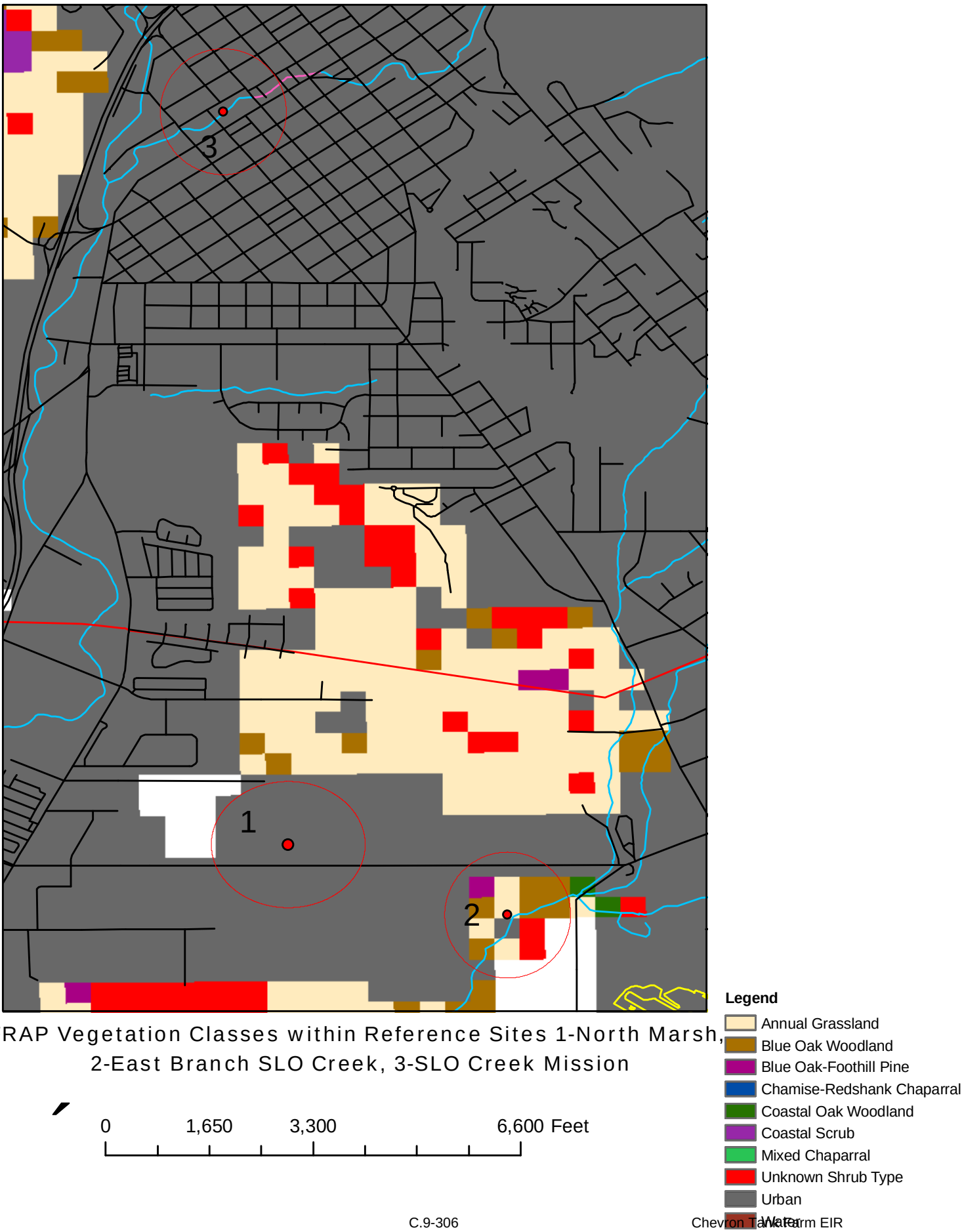
Land Use Classification for HGM Functional Assessment Variables

A simplified land use classification was used as the basis to scale three variables in the HGM functional assessment protocol; $V_{PATCHNUMBER}$, $V_{PATChLATCON}$ and $V_{PATCHLONGCON}$. These variables were created to assess the effect land use and vegetation cover has on faunal habitat contiguity. A rating system designating three habitat quality subclasses, excellent, good, and poor were defined based on specific vegetation cover types. For example, a region of excellent habitat defined within a reference site VAA would be dominated by a native perennial or wetland plant community (*i.e.*, coastal scrub, oak woodland, and emergent wetland). Using the FRAP vegetation grid layer, all 11 reference site locations were characterized within the VAA to determine the appropriate habitat classifications for each continuous grid (i.e. vegetation) area. The second vegetation GIS layer restricted to the SLO planning area was used for comparison for sites falling within the data layer (in this case, reference sites 2, 3, 8, and 9). Each reference site was re-classified using the vegetation cover data and in some instances was altered to reflect field observations and best professional judgment. Using this methodology the variable $V_{PATCHNUMBER}$ was scaled to reflect the appropriate percentage of each habitat sub-classification (*i.e.*, patch number).

A roads layer and transmission line layer were added to the GIS to pinpoint breaks within a contiguous habitat class in order to scale the variables $V_{PATChLATCON}$ and $V_{PATCHLONGCON.}$ The reference road layer was accessed on the SLO Datafinder website and was created from the Census TIGER database (U.S. Census Bureau). Transmission line countywide data (developed by the County of San Luis Obispo) included major power lines connected to the Morro Bay and Diablo Power Plants along the coast. These data were combined in addition to notable breaks between habitat classes (i.e. patches) to scale the variable $V_{PATChLATCON}$, which was defined as the lateral contiguity (i.e. perpendicular to the general valley trend of channel) of habitat patches within the 1,000 ft VAA. Breaks within habitat contiguity were measured by first drawing within the GIS a straight, perpendicular line to the stream channel and crossing the reference site point, and then counting the number of intersecting habitat patch interruptions. A similar methodology was used to scale the variable $V_{PATChLATCON}$; however, in this case habitat patch interruptions were counting longitudinally, along the channel.

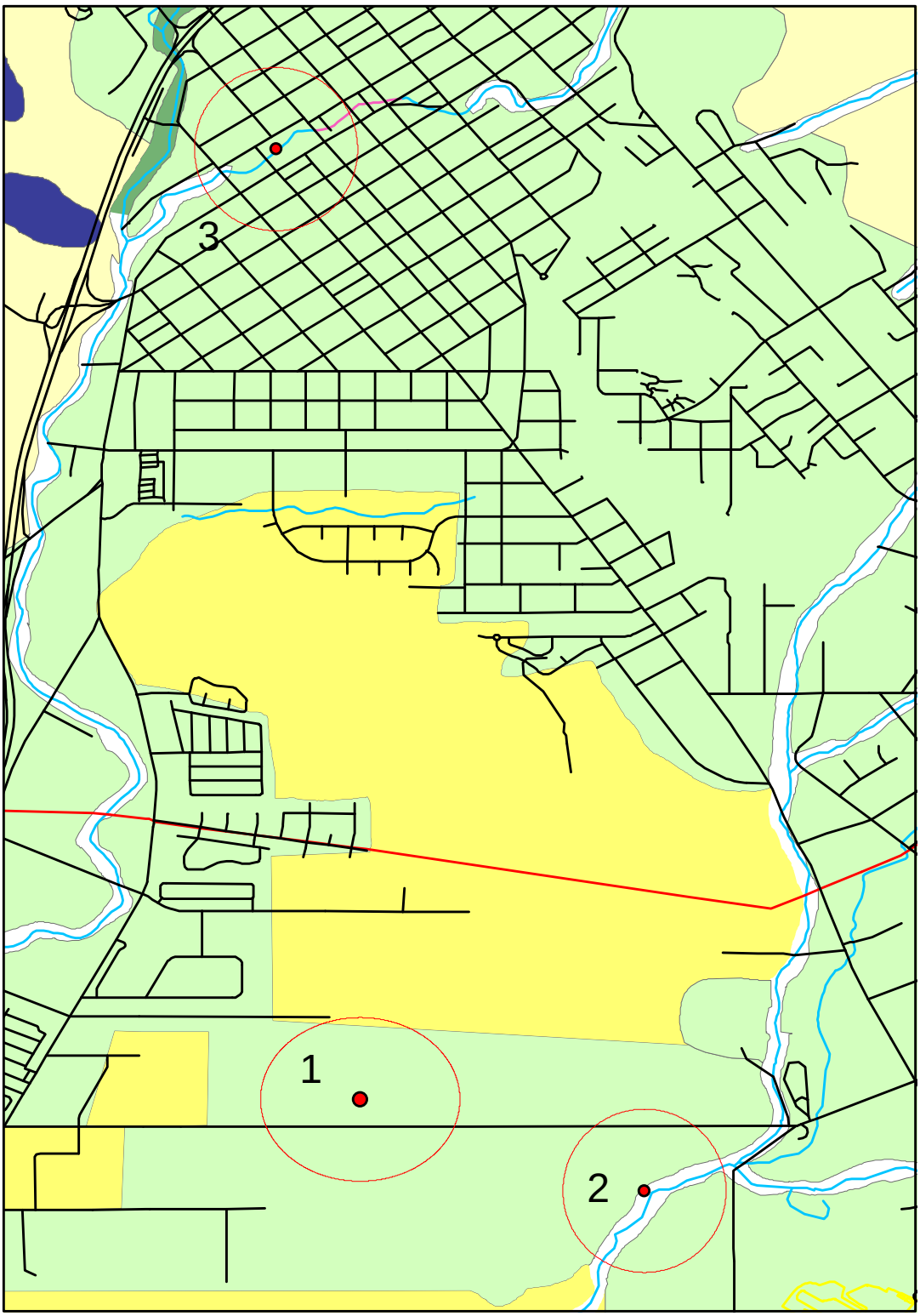
Appendix F
GIS Maps Used to Score Landscape Variables for the San Luis Obispo Riverine HGM Guidebook

Figure F-1



FRAP Vegetation Classes within Reference Sites 1-North Marsh, 2-East Branch SLO Creek, 3-SLO Creek Mission

Figure F-2



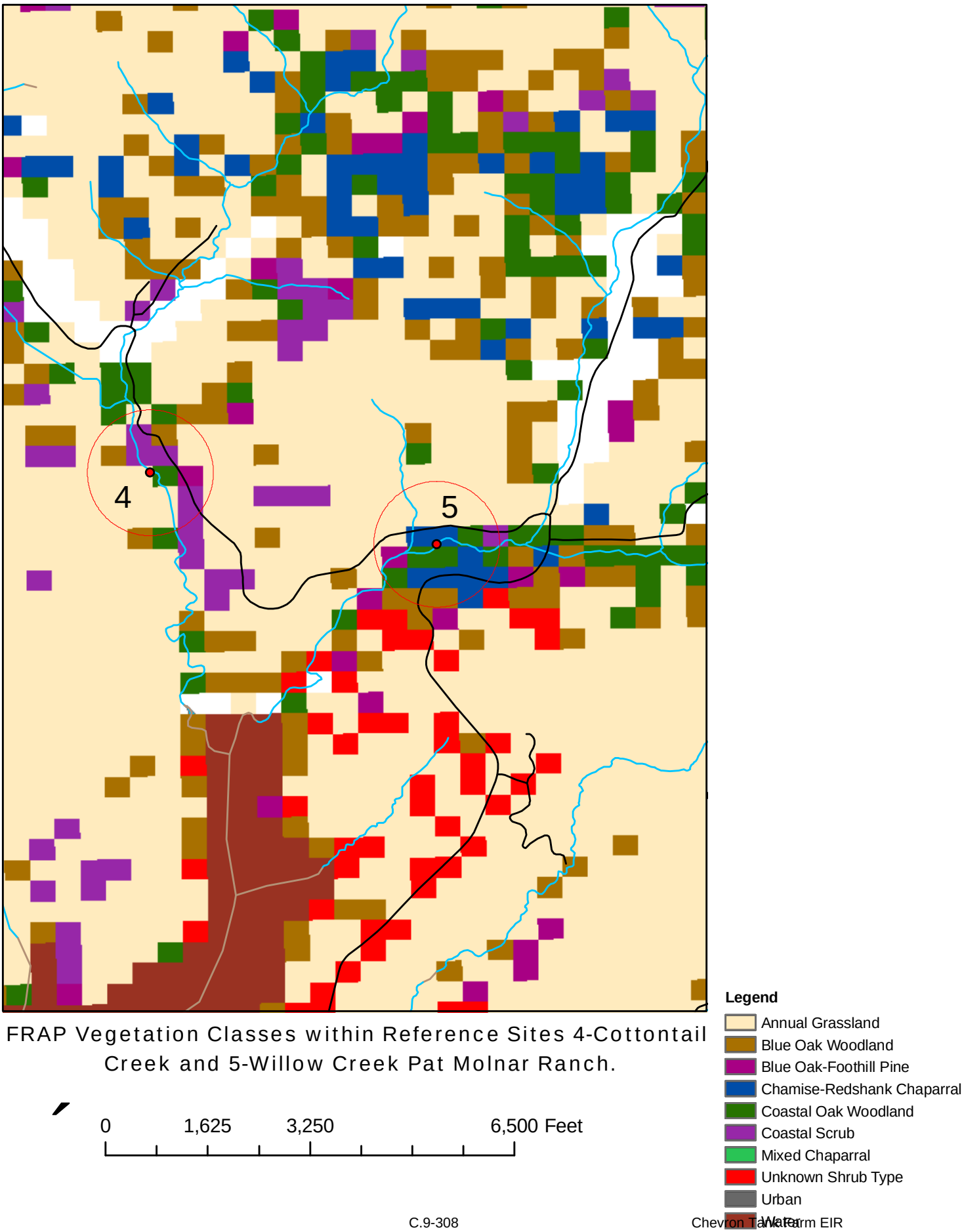
SLO Planning Area Vegetation Classes within Reference Sites 1-N. Marsh, 2-E. Branch SLO Creek, and 3-SLO Creek Mission.

Legend

- Agriculture
- Coastal Scrub
- Developed
- Non-Native Grass
- Oak Woodland
- Riparian Woodland

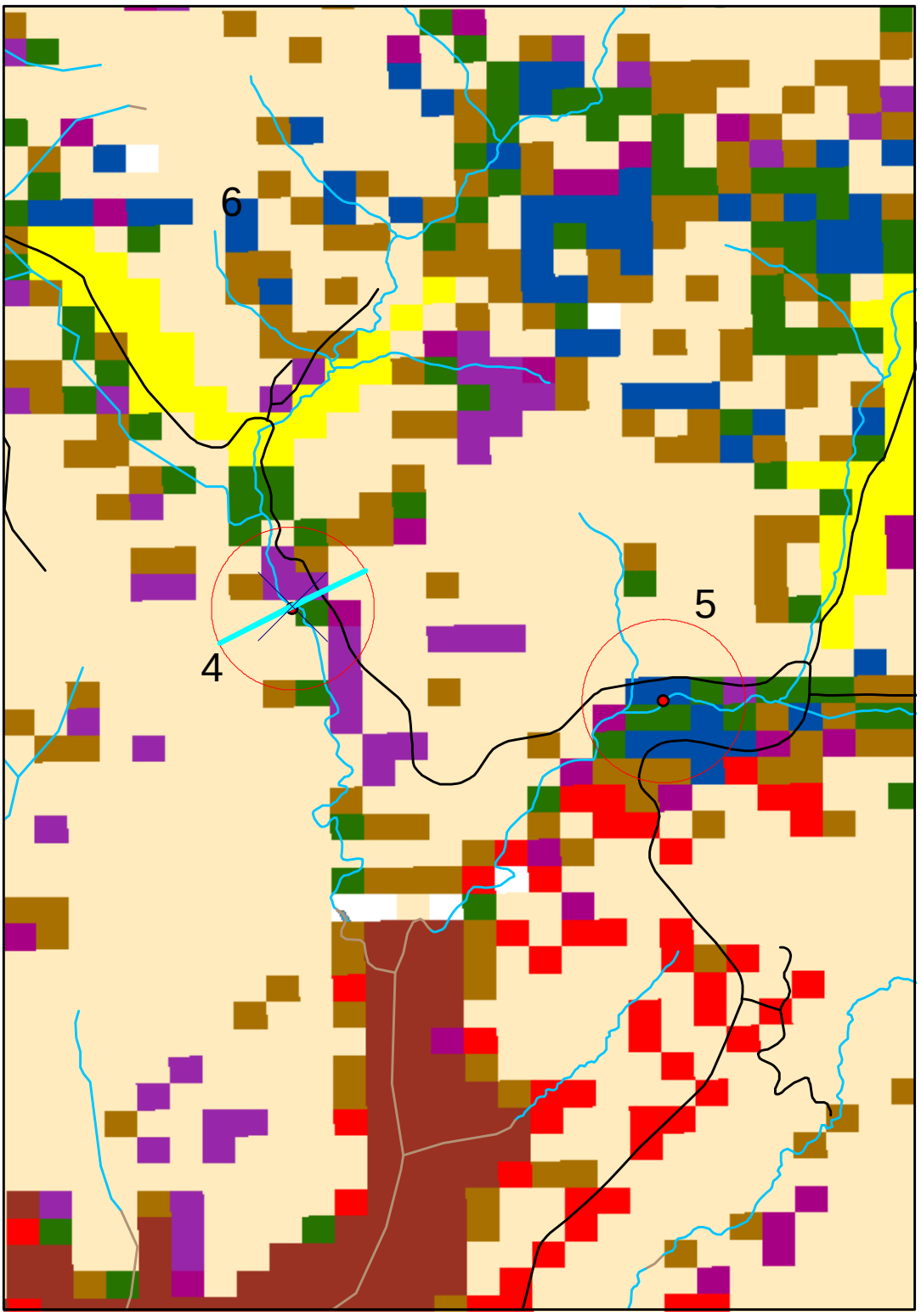
0 1,600 3,200 6,400 Feet

Figure F-3



FRAP Vegetation Classes within Reference Sites 4-Cottontail Creek and 5-Willow Creek Pat Molnar Ranch.

Figure F-4



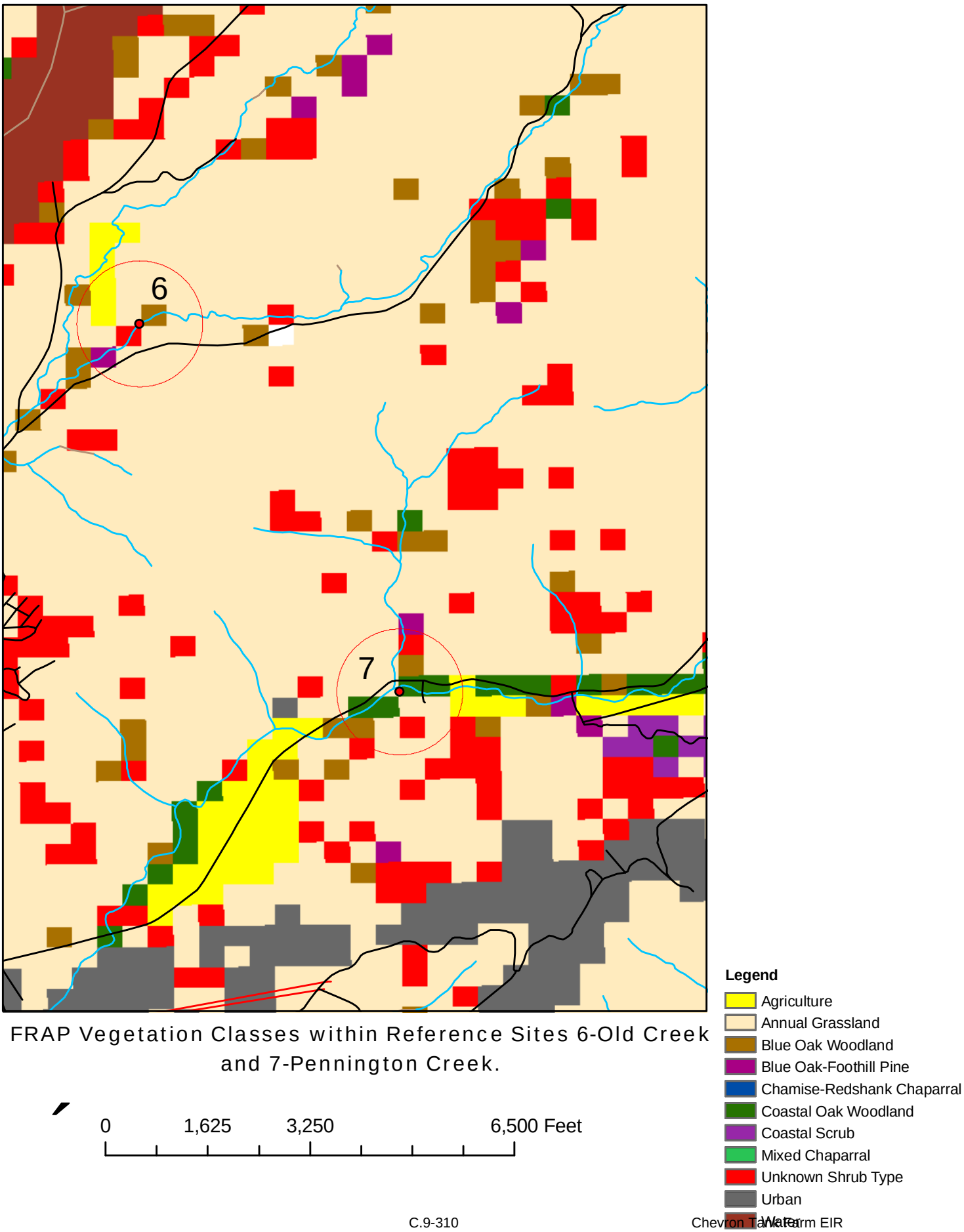
Perpendicular Cross-Section at Reference Site
4-Cottontail Creek with FRAP Vegetation Classes.

0 1,600 3,200 6,400 Feet

Legend

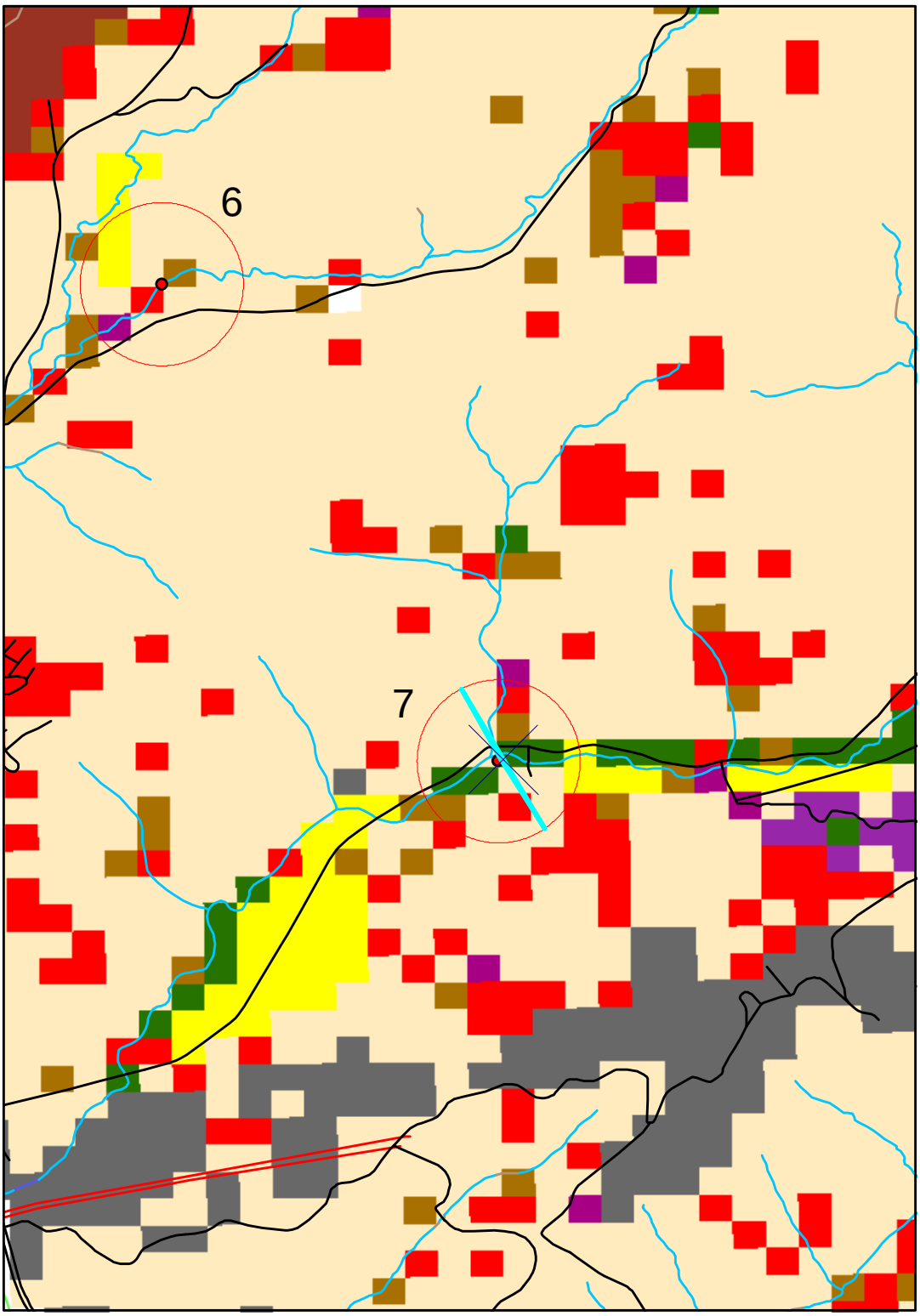
- Agriculture
- Annual Grassland
- Blue Oak Woodland
- Blue Oak-Foothill Pine
- Chamise-Redshank Chaparral
- Coastal Oak Woodland
- Coastal Scrub
- Mixed Chaparral
- Unknown Shrub Type
- Urban
- Water

Figure F-5



FRAP Vegetation Classes within Reference Sites 6-Old Creek and 7-Pennington Creek.

Figure F-6



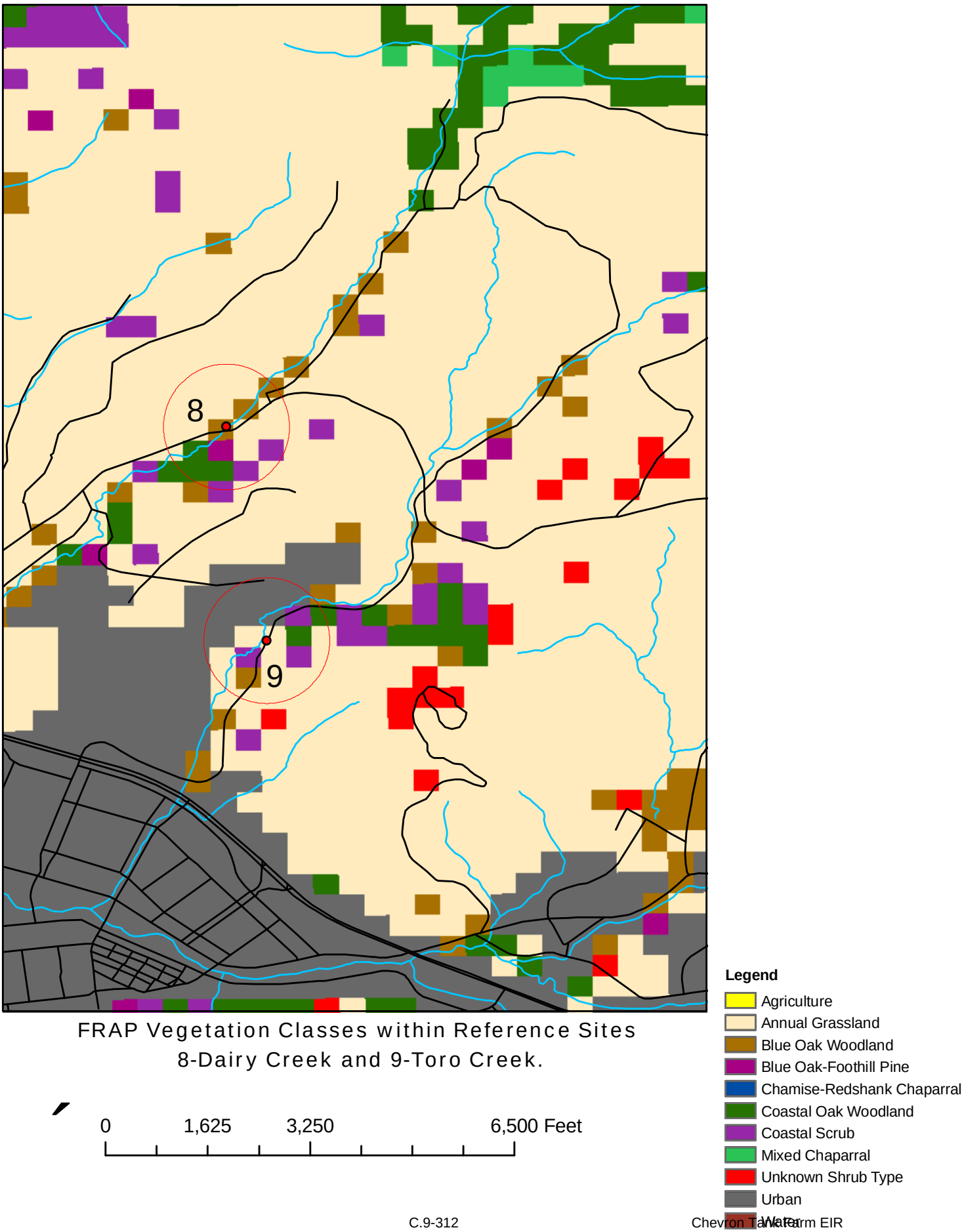
Perpendicular Cross-Section at Reference Site
7-Pennington Creek with FRAP Vegetation Classes.

0 1,600 3,200 6,400 Feet

Legend

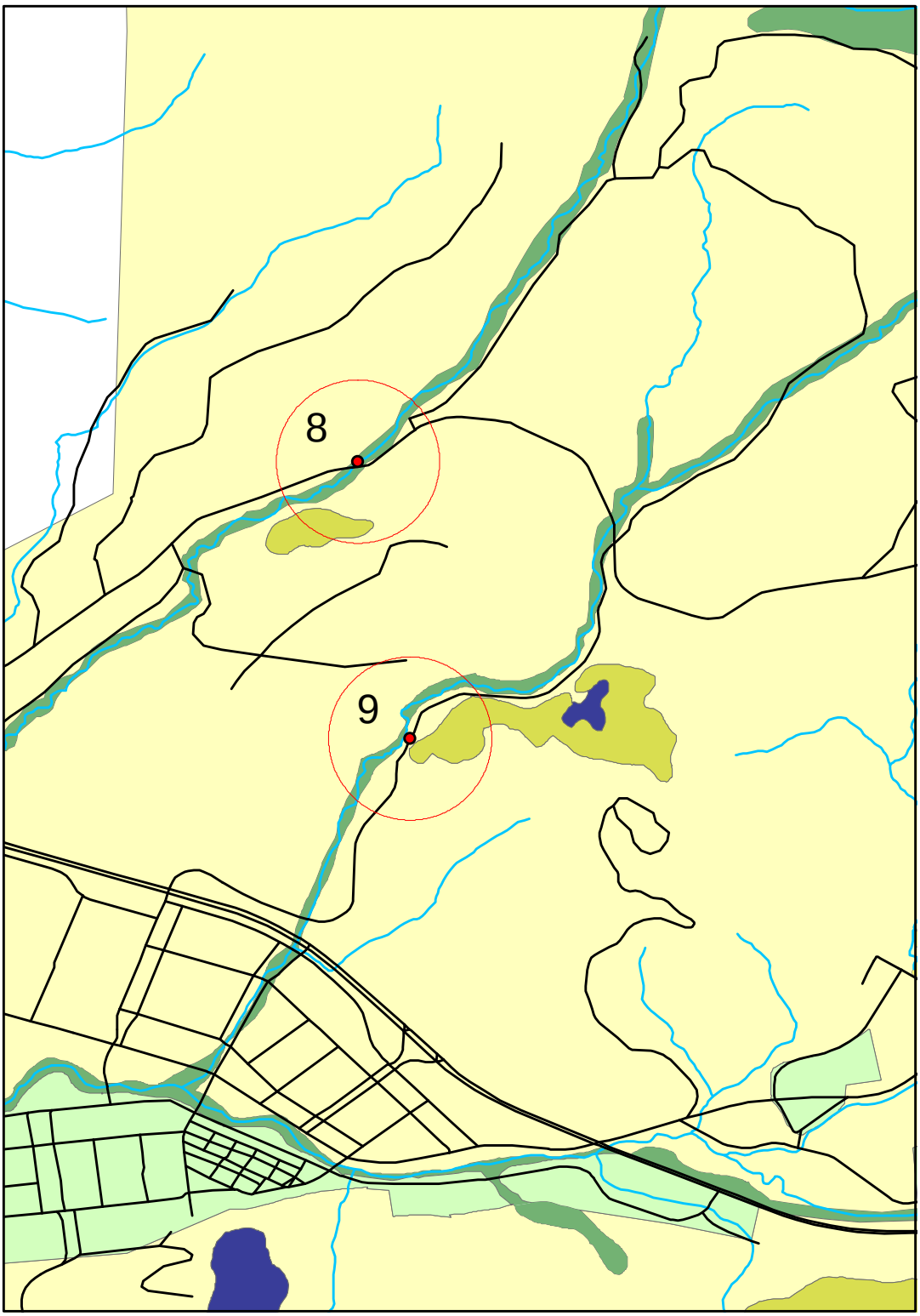
- Agriculture
- Annual Grassland
- Blue Oak Woodland
- Blue Oak-Foothill Pine
- Chamise-Redshank Chaparral
- Coastal Oak Woodland
- Coastal Scrub
- Mixed Chaparral
- Unknown Shrub Type
- Urban
- Water

Figure F-7



FRAP Vegetation Classes within Reference Sites 8-Dairy Creek and 9-Toro Creek.

Figure F-8



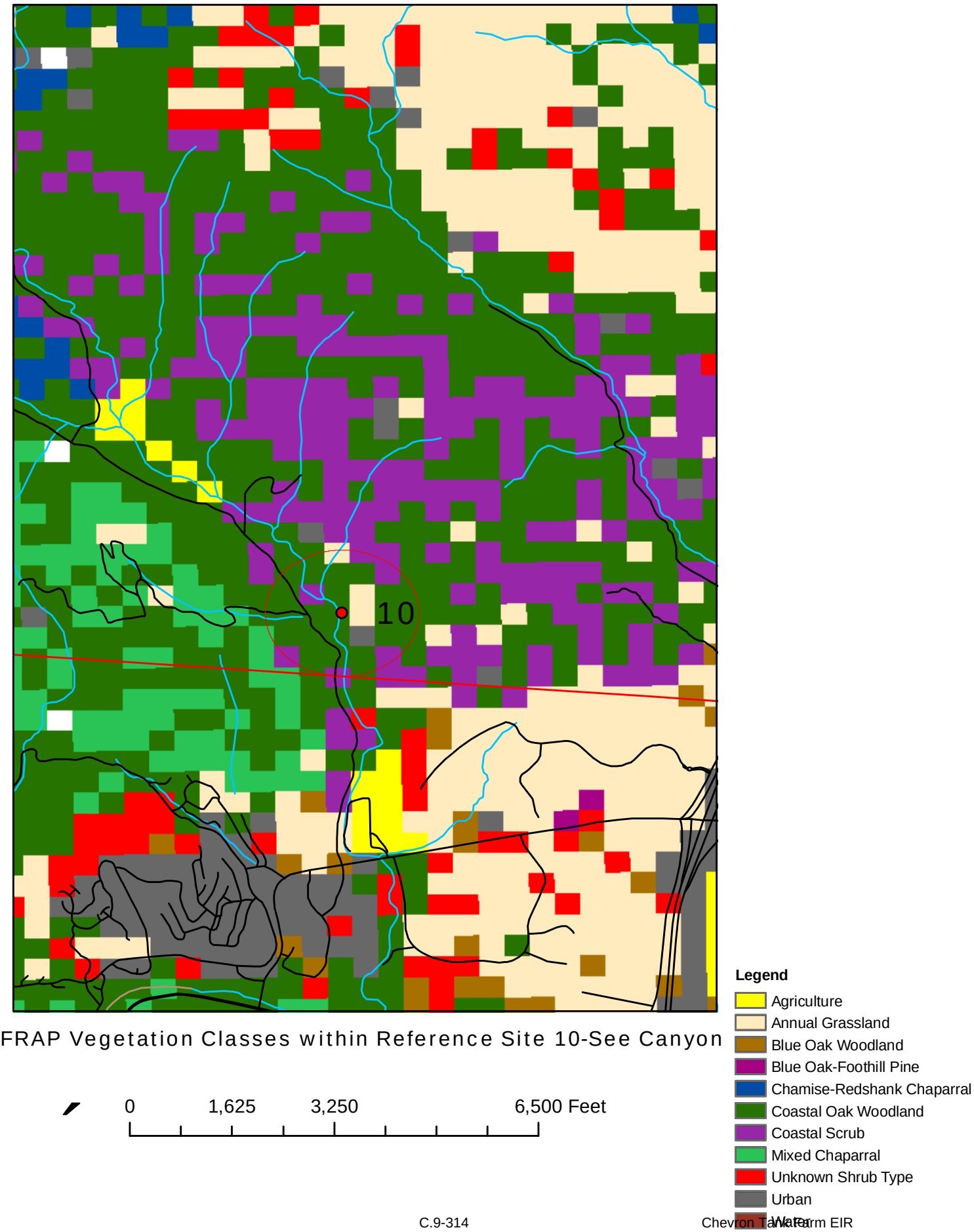
SLO Planning Area Vegetation Classes within Reference Sites 8-Dairy Creek and 9-Torro Creek.

0 1,600 3,200 6,400 Feet

Legend

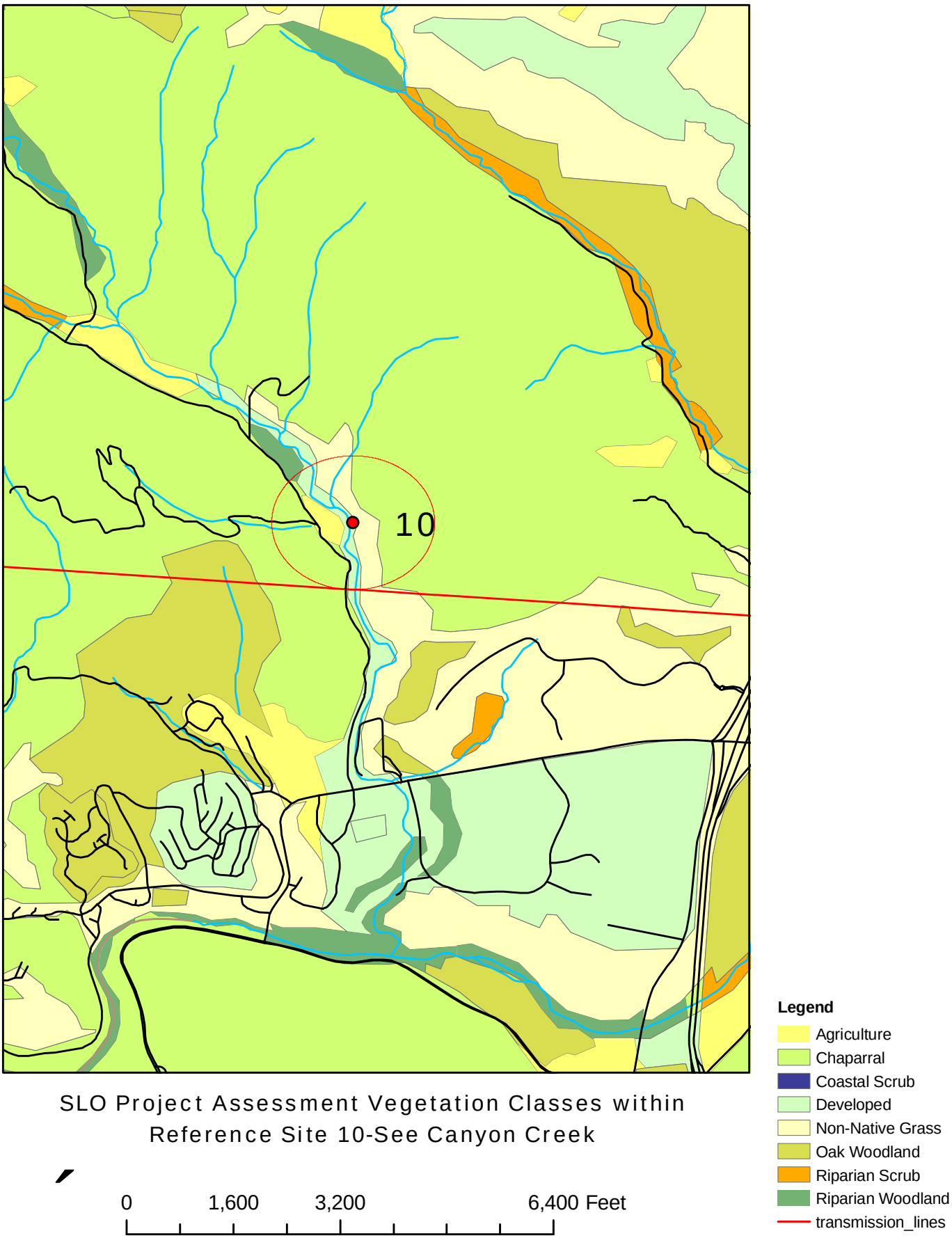
- Agriculture
- Coastal Scrub
- Developed
- Non-Native Grass
- Oak Woodland
- Riparian Woodland

Figure F-9



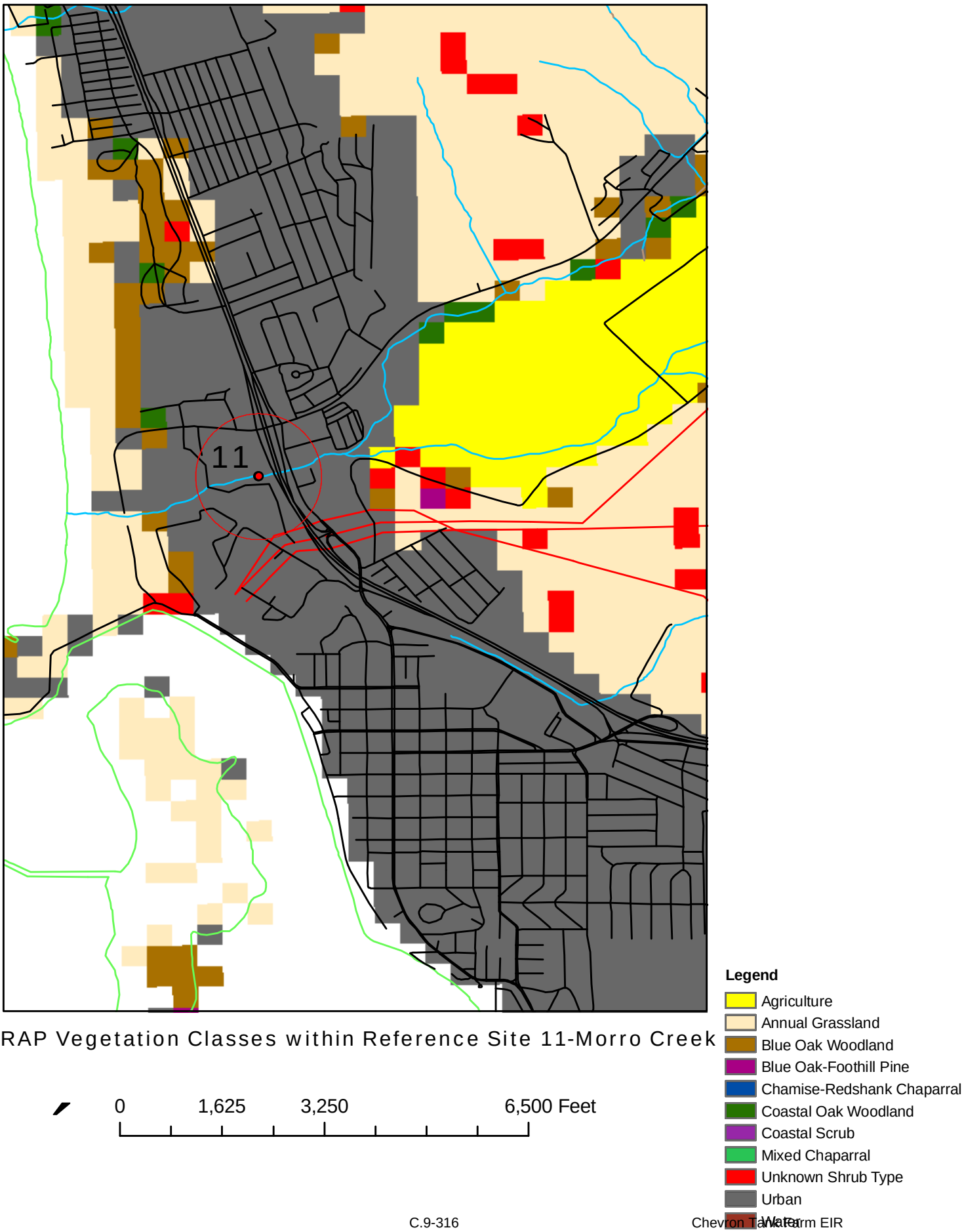
FRAP Vegetation Classes within Reference Site 10-See Canyon

Figure F-10



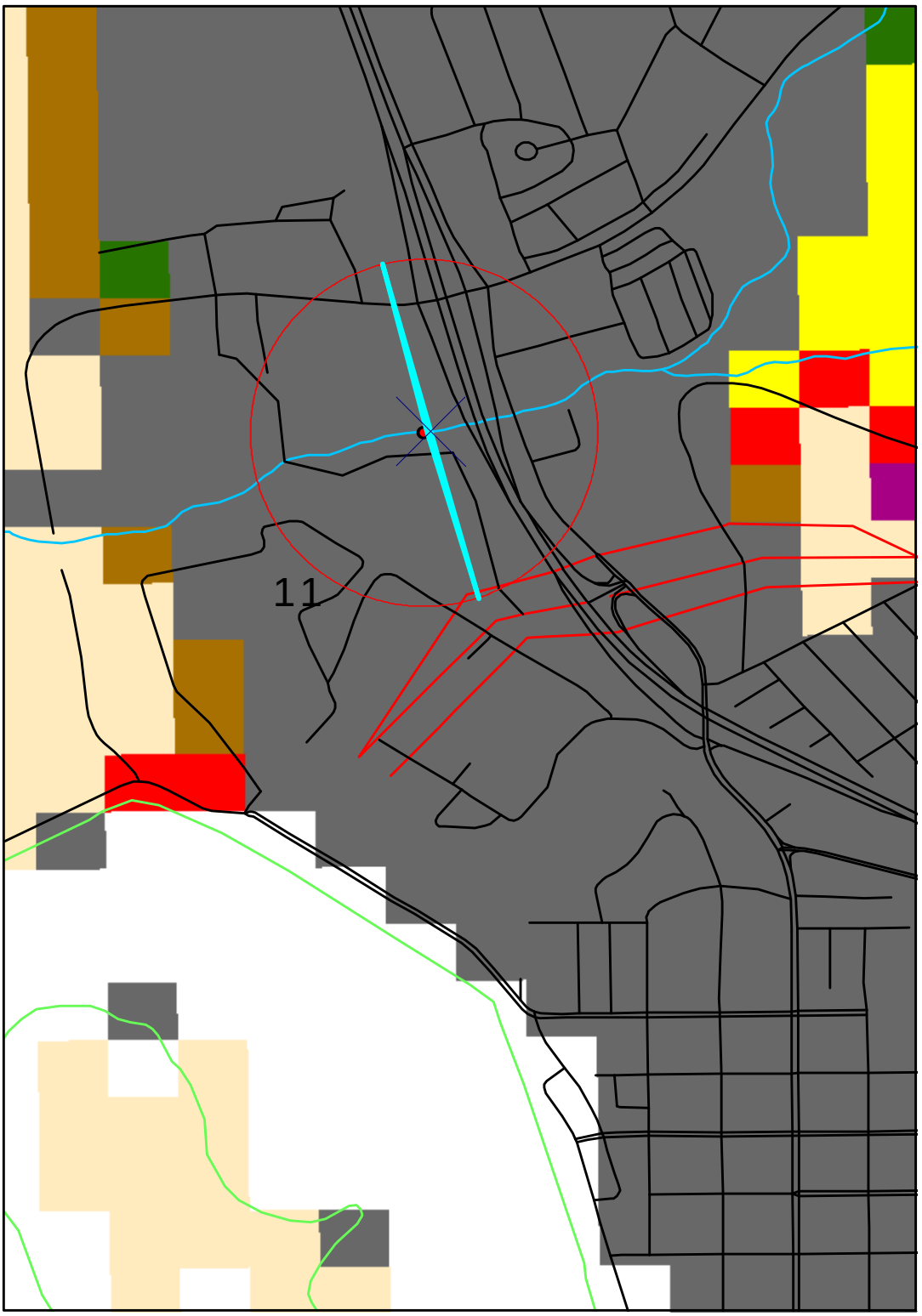
SLO Project Assessment Vegetation Classes within Reference Site 10-See Canyon Creek

Figure F-11



FRAP Vegetation Classes within Reference Site 11-Morro Creek

Figure F-12



Perpendicular Cross-Section at Site 11-Morro Creek with FRAP Vegetation Classes.

0 750 1,500 3,000 Feet

Legend

- Agriculture
- Annual Grassland
- Blue Oak Woodland
- Blue Oak-Foothill Pine
- Chamise-Redshank Chaparral
- Coastal Oak Woodland
- Coastal Scrub
- Mixed Chaparral
- Unknown Shrub Type
- Urban
- Water

Appendix G
Variable Scores and Indices of Riverine Waters/Wetlands Ecosystem Functions for San Luis Obispo Riverine HGM Reference Sites

Appendix G
Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site #1 North Marsh, SLO Tank Farm

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.50		**T**	**T**
2.	$V_{BUFFCOND}$	0.25		0.25	0.25	0.25	0.25	0.25			0.25		**O**	**O**
3.	$V_{BUFFCONT}$	0.25		0.25	0.25	0.25	0.25	0.25			0.25			
4.	$V_{CHANROUGH}$	0.10					0.10						**B**	**B**
5.	V_{DECOMP}				0.10			0.10		0.10			**E**	**E**
6.	V_{FPAXS}		0.75	0.75								0.75		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				**D**	**D**
8.	V_{INCWD}	0.10			0.10			0.10		0.10			**E**	**E**
9.	$V_{LONGPROF}$			0.10		0.10		0.10					**T**	**T**
10.	V_{OFFCWD}				0.10					0.10			**E**	**E**
11.	$V_{PATCHAREA}$											0.10	**R**	**R**
12.	$V_{PATCHLATCON}$											0.10	**M**	**M**
13.	$V_{PATCHLONGCON}$											0.10	**I**	**I**
14.	V_{RATIO}								0.25				**N**	**N**
15.	V_{REGEN}								0.10				**E**	**E**
16.	V_{SED}		0.10		0.10	0.10	0.10						**D**	**D**
17.	V_{SHADE}										0.10			
18.	$V_{SHRUBCC}$	0.10			0.10	0.10	0.10	0.10	0.10					
19.	V_{SNAG}									0.10	0.10			
20.	$V_{SOILINT}$		0.25	0.25	0.25	0.25								
21.	V_{STRATA}								0.25		0.25			
22.	V_{SURFIN}			0.10										
23.	V_{TREECC}	0.10			0.10	0.10	0.10	0.10	0.10					

Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site # 2 East Fork San Luis Obispo Creek, SLO Tank Farm

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.75		**T**	**T**
2.	$V_{BUFFCOND}$	0.25		0.25	0.25	0.25	0.25	0.25			0.25		**O**	**O**
3.	$V_{BUFFCONT}$	0.25		0.25	0.25	0.25	0.25	0.25			0.25			
4.	$V_{CHANROUGH}$	0.50					0.50						**B**	**B**
5.	V_{DECOMP}				0.25			0.25		0.25			**E**	**E**
6.	V_{FPAXS}		0.25	0.25								0.25		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				**D**	**D**
8.	V_{INCWD}	0.25			0.25			0.25		0.25			**E**	**E**
9.	$V_{LONGPROF}$			0.50		0.50		0.50					**T**	**T**
10.	V_{OFFCWD}				0.25					0.25			**E**	**E**
11.	$V_{PATCHAREA}$											0.25	**R**	**R**
12.	$V_{PATCHLATCON}$											0.75	**M**	**M**
13.	$V_{PATCHLONGCON}$											0.75	**I**	**I**
14.	V_{RATIO}								0.25				**N**	**N**
15.	V_{REGEN}								0.10				**E**	**E**
16.	V_{SED}		0.10		0.10	0.10	0.10						**D**	**D**
17.	V_{SHADE}										0.25			
18.	$V_{SHRUBCC}$	0.50			0.50	0.50	0.50	0.50	0.50					
19.	V_{SNAG}									0.10	0.10			
20.	$V_{SOILINT}$		0.50	0.50	0.50	0.50								
21.	V_{STRATA}								0.25		0.25			
22.	V_{SURFIN}			0.10										
23.	V_{TREECC}	0.25			0.25	0.25	0.25	0.25	0.25					

Appendix G-2

Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site #3 San Luis Obispo Creek

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.25		T	T
2.	$V_{BUFFCOND}$	0.00		0.00	0.00	0.00	0.00	0.00			0.00		O	O
3.	$V_{BUFFCONT}$	0.00		0.00	0.00	0.00	0.00	0.00			0.00			
4.	$V_{CHANROUGH}$	0.00					0.00						B	B
5.	V_{DECOMP}				0.10			0.10		0.10			E	E
6.	V_{FPAXS}		0.00	0.00								0.00		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				D	D
8.	V_{INCWD}	0.10			0.10			0.10		0.10			E	E
9.	$V_{LONGPROF}$			0.00		0.00		0.00					T	T
10.	V_{OFFCWD}				0.00					0.00			E	E
11.	$V_{PATCHAREA}$											0.00	R	R
12.	$V_{PATCHLATCON}$											0.00	M	M
13.	$V_{PATCHLONGCON}$											0.10	I	I
14.	V_{RATIO}								0.10				N	N
15.	V_{REGEN}								0.25				E	E
16.	V_{SED}		0.00		0.00	0.00	0.00						D	D
17.	V_{SHADE}										0.25			
18.	$V_{SHRUBCC}$	0.10			0.10	0.10	0.10	0.10	0.10					
19.	V_{SNAG}									0.50	0.50			
20.	$V_{SOILINT}$		0.00	0.00	0.00	0.00								
21.	V_{STRATA}								0.25		0.25			
22.	V_{SURFIN}			0.00										
23.	V_{TREECC}	0.25			0.25	0.25	0.25	0.25	0.25					

Appendix G-3

Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site #4 Cottontail Creek

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.75		**T**	**T**
2.	$V_{BUFFCOND}$	0.75		0.75	0.75	0.75	0.75	0.75			0.75		**O**	**O**
3.	$V_{BUFFCONT}$	1.00		1.00	1.00	1.00	1.00	1.00			0.25			
4.	$V_{CHANROUGH}$	1.00					1.00						**B**	**B**
5.	V_{DECOMP}				0.25			0.25		0.25			**E**	**E**
6.	V_{FPAXS}		1.00	1.00								1.00		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				**D**	**D**
8.	V_{INCWD}	0.25			0.25			0.25		0.25			**E**	**E**
9.	$V_{LONGPROF}$			0.75		0.75		0.75					**T**	**T**
10.	V_{OFFCWD}				0.75					0.75			**E**	**E**
11.	$V_{PATCHAREA}$											0.75	**R**	**R**
12.	$V_{PATCHLATCON}$											0.75	**M**	**M**
13.	$V_{PATCHLONGCON}$											0.75	**I**	**I**
14.	V_{RATIO}								1.00				**N**	**N**
15.	V_{REGEN}								0.75				**E**	**E**
16.	V_{SED}		0.75		0.75	0.75	0.75						**D**	**D**
17.	V_{SHADE}										0.25			
18.	$V_{SHRUBCC}$	0.50			0.50	0.50	0.50	0.50	0.50					
19.	V_{SNAG}									0.10	0.10			
20.	$V_{SOILINT}$		0.50	0.50	0.50	0.50								
21.	V_{STRATA}								0.75		0.75			
22.	V_{SURFIN}			0.50										
23.	V_{TREECC}	0.25			0.25	0.25	0.25	0.25	0.25					

Appendix G-4

Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site #5 Old Creek

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.75		**T**	**T**
2.	$V_{BUFFCOND}$	0.50		0.50	0.50	0.50	0.50	0.50			0.50		**O**	**O**
3.	$V_{BUFFCONT}$	0.50		0.50	0.50	0.50	0.50	0.50			0.50			
4.	$V_{CHANROUGH}$	0.75					0.75						**B**	**B**
5.	V_{DECOMP}				0.25			0.25		0.25			**E**	**E**
6.	V_{FPAXS}		1.00	1.00								1.00		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				**D**	**D**
8.	V_{INCWD}	0.25			0.25			0.25		0.25			**E**	**E**
9.	$V_{LONGPROF}$			0.75		0.75		0.75					**T**	**T**
10.	V_{OFFCWD}				0.25					0.25			**E**	**E**
11.	$V_{PATCHAREA}$											0.75	**R**	**R**
12.	$V_{PATCHLATCON}$											0.75	**M**	**M**
13.	$V_{PATCHLONGCON}$											0.75	**I**	**I**
14.	V_{RATIO}								0.50				**N**	**N**
15.	V_{REGEN}								0.75				**E**	**E**
16.	V_{SED}		0.50		0.50	0.50	0.50						**D**	**D**
17.	V_{SHADE}										0.10			
18.	$V_{SHRUBCC}$	0.50			0.50	0.50	0.50	0.50	0.50					
19.	V_{SNAG}									0.10	0.10			
20.	$V_{SOILINT}$		0.50	0.50	0.50	0.50								
21.	V_{STRATA}								0.75		0.75			
22.	V_{SURFIN}			0.50										
23.	V_{TREECC}	0.50			0.50	0.50	0.50	0.50	0.50					

Appendix G-5

Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site #6 Willow Creek

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.75		**T**	**T**
2.	$V_{BUFFCOND}$	0.50		0.50	0.50	0.50	0.50	0.50			0.50		**O**	**O**
3.	$V_{BUFFCONT}$	0.25		0.25	0.25	0.25	0.25	0.25			0.25			
4.	$V_{CHANROUGH}$	0.75					0.75						**B**	**B**
5.	V_{DECOMP}				0.10			0.10		0.10			**E**	**E**
6.	V_{FPAXS}		0.50	0.50								0.50		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				**D**	**D**
8.	V_{INCWD}	0.10			0.10			0.10		0.10			**E**	**E**
9.	$V_{LONGPROF}$			0.75		0.75		0.75					**T**	**T**
10.	V_{OFFCWD}				0.50					0.50			**E**	**E**
11.	$V_{PATCHAREA}$											0.50	**R**	**R**
12.	$V_{PATCHLATCON}$											0.75	**M**	**M**
13.	$V_{PATCHLONGCON}$											0.75	**I**	**I**
14.	V_{RATIO}								0.25				**N**	**N**
15.	V_{REGEN}								0.10				**E**	**E**
16.	V_{SED}		0.25		0.25	0.25	0.25						**D**	**D**
17.	V_{SHADE}										0.75			
18.	$V_{SHRUBCC}$	0.50			0.50	0.50	0.50	0.50	0.50					
19.	V_{SNAG}									0.25	0.25			
20.	$V_{SOILINT}$		0.50	0.50	0.50	0.50								
21.	V_{STRATA}								0.75		0.75			
22.	V_{SURFIN}			0.10										
23.	V_{TREECC}	0.50			0.50	0.50	0.50	0.50	0.50					

Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site #7 Toro Creek

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.75		**T**	**T**
2.	$V_{BUFFCOND}$	0.50		0.50	0.50	0.50	0.50	0.50			0.50		**O**	**O**
3.	$V_{BUFFCONT}$	0.25		0.25	0.25	0.25	0.25	0.25			0.25			
4.	$V_{CHANROUGH}$	0.75					0.75						**B**	**B**
5.	V_{DECOMP}				0.25			0.25		0.25			**E**	**E**
6.	$V_{FPA__S}$		0.50	0.50								0.50		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				**D**	**D**
8.	V_{INCWD}	0.10			0.10			0.10		0.10			**E**	**E**
9.	$V_{LONGPROF}$			0.75		0.75		0.75					**T**	**T**
10.	V_{OFFCWD}				0.10					0.10			**E**	**E**
11.	$V_{PATCHAREA}$											0.75	**R**	**R**
12.	$V_{PATCHLATCON}$											0.50	**M**	**M**
13.	$V_{PATCHLONGCON}$											0.75	**I**	**I**
14.	V_{RATIO}								1.00				**N**	**N**
15.	V_{REGEN}								0.10				**E**	**E**
16.	V_{SED}		0.50		0.50	0.50	0.50						**D**	**D**
17.	V_{SHADE}										0.75			
18.	$V_{SHRUBCC}$	0.25			0.25	0.25	0.25	0.25	0.25					
19.	V_{SNAG}									0.10	0.10			
20.	$V_{SOILINT}$		0.50	0.50	0.50	0.50								
21.	V_{STRATA}								0.50		0.50			
22.	V_{SURFIN}			0.50										
23.	V_{TREECC}	0.50			0.50	0.50	0.50	0.50	0.50					

Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site #8 Pennington Creek

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.75		T	T
2.	$V_{BUFFCOND}$	0.50		0.50	0.50	0.50	0.50	0.50			0.50		O	O
3.	$V_{BUFFCONT}$	0.50		0.50	0.50	0.50	0.50	0.50			0.50			
4.	$V_{CHANROUGH}$	0.75					0.75						B	B
5.	V_{DECOMP}				0.50			0.50		0.50			E	E
6.	$V_{FPA__S}$		0.50	0.50								0.50		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				D	D
8.	V_{INCWD}	0.25			0.25			0.25		0.25			E	E
9.	$V_{LONGPROF}$			0.75		0.75		0.75					T	T
10.	V_{OFFCWD}				0.75					0.75			E	E
11.	$V_{PATCHAREA}$											0.75	R	R
12.	$V_{PATCHLATCON}$											0.50	M	M
13.	$V_{PATCHLONGCON}$											0.75	I	I
14.	V_{RATIO}								1.00				N	N
15.	V_{REGEN}								0.25				E	E
16.	V_{SED}		0.25		0.25	0.25	0.25						D	D
17.	V_{SHADE}										0.75			
18.	$V_{SHRUBCC}$	0.25			0.25	0.25	0.25	0.25	0.25					
19.	V_{SNAG}									0.10	0.10			
20.	$V_{SOILINT}$		0.50	0.50	0.50	0.50								
21.	V_{STRATA}								0.50		0.50			
22.	V_{SURFIN}			0.50										
23.	V_{TREECC}	0.50			0.50	0.50	0.50	0.50	0.50					

Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site #9 Dairy Creek

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.50		T	T
2.	$V_{BUFFCOND}$	0.50		0.50	0.50	0.50	0.50	0.50			0.50		O	O
3.	$V_{BUFFCONT}$	0.50		0.50	0.50	0.50	0.50	0.50			0.50			
4.	$V_{CHANROUGH}$	0.75					0.75						B	B
5.	V_{DECOMP}				0.25			0.25		0.25			E	E
6.	V_{FPAXS}		0.50	0.50								0.50		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				D	D
8.	V_{INCWD}	0.10			0.10			0.10		0.10			E	E
9.	$V_{LONGPROF}$			0.75		0.75		0.75					T	T
10.	V_{OFFCWD}				0.50					0.50			E	E
11.	$V_{PATCHAREA}$											0.50	R	R
12.	$V_{PATCHLATCON}$											0.75	M	M
13.	$V_{PATCHLONGCON}$											0.50	I	I
14.	V_{RATIO}								0.75				N	N
15.	V_{REGEN}								0.25				E	E
16.	V_{SED}		0.25		0.25	0.25	0.25						D	D
17.	V_{SHADE}										0.75			
18.	$V_{SHRUBCC}$	0.25			0.25	0.25	0.25	0.25	0.25					
19.	V_{SNAG}									0.25	0.25			
20.	$V_{SOILINT}$		0.50	0.50	0.50	0.50								
21.	V_{STRATA}								0.75		0.75			
22.	V_{SURFIN}			0.50										
23.	V_{TREECC}	0.50			0.50	0.50	0.50	0.50	0.50					

Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site #10 Morro Creek

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.75		**T**	**T**
2.	$V_{BUFFCOND}$	0.25		0.25	0.25	0.25	0.25	0.25			0.25		**O**	**O**
3.	$V_{BUFFCONT}$	0.25		0.25	0.25	0.25	0.25	0.25			0.25			
4.	$V_{CHANROUGH}$	0.10					0.10						**B**	**B**
5.	V_{DECOMP}				0.25			0.25		0.25			**E**	**E**
6.	$V_{FPA__S}$		0.50	0.50								0.50		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				**D**	**D**
8.	V_{INCWD}	0.10			0.10			0.10		0.10			**E**	**E**
9.	$V_{LONGPROF}$			0.00		0.00		0.00					**T**	**T**
10.	V_{OFFCWD}				0.10					0.10			**E**	**E**
11.	$V_{PATCHAREA}$											0.10	**R**	**R**
12.	$V_{PATCHLATCON}$											0.10	**M**	**M**
13.	$V_{PATCHLONGCON}$											0.10	**I**	**I**
14.	V_{RATIO}								0.25				**N**	**N**
15.	V_{REGEN}								0.10				**E**	**E**
16.	V_{SED}		0.10		0.10	0.10	0.10						**D**	**D**
17.	V_{SHADE}										0.75			
18.	$V_{SHRUBCC}$	0.25			0.25	0.25	0.25	0.25	0.25					
19.	V_{SNAG}									0.10	0.10			
20.	$V_{SOILINT}$		0.50	0.50	0.50	0.50								
21.	V_{STRATA}								0.75		0.75			
22.	V_{SURFIN}			0.10										
23.	V_{TREECC}	0.50			0.50	0.50	0.50	0.50	0.50					

Scaling of Variables to Functions in San Luis Obispo County Riverine Wetlands – Site #11 See Canyon Creek

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and Exchange	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	V_{ASIGN}										0.50		**T**	**T**
2.	$V_{BUFFCOND}$	0.25		0.25	0.25	0.25	0.25	0.25			0.25		**O**	**O**
3.	$V_{BUFFCONT}$	0.25		0.25	0.25	0.25	0.25	0.25			0.25			
4.	$V_{CHANROUGH}$	0.75					0.75						**B**	**B**
5.	V_{DECOMP}				0.50			0.50		0.50			**E**	**E**
6.	V_{FPAXS}		0.50	0.50								0.500		
7.	V_{HERB}	0.50			0.50	0.50	0.50	0.50	0.50				**D**	**D**
8.	V_{INCWD}	0.10			0.10			0.10		0.10			**E**	**E**
9.	$V_{LONGPROF}$			0.75		0.75		0.75					**T**	**T**
10.	V_{OFFCWD}				0.50					0.50			**E**	**E**
11.	$V_{PATCHAREA}$											0.50	**R**	**R**
12.	$V_{PATCHLATCON}$											0.75	**M**	**M**
13.	$V_{PATCHLONGCON}$											0.75	**I**	**I**
14.	V_{RATIO}								1.00				**N**	**N**
15.	V_{REGEN}								0.25				**E**	**E**
16.	V_{SED}		0.50		0.50	0.50	0.50						**D**	**D**
17.	V_{SHADE}										0.75			
18.	$V_{SHRUBCC}$	0.75			0.75	0.75	0.75	0.75	0.75					
19.	V_{SNAG}									0.25	0.25			
20.	$V_{SOILINT}$		0.50	0.50	0.50	0.50								
21.	V_{STRATA}								0.75		0.75			
22.	V_{SURFIN}			0.25										
23.	V_{TREECC}	0.50			0.50	0.50	0.50	0.50	0.50					

Appendix G

Indices of Functions for Riverine Waters/Wetland Ecosystem Functions at the San Luis Obispo Riverine HGM Reference Sites

		Hydrologic			Biogeochemical				Plant Community		Faunal Support / Habitat			
		Energy Dissipation	Surface and Subsurface Water Storage and E__change	Landscape Hydrologic Connections	Cycling of Elements and Compounds	Removal of Imported Elements and Compounds	Particulate Retention and Detention	Organic Carbon Export	Plant Community	Detrital System	Spatial Structure of Habitats	Interspersion and Connectivity of Habitats	Distribution and Abundance of Invertebrates	Distribution and Abundance of Vertebrates
1.	North Marsh	0.17	0.37	0.31	0.17	0.19	0.17	0.16	0.23	0.10	0.25	0.32	**T**	**T**
2.	E Fork, SLO Creek	0.36	0.28	0.32	0.29	0.37	0.32	0.33	0.28	0.20	0.43	0.42	**O**	**O**
3.	SLO Creek	0.095	0.00	0.00	0.09	0.07	0.07	0.096	0.21	0.22	0.15	0.017		
4.	Cottontail Creek	0.64	0.75	0.73	0.53	0.67	0.76	0.51	0.75	0.28	0.75	0.83	**B**	**B**
5.	Old Creek	0.50	0.67	0.65	0.40	0.56	0.56	0.45	0.60	0.20	0.59	0.83	**E**	**E**
6.	Willow Creek	0.43	0.42	0.45	0.33	0.50	0.47	0.37	0.47	0.27	0.61	0.58		
7.	Toro Creek	0.41	0.50	0.53	0.33	0.51	0.51	0.38	0.61	0.15	0.58	0.67	**D**	**D**
8.	Pennington Creek	0.48	0.42	0.55	0.46	0.51	0.48	0.48	0.63	0.37	0.61	0.63	**E**	**E**
9.	Dairy Creek	0.44	0.42	0.55	0.37	0.51	0.48	0.40	0.63	0.27	0.58	0.54	**T**	**T**
10.	Morro Creek	0.28	0.37	0.27	0.26	0.24	0.22	0.20	0.45	0.15	0.41	0.23	**‘**	**‘**
11.	See Canyon Creek	0.42	0.50	0.45	0.43	0.52	0.52	0.44	0.75	0.35	0.52	0.58	**D**	**D**