Appendix A Nomenclature of Plant and Animal Species Mentioned in the MMP

Appendix A Nomenclature of Plant and Animal Species Mentioned in the MMP

Table A-1. Plant Species

Common Name	Scientific Name	Status[a]
Alisma-leafed buttercup	*Ranunculus alismifolius*	FACW
American slough-grass	*Beckmannia syzigachne*	OBL
Annual hairgrass	*Deschampsia danthonioides*	FACW
Arroyo willow	*Salix lasiolepis*	FACW
Avens	*Geum macrophyllum*	FACW
Baker's meadowfoam	*Limnanthes bakeri*	OBL
Baltic rush	*Juncus balticus*	OBL
Bedstraw	*Galium* sp.	N/A
Black cottonwood	*Populus balsamifera* ssp. *trichocarpa*	FACW
Blue elderberry	*Sambucus Mexicana*	FAC
Blue oak	*Quercus douglasii*	UPL
Bluegrass	*Poa* sp.	N/A
Blue wildrye	*Elymus glaucus* ssp*. glaucus*	FACU
Bolander's water-starwort	*Callitriche heterophylla* ssp. *bolanderi*	OBL
Box elder	*Acer negundo* var*. californicum*	FACW
Bracted popcornflower	*Plagiobothrys bracteatus*	OBL
Broadleaf cattail	*Typha latifolia*	OBL
Broadleaf water-plantain	*Alisma plantago-aquatica* var*. americana*	OBL
Brown headed rush	*Juncus phaeocephalus*	FACW
Bur-clover	*Medicago polymorpha*	UPL
Buttercup	*Ranunculus* sp.	FACW
California blackberry	*Rubus ursinus (R. vitifolius)*	FACW
California black oak	*Quercus kelloggii*	UPL
California oatgrass	*Danthonia californica*	FACW
California rose	*Rosa californica*	FAC
Camas	*Camasia quamash*	FACW
Chicory	*Cichorium intybus*	UPL
Clematis	*Clematis* sp.	N/A
Clustered dock	*Rumex conglomeratus*	FACW
Coast redwood	*Sequoia sempervirens*	UPL
Cocklebur	*Xanthium strumarium*	FAC
Common dandelion	*Taraxacum officinale*	FACU
Common meadow rue	*Thalictrum polycarpum*	UPL
Common spikerush	*Eleocharis macrostachya*	OBL
Common velvet grass	*Holcus lanatus*	FAC
Cow parsnip	*Heracleum lanatum (H. maximum)*	FACU
Coyote thistle	*Eryngium aristulatum*	OBL
Creeping bentgrass	*Agrostis stolonifera*	FACW
Creeping ryegrass	*Leymus triticoides*	FAC
Curly dock	*Rumex crispus*	FACW
Cutleaf geranium	*Geranium dissectum*	UPL

Table A-1. Continued

Common Name	Scientific Name	Status[a]
Davy's semaphore grass	*Pleuropogon californicus* var. *davyi*	OBL
Dense sedge	*Carex densa*	OBL
Dogwood	*Cornus* sp.	N/A
Douglas' meadowfoam	*Limnanthes douglasii*	OBL
Douglas-fir	*Pseudotsuga menziesii* var. *menziesii*	UPL
Downingia	*Downingia* sp.	N/A
Fescue	*Festuca* sp.	FACU
Field bindweed	*Convolvulus arvensis*	UPL
Field sedge	*Carex praegracilis*	FACW
Filaree	*Erodium* sp.	N/A
Fowl bluegrass	*Poa palustris*	FACW
Fremont cottonwood	*Populus fremontii* ssp. *fremontii*	FACW
Gooseberry	*Ribes* sp.	N/A
Greensheath sedge	*Carex feta*	OBL
Harding grass	*Phalaris aquatic*	FAC
Hawthorn	*Crataegus* sp.	N/A
Hedge nettle	*Stachys rigida*	FACW
Hedgehog dogtail grass	*Cynosurus echinatus*	UPL
Himalayan blackberry	*Rubus armeniacus (R. discolor)*	FACW
Honeysuckle	*Lonicera* sp.	N/A
Italian ryegrass	*Lolium multiflorum*	FAC
Kentucky bluegrass	*Poa pratensis*	FACU
Knotweed	*Polygonum* sp.	N/A
Manzanita	*Arctostaphylos manzanita*	UPL
Meadow barley	*Hordeum brachyantherum* ssp. *brachyantherum*	FACW
Meadow foxtail	*Alopecurus pratensis*	FACW
Mediterranean barley	*Hordeum marinum* ssp. *gussoneanum*	FAC
Medusa-head grass	*Taeniatherum caput-medusae*	UPL
Mountain mint	*Pycnanthemum californicum*	UPL
Navarretia	*Navarretia* sp.	N/A
Nebraska sedge	*Carex nebrascensis*	OBL
North Coast semaphore grass	*Pleuropogon hooverianus*	FACW
Orchard grass	*Dactylis glomerata*	FACU
Oregon ash	*Fraxinus latifolia*	FACW
Oregon white oak	*Quercus garryana*	UPL
Pacific foxtail	*Alopecurus saccatus*	OBL
Pacific madrone	*Arbutus menziesii*	UPL
Pacific ninebark	*Physocarpus capitatus*	FACW
Pennyroyal	*Mentha pulegium*	OBL
Perennial ryegrass	*Lolium perenne*	FAC
Plantain	*Plantago* sp.	N/A
Poison hemlock	*Conium maculatum*	FACW
Poison-oak	*Toxicodendron diversilobum*	UPL
Ponderosa pine	*Pinus ponderosa*	FACU
Purple needlegrass	*Nassella pulchra*	UPL
Purslane speedwell	*Veronica peregrina* ssp. *xalapensis*	OBL

Table A-1. Continued

Common Name	Scientific Name	Status[a]
Rayless goldfields	*Lasthenia glaberrima*	OBL
Red alder	*Alnus rubra*	FACW
Red fescue	*Festuca rubra*	FAC
Red-twig dogwood	*Cornus sericea*	FACW
Red willow	*Salix laevigata*	≥FAC[c]
Reed canary grass	*Phalaris arundinacea*	OBL
Ripgut brome	*Bromus diandrus*	UPL
Rose clover	*Trifolium hirtum*	FACU
Rough bluegrass	*Poa trivialis*	FACW
Rough cat's ear	*Hypochaeris radicata*	UPL
Scouler's willow	*Salix scouleriana*	FAC
Sedge	*Carex* sp.	FACW
Semaphore grass	*Pleuropogon* sp.	N/A
Shamrock	*Trifolium dubium*	FACU
Short-scale sedge	*Carex deweyana* ssp. *leptopoda (C. leptopoda)*	FACW
Slender beak sedge	*Carex athrostachya*	FACW
Slender fescue	*Vulpia octoflora*	UPL
Slender hairgrass	*Deschampsia elongata*	FACW
Rayless goldfields	*Lasthenia glaberrima*	OBL
Soft chess	*Bromus hordeaceus*	FACU
Soft rush	*Juncus effuses*	OBL
Solomon's seal	*Smilacina racemosa*	FAC
Spikerush	*Eleocharis macrostachya*	OBL
Spreading gooseberry	*Ribes divaricatum*	FACW
Spreading rush	*Juncus patens*	FAC
Stipulate popcornflower	*Plagiobothrys stipitatus*	OBL
Straight beaked buttercup	*Ranunculus orthorhynchus*	FACW
Straight-leaf rush	*Juncus orthophyllus*	FACW
Tall fescue	*Festuca arundinacea*	FAC
Teasel	*Dipsacus fullonum*	UPL
Timothy grass	*Phleum alpinum*	FACW
Toad rush	*Juncus bufonius*	FACW
Tufted hairgrass	*Deschampsia cespitosa*	FACW
Tule	*Schoenoplectus acutus (Scirpus acutus)*	OBL
Valley oak	*Quercus lobata*	FAC
Common velvet grass	*Holcus lanatus*	FAC
Vetch	*Vicia sativa*	FACU
Water plantain buttercup	*Ranunculus alismifolius* var. *alismifolius*	FACW
Western buttercup	*Ranunculus occidentalis*	FACW
Western goldenrod	*Euthamia occidentalis*	OBL
White alder	*Alnus rhombifolia*	FACW

Table A-1. Continued

Common Name	Scientific Name	Status[a]
White brodiaea	*Triteleia hyacinthina*	FACW
White clover	*Trifolium repens*	FACU
White snowberry	*Symphoricarpos* sp.	N/A

[a] Indicator Status Definitions:

OBL = Obligate, almost always occurs in wetlands (>99% probability of occurrence)
FACW = Facultative wetland, usually occurs in wetlands (66%–99% probability)
FAC = Facultative, equally likely to occur in wetlands or nonwetlands (34%–66% probability)
FACU = Facultative upland, usually occurs in nonwetlands but occasionally in wetlands (1%–33% probability)
UPL = Obligate upland, almost never occurs in wetlands (<1% probability)
NI = No indicator
N/A = Not applicable; no status because not identified to species level.

Source: Reed 1988.

[b] Not assigned status in Reed (1988), but appears to be at least FAC because its habitat as described in the Jepson Manual includes meadows (Hickman 1993).

[c] Appears to have a status of FAC or wetter based on habitat as described in the Jepson Manual: riverbanks, seepage areas, lake shores, canyons, and ditches (Hickman 1993).

Table A-2. Wildlife Species

Common Name	Scientific Name
American coot	*Fulica americana*
American wigeon	*Anas americana*
Black-tailed deer	*Odocoileus hemionus*
California coastal Chinook salmon	*Oncorhynchus tshawytscha*
Coho salmon	*Oncorhynchus kisutch*
California roach	*Lavinia symmetricus*
Cinnamon teal	*Anas cyanoptera*
Elk	*Cervus canadensis*
Largemouth bass	*Micropterus salmoides*
Mallard	*Anas platyrhynchos*
Northern California steelhead	*Oncorhynchus mykiss*
Northern shoveler	*Anas clypeata*
Sunfish	*Lepomis* sp.
Western pond turtle	*Actinemys marmorata*
Willow flycatcher	*Empidonax traillii*
Wood duck	*Aix sponsa*
Yellow warbler	*Dendroica petechia*
Yellow-breasted chat	*Icteria virens*

Appendix G Invasive Plant Management Plan for Offsite Mitigation Parcels

Chapter 1 Introduction

The California Department of Transportation (Caltrans) in conjunction with the Federal Highway Administration (FHWA) is proposing to construct the Willits Bypass project (bypass project), a new section of U.S. Highway 101 (US 101) that will bypass the city of Willits in Mendocino County. The bypass will result in impacts on natural resources in and adjacent to the bypass project right-of-way. Caltrans is proposing compensatory mitigation for impacts on riparian and oak woodland habitat, jurisdictional wetlands and other waters of the United States, and special-status plants and fish.

As part of the bypass project's compensatory mitigation 37 parcels (totaling 2,098 acres) in Little Lake Valley have been identified for offsite mitigation that include restoration, creation, enhancement, and protection actions. The introduction and spread of invasive plants is a significant concern for the long-term health and sustainability of the offsite mitigation parcels.

1.1 Purpose of the Invasive Plant Management Plan

The purpose of this invasive plant management plan (IPMP or plan) is to provide methods for establishing the invasive plant baseline on the offsite mitigation parcels, and success criteria for measuring the success of the mitigation actions which specifically address invasive plants, and monitoring requirements. In addition, the plan provides an adaptive management framework to minimize the introduction and spread of invasive plants over time.

It should be noted that while this plan presents suggestions for invasive plant management, determining specific management at each offsite mitigation parcel may require adjustments after baseline distribution data is collected. The bypass project's mitigation program has an adaptive management component that allows for such adjustments. Practicality and flexibility are essential requirements of a successful invasive plant management plan.

Significant adjustments to the recommendations contained in this plan will be coordinated with the resource agencies and documented in an annual monitoring report.

Caltrans will work with the Mendocino County Resource Conservation District (MCRCD), to review this plan and, as necessary, assist with the development of specific offsite mitigation invasive plant management requirements. If necessary, Caltrans will consult with local experts to further refine the management program.

Once the short-term maintenance period is completed (after completion of performance monitoring and resource agency agreement that all mitigation has met the success criteria), the long-term management period will begin. At this time, this plan and all management recommendations will be reviewed to determine ongoing appropriateness. After this review, the plan will be reviewed a minimum of once every ten years to determine the need to adjust any of the management recommendations. The plan may be reevaluated sooner than once every ten years if the plan is not achieving its objectives. See Chapter 11, Long-Term Management Plan, in the MMP for more information on the IPMP review schedule.

1.2 Invasive Plant Management Goals and Objectives

The goal of the IPMP is to ensure existing invasive plant populations are documented, maintained at or below baseline levels and that new invasive plants are not introduced into offsite mitigation parcels.

In order to achieve the IPMP's goals, the following management objectives have been developed:

- Manage target invasive plant species so that their cover does not increase over the baseline level or is reduced.
- Adaptively manage invasive plant populations.
- Repair or address adverse conditions that are human-caused that may contribute to invasive plant introduction and spread.

1.3 Background

In California, the majority of plants are native (79%). Nonnative, non-invasive plants are the second largest category (19%), and invasive plants are the smallest category (2%) (Hrusa et. al. 2002; Rejmanek and Randall 1994). The vast majority of nonnative introduced plants do not become invasive, and it is the invasive plants that are the focus of this IPMP.

1.3.1 Definition of Invasive Plants

Invasive plants can be defined as plants that invade agricultural crops or infrastructures such as canals, or plants that invade natural communities, displace native species, and alter ecosystem functions (such as fire regime, hydrologic functions, and nutrient cycling) (Bossard et al. 2000).

For the IPMP, *invasive plants* are defined as those listed by the U.S. Department of Agriculture (USDA) as “Noxious”, the California Department of Food and Agriculture (CDFA) as A, B or Q, or the California Invasive Plant Council (Cal-IPC) as “High” (USDA National Invasive Species Information Center 2008, CDFA 2009, Cal-IPC 2006 and 2007). Additional definitions are included below:

- **Weeds—***Weeds* are plants that grow in sites where they are not wanted and that usually have detectable economic or environmental effects (synonyms include pest plants, plants out of place, and prolific plants).
- **Noxious weed—***Noxious weed* is a term for plant species or groups of species that have been legally designated as pests by a county, state, or federal agency. Not all such designated noxious weeds are problems in natural areas, and only a small subset of the plant species that are problems in natural areas have been designated as noxious.
- **Invasive plants—***Invasive plants* are naturalized plants that produce reproductive offspring, often in very large numbers, at considerable distances from parent plants and thus have the potential to spread over a considerable area.
- **Nonnative—**The term *nonnative* is used for species that were directly or indirectly introduced by humans, that were not present in the region before this introduction, and that would not have spread into the area without human interference.
- **Vector—**A *vector* is an action, process, or activity, natural or human-induced, that moves an invasive species (or species propagule) along a pathway to a new location where it becomes established.

The following sections present noxious weed definitions provided by the U.S. Department of Agriculture (USDA) California Department of Food and Agriculture (CDFA) and Cal-IPC.

1.3.2 U.S. Department of Agriculture

The Federal Noxious Weed Act of 1974 defines a "noxious weed" as:

> Any living stage (including, but not limited to, seeds and reproductive parts) of any parasitic or other plant of a kind, or subdivision of a kind, which is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, other useful plants, livestock, or poultry or other interests of agriculture, including the fish and wildlife resources of the United States or the public health.

1.3.3 California Department of Food and Agriculture

The California Agricultural Code states:

> Section 5004. "Noxious weed" means any species of plant that is, or is liable to be, troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate, which the director, by regulation, designates to be a noxious weed. In determining whether or not a species shall be designated a noxious weed for the purposes of protecting silviculture or important native plant species, the director shall not make that designation if the designation will be detrimental to agriculture.

CDFA maintains a list of noxious weeds and advises the County Agricultural Commissioners on the action to take regarding each noxious weed species[1] (California Department of Food and Agriculture 2009).

- A-rated weeds are subject to eradication, containment, rejection, or other holding action at the state-county level.
- B-rated weeds are subject to eradication, containment, control, or other holding action at the discretion of the County Agricultural Commissioner.
- C-rated weeds are subject to action to retard their spread outside of nurseries at the discretion of the County Agricultural Commissioner.
- The Q-rating is a temporary A-rating pending further investigation by CDFA.

[1] Current state and federal weed lists can be found at the California Department of Food and Agriculture website http://www.cdfa.ca.gov/phpps/ipc/encycloweedia/encycloweedia_hp.htm.

1.3.4 California Invasive Plant Council

Cal-IPC maintains a categorized list of nonnative invasive plants with a ranking for each species to indicate the level of its negative ecological impact. The Cal-IPC ranking system is the most comprehensive compilation of invasive plant properties and their impacts available for California. The ranking process is based on best available scientific information and peer review by experts. These rankings are defined below.

- **High.** These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Ecological amplitude and distribution are widespread.
- **Moderate.** These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, although establishment generally is dependent on ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
- **Limited.** These species are invasive, but their ecological impacts are minor on a statewide level or there is not enough information to justify a higher ranking. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution generally are limited, but these species may be locally persistent and problematic.

1.4 Land Manager

MCRCD will be designated by Caltrans as the Land Manager for the offsite mitigation parcels. MCRCD will be responsible for coordinating invasive plant surveys, annual reporting, and management on the offsite mitigation parcels consistent with the IPMP.

Chapter 2 Establishment of Invasive Plant Baseline

Before specific invasive plant management for each offsite mitigation parcel can be developed baseline surveys will need to be completed. These surveys will be conducted in the summer of 2010.

2.1 Development of Invasive Plant Target List

Lists of the invasive plants that are known to occur, and/or have the potential to become introduced into the offsite mitigation parcels are presented in Tables 2-1 and 2-2. These lists include:

- Invasive plants known to occur on the offsite mitigation parcels and in the vicinity, based on field work conducted by Caltrans and their consultants;
- A query of Calfora's database for "what grows here?" centered on Willits (Calflora 2010); and
- The Red Alert weed list posted by the Inland Mendocino Cooperative Weed Management Area (2010).

In addition to the species and whether or not it is known to occur on the offsite mitigation parcels, the tables list the Cal-IPC rank, CDFA list and whether or not it is included on the Federal Noxious Weed List. A brief description of the habitat in which the plant is normally found is also included.

Table 2-1. List of Known and Potentially Occurring Invasive Plants on the Offsite Mitigation Parcels for the Willits Bypass Project—Proposed as Target Species for Baseline Weed Mapping, Monitoring and Management

Species Name	Known or Potential	Cal-IPC Rating	State Listing	Federal Listing	Habitats and Distribution
Barbed goatgrass (*Aegilops triuncialis*)	Potential (Calflora)	High	B	–	Grassland, oak woodland
Giant reed (*Arundo donax*)	Potential (observed by ICF botanist in Mendocino Co.)	High	B	–	Edge of streams and ditches, edge of riparian woodland
Woolly distaff thistle (*Carthamus lanatus*)	Potential (Calflora)	Moderate	B	–	Grasslands
Purple starthistle (*Centaurea calcitrapa*)	Potential (Calflora)	Moderate	B	–	Grasslands
Meadow knapweed (*Centaurea debeauxii* ssp. *thuillierii*)	Potential (Inland Mendocino WMA)	Moderate	–	–	Grasslands
Spotted knapweed (*Centaurea maculosa*)	Potential (Calflora)	High	A	–	Riparian, grasslands, wet meadows, forests
Yellow star-thistle (*Centaurea solstitialis*)	Known	High	C	–	Grassland, oak woodland, open habitats
Rush skeleton weed (*Chondrilla juncea*)	Potential (Inland Mendocino WMA)	Moderate	A	–	Grasslands
Pampas grass (*Cortaderia selloana* and *C. jubata*)	Potential (observed by ICF botanist in Mendocino Co.)	High	B	–	Grassland, open woodland
Scotch broom (*Cytisus scoparius*)	Known	High	C	–	Coastal scrub, oak woodland
Teasel (*Dipsacus fullonum*)	Known	Moderate	–	–	Grasslands, seep, riparian scrub, wetlands
Eggleaf spurge (*Euphorbia oblongata*)	Potential (Inland Mendocino WMA)	Limited	B	–	Meadows, woodlands
Edible fig (*Ficus carica*)	Potential (observed by ICF botanist in Mendocino Co.)	Moderate	–	–	Riparian woodland; scattered individuals and clumps
Sweet fennel (*Foeniculum vulgare*)	Known	High	–	–	Mesic grasslands
French broom (*Genista monspessulana*)	Known	High	C	–	Oak woodland, grassland
Little robin (*Geranium purpureum*)	Potential (Inland Mendocino WMA)	–	–	–	Riparian (streambanks) and woodland areas
Dyer's woad (*Isatis tinctora*)	Potential (Calflora)	Moderate	B	–	Great Basin scrub and grasslands, coniferous forest
Perennial pepperweed (*Lepidium latifolium*)	Potential (Calflora)	High	B	–	Mesic grasslands, wetlands

Species Name	Known or Potential	Cal-IPC Rating	State Listing	Federal Listing	Habitats and Distribution
Purple loosestrife (*Lythrum salicaria*)	Potential (Calflora)	High	B	–	Wetlands, marshes, riparian areas
Parrot's feather *(Myriophyllum aquaticum*)	Potential (Inland Mendocino WMA)	High	B	–	Freshwater aquatic systems (e.g., ponds, lakes, ditches)
Himalayan blackberry (*Rubus armeniacus*, formerly *R. discolor*)	Known	High	–	–	Riparian woodland; widespread
Tansy ragwort (*Senecio jacobaea*)	Known	Limited	B	–	Grasslands, riparian
Red sesbania (*Sesbania punicea*)	Potential (Inland Mendocino WMA)	High	B	–	Riparian areas
Spanish broom (*Spartium junceum*)	Potential	High	C	–	Riparian woodland, oak woodland, wetlands; scattered shrubs
Medusa-head (*Taeniatherum caput-medusae*)	Known	High	C	–	Grassland, oak woodland, open habitats

Notes:

California Invasive Plant Council (Cal-IPC) ratings:

High. These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Ecological amplitude and distribution are widespread.

Moderate. These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, although establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Limited. These species are invasive, but their ecological impacts are minor on a statewide level or there is not enough information to justify a higher ranking. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

The California Department of Food and Agriculture (CDFA) ratings:

A: A-rated weeds are subject to eradication, containment, rejection, or other holding action at the state-county level.

B: B-rated weeds are subject to eradication, containment, control, or other holding action at the discretion of the County Agricultural Commissioner.

C: C-rated weeds are subject to action to retard their spread outside of nurseries at the discretion of the County Agricultural Commissioner.

Federal Ratings from the U.S. Department of Agriculture (USDA)

NW: noxious weed

Sources: Calflora website (http://www.calflora.org), using the What Grows Here? search tool for Willits area

Inland Mendocino County WMA Red Alert website (http://cemendocino.ucdavis.edu/files/56646.pdf)

Field notes from ICF International and Caltrans biologists

Cal-IPC lists (http://www.cal-ipc.org/ip/inventory/pdf/Inventory2006.pdf and http://www.cal-ipc.org/ip/inventory/pdf/WebUpdate2007.pdf)

CDFA lists (http://www.cdfa.ca.gov/phpps/ipc/weedinfo/winfo_list-pestrating.htm)

Table 2-2. List of Known and Potentially Occurring Invasive Plants within the Onsite and Offsite Willits Bypass Project Area—Not Proposed for Baseline Mapping, Monitoring and Management

Species Name	Known or Potential	Cal-IPC Rating	State Listing	Federal Listing	Habitats and Distribution
Ovate goatgrass (*Aegilops ovata*)	Potential (Calflora)	–	B	–	Disturbed fields, roadsides, grassland, oak woodland
Bent grass (*Agrostis stolonifera*)	Known	Limited	–	–	Wetlands, riparian
Tree-of-heaven (*Ailanthus altissima*)	Potential (observed by ICF botanist in Mendocino Co.)	Moderate	C	–	Riparian areas, grasslands, oak woodland
Wild garlic (*Allium vineale*)	Potential (Calflora)	–	B	–	Disturbed places
Sweet vernal grass (*Anthoxanthum odoratum*)	Known	Moderate	–	–	Coastal prairie, coniferous forest
Slender wild oat (*Avena barbata*)	Known	Moderate	–	–	Coastal scrub, grasslands, oak woodland, forest
Wild oat (*Avena fatua*)	Known	Moderate	–	–	Coastal scrub, grasslands, chaparral, woodland, forest
Black mustard (*Brassica nigra*)	Known	Moderate	–	–	Widespread, many habitats
Field mustard (*Brassica rapa*)	Potential (Calflora)	Limited	–	–	Coastal scrub, grasslands, meadows, riparian
Quaking grass (*Briza maxima*)	Known	Limited	–	–	Grasslands
Ripgut brome (*Bromus diandrus*)	Known	Moderate	–	–	Grasslands, dunes, scrub, woodland, forest
Soft chess (*Bromus hordeaceus*)	Known	Limited	–	–	Grasslands, sagebrush, serpentine soils
Red brome (*Bromus madritensis*)	Known	High	–	–	Widespread, incl. scrub, grasslands, desert washes, woodlands
Cheatgrass (*Bromus tectorum*)	Potential (Calflora)	High	–	–	Interior scrub, woodlands, grasslands
Italian thistle (*Carduus pycnocephalus*)	Known	Moderate	C	–	Forest, scrub, grasslands, woodlands
Tocalote (*Centaurea melitensis*)	Known	Moderate	C	–	Grasslands, oak woodland

Species Name	Known or Potential	Cal-IPC Rating	State Listing	Federal Listing	Habitats and Distribution
Bull thistle (*Cirsium vulgare*)	Known	Moderate	C	–	Riparian areas, marshes, meadows
Poison hemlock (*Conium maculatum*)	Known	Moderate	–	–	Riparian woodland, grassland
Bindweed (*Convolvulus arvensis*)	Known	–	C	–	Grasslands
Bermuda grass (*Cynodon dactylon*)	Known	Moderate	–	–	Riparian scrub in southern CA.
Hedgehog dogtail-grass (*Cynosurus echinatus*)	Known	Moderate	–	–	Oak woodland, grassland
Orchard grass (*Dactylis glomerata*)	Known	Limited	–	–	Grasslands, broadleafed forest, woodlands
Patterson's curse (*Echium plantagineum*)	Potential (Inland Mendocino WMA)	–	–	–	Disturbed areas, fields
Redstem filaree (*Erodium cicutarium*)	Known	Limited	–	–	Widespread, many habitats
Tall fescue (*Festuca arundinacea*)	Known	Moderate	–	–	Coastal scrub, grasslands
Cutleaf geranium (*Geranium dissectum*)	Known	Limited	–	–	Widespread, many habitats
Waxy mannagrass (*Glyceria declinata*)	Known	Moderate	–	–	Vernal pools, wetlands, wet meadows
Velvet grass (*Holcus lanatus*)	Known	Moderate	–	–	Coastal grasslands, wetlands
Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*)	Known	Moderate	–	–	Grasslands
Foxtail barley (*Hordeum murinum* ssp. *leporinum*)	Known	Moderate	–	–	Grasslands
Klamathweed (*Hypericum perforatum*)	Known	Moderate	C	–	Grassland, oak woodland, open habitats; scattered
Smooth cat's ear (*Hypochaeris glabra*)	Known	Limited	–	–	Scrub and woodlands
Rough cat's ear (*Hypochaeris radicata*)	Known	Moderate	–	–	Coastal dunes, scrub, and prairie, woodland, forest
Italian ryegrass (*Lolium multiflorum*)	Known	Moderate	–	–	Grasslands, oak woodland, pinyon-juniper woodland
Hyssop loosestrife (*Lythrum hyssopifolium*)	Known	Limited	–	–	Grasslands, wetlands, vernal pools

Species Name	Known or Potential	Cal-IPC Rating	State Listing	Federal Listing	Habitats and Distribution
Bur-clover (*Medicago polymorpha*)	Known	Limited	–	–	Grasslands
Pennyroyal (*Mentha pulegium*)	Known	Moderate	–	–	Vernal pools, wetlands, wet meadows
Yellow glandweed (*Parentcellia viscosa*)	Known	Limited	–	–	Coastal prairie, grasslands, dunes, wetlands
Harding grass (*Phalaris aquatica*)	Known	Moderate	–	–	Coastal sites, especially moist soils
Bristly oxtongue (*Picris echioides*)	Known	Limited	–	–	Coastal prairie, scrub, riparian woodland
English plantain (*Plantago lanceolata*)	Known	Limited	–	–	Many habitats, primarily a turf weed
Kentucky bluegrass (*Poa pratensis*)	Known	Limited	–	–	Grasslands, scrub, riparian areas
Rabbitsfoot grass (*Polypogon monspeliensis*)	Known	Limited	–	–	Margins of ponds or streams, seasonally wet places, edge of coastal dunes
Wild radish (*Raphanus sativus*)	Known	Limited	–	–	Widespread, many habitats
Sheep sorrel (*Rumex acetosella*)	Known	Moderate	–	–	Many habitats, riparian areas, forest, wetlands
Curly dock (*Rumex crispus*)	Known	Limited	–	–	Grasslands, vernal pools, meadows, riparian
Russian thistle (*Salsola tragus*)	Known	Limited	C	–	Desert dunes and scrub, alkali playa
Blessed milkthistle (*Silybum marianum*)	Known	Limited	–	–	Grasslands, riparian
Hedge parsley (*Torilis arvensis*)	Known	Moderate	–	–	Grasslands, forest, woodland
Common mullein (*Verbascum thapsus*)	Known	Limited	–	–	Meadows, riparian, sagebrush, pinyon-juniper woodlands
Periwinkle (*Vinca major*)	Known	Moderate	–	–	Riparian, oak woodland, coastal scrub
Rattail fescue (*Vulpia myuros* ssp. *myuros*)	Known	Moderate	–	–	Coastal sage scrub, chaparral, grasslands
Notes: See Table 2-1 Notes.					

Table 2-1 contains the list of the most highly invasive plants observed or with the potential to occur on the offsite mitigation parcels. The list contains all of the plants listed by CDFA as “A” and ranked by Cal-IPC as High, with the exception of red brome and cheatgrass, which are widespread and considered more damaging to desert habitats. Some CDFA B listed and Cal-IPC ranked Moderate plants are included if they are already known from the offsite mitigation parcels or if they are already enhancement management targets (e.g., teasel). The species in Table 2-1 are recommended for mapping during baseline surveys, development of management objectives, monitoring and long-term management.

Plants which are not as highly ranked by CDFA or Cal-IPC are included in Table 2-2. These include some of the nonnative annual grasses which are widespread throughout California, as well as species with generalized habitat needs which are also widespread throughout the state. Species in Table 2-2 may be moved to Table 2-1 if they are observed to expand into habitat creation areas, compete with listed plants, or otherwise threaten management targets.

While the lists in Tables 2-1 and 2-2 are not an exhaustive inventory of all the nonnative plants present on the offsite mitigation parcels, they do include the most highly invasive plants known to occur in the area. During baseline surveys, crews will be directed to record all invasive plants observed, so it is possible the list may be increased after that effort. The rest of the plants in Table 2-1 which were not directly observed during surveys can serve as a “watch list” for future monitoring efforts, and if those plants are observed they should be reported immediately to the MCRCD, the Weed Management Area and the County Agricultural Commissioner.

2.2 Methods for Invasive Plant Baseline Surveys

Baseline invasive plant surveys will be conducted at each offsite mitigation parcel before project construction activities begin to determine which invasive plants are present at the site. Surveys are planned for summer 2010.

Invasive plant surveys will be conducted by biologists experienced with the vegetation of the offsite mitigation parcels and the identification of all potentially occurring invasive plants. Surveys will be conducted at an appropriate time of year when known and potentially occurring species will be evident and identifiable. The biologists will walk systematically back and forth through the offsite mitigation parcel, aiming for 100% visual coverage, until the entire project site has been observed for invasive plants.

All plant species encountered will be identified to the level necessary to determine whether they are invasives. Invasive plant locations will be identified and the approximate boundaries of the infestation mapped using handheld Global Positioning System (GPS) Units and/or marked on maps showing aerial photography overlaid with the offsite mitigation parcel, access roads, and other features. Each invasive plant location observed during a survey will be recorded using the Noxious Weed Inventory Form (Attachment A).

Each observation of invasive plants will include the assignment of a sequential unique location number and a visual estimate of the area of coverage and the number or density of plants as appropriate. Percent of absolute plant cover within infestation boundaries will be categorized in cover/distribution categories:

- Trace (rare): less than 1% cover;
- Low (occasional plants): 2–5% cover;
- Moderate (scattered plants): 6–25% cover;
- High (fairly dense): 26–50% cover; and
- Dense (very dense): more than 51% cover.

During the surveys, the biological monitors will record all nonnative plants encountered, and will be alert for invasive plants that may be new to the project site—such species will be mapped and their occurrence analyzed for inclusion in the weed maps and discussion of appropriate control measures. Examples of these types of plants include species that are recently emerging as a threat in the inland Mendocino County region (e.g., red sesbania [*Sesbania punicea*]) or species that are known to be invasive in other regions but are not yet known to occur or have limited distribution in the Outlet Creek watershed (e.g., eggleaf spurge [*Euphorbia oblongata*], woolly distaff thistle (*Carthamus lanatus*), and perennial pepperweed [*Lepidium latifolium*]).

Following the survey, invasive plant locations will be digitized into a geographic information system database compatible with the North American Invasive Plant Mapping Standards (North American Weed Management Association 2010). The resulting geodatabase will enable comparison of baseline and long-term invasive plant populations in order to determine whether mitigation installation activities have resulted in the introduction and spread of new invasive plant species or populations.

2.3 Invasive Plant Baseline Report

After baseline surveys are completed, an invasive plant baseline conditions report will be prepared and submitted to the resource agencies, including US Environmental Protection Agency (USEPA), US Fish and Wildlife Service (USFWS), and California Department of Fish and Game (CDFG). The report will include the survey methods, list of invasive plants observed, maps showing locations of invasive plant infestations, and general recommendations to manage invasive plants, as appropriate. Report will be submitted to the agencies by December 31, 2010.

Chapter 3 Invasive Plant Monitoring and Reporting

A critical step in developing an effective and ecologically sound IPMP is establishing criteria by which the prescription's implementation and effectiveness will be measured. Data collection over time allows for detecting trends related to the target invasive plants. Furthermore, monitoring after management actions have been initiated will ensure the effectiveness of the management actions. Invasive plant monitoring, which will continue in perpetuity, is the responsibility of MCRCD.

Invasive plant management is a key component of adaptive management, which will be an essential tool in the management at the offsite mitigation parcels. The adaptive management component of the mitigation program is described in Chapter 12 in the MMP.

3.1 Purpose of Monitoring

The offsite mitigation parcels will be monitored periodically to assess changes from baseline invasive plant conditions. The purpose of monitoring is to 1) determine the overall status and condition of the parcels; 2) identify whether invasive plant populations have increased; 3) document invasive plant management activities conducted on the offsite mitigation parcels and assess whether they have been successful; and 4) recommend corrective actions if the invasive plant management activities have not been successful.

3.2 Success Criteria

During the baseline invasive plant survey, each parcel will be surveyed and a list of invasive plants occurring there will be compiled. An estimate of absolute cover within the infestation area and throughout the community type it occurs in (wetland, riparian or oak woodland) present on the parcel will be prepared. This information will be used as the "baseline" of invasive plant infestation, and the performance criteria is listed in Table 3-1.

Table 3-1. Invasive Plant Success Criteria for each Sensitive Habitat Type.

Plant Community	Success Criteria
Jurisdictional Wetlands	The percent vegetation cover (i.e., absolute cover) for invasive plants must be no higher than the baseline amount at Year 5 for all the wetland habitat on each parcel.
Riparian Woodland	The percent vegetation cover (i.e., absolute cover) for invasive plants must be no higher than the baseline amount at year 10 for all the riparian woodland habitat on each parcel.
Oak Woodland	The percent vegetation cover (i.e., absolute cover) for invasive plants must be no higher than the baseline amount at year 10 for all the oak woodland habitat on each parcel.

3.3 Invasive Plant Monitoring Methods

3.3.1 Qualitative Inspections

The long-term management plan in Chapter 11 in the MMP requires qualitative inspections of the offsite mitigation parcels to document the overall condition of the parcels. These inspections will include checking fences and gates, trash accumulation, etc. These inspections will also include compliance with the grazing lease (e.g., proper placement of artificial water sources and salt licks). The inspections will be documented in a log book. For each inspection, the minimum information to be documented will include date, monitor’s full name(s), other personnel present (full names, companies, etc.) parcel monitored, description of any specific events or activities monitored or problems encountered, reference to accompanying ground-level digital image(s) if applicable, and recommended remedial actions.

Qualitative monitoring will also include aerial photograph documentation of overall site conditions. Non-rectified aerial photographs will be taken every five years.

3.3.2 Quantitative Monitoring

Quantitative monitoring will be performed during the first year (year 1) of the performance monitoring period at the offsite mitigation parcels in order to establish baseline conditions, and repeated every five years thereafter. Table 3-2 presents the schedule for quantitative monitoring. Quantitative monitoring will include assessment of invasive plant cover in conjunction with monitoring of riparian and oak woodland habitat, jurisdictional wetlands, upland/grassland habitat, and grazing plan monitoring.

Data on invasive plant cover will be collected by walking transects through each offsite mitigation parcel and noting the species encountered along each transect. When one of the invasive plants listed in Table 2-1 is encountered a polygon of the plant boundary will be taken with GPS, then an estimate of percent cover within the polygon will be recorded using smaller sampling quadrats. The community type the invasive plant occurs in will also be noted, as well as general notes on the phenology of the infestation.

Data will be analyzed for comparison with the success criteria provided in Table 3-1. Data will be analyzed in a timely manner in order to be used along with annual invasive plant measurements to determine if management activities should be adjusted in subsequent years.

Invasive plant cover will be measured and recorded during years 1, 2, 3, and 4 and success of mitigation actions will be determined in year 5. Long-term monitoring will be conducted in years 5, 10 and 15 and every 10 years thereafter, after the success of the mitigation actions is determined. Monitoring will occur when plants in Table 1 are identifiable (usually during the summer) to determine whether percent cover is increasing over baseline. Areas which received management actions in previous years will also be monitored to determine whether percent cover of invasive plants is decreasing.

3.3.3 Photodocumentation

Digital images will be taken, from preset photostations, of key locations to document site conditions and management actions. Digital images will be annotated with photostation number (corresponding with accompanying photodocumentation key map) and date of photograph. In the event that invasive plants are removed and do not return over time the photodocumentation for their presence may be discontinued.

3.3.4 Monitoring Schedule

Table 3-2 presents the recommended monitoring schedule for the offsite mitigation parcels.

Table 3-2. Success Criteria Monitoring Schedule

Task	Responsible Party	Frequency
Qualitative Monitoring	Land Manager	Quarterly or at lesser intervals as described in Chapters 9, 10, and 11 in the MMP
Quantitative Monitoring	Land Manager	Every five years or at lesser intervals as described in Chapters 9, 10, and 11 in the MMP

3.4 Reports

Monitoring reports will be prepared to describe the results of the monitoring each year it is conducted. The annual reports will be completed by March 30 of the subsequent year and submitted to the resource agencies. At a minimum, the monitoring report will include the following items.

- A summary of invasive plant management activities and an evaluation of site conditions at each offsite mitigation parcel.
- A summary of the success criteria and monitoring methods.
- A summary and analysis of the monitoring results, including an evaluation of site conditions.
- Management recommendations, including discussion of areas with inadequate performance and recommendations for remedial actions.
- A discussion of modifications made to the monitoring methods.
- A list of personnel who prepared the content of the annual report and/or participated in monitoring activities that year.
- Digital images taken from predetermined photodocumentation stations (can be included as an appendix).

Chapter 4 Adaptive Management Recommendations

Adaptive management for the offsite mitigation parcels is covered in Chapter 12 of the MMP. It will be the responsibility of the land manager to develop methods for managing invasive plants on the offsite mitigation parcels. Some of the management options are discussed briefly below.

4.1 Invasive Plant Management Options

A comprehensive strategy for controlling invasive plants including mechanical, chemical and physical control methods is referred to as Integrated Pest Management (IPM). IPM stresses the inclusion of a wide variety of factors when considering which management techniques to employ. Some of the factors to consider when choosing a control technique are: effectiveness of a technique to accomplish management objectives, disturbance to the environment, the time period required for control and the cost. The following discussion of invasive plant control techniques is based on the Weed *Control Methods Handbook* (Tu et al., 2001) and the *Weed Workers' Handbook* (Watershed Project and California Invasive Plant Council 2004).

4.1.1 Manual and Mechanical Techniques

Manual and mechanical techniques such as pulling, cutting, and otherwise damaging plants, may be used to control some invasive plants, particularly if the population is relatively small. These techniques can be extremely specific, minimizing damage to desirable plants and animals, but they are generally labor and time intensive. Treatments must typically be administered several times to prevent the weed from re-establishing, and in the process, laborers and machines may severely trample vegetation and disturb soil, providing prime conditions for re-invasion by the same or other invasive species. Techniques include pulling by hand or with tools, mowing, brush cutting, weed-eating with string trimmers, girdling, mulching, soil solarization, tilling and flooding.

4.1.2 Grazing and Prescribed Fire

The MMP contains another appendix exclusively devoted to grazing (Appendix I). Grazing can either promote or reduce weed abundance at a particular site. By itself, grazing will rarely, if ever, completely eradicate invasive plants. However, when grazing treatments are combined with other control techniques, such as herbicides or biocontrol, severe infestations can be reduced and small infestations may be eliminated. Grazing animals may be particularly useful in areas where herbicides cannot be applied (e.g., near water) or are prohibitively expensive (e.g., large infestations).

Organizations that manage land for biodiversity often use prescribed burns to promote desired vegetation and species. Fire is sometimes necessary to prompt the germination of some plants, including a number of rare and endangered species. On the other hand, fire can also sharply reduce the abundance of some species. The weather, topography, and available fuel will determine the temperature and intensity of the prescribed burn, and this along with the timing of the treatment, largely determine how the burn impacts the vegetation and the abundance of particular species. The most effective fires for controlling invasive plant species are typically those administered just before flower or seed set, or at the young seedling/sapling stage. In some cases, however, prescribed burns can unexpectedly promote an invasive, such as when their seeds are specially adapted to fire, or when they resprout vigorously. Most successful weed control efforts that result from burning are due to the restoration of historical (natural) fire regimes, which had been disrupted by land use changes, urban development, fire breaks, or fire suppression practices. Repeated burns are sometimes necessary to effectively control weedy plants, and herbicide treatments may be required to kill the flush of seedlings that germinate following a burn.

4.1.3 Chemical

Determining the right course of action in weed management can be difficult. For many land managers, whether to apply herbicides is an ethical decision that is not taken lightly. Herbicides are often used as a last resort, when other attempts have failed, and action is imperative. Integrated Pest Management considers the overall impacts of herbicide use on sensitive habitats and the ecological system and the decision to use herbicides should be based on the management objectives of the site. Table 1 contains a list of the herbicides which could be used on the offsite mitigation parcels. However, it will be the responsibility of the Land Manger to determine whether or not herbicides are an appropriate management option for each offsite mitigation parcel. Table 4-1 lists some commonly used herbicides which could be used on the offsite mitigation parcels.

Table 4.1. Example List of Herbicides that Could Be Used on the Offsite Mitigation Parcels

Herbicide	Brand Name Examples	Chemical Name	Herbicide Family	Target Weed Sps.	Notes
2,4 D	Navigate®, Class®, Weed-Pro®, Justice®	(2,4-dichlorophenoxy) acetic acid	phenoxy	broadleaf weeds	Inexpensive and common herbicide used for over 50 years.
Clopyralid	Reclaim®, Curtail®, Transline®	3,6-dichloro-2-pyridinecarboxylic acid	pyridine	annual and perennial broadleaf weeds	Highly selective herbicide developed as an alternative to picloram.
Fluazifop-p-Butyl	Fusilade DX®, Fusion®, Tornado®	(R)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy] propanoic acid	arylozyphenoxy-propionate	annual and perennial grasses	Toxic to most grasses except annual bluegrass and all fine fescues.
Glyphosate	RoundUp®, Rodeo®, Accord®	N-(phosphonomethyl) glycine	none generally recognized	annual and perennial weeds	Little to no soil activity.
Imazapic	Plateau®, Plateau Eco-Pak®, Cadre®	(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1 H-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid	imidazolinone	annual and perennial weeds	Degree of control depends on selectivity of individual plants.
Imazapyr	Arsenal®	(+)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid	imidazolidinone	annual and perennial grasses, broadleafs, vines, brambles, brush, and trees	Provides long-term total vegetation control.
Sethoxydim	Poast®	2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one	cyclohexanedione	annual and perennial grasses	Rapid degradation can limit effectiveness.
Triclopyr	Garlon®, Remedy®	[(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid	pyridine	woody and annual broadleaf weeds	Commonly used herbicide for woody vegetation.
Source: Weed Control Methods Handbook (Tu et al. 2001)					

4.1.4 Biological

Biological control (biocontrol for short) is the use of animals, fungi, or other microbes to feed upon, parasitize or otherwise interfere with a targeted invasive plant. Organisms used to feed on, parasitize, or otherwise interfere with invasive plants are called biocontrol agents. Successful biocontrol programs usually significantly reduce the abundance of the pest, but in some cases, they simply prevent the damage caused by the pest (e.g. by preventing it from feeding on valued crops) without reducing pest abundance (Lockwood 2000). Biocontrol is often viewed as a progressive and environmentally friendly way to control pest organisms because it leaves behind no chemical residues that might have harmful impacts on humans or other organisms, and when successful, it can provide essentially permanent, widespread control with a very favorable cost-benefit ratio. However, some biocontrol programs have resulted in harm to untargeted (non-pest) organisms and to ecological processes. Therefore, before releasing a biocontrol agent (or using other methods), it is important to balance its potential to benefit conservation targets and management goals against its potential to cause harm.

Chapter 5 References

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Appendix H Assessment of Erosion Sites on Offsite Mitigation Parcels in Little Lake Valley

Willits Bypass Project

Little Lake Valley (Taylor Ranch), Looking South

Technical Memorandum:
Assessment of Erosion Sites
On Offsite Mitigation Parcels in Little Lake Valley

U.S. Highway 101

Mendocino County, near Willits, California

PM 43.31-52.3

01-26200

June 2010

Caltrans

CALIFORNIA DEPARTMENT OF TRANSPORTATION

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Willits Bypass Project

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June 2010

STATE OF CALIFORNIA
Department of Transportation

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Chapter 1 Introduction

1.1 Purpose of Technical Memorandum

The California Department of Transportation (Caltrans) submitted a Clean Water Act Section 401 water quality certification request (Caltrans 2010) to the North Coast Regional Water Quality Control Board (RWQCB) on March 1, 2010, for the Willits Bypass Project (project) in Mendocino County, California.

As part of their review of the Section 401 water quality certification request (Caltrans 2010), the RWQCB indicated that they were concerned about sedimentation in Little Lake Valley/Outlet Creek Basin and believed that repairing headcuts in the basin would be important to address sedimentation and that this should be included as part of the project's compensatory mitigation. The RWQCB provided Caltrans with two digital images that were taken by RWQCB staff during a 2005 field visit to the Valley as part of a field review of the offsite mitigation parcels. The images were said to be representative of headcuts that the RWQCB believed to be contributing sediment and causing water quality degradation to streams in the Valley. One digital image was of a headcut on the Lusher offsite mitigation parcel and the second digital image was of a headcut on the Hebrard parcel. The Hebrard parcel is privately held and at this time there are no plans to purchase this parcel as part of project mitigation. As such, the headcut on the Hebrard parcel is beyond the scope of this erosion site assessment (see below). However, recognizing the RWQCB's interest in this particular headcut, efforts were made to observe the headcut from adjacent parcels under Caltrans ownership. These qualitative observations are presented in Chapter 3, Results, in a separate section of the chapter but are not included further in this assessment.

In response to the RWQCB's concern about sedimentation, Caltrans conducted an assessment of existing erosion sites **at the offsite mitigation parcels** in May 2010. This erosion site assessment:

- documents existing erosion point (e.g., headcuts) and linear (e.g., eroding banks) features found on upland and instream areas (each erosion feature is mapped and documented with a unique identification number);
- evaluates existing erosion features in terms of contribution of sediment to swales and creeks, effects on adjacent sensitive resources, and ease of constructability/access;
- recommends five erosion features that could be addressed to satisfy the RWQCB's concerns regarding sedimentation and water quality in Outlet Creek Basin; and
- provides typical cross-sections that show techniques to address the recommended erosion sites to be repaired.

This technical memorandum summarizes the May 2010 erosion assessment. The technical memorandum is organized into the following chapters:

- Chapter 1, “Introduction.”
- Chapter 2, “Methods.”
- Chapter 3, “Results.”
- Chapter 4, “Summary and Recommendations.”
- Chapter 5, “References.”
- Chapter 6, “List of Preparers.”
- Appendix A, “Digital Images of Erosion Sites, By Parcel.”

Chapter 2 Methods

2.1 Assessment Dates and Team Qualifications

The erosion site assessment of offsite mitigation parcels occurred over a 5-day period on May 3 through May 7, 2010. During this period, the 35 offsite mitigation parcels were surveyed, covering approximately 2,000 acres. Table 2-1 lists the offsite mitigation parcel, its' Assessor's Parcel Number (APN), and when the parcel was surveyed during the erosion site assessment.

Table 2-1. Erosion Site Assessment Dates for Offsite Mitigation Parcels

Property Owner	APN	Size (acres)	Date Surveyed
Arkelian	103-230-04	9.96	5-3-10
Benbow	007-010-04	36.16	5-5-10
	007-020-03	33.54	5-5-10 and 5-6-10
	108-020-06	46.53	5-5-10
	108-030-07	54.74	5-5-10
	108-040-13	40.96	5-5-10
Brooke	108-020-03	9.20	5-4-10
	108-030-01	16.90	5-4-10
	038-020-11	11.89	5-4-10
	038-040-09	14.99	5-4-10
Ford	108-010-05	76.57	5-5-10
	108-010-06	144.77	5-3-10 and 5-4-10
	108-020-04	151.61	5-3-10 and 5-4-10
	108-030-02	50.99	5-3-10 and 5-4-10
	108-030-05	80.39	5-3-10
Frost	108-070-04	46.53	5-4-10
Goss	103-230-02	10.08	5-3-10
Huff	037-240-RW	12.65	5-6-10
Lusher	038-060-08	18.65	5-3-10 and 5-4-10
	108-030-04	66.17	5-3-10
	108-030-03	23.88	5-3-10 and 5-4-10
MGC Plasma North	103-230-06	18.22	5-3-10
MGC Plasma Middle	103-250-14	27.04	5-3-10
MGC Plasma South	103-250-16	66.27	5-3-10
Nance	108-050-06	73.90	5-5-10
Niesen	108-040-02	27.43	5-4-10
Taylor	037-221-68	161.29	5-7-10
	037-240-41	144.15	5-6-10
Watson	037-221-30	115.59	5-6-10
Wildlands	108-070-08	64.06	5-5-10
	108-070-09	121.87	5-4-10
	108-060-01	63.39	5-5-10
	108-060-02	106.81	5-4-10
	108-020-07	7.77	5-5-10
	108-030-08	8.00	5-5-10

The survey team consisted of a geomorphologist with expertise in channel, floodplain, and wetland restoration and erosion site assessment, and a fish biologist with similar qualifications and extensive knowledge on Outlet Creek Basin hydrology and physical geography of the offsite mitigation parcels. In order to ensure the greatest possible consistency of survey methods and the most accurate documentation, survey team members collected data together at the beginning of the survey period as part of field calibration efforts. After field calibration of methods was complete, the survey team usually split up and covered separate areas, as appropriate.

2.2 Assessment Methods and Definitions

Prior to beginning the erosion site assessment field work, aerial photographs were reviewed for evidence of headcuts and other erosion features at the offsite mitigation parcels. In addition, Appendix C of the project's Mitigation and Monitoring Proposal (MMP; Caltrans 2010) was reviewed for information on existing sensitive biological resources (e.g., special-status plants and jurisdictional wetlands) at the offsite mitigation parcels.

Each offsite mitigation parcel was surveyed via a walking survey. Each offsite mitigation parcel was evaluated by the survey team, with an emphasis on identifying erosion sites on channels or other areas of concentrated flow (e.g., swales and drainages). The concentrated flow could be perennial, intermittent, or ephemeral. If no channels or other areas of concentrated flow were present, the survey team walked separate diagonal transects on the parcel in order to cover its entirety. The emphasis on channels and other areas of concentrated flow was a result of the digital images provided by the RWQCB, where the headcuts of concern are located on channels. Erosion features not associated with concentrated flow conditions (e.g., stand-alone rotational slumps and eroding upland cattle trails) were not documented.

The three main erosion features usually found in areas of concentrated flow and that have the potential to contribute an excessive amount of sediment are eroding banks and eroding gullies, and headcuts. In riverine (and to a lesser extent, wetland) environments where no other significant land use practices that destabilize and introduce sediment to the surrounding topography occur, eroding banks and gullies are generally thought to be the principal source of excessive sedimentation locally (Hooke 1980; Lawler 1992, 1995; Lawler et al. 1997; Rosgen 1996). Much of Little Lake Valley has been used for livestock grazing. Livestock grazing in riverine environments can also lead to bank erosion as a result of trampled ground that becomes compacted enough to prohibit the establishment of vegetation but not so much as to prohibit the contribution of soil particles to the water column from high velocity flows (Myers and Swanson 1993). Bank erosion of streams running through Little Lake Valley likely delivers much of the fine sediment in the Outlet Creek Basin (LeDoux-Bloom and Downie 2008). Headcuts can also provide excessive sediment contribution, although the contribution of excess sediment is more pronounced in high-gradient gully systems than in low-gradient valleys such as Little Lake Valley (Knighton 1998; Patton and Schumm 1981; Schumm 1977).

Other erosion features, such as depressional wetlands, potholes, scour areas, and slumps (herein referred to as "other point features") that were observed during the erosion site assessment with the potential to increase sedimentation to either the surrounding channels (both named and unnamed) and wetlands were also documented.

Figure 2-1 shows the data collection form that was used in the field to document pertinent information for each erosion site.

The following definitions for erosion sites are used in this technical memorandum:

- Depressional wetland: see definition for pothole below.
- Eroding bank: a streambank that is currently experiencing or has experienced significant bank retreat (i.e., the net linear recession of the streambank); usually, adequate bank-stabilizing vegetation or other cover is not present on the eroding bank.
- Eroding gully: a gully (i.e., small-scale drainage) that is experiencing either continuous or discontinuous erosion as evidenced by incision, localized slumping, or other erosion features.
- Headcut: the upslope limit of a gully or channel system, characterized by a steep wall which is cut back (i.e., mostly vertical) and migrating upslope (i.e., experiencing headward migration) as further erosion occurs.
- Headward migration: the lengthening of a gully or channel from erosion at its head, accomplished by concentrated water flow from rainwash, gullying, and/or slumping.
- Knickpoint: a break or interruption of slope in the longitudinal profile (i.e., channel bed) of a channel.
- Pothole: a depressional feature that has steep banks and is less than 15 feet in length and less than 10 feet in width.
- Scour area: an area on a gully or channel that is being deepened or widened as a result of concentrated flow, but that is not experiencing headward migration.
- Slump: an erosion feature at the head of an eroding gully that is more gravitationally-induced than scour-induced, but that has a definable headcut at its head.

2.3 Data Collection

Upon identification of an eroding bank, eroding gully, headcut, or other point feature, the following information was documented on a data collection form:

- Topographic position (whether or not the feature was located in a lowland channel or on an upland surface);
- Type of erosion site (e.g., headcut, eroding bank, eroding gully, depressional wetland, pothole, scour area, or slump);
- Vertical distance to the deepest portion at the base of the erosion site on the downstream or downslope end (called the “drop”; this variable is only applicable to headcuts, potholes, scour areas, and slumps);

- Average width of the erosion site (this variable measures the average width of the affected area downstream or downslope of the erosion site, and is only applicable to headcuts and other point features);
- Length of the erosion site (the total length of either the eroding bank or eroding gully, or the total length of the affected area downstream or downslope of a headcut, depressional wetland, pothole, scour area, or slump); and
- Ancillary notes describing the location, severity, and digital photograph number(s) of the erosion site.

Each erosion site was given a unique identification label. The erosion site was labeled based on its parcel owner, APN, and the order in which it was identified on that particular parcel. For example, Benbow 007-020-03_1 is the first documented erosion site on the Benbow APN 007-020-03 parcel. The location of each erosion site was hand-mapped on aerial photographs and precision-mapped with a sub-meter GPS, and photo-documented in the upstream and downstream direction, as applicable.

J Peters and J Kozlowski 5-3-10 | ***PARCEL: MGC Plasma North*** | ***APN: 103-230-06***

Category I: Vegetated areas where anadromous fish are known to occur (e.g., Haehl, Baechtel, Broaddus, Mill, Upp, Davis, Outlet).

Category II: Vegetated areas along tribs of Category I riparian corridors w/in 1000 ft u/s of confluence of Category I stream (e.g., Fulweiter).

Category III: Vegetated areas along tribs of Category I riparian corridors more than 1000 ft u/s of confluence of Category I stream (e.g., upper Fulweiter).

Perennial: flows year round

Intermittent: flow for only certain times of the year and receive water from both surface and gw

Ephemeral: channels are above water table year round and only receive water from surface runoff

Equipment:
measuring tape   data forms
stadia rods   maps
GPS
digital camera

SITE	INSTREAM / UPLAND	TYPE	DROP (ft)	AVE WIDTH (FT)	LENGTH (ft)	NOTES
1	IN	headcut	0.90	3.25	14.00	heacut on main drainage ditch on western end of parcel (photos 1-3)

Figure 2-1
Example Data Collection Form

Chapter 3 Results

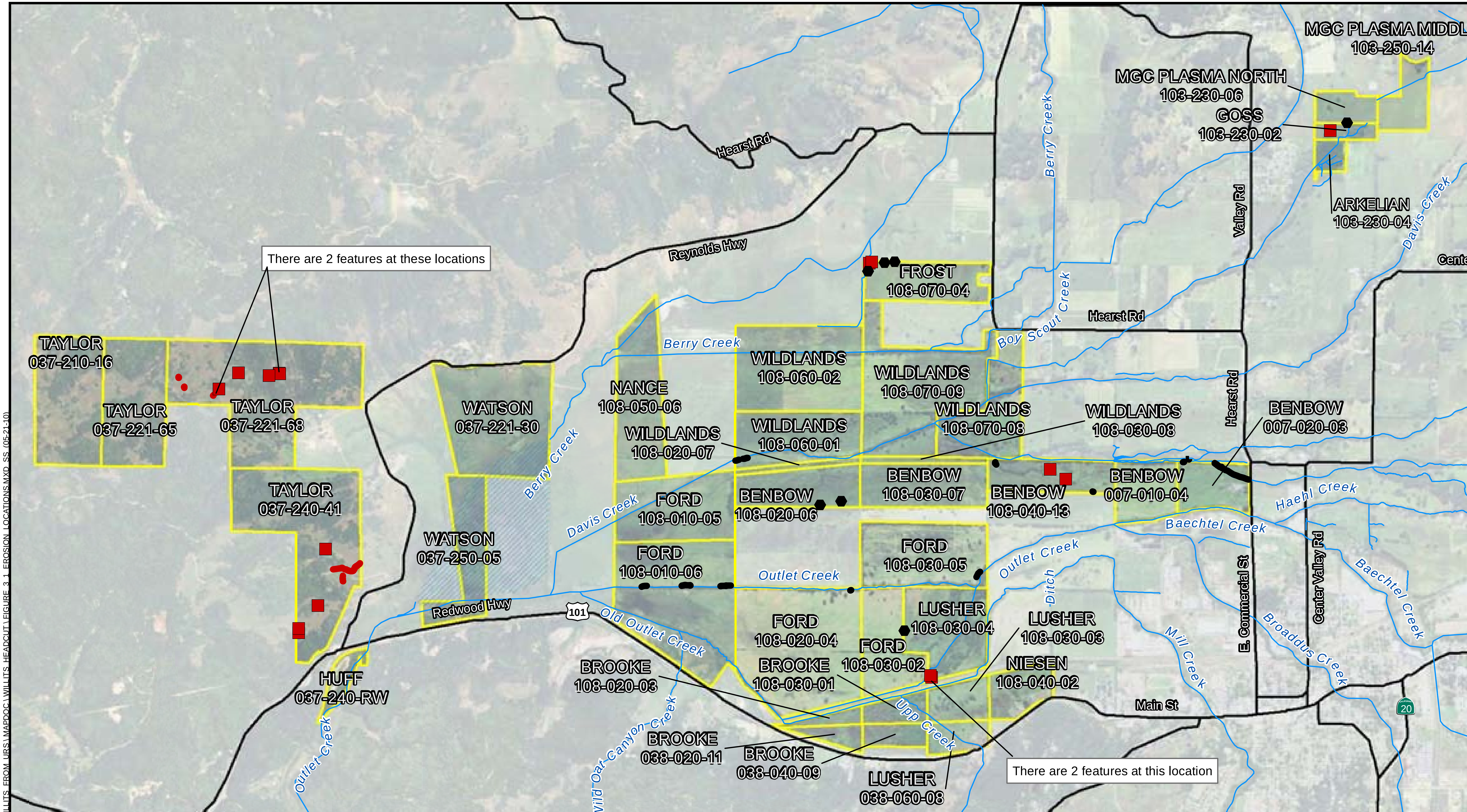
This chapter presents the results of the May 2010 erosion site assessment, by offsite mitigation parcel. Offsite mitigation parcels without erosion sites are not discussed herein.

Table 3-1 summarizes the relevant information that was collected for each erosion site at the offsite mitigation parcels, as applicable (Chapter 2). Figure 3-1 illustrates the location of each erosion site. As shown in Table 3-1 and on Figure 3-1, there are a total of 40 erosion sites on the offsite mitigation parcels: 11 eroding banks, 6 eroding gullies (5 with headcuts at their origin), 16 headcuts, and 7 other point features. On those offsite mitigation parcels located on the Little Lake Valley floor, most eroding bank sites are located on Outlet Creek and Davis Creek, and most headcuts and other point features are located in areas of concentrated flow with a slight increase in local gradient. On those offsite mitigation parcels located on the Outlet Creek Basin slopes (i.e., Taylor Ranch), almost all erosion sites are associated with culverts along Goat Rocks Road on the northern Taylor parcel (APN 037-221-68), and the PG&E access road on the southern Taylor parcel (APN 037-240-41).

Appendix A includes representative digital images of each erosion site, presented by parcel.

Table 3-1. Erosion Sites, by Offsite Mitigation Parcel

Parcel[a]	Identification Number	Instream/ Upland	Type	Drop (ft)	Average Width (ft)	Length (ft)	Notes
Benbow	108-020-06_1	Instream	Headcut	0.5	3.5	11.0	Very small headcut along drainage that flows north along western boundary of parcel
	108-020-06_2	Instream	Headcut	0.6	1.0	6.0	Small headcut on small tributary just upstream from larger channel that drains wetland
Benbow	108-040-13_1	Instream	Eroding bank	n/a	n/a	64.0	On left bank; scalloped; Category III abandoned channel; banks 2-3' high
	108-040-13_2	Upland	Pothole	2.5	5.0	12.0	Depressional pothole adjacent to swale; south and tributary to Category III abandoned channel
	108-040-13_3	Upland	Headcut	3.4	3.0	27.0	Large headcut on swale tributary to main swale that eventually connects to Category III abandoned channel
	108-040-13_4	Instream	Eroding bank	n/a	n/a	20.0	On left bank; scalloped; one of the main swales on parcel; at western end of parcel; banks ~ 2' high
Benbow	007-020-03_1	Instream	Eroding bank	n/a	n/a	30.0	Eroding berm/levee between two Category III channels; erosion primarily occurs at confluence
	007-020-03_2	Instream	Eroding bank	n/a	n/a	820.0	Incised gully that crosses southern boundary of parcel; erosion primarily on right bank; erosion locations extend south across to road but not accessible at time of survey
Ford	108-010-06_1	Instream	Eroding bank	n/a	n/a	110.0	Unstable, mostly unvegetated right bank associated with riffle convergence flow (i.e., outer bend cutbank); banks 6' tall from toe
	108-010-06_2	Instream	Eroding bank	n/a	n/a	180.0	Unstable, mostly unvegetated right bank associated with riffle convergence flow (i.e., outer bend cutbank); banks 6' tall from toe
	108-010-06_3	Instream	Eroding bank	n/a	n/a	180.0	Unstable, mostly unvegetated right bank associated with riffle convergence flow (i.e., outer bend cutbank); banks 6' tall from toe
	108-020-04_1	Instream	Eroding bank	n/a	n/a	35.0	On LB; scalloped erosional feature; nearly vertical in places; trampled by cattle; banks ~ 6-8' high into left bank levee
	108-030-05_1	Instream	Eroding bank	n/a	n/a	20.0	Rotational slump on right bank; main stem Outlet Creek; banks ~ 4-6' high; on southern boundary of parcel
Frost[b]	108-070-04_1	Instream	Headcut	3.5	12.0	75.0	Headcut leading off parcel to east at top of unstable Category III channel
	108-070-04_2	Instream	Headcut	4.0	7.0	20.0	Headcut in center of unstable Category III channel
	108-070-04_3	Upland	Headcut	1.5	3.0	20.0	Headcut on upland adjacent to first tributary to Category III channel
	108-070-04_4	Upland	Headcut	1.2	3.0	18.0	Headcut at top of second tributary to Category III channel



Legend

- Streams
- Major Road
- Offsite Mitigation Parcel

Headcut and Other Point Feature Locations

- Instream
- Upland

Eroding Gully/Bank Location

- Instream
- Upland

0 0.5 1 Miles

N

Data Sources
Aerials - ArcGIS Online (NAIP 2005)
Parcels - Caltrans (10/5/2009)
Stream - URS (2008)
Erosion Sites - ICF (2010)

Figure 3-1

Willits Bypass Project
Erosion Site Locations
On Offsite Mitigation Parcels

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Parcel[a]	Identification Number	Instream/ Upland	Type	Drop (ft)	Average Width (ft)	Length (ft)	Notes
	108-070-04_5	Instream	Headcut	1.4	8.0	68.0	Headcut in center of unstable Category III channel; close to first tributary
Goss	103-230-02_1	Upland	Headcut	0.70	3.0	7.0	Headcut at confluence of east to west swale with main drainage ditch on western end of parcel
Lusher	108-030-04_1	Instream	Depressional wetland	n/a	15.0	200.0	Large depressional wetland with slumping banks on swale in middle of Lusher parcel; not a true headcut because it is not progressing upstream
	108-030-04_2	Upland	Headcut	2.5	4.0	25.0	Large headcut on small swale to Old Outlet Creek near railroad crossing
	108-030-04_3	Upland	Headcut	1.2	6.0	22.6	Large headcut on small swale to Old Outlet Creek near railroad crossing
MGC Plasma North	103-230-06_1	Instream	Headcut	0.9	3.5	14.0	Headcut on main drainage ditch on western end of parcel
Taylor[c]	037-221-68_1	Upland	Headcut	3.5	5.5	13.5	Headcut upslope of Goat Rocks Road
	037-221-68_2	Upland	Scour area	3.5	4.0	14.5	Scour area downslope of road
	037-221-68_3	Upland	Scour area	2.3	2.0	3.3	Scour area downslope of road; associated with culvert; no headcut upslope
	037-221-68_4	Upland	Headcut	1.2	2.0	20.0	Small headcut on swale along upslope of road
	037-221-68_5	Upland	Scour area	1.3	3.0	5.0	Scour area downslope of road; associated with culvert; headcut (037-221-68_6) is upslope
	037-221-68_6	Upland	Headcut/eroding gully	3.0	2.5	60.0	Headcut at top of eroding gully upslope of 037-221-68_5
	037-221-68_7	Upland	Headcut/eroding gully	2.7	1.8	15.8	On same eroding gully as 037-221-68_6; a double headcut adjacent to road
	037-221-68_8	Upland	Headcut/eroding gully	3.2	7.0	6.0	Headcut on eroding gully in open area way from road
	037-221-68_9	Upland	Headcut/eroding gully	1.3	3.0	19.0	Headcut at edge of small livestock pond
	037-240-41_1	Upland	Eroding gully	n/a	n/a	680.0	Long incised gully adjacent to and most likely initiated by access road; eroding in areas but bedrock acts as grade control throughout
	037-240-41_2	Upland	Eroding gully/headcut	1.5	5.0	106.0	Incised eroding gully leading to headcut; deeper soil and not as much bedrock as 037-240-41_1
	037-240-41_3	Upland	Slump/headcut	2.0	18.0	36.0	Rotational slump with small headcut on downslope of road
	037-240-41_4	Upland	Headcut	1.6	2.0	5.5	Minor headcut on rocked gully on upslope of road
	037-240-41_5	Upland	Slump/headcut	4.0	7.0	32.0	Slump/headcut at start of swale

Parcel[a]	Identification Number	Instream/ Upland	Type	Drop (ft)	Average Width (ft)	Length (ft)	Notes
	037-240-41_6	Upland	Headcut	1.3	2.0	6.0	Small headcut on small east-facing swale; associated with cattle trail where flow collects and concentrates; entire swale downstream has pockets of moderate erosion
Wildlands	108-060-01_1	Instream	Eroding bank	n/a	n/a	90.0	Erosion on both banks; vertical banks lacking adequate vegetation cover; some slumping; extends to parcel boundary; banks 4-6' high
	108-060-01_2	Instream	Eroding bank	n/a	n/a	105.0	Erosion on both banks; vertical banks lacking adequate vegetation cover; some slumping; banks 4-8' high

[a] Overview map showing all eroding sites described in this table is provided in Figure 3-1.
[b] All five erosion sites on the Frost parcel are collectively referred to as the Frost Complex (Figure 3-2).
[c] Taylor sites 037-221-68_1 through 037-221-68_7 are collectively referred to as the Taylor Complex (Figure 3-3).

3.1 Little Lake Valley

3.1.1 Benbow 108-020-06

The Benbow 108-020-06 parcel has two erosion sites (Table 3-1, Figure 3-1, Appendix A). Both of these sites (108-020-06_1 and 108-020-06_2) are instream headcuts that occur on swales in the southwest corner of the parcel (Figure 3-1). Both have very small drops and any associated sediment derived from these headcuts is minimal and is spread out and deposited in the existing wetland complex to the north.

The areas of and adjacent to each headcut are well-vegetated wet meadow with sandy loam soils (Gielow sandy loam, 0 to 5 percent slopes). Concentrated flows from the swales upstream, combined with direct trampling by livestock, have likely initiated these headcuts; however, both headcuts appear relatively stable.

3.1.2 Benbow 108-040-13

The Benbow 108-040-13 parcel has four erosion sites (Table 3-1, Figure 3-1, Appendix A). There are two instream eroding bank sites (108-040-13_1 and 108-040-13_4) and two upland sites (108-040-13_2 and 108-040-13_3). Erosion site 108-040-13_1 is located in the northeast corner of the parcel and 108-040-13_4 is located in the southwest corner of the parcel (Figure 3-1). These two eroding bank sites have streambanks that range from 2 to 3 feet high, and although they are noticeably vertical in nature, the soil that binds the banks together is relatively compact and stable. The pothole feature (108-040-13_2), located in the center of the parcel (Figure 3-1), is isolated (i.e., not on a noticeable swale) and is not undergoing headward migration. The headcut (108-040-13_3), also located in the center of the parcel (Figure 3-1), is one of the largest observed during the course of the assessment and is discussed further in Chapter 4.

Any associated sediment derived from these erosion sites enters the Category III abandoned/discontinuous channel that runs along the eastern edge of the parcel. This watercourse appears to have once been connected to Davis Creek, but no longer has an active hydrologic connection to the creek. As such, potential sedimentation from these sites essentially enters an active sediment sink (the Category III abandoned/discontinuous channel). Furthermore, the potential contribution of sediment from 108-040-13_1 and 108-040-13_4 appears to be minimal, while dislodged sediment from 108-040-13_2 most likely never exits the pothole.

The areas of and adjacent to each erosion site are well-vegetated wet meadow, swale, and/or riparian woodland with clay loam soils (Cole clay loam, 0 to 2 percent slopes). Concentrated flows from the swales upstream, combined with direct trampling by livestock, have likely initiated these erosion features; however, all erosion sites except 108-040-13_2 appear relatively stable.

3.1.3 Benbow 007-020-03

The Benbow 007-020-03 parcel has two erosion sites (Table 3-1, Figure 3-1, Appendix A). Both of these sites (007-020-03_1 and 007-020-03_2) are instream eroding banks located along the eastern edge of the parcel (Figure 3-1). Erosion site 007-020-03_1 consists of an eroding berm/levee at the confluence of two Category III channels. Erosion site 007-020-03_2 is an incised gully with pockets of bank erosion that crosses the southern boundary of the parcel. Similar to the erosion sites in Benbow 108-040-13, potential sedimentation from these sites essentially enters the same active sediment sink as described above.

The area of and adjacent to 007-020-03_1 is well-vegetated valley oak riparian woodland with loam soils (Feliz loam, 0 to 2 percent slopes). The area of and adjacent to 007-020-03_2 is fairly well-vegetated upland grazing land with clay loam soils (Cole clay loam, 0 to 2 percent slopes). Channel flows from upstream, combined with direct trampling by livestock, have likely initiated these erosion features; however, both features appear relatively stable.

3.1.4 Ford 108-010-06

The Ford 108-010-06 parcel has three erosion sites (Table 3-1, Figure 3-1, Appendix A). Each of these sites (108-010-06_1, 108-010-06_2, and 108-010-06_3) is an instream eroding bank that occurs on Outlet Creek in the center of the parcel (Figure 3-1). All three sites are remarkably similar in nature in that they have unstable, mostly unvegetated right (i.e., east) cutbanks created by convergence flow on the riffle/gravel bar complex on the opposite side of the cutbank. The banks are approximately 6 feet tall from the toe of the bank. Each eroding bank site represents the largest contributors of sediment from streambanks observed during the course of the assessment and all three sites are discussed further in Chapter 4.

The erosion sites are located in Oregon ash riparian woodland. The areas adjacent to each erosion site on the east and west are well-vegetated wet meadow with soils that have been altered through levee construction. Channel flows from upstream, combined with direct trampling by livestock, have likely initiated these erosion features. All three erosion sites appear unstable, as evidenced by active slumping (Appendix A-9).

3.1.5 Ford 108-020-04

The Ford 108-020-04 parcel has one erosion site (Table 3-1, Figure 3-1, Appendix A). The site (108-020-04_1) is an instream eroding bank that occurs on Outlet Creek in the southeast corner of the parcel (Figure 3-1). The eroding bank is located on the left (i.e., west) bank, is scalloped, near vertical in places, with banks approximately 6 to 8 feet high from the toe. This site is not one of the larger contributors of sediment observed, and appears to have somewhat stabilized, based on the fair amount of vegetative growth on and adjacent to the bank.

The erosion site itself is located in well-vegetated mixed riparian woodland with fluvaquent soils (Fluvaquents, 0 to 1 percent slopes). The areas adjacent to the erosion site on the east and west are well-vegetated wet meadow with similar soils. Channel flows from upstream, combined with direct trampling by livestock, have likely initiated this erosion feature.

3.1.6 Ford 108-030-05

The Ford 108-030-05 parcel has one erosion site (Table 3-1, Figure 3-1, Appendix A). The site (108-030-05_1) is an instream eroding bank that occurs on Outlet Creek on the southern boundary of the parcel (Figure 3-1). The eroding bank is located on the right (i.e., east) bank, is a slumped erosion feature, and is near vertical in places with banks approximately 4 to 6 feet high from the toe. This site is not one of the larger contributors of sediment observed, and appears to have stabilized based on the good amount of vegetative growth on and adjacent to the bank.

The erosion site itself is located in well-vegetated valley oak riparian woodland with Fluvaquent soils (Fluvaquents, 0 to 1 percent slopes). The areas adjacent to the erosion site on the east and west are well-vegetated wet meadow with sandy loam soils (Gielow sandy loam, 0 to 5 percent slopes). Channel flows from upstream, combined with direct trampling by livestock, have likely initiated this erosion feature.

3.1.7 Frost 108-070-04

The Frost 108-070-04 parcel has five erosion sites (Table 3-1, Figure 4-2, Appendix A), collectively referred to as the “Frost Complex” (Figure 3-2). There are three instream headcut sites (108-070-04_1, 108-070-04_2, and 108-070-04_5) and two upland headcut sites (108-070-04_3 and 108-070-04_4), each located in the northeast corner of the parcel (Figures 3-1 and 3-2). These are some one of the larger headcuts observed during the course of the assessment and are discussed further in Chapter 4.

Any associated sediment derived from these erosion sites enters an unnamed tributary that eventually connects to Berry Creek (under high flows). As such, potential sedimentation from these sites essentially enters an active channel. The potential contribution of sediment from each site (especially 108-070-04_1) appears to be significant.

The areas of and adjacent to each erosion site are located in a sparsely-vegetated, Oregon ash riparian woodland with Haplaquept soils (Haplaquepts, 0 to 1 percent slopes). Concentrated flows from the swales upstream, combined with direct trampling by livestock, have likely initiated these erosion features. All five erosion sites appear unstable.

3.1.8 Goss 103-230-02

The Goss 103-230-02 parcel has one erosion site (Table 3-1, Figure 3-1, Appendix A). This site (103-230-02_1) is an upland headcut that occurs at the confluence of an east-to west-swale with the main drainage ditch on the western end of parcel (Figure 3-1). It has a very small drop and no associated sediment derived from this headcut was observed on the parcel.

The areas of and adjacent to the erosion site is well-vegetated valley oak riparian woodland with sandy loam soils (Gielow sandy loam, 0 to 5 percent slopes). Concentrated flows from the swales upstream, combined with direct trampling by livestock, has likely initiated this headcut; however, the headcut appears relatively stable.

3.1.9 Lusher 108-030-04

The Lusher 108-030-04 parcel has three erosion sites (Table 3-1, Figure 3-1, Appendix A). There is one instream depressional wetland site (108-030-04_1) and two instream headcut sites (108-030-04_2 and 108-030-04_3), each located on the northern boundary of the parcel (Figure 3-1). The depressional wetland is located on a swale and has slumping banks; however, it does not have a headcut associated with it and is not undergoing headward migration in either direction. The instream headcuts, however, are two of the larger headcuts observed during the erosion site assessment and are discussed further in Chapter 4.

Any associated sediment derived from 108-030-04_1 is self-contained within the depressional wetland. Any associated sediment derived from 108-030-04_2 and 108-030-04_3 enter a swale that eventually connects to Old Outlet Creek (under high flows). As such, potential sedimentation from these sites essentially enters an active channel, and appears to be significant.

Erosion site 108-030-04_1 is located in well-vegetated Oregon ash riparian woodland with sandy loam soils (Gielow sandy loam, 0 to 5 percent slopes). The areas adjacent to 108-030-04_1 on the east and west are well-vegetated wet meadow with similar soils. Erosion site 108-030-04_2 and 108-030-04_3 are located in well-vegetated mixed riparian woodland, with Fluvaquent soils (Fluvaquents, 0 to 1 percent slopes). The areas adjacent to 108-030-04_2 and 108-030-04_3 on all sides are a mixture of well-vegetated oak woodland grassland, Oregon ash riparian woodland, mixed riparian woodland, and wet meadow (all with similar soils).

Direct trampling by livestock has likely initiated 108-030-04_1; however, it appears to be stable. Concentrated flows from the swale upstream, combined with direct trampling by livestock, have likely initiated 108-030-04_2 and 108-030-04_3. These erosion sites appear unstable.

3.1.10 MGC Plasma North 103-230-06

The MGC Plasma North 103-230-06 parcel has one erosion site (Table 3-1, Figure 3-1, Appendix A). This site (103-230-06_1) is an instream headcut that occurs on the main drainage ditch on western end of parcel (Figure 3-1). It has a very small drop and any associated sediment derived from this headcut is minimal and gets spread out and deposited in the local wetland complex to the north.

The areas of and adjacent to each erosion site are well-vegetated wet meadow with clay soils (Clear Lake clay, 0 to 2 percent slopes). Concentrated flows from the swales upstream, combined with direct trampling by livestock, has likely initiated this headcut; however, the headcut appears relatively stable.

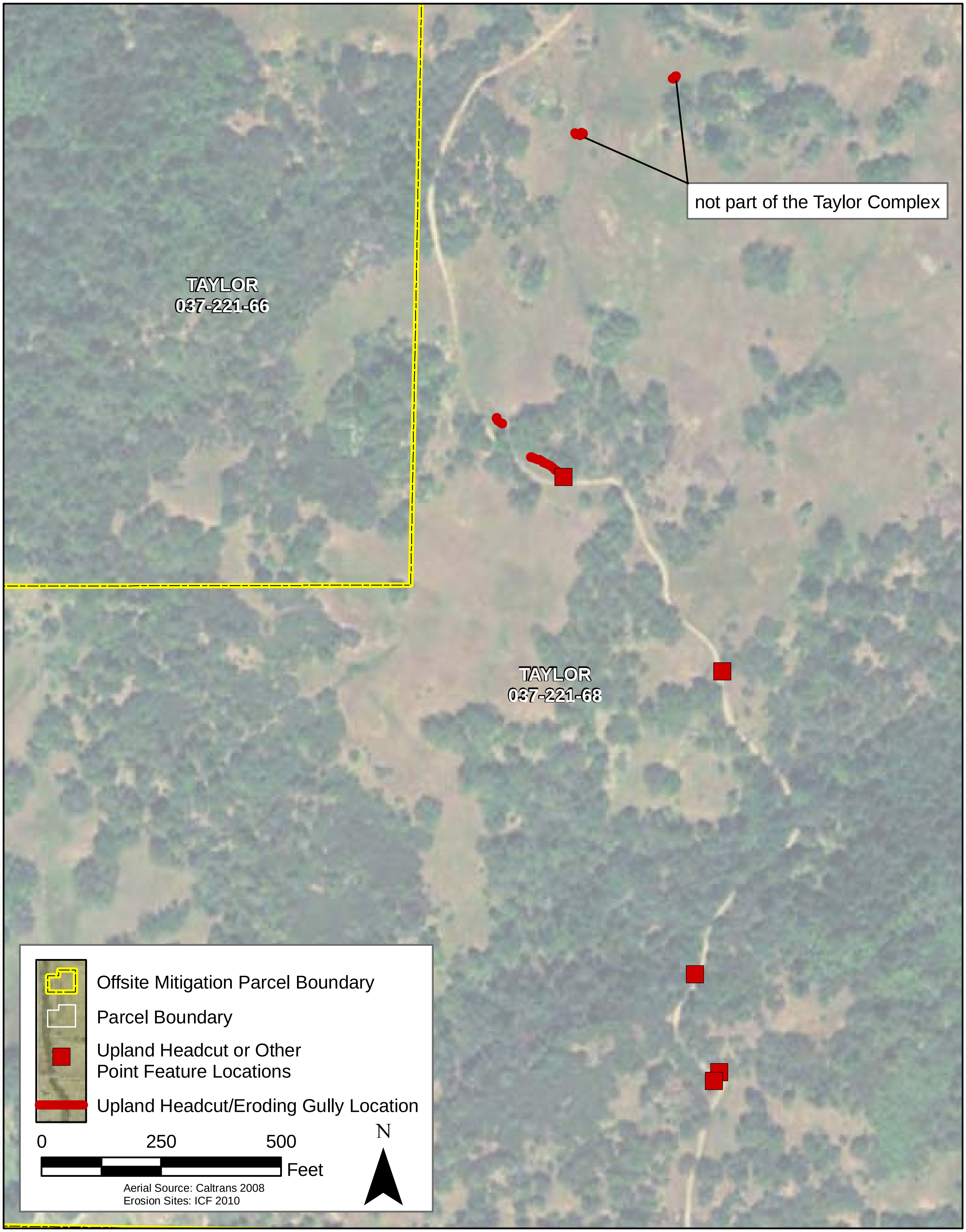


Figure 3-2
Taylor (APN 037-221-68) Complex
Erosion Site Locations

3.1.11 Wildlands 108-060-01

The Wildlands 108-060-01 parcel has two erosion sites (Table 3-1, Figure 3-1, Appendix A). Both of these sites (108-060-01_1 and 108-060-01_2) are instream eroding banks that occur on Davis Creek on the northern boundary of the parcel (Figure 3-1). Both sites are similar in that they have partially unstable banks on each side, with a noticeable absence of vegetation. They are not associated with the convergence of flow from a gravel bar as evidenced on the Ford 108-010-06 parcel; rather, the lower banks appear to be scoured from high flows. The banks range from 4 to 8 feet high from the toe. These sites are not of critical concern as they will be addressed with riparian planting mitigation actions.

The erosion sites themselves are located in sparsely-vegetated willow riparian scrub. The areas adjacent to each erosion site on the east and west are well-vegetated wet meadow with sandy loam soils (Gielow sandy loam, 0 to 5 percent slopes). Channel flows from upstream, combined with direct trampling by livestock, have likely initiated these erosion features.

3.2 Outlet Creek Basin Slopes

3.2.1 Taylor 037-221-68

The Taylor 037-221-68 parcel has nine erosion sites (Table 3-1, Figure 3-1, Appendix A), the first seven of which are collectively referred to as the “Taylor Complex” (Figure 3-2). All erosion sites are located in upland and are typified by headcuts, scour areas, and/or eroding gullies with headcuts. All erosion sites are located in the north-central portion of the parcel (Figures 3-1 and 3-2). Since the cause of all erosion sites within the Taylor Complex is the presence of the access road with its associated culvert crossings (and to a lesser extent direct trampling by livestock), the Taylor Complex (as well 037-221-68_8 and 037-221-68_9) are discussed further in Chapter 4.

Any associated sediment derived from these erosion sites enters unnamed tributaries that eventually connect to the lowlands (i.e., Little Lake Valley) below. However, all observed erosion sites are high up in the watershed and contribute a relatively small fraction of sediment to downstream receiving channels. Furthermore, any sediment that is eroded and transported most likely gets deposited and stored in the high-gradient unnamed tributaries as a sediment source and is only transported further downstream in slugs during large storm events. Finally, if the sediment is carried to the Valley floor, it would end up in an unnamed alluvial fan channel that eventually drains onto the Watson parcels. However, approximately one mile separates the Taylor 037-221-68 parcel and the Watson parcels and presumably much of the sediment load from upstream sources gets deposited in this reach of the alluvial fan channel as it is a low-gradient “response” reach, adjusting its channel bed to both water and delivered sediment. This channel on the Watson parcel does not have a noticeable hydrologic connection to any named channel, such as Berry Creek; rather, its terminus is a large existing wetland complex (on the eastern portion of Watson 037-221-30 and the western portion of Watson 037-250-05).

The areas of and adjacent to each erosion site are located in a moderately-vegetated upland forest setting with thin soils (Hopland-Witherell-Squawrock Complex, 30 to 50 percent slopes; Yorkville- Squawrock-Witherell Complex, 30 to 50 percent slopes).

3.2.2 Taylor 037-240-41

The Taylor 037-240-41 parcel has six erosion sites (Table 3-1, Figure 3-1, Appendix A). All erosion sites are located in upland and are typified by headcuts, slumps with headcuts, eroding gullies, and/or eroding gullies with headcuts. All erosion sites are generally located in the western portion of the parcel (Figure 3-1). Erosion site 037-240-41_1 is a long incised gully, approximately 680 feet in length (on the parcel), adjacent to and most likely initiated by the local access road. It is eroding in areas but the underlying bedrock acts as grade control throughout its length and it not an immediate erosion concern. Erosion site 037-240-41_2 is also a long incised gully approximately 106 feet in length (on the parcel), that has a headcut at its upper end. However, similar to 037-240-41_1, the underlying bedrock acts as grade control throughout its length and it not an immediate erosion concern.

The remaining four erosion sites consist of headcuts and/or slumps with headcuts. Three are associated with a PG&E access road and could be addressed in a similar manner to those discussed in Chapter 4 for the Taylor Complex. The fourth erosion site, 037-240-41_6, consists of a small headcut on a small east-facing swale. It is associated with a livestock trail where flow collects and concentrates, and the entire swale downstream has pockets of moderate erosion that are not considered significant due to the local bedrock control.

As with the Taylor 037-221-68 parcel, any associated sediment derived from these erosion sites enters unnamed tributaries that eventually connect to the lowlands (i.e., Little Lake Valley) below. Lowland sedimentation is not a significant concern for the same reasons described above. However, the receiving channels and wetlands in the lowlands are closer to Outlet Creek than the receiving channels associated with the Taylor 037-221-68 parcel.

The areas of and adjacent to each erosion site are located in a moderately-vegetated upland forest setting with thin soils (Shortyork-Yorkville- Witherell Complex, 15 to 30 percent slopes; Casabonne-Wohly loams, 30 to 50 percent slopes; Yorkville-Yorktree-Squawrock Complex, 30 to 50 percent slopes).

3.3 Erosion Potential on Offsite Mitigation Parcels

3.3.1 Literature Review

Prior to development if this technical memorandum, a complete review of the *Outlet Creek Basin Assessment Report* (LeDoux-Bloom and Downie 2008) was performed to gage the overall stability of Little Lake Valley/Outlet Creek Basin. Little Lake Valley is situated in the Southern Subbasin of the Outlet Creek Basin (it is also in the Lower Davis Creek CalWater 2.2a Planning Watershed).

Based on the *Outlet Creek Basin Assessment Report* (LeDoux-Bloom and Downie 2008), identified watershed issues that are relevant to erosion and stability on the offsite mitigation parcels include the following:

- The six dams in the Southern Subbasin[1] collect early winter rain which decreases or eliminates the stream flow at that time of year. From a geomorphic perspective, these dams act as sediment traps, limiting the transport of gravels. The channels below dams often become incised, straighter, and typically experience more bank erosion than systems that are not downstream of dams (Knighton 1998; Thorne et al. 1996).
- Channel volume has been reduced because of sediment deposition.
- Realignment of portions of Outlet Creek and other tributaries has exacerbated channel incision and bank erosion.
- Poorly maintained and undersized Mendocino County residential roads and road culverts have created sedimentation.
- Wildlife and livestock grazing in riparian areas have caused streambank erosion.

Based on the *Outlet Creek Basin Assessment Report* (LeDoux-Bloom and Downie 2008), findings that are relevant to erosion and stability in the offsite mitigation parcels include the following:

- Fine sediment deposits in low gradient reaches contribute to shallow pool depth and small spawning substrate (and can lead to an increase in flooding through loss of channel capacity, which in turn exacerbates bank erosion).
- Embeddedness levels are unsuitable in many streams (which signals fine-sediment deposition from bank and near-bank processes).
- The six dams have significantly decreased downstream gravel recruitment.

Other pertinent issues in the *Outlet Creek Basin Assessment Report* (LeDoux-Bloom and Downie 2008) include the idea that the geology of the highlands in the Southern Subbasin is very soft and highly erodible. Fine sediment is consistently contributed from Little Lake Valley downstream and into the Eel River. Additionally, high precipitation and high peak flows have created flashy instream conditions and increased fine sediment delivery. High erosion potential combined with flashy instream conditions on banks covered by shallow rooted and annual species has created easily eroded stream banks.

3.3.2 Observed Erosion Potential

Eleven eroding bank sites were identified on the offsite mitigation parcels during the erosion site assessment in Little Lake Valley (an area that encompasses approximately 1,700 acres). Of these

[1] These include Lake Emily Dam (on Willits Creek with a surface area of 275 acre-feet [af]); Ada Rose Dam (on Willits Creek with a surface area of 138 af); Boy Scout Camp Dam (on Boy Scout Creek with a surface area of 800 af); Pine Mountain Dam (on Moore Creek with a surface area of 45 af); Morris Dam (on Davis Creek with a surface area of 620 af); and Centennial Dam (on Davis Creek with a surface area of 512 af).

eleven eroding bank sites, only three are significant contributors of sediment. As will be discussed in Chapter 4, only Ford 108-010-06_1, 108-010-06_2, and 108-010-06_3 were observed to have the potential to significantly increase sedimentation to downstream channels.

Most of the channels and streams in Little Lake Valley are incised as a result of artificial straightening and limited access to their floodplains from levee and berm construction. However, most of the channels and streams have adequate vegetation cover and the observed small amount of eroding banks in proportion to the total linear feet of streams in the offsite mitigation parcels does not point to any large-scale channel instability within the offsite mitigation parcels.

Twelve headcuts were identified on the offsite mitigation parcels during the erosion site assessment Little Lake Valley. Of these twelve headcuts, five occur together as the Frost Complex, three are located on various Benbow parcels, two are located on the Lusher parcel, and the remaining two are located on the Goss and MGC Plasma North parcels, respectively. As will be discussed in Chapter 4, only the Frost Complex, Lusher 108-030-04_2 and 108-030-04_3, and Benbow 108-040-13_3 were observed to have the potential to significantly increase sedimentation to either the surrounding wetlands or channels.

Prior to the relocation and dredging of stream channels in the 1900s, Little Lake Valley functioned as a large, shallow lake and wetland until late spring or early summer, depending upon the amount of rainfall of that given year. The resultant topography of the offsite mitigation parcels observed during this study is a low-gradient, mostly stable landscape. Even though sedimentation has been identified as a major concern (LeDoux-Bloom and Downie 2008), the headcuts and other point features generally associated with a subtle rise in topography do not signify a landscape in a degradation phase. In fact, no mention of the term “headcut” exists in the *Outlet Creek Basin Assessment Report* (LeDoux-Bloom and Downie 2008).

However, this erosion site assessment was performed once and represents a snapshot of stability. It is entirely plausible that base level changes downstream in the Outlet Creek watershed could potentially affect the headward migration of the observed eroding banks, headcuts, and other point features, as well as create additional erosion features in the future. Furthermore, continued grazing practices (especially close to and within riparian habitat) could also lead to further channel instability (Myers and Swanson 1993).

3.4 Qualitative Observations for Hebrard 103-030-01

The RWQCB provided Caltrans with a digital image of two headcuts that the RWQCB believed to be contributing sediment and causing water quality degradation to streams in Little Lake Valley. During the erosion site assessment, these two headcuts were observed: one is located on one of the Lusher offsite mitigation parcels while the other is located on the Hebrard parcel. The Hebrard parcel is privately held and at this time there are no plans to purchase this parcel as part of project mitigation. As such, the headcut on the Hebrard parcel is beyond the scope of this erosion site assessment. However, recognizing the RWQCB’s interest in this particular headcut, efforts were made to observe the headcut from the adjacent Benbow 007-010-04 parcel under

Caltrans ownership. Qualitative observations of the headcut on the Hebrard parcel are presented below but are not discussed further in this assessment.

The Hebrard 103-030-01 parcel has one known erosion site. This site appears to be an instream headcut that occurs on the tributary to the channel that runs along the eastern edge of Benbow 007-010-04. This headcut was one of the largest observed during the course of the assessment. Similar to the erosion sites on Benbow 108-040-13 and 007-020-03, potential sedimentation from this headcut essentially enters the same active sediment sink as described above for the Benbow 108-040-13 and 007-020-03 parcels.

The area surrounding the erosion site is well-vegetated valley oak riparian woodland with loam soils (Feliz loam, 0 to 2 percent slopes). Channel flows, combined with direct trampling by livestock, have likely initiated this erosion feature. This erosion site appears highly unstable, as evidenced by the incision downstream of the headcut.

Chapter 4 Summary and Recommendations

This chapter summarizes the results of the erosion site assessment, and provides recommendations for five erosion features that could be addressed to satisfy the RWQCB's concerns regarding sedimentation and water quality in Outlet Creek Basin based primarily on data collected during the field assessment, as presented in Chapter 3.

4.1 Summary of Erosion Sites

The survey team walked each of the offsite mitigation parcels and recorded the location of each erosion site using GPS units and aerial photograph base maps (Chapter 2, Methods) for a variety of environmental indicators related to erosion features (Chapter 3, Results). Surveys took place in May 2010. Various types of erosion features with the potential to significantly increase sedimentation in Little Lake Valley were identified. The following list summarizes these erosion features and their significance:

- Depressional wetland: One depressional wetland (Lusher 108-030-04_1) was identified and this feature appears stable due to the lack of headward migration.
- Eroding bank: Eleven discrete portions of streambank that are currently experiencing or have experienced significant bank retreat were identified. Of these eleven sites, three appear to be the most significant sediment contributors: Ford 108-010-06_1, 108-010-06_2, and 108-010-06_3.
- Eroding gully: Six gullies experiencing either continuous or discontinuous erosion as evidenced by incision, localized slumping, or other erosion features were identified. All erosion sites are located on the Taylor 037-221-68 and 037-240-41 parcels.
- Headcut: A total of 16 headcuts were identified. Of the 16 headcuts, four appear to be significant sediment contributors: Frost Complex, Lusher 108-030-04_2 and 108-030-04_3, and Benbow 108-040-13_3.
- Pothole: One pothole (Benbow 108-040-13_2) was identified and this feature appears stable due to the lack of headward migration.
- Scour area: Three scour areas where a gully is being deepened or widened as a result of concentrated flow on the downslope end of a culvert were identified. All erosion sites are located on the Taylor 037-221-68 parcel.
- Slump: Two slumps at the head of an eroding gully (with headcuts) were identified on the Taylor 037-240-41 parcel.

4.2 Prioritization of Restoration Opportunities

Erosion features on the offsite mitigation parcels that are contributing excessive sediment and causing water quality degradation to channels and streams in Little Lake Valley have been prioritized for restoration as follows:

- The erosion feature contributes significantly to water quality degradation, as related to the contribution of excessive sediment from erosion of native soil.
- The erosion feature can be restored without impacts to existing sensitive biological resources, including special-status plants and jurisdictional wetlands.
- The erosion feature can be restored in coordination with planned mitigation actions.
- The erosion feature can be restored using restoration approaches that are very constructable (ease of constructability and access to the feature is direct).
- The erosion feature's restoration will create a synergy, as related to combining site-specific restoration opportunities to create a major effect at a cumulative level.

4.2.1 Restoration Sites

Priority status is given to particular erosion sites because restoration actions at these sites can immediately address many of the priority items above. The following are considered to be the top five priority erosion sites:

1. Ford 108-010-06_1, 108-010-06_2, and 108-010-06_3 (Figure 4-1; these individual eroding bank sites are grouped together because of their close proximity and their identical nature)
2. Frost 108-070-04 Complex (Figure 4-2; there are five headcut sites located in the northeast corner of the parcel: three are instream headcut sites [108-070-04_1, 108-070-04_2, and 108-070-04_5] and two are upland headcut sites [108-070-04_3 and 108-070-04_4])
3. Lusher 108-030-04_2 (Figure 4-3; headcut)
4. Lusher 108-030-04_3 (Figure 4-3; headcut)
5. Benbow 108-040-13_3 (Figure 4-4; headcut)

The potential restoration actions and designs presented below are conceptual do not represent the only restoration approach for the erosion sites. Rather, they are presented as typical and generalized treatment examples for the types of erosion sites identified during the surveys. Prior to restoration planning, each erosion site should be re-visited and various site-specific treatment alternatives should be developed.

4.2.1.1 Ford 108-010-06_1, 108-010-06_~~1~~2, and 108-010-06_3

Problem/Need Statement

All three erosion sites (Figure 4-1) are contributing excessive sediment and causing water quality degradation in Outlet Creek. Lawler (1992) groups unstable banks into three categories:

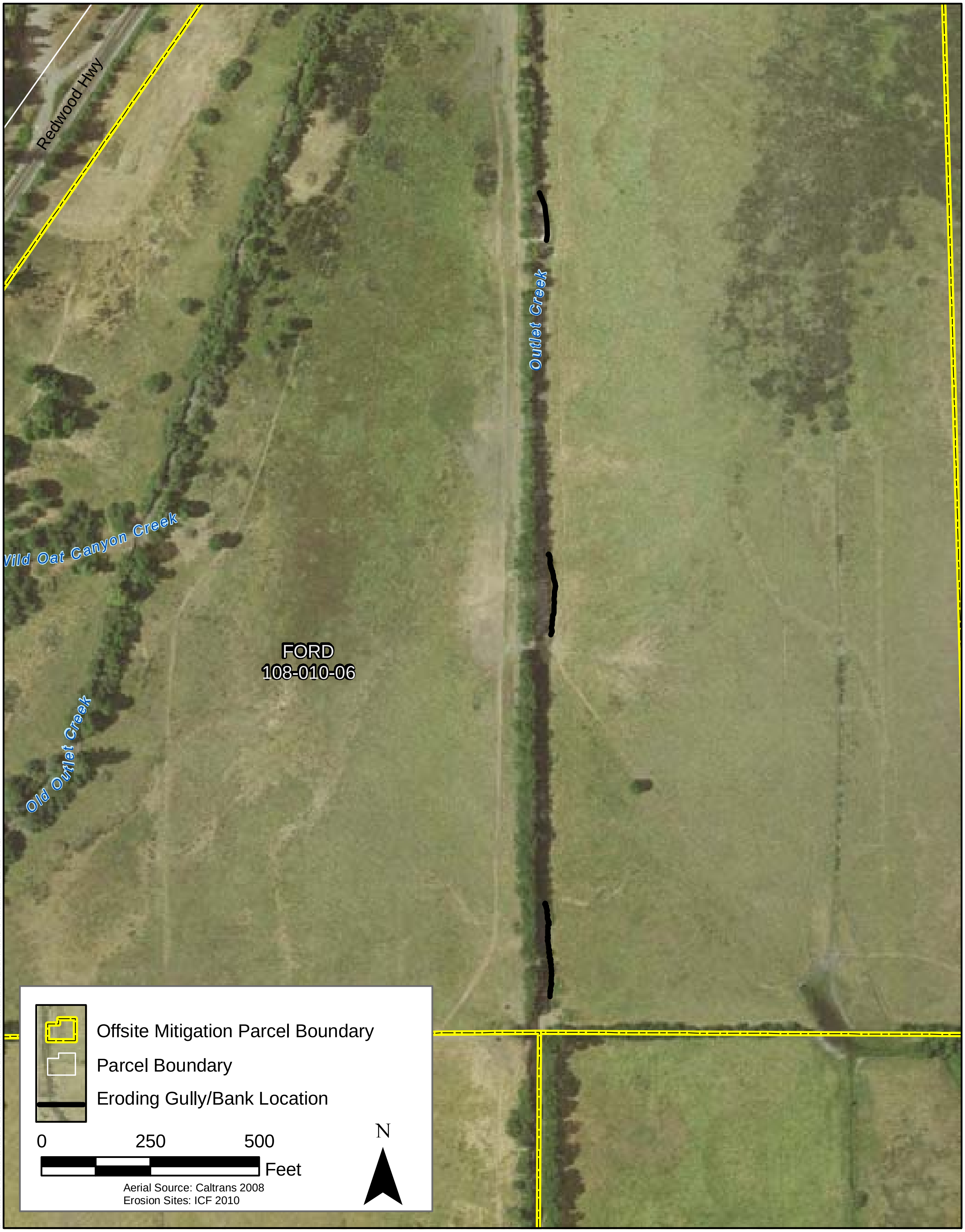


Figure 4-1
Ford (APN 108-010-06)
Erosion Site Locations

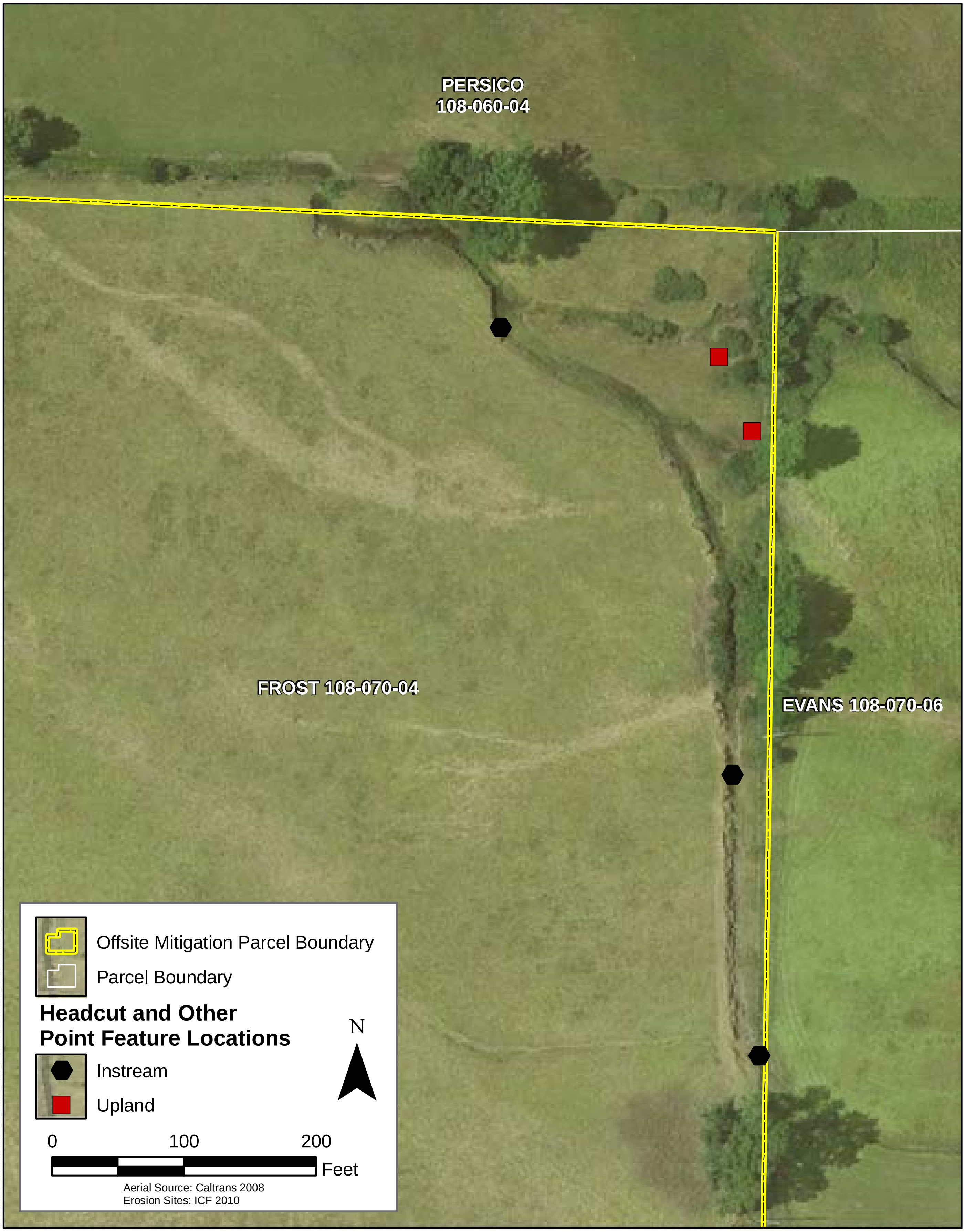


Figure 4-2
Frost (APN 108-070-04) Complex
Erosion Site Locations

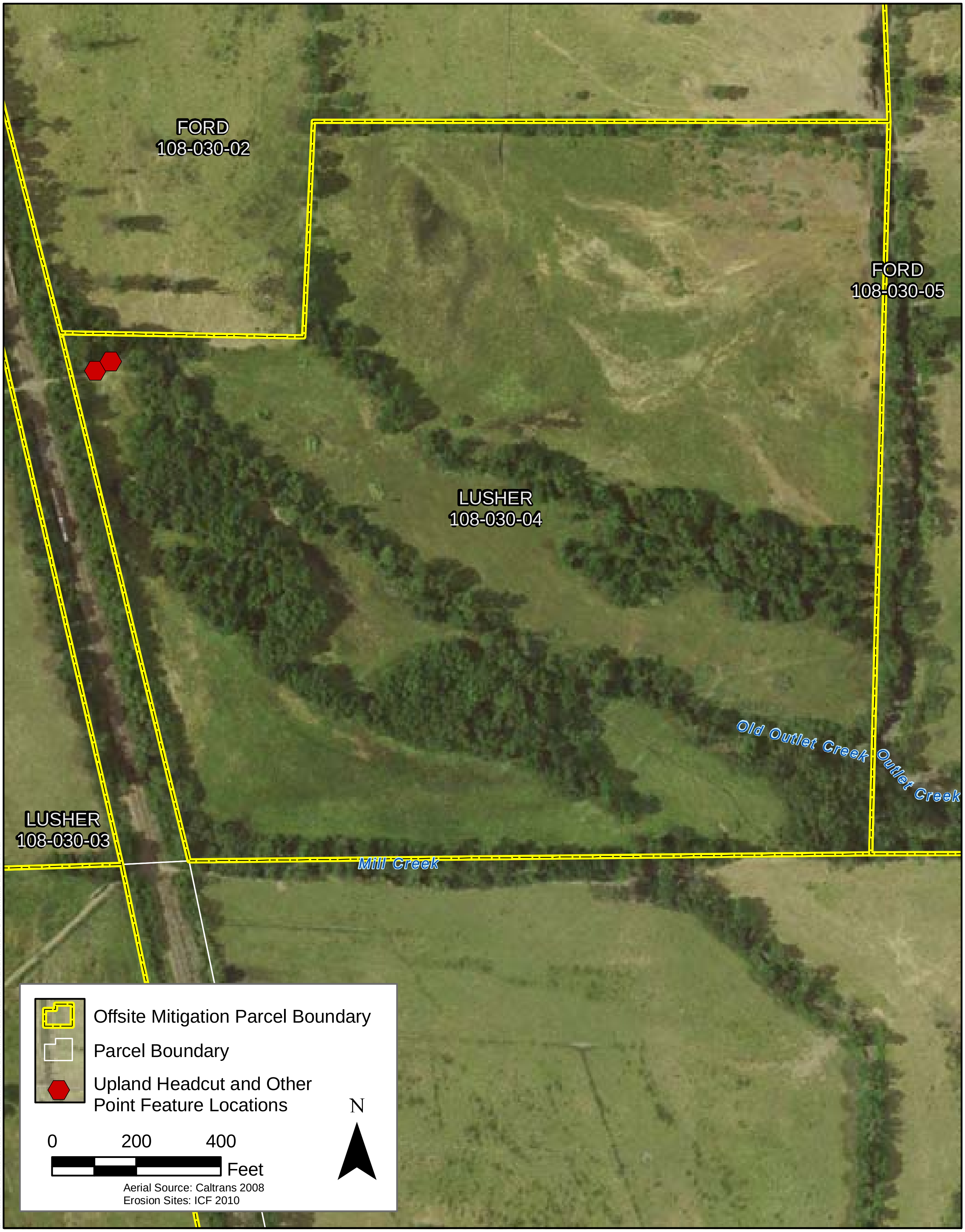


Figure 4-3
Lusher (APN 108-030-04)
Erosion Site Locations

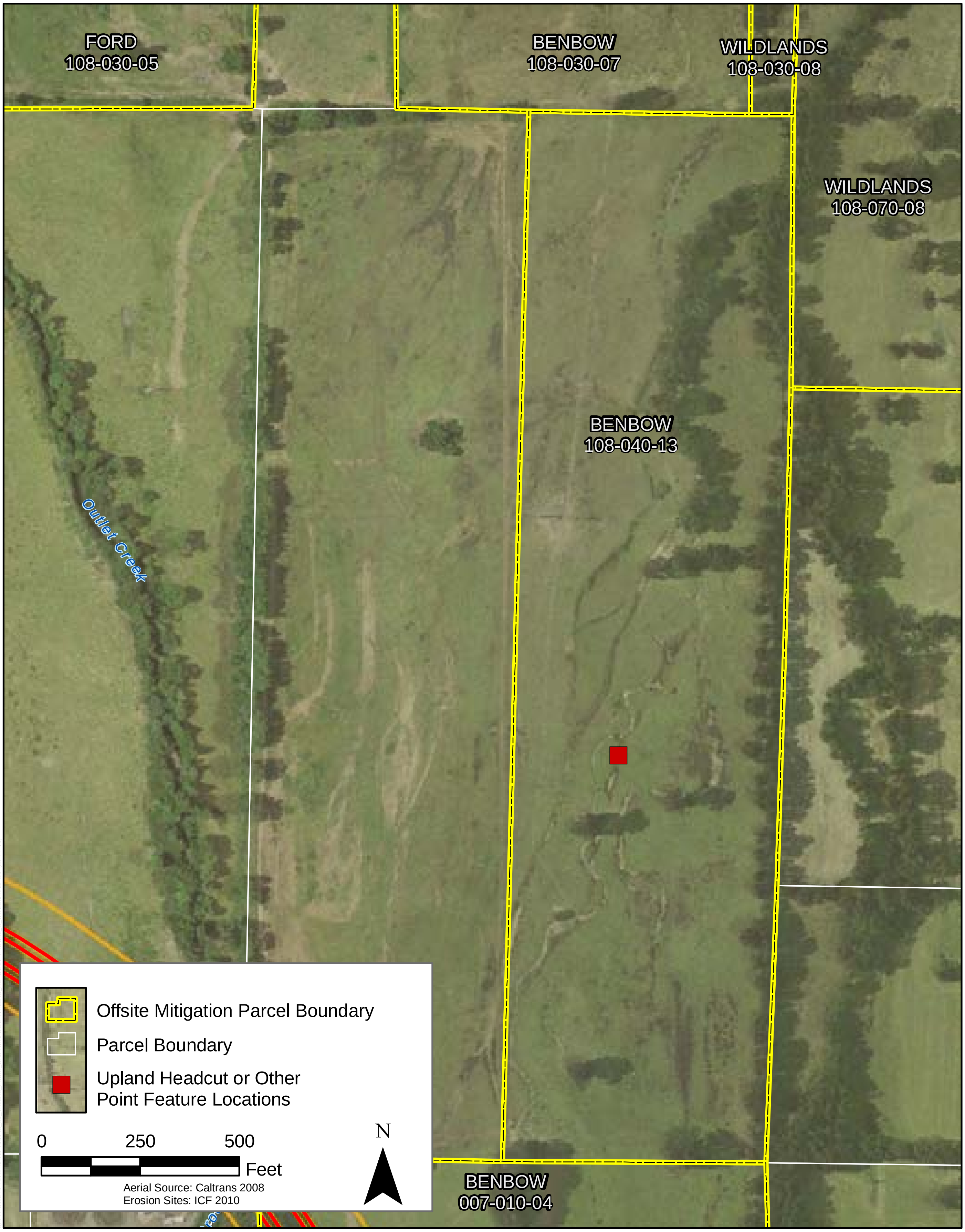


Figure 4-4
Benbow (APN 108-040-13)
Erosion Site Locations

weakening, fluvial erosion, and mass-failure processes. Weakening processes erode or prepare banks for further erosion (e.g., storm events that dislodge individual particles on the banks). Fluvial erosion processes (i.e., erosion by water) are related to the energy of flow (i.e., boundary shear stress). Mass-failure processes cause gravitational collapse of all or part of the bank. Weakening, fluvial, and mass-failure processes are acting together at these sites on the Ford 108-010-06 parcel.

All three erosion sites are remarkably similar in that they have unstable, mostly unvegetated right (i.e., east) cutbanks created by convergence flow on the riffle/gravel bar complex on the opposite side of the cutbank. The banks are approximately 6 feet tall from the toe of the bank. Channel flows from upstream, combined with direct trampling by livestock, have likely initiated these erosion features. All three erosion sites appear unstable, as evidenced by active slumping (Appendix A-9).

Impacts to Existing Sensitive Biological Resources

The floodplain adjacent to each erosion site is considered potential habitat for Baker's Meadowfoam, with known occurrences further away from Outlet Creek (Caltrans 2010a). However, no Baker's Meadowfoam was observed on the streambanks/levees adjacent to the creek. Nonetheless, potential construction staging areas and access routes would need to avoid Baker's Meadowfoam plants. Wet meadow and mixed marsh are the existing jurisdictional wetlands adjacent to the creek. Standard Best Management Practices (BMPs) would reduce temporary construction impacts to a less-than-significant level.

Desired Condition and Construction Methods

Bank stabilization can be divided into two main categories: biotechnical stabilization and hardscaping. Biotechnical stabilization involves the use of natural materials (e.g., vegetation and large woody material) to stabilize banks. Often, these natural materials are placed on the unstable bank once the bank has been re-graded to a less steep slope that will decrease the likelihood of erosion due to mass failure. Hardscaping involves the use of rip-rap, concrete, gabions, and other hard materials for stabilizing banks. These methods are not as environmentally sensitive as biotechnical stabilization methods and typically are only used when biotechnical stabilization methods are not feasible.

Construction methods for bank stabilization are site-specific. Methods may include:

- revegetation of the stream bank (biotechnical)
- re-grading of the stream bank followed by revegetation (biotechnical)
- stabilizing the bottom (i.e., toe) of the stream bank with natural materials (biotechnical) or hard materials (hardscaping)
- stabilizing the entire stream bank with hardscape (hardscaping)

Figure 4-5 illustrates a typical eroding bank treatment that could be applied to these erosion sites. In brief, the east bank could be re-graded to produce a gentler vegetated slope, and a low riparian bench could be constructed to dissipate the energy of high flows. The contact point between the toe of the east bank and the low riparian bench could be secured and stabilized using a rootwad bundle. This rootwad bundle would also hypothetically promote localized scour, which is a normal and beneficial component of a cutbank area.

Access, Scheduling, and Cost

The easiest access to these erosion sites is from the north and east along Highway 101. Bank stabilization activities should occur during late summer or early fall when water levels in the creek are at their lowest. Cost associated with bank stabilization is approximately $500 per linear foot. However, cost varies significantly because of accessibility, the type of bank material, and the specific methods of construction.

4.2.1.2 Frost Complex (108-070-04_1, 108-070-04_2, 108-070-04_3, 108-070-04_4, and 108-070-04_5)

Problem/Need Statement

All five erosion sites in the Frost Complex (Figure 4-2) are contributing excessive sediment and causing local water quality degradation. Sediment from these erosion sites enters an unnamed tributary that eventually connects to Berry Creek (under high flows). As such, sediment from these sites enters an active channel. The potential contribution of sediment from each site (especially 108-070-04_1) appears to be significant. Concentrated flows from the swales upstream, combined with direct trampling by livestock, have likely initiated these erosion features. All five erosion sites appear unstable.

Additionally, the headcuts have led to deepened incised pools in their respective downstream directions. This incision is detrimental for the following reasons:

- Channel incision leads to a deepened channel. A deepened channel limits channel-floodplain interaction, thereby increasing such variables as unit stream power (Brizga and Finlayson 1990). This increase in unit stream power further increases the instability of the streambanks locally (and is possibly responsible for the erosion observed at Benbow 007-020-03_1), as all the energy of the streamflow is contained within the bed and banks of the channel and does not have the opportunity to dissipate onto the floodplain. Limited channel-floodplain interaction also restricts ecological interactions between the channel and the floodplain (Doyle et al. 2000).
- The incised nature of this reach increases the flashy response of hydrologic events, where winter precipitation events dominate geomorphic effectiveness (Wolman 1988).
- Channel habitat units, such as pool-riffle sequences, are rare in incised channels such as the unnamed Category III stream that the erosion sites are located on, and those that do exist do so for only limited time intervals (Shields et al. 1998).
- The increased depth of flow associated with incision, combined with an increased flashy regime, results in bed armoring and a decreased frequency of bed mobilization (Doyle et al. 2000).
- Eroded material from unstable streambanks is added to the channel bed of the creek (often in the form of sandy, lateral bars), decreasing channel capacity and exacerbating flooding.

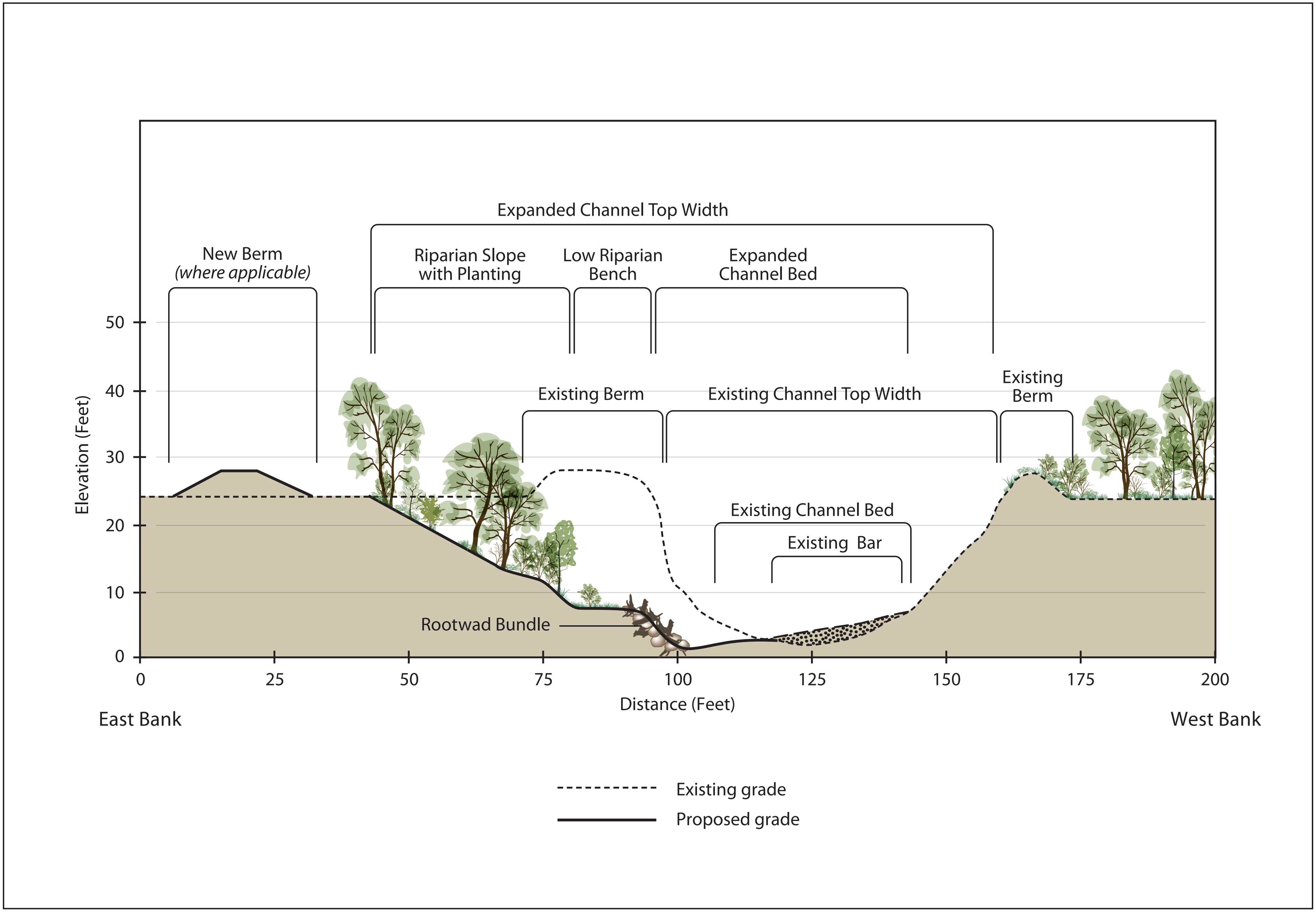


Figure 4-5
Typical Eroding Bank Treatment

Impacts to Existing Sensitive Biological Resources

No special-status plants (i.e., (Baker's Meadowfoam and North Coast semaphore grass) have been observed on or adjacent to the erosion sites (Caltrans 2010a). The erosion sites are located in the vicinity of a sparsely-vegetated, Oregon ash riparian woodland. Some loss of these riparian species could be expected due to restoration activities and appropriate mitigation strategies would need to be developed to offset these impacts. Standard BMPs would reduce temporary construction impacts to a less-than-significant level.

Desired Condition and Construction Methods

Similar to bank stabilization, headcut stabilization can be divided into two main categories: biotechnical stabilization and hardscaping. Biotechnical stabilization involves the use of natural materials (e.g., vegetation, keyed-in logs, and sod plugs) to stabilize headcuts. Often, these natural materials are placed in the headcut itself or downstream of the headcut to promote stability. Hardscaping involves the use of constructed step-pool structures for stabilizing headcuts. This hardscaping is generally as environmentally sensitive as biotechnical stabilization methods and is typically employed when channels and gullies have similar channel bottom and bank substrates to that of the step-pool structures (i.e., gravels and cobbles).

Construction methods for headcut stabilization are site-specific. Methods may include:

- Re-grading (i.e., laying back) and re-vegetating the headcut in the upstream direction and placing native soil and/or sod plugs in the downstream direction (biotechnical, referred to as the “Soil Fill Placement Method”)
- Filling the downslope area of the headcut with native soil and/or sod plugs and incorporating (i.e., keying in) logs into the body of the headcut itself (biotechnical, referred to as the “Log Step-Pool Design”)
- Placing native soil and incorporating step-pool structures in the downstream direction (biotechnical/hardscaping, referred to as the “Rock Step-Pool Design”)

Figure 4-6 illustrates a typical headcut treatment that could be applied to these erosion sites (“Rock Step-Pool Design”). In brief, the area downstream of the headcut could be filled with native soil and rock step-pool structures could be incorporated throughout the length of the affected area. The rock step-pool structures would mimic a natural step-pool in an undisturbed environment, and the erosive force of the water in the swale, channel, or gully would be readily dissipated. Furthermore, the undercutting action that leads to headward migration in a typical headcut would be minimized due to the stepped nature of the design.

Figure 4-6 shows three separate rock step-pool structures. However, the amount of rock step-pool structures depends on the drop of the headcut and the average width and total length of the affected area. For the headcuts in the Frost Complex, the lengths of the affected areas (the entrenched pools at the base of the headcuts) range from approximately 20 to 75 feet. Accordingly, and depending on the drop of the headcut, more rock step-pool structures would be required for longer affect areas. As a general rule, rock step-pool structures are employed every 5 to 7 channel widths as measured in a non-disturbed portion of the stream upstream or downstream of the headcut. For example, if the width of the channel in an area not affected by the headcut is 3 feet, then rock-step pools should be incorporated every 15 to 21 feet downstream of the headcut.

Access, Scheduling, and Cost

The easiest access to these erosion sites is from the south along Hearst Road. Headcut stabilization activities should occur during later summer or early fall when water levels in the channels are at their lowest or the channels are dry. Cost associated with headcut stabilization is approximately $100 per linear foot. However, cost varies because of accessibility, the types of material used, and the specific methods of construction.

4.2.1.3 Lusher 108-030-04_2

Problem/Need Statement

The Lusher 108-030-04_2 erosion site (Figure 4-3) is contributing excessive sediment and causing local water quality degradation. Sediment from 108-030-04_2 enters an unnamed tributary that eventually connects to Old Outlet Creek (under high flows). As such, sediment from this site enters an active channel. Concentrated flows from the swale upstream, combined with direct trampling by livestock, have likely initiated 108-030-04_2. This erosion site appears unstable.

Impacts to Existing Sensitive Biological Resources

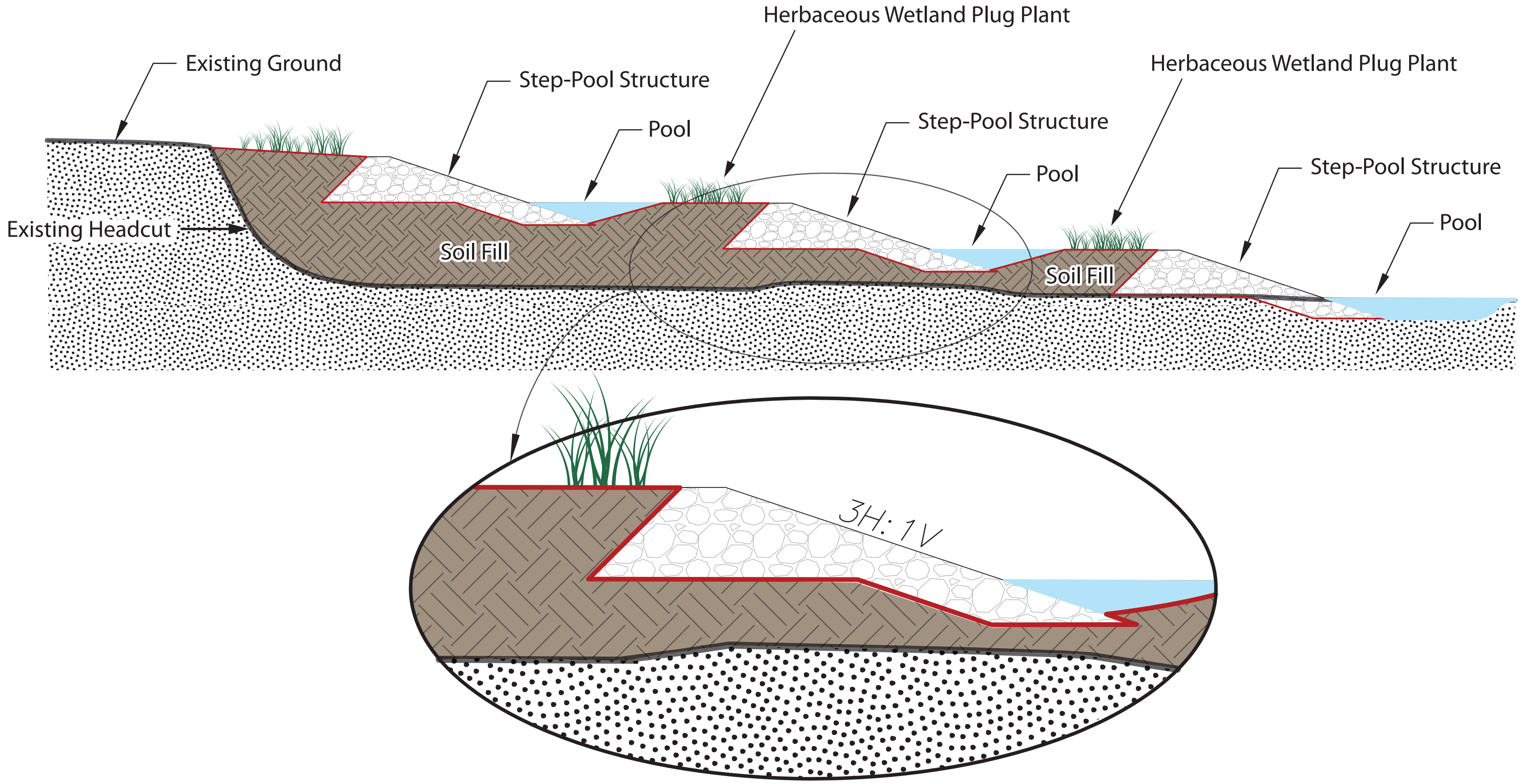
No special-status plants (i.e., (Baker's Meadowfoam and North Coast semaphore grass) have been observed on or adjacent to the erosion site (Caltrans 2010a). Erosion site 108-030-04_2 is located in well-vegetated mixed riparian woodland, and the areas around the site are a mixture of well-vegetated oak woodland grassland, Oregon ash riparian woodland, mixed riparian woodland, and wet meadow. No significant loss or disruption to these habitats is expected because of the isolated location and accessibility of the site. Standard BMPs would reduce temporary construction impacts to a less-than-significant level.

Desired Condition and Construction Methods

Construction methods for headcut stabilization at Lusher 108-030-04_2 are similar to those described above for the Frost Complex headcuts. A Rock Step-Pool Design would be appropriate for this site. Figure 4-6 shows three separate rock step-pool structures. For Lusher 108-030-04_2, one or two rock step-pool structures would be required based on the headcut and surrounding channel dimensions.

Access, Scheduling, and Cost

The easiest access to this erosion site is from the west along Highway 101, where an access road leads to the old railroad crossing between Old Outlet Creek and Mill Creek. The erosion site is few hundred feet away from the railroad tracks. Headcut stabilization activities should occur during the late summer or early fall when water levels in the channels are at their lowest or the channels are dry. Cost associated with headcut stabilization is approximately $100 per linear foot. However, cost varies because of accessibility, the types of material used, and the specific methods of construction.



Notes:

1. Depth of headcut and slope are not to scale. Rock step pools will be designed using this method and adjusted based on site specific conditions.
2. Rock fill and soil to be gathered from adjacent upland areas.
3. Soil fill will be seeded and planted.

NOT TO SCALE

Figure 4-6
Typical Headcut Treatment

4.2.1.4 Lusher 108-030-04_3

Problem/Need Statement

The Lusher 108-030-04_3 erosion site (Figure 4-3) is contributing excessive sediment and causing local water quality degradation. Sediment from 108-030-04_3 enters an unnamed tributary that eventually connects to Old Outlet Creek (under high flows). As such, sediment from this site enters an active channel. Concentrated flows from the swale upstream, combined with direct trampling by livestock, have likely initiated 108-030-04_3. This erosion site appears unstable.

Impacts to Existing Sensitive Biological Resources

No special-status plants (i.e., (Baker's Meadowfoam and North Coast semaphore grass) have been observed on or adjacent to the erosion site (Caltrans 2010a). Erosion site 108-030-04_3 is located in well-vegetated mixed riparian woodland, and the areas around the site are a mixture of well-vegetated oak woodland grassland, Oregon ash riparian woodland, mixed riparian woodland, and wet meadow. No significant loss or disruption to these habitats is expected due to the isolated location and accessibility of the site. Standard BMPs would reduce temporary construction impacts to a less-than-significant level.

Desired Condition and Construction Methods

Construction methods for headcut stabilization at Lusher 108-030-04_3 are similar to those described above for the Lusher 108-030-04_2 site. A Rock Step-Pool Design would be appropriate for this site. Figure 4-6 shows three separate rock step-pool structures. For Lusher 108-030-04_3, one or two rock step-pool structures would be required based on the headcut and surrounding channel dimensions.

Access, Scheduling, and Cost

The easiest access to this erosion site is from the west along Highway 101, where an access road leads to the old railroad crossing between Old Outlet Creek and Mill Creek. The erosion site is few hundred feet away from the railroad tracks. Headcut stabilization activities should occur during the late summer or early fall when water levels in the channels are at their lowest or the channels are dry. Cost associated with headcut stabilization is approximately $100 per linear foot. However, cost varies because of accessibility, the types of material used, and the specific methods of construction.

4.2.1.5 Benbow 108-040-13_3

Problem/Need Statement

The Benbow108-040-13_3 erosion site (Figure 4-6) is contributing excessive sediment and causing local water quality degradation. However, sediment derived this site enters a Category III abandoned/discontinuous channel that runs along the eastern edge of the parcel. This watercourse appears to have once been connected to Davis Creek, but no longer has an active hydrologic connection to it. As such, sedimentation from this site enters an active sediment sink (the Category III abandoned/discontinuous channel).

Nonetheless, the potential contribution of sediment from this site appears to be significant, as this is the largest headcut observed on any of the offsite mitigation parcels during the surveys. Concentrated flows from the swales upstream, combined with direct trampling by livestock, have likely initiated this erosion feature. This erosion site appears unstable.

Impacts to Existing Sensitive Biological Resources

The area adjacent to the site is considered potential habitat for Baker's Meadowfoam, with one known occurrence to the northeast (Caltrans 2010a). However, no Baker's Meadowfoam was observed on the site itself, and no North Coast Semaphore grass is known to exist in the vicinity of the site. Nonetheless, potential construction staging areas and access routes would need to avoid any Baker's Meadowfoam plants. Wet meadow and swale are the existing jurisdictional wetlands adjacent to the site. Standard BMPs would reduce temporary construction impacts to a less-than-significant level.

Desired Condition and Construction Methods

Construction methods for headcut stabilization at Benbow108-040-13_3 are similar to those described above for the headcuts in the Frost Complex. A Rock Step-Pool Design would be appropriate for this site. Figure 4-6 shows thee separate rock step-pool structures. For Benbow108-040-13_3, two rock step-pool structures would be required based on the headcut and surrounding channel dimensions.

Access, Scheduling, and Cost

The easiest access to this erosion site is from the south along Hearst Road. Headcut stabilization activities should occur during the late summer or early fall when the channel is dry. Cost associated with headcut stabilization is approximately $100 per linear foot. However, cost varies because of accessibility, the types of material used, and the specific methods of construction.

4.2.2 Restoration Sites on the Taylor Parcels

Although not identified by the assessment as a priority for restoration, erosion sites on the Taylor parcels provide a unique opportunity to limit sedimentation from an upland environment and could be undertaken as part of general maintenance efforts based on the simplicity of the restoration methods required to address the erosion sites.

4.2.2.1 Taylor Complex 037-221-68_1 through 037-221-68_7

The seven erosion sites that comprise the Taylor Complex (Figure 3-2) are spaced at regular intervals along Goat Rocks Road. Culverts on either side of the road have created headcuts upslope of the road, and scour areas downslope of the road. The headcuts could easily be addressed using the same treatments for headcuts previously described but at a smaller scale (use of hand tools and local materials such as small boulders located near the erosion sites). For the scour areas, appropriate dissipation of energy with placement of rocks and/or extending the culvert length and reconfiguring the outlet of the culvert to meet the channel bed on the downslope would eliminate or reduce the erosive power of the water in the culvert.

The areas of and adjacent to each erosion site are located in a moderately-vegetated upland forest setting. However, all work would occur in the vicinity of Goat Rocks Road and standard BMPs would reduce temporary construction impacts to a less-than-significant level. Access to these erosion sites is from Goat Rocks Road on the southern end of the parcel (right off the Reynolds Highway). Site stabilization activities should occur during the summer and fall when water levels in the channels, gully, and culverts are at their lowest. Cost associated with site stabilization is approximately $1,000 per site if only headcut repair and boulder placement were to occur. The cost would increase if culvert extension/reconfiguration were to occur. Restoration activities on the Taylor Complex could be performed by local landowners with minimal need for agency permitting.

4.2.2.2 Taylor 037-221-68_8 and 037-221-68_9

The Taylor 037-221-68_8 erosion site consists of a headcut on an eroding gully in an open area near Goat Rocks Road. The headcut could be addressed using the same treatments for the headcuts previously described. However, the eroding gully would benefit from the incorporation of grade control structures at specific intervals throughout its length, and the banks should be re-graded and planted with native vegetation. The Taylor 037-221-68_9 erosion site consists of a headcut at the edge of small livestock pond. The headcut could be addressed using the same treatments for the headcuts described above; however, it is recommended that an approximately 3 foot high berm be constructed around the livestock pond so that once the headcut is repaired, it would not have further opportunity to compromise the stability of the pond outlet and surrounding areas.

The areas of and adjacent to each of these two erosion site are located in a sparsely-vegetated upland forest setting. The sites are close to Goat Rocks Road and standard BMPs would reduce temporary construction impacts to a less-than-significant level. Access to these erosion sites is from Goat Rocks Road on the southern end of the parcel (right off the Reynolds Highway). Site stabilization activities should occur during the summer and fall when water levels in the gully and the livestock pond are at their lowest. Cost associated with site stabilization for Taylor 037-221-68_8 is approximately $100 per linear foot for the headcut. Cost associated with the eroding gully is approximately $500 per linear foot plus approximately $1,000 per grade control structure. Cost associated with site stabilization for Taylor 037-221-68_9 is approximately $100 per linear foot, plus approximately $1,000 to build the berm. However, cost varies because of accessibility, the types of material used, and the specific methods of construction.

4.2.2.3 Taylor 037-240-41

The same methods previously described could also be used to address the two slump and headcut and two headcut erosion sites on the Taylor 037-240-41 parcel associated with the PG&E access road. The areas of and adjacent to each of these four erosion sites are located in a sparsely-vegetated upland forest setting. The sites are all on the PG&E access road and standard BMPs would reduce temporary construction impacts to a less-than-significant level. Access to these erosion sites is from the main access road on the Taylor 037-240-41 parcel (right off the Reynolds Highway). Site stabilization activities should occur during the summer and fall when water levels at their lowest. Cost associated with site stabilization is approximately $100 per linear foot. However, cost varies because of accessibility, the types of material used, and the specific methods of construction.

Chapter 5 References

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Chapter 6 List of Preparers

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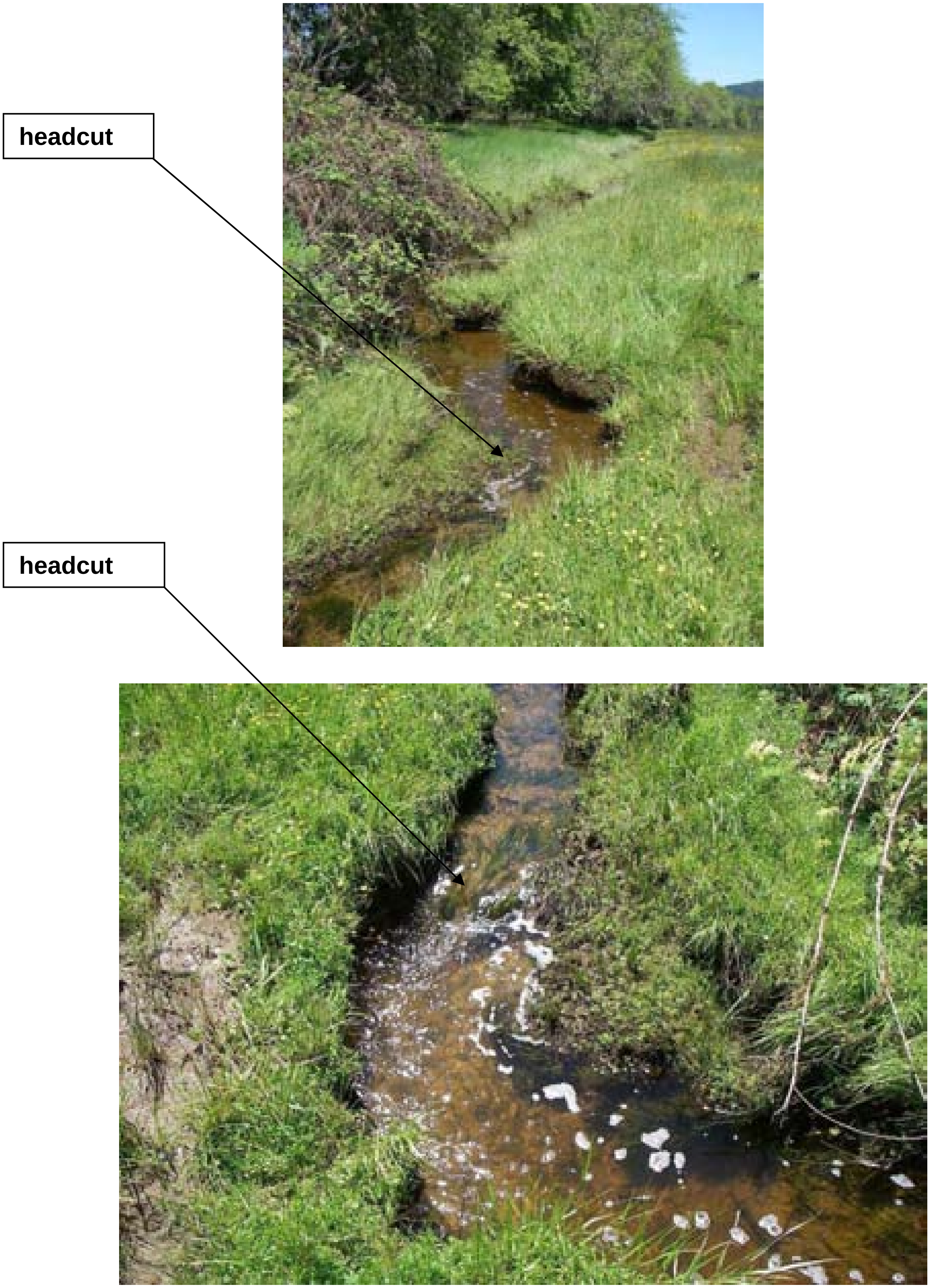
John Durnan	Graphic Artist
Darle Tilly	Technical Editor
Corrine Ortega	Publications Specialist

Appendix A Digital Images of Erosion Sites, By Parcel



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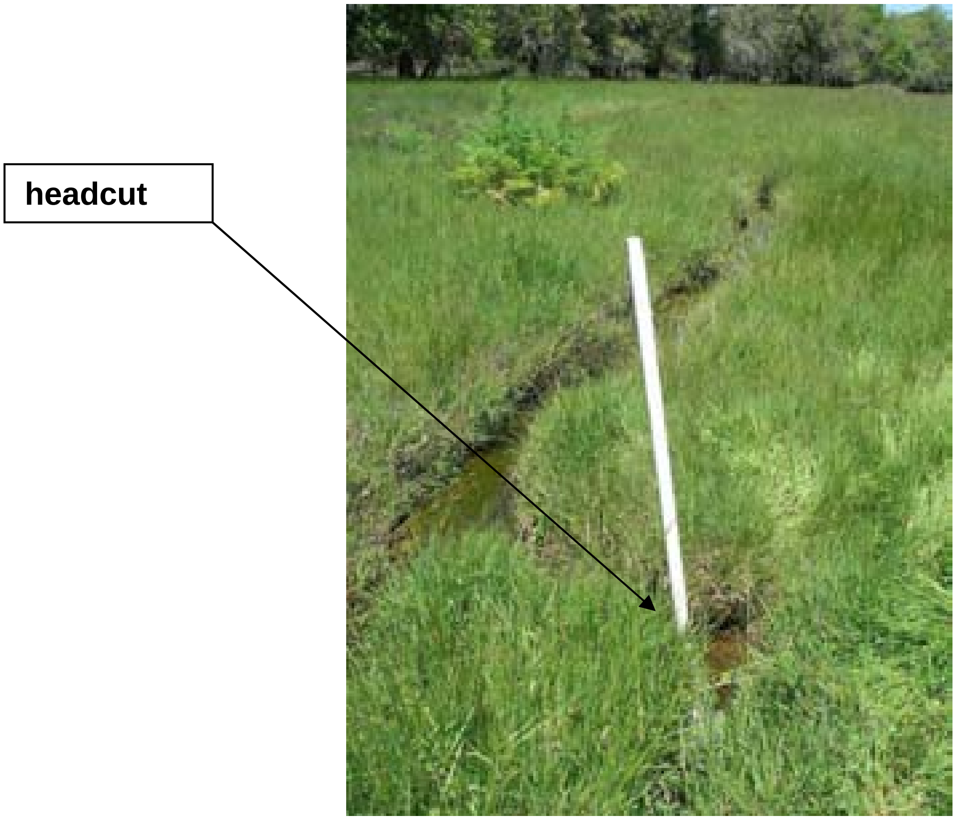
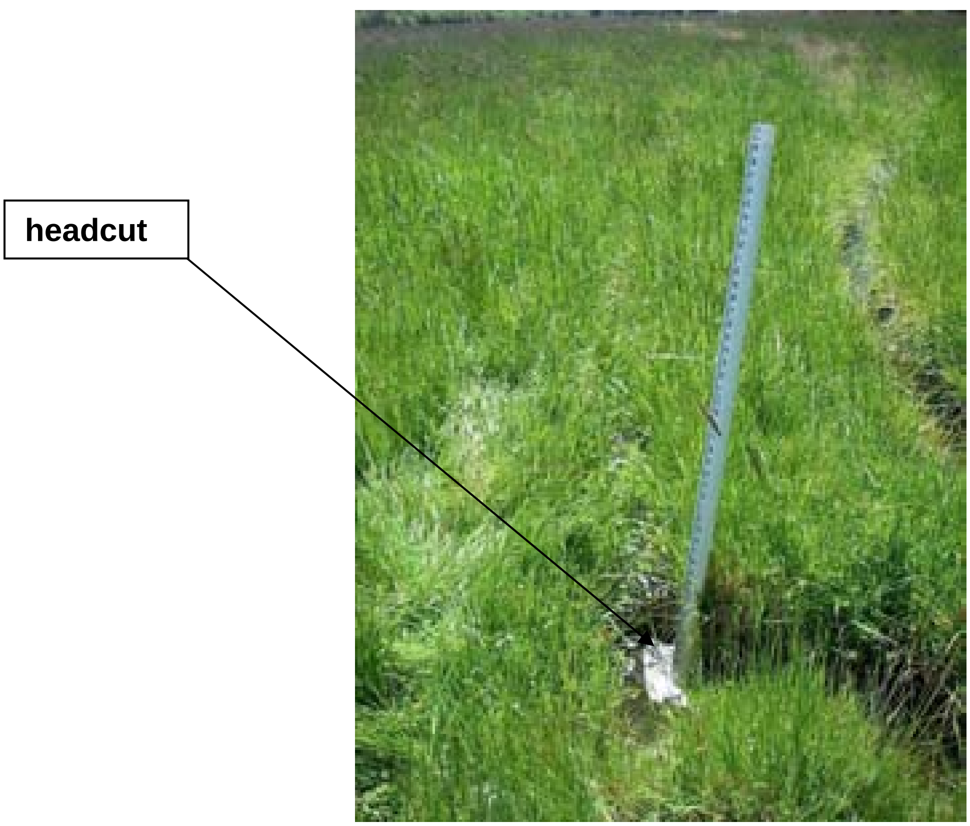
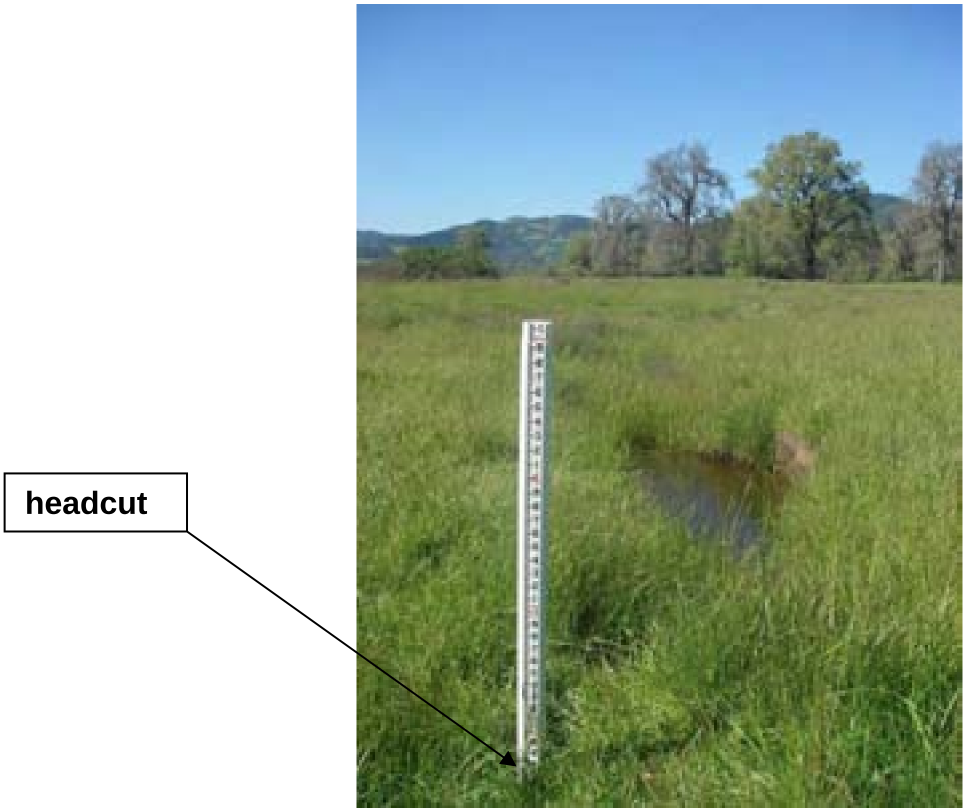




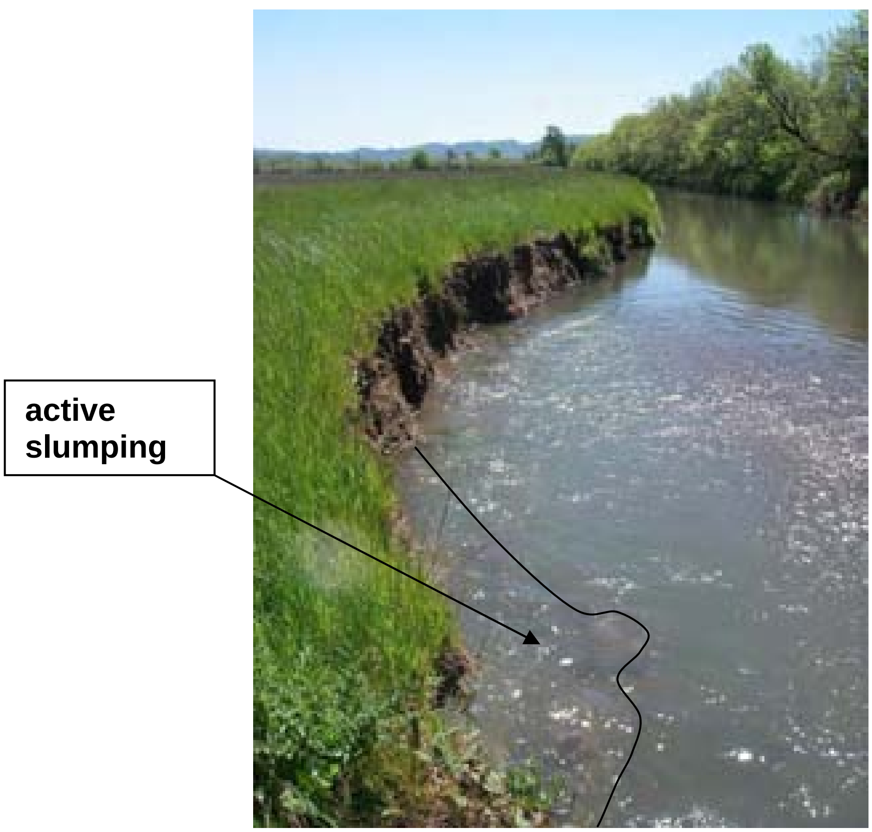
Appendix A-2. Benbow 108-020-06_2

pothole



Appendix A-5. Benbow 108-040-13_3

Appendix A-6. Benbow 108-040-13_4



Appendix A-9. Ford 108-010-06_1

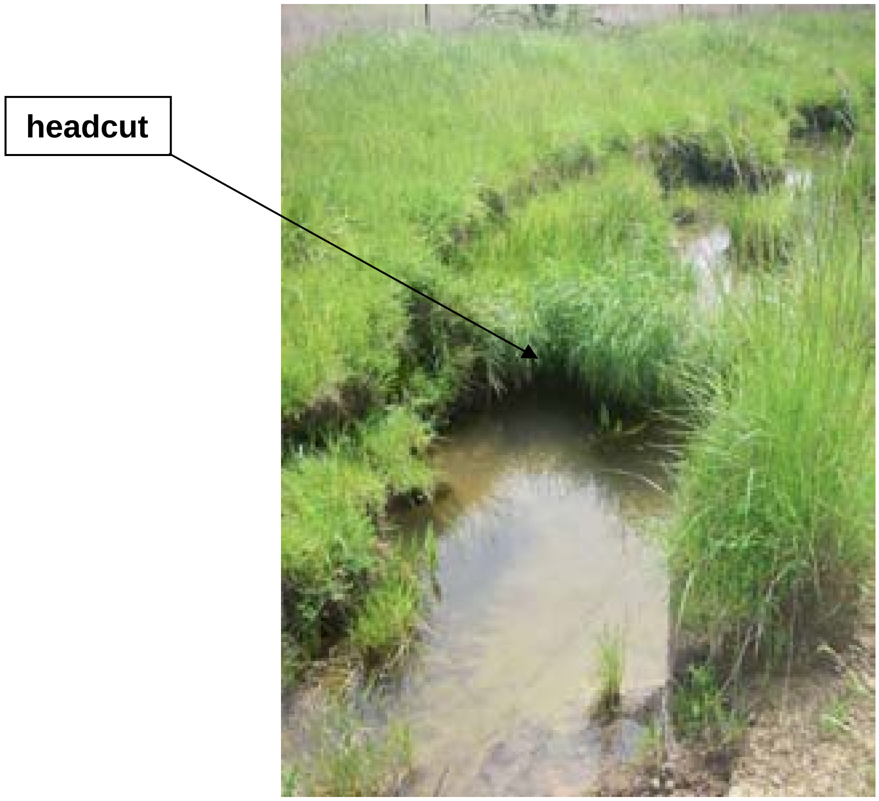
Appendix A-10. Ford 108-010-06_2

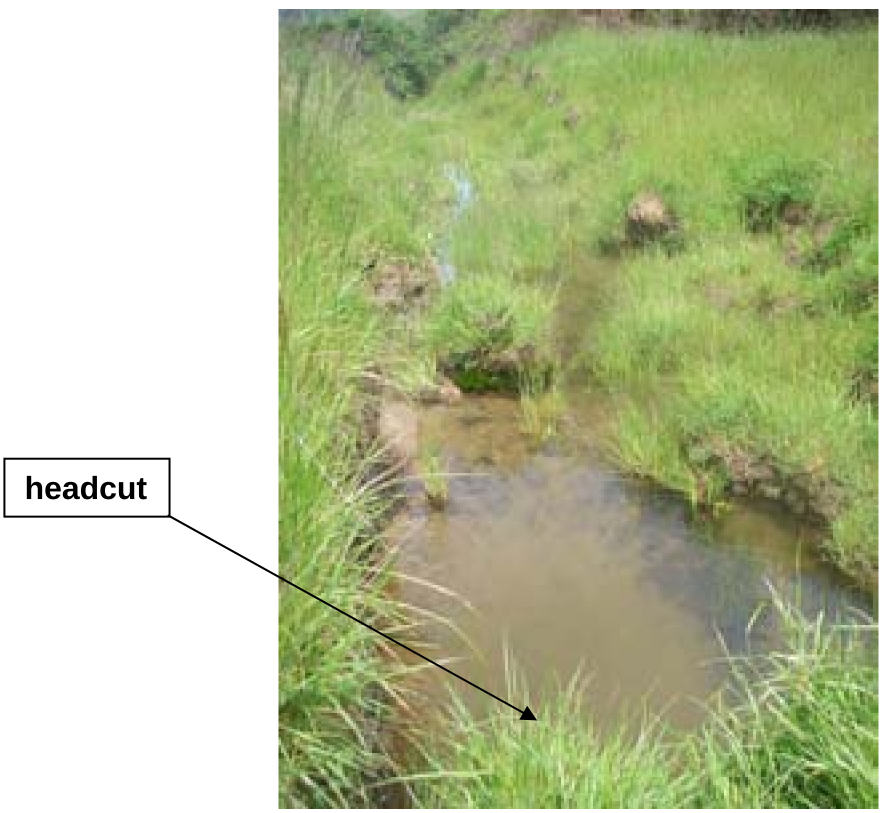
Appendix A-11. Ford 108-010-06_3

Appendix A-13. Ford 108-030-05_1


headcut


headcut





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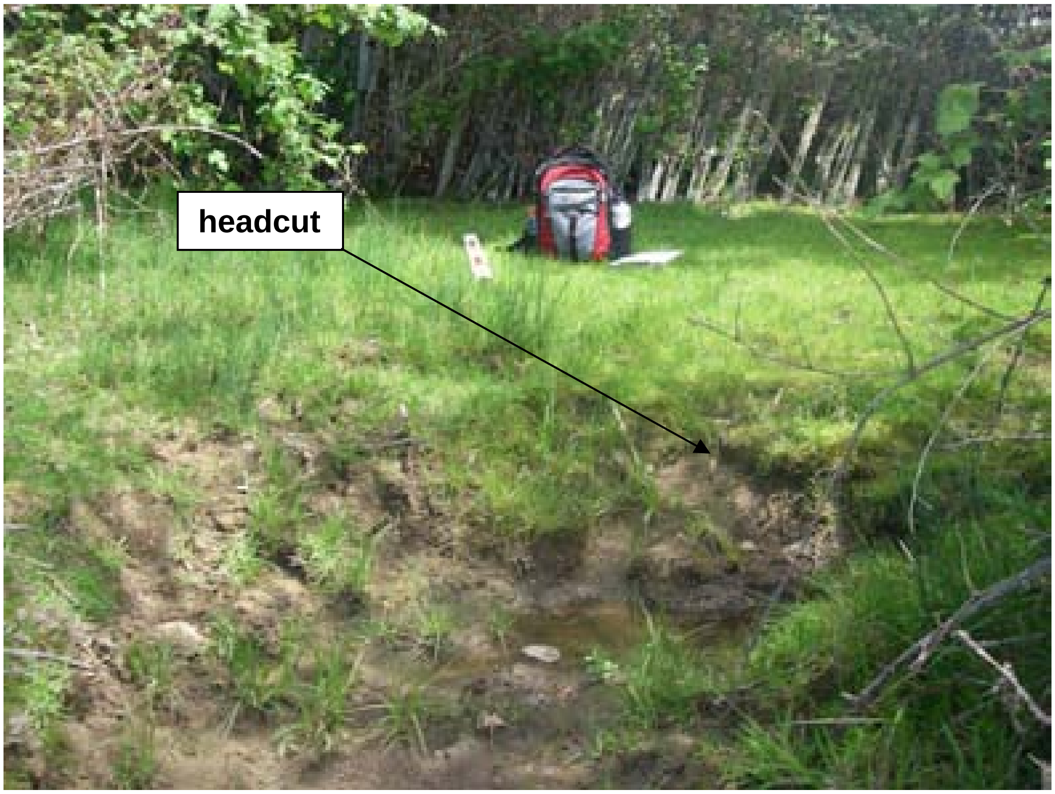
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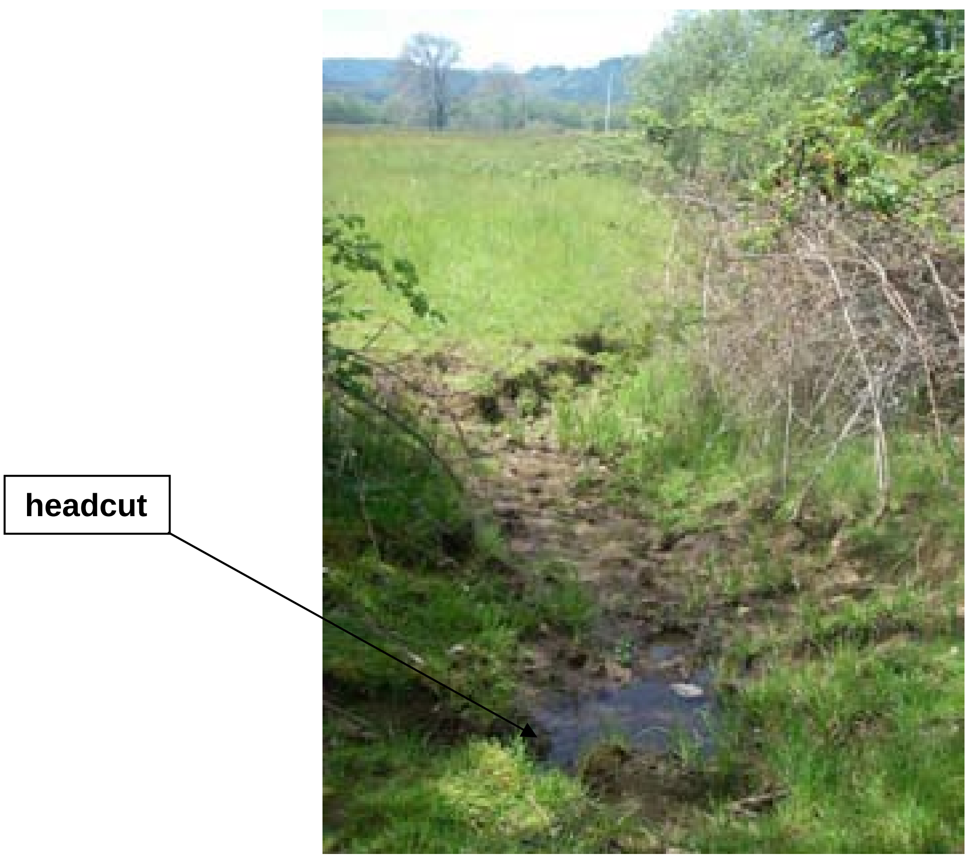
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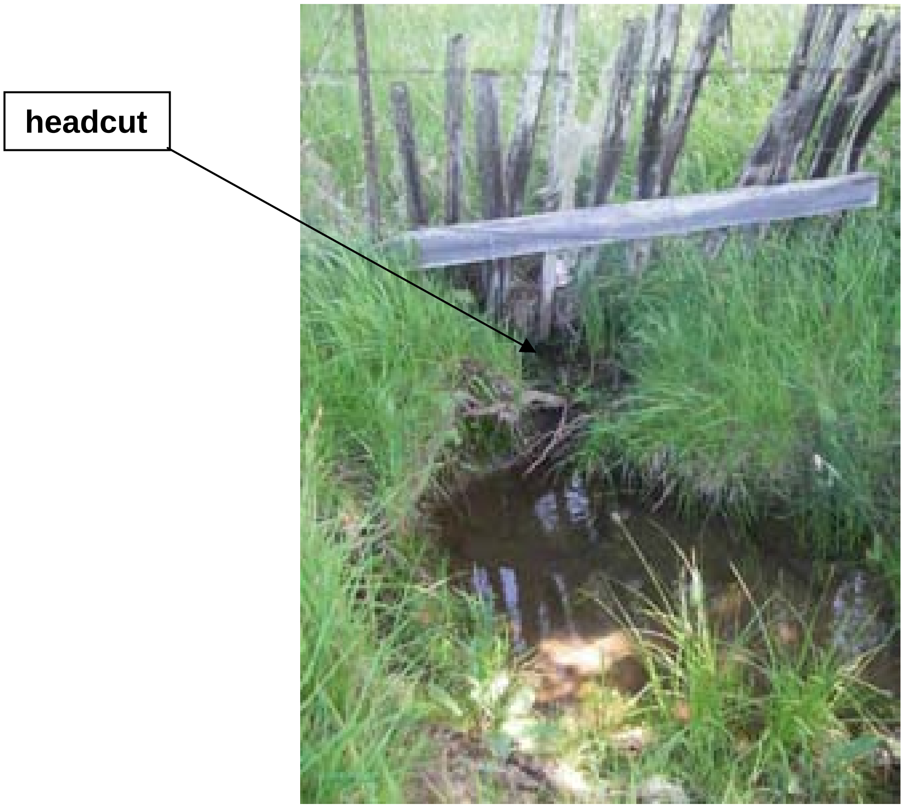

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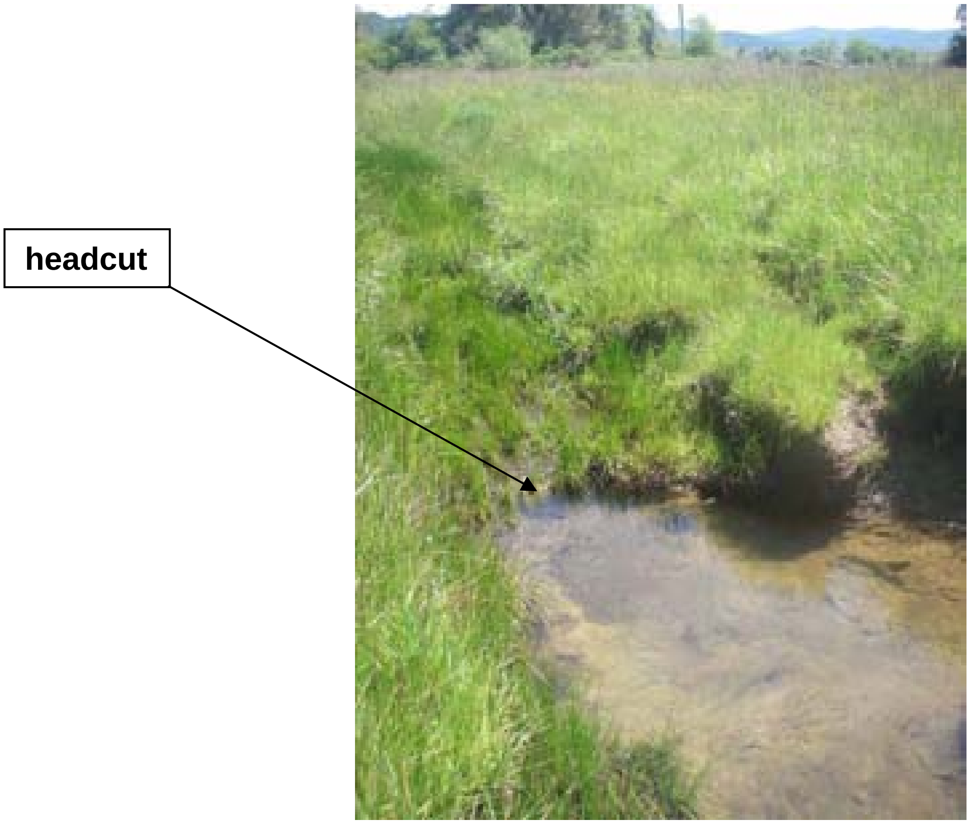

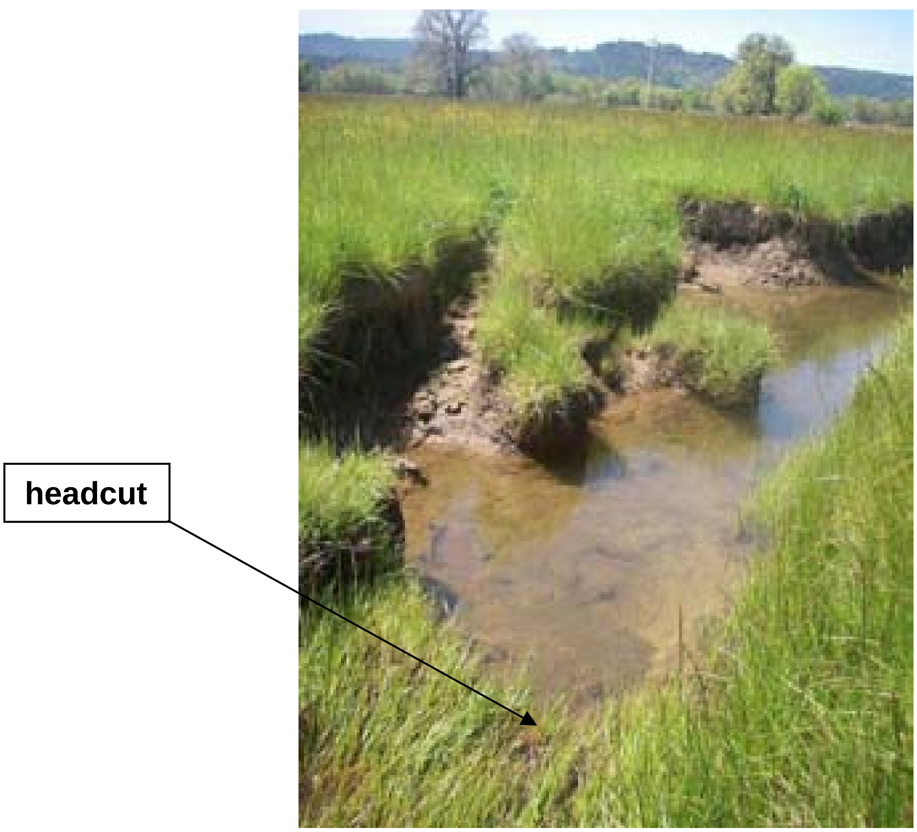

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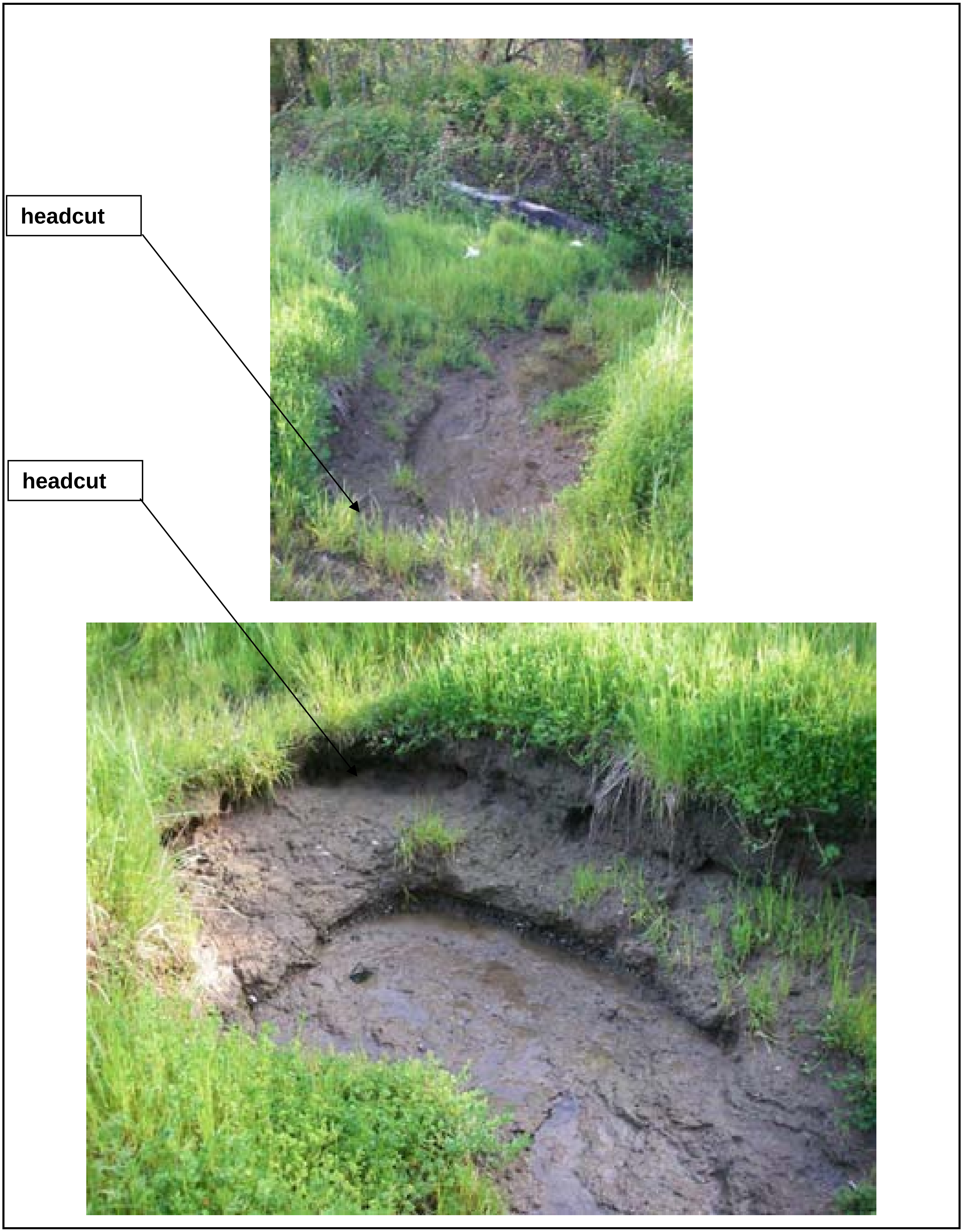
Appendix A-19. Goss 103-230-02_1



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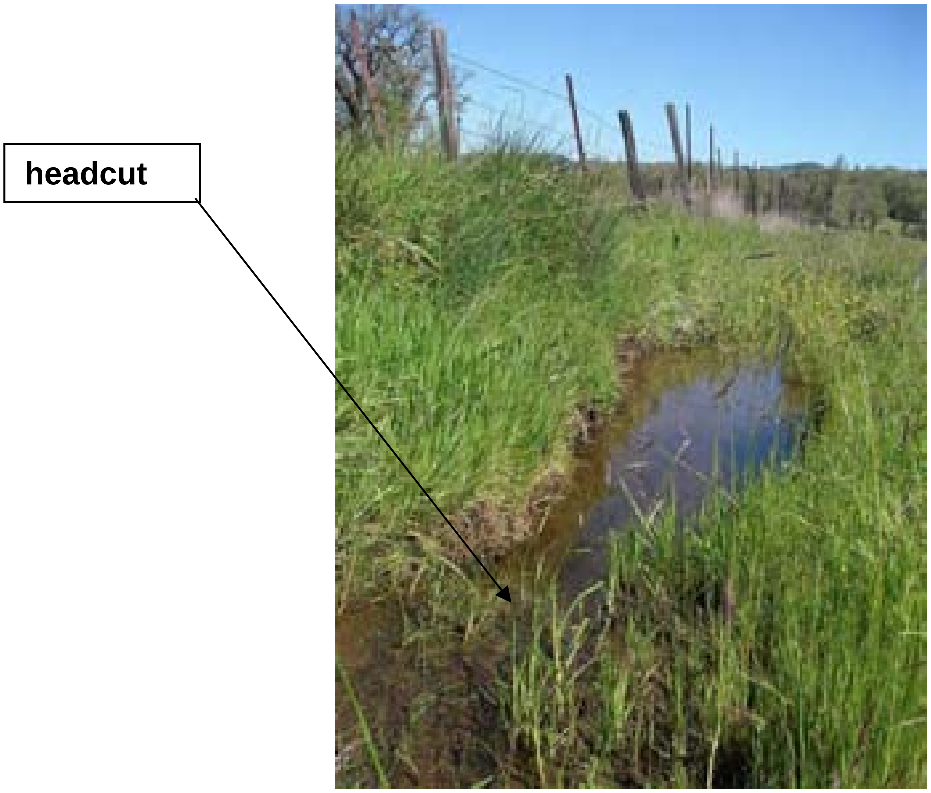
Appendix A-22. Lusher 108-030-04_3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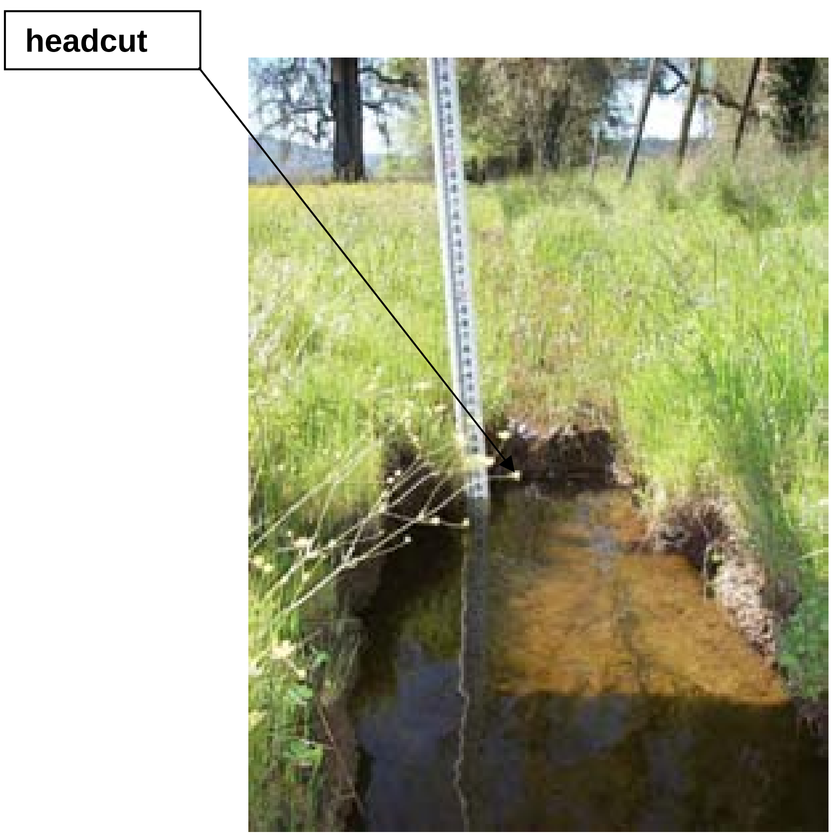
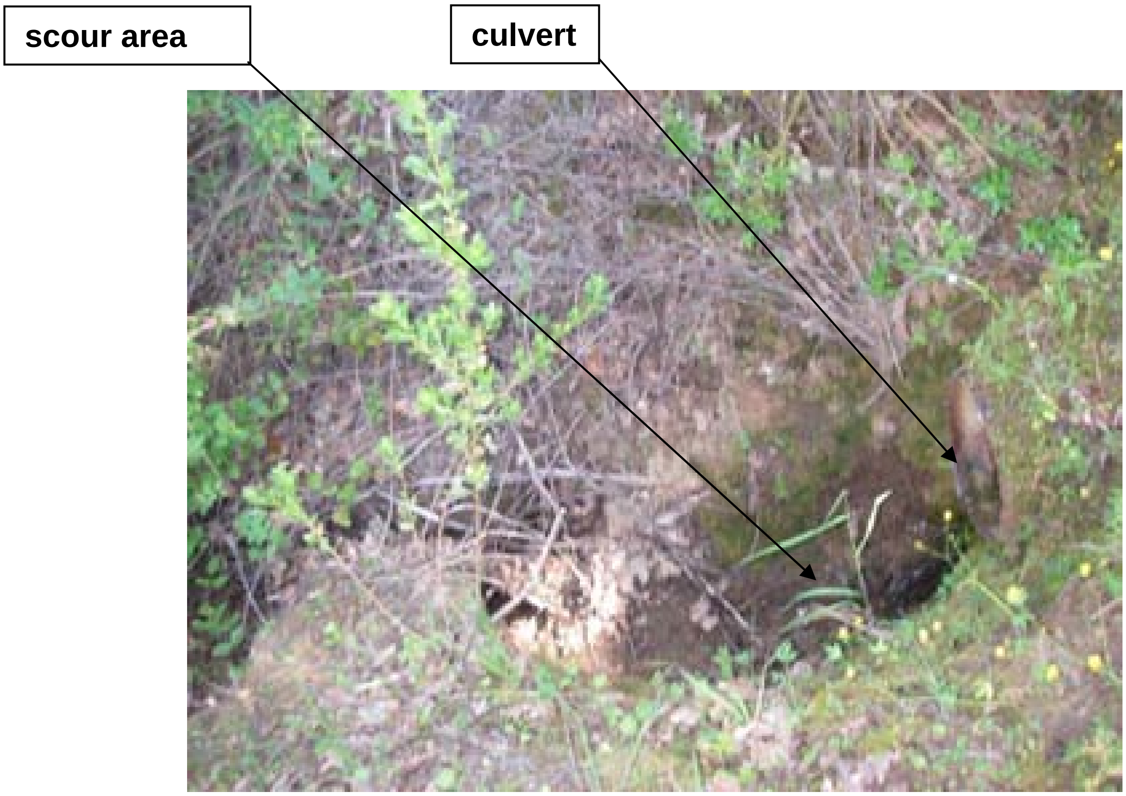
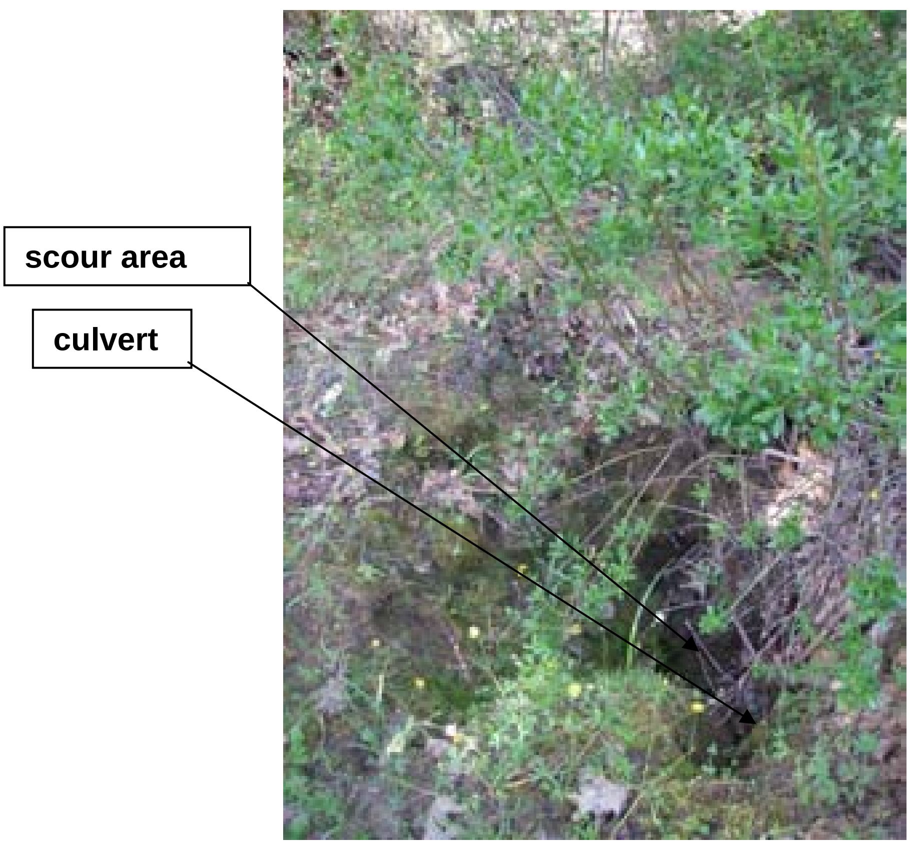

headcut

Appendix A-24. Taylor 037-221-68_1

Appendix A-25. Taylor 037-221-68_2


scour area
culvert


scour area
culvert

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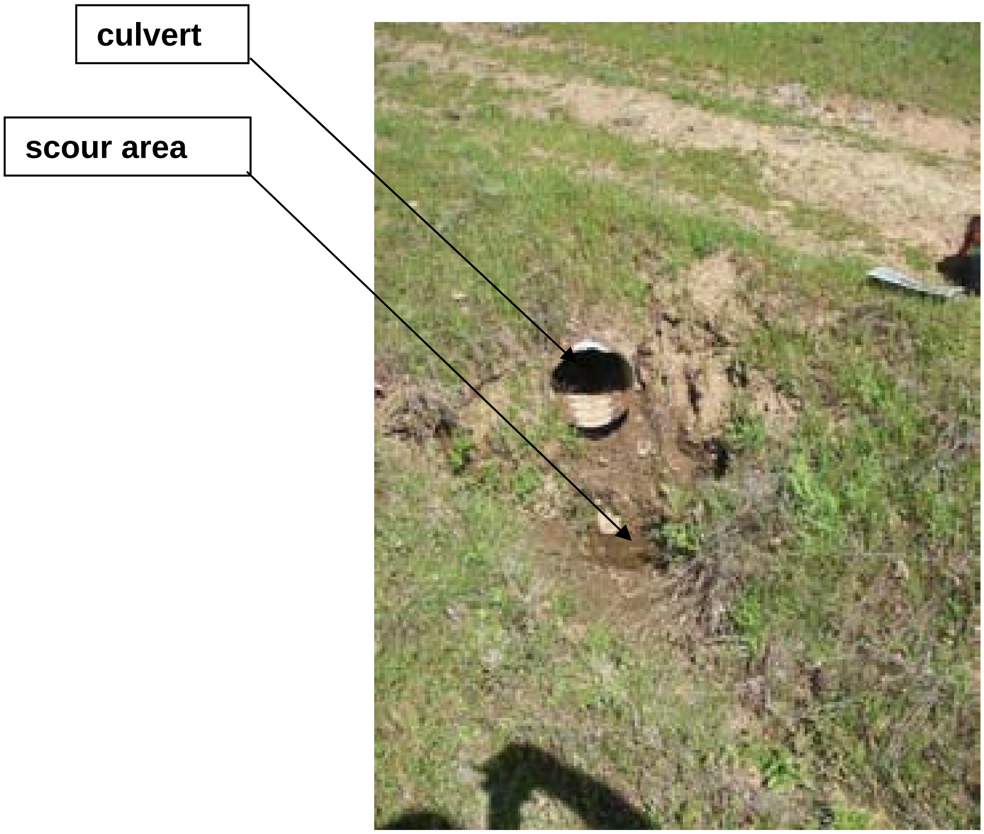

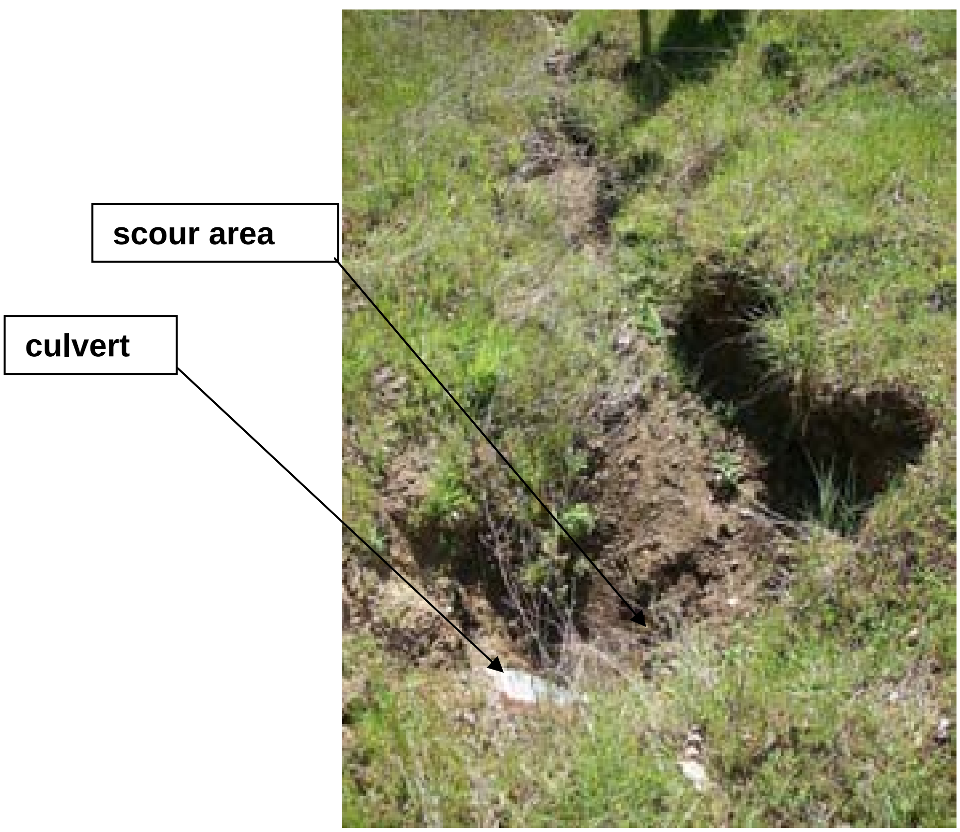

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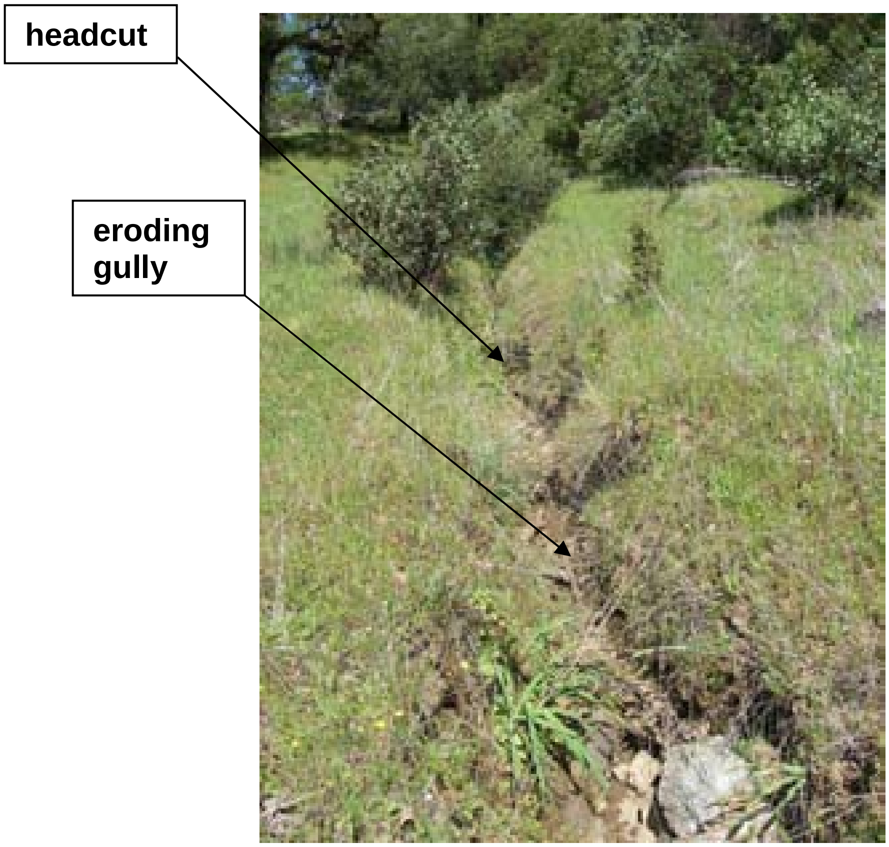

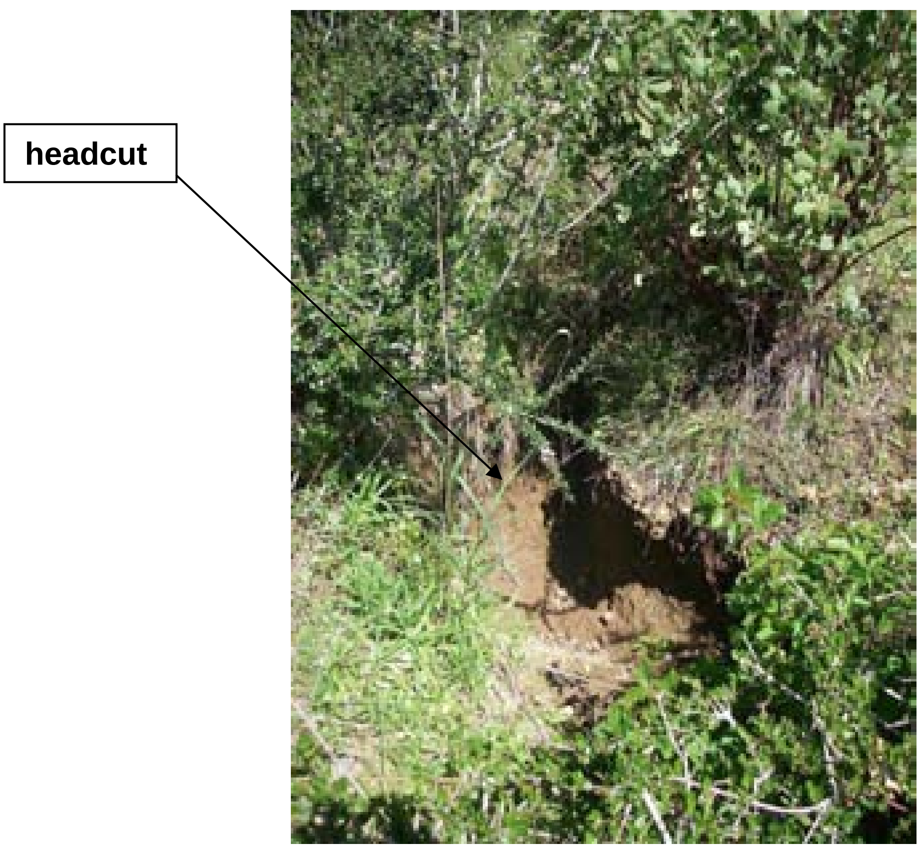

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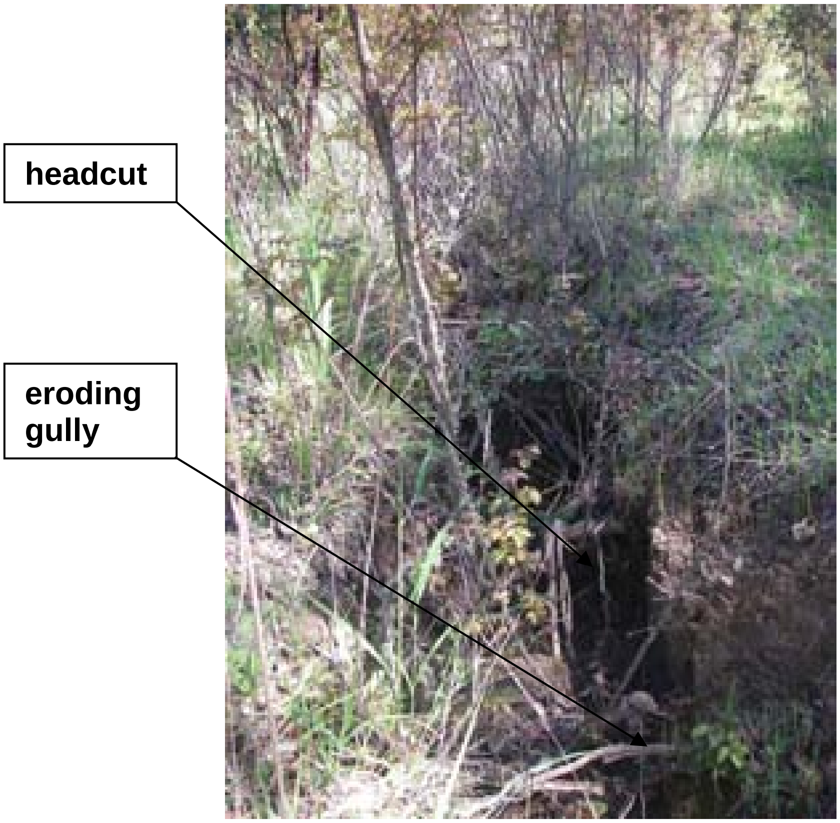
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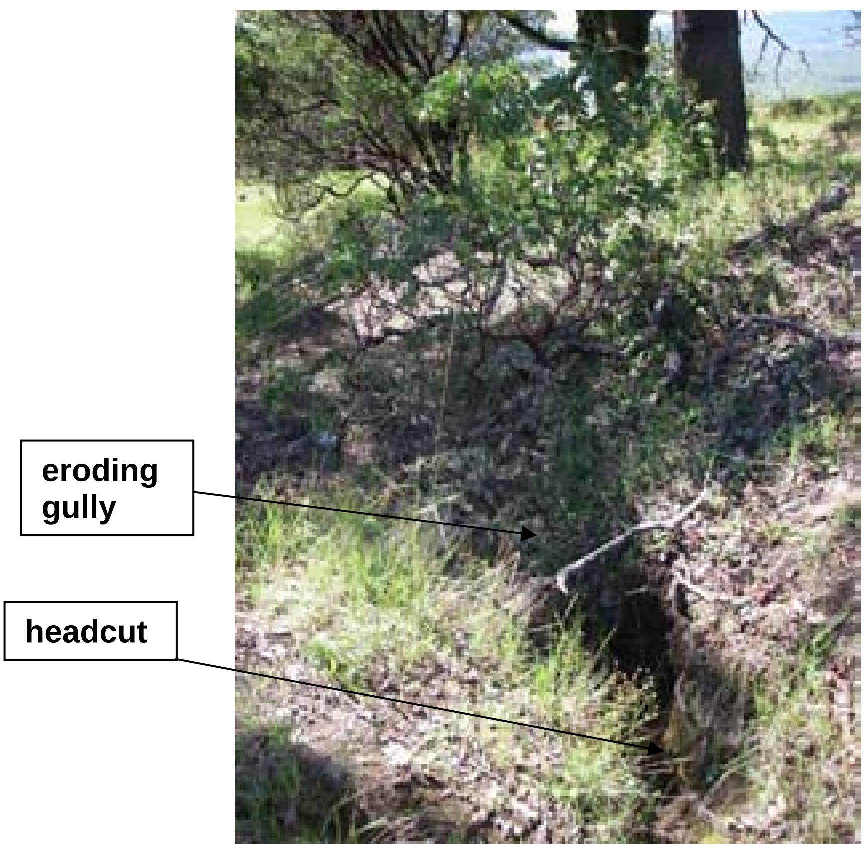
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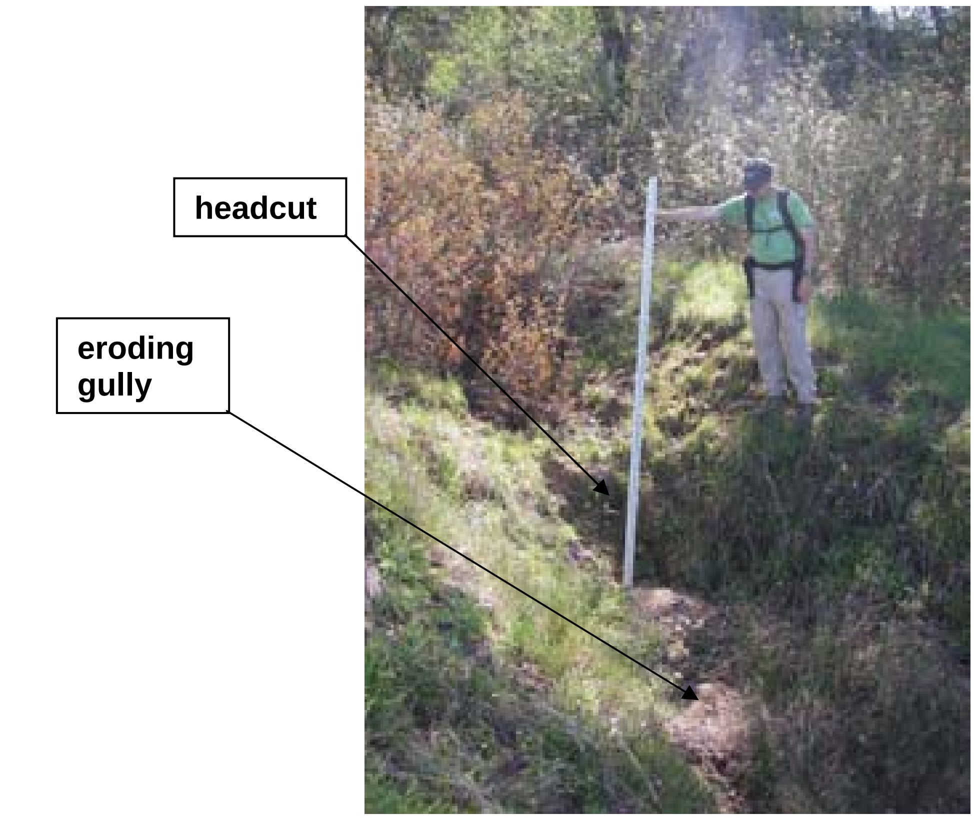

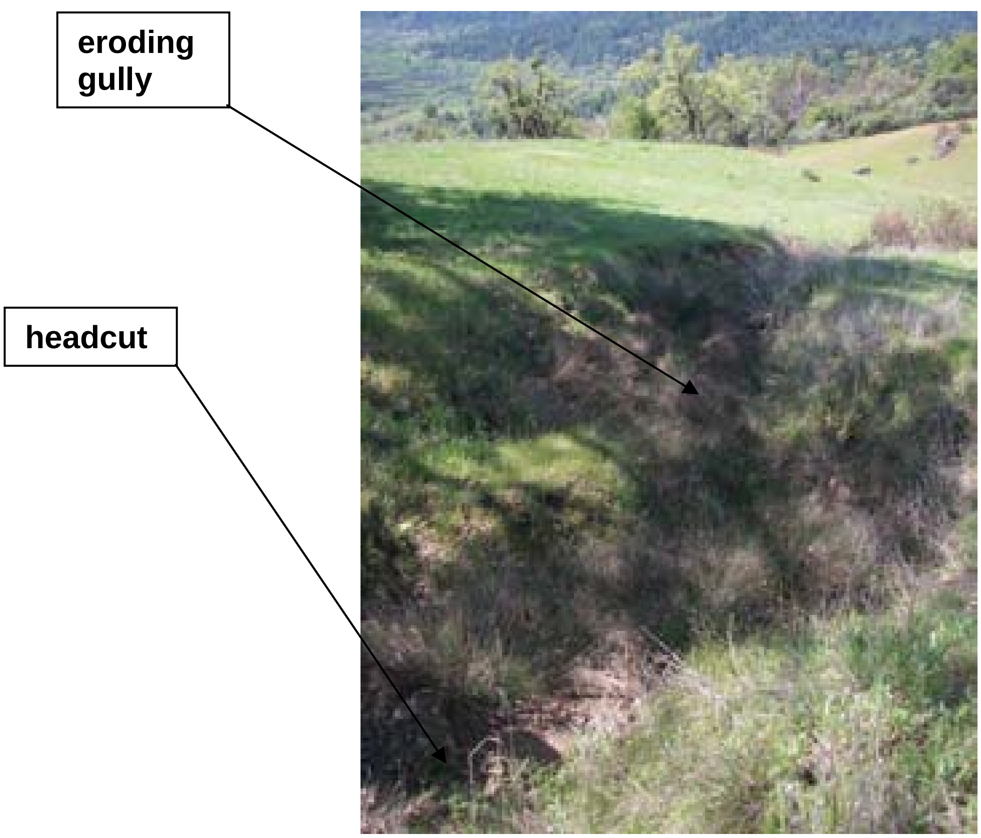

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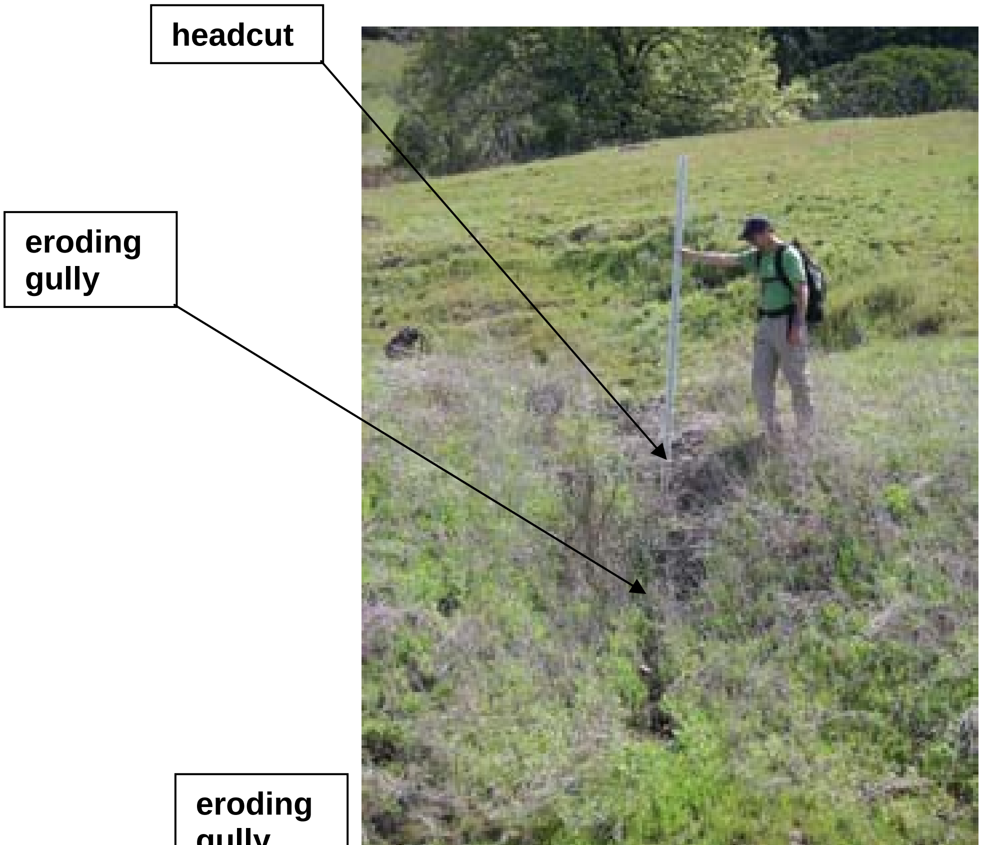
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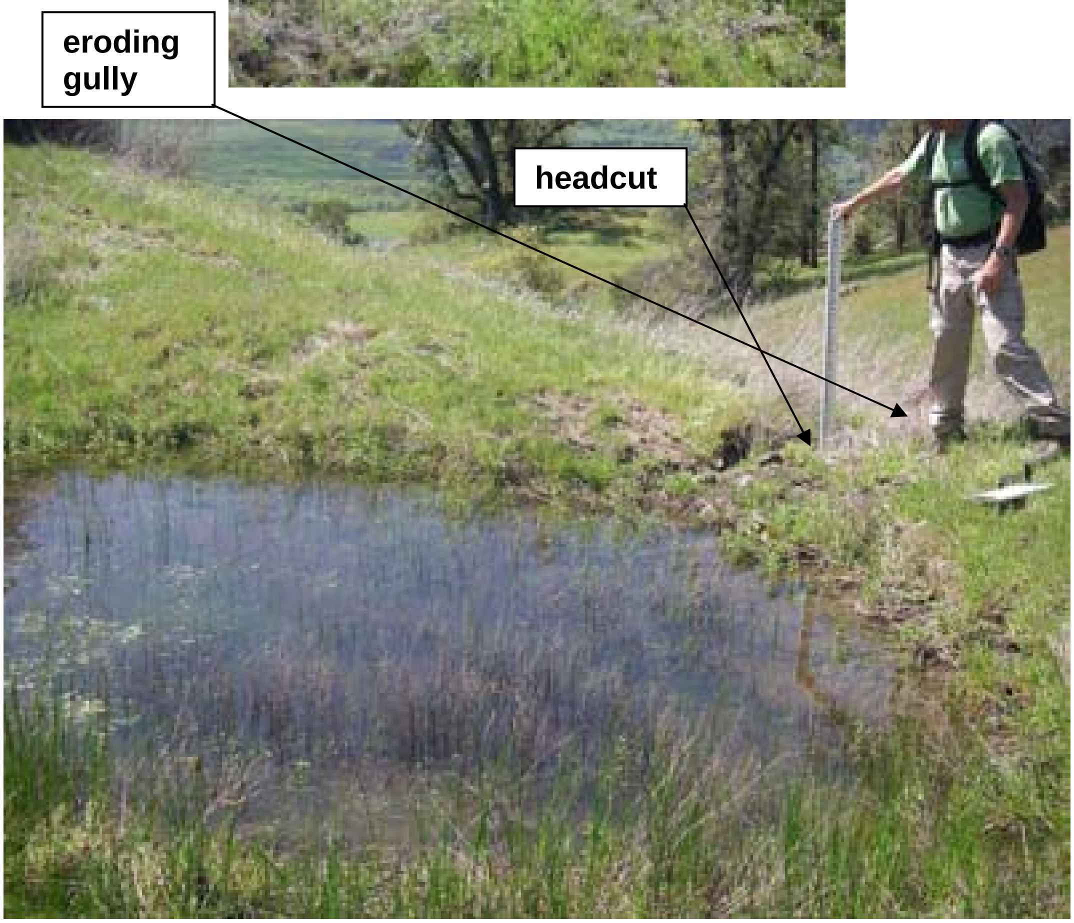
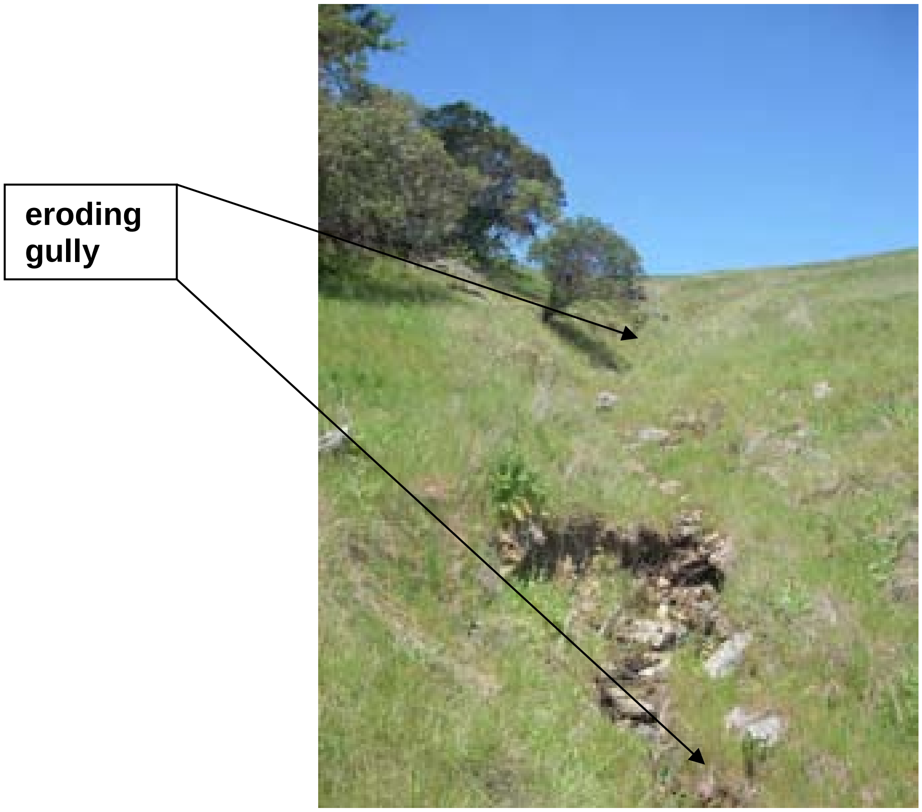
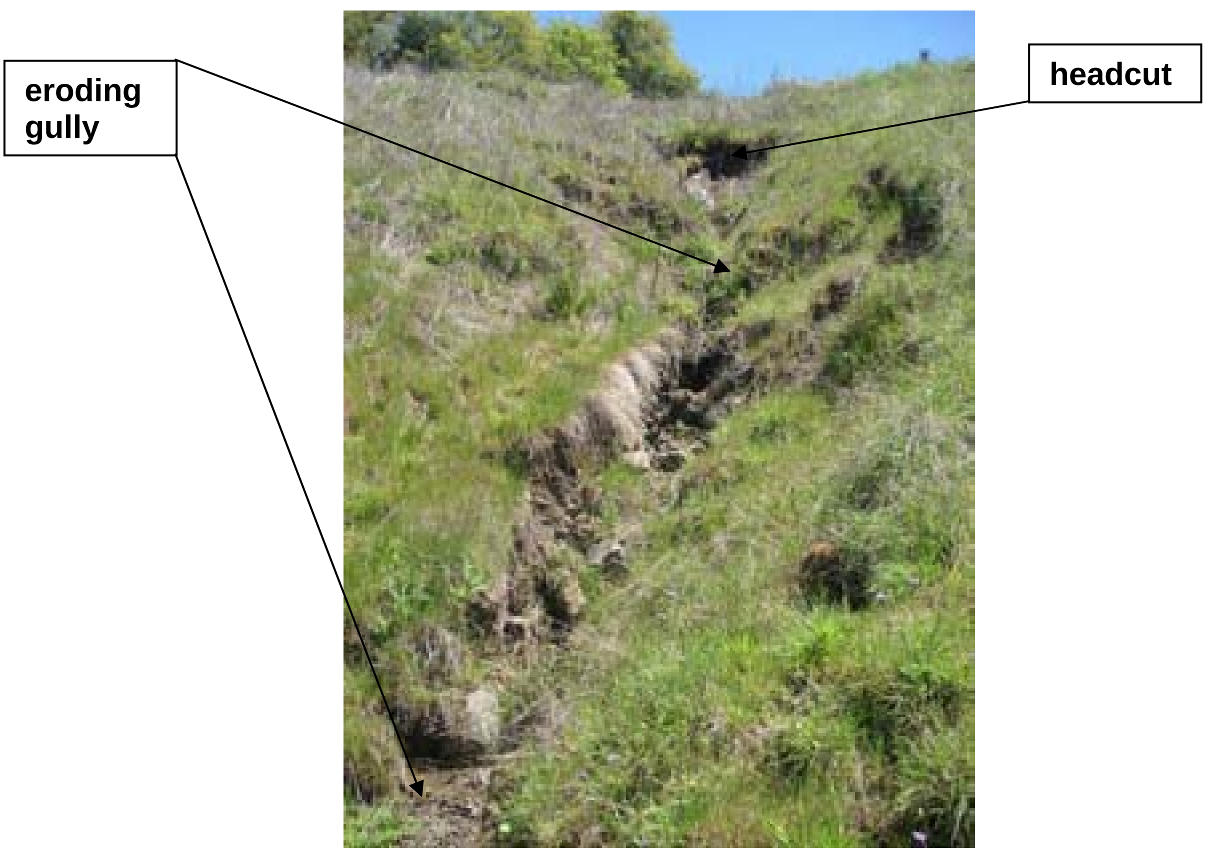
eroding gully

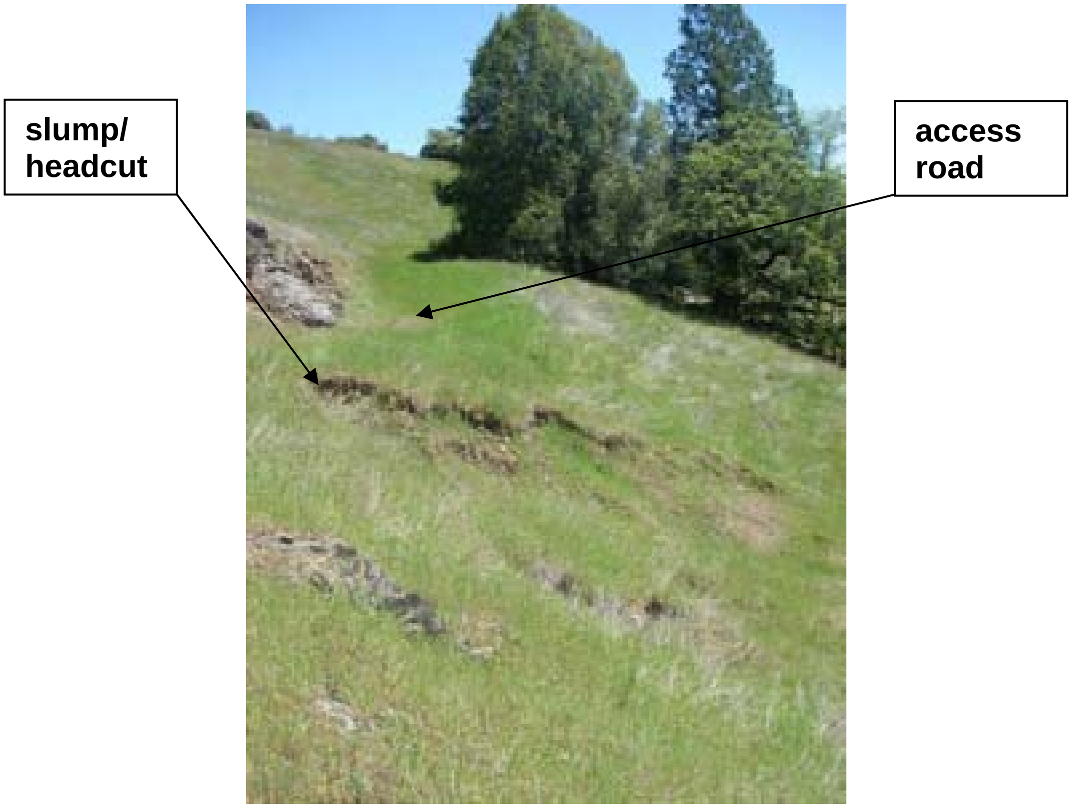

eroding gully
headcut


eroding
gully


eroding
gully



Appendix A-34. Taylor 037-240-41_2



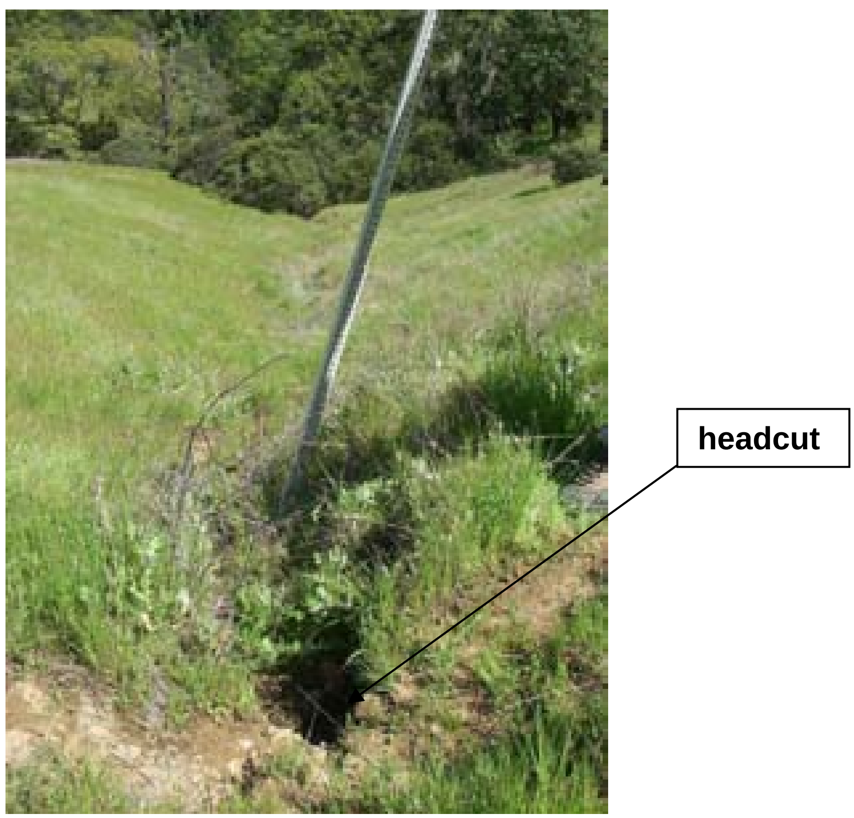
Appendix A-35. Taylor 037-240-41_3

Appendix A-36. Taylor 037-240-41_4


slump/
headcut


slump/
headcut


headcut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