HABITAT RESTORATION COST REFERENCES
FOR SALMON RECOVERY PLANNING

Cynthia J. Thomson
Corinne Pinkerton

NOAA-TM-NMFS-SWFSC-425
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Introduction

The Endangered Species (ESA) requires that recovery plans for listed species include “estimates of the time required and the cost to carry out those measures needed to achieve the plan’s goal and to achieve intermediate steps toward that goal” (ESA Section 4(f)(1)(B)(iii)). The purpose of this report is to facilitate recovery planning for ESA-listed salmonid stocks in California by providing information on costs associated with habitat restoration activities relevant to their recovery.

Data from publicly available sources were used to obtain estimates of restoration cost. Ideally these estimates would be identifiable to a specific restoration activity (e.g., fish screen, culvert replacement), include life cycle project costs (e.g., planning, design, permitting, construction, monitoring, maintenance), and be relatable to the scale, scope and location of the project. However, sources vary in terms of the extent to which they provide such details. Most cost estimates originate from sources generally intended for purposes other than recovery planning (e.g., contract administration). Thus reported costs may be incomplete if, for instance, some aspects of restoration are not covered by the contract or if the work involves a match from another funding source. For projects involving multiple restoration activities, costs are more typically broken down by input (e.g., labor, materials) than by activity. Given the diverse factors that affect restoration costs (see Allen et al. 2004) and the lack of standardization in available project and cost data, a meta-analysis of project costs as they relate to project characteristics was not possible. However, some of the sources do provide insights into factors affecting costs; to the extent that such information is available, it is briefly summarized in the tables below.

Many of the projects discussed in this report were funded by the California Department of Fish and Game (CDFG) as part of the Fisheries Restoration Grants Program and (to a lesser extent) the Klamath River Restoration Grant Program. The report is thus approximately organized according to the restoration categories used by these two programs. Restoration activities covered by this report are as follows:

- Fish ladders (FL)
- Fish passage at stream crossings (FP) - culvert replacement/improvement
- Fish screening of diversions (SC)
- Instream barrier modification (HB) - modification of fish passage barriers in the stream channel and along the streambank (tidegates, sandbars, dams, other non-culvert barriers)
- Instream habitat restoration (HI) - enhancement of stream channel and streambank habitat (instream structures, spawning gravel supplementation, floodplain tributary reconnection, side channel reconnection, wetland/floodplain restoration, levee evaluation/repair/setback)
- Riparian restoration - restoration of area, including fencing, between the fence and middle of stream (e.g., livestock exclusion, revegetation)
• Streambank stabilization (HS) - stabilization of eroding, collapsing of otherwise destabilized banks
• Upland watershed restoration (HU) - largely pertains to upslope erosion control (e.g., road decommissioning/upgrade, landslide/gully stabilization, upslope planting)
• Tailwater management (TM)
• Water conservation (WC) - e.g., ditch lining, piping
• Water purchase/lease (WP)
• Habitat acquisition and conservation easement (HA)
• Monitoring status and trends (MD) - monitoring of baseline conditions and status/trends in habitat, watershed processes and/or populations.
• Monitoring watershed restoration (MO) - monitoring to determine if project treatments were constructed correctly and as planned, effectiveness monitoring to determine if restoration has produced desired habitat conditions and/or watershed processes, and validation monitoring to determine if hypothesized responses of habitat, watershed processes and/or populations to restoration were correct
• Watershed evaluation, assessment and planning (PL) - developing watershed plans with site-specific, prioritized recommendations for restoration of salmon/steelhead habitat. Includes partial assessments (e.g., road erosion surveys, stream surveys).
• Watershed organizational support and assistance (OR) - organizational support to local watershed groups and development/maintenance of databases that facilitate organizational aspects of restoration
• Cooperative fish rearing (RE)
• Water measuring devices (WD) - e.g., head gate
• Wildlife management (WM) - e.g., control of exotic species such as pike minnow
• Research (RES) - general research on productivity (e.g., life cycle monitoring/analysis), spatial structure (fish distribution surveys), genetic diversity (laboratory analysis of tissue samples), and estimation of abundance.

Restoration cost estimates were obtained by searching the published and gray literature, including the following:

• reports that provide actual or estimated costs associated with specific projects (e.g., grant proposals, contract reports),
• reports that provide average costs for multiple projects involving the same restoration activity,
• reports that describe “typical” costs associated with a particular restoration activity,
• cost guidelines associated with environmental improvement programs sponsored by entities such as the Natural Resources Conservation Service (NRCS),
• reports that use regression and other methods to relate project costs to selected project characteristics, and
• environmental impact statements that provide cost estimates for each of the restoration alternatives considered.
Only restoration cost estimates that met at least one of the following criteria are included in this report:

- Top priority for inclusion are cost estimates pertaining to restoration activities in California. However, examples from other states are also included (as available) for those activities where California examples are limited. A notable exception: Cost estimates developed by Evergreen Funding Consultants for restoration in Puget Sound (Evergreen 2003) are particularly instructive, as they cover a wide range of restoration activities, provide life cycle estimates of project costs, and demonstrate how costs vary with project characteristics. Thus all of Evergreen’s cost estimates are included in this report - even when they pertain to activities where a fairly large number of California examples are also available.

- Cost estimates are generally more useful for recovery planning when related to the scale of restoration. Thus only cost estimates that are accompanied by a relevant measure of project scale (e.g., stream miles, acres of land) are included in this report.

- For most projects involving multiple types of restoration activities, data sources typically do not provide a cost breakdown by activity. Given the focus of this report on activity-specific costs, most of the cost estimates were by necessity obtained from single-activity projects. However, to ensure some representation of multi-activity projects, some projects involving several closely related activities (e.g., fencing + stockwater system, fish ladder + screen) conducted at the same site are included in this report. Also, cost summaries provided by the Pacific States Marine Fisheries Commission for projects sponsored by CalFED’s Ecosystem Restoration Program (Holycross et al. 2007) include some estimates of cost per activity for multi-activity projects.

- To help ensure that cost estimates reflect fairly recent restoration technology, the report focuses largely on projects that have occurred since 1998. However, in cases where project data for a particular restoration activity are sparse, pre-1998 project data are also provided, as available.

All costs described in this report pertain to direct expenditures on restoration and do not include economic opportunity costs (e.g., foregone profits associated with restrictions on livestock grazing, timber harvest and other activities). It is important to note the following:

- Even the direct costs described in this report are not necessarily comparable across projects, as some cost estimates are more inclusive than others. Some data sources - e.g., Evergreen Funding Consultants (2003), Neal (2004), Steere (2004) - provide cost estimates that include pre- and post-construction requirements as well as construction itself. In other cases, cost estimates are largely limited to engineering and/or implementation aspects of the project (e.g., CDFG’s Fisheries Restoration Grants
The recovery domains include: Southern Oregon/Northern California Coast (SONC), North/Central California Coast (NOCECA), Central Valley, and South Central California Coast (SCACO). There is an area of geographic overlap between the SONC and NOCECA, which is referenced in this report as NOCECA-SONC.

Program, NRCS Environmental Quality Improvement Program) and do not include agency involvement in planning, design, management, maintenance and monitoring. In still other cases, documentation is not adequate to determine exactly what is included and excluded from the cost estimates.

- For most projects involving capital construction (e.g., bridges, fish screens), costs are not amortized but rather provided as a lump sum. One notable exception is the Independent Economic Analysis Board’s (2002) estimates of amortized capital construction costs for Columbia River hatcheries.

For each restoration activity, one or more tables are provided that include cost estimates for that activity - by location, year, project scale, cost per scale unit, and data source.

- Depending on available information, each project example is variously identified by stream/creek/river, watershed, county, recovery domain,1 or state.

- Depending on the source of a cost estimate, year may pertain to the year of a funding proposal or contract. In cases where a document includes cost estimates for projects conducted in years prior to publication of the document, the project year is used when available; otherwise the publication year is used.

- The metric used for project scale varies, depending on the nature of the restoration activity. Thus for instance, design approach velocity (cubic feet per second, cfs) is used for fish screens; linear feet for levee work, fencing, bank stabilization; acres for revegetation, wetland restoration, land purchase/easement; and miles for road decommissioning/upgrade.

- As indicated above, this report focuses largely on 1998-2006 projects. Cost estimates for these projects are provided in current dollars (uncorrected for inflation). In situations where paucity of 1998-2006 data warranted inclusion of pre-1998 projects, costs of pre-1998 projects were corrected to 2006 dollars. In some cases, the data sources themselves provide inflation-corrected cost estimates. The base year for these estimates is documented in this report, along with the year(s) when the restoration actually occurred (e.g., Hildner/Thomson’s (2007a) results are denoted “98-05” and “2003$” to reflect the fact that their cost estimates are based on 1998-2005 project data and have been corrected to 2003 dollars).

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1 The recovery domains include: Southern Oregon/Northern California Coast (SONC), North/Central California Coast (NOCECA), Central Valley, and South Central California Coast (SCACO). There is an area of geographic overlap between the SONC and NOCECA, which is referenced in this report as NOCECA-SONC.
• The nature of the cost estimates vary somewhat, depending on the data source: (i) In cases where cost is reported for a specific project, total project cost, project scale, and average cost per scale unit are provided, as available. (ii) In cases where cost is reported as an average value across multiple projects, the sample size and range of project costs (as available) are reported along with average cost. (iii) In cases where a “typical” cost is reported, the “typical” cost and the range of “typical” costs (as available) are provided. (iv) In cases where cost is estimated from a regression equation, the equation itself is provided as well as a range of fitted values associated with the regression parameters.

• In cases where management/administrative costs are reported for a multi-activity project and the cost estimate in the table pertains to one activity, management/administrative costs (which are not solely attributable to that one activity) are provided separately and not included in the calculation of cost per scale unit.

• Data sources are identified in the tables by last name or initials of author(s) and table and/or page numbers as appropriate. In cases where the data sources were grant proposals submitted to CDFG’s Fisheries Restoration Grants Program (FRGP) or Klamath River Restoration Grant Program (KRRGP), those sources are identified in the tables by the fiscal year in which the proposal was submitted (01-02 through 06-07) and the project ID number (CDFG-xxx for the FRGP, Kxxx for the KRRGP). In cases where the data sources are projects sponsored by CALFED’s Ecosystem Restoration Program (ERP), the projects are identified by the year of the proposal and the project ID (ERP-xx-xxx). If costs associated with an ERP project could be broken down by activity, that project ID appears multiple times in the tables. All data sources are fully documented in the “References” section at the end of this report.
FL - FISH LADDER.

Table FL-1 provides estimates of fish ladder costs. CDFG’s Coho Recovery Strategy (CDFG’04, p1.14) assumed $500K/ladder on tributaries and $900K/ladder on streams. This cost range pertains to central/northern CA coastal streams and is not necessarily applicable to projects outside that geographic range. However, most of the projects in Table FL-1 do fall within that range. Notable exceptions (exceeding $2M/ladder) include a project in the South Central California Coast (SCACO) recovery domain (HT07a-T61, p121) and several Central Valley projects (HT07a-T61, p121, ERP-99-B03). Note: Some of the projects pertain to ladders only, others to ladder/screen combinations.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2004</td>
<td>typical</td>
<td>Small waterway (tributary): $500K/ladder Large waterway (stream): $900K/ladder</td>
<td>CDFG’04, p1.14</td>
</tr>
<tr>
<td>Young’s Dam</td>
<td>03-04</td>
<td>1ladder</td>
<td>$494K - sloping plate, selfclean, excluding design</td>
<td>CDFG-057</td>
</tr>
<tr>
<td>SONC CentralVly</td>
<td>98-05</td>
<td>1site</td>
<td>$530.1K</td>
<td>HT07a-T61, p121</td>
</tr>
<tr>
<td>SCACO</td>
<td>2003$</td>
<td>1site</td>
<td>$2.1M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1site</td>
<td>$2.1M</td>
<td></td>
</tr>
<tr>
<td>Gorrill Dam/Butte Creek</td>
<td>1997</td>
<td>2ladder</td>
<td>$660K ($330/ladder) +$12.8K project mgmt + $58.8K construction mgmt - construct ladder and screen</td>
<td>ERP-97-M03</td>
</tr>
<tr>
<td>Adams Dam/Butte Creek</td>
<td>1997</td>
<td>1ladder</td>
<td>$298.7K (+$6.3K project mgmt + $3K project coordination) - construct ladder and screen</td>
<td>ERP-97-M04</td>
</tr>
<tr>
<td>Battle/Soap/Ripley Creeks</td>
<td>1999</td>
<td>3projs</td>
<td>$2.7M ($902.7K/project) - decommission several PG&amp;E dams, provide ladders/screens for remaining dams</td>
<td>ERP-99-B01</td>
</tr>
<tr>
<td>Sacramento River</td>
<td>1999</td>
<td>2projs</td>
<td>$4.56M ($2.28M/project) + $130K project mgmt - Anderson-Cottonwood Irrig Dist</td>
<td>ERP-99-B03</td>
</tr>
<tr>
<td>Battle Creek</td>
<td>1999</td>
<td>1proj</td>
<td>$731K +$105.3K project mgmt - improve CNFH fish ladder &amp; barrier weir</td>
<td>ERP-99-B08</td>
</tr>
</tbody>
</table>
FP - FISH PASSAGE AT STREAM CROSSINGS.

Tables FP-1 and FP-2 pertain to culvert replacement, Table FP-3 to culvert replacement with a bridge, and Table FP-4 to culvert improvement.

Table FP-1 describes Evergreen’s estimates of culvert replacement costs, while Table FP-2 provides similar estimates from other data sources. Evergreen’s estimates include not only construction but also design, permitting, monitoring, maintenance and management, and are much more inclusive than the estimates in Table FP-2. Most of the latter examples are derived from grant proposals submitted to CDFG’s Fisheries Restoration Grants Program - with costs largely limited to engineering/construction aspects of the project. The Table FP-2 estimates generally fall within the range of $100K-$400K/culvert, although there are some projects that cost in the $10,000s (e.g., Dupont-T10, p66; HT07a-T60, p118; HT07a-T61, p121) and one very costly project ($4.1M, CntySBPublicWrks) in Santa Barbara. Culvert type is reported here when available from the data source.

Evergreen’s estimates show typical culvert replacement costs for Puget Sound by road type and size of waterway. Like Evergreen, Hildner/Thomson show cost per culvert being lower for rural roads than major highways (HT07b-T42, p61) and increasing with stream order (HT07b-T44, p62). Excluding 4+ lane highways (which are not covered by Hildner/Thomson), the estimates obtained by HT from restoration contractors fall within Evergreen’s cost ranges. E.g., forest roads - Evergreen: $15K-$150K, HT: $23.4K; minor 2 lane road - Evergreen: $50K-$280K, HT: $227K; major 2 lane road - Evergreen: $100K-$450K, HT: $420K. Small waterway - Evergreen: $15K-$200K, HT: $70K; medium waterway - Evergreen: $50K-$350K, HT: $175K; large waterway - Evergreen: $80K-$450K, HT: $286K.

<table>
<thead>
<tr>
<th>Size of Waterway</th>
<th>Road Type</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Forest Road</td>
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<tr>
<td>Small 0-10'</td>
<td>$15K-$40K</td>
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<tr>
<td>Med 10-20'</td>
<td>$50K-$100K</td>
</tr>
<tr>
<td>Large 20-30'</td>
<td>$80K-$150K</td>
</tr>
<tr>
<td>Location</td>
<td>Year</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>AlbionR/Marsh Crk-MendenoCnty</td>
<td>01-02</td>
</tr>
<tr>
<td>PeacockCrk-DelNorteCnty</td>
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</tr>
<tr>
<td>JohnsonCrk-MendenoCnty</td>
<td></td>
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<tr>
<td>DeerCrk-MendenoCnty</td>
<td></td>
</tr>
<tr>
<td>JordanCrk-DelNorteCnty</td>
<td></td>
</tr>
<tr>
<td>RyanCrk-MendenoCnty</td>
<td></td>
</tr>
<tr>
<td>PorterCrk-RussianR</td>
<td>02-03</td>
</tr>
<tr>
<td>StansberryCrk-MattoleR</td>
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</tr>
<tr>
<td>GibsonCrk-MattoleR</td>
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<tr>
<td>StanleyCrk-MattoleR</td>
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<tr>
<td>SaundersCrk-MattoleR</td>
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</tr>
<tr>
<td>IndianCrk-MattoleR</td>
<td></td>
</tr>
<tr>
<td>DarkGulch-MendocenoCnty</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Date</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>AlbionR/Marsh Crk-MendocnoCnty</td>
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<tr>
<td>RyanCrk-MendocnoCnty</td>
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<tr>
<td>JohnsonCrk-BigR-MendocnoCnty</td>
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<tr>
<td>YonkersCrk-DelNorteCnty</td>
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<tr>
<td>GrahamGulch-HumboldtCnty</td>
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<tr>
<td>PainterCrk-MattoleR-HumboldtCnty</td>
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<td>SoldierCrk-TrinityR-TrinityCnty</td>
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<tr>
<td>BatesCanyonCrk-MarinCnty</td>
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<td>WarrenCrk-MadR-HumboldtCnty</td>
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<td>WardenCrk-EelR-HumboldtCnty</td>
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<tr>
<td>RockyGulch-HumboldtCnty</td>
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<tr>
<td>CA</td>
<td>98-05</td>
</tr>
<tr>
<td>2003</td>
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<td>SONC-NOCECA SCACO</td>
<td>2003</td>
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</tbody>
</table>
Costs of culvert replacement with bridge described in Table FP-3 generally range from $100K to $500K/bridge. A few projects cost <$50K (e.g., 02-03 CDFG-065; 03-04 CDFG-201 & CDFG-311; 05-06 CDFG-077; Dupont-T9, p65). Projects that cost >$650K all occurred in southern or south-central California (04-05 CDFG-031 & CDFG-241; 06-07 CDFG-090). Information on bridge type - which is reported here when available from the data source - suggests that prefabricated bridges fall toward the lower end of the cost spectrum. Dupont provides information on expected lifetime of various types of bridges, although his information pertains to Idaho rather than California.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>JohnSmithCrk-MendenoCnty</td>
<td>01-02</td>
<td>1bridge</td>
<td>$189.5K - flat car bridge</td>
<td>CDFG-043</td>
</tr>
<tr>
<td>HayworthCrk-MendenoCnty</td>
<td></td>
<td>2bridge</td>
<td>$89,711 ($44.9K/bridge)</td>
<td>CDFG-060</td>
</tr>
<tr>
<td>ApanolioCyn-SanMateoCnty</td>
<td>02-03</td>
<td>1bridge</td>
<td>$250K - 3sided bridge</td>
<td>CDFG-015</td>
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<tr>
<td>OldCreekRd-VenturaR</td>
<td></td>
<td></td>
<td>$111.5K</td>
<td>CDFG-038</td>
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<td>SoFork</td>
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<td>$22.6K</td>
<td>CDFG-065</td>
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<tr>
<td>CottanevaCrk-MendenoCnty</td>
<td></td>
<td></td>
<td>$500K</td>
<td>CDFG-119</td>
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<tr>
<td>TrinityR</td>
<td></td>
<td></td>
<td>$163.2K</td>
<td>CDFG-284</td>
</tr>
<tr>
<td>KellyGulch-SiskiyouCnty</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Location</td>
<td>Year</td>
<td>Bridge Type</td>
<td>Cost</td>
<td>Notes</td>
</tr>
<tr>
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</tr>
<tr>
<td>FrenchmansCrk-SanMateoCnty</td>
<td>03-04</td>
<td>1bridge</td>
<td>$130.2K - clear span bridge</td>
<td>CDFG-028</td>
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<tr>
<td>FrykmanGulch-BigR-MendcnoCnty</td>
<td></td>
<td></td>
<td>$77.6K</td>
<td>CDFG-052</td>
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<tr>
<td>IndianCrk-HumboldtCnty</td>
<td></td>
<td></td>
<td>$437.3K</td>
<td>CDFG-168</td>
</tr>
<tr>
<td>LindsayCrk-MadR QuarryBridge-GualalaR</td>
<td></td>
<td></td>
<td>$26.0K - manufactured</td>
<td>CDFG-201</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$46.0K - 45' modular</td>
<td>CDFG-311</td>
</tr>
<tr>
<td>ArroyoSecoR-MontereyCnty</td>
<td>04-05</td>
<td>1bridge</td>
<td>$1.5M</td>
<td>CDFG-031</td>
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<tr>
<td>CampCrk-NavarroR-MendenoCnty</td>
<td></td>
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<td>$234.6K - includes rock weirs</td>
<td>CDFG-041</td>
</tr>
<tr>
<td>O’NeilCrk-KlamathR-SiskiyouCnty</td>
<td></td>
<td></td>
<td>$100K - concrete, single span</td>
<td>CDFG-064</td>
</tr>
<tr>
<td>SolsticeCrk-LA</td>
<td></td>
<td></td>
<td>$653.3K - precast open bottom</td>
<td>CDFG-241</td>
</tr>
<tr>
<td>LindsayCrk-MadR-HumboldtCnty</td>
<td>05-06</td>
<td>1bridge</td>
<td>$54K</td>
<td>CDFG-077</td>
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<tr>
<td>CedarCrk-SmithR-DelNorteCnty</td>
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<td>$347.9K</td>
<td>CDFG-269</td>
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<tr>
<td>StaRosaCrk-SanLuisObispo SoquelCrk-StaCruzCnty</td>
<td>06-07</td>
<td>1bridge</td>
<td>$746.3K</td>
<td>CDFG-090</td>
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<td></td>
<td></td>
<td>$409.6K</td>
<td>CDFG-195</td>
</tr>
<tr>
<td>HorseCrk-Klamath</td>
<td>06-07</td>
<td>1bridge</td>
<td>$230.5K</td>
<td>K002</td>
</tr>
<tr>
<td>Idaho</td>
<td>2000</td>
<td>typical</td>
<td>Bridge Type:</td>
<td>Dupont-T9, p65</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wood stringer, 25-50yr lifetime: $10-$20K</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Prefab concrete, 40-60yr lifetime: $15K-$25K</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Railroad, 40-60yr lifetime: $15K-$30K</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Steel/concrete, 50-75yr lifetime: $30K-$50K</td>
<td></td>
</tr>
<tr>
<td>SONC</td>
<td>98-05</td>
<td>1site</td>
<td>$109.6K</td>
<td>HT07a-T61, p121</td>
</tr>
</tbody>
</table>
Most of the culvert improvement costs described in Table FP-4 range from about $5K to $65K. The two notable exceptions are $463.1K (03-04 CDFG-320) and $485K (05-06 CDFG-162) - both of which seemed to also involve substantial habitat work around the culvert. The NRCS examples pertain to culvert removal rather than improvement, but are included here in case such actions are considered for farmland in recovery planning.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>JollyGiantCrk-Arcata</td>
<td>01-02</td>
<td>1 culvrt</td>
<td>$10.2K</td>
<td>CDFG-124</td>
</tr>
<tr>
<td>SoForkBigR-MendenoCnty</td>
<td>02-03</td>
<td>1 culvrt</td>
<td>$23.3K</td>
<td>CDFG-286</td>
</tr>
<tr>
<td>ElCapitanCrk-StaBarbCnty</td>
<td>03-04</td>
<td>1 culvrt</td>
<td>$463.1K - baffles, replace culvert floor, construct pools</td>
<td>CDFG-320</td>
</tr>
<tr>
<td>BrownsCrk-PajaroR-StaCruzCnty</td>
<td>04-05</td>
<td>1 culvrt</td>
<td>$65.5K - replace floor, add weirs</td>
<td>CDFG-068</td>
</tr>
<tr>
<td>ChaddCrk-EelR-HmboldtCnty</td>
<td>05-06</td>
<td>1 culvrt</td>
<td>$485K - 9.5 ft dia steel plate culvert, retrofit w/baffles &amp; jump pools</td>
<td>CDFG-162</td>
</tr>
</tbody>
</table>
| Idaho               | 2000 | 1 culvrt | Culvert Type: 
|                     |      |       | Angle iron fish ladder: $1,185
|                     |      |       | Chimney block fish ladder - $375
|                     |      |       | Baffles - $2,530
|                     |      |       | Downstream drop structure - $1,180 | Dupont-T1, p59
|                     |      |       | Dupont-T2, p60 | Dupont-T3, p60
|                     |      |       | Dupont-T4, p61 |
| NOCECA              | 98-05| 1 site | $4.7K/baffle | HT07a-T61,p121  |

Table FP-4. Existing Culvert Improvement - $/project
**SC - FISH SCREENING OF DIVERSIONS**

Table SC-1 provides cost estimates for fish screens relative to the design approach velocity of the screen (cubic feet per second, cfs). Cost of screens produced by the CDFG screen shop range from $2K to $10K/cfs (BM, p. J-3). Most of the other cost estimates in the table fall within this range. Some notable exceptions include projects on the Klamath River (e.g., 05-06 CDFG-200) and in the Central Valley (e.g., ERP-00-B02, ERP-95-M05, ERP-96-07, ERP-97-C01, ERP-97-M07).

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2005</td>
<td>typical</td>
<td>$2K-$10K/cfs (CDFG screen shop)</td>
<td>BM, pJ-3</td>
</tr>
<tr>
<td>KlamathR</td>
<td>05-06</td>
<td>15.3cfs</td>
<td>$99,173/screen ($6.5K/cfs) - self clean</td>
<td>CDFG-049</td>
</tr>
<tr>
<td>KlamathR</td>
<td>05-06</td>
<td>3.51cfs</td>
<td>$39,758/screen ($11.3K/cfs)</td>
<td>CDFG-173</td>
</tr>
<tr>
<td>KlamathR</td>
<td>05-06</td>
<td>1.2cfs</td>
<td>$29,961/screen ($25K/cfs) - design/install preexisting tube screen</td>
<td>CDFG-200</td>
</tr>
<tr>
<td>CA</td>
<td>2004</td>
<td>typical</td>
<td>Type of Waterway: Small tributary: $10K/screen Large stream: $40K/screen</td>
<td>CDFG’04, p1.15</td>
</tr>
<tr>
<td>CalFED</td>
<td>2000</td>
<td>4scrns</td>
<td>Flow Range: 350-800cfs: $8.5K-$15K/cfs</td>
<td>Hayes-Fig2,p174</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1scrn</td>
<td>15-20cfs: $100K ($3.3K-$5K/cfs)</td>
<td>Hayes-p183</td>
</tr>
<tr>
<td>WA</td>
<td>2000</td>
<td>Sample of 1-15cfs screens</td>
<td><strong>Figure 2:</strong> $C=6060.4 \text{ cfs}^{1.2405}$</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>2cfs: $14,320$/screen ($7.2K$/cfs)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>4cfs: $33,834$/screen ($8.5K$/cfs)</td>
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<td></td>
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<td></td>
<td>6cfs: $55,950$/screen ($9.3K$/cfs)</td>
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<td></td>
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<td></td>
<td>8cfs: $79,944$/screen ($10K$/cfs)</td>
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<td></td>
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<td>10cfs: $105,439$/screen ($10.5K$/cfs)</td>
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<td>12cfs: $132,198$/screen ($11K$/cfs)</td>
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<td>14cfs: $160,056$/screen ($11.4K$/cfs)</td>
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<td></td>
<td><strong>Figure 3:</strong> $C=8221.2 \text{ cfs}^{1.0108}$</td>
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<td>10cfs: $84,282$/screen ($8.4K$/cfs)</td>
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<td>20cfs: $169,831$/screen ($8.5K$/cfs)</td>
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<td></td>
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<td></td>
<td>30cfs: $255,864$/screen ($9K$/cfs)</td>
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<td></td>
<td></td>
<td></td>
<td>40cfs: $342,214$/screen ($8.6K$/cfs)</td>
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<td></td>
<td></td>
<td>50cfs: $428,799$/screen ($8.6K$/cfs)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>60cfs: $515,573$/screen ($8.6K$/cfs)</td>
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<td></td>
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<td></td>
<td><strong>Figure 4:</strong> $C=11083 \text{ cfs}^{0.9025}$</td>
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<td></td>
<td></td>
<td></td>
<td>50cfs: $344,279$/screen ($6.9K$/cfs)</td>
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<td></td>
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<td></td>
<td>100cfs: $643,561$/screen ($6.4K$/cfs)</td>
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<tr>
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<td></td>
<td>150cfs: $927,923$/screen ($6.2K$/cfs)</td>
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<td></td>
<td></td>
<td>200cfs: $1,203,010$/screen ($6K$/cfs)</td>
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</table>

<table>
<thead>
<tr>
<th>OR</th>
<th>2000</th>
<th>Screen Type, Flow Range*:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Rotary drum, 0.4-25 cfs: $1.3K$-$11.3K$/cfs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rotary drum prefab, 0.8-2cfs: $3.9K$-$9.4K$/cfs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Belt, 10cfs: $2.3K$-$3.2K$/cfs</td>
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<tr>
<td></td>
<td></td>
<td>Panel, 12-30cfs: $2.8$-$3.1K$/cfs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pump, low veloc, 0.5-1.8cfs: $0.8K$-$1.9K$/cfs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pump, Clemons, 0.6-4.2cfs: $0.5K$-$2.2K$/cfs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pump, SureFlo, 0.5-6cfs: $0.5K$-$2.5K$/cfs</td>
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</table>

* Engineering costs incurred only for screens >25 cfs.

<table>
<thead>
<tr>
<th>CA farmland</th>
<th>FY07</th>
<th>typical</th>
<th>Flow Range*:</th>
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<tbody>
<tr>
<td></td>
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<td></td>
<td>&lt;1cfs: $2K$/screen ($2K$/cfs)</td>
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<td>1-5cfs: $6K$/screen ($6K$/cfs)</td>
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<td>5.1-10cfs: $14K$/screen ($14K$/cfs)</td>
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<td>&gt;10cfs: $20K$/screen ($20K$/cfs)</td>
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</table>

* $$/cfs estimated using midpoint of cfs range

<table>
<thead>
<tr>
<th>CA farmland</th>
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<th>Flow Range*:</th>
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<tr>
<td></td>
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<td>&lt;1cfs: $2K$/screen ($2K$/cfs)</td>
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<td>1-5cfs: $6K$/screen ($6K$/cfs)</td>
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<td></td>
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<td>5.1-10cfs: $14K$/screen ($14K$/cfs)</td>
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<td></td>
<td></td>
<td></td>
<td>&gt;10cfs: $20K$/screen ($20K$/cfs)</td>
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</table>

* $$/cfs estimated using midpoint of cfs range
<table>
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<th>WDFW</th>
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<tr>
<td></td>
<td></td>
<td>1-10cfs: $3.6K-$17.8K/cfs</td>
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<td>10-50cfs: $4.5K-$16.6K/cfs</td>
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<tr>
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<td>50-100cfs: $4.5K-$9.8K/cfs</td>
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<tr>
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<td></td>
<td>100-1000cfs: $2.4K-$7.0K/cfs</td>
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<tr>
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<td>&gt;1000cfs: $2.0K-$7.0K/cfs</td>
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<tr>
<td>Sacramento</td>
<td>1999$</td>
<td>16scrns $3.6K-$17.8K/cfs</td>
<td>ERP-97-07</td>
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<tr>
<td>River</td>
<td></td>
<td>19scrns $4.5K-$16.6K/cfs</td>
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<tr>
<td></td>
<td></td>
<td>5scrs $4.5K-$9.8K/cfs</td>
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<td>7scrs $2.4K-$7.0K/cfs</td>
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<td>5scrs $2.0K-$7.0K/cfs</td>
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<td><strong>Flow Range:</strong></td>
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<td>1-10cfs: $3.6K-$17.8K/cfs</td>
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<td>10-50cfs: $4.5K-$16.6K/cfs</td>
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<td>50-100cfs: $4.5K-$9.8K/cfs</td>
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<td>100-1000cfs: $2.4K-$7.0K/cfs</td>
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<td>&gt;1000cfs: $2.0K-$7.0K/cfs</td>
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<tr>
<td>Sacramento</td>
<td>2000</td>
<td>1 scrn $303K +5K project mgmt + $2.5K project coordination + $59.6K engineering design (20 cfs screen, $15K/cfs)</td>
<td>ERP-00-B01</td>
</tr>
<tr>
<td>River</td>
<td></td>
<td>$435.4K (44.6 cfs screen, $10K/cfs) - Pump Station #1</td>
<td></td>
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</tr>
<tr>
<td>Amer/Sacramento</td>
<td>2001</td>
<td>2 projects $40.4M + $750K project mgmt + $3.1M construction mgmt ($20.2M/screen) - replace intake SacR Water Treatment Plant, replace screen EA Fairbairn Water Treatment Plant.</td>
<td>ERP-01-N51</td>
</tr>
<tr>
<td>River</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>$1.1M + $521.7K program admin/mgmt/coordination ($111.7K/screen)</td>
<td>ERP-01-N52</td>
</tr>
<tr>
<td></td>
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<tr>
<td>Sacramento</td>
<td>2001</td>
<td>10scrns 8-39cfs $3.2M + $100K project mgmt + $173K construction mgmt ($21.3K/cfs) - decommission old diversion at M&amp;T Ranches’ Parrot-Phelan Pumping Station, relocate/construct/screen new diversion</td>
<td>ERP-95-M05</td>
</tr>
<tr>
<td>River</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Suisun</td>
<td>1995</td>
<td>5 screens $765.3K ($153.1K/screen)</td>
<td>ERP-95-M07</td>
</tr>
<tr>
<td>Marsh</td>
<td></td>
<td>Phase 1 - diversion evaluation &amp; selection</td>
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<tr>
<td>Sacramento</td>
<td>1996</td>
<td>1 projct 600 cfs $9.4M + $698.3K project coordination ($15.7K/cfs) - consolidate 3 diversions into 1 new diversion, Princeton-Codora-Glenn Irrig Dist &amp; Provident Irrig District</td>
<td>ERP-96-07</td>
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<tr>
<td>River</td>
<td></td>
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<tr>
<td>Yuba</td>
<td>1996</td>
<td>1 projct 65 cfs $202K ($3.1K/cfs) - Browns Valley Irrig District</td>
<td>ERP-96-M17</td>
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<tr>
<td>River</td>
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<tr>
<td>Sacramento</td>
<td>1997</td>
<td>1 projct 700 cfs $10.4M ($14.0K/cfs) - Reclamation District 108's diversion structure at Wilkins Slough</td>
<td>ERP-97-C01</td>
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<td>River</td>
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<tr>
<td>Butte</td>
<td>1997</td>
<td>1 projct 162 cfs $660.3K + $12.8K project mgmt + $58.8K construction mgmt ($4.1K/cfs) - Gorrill Dam</td>
<td>ERP-97-M03</td>
</tr>
<tr>
<td>Creek</td>
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</tr>
<tr>
<td>Location</td>
<td>Year</td>
<td>Project No.</td>
<td>Water Flow</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------</td>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>Butte Creek</td>
<td>1997</td>
<td>1 projct 135 cfs</td>
<td>$515.9K + $6.3K project mgmt + $3K project coordination ($3.8K/cfs) - Adams Dam</td>
</tr>
<tr>
<td>San Joaquin R</td>
<td>1997</td>
<td>1 projct 250 cfs</td>
<td>$7.6M + $62K project mgmt + $411K construction mgmt + $154K post-construction services ($30.4K/cfs) - vertical V fish screen, Banta-Carbona Irrig District</td>
</tr>
<tr>
<td>Sacramento River</td>
<td>1998</td>
<td>1 projct 22 cfs</td>
<td>$270.5K ($12.3K/cfs) - Boeger Family Farm Fish Screen Phase II: Construction</td>
</tr>
<tr>
<td>Lindsay Slough/Cache Slough</td>
<td>1998</td>
<td>1 projct 53 cfs</td>
<td>$416K ($7.8K/cfs) - Hastings Tract Fish Screen Phase II: Construction</td>
</tr>
<tr>
<td>Battle/Soap/Ripley Creeks</td>
<td>1999</td>
<td>1 projct</td>
<td>$1.06M (3 screens - 55 cfs, 70 cfs, 220 cfs; $3.1K/cfs) - decommission several PG&amp;E diversion dams, provide ladders/screens for those that remain</td>
</tr>
<tr>
<td>Sacramento River</td>
<td>1999</td>
<td>1 projct 450 cfs</td>
<td>$4.56M + $130K project mgmt ($10.1K/cfs) - ACID Fish Screen Phase III: Construction</td>
</tr>
<tr>
<td>Sacramento River</td>
<td>1999</td>
<td>1 projct 960 cfs</td>
<td>$6.222M ($6.5K/cfs) - Tisdale Positive Barrier Phase IV: Construction/Performance Eval</td>
</tr>
</tbody>
</table>
HB - INSTREAM BARRIER MODIFICATION FOR FISH PASSAGE

This section covers modification of non-culvert fish passage barriers in the stream channel and along the stream bank. Table HB-1 focuses on tide gates, Table HB-2 on sandbars, Table HB-3 on dam,, and Table HB-4 on other barriers.

Based on a limited number of examples, the replacement cost of a tide gate is ~$105K; retrofit cost is $26K.

Table HB-1. Tide Gates - $/unit

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humboldt Bay</td>
<td>03-04</td>
<td>3 tidegates</td>
<td>$317,148 ($105.7K/tidegate) - replace 2 tidegates &amp; add 3rd</td>
<td>CDFG-143</td>
</tr>
<tr>
<td>Humboldt Bay</td>
<td>2005</td>
<td>1 tidegate</td>
<td>Retrofit: $26K</td>
<td>MA, p2</td>
</tr>
</tbody>
</table>

Based on a single example, cost of sandbar breaching is $13K/breaching.

Table HB-2. Sandbar Breaching - $/unit

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estero de San Antonio (MarinCnty)</td>
<td>1993</td>
<td>1 breaching</td>
<td>$10K/breaching (2006$: $13.1K) - incl equip rental</td>
<td>WC, p19</td>
</tr>
</tbody>
</table>

Based on a single example, cost of dam decommission is $1.5M.

Table HB-3. Dam Decommission/Removal - $/unit

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>BattleCreek/SoapCreek/RipleyCreek</td>
<td>1999</td>
<td>5 dams</td>
<td>$7.53M ($1.5M/decommission)</td>
<td>ERP-99-B01</td>
</tr>
</tbody>
</table>
Barrier modification projects identified in Table HB-4 typically involve weirs, head gates, fish screens and/or measuring structures. Most of the modifications cost $30K-$170K, with the exception of two $1M+ barrier removal/fish screen projects on the Shasta River (06-07 K010 & K011). A single estimate of weir repair cost is provided: $10.8K/weir (06-07 K034).

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>EastForkScott/French Crk/ShacklefordCrk//ScottR-KlamathRiver</td>
<td>06-07</td>
<td>13 barriers</td>
<td>$962.9K ($74.1K/barrier) - remove seasonal barriers/install head gate to measure diversion volume</td>
<td>K025</td>
</tr>
<tr>
<td>ShastaR-Klamath</td>
<td>06-07</td>
<td>1 barrier</td>
<td>$1356.5K - remove barrier/install fish screen</td>
<td>K010</td>
</tr>
<tr>
<td>ShastaR-Klamath</td>
<td>06-07</td>
<td>1 barrier</td>
<td>$981.9K - remove barrier/install fish screen</td>
<td>K011</td>
</tr>
<tr>
<td>ColdCrk-KlamathR</td>
<td>06-07</td>
<td>1 barrier</td>
<td>$65.1K - replace diversion w/fish passable weir, update screen</td>
<td>K014</td>
</tr>
<tr>
<td>ShastaR-Klamath</td>
<td>06-07</td>
<td>4 barriers</td>
<td>$120.9K ($30.2K/barrier) - replace 2 barriers w/boulder weirs; install head gate/fish screen/measuring weir on 2 unscreened diversions</td>
<td>K023</td>
</tr>
<tr>
<td>Scott-KlamathR</td>
<td>06-07</td>
<td>1 barrier</td>
<td>$170K - replace barrier with boulder weirs/head gate/measuring structure</td>
<td>K032</td>
</tr>
<tr>
<td>FrenchCrk/MinersCrk/ PattersonCrk/ ShackelfordCrk-KlamathR</td>
<td>06-07</td>
<td>6 weirs</td>
<td>$65K (10.8K/weir) - repair storm-damaged secondary weirs in 6 locations</td>
<td>K034</td>
</tr>
<tr>
<td>Guadalupe River (So SanFran Bay)</td>
<td>1998</td>
<td>2 passage structures</td>
<td>$147.9K ($74K/structure)</td>
<td>ERP-98-B23</td>
</tr>
<tr>
<td>Carriger Creek (Sonoma Creek)</td>
<td>2001</td>
<td>1 barrier</td>
<td>$67.6K - boulder weir ladder</td>
<td>ERP-01-N27</td>
</tr>
</tbody>
</table>
HI - INSTREAM HABITAT RESTORATION

This section covers restoration of instream habitat. Tables HI-1 & HI-2 pertain to instream structures such as wood/boulder structures and large woody debris, Table HI-3 to spawning gravel supplementation, Table HI-4 to floodplain tributary reconnection, Tables HI-5 and HI-6 to channel restoration, and Table HI-7 to wetland/floodplain restoration.

Evergreen (Table HI-1) estimates restoration costs for small/medium streams with small/medium transportation & material requirements on a per-mile basis, and estimates costs for large streams with medium/high transportation & material requirements on a per-structure basis. The examples in Table HI-2 also represent a mixture of per-mile and per-structure estimates; however, the units of measure in Table HI-2 were not based on any systematic criterion (as per Evergreen) but rather reflect whatever units were available from each data source. Cost-per-mile tends to be lower using Evergreen’s estimates ($10K-$50K/mile) than the Table HI-2 estimates, which ranged from ~$25K to $500K/mile (with the exception of a $1.4M/mile project (01-02 CDFG-156) where cost per mile was derived by expanding the cost of that 40' project to an entire mile). Conversely cost-per-structure tends to be higher using Evergreen’s estimates ($10K-$80K/structure) than the Table HI-2 estimates (~$500-$11K/structure). These results are not surprising, given that Evergreen systematically applied cost-per-mile to lower-cost projects and cost-per-structure to higher-cost projects.

<table>
<thead>
<tr>
<th>Stream Size (cfs)</th>
<th>Transportation &amp; Material Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Cost</td>
</tr>
<tr>
<td>Small 1-100 cfs</td>
<td>$10K-30K*</td>
</tr>
<tr>
<td>Med 100-2000 cfs</td>
<td>$20K-50K*</td>
</tr>
<tr>
<td>Lge 2000+ cfs</td>
<td>$10K-20K</td>
</tr>
</tbody>
</table>

* Cost per stream mile, assuming 100-400 pieces per stream mile. Estimates in all other cells measured as cost per structure.
<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>WindR-WA</td>
<td>2000</td>
<td>typical</td>
<td>Channel rehab: $86K ($41K-$137K)/mi</td>
<td>Bair-pp107-108</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 project</td>
<td>Onsite material: $65K/mi</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 project</td>
<td>Imported material: $140K-$160K/mi</td>
<td></td>
</tr>
<tr>
<td>UpperMattoleR-HumboldtCntyEelR</td>
<td>01-02</td>
<td>12 strctrs</td>
<td>$23,507 ($1959/structure) - log</td>
<td>CDFG-048</td>
</tr>
<tr>
<td>LowerSodaCrk-EelR-MendenoCnty</td>
<td></td>
<td>40'</td>
<td>$10,979 ($1.4M/mi)</td>
<td>CDFG-156</td>
</tr>
<tr>
<td></td>
<td></td>
<td>640'</td>
<td>$54,329 ($448.8K/mi)</td>
<td>CDFG-258</td>
</tr>
<tr>
<td>FelizCrk-RussianRiverMoonCrk-KlamathR-DelNorteCnty</td>
<td>02-03</td>
<td>1300'</td>
<td>$20,580 ($83.7K/mi)</td>
<td>CDFG-011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 strctrs</td>
<td>$40,600 ($2707/structure)</td>
<td>CDFG-127</td>
</tr>
<tr>
<td>HayworthCrk/NFNoYoR-MendenoCntyUpperMattole-HumboldtCnty</td>
<td>03-04</td>
<td>55 strctrs</td>
<td>$30,422 ($553/structure)</td>
<td>CDFG-216</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 strctrs</td>
<td>$36,510($2608/structure) - wood/boulder</td>
<td>CDFG-233</td>
</tr>
<tr>
<td>SultanCrk-SmithR-DelNorteCntyWilsonCrk-DelNorteCntyRedwoodCrk-RussianR-SonomaCnty</td>
<td>04-05</td>
<td>10 strctrs</td>
<td>$20,497 ($2050/structure)</td>
<td>CDFG-143</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 strctrs</td>
<td>$25,998 ($2600/structure)</td>
<td>CDFG-145</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.08 mi</td>
<td>$60,419 ($55.9K/mi)</td>
<td>CDFG-247</td>
</tr>
<tr>
<td>EelR DelNorteCnty</td>
<td>06-07</td>
<td>4.5 mi</td>
<td>$112,437 ($25K/mi)</td>
<td>CDFG-056</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 strctrs</td>
<td>$46,753 ($4675/struc) - +1000 native conifers to replenish wood instream</td>
<td>CDFG-110</td>
</tr>
<tr>
<td>Location</td>
<td>Year</td>
<td>Type</td>
<td>Distance from Road:</td>
<td>Total Cost</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------</td>
<td>---------------</td>
<td>---------------------</td>
<td>------------</td>
</tr>
<tr>
<td>TectahCreek-KlamathR</td>
<td>06–07</td>
<td>5 mi</td>
<td>$275.4K ($55.1K/mi) - LWD construction/placement with helicopter</td>
<td>K003</td>
</tr>
<tr>
<td>ScottR-Klamath</td>
<td>06-07</td>
<td>6-8 major structures</td>
<td>$65.8K ($8.2K-$11K/structure)</td>
<td>K037</td>
</tr>
<tr>
<td>CA 2004 typical</td>
<td></td>
<td></td>
<td>0.25-0.5mi: $26K/mi 1-2mi: $27K/mi 2-3mi: $28K/mi &gt;3mi: $29K/mi</td>
<td>CDFG’04 p1.24</td>
</tr>
<tr>
<td>CA</td>
<td>06-07</td>
<td>20 struc/mi: $25.3K ($5.6K-$70.8K)/mi, $1762/structure</td>
<td>$275.4K ($55.1K/mi) - LWD construction/placement with helicopter</td>
<td>Hampton-T1, pp122-123</td>
</tr>
<tr>
<td>CA</td>
<td>98-05</td>
<td>24 sites 5 sites</td>
<td>$2.5K ($214-$11.3K)/structure</td>
<td>HT07a-T60, p118</td>
</tr>
<tr>
<td>CA</td>
<td>98-05</td>
<td>3 sites 1 site 15 sites 4 sites 1 site</td>
<td>$1.3K ($214-$2.1K)/structure $3K ($2.4K-$3.5K)/structure $534.1K/mi $2K ($680-$4.1K)/structure $322K ($220.5-$552.1K)/mi $11.3K/structure</td>
<td>HT07a-T61, p121</td>
</tr>
<tr>
<td>CA</td>
<td>02-04</td>
<td>58 sites</td>
<td>$12,375 ($250-$175K)/structure</td>
<td>HT07b-T53, p74,contractr</td>
</tr>
<tr>
<td>CA</td>
<td>02-04</td>
<td>45 sites</td>
<td>$2.2M ($4K-$46.8M)/mi</td>
<td>HT07b-T54, p75,contractr</td>
</tr>
<tr>
<td>OR-priv forest</td>
<td>2000</td>
<td>typical</td>
<td>Assume 120 trees/mile: $77.6K/mi - non-contract $82.4K/mi - contract $47.6K/mi - LWD-helicopter</td>
<td>Lacy-p139, Lacy-p139, Lacy-p140</td>
</tr>
<tr>
<td>King County, WA</td>
<td>600'</td>
<td></td>
<td>$113.5K ($99.8K/mi)</td>
<td>Neal-T4, p163</td>
</tr>
</tbody>
</table>

\( \$/mile=24,482+427*\#structures/mi \)

Lacy-p139
Table HI-3 pertains to spawning gravel supplementation. The WDFW example (WDFW-T3, p14), which is actually based on a British Columbia data source, estimates cost of spawning gravel supplementation at $20-$40/cubic yard. With the notable exception of the Stanislaus River project (ERP-97-N21) - where costs include evaluation as well as gravel treatment - the Central Valley examples indicate a range of costs ($11-$36/cubic yard) similar to WDFW’s.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
</table>
| WA             | 2004 | typical | Gravel placement: $50-$70/m³*  
Sorted gravel: $20-$40/cubic yard | WDFW-T3, p14       |
| Tuolumne River | 2002 | 10K cy | $3.59M + $50K project mgmt/admin ($36/cy)                               | ERP-02-P29         |
| Sacramento River| 1995 | 4964 cy | $52.5K ($11/cy)                                                              | ERP-95-M04         |
| Tuolumne River | 1997 | 6632 cy | $191.2K ($20/cy)                                                            | ERP-97-C11         |
| Stanislaus River| 1997 | 9220 cy | $667.9K ($72/cy) - Knights Ferry, incl evaluation of effects of diff size/sources of gravel on habitat utilization | ERP-97-N21         |

* Gravel placement - sorted gravel supplied, limited delivery distance, machine placed, does not include control structures.
Tables HI-4 and HI-5 describe Evergreen’s cost estimates for floodplain tributary reconnection (which vary with material and earthmoving requirements) and sidechannel reconnection (which vary with earthmoving requirements and energy of waterway).

Table HI-4. Floodplain Tributary Reconnection - $/acre
(Source: Evergreen 2003, p. 39)
Cost estimates pertain to Puget Sound. Estimates include construction, design, permitting, basic monitoring & routine maintenance (2 yrs), reestablishing site to prior conditions, project management.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Extent of Earthmoving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimal</td>
</tr>
<tr>
<td>Minimal</td>
<td>$5K-10K</td>
</tr>
<tr>
<td>Moderate</td>
<td>$10K-20K</td>
</tr>
<tr>
<td>Substantial</td>
<td>$30K-40K</td>
</tr>
</tbody>
</table>

Table HI-5. Side Channel Reconnection - $/acre (Source: Evergreen 2003, p. 41)
Cost estimates pertain to Puget Sound. Estimates include construction, design, permitting, basic monitoring & routine maintenance (2 yrs), reestabishing site to prior conditions, project management.

<table>
<thead>
<tr>
<th>Extent of Earthmoving</th>
<th>Energy of Waterway</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Minimal/Near</td>
<td>$20K-40K</td>
</tr>
<tr>
<td>Moderate/Avg Distance</td>
<td>$40K-60K</td>
</tr>
<tr>
<td>Substantial/Far</td>
<td>$60K-100K</td>
</tr>
</tbody>
</table>
Table HI-6 provides cost estimates for channel restoration projects. All estimates pertain to Central Valley rivers and range from $1.2M/mile (ERP-99-B01) to $8.7M/mile (ERP-97-M08).

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Unit</th>
<th>Cost per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merced River</td>
<td>1999</td>
<td>2.19 mi</td>
<td>$2.635M ($1.2M/mi) - large-scale reach restoration-channel realignment/floodplain creation</td>
<td>ERP-99-B01</td>
</tr>
<tr>
<td>Tuolumne River</td>
<td>2002</td>
<td>1.2 mi</td>
<td>$8.29M + $74.1K construction mgmt ($6.9M/mile) - large-scale reach restoration-channel realignment/floodplain creation</td>
<td>ERP-02-P19-D</td>
</tr>
<tr>
<td>Tuolumne River</td>
<td>1997</td>
<td>0.23 mi</td>
<td>$2.011M + $174K construction/proj mgmt ($8.7M/mile) - restore natural channel morphology</td>
<td>ERP-97-M08</td>
</tr>
<tr>
<td>Tuolumne River</td>
<td>1997</td>
<td>2.6 mi</td>
<td>$5.054M + $284 construction mgmt ($1.9M/mile) - restore natural channel morphology</td>
<td>ERP-97-M09</td>
</tr>
<tr>
<td>Tuolumne River</td>
<td>1998</td>
<td>2.2 mi</td>
<td>$5.054M ($2.3M/mile) - restore natural channel processes &amp; habitats</td>
<td>ERP-98-F06</td>
</tr>
<tr>
<td>Merced River</td>
<td>1998</td>
<td>2.2 mi</td>
<td>$3.635M ($1.7M/mile) - restore natural channel processes &amp; habitats</td>
<td>ERP-98-F11</td>
</tr>
</tbody>
</table>

Most of the wetland restoration cost estimates in Table HI-7 pertain to San Francisco Bay/Estuary; several estimates of annual operations & maintenance (O&M) and monitoring costs are included. Steere’s information is notable in that he provides estimates by wetland type. The NRCS estimates indicate much lower wetland restoration costs for farmland ($75-$375/acre); these projects are likely much more modest in scale than the types of projects that occur in San Francisco Bay.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topanga Crk-LA</td>
<td>05-06</td>
<td>12 acres</td>
<td>$249.8K ($20.8K/acre) - remove 26Ktons of lead contaminated fill matl</td>
<td>CDFG-029</td>
</tr>
<tr>
<td>SF Bay/ Estuary</td>
<td>Year</td>
<td>Typical</td>
<td>Wetland Type:</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>------</td>
<td>---------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>typical</td>
<td>Tidal wetland: $5K-$100K/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Seasonal wetland: $9K/acre (large-scale project)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wetland enhancement: $1K/acre (reveg, exotic species removal, limited irrig, modest mgmt)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Monitoring: $500/acre for 5 yrs</td>
<td></td>
</tr>
<tr>
<td>SF Bay/ Estuary</td>
<td>1999</td>
<td>5 sites</td>
<td>(1) 500 acre wetland: $14K/acre/yr for 5 yrs, $35K/yr thereafter (land acquisition =$5M, planning/permitting=$250K, construction=$1.3M, monitoring=$25K/yr for 5 yrs, O&amp;M=$35K/yr)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2) $1K/acre (restore tidal action to salt pond)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3) $18K/acre (seasonal/tidal wetland)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4) $27K/acre (levee construction/repair, extensive dredging)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(5) $56K/acre (highly engineered, large soil volume, channel excavation, low berms)</td>
<td></td>
</tr>
<tr>
<td>CA farmland</td>
<td>FY07</td>
<td>typical</td>
<td>Light: $75/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderate: $187.50/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Intensive: $375/acre</td>
<td></td>
</tr>
</tbody>
</table>

**HR - RIPARIAN RESTORATION**

*This section covers restoration of erosion-prone banks adjacent to the stream and within the riparian corridor. Riparian area is defined as the area, including any necessary fencing, between the fence and the middle of the stream. Table HR-1 pertains to fencing/livestock exclusion, Table HR-2 to fence maintenance, Tables HR-3 and HR-4 to riparian planting, Table HR-5 to irrigation, and Table HR-6 to invasive/noxious weed control.*
As indicated in Table HR-1, Evergreen (Evergrn p11) estimates fence construction costs at $1-$12/foot, with an “overall average” of $3-$12/foot. CDFG’s Coho Recovery Strategy (CDFG’04, p1.20) uses the midpoint of this latter range ($8/foot). Cost of all individual fencing projects (CDFG-xxx, HT07a, HT07b, NRCS CA) are expressed in $ per foot, even for projects that also include components other than fencing (e.g., revegetation, irrigation, stock water systems). For most of these projects (even those with added components), costs generally fall within the $1-$12/foot range indicated by Evergreen.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puget Snd</td>
<td>2003</td>
<td>typical</td>
<td>$1-$4/ft, $5-$8/ft, $9-$12/ft, $3-$12/ft</td>
<td>Evergrn p11</td>
</tr>
<tr>
<td>CA</td>
<td>2004</td>
<td>typical</td>
<td>$8/ft</td>
<td>CDFG’04, p1.20</td>
</tr>
<tr>
<td>ShastaR</td>
<td>01-02</td>
<td>7800'</td>
<td>$56.6K ($7.26/ft, 7800' fence, 6 stockwater areas)</td>
<td>CDFG-065</td>
</tr>
<tr>
<td>EelR</td>
<td>02-03</td>
<td>1.1 mi</td>
<td>$40,800 ($7.02/ft)</td>
<td>CDFG-026</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>2 mi</td>
<td>$19,993 ($1.89/ft)</td>
<td>CDFG-116</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>3.5 mi</td>
<td>$28,664 ($1.55/ft)</td>
<td>CDFG-193</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>7600'</td>
<td>$56.4K ($7.42/ft; fencing, alternative water sources for cattle, riparian planting, temporary irrigation)</td>
<td>CDFG-243</td>
</tr>
<tr>
<td>TrinityCnty</td>
<td></td>
<td>1 mi</td>
<td>$31,138 ($5.90/ft)</td>
<td>CDFG-251</td>
</tr>
<tr>
<td>ShastaR</td>
<td></td>
<td>1250'</td>
<td>$7,032 ($5.63/ft, +10yr maint &amp; grazing exclusion)</td>
<td>CDFG-324</td>
</tr>
<tr>
<td>ShastaR</td>
<td></td>
<td>850'</td>
<td>$4963 ($5.84/ft, +10yr maint &amp; grazing exclusion)</td>
<td>CDFG-342</td>
</tr>
<tr>
<td>SmithR</td>
<td>03-04</td>
<td>2K’</td>
<td>$32,890 ($16.45/ft, incl riparian plant)</td>
<td>CDFG-131</td>
</tr>
<tr>
<td>RussianR</td>
<td></td>
<td>800'</td>
<td>$6.7K ($8.40/ft; fencing, water pump in stream to provide water for livestock)</td>
<td>CDFG-195</td>
</tr>
<tr>
<td>ShastaR</td>
<td>04-05</td>
<td>13,500'</td>
<td>$91,944 ($6.81/ft,native plants 1,685')</td>
<td>CDFG-194</td>
</tr>
<tr>
<td>ShastaR</td>
<td></td>
<td>25,000'</td>
<td>$116,674 ($4.70/ft)</td>
<td>CDFG-231</td>
</tr>
<tr>
<td>ShastaR</td>
<td></td>
<td>3200'</td>
<td>$61,604 ($19.25/ft)</td>
<td>CDFG-243</td>
</tr>
<tr>
<td>SmithR</td>
<td>05-06</td>
<td>3000'</td>
<td>$21,259 ($7.09/ft, native trees)</td>
<td>CDFG-046</td>
</tr>
<tr>
<td>KlamathR</td>
<td></td>
<td>2600'</td>
<td>$17,494 ($6.73/ft, trees 3 acres)</td>
<td>CDFG-188</td>
</tr>
<tr>
<td>KlamathR</td>
<td></td>
<td>3600'</td>
<td>$25,850 ($7.18/ft)</td>
<td>CDFG-266</td>
</tr>
<tr>
<td>ShastaR</td>
<td>06-07</td>
<td>3500'</td>
<td>$28,213 ($8.06/ft, riparian veg)</td>
<td>CDFG-078</td>
</tr>
<tr>
<td>-----------</td>
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<td>----------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>CA</td>
<td>98-05</td>
<td>10 sites</td>
<td>$7 ($2.43-$22.07)/ft - $37K/mi</td>
<td>HT07a-T60, p118</td>
</tr>
<tr>
<td>CA</td>
<td>2003$</td>
<td>2003$</td>
<td>6 sites 3 sites 1 site</td>
<td></td>
</tr>
<tr>
<td>SONC</td>
<td>98-05</td>
<td>$9 ($4.58-$22.07)/ft - $48.1K/mi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SONC-NOCECA</td>
<td>2003$</td>
<td>3 sites 1 site $3.39 ($2.43-$4.89)/ft - $7.9K/mi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCACO</td>
<td>2003$</td>
<td>$5.15/ft - $27.2K/mi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>02-04</td>
<td>2 sites 7 sites 2 sites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>98-05</td>
<td>9 sites $7.24 ($2.43-$22.07)/ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>FY07</td>
<td>typical Fence Material:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td></td>
<td>Conventional: $3/ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td></td>
<td>Conventional extreme terrain: $8/ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td></td>
<td>Electric: $2/ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td></td>
<td>Woven: $6/ft</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fence Material:
Conventional: $3/ft
Conventional extreme terrain: $8/ft
Electric: $2/ft
Woven: $6/ft

NRCS CA
Fence maintenance costs described in Table HR-2 range from $0.09 to $0.26/foot/year, depending on the fencing material. It should be noted that these estimates pertain to Iowa, not California.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa</td>
<td>2005</td>
<td>1330'</td>
<td>Fence Material:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Woven wire: $0.26/ft/yr</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Barbed wire: $0.21/ft/yr</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hi-tensile, non-elec: $0.15/ft/yr</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hi-tensile, elec: $0.09/ft/yr</td>
<td>MO-T6</td>
</tr>
</tbody>
</table>
Table HR-3 describes Evergreen’s estimates of riparian planting cost, while Table HR-4 describes estimates from other data sources. Evergreen’s estimates are $5K-135K/acre, and vary with the level of site preparation and material/site accessibility. The estimates used for CDFG’s Coho Recovery Strategy (CDFG-04, p1.17) are $30K-60K/acre and were selected to fall within the range of Evergreen’s estimates. Project costs reported in HT07a and HT07b are ~ $100K-$120K/acre (with the notable exception of a $434.8K/acre project). The NRCS estimates are at the low end of this range: ~$100-$1800/acre - depending on what is planted (trees or plants) and planting requirements (e.g., protected, shelters, wire cages, native species). An NRCS estimate of landing clearing costs is also included to address situations where clearing is a prerequisite for planting. The Bair example - $110/acre, pertaining to riparian reforestation - was also at the lower end of Evergreen’s range.

For the examples from CDFG and Hampton, costs could be calculated on a per-mile but not a per-acre basis. Costs vary widely ($1K to > $200K/mile); some of this difference may be due to variations in the width of the buffer being planted (which is not clear from the data sources).

Evergreen uses the following conversion from miles to acres (with acreage doubled when planting on both sides of the stream):

- 1 mile x 50 foot buffer = 6 acres (100% planted)
- 1 mile x 50 foot buffer = 1.8 acres (30% planted)
- 1 mile x 150 foot buffer = 18.2 acres (100% planted)
- 1 mile x 150 foot buffer = 5.5 acres (30% planted).

### Table HR-3. Riparian Planting Projects - $/acre (Source: Evergreen 2003, p. 16)

Cost estimates pertain to Puget Sound. Estimates include construction, design, permitting, basic monitoring & routine maintenance (2 yrs), reestablishing site to prior conditions, project management.

<table>
<thead>
<tr>
<th>Materials/Site Accessibility</th>
<th>Level of Site Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flat/Light Clearing</td>
</tr>
<tr>
<td>Low Cost</td>
<td>$5K-25K</td>
</tr>
<tr>
<td>Medium Cost</td>
<td>$10K-35K</td>
</tr>
<tr>
<td>High Cost</td>
<td>$30K-50K</td>
</tr>
</tbody>
</table>
**Table HR-4. Planting - $/acre, $/stream length**

For entries involving multiple projects, cost reported as mean or mean (range) as avail.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2004</td>
<td>typical</td>
<td>Distance from Road (assuming 50' buffer along streams):</td>
<td>CDFG-04 p1.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&lt;0.25 mi: $30K/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.25-0.5mi: $35K/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.5-1mi: $45K/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1-2mi: $50K/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2-3mi: $55K/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;3mi: $60K/acre</td>
<td></td>
</tr>
<tr>
<td>SONC</td>
<td>98-05</td>
<td>1 site(10ac)</td>
<td>$1.8K/acre</td>
<td>HT07a-T61, pp121-125</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>2 sites(4mi)</td>
<td>$30.8K ($8.8K-$52.9K)/mi</td>
<td></td>
</tr>
<tr>
<td>NOCECA</td>
<td></td>
<td>4sites(128ac)</td>
<td>$8K ($1.8K-$13.5K)/acre</td>
<td></td>
</tr>
<tr>
<td>NOCECA</td>
<td></td>
<td>7 sites(3mi)</td>
<td>$95K ($3.7K-$436.6K)/mi</td>
<td></td>
</tr>
<tr>
<td>CentralVly</td>
<td></td>
<td>4sites(610ac)</td>
<td>$4.8K ($2K-$7.8K)/acre</td>
<td></td>
</tr>
<tr>
<td>SCACO</td>
<td></td>
<td>1 site(28ac)</td>
<td>$23.6K ($495-$63.1K)/acre</td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>02-04</td>
<td>18 sites</td>
<td>Site Accessibility: Easy: $55.8K ($600-$434.8K)/acre (median=$8.9K/acre)</td>
<td>HT07b-T21, p 43.contrctr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Average: $9.1K ($40-$87.5K)/acre (median=$1.3K/acre)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 sites</td>
<td>Difficult: $4K ($910-$15.1K)/acre (median=$2.3K/acre)</td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>CA</td>
<td>02-04</td>
<td>19 sites</td>
<td>Prevailing Wages Required: No: $1.8K ($40-$8.5K)/acre</td>
<td>HT07b-T30, p50,contrctr</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11 sites</td>
<td>Yes: $77.1K ($1.8K-$434.8K)/acre</td>
<td></td>
</tr>
<tr>
<td>Area</td>
<td>Site Year</td>
<td>Site Type</td>
<td>Irrigation Type</td>
<td>Cost per Acre</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
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<td>----------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>CA 02-04</td>
<td></td>
<td></td>
<td>Dri-water: $46.1K ($8.5K-$83.7K)/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Drip irrig: $33.0K ($163-$120.5K)/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hand irrig: $26.2K ($414-$100K)/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>None: $27.1K ($40-$434.8K)/acre</td>
<td></td>
</tr>
<tr>
<td>CA farmland</td>
<td>FY07</td>
<td>typical</td>
<td>170-259 trees/acre: $109/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>260-300 trees/acre: $154/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>301-435 trees/acre: $182/acre</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>436-681 trees/acre: $240/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>110 trees/acre (protected): $770/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>300 trees/acre (protected): $200/acre</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>170-260 trees/acre (shelters):</td>
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<td></td>
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<td></td>
<td>$130/acre</td>
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<td></td>
<td>261-325 trees/acre (shelters):</td>
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<td></td>
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<td>$175/acre</td>
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<td>326-434 trees/acre (shelters):</td>
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<td></td>
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<td></td>
<td>$200/acre</td>
<td></td>
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<td></td>
<td>&gt;435 trees/acre (shelters): $260/acre</td>
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<td></td>
<td></td>
<td>95-150 plants/acre (wire cages):</td>
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<td></td>
<td></td>
<td></td>
<td>$225/acre</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>151-200 plants/acre (wire cages):</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>$320/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>201-325 plants/acre (wire cages):</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$470/acre</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>95-150 plants/acre (native spp):</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>$735/acre</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>150-200 plants/acre (native spp):</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>$1050/acre</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>200-260 plants/acre (native spp):</td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td>$1380/acre</td>
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<td></td>
<td></td>
<td></td>
<td>261-325 plants/acre (native spp):</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$1755/acre</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Land clearing: $400/acre</td>
<td></td>
</tr>
<tr>
<td>WindR-WA</td>
<td>2000</td>
<td>mile</td>
<td>$5K ($4K-$8K)/mi; $110/acre - riparian reforestation</td>
<td></td>
</tr>
<tr>
<td>MaacamaCrk-SonomaCty</td>
<td>01-02</td>
<td>300'</td>
<td>$12,790 ($225K/mi) - willow walls</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Year</td>
<td>Units</td>
<td>Cost Per Unit</td>
<td>Source</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------</td>
<td>--------</td>
<td>---------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>KlamathR WilsonCrk ShastaR</td>
<td>02-03</td>
<td>2600' 1 mi 2 mi</td>
<td>$27.6K ($52.8K/mi) $18.1K/mi $109,934 ($55K/mi)</td>
<td>CDFG-170 CDFG-208 CDFG-296</td>
</tr>
<tr>
<td>GarciaR-MendCnty LowerTerwer Crk-KlamathR-DelNorteCnty</td>
<td>03-04</td>
<td>1600' 1600'</td>
<td>$67,695 ($223K/mi) bioengineer $39,671 ($131K/mi) willows, native</td>
<td>CDFG-117 CDFG-223</td>
</tr>
<tr>
<td>Klamath ShastaR</td>
<td>04-05</td>
<td>1600' 7000'</td>
<td>$55,868 ($184K/mi) willow/native trees bioengineer removal of exotics $79,573 ($60K/mi)</td>
<td>CDFG-122 CDFG-172</td>
</tr>
<tr>
<td>CA 2000</td>
<td>11 projects</td>
<td></td>
<td>$13.7K ($1.0K-$47K/mi)</td>
<td>Hampton-T3, p125</td>
</tr>
<tr>
<td>CA 2000</td>
<td>12 projects</td>
<td></td>
<td>$8 ($0.17-$23)/ft or $42.2K ($898-$121K/mi)</td>
<td>Hampton-T4, p125</td>
</tr>
</tbody>
</table>

Some of the projects in Table HR-4 above included irrigation in combination with revegetation. Table HR-5 provides estimates of irrigation costs only (NRCS CA) that range from $800 to $3K/acre and vary by irrigation method and habitat type. An example of capital cost (irrigation pumps, CDFG-279) is also provided.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA farmland FY07</td>
<td>typical</td>
<td></td>
<td>Irrig system, surf &amp; subsurface: $3K/acre Micro-irrig, hillside: $1.5K/acre Micro-irrig, wildlife-upland habitat: $800/acre Sprinkler irrig, hillside/sloping: $2.5K/acre</td>
<td>NRCS CA</td>
</tr>
<tr>
<td>Eel R 04-05</td>
<td></td>
<td></td>
<td>$17.3K - solar powered irrigation pumps to ensure seedling survival until natural roots grow</td>
<td>CDFG-279</td>
</tr>
</tbody>
</table>
Information on invasive weed control is limited: $5K-$12K/acre for projects on the Napa and Smith Rivers (04-05 CDFG-072 & CDFG-077). NRCS cost estimates for farmland are much lower ($10-$375/acre) and vary, depending on eradication method (e.g., mechanical/chemical, mechanical/chemical/handtool), land type (e.g., upland, wetland), and vegetation type (e.g., woody, herbaceous). A Russian River project (02-03 CDFG-325) can be costed on a per-mile basis but cost per acre is not known.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>RussianR</td>
<td>02-03</td>
<td>2.5mi</td>
<td>$30.2K ($12.1K/mi, broom, native reveg)</td>
<td>CDFG-325</td>
</tr>
<tr>
<td>NapaR</td>
<td>04-05</td>
<td>22,865yd² (4.7acres)</td>
<td>$55.7K ($11.9K/acre, arundo erad)</td>
<td>CDFG-072</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10acres</td>
<td>$49.5K ($5K/acre, Eng ivy, plantseeding)</td>
<td>CDFG-077</td>
</tr>
<tr>
<td>CA farmland</td>
<td>FY07 typical</td>
<td>Exotic Vegetation Management</td>
<td>NRCS CA</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>------------------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Woody veg, mech/chem/handtool</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light: $18.75/acre</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Moderate: $37.50/acre</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Intensive: $75/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mechanical/chemical, upland</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light: $10/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate: $20/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intensive: $50/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Woody veg (early successional), mech/chem/handtool</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intensive: $50/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Herbaceous veg, early successional, mech/chem/handtool</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate: $25/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multi applic/yr, wetland, mech/chem/handtool</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light: $75/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate: $187.5/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intensive: $375/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Competing Vegetation Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conservation cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>General: $50/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Riparian herbaceous: $50/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forest stand improvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mastication: $920/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hand, 0-15%slope, 20-40%cover:$600/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hand, 15-30%slope, 40-60%cover:$900/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hand, 30-50%slope, 60-90%cover:$1200/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brush rake: $379/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chemical: $150/acre</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**HS - BANK STABILIZATION**

This section covers stabilization of eroding, collapsing or otherwise de-stabilized banks. Table HS-1 provides Evergreen’s cost estimates for streambank stabilization, Table HS-2 provides similar estimates from other data sources, and Table HS-3 focuses on levee restoration.

Evergreen’s estimates ($30-$1000/foot) vary by extent of excavation and waterway size. Cost estimates used in CDFG’s Coho Recovery Strategy (CDFG’04, p1.19) were $250-$350/foot and fall within the range of Evergreen’s estimates for small/medium waterways. Generally speaking, other project costs in Table HR-2 also fall within Evergreen’s range of estimates.
The higher cost projects appear to involve stabilization work other than just revegetation and/or work on steep terrain (e.g., 03-04 CDFG-285, 04-05 CDFG-263). For those projects that are identifiable to location, costs also appear to be higher in urban areas - e.g., southern California (05-06 CDFG-065, 069, 097) and King County, WA (Neal-T2, p159 & Neal-T3, p161). By contrast, cost in the rural Wind River watershed ($9-$42/ft, Bair-p107) falls toward the low end of Evergreen’s range.

Table HS-1. Streambank Improvements - $/lineal foot (Source: Evergreen 2003, p. 30)
Cost estimates pertain to Puget Sound. Estimates include construction, design, permitting, basic monitoring & routine maintenance (2 yrs), reestablishing site to prior conditions, project management.

<table>
<thead>
<tr>
<th>Extent of Excavation</th>
<th>Size of Waterway</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small</td>
</tr>
<tr>
<td>Minimal</td>
<td>$30-60</td>
</tr>
<tr>
<td>Moderate</td>
<td>$60-100</td>
</tr>
<tr>
<td>Substantial</td>
<td>$100-200</td>
</tr>
</tbody>
</table>

Table HS-2. Bank Stabilization - $/foot

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2004</td>
<td>typical</td>
<td>Distance from Road: 0.25-0.5mi: $250/ft 0.5-1mi: $275/ft 1-2mi: $300/ft 2-3mi: $325/ft &gt;3mi: $350/ft</td>
<td>CDFG’04, p1.19</td>
</tr>
<tr>
<td>GualalaR</td>
<td>01-02</td>
<td>3200'</td>
<td>$91,850 ($29/ft)</td>
<td>CDFG-196</td>
</tr>
<tr>
<td>NF MattoleR EelR</td>
<td>02-03</td>
<td>1500'</td>
<td>$46,806 ($31/ft)</td>
<td>CDFG-096</td>
</tr>
<tr>
<td>BearR-HmbldtCnty</td>
<td></td>
<td>4915'</td>
<td>$157.3K ($32/ft)</td>
<td>CDFG-134</td>
</tr>
<tr>
<td></td>
<td></td>
<td>260'</td>
<td>$37,962 ($146/ft)</td>
<td>CDFG-181</td>
</tr>
<tr>
<td>StaRosaCrk-SonomaCnty</td>
<td>03-04</td>
<td>350' long x 30' high creekbank</td>
<td>$124,201 ($355/ft) - stabilize/construct/revegetate</td>
<td>CDFG-285</td>
</tr>
<tr>
<td>Location</td>
<td>Year</td>
<td>Length</td>
<td>Cost/foot</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>------</td>
<td>--------</td>
<td>-----------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Salmon Crk</td>
<td>04-05</td>
<td>150'</td>
<td>$15,187</td>
<td>$101/ft - bioengineer</td>
</tr>
<tr>
<td>Russian R</td>
<td></td>
<td>150'</td>
<td>$18,774</td>
<td>$125/ft - bioengineer</td>
</tr>
<tr>
<td>Sta Ynez R</td>
<td></td>
<td>1500'</td>
<td>$75,065</td>
<td>$50/ft - boulder, bioengineer</td>
</tr>
<tr>
<td>Sta Ynez R</td>
<td></td>
<td>520'</td>
<td>$296,692</td>
<td>$571/ft - stabilize/construct/revegetate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$15,187</td>
<td>$101/ft - bioengineer</td>
</tr>
<tr>
<td>Ventura R</td>
<td>05-06</td>
<td>300'</td>
<td>$62,571</td>
<td>$209/ft - bioengineer</td>
</tr>
<tr>
<td>Sta Ynez R</td>
<td></td>
<td>1600'</td>
<td>$264,605</td>
<td>$165/ft - bioengineer</td>
</tr>
<tr>
<td>Sta Monica By</td>
<td></td>
<td>300'</td>
<td>$110,894</td>
<td>$370/ft - bioengineer</td>
</tr>
<tr>
<td>Klamath R</td>
<td></td>
<td>950'</td>
<td>$86,609</td>
<td>$91/ft - bioengineer</td>
</tr>
<tr>
<td>Eel R</td>
<td></td>
<td>3080'</td>
<td>$92,241</td>
<td>$30/ft - incl riparian tree planting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$62,571</td>
<td>$209/ft - bioengineer</td>
</tr>
<tr>
<td>SONC</td>
<td>98-05</td>
<td></td>
<td>$163.9K/mi</td>
<td>$31/ft - bioengineering</td>
</tr>
<tr>
<td>NOSECA/SONC</td>
<td></td>
<td></td>
<td>$181.9K/mi</td>
<td>$34/ft - bioengineering</td>
</tr>
<tr>
<td>SCACO</td>
<td></td>
<td></td>
<td>$510K/mi</td>
<td>$97/ft - bioengineering</td>
</tr>
<tr>
<td>CA</td>
<td>98-05</td>
<td></td>
<td>$163.9K/mi</td>
<td>$31/ft - bioengineering</td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td></td>
<td>$181.9K/mi</td>
<td>$34/ft - bioengineering</td>
</tr>
<tr>
<td>CA</td>
<td>02-04</td>
<td></td>
<td>$54</td>
<td>$31-$97/ft - bioengineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$54</td>
<td>$31-$97/ft - bioengineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Material Complexity:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Minimal: $30 ($5-$59)/ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderate: $120 ($4-$750)/ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Substantial: $181 ($6-$895)/ft</td>
<td></td>
</tr>
<tr>
<td>Sacramnto/San Joaquin Delta</td>
<td>2002</td>
<td>3.72 mi</td>
<td>$1.5M ($76/ft)</td>
<td>bioengineering, planting/baffling</td>
</tr>
<tr>
<td>Wind R-WA</td>
<td>2000</td>
<td>typical</td>
<td>$9-$42/ft</td>
<td>bioengineering</td>
</tr>
<tr>
<td>King County, WA</td>
<td>1995</td>
<td>1400'</td>
<td>$444K ($317/ft)</td>
<td>- instream/floodplain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100'</td>
<td>$93K ($930/ft)</td>
<td>- LWD/bank stabilization*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2006$: $560K/project, $400/ft)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2006$: $113K/project, $1133/ft)</td>
<td></td>
</tr>
</tbody>
</table>

* Includes design, land/easements, permits, SEPA and construction. For 1995 project, replanting, irrigation and 5 year plant maintenance also included.
Table HS-3 provides levee-related cost estimates for several Central Valley rivers, the Pajaro and San Lorenzo Rivers (in Santa Cruz/Monterey counties), and Green River (in Washington). Comparison of estimates from different time periods suggests that levee repair costs have increased significantly (beyond the rate of inflation) - perhaps reflecting major change in levee demand and/or input supply conditions in recent years. **Central Valley:** A single example of levee evaluation costs was found ($11/foot; Harder 06, p21). Levee repair costs from the 1980s and early 1990s were ~$500-$1000/foot (after correcting for inflation). More recent cost estimates are ~$5K-$6K/foot. Although per-foot cost estimates were not available for the Yuba/Feather River project (EPS ‘06, Tables B1&B2), levee improvement: environmental mitigation cost ratios from that project (25:1 for the Yuba, 8:1 for the Feather) are provided here, as they may also be useful for recovery planning. **Pajaro/San Lorenzo River:** The 1989 cost estimates were ~$200-$500/foot (after correcting for inflation). The more recent estimates (developed by USACOE to evaluate various alternatives for Pajaro River flood protection) are ~$1.5K to $5K/foot. **Green River:** Suggests the wide range of costs possible for levee repair.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Valley</td>
<td>2006</td>
<td>typical</td>
<td>$60K/mi (11/ft) structural re-evaluation</td>
<td>Harder 06, p.21</td>
</tr>
<tr>
<td>SacrR</td>
<td>2006</td>
<td>29 sites, 30K ft</td>
<td>$172.5M ($5750/ft) emergency erosion repair</td>
<td>DWR 06</td>
</tr>
<tr>
<td>Bear River</td>
<td>2007</td>
<td>10K ft</td>
<td>$51M ($5.1K/ft) - setback</td>
<td>GEI 07</td>
</tr>
<tr>
<td>Twitchell Island, SanJoaqR</td>
<td>early 90s</td>
<td>3K ft</td>
<td>$2.5M/mi ($473/ft) - setback (2006$: $636/ft) $3.5-$4M/mi ($663-$758/ft) - setback+planting (2006$: $891-$1019/ft)</td>
<td>Nuedeck 00</td>
</tr>
<tr>
<td>Yuba R Plain FeatherRPlain</td>
<td>2006</td>
<td></td>
<td>Levee improve$:envir mitigatn$ $40.5M:$1.6M=25:1 $191.6M/$23.4M=8:1</td>
<td>EPS 06, Tables B-1 &amp; B-2</td>
</tr>
<tr>
<td>Region</td>
<td>Year</td>
<td>Length</td>
<td>Description</td>
<td>Cost</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------</td>
<td>--------</td>
<td>--------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Pajaro River mainstem</td>
<td>2002</td>
<td>11.4mi*</td>
<td>Alt 1-$145.8M ($2422/ft), floodwall/levee raise</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>60,192'</td>
<td>Alt 2-$175.4M (2914/ft), 100'setback</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alt 3-$177.3M ($2946/ft), 100'-225' setback</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alt 4-$322.2M ($5353/ft), floodwall</td>
<td></td>
</tr>
<tr>
<td>Pajaro River tributaries</td>
<td>2002</td>
<td>4.4mi*</td>
<td>Alt T1-$35.1M ($1511/ft), levee raise</td>
<td></td>
</tr>
<tr>
<td>(Salsipuedes &amp; Corralitos</td>
<td></td>
<td>23,232'</td>
<td>Alt T2-$38.8M (1670/ft), setback</td>
<td></td>
</tr>
<tr>
<td>Creeks)</td>
<td></td>
<td></td>
<td>Alt T3-$34.7M ($1494/ft), hybrid raise/setback</td>
<td></td>
</tr>
<tr>
<td>Pajaro River mainstem (MS) &amp;</td>
<td>2003</td>
<td>15.8mi*</td>
<td>Alts 2A&amp;T4-$217.7M ($2610/ft), 100' setback</td>
<td></td>
</tr>
<tr>
<td>tributaries (T)</td>
<td></td>
<td>83,424'</td>
<td>Alts 3&amp;T3-$218.3M ($2617/ft), 225' setback</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alts 2A&amp;T3-$215.3M ($2581/ft), 100' MS, 225' T</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alts 3&amp;T4-$220.7M ($2646/ft); 225' MS, 100' T</td>
<td></td>
</tr>
<tr>
<td>* Info on project size obtained from MIG Inc (2001), p. 14. Mainstem includes river reaches 1-4; tributaries include river reaches 5-6.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green River, Seattle</td>
<td>2007</td>
<td>typical</td>
<td>$1K-$15K/ft, repair</td>
<td></td>
</tr>
</tbody>
</table>

**HU - WATERSHED RESTORATION (UPSLOPE)**

This section covers upslope restoration to reduce stream sedimentation. Table HU-1 pertains to road decommissioning, Table HU-2 to road upgrade, Table HU-3 to landslide/gully stabilization and Table HU-4 to planting in upland areas (as distinct from riparian planting described in Table HR-4).

According to Weaver/Hagans (WH-T7, p100), road decommissioning costs generally range from $2K-$35K/mile but may go as high as $51K/mile for moderately difficult roads. Most of the other examples fall within Weaver/Hagans’ range. CDFG’s Coho Recovery Strategy (CDFG ‘04, p1.28) assumes $9K/mile, which is toward the lower end of the Weaver/Hagans’ range.
<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2000</td>
<td>typical</td>
<td>Moderately difficult roads: $51K/mi</td>
<td>WH-T7, p100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Range of roads: $2K-$35K/mi</td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>2004</td>
<td>typical</td>
<td>$9K/mi</td>
<td>CDFG’04 p1.28</td>
</tr>
<tr>
<td>KlamathR</td>
<td>02-03</td>
<td>9 mi</td>
<td>$32,029 ($3.6K/mi) - timber road</td>
<td>CDFG-214</td>
</tr>
<tr>
<td>Mendcno</td>
<td></td>
<td>3.5 mi</td>
<td>$105,025 ($30K/mi)</td>
<td>CDFG-233</td>
</tr>
<tr>
<td>Klamath</td>
<td></td>
<td>34.3 mi</td>
<td>$348,407 ($10.2K/mi) - forest road</td>
<td>CDFG-331</td>
</tr>
<tr>
<td></td>
<td>03-04</td>
<td>3.6 mi</td>
<td>$43,690 ($12.1K/mi)</td>
<td>CDFG-197 CDFG-267</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.5 mi</td>
<td>$137,495 ($16.2K/mi)</td>
<td></td>
</tr>
<tr>
<td>SalmonR</td>
<td>04-05</td>
<td>5.9 mi</td>
<td>$259,087 ($43.9K/mi)</td>
<td>CDFG-004</td>
</tr>
<tr>
<td>KlamathR</td>
<td></td>
<td>4.5 mi</td>
<td>$257,787 ($57.3K/mi)</td>
<td>CDFG-006</td>
</tr>
<tr>
<td>TrinityR</td>
<td></td>
<td>1.4 mi</td>
<td>$130,567 ($93.3K/mi)</td>
<td>CDFG-251</td>
</tr>
<tr>
<td></td>
<td>05-06</td>
<td>5 mi</td>
<td>$320,866 ($64.2K/mi)</td>
<td>CDFG-015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.25 mi</td>
<td>$188,560 ($83.8K/mi)</td>
<td>CDFG-119</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 mi</td>
<td>$333,736 ($111.2K/mi)</td>
<td>CDFG-120</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.7 mi</td>
<td>$411,567 ($42.4K/mi)</td>
<td>CDFG-121</td>
</tr>
<tr>
<td></td>
<td>06-07</td>
<td>13.3 mi</td>
<td>$392,797 ($29.5K/mi)</td>
<td>CDFG-169 CDFG-104</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.33 mi</td>
<td>$25,000 ($10.7K/mi)</td>
<td></td>
</tr>
<tr>
<td>SONC</td>
<td>98-05</td>
<td>2 sites</td>
<td>$121.6K ($8.2K-$235K)/mi</td>
<td>HT07a-T61, p121</td>
</tr>
<tr>
<td></td>
<td>2003$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>02-04</td>
<td>39 sites</td>
<td>$34,090 ($4K-$200K)/mi</td>
<td>HT07b-T76, p101.contrctr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>98-05</td>
<td>3 sites</td>
<td>$285.2K ($164K-$510K)/mi</td>
<td>HT07b-T77, p102,CHRHPD</td>
</tr>
<tr>
<td></td>
<td>2003$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WA-ForestSvc</td>
<td>2000</td>
<td>6 sites</td>
<td>$6,522 ($1.8K-$15K)/km, or $4.1K ($1.1K-$9.3K)/mi</td>
<td>Coffin-T1, p53</td>
</tr>
</tbody>
</table>
According to Weaver/Hagans (WH-T7, p100), road upgrade costs are generally $10K-$35K/mile but may go higher than $45K/mile for difficult or high-density sites. CDFG’s Coho Recovery Strategy (CDFG ‘04, p1.27) assumes $15.9K/mile, which is toward the lower end of the Weaver/Hagans’ range (~$23K/mile). Most of the other examples fall within Weaver/Hagans’ range.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2000</td>
<td>typical</td>
<td>Upgrade Type:</td>
<td>WH-T7, p100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Difficult, 100 yr design: $42.5K/mi</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mod-diff, hi-site density: $45.5K/mi</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Watershed-wide, low/high priority, 100 yr design:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$25K-$35K/mi</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Watershed-wide avg, 100 yr design: $10K-$35K/mi</td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>2004</td>
<td>typical</td>
<td>$15.9K/mi</td>
<td>CDFG’04 p1.27</td>
</tr>
<tr>
<td>MendenoCnty</td>
<td>01-02</td>
<td>1.1 mi</td>
<td>$32,963 ($30K/mi)</td>
<td>CDFG-159</td>
</tr>
<tr>
<td>SiskiyouCnty</td>
<td></td>
<td>17.6 mi</td>
<td>$741,656 ($42.1K/mi)</td>
<td>CDFG-165</td>
</tr>
<tr>
<td>KlamathR</td>
<td>02-03</td>
<td>22.2 mi</td>
<td>$558,016 ($25.1K/mi)</td>
<td>CDFG-017</td>
</tr>
<tr>
<td>SalmonR</td>
<td></td>
<td>16.7 mi</td>
<td>$698,384 ($41.8K/mi)</td>
<td>CDFG-018</td>
</tr>
<tr>
<td>SalmonR</td>
<td></td>
<td>16.7 mi</td>
<td>$492,376 ($29.5K/mi)</td>
<td>CDFG-019</td>
</tr>
<tr>
<td>SmithR</td>
<td>03-04</td>
<td>10.9 mi</td>
<td>$509,363 ($46.7K/mi)</td>
<td>CDFG-007</td>
</tr>
<tr>
<td>MndocinoCnty</td>
<td></td>
<td>6 mi</td>
<td>$173.3 ($28.9K/mi)</td>
<td>CDFG-037</td>
</tr>
<tr>
<td>EelR</td>
<td>04-05</td>
<td>12.1 mi</td>
<td>$176,718 ($14.6K/mi)</td>
<td>CDFG-027</td>
</tr>
<tr>
<td>RussianR</td>
<td></td>
<td>11.7 mi</td>
<td>$560,476 ($47.9K/mi)</td>
<td>CDFG-111</td>
</tr>
<tr>
<td>GarciaR</td>
<td></td>
<td>5.25 mi</td>
<td>$155,382 ($29.6K/mi)</td>
<td>CDFG-195</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>23.1 mi</td>
<td>$299,076 ($12.9K/mi)</td>
<td>CDFG-225</td>
</tr>
<tr>
<td>RussianR</td>
<td></td>
<td>11 mi</td>
<td>$427,212 ($38.8K/mi)</td>
<td>CDFG-268</td>
</tr>
<tr>
<td>MattoleR</td>
<td></td>
<td>2 mi</td>
<td>$59,706 ($29.9K/mi)</td>
<td>CDFG-285</td>
</tr>
<tr>
<td>EelR</td>
<td>06-07</td>
<td>8 mi</td>
<td>$389,486 ($48.7K/mi)</td>
<td>CDFG-009</td>
</tr>
<tr>
<td>CA</td>
<td>98-05</td>
<td>12 sites</td>
<td>$18K ($1.9K-$52K/mi)</td>
<td>HT07a-T60, p118</td>
</tr>
<tr>
<td></td>
<td>2003$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Limited information contained in Table HU-3 (mostly from the Eel River) shows landslide repair costs ~ $1K-$3.5K/site.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>EelR</td>
<td>04-05</td>
<td>34 sites</td>
<td>$115.9K ($3410/site)</td>
<td>CDFG-156</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>54 sites</td>
<td>$86.5K ($1601/site)</td>
<td>CDFG-160</td>
</tr>
<tr>
<td>MarinCnty</td>
<td></td>
<td>80 sites</td>
<td>$279.8K ($3497/site)</td>
<td>CDFG-174</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>30 sites</td>
<td>$29.7K ($990/site)</td>
<td>CDFG-213</td>
</tr>
</tbody>
</table>

The estimate of upland planting cost in Table HU-4 falls toward the lower end of riparian planting costs previously described in Table HR-4; however, it is difficult to generalize from a single example.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>TrinityCnty</td>
<td>02-03</td>
<td>100 acres</td>
<td>$194,468 ($1945/acre)</td>
<td>CDFG-254</td>
</tr>
</tbody>
</table>
**TW - TAILWATER MANAGEMENT**

Cost of tailwater management is represented in Table TW-1 in terms of acres of farmland irrigated by tailwater. Costs are ~$20-$400/acre. The NRCS example suggests that cost per acre declines as total acreage increases.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiskiyouCnty</td>
<td>01-02</td>
<td>540 ac</td>
<td>$220.2K ($408/acre, collect, hold and return water to high end of unit for re-use)</td>
<td>CDFG-049</td>
</tr>
<tr>
<td>CA-rice</td>
<td>1990</td>
<td>typical</td>
<td>Static Type: Static irrig system*: $95/acre (6-10 acre basin) $135/acre (2006$: $20/acre (1000 acre system) to $150/acre (80 acre system) $28-$214/acre (2006$: Hill 4/7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Recirculating system: $20/acre (1000 acre system) to $150/acre (80 acre system)</td>
<td>Hill 3/7</td>
</tr>
</tbody>
</table>

* Static irrigation consists of a ditch and flashgated pipe system that limit inflow into basin to amount required to replenish water lost to evapotranspiration and percolation. This recent innovation in rice irrigation eliminates possibility of tailwater spillage into public drains.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Size of Area Covered by System:</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA-cotton</td>
<td>2000</td>
<td>typical</td>
<td>Furrow irrig+tailwater system: $60-$80/acre</td>
<td>Sanden</td>
</tr>
<tr>
<td>Colorado</td>
<td>1998</td>
<td>typical</td>
<td>$150-$225/acre (earthwork, pipeline install, pump assembly)</td>
<td>Broner</td>
</tr>
</tbody>
</table>
WC - WATER CONSERVATION MEASURES

This section pertains to methods of providing more efficient use of water extracted from stream systems. Table WC-1 pertains to ditch lining and Table WC-2 to piping.

Canal lining costs described in Table WC-1 are ~ $15-$96/foot. Such projects often involve installation of related equipment such as control structures. For large projects, the cost of planning/environmental/administrative aspects can comprise a substantial portion of total project costs (e.g., 62% of total costs for the ACID project). Project life ranges from 20-50 years. In cases where proponents provided estimates of project benefits (in terms of value of conserved water), benefits were estimated using water prices of $25-$75/acre foot.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson</td>
<td>01-03</td>
<td>2 mi</td>
<td>Cost Breakdown:</td>
<td>ACID</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Planning/environ/admin: ~$4M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Control struc, measurement flumes, SCADA systems@13 sites: $1.494M ($114.9K/site)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Concrete anal lining: $1M ($96/ft)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Project life=30yrs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Value conserved water=$50/af</td>
<td></td>
</tr>
<tr>
<td>MercedCnty</td>
<td>01-03</td>
<td>25K'</td>
<td>$2M ($79/ft, $3.4K/acre)</td>
<td>MCWD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>600 ac</td>
<td>Includes 50 control structures</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Project life=50yrs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Value conserved water=$25/af</td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>FY07</td>
<td>typical</td>
<td>Liner Type:</td>
<td>NRCS CA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Plain concrete: $20/ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Flexible membrane: $15/ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Galvanized steel: $20/ft</td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>01-03</td>
<td>13.5K'</td>
<td>$251K ($19/ft) - concrete</td>
<td>OWID</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Project life=20yrs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Value conserved water=$75/af</td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>2001</td>
<td>8K'</td>
<td>$242K ($30/ft) - concrete</td>
<td>OWID ‘01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Project life=20yrs</td>
<td></td>
</tr>
</tbody>
</table>
PlacerCnty 01-02 3 mi

Cost Breakdown:
Planning/environ/admin: $81K
12 remote flow monitoring stns:$450K ($37.5K/stn)
Canal lining: $794K ($50/ft) - concrete
Project life=25 yrs
Value conserved water=$40/af

As indicated in Table WC-2, the only piping example found was $16/foot.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA farmland</td>
<td>FY07</td>
<td>typical</td>
<td>$16/ft - irrig water conveyance, aluminum pipeline</td>
<td>NRCS CA</td>
</tr>
</tbody>
</table>

WD - WATER MEASURING DEVICES

This section pertains to instream and water diversion measuring devices to track mainstem/tributary flows. Table HB-4 above provides cost estimates for instream projects that involve use of head gates with other devices. Table WD-1 pertains to head gates alone. The limited examples provided indicate head gate costs of $2.8K-$10K.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiskiyouCnty</td>
<td>01-02</td>
<td>123</td>
<td>$350K ($2.8K/diversion) - lockable head gate &amp; flow measuring device</td>
<td>CDFG-056</td>
</tr>
<tr>
<td>ScottR-Klamath</td>
<td>06-07</td>
<td>14</td>
<td>$142K ($10.1K/diversion) - head gate &amp; flow measuring device</td>
<td>K033</td>
</tr>
<tr>
<td>CA farmland</td>
<td>FY07</td>
<td>typical</td>
<td>Headgate &lt;3cfs: $5K Headgate &gt;3cfs: $10K</td>
<td>NRCS CA</td>
</tr>
</tbody>
</table>
WP - WATER PURCHASE/LEASE

Table WP-1 pertains to purchase/lease/acquisition of short- or long-term water rights to improve water quality and/or quantity. The DWR sources indicate Central Valley water transfer prices of $43 - $246/acre foot/year. CDFG’s Coho Recovery Strategy (CDFG’04, p1.43) assumes $100/af/yr - a value within the range of the DWR data. The water prices in Table WC-2 (previously presented in section “WC-Water Conservation Measures”) are considerably higher than the prices imputed to water conserved in estimating value of water conserved by ditch lining in Table WC-2. A major distinction between the two is that Table WC-2 pertains to conserved water valued at the existing price being paid by the water user, while the Table WP-1 prices are transfer prices.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2004</td>
<td>typical</td>
<td>$100/af/yr</td>
<td>CDFG’04 p1.43</td>
</tr>
<tr>
<td>Central Valley</td>
<td>01-02</td>
<td>135K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.1K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>36.8K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>60.6K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upstream of Delta</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>State-YubaCntyWaterAgency: $10.1M ($75/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fed-SacmntoGrndwtrAgency: $535.7K ($75/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>South of Delta</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>State-KernCntyWtrAgency: $6.7M ($181/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fed-KernCntyWaterAgency: $11M ($181/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
<tr>
<td>Central Valley</td>
<td>02-03</td>
<td>4.9K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>65K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>125K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upstream of Delta</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>State-Orovil1WyandotteIrrigDist: $386.6K ($75/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>State-YubaCntyWaterAgency: $5.5M ($85/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>South of Delta</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>State-KernCntyWaterAgency: $21.3M ($170/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fed-StaClaravlyWaterDist: $3.2M ($162/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
<tr>
<td>Central Valley</td>
<td>03-04</td>
<td>100K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>35K af</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upstream of Delta</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>State-YubaCntyWaterAgency: $8.8M ($88/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>State-PlacerCntyWaterAgency: $1.7M ($83/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>South of Delta</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>State-KernCntyWaterAgency: $8.6M ($246/af/yr)</td>
<td>DWR</td>
<td></td>
</tr>
</tbody>
</table>
Central Valley | 04-05 | **Upstream of Delta**  
State-YubaCntyWaterAgency: $200K ($43/af/yr)  
**South of Delta**  
State-KernCntyWaterAgency: $15.8M ($177/af/yr)  
State-StaClaraVlyWaterDist: $1.6M ($184/af/yr) | DWR

<table>
<thead>
<tr>
<th>Proximity to Urban Area</th>
<th>Zoning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Forest</td>
</tr>
<tr>
<td>Far 41+ mi</td>
<td>$700-1800</td>
</tr>
<tr>
<td>Medium 21-40 mi</td>
<td>$1800-2400</td>
</tr>
<tr>
<td>Near 0-20 mi</td>
<td>$2400-4800</td>
</tr>
</tbody>
</table>

**HA - HABITAT ACQUISITIONS/LEASES/CONSERVATION EASEMENTS ($/ACRE)**

*Tables HA-1 and HA-2 respectively describe Evergreen’s cost estimates for undevelopable land and parcels with medium-high development potential. Table HA-3 describes costs of easements and land purchases administered by California’s Wildlife Conservation Board (WCB). Tables HA-4 and HA-5 respectively describe land acquisition and easement costs from a variety of other sources. Evergreen’s estimates are inclusive of transaction and management costs as well as land acquisition price, while WCB’s estimates include only acquisition price. The other data sources likely also include only acquisition price.*

*Evergreen’s prices are $700-$4800/acre for undevelopable land (Table HA-1. For parcels with medium/high development potential and low to high amenity value, prices are $5K-$300K/acre for rural residential land, $60K-$600K/acre for suburban residential land, and $300K-$1.2M/acre for urban land; prices of parcels with very high amenity value are unpredictable (Table HA-2).*

**Table HA-1. Cost of Undevelopable Land - $/acre (Source: Evergreen 2003, p. 7)**

Cost estimates pertain to Puget Sound. Estimates include appraisal, closing, commission, surveying, legal, project management costs.
Table HA-2. Cost of Parcels with Medium-High Development Potential - $/acre
(Source: Evergreen 2003, p. 6)
Cost estimates pertain to Puget Sound. Estimates include appraisal, closing, commission, surveying, legal, project management costs.

<table>
<thead>
<tr>
<th>Zoning</th>
<th>Amenity Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Rural Residential</td>
<td>$5K-35K</td>
</tr>
<tr>
<td>Suburban Residtl</td>
<td>$60K-120K</td>
</tr>
<tr>
<td>Urban</td>
<td>$300K-600K</td>
</tr>
</tbody>
</table>

The prices in Table HA-3 were derived by dividing WCB’s expenditures for purchase/easement in each county by the number of acres subject to purchase/easement. These derived prices are $42-$104.7K/acre for easements, and $267-$45.5K/acre for acquisitions. The acquisition prices are on the low side relative to Evergreen’s estimates of $5K-$300K/acre for rural land and $300K-$1.2M/acre for urban land, (Table HA-2) and likely underestimate actual costs, as WCB’s wildlife habitat acquisitions are often done on a cost-share basis.

Table HA-3. WCB Actions in 2000-2004: Total Acreage and $/Acre, by County
(Source: Wildlife Conservation Board, 2005)

<table>
<thead>
<tr>
<th>County</th>
<th>Conservation Easement</th>
<th>Fee Title</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres</td>
<td>$/Acre</td>
</tr>
<tr>
<td>Alameda</td>
<td>16,500</td>
<td></td>
</tr>
<tr>
<td>Alpine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butte</td>
<td>10,369</td>
<td>$866</td>
</tr>
<tr>
<td>Calaveras</td>
<td>3,669</td>
<td>$395</td>
</tr>
<tr>
<td>Colusa</td>
<td>13,131</td>
<td>$128</td>
</tr>
<tr>
<td>Contra Costa</td>
<td>3,808</td>
<td>$843</td>
</tr>
<tr>
<td>Del Norte</td>
<td>25,675</td>
<td>$812</td>
</tr>
<tr>
<td>El Dorado</td>
<td>1,178</td>
<td>$501</td>
</tr>
<tr>
<td>Fresno</td>
<td>1,310</td>
<td>$7,291</td>
</tr>
<tr>
<td>County</td>
<td>Code</td>
<td>Population</td>
</tr>
<tr>
<td>-------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>Glenn</td>
<td></td>
<td>24,158</td>
</tr>
<tr>
<td>Humboldt</td>
<td>3,640</td>
<td>5,905</td>
</tr>
<tr>
<td>Imperial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inyo</td>
<td>218</td>
<td></td>
</tr>
<tr>
<td>Kern</td>
<td>4,743</td>
<td>$1,093</td>
</tr>
<tr>
<td>Lake</td>
<td>269</td>
<td>$968</td>
</tr>
<tr>
<td>Lassen</td>
<td>278</td>
<td>$1,079</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>4,178</td>
<td>$43,083</td>
</tr>
<tr>
<td>Madera</td>
<td>443.5</td>
<td>1,140</td>
</tr>
<tr>
<td>Marin</td>
<td>737</td>
<td>$7,017</td>
</tr>
<tr>
<td>Mariposa</td>
<td>6,801</td>
<td>$487</td>
</tr>
<tr>
<td>Mendocino</td>
<td>560</td>
<td>$267</td>
</tr>
<tr>
<td>Merced</td>
<td>15,620</td>
<td>4,359</td>
</tr>
<tr>
<td>Modoc</td>
<td>2,080</td>
<td>$640</td>
</tr>
<tr>
<td>Mono</td>
<td>6,350</td>
<td>$1,387</td>
</tr>
<tr>
<td>Monterey</td>
<td>27,715</td>
<td>14,598</td>
</tr>
<tr>
<td>Napa</td>
<td>17</td>
<td>$546</td>
</tr>
<tr>
<td>Nevada</td>
<td>494</td>
<td>$1,387</td>
</tr>
<tr>
<td>Orange</td>
<td>6,508</td>
<td>$12,782</td>
</tr>
<tr>
<td>Placer</td>
<td>155</td>
<td>$1,131</td>
</tr>
<tr>
<td>Plumas</td>
<td>21,137</td>
<td>279</td>
</tr>
<tr>
<td>Riverside</td>
<td>1,324</td>
<td>$1,871</td>
</tr>
<tr>
<td>Sacramento</td>
<td>5,526</td>
<td>$1,159</td>
</tr>
<tr>
<td>San Bernardino</td>
<td>572</td>
<td>$6,324</td>
</tr>
<tr>
<td>San Diego</td>
<td>54,871</td>
<td>$2,135</td>
</tr>
<tr>
<td>San Francisco</td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Joaquin</td>
<td>3,515</td>
<td>$545</td>
</tr>
<tr>
<td>County</td>
<td>Acreage</td>
<td>Cost/acre</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
<td>-----------</td>
</tr>
<tr>
<td>San Luis Obispo</td>
<td>82,106</td>
<td>$420</td>
</tr>
<tr>
<td>San Mateo</td>
<td>1,000</td>
<td>0</td>
</tr>
<tr>
<td>Santa Barbara</td>
<td>1,406</td>
<td>$2,156</td>
</tr>
<tr>
<td>Santa Clara</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Santa Cruz</td>
<td>18</td>
<td>$167</td>
</tr>
<tr>
<td>Shasta</td>
<td>3,784</td>
<td>$158</td>
</tr>
<tr>
<td>Sierra</td>
<td>500</td>
<td>$620</td>
</tr>
<tr>
<td>Siskiyou</td>
<td>2,479</td>
<td>$42</td>
</tr>
<tr>
<td>Solano</td>
<td>535</td>
<td>$1,903</td>
</tr>
<tr>
<td>Sonoma</td>
<td>165</td>
<td>$10,333</td>
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<tr>
<td>Stanislaus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sutter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tehama</td>
<td>21,557</td>
<td>$116</td>
</tr>
<tr>
<td>Tulare</td>
<td>722</td>
<td>$176</td>
</tr>
<tr>
<td>Tuolumne</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventura</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yolo</td>
<td>6,983</td>
<td>$351</td>
</tr>
<tr>
<td>Yuba</td>
<td>2,115</td>
<td>$56</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Tables HA-4 and HA-5 include information on habitat type, when available. Several projects involved expenditures on both acquisition and easement where it was not possible to determine how much was spent on each. Such projects were placed in Table HA-4 if most of the acreage involved acquisition and in Table HA-5 if most of the acreage involved easement; cost per acre was estimated by dividing total cost by total acreage (acquisition + easement).*

*Land acquisition values used by NMFS for the Columbia River Estuary Recovery Plan were $5K/acre for rural land and $100K/acre for urban land (Table HA-4, NOAA p5-46). These values are as low or lower than Evergreen’s lowest prices for rural and urban land ($5K/acre and $300K/acre respectively, Table HA-2). For most other acquisitions described in Table HA-4, prices are ~ $200-$20K/acre, with the notable exception of several multi-million-dollar-per-*
acre purchases in north/central California and southern California - both highly urbanized areas (Table HA-4: HT07a-T61, p121, NOCECA and SCACO). Prices of conservation easements (Table HA-5) are ~$300-$5.7K/acre - with the notable exception of a $65K/acre easement in Santa Barbara (CntySBPublicWrks).

<table>
<thead>
<tr>
<th>Table HA-4. Land Acquisition - $/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
</tr>
<tr>
<td>ColR</td>
</tr>
<tr>
<td>Mill/RockCrks-SmithR-DelNorteCnty</td>
</tr>
<tr>
<td>SLOCreek</td>
</tr>
<tr>
<td>SONC</td>
</tr>
<tr>
<td>NOCECA CentralValley SCACO</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>SanFranBay</td>
</tr>
<tr>
<td>Badger Creek (Cosumnes River)</td>
</tr>
<tr>
<td>Cache Slough (Sacramento/ SanJoaquinDelta)</td>
</tr>
<tr>
<td>San Joaquin River</td>
</tr>
<tr>
<td>Sacramento River</td>
</tr>
<tr>
<td>Sacramento River</td>
</tr>
<tr>
<td>Butte Creek</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Merced River, Tuolumne River</td>
</tr>
<tr>
<td>Butte Creek</td>
</tr>
<tr>
<td>Sacramento River</td>
</tr>
<tr>
<td>Petaluma River</td>
</tr>
<tr>
<td>San Joaquin River</td>
</tr>
<tr>
<td>Napa River Marsh</td>
</tr>
<tr>
<td>Cosumnes River</td>
</tr>
<tr>
<td>Tuolumne River</td>
</tr>
<tr>
<td>Cosumnes/Mokelumne Rivers</td>
</tr>
<tr>
<td>Stanislaus River</td>
</tr>
<tr>
<td>Sacramento/San Joaquin Delta</td>
</tr>
</tbody>
</table>
### Table HA-5. Conservation Easement - $/acre

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacrmnto/San Joaquin Delta</td>
<td>2002</td>
<td>1166 acres</td>
<td>$23M ($19.7K/acre) - wetland/upland, Dutch Slough</td>
<td>ERP-02-C07-D</td>
</tr>
<tr>
<td>Tuolumne River</td>
<td>2002</td>
<td>198 acres</td>
<td>$706.6K($3.6K/acre) - floodplain/riparian habitat, Big Bend 66 acres fee, 132 acres easement</td>
<td>ERP-02-D01</td>
</tr>
<tr>
<td>Stanislaus River</td>
<td>2002</td>
<td>184 acres</td>
<td>$2.4M + $357K project mgmt &amp; admin ($13.2K/acre)</td>
<td>ERP-02D-C11</td>
</tr>
<tr>
<td>PetalumaRivDelta, SanPabloBay</td>
<td>2002</td>
<td>631 acres</td>
<td>$2.0M ($3.2K/acre) - tidal wetland/adjacent upland, Bahia site</td>
<td>ERP-02-P14</td>
</tr>
<tr>
<td>BigChicoCreek/MudCreek/SacrmntoRiver</td>
<td>2002</td>
<td>146 acres</td>
<td>$2.278M + $59.5K project mgmt &amp; admin ($15.6K/acre) - irrigated cropland</td>
<td>ERP-02-P16-D</td>
</tr>
<tr>
<td>Crevis Creek (Deer Creek, Cosumnes River)</td>
<td>2002</td>
<td>294 acres</td>
<td>$823.2K ($2.8K/acre)</td>
<td>ERP-02-P49</td>
</tr>
<tr>
<td>CA-03-04 typical</td>
<td></td>
<td></td>
<td>$209-$730/acre - rangeland</td>
<td>Anon’06,p4</td>
</tr>
<tr>
<td>Wolverton Gulch-Van DuzenR-HmboldtCnty ArroyoSeco R-MntereyCnty</td>
<td>04-05</td>
<td>48 acres</td>
<td>$30K ($625/acre)</td>
<td>CDFG-128</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100 acres</td>
<td>$300K ($3K/acre)</td>
<td>CDFG-259</td>
</tr>
<tr>
<td>SouthCoast StaBarbCnty</td>
<td>07-12</td>
<td>5 acres</td>
<td>$3.525M ($65K/acre)</td>
<td>CntySB PublicWrks</td>
</tr>
<tr>
<td>San Joaquin River</td>
<td>2001</td>
<td>362 acres</td>
<td>$2.075M ($5.7K/acre) - riparian/seasonal wetland</td>
<td>ERP-01-N08</td>
</tr>
<tr>
<td>Battle Creek</td>
<td>2001</td>
<td>2499 acres</td>
<td>$851.6K ($341/acre)</td>
<td>ERP-01-N24</td>
</tr>
<tr>
<td>Location</td>
<td>Year</td>
<td>Acres</td>
<td>Cost (Price/acre)</td>
<td>Details</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------</td>
<td>--------</td>
<td>-----------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>North Fork Cosumnes R</td>
<td>2002</td>
<td>2,162</td>
<td>$2.0M ($925/acre) - riparian/upslope</td>
<td>1,814 acres easement, 348 acres fee</td>
</tr>
<tr>
<td>Mill Creek/Deer Creek</td>
<td>2002</td>
<td>23,846</td>
<td>$4.470K ($187/acre) - agricultural land</td>
<td></td>
</tr>
<tr>
<td>Tuolumne River</td>
<td>1998</td>
<td>140</td>
<td>$687.0K ($4.9K/acre) - permanent easement, Grayson Riv Ranch</td>
<td></td>
</tr>
<tr>
<td>San Joaquin River Delta</td>
<td>1998</td>
<td>168</td>
<td>$425K ($2.5K/acre) - permanent easement, Fern Headreach Island complex</td>
<td></td>
</tr>
<tr>
<td>Deer Crk/Mill Crk - Sac R</td>
<td>1998</td>
<td>166</td>
<td>$688K ($4.2K/acre) - orchards/row crop agriculture/lowlands</td>
<td></td>
</tr>
<tr>
<td>Sacramento River</td>
<td>1999</td>
<td>1,512</td>
<td>$2.0M ($1.3K/acre) - riparian/riverine</td>
<td></td>
</tr>
<tr>
<td>Lwr Tuolumne/San Joaquin</td>
<td>1999</td>
<td>1,073</td>
<td>$1.4M ($1.3K/acre) - floodplain</td>
<td></td>
</tr>
<tr>
<td>Battle Creek</td>
<td>1999</td>
<td>6,851</td>
<td>$2.048M ($299/acre) - 3 ranches, woodland/riparian/grassland/chaparral</td>
<td></td>
</tr>
</tbody>
</table>

**MD - MONITORING STATUS AND TRENDS** (includes monitoring of baseline, status and trends in habitat, watershed processes and/or populations)

*Table MD-1 includes monitoring projects funded by CDFG’s Fisheries Restoration Grants Program over the past three fiscal years. Information on the nature of monitoring is provided, as available. Most of the projects focus on life history, migration, distribution, and abundance of particular species on particular streams. Costs are ~$12K-$300K/project. Most of the >$200K projects (e.g., 04-05 CDFG-054, CDFG-208, CDFG-260, CDFG-261; 05-06 CDFG-158 and CDFG-159) appear to have a strong analytical as well as monitoring component.*
<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>TopangaCrk</td>
<td>04-05</td>
<td>$98.3K-relate rainfall to recruitment/survival</td>
<td>CDFG-009</td>
</tr>
<tr>
<td>StaMonicaBay</td>
<td></td>
<td>$152.9K-steelhead abund/distribution</td>
<td>CDFG-010</td>
</tr>
<tr>
<td>MillCrk</td>
<td></td>
<td>$156.9K-life history, pop size</td>
<td>CDFG-012</td>
</tr>
<tr>
<td>SproulCrk(EelR)</td>
<td></td>
<td>$45.9K-production, run timing &amp; size</td>
<td>CDFG-040</td>
</tr>
<tr>
<td>HumboldtBay</td>
<td></td>
<td>$216.2K-estuary use/residence time</td>
<td>CDFG-048</td>
</tr>
<tr>
<td>UpprRedwdCrk</td>
<td></td>
<td>$65.1K-juvenile migration, biometric data</td>
<td>CDFG-051</td>
</tr>
<tr>
<td>LowrRedwdCrk</td>
<td></td>
<td>$62.3K-juvenile migration, biometric data</td>
<td>CDFG-052</td>
</tr>
<tr>
<td>MendocnoCnty</td>
<td></td>
<td>$281.2K-life history in 6 streams, eval potential biases in spawning surveys</td>
<td>CDFG-054</td>
</tr>
<tr>
<td>ScottCrk</td>
<td></td>
<td>$192K-life history, support artificial propag programs to maintain ESA-listed pops</td>
<td>CDFG-153</td>
</tr>
<tr>
<td>SoCenCA</td>
<td></td>
<td>$82.4K-baseline data on spawning/rearing habitat conditions in 8 watersheds</td>
<td>CDFG-196</td>
</tr>
<tr>
<td>ScottR</td>
<td></td>
<td>$67K-data on watershed condition/stock status</td>
<td>CDFG-200</td>
</tr>
<tr>
<td>ScottR</td>
<td></td>
<td>$77.8K-outmigrant trapping</td>
<td>CDFG-202</td>
</tr>
<tr>
<td>ScottR</td>
<td></td>
<td>$45.9K-streamflow/precip gauging for Water Balance Model</td>
<td>CDFG-205</td>
</tr>
<tr>
<td>PrairieCrk-Hmbldt</td>
<td></td>
<td>$211.2K-validate monitoring protocols for watershed restoration</td>
<td>CDFG-208</td>
</tr>
<tr>
<td>Scott/ShastaR</td>
<td></td>
<td>$169.4K-juvenile migration</td>
<td>CDFG-224</td>
</tr>
<tr>
<td>DelNorte/Hmbldt</td>
<td></td>
<td>$307.1K-juvenile sal abundance for 2 regional watersheds, validate effectiveness of juvenile abundance trends as indic of adult pop cons</td>
<td>CDFG-260</td>
</tr>
<tr>
<td>SLO</td>
<td></td>
<td>$238.3K-distribution/habitat use; quantify linkages among stream physical habitat, water quality, macroinverts, land use &amp; fish</td>
<td>CDFG-261</td>
</tr>
<tr>
<td>CanoeCrk-Hmbldt</td>
<td></td>
<td>$65.8K-effect of wildfire on habitat &amp; aquatic ecosystem processes</td>
<td>CDFG-071</td>
</tr>
<tr>
<td>Location</td>
<td>Year</td>
<td>Project Description</td>
<td>Cost</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Mattole, Eel/Salinas, SLrnzo, McGarvey Crk (Klamath River)</td>
<td>05-06</td>
<td>$11.5K-life stage monitoring, smolt prod est</td>
<td>CDFG-082</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$78.2K-historical baseline for genetic monitoring</td>
<td>CDFG-089</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$141.9K-life history, pop status</td>
<td>CDFG-116</td>
</tr>
<tr>
<td>Mendocino County</td>
<td></td>
<td>$183.8K-life history 3 streams, evaluate potential biases in spawning surveys</td>
<td>CDFG-158</td>
</tr>
<tr>
<td>Freshwater Crk</td>
<td></td>
<td>$264.8K-life history, eval potential biases in spawning surveys</td>
<td>CDFG-159</td>
</tr>
<tr>
<td>Upper Rdwood Crk</td>
<td></td>
<td>$48K-estimate smolt pop using mark-recapture</td>
<td>CDFG-164</td>
</tr>
<tr>
<td>Lower Rdwood Crk</td>
<td></td>
<td>$53.9K-estimate smolt pop using mark-recapture</td>
<td>CDFG-166</td>
</tr>
<tr>
<td>Tomales Bay</td>
<td></td>
<td>$149.5K-life history</td>
<td>CDFG-245</td>
</tr>
<tr>
<td>Scott/Shasta R</td>
<td></td>
<td>$170.4K-juvenile migration</td>
<td>CDFG-252</td>
</tr>
<tr>
<td>Matilija Crk</td>
<td></td>
<td>$140K-steelhead assessment</td>
<td>CDFG-277</td>
</tr>
<tr>
<td>Mattole R</td>
<td>06-07</td>
<td>$15.6K-downstream migrant monitoring, abundance estimate for chinook/coho</td>
<td>CDFG-207</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$17K-smolt production monitoring</td>
<td>CDFG-208</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$48.4K-smolt abundance estimation</td>
<td>CDFG-064</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$54.4K-smolt abundance estimation</td>
<td>CDFG-066</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$170K-juvenile emigration monitoring</td>
<td>CDFG-127</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$30K-escapement monitoring</td>
<td>CDFG-204</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$168K-estuary use/residence time by juv sal</td>
<td>CDFG-062</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$55.3K-steelhead distribution/abundance</td>
<td>CDFG-027</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$76.6K-juvenile stlhead distribution/abundance</td>
<td>CDFG-034</td>
</tr>
</tbody>
</table>

**MO - MONITORING WATERSHED RESTORATION**

*Table MO-1 pertains to implementation monitoring to determine if project treatments were constructed correctly and as planned, effectiveness monitoring to determine if restoration has produced desired habitat conditions and/or watershed processes, validation monitoring to determine if hypothesized responses of habitat, watershed processes and/or populations to restoration were correct.*

*The descriptions in Table MO-1 pertain to the type of restoration activity being monitored, with the cost estimates pertaining only to the monitoring component. The highest cost ($221.7K, ERP-97-N13) was for a bank stabilization project involving large-scale monitoring of many variables. Costs associated with monitoring of other individual projects ranged from $7K (for revegetation project ERP-97-N08) to $90K (for fish screen evaluation project ERP-97-C02). Several other estimates ($87.4K for 04-05 CDFG-036, $142K for 05-06 CDFG-171) involved monitoring of multiple projects funded by CDFG’s Fisheries Restoration Grants Program.*
<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>04-05</td>
<td>$87.4K - monitor pending/completed Fisheries Restoration Grants projects</td>
<td>CDFG-036</td>
</tr>
<tr>
<td>CanoeCrk-Hmbldt</td>
<td></td>
<td>$65.8K - effect of wildfire on habitat &amp; aquatic ecosystem processes</td>
<td>CDFG-071</td>
</tr>
<tr>
<td>ShastaR</td>
<td></td>
<td>$61.4K - monitor restoration sites for project effectiveness (habitat and fish)</td>
<td>CDFG-273</td>
</tr>
<tr>
<td>Mattole</td>
<td></td>
<td>$65.1K - evaluate effectiveness of watershed rehab project</td>
<td>CDFG-284</td>
</tr>
<tr>
<td>CA</td>
<td>05-06</td>
<td>$142K - monitor pending/completed Fisheries Restoration Grants projects</td>
<td>CDFG-171</td>
</tr>
<tr>
<td>Sacramento River</td>
<td>1997</td>
<td>$90K - screen evaluation project at Princeton Pumping Plant Fish Screen Facility</td>
<td>ERP-97-C02</td>
</tr>
<tr>
<td>Tuolumne River</td>
<td>1997</td>
<td>$47.6K - spawning gravel introduction (11K tons)</td>
<td>ERP-97-C11</td>
</tr>
<tr>
<td>Sacramento River</td>
<td>1997</td>
<td>$34K - restoration of 200 acres agricultural land to native riparian forest</td>
<td>ERP-97-N03a</td>
</tr>
<tr>
<td>Sacramento River</td>
<td>1997</td>
<td>$102.5K - restoration of 93 acres agricultural land to native riparian forest</td>
<td>ERP-97-N03b</td>
</tr>
<tr>
<td>Mill Creek/Sacramento River</td>
<td>1997</td>
<td>$7.0K - restoration of native riparian vegetation for anadromous fish</td>
<td>ERP-97-N08</td>
</tr>
<tr>
<td>Barker/Lindsay/Cache Sloughs-Sac/SanJoaqDelta</td>
<td>1997</td>
<td>$29.8K - vegetative restoration</td>
<td>ERP-97-N10</td>
</tr>
<tr>
<td>Barker/Lindsay/Cache Sloughs-Sac/SanJoaqDelta</td>
<td>1997</td>
<td>$48.7K - exotic species removal</td>
<td>ERP-97-N10</td>
</tr>
<tr>
<td>Georgiana Slough/NoMokelumne R-Sac/SanJoaqDelta</td>
<td>1997</td>
<td>$221.7K - evaluation of alternative vegetative/biotechnical techniques for stabilizing bank erosion/restoring levees</td>
<td>ERP-97-N13</td>
</tr>
<tr>
<td>Tolay Creek-San Pablo Bay</td>
<td>1997</td>
<td>$60K - 435 acre wetland restoration</td>
<td>ERP-97-N19</td>
</tr>
<tr>
<td>Sacramento River</td>
<td>1998</td>
<td>$49K - fish screen construction</td>
<td>ERP-98-B26</td>
</tr>
<tr>
<td>Sacramento River</td>
<td>2000</td>
<td>$10.8K - fish screen installation on intake structure at Pump Station #1</td>
<td>ERP-00-B01</td>
</tr>
<tr>
<td>San Joaquin River</td>
<td>2001</td>
<td>$233.4K - riparian/wetland restoration</td>
<td>ERP-01-N08</td>
</tr>
<tr>
<td>Sacramento River</td>
<td>2001</td>
<td>$86.3 ($8.6K/screen) 10 vertical screens &lt;40 cfs</td>
<td>ERP-01-N52</td>
</tr>
<tr>
<td>Tuolumne River</td>
<td>2002</td>
<td>$203K - riparian floodplain/riverine habitat</td>
<td>ERP-02-P19-D</td>
</tr>
<tr>
<td>Mokelumne River</td>
<td>2002</td>
<td>$224.9K - songbird response to riparian restoration</td>
<td>ERP-02-P20</td>
</tr>
</tbody>
</table>

**PL - WATERSHED EVALUATION, ASSESSMENT AND PLANNING**

*Table PL-1 provides examples of watershed evaluations/assessments, including partial assessments such as road erosion surveys and stream surveys. Almost all of the examples in the table come from CDFG’s Fisheries Restoration Grants Program. Information on the nature of the assessment is provided, as available. Included are road inventory/sediment assessments (costed at $/mile), stream crossing assessments (costed at $/crossing), and watershed/estuary plans (costed at $/acre). According to Weaver/Hagans (WH-p91), the Grants Program allows up to $1.2K/mile for road assessments; just about all the road assessment examples in Table PL-1 meet this criterion. Stream crossing assessments cost $650-$1365/crossing. Most of the watershed plans cost $8-$13/acre and appeared to pertain mostly to erosion control. Several exceptions include a project on the Klamath River to address riparian/channel problems ($76/acre, 05-06 CDFG-115) and two projects involving Humboldt Bay ($853 and $3157/acre, 02-03 CDFG-169 & 227). CDFG’s Coho Recovery Strategy (CDFG’04, p1.34) uses a planning cost estimate that is not scaled to the size of the plan ($200K/planning exercise).*
<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2000</td>
<td>mile</td>
<td>$1.2K (max allowed by CDFG FRGP for full inventory/assessment/erosion control plan for roads)</td>
<td>WH-p91</td>
</tr>
<tr>
<td>HumboldtCnty</td>
<td>01-02</td>
<td>6063 ac</td>
<td>$48,080 ($8/acre) - erosion/hab rest</td>
<td>CDFG-106</td>
</tr>
<tr>
<td>DelNorteCnty</td>
<td></td>
<td>8718 ac</td>
<td>$83,959 ($10/acre) - erosion/hab rest</td>
<td>CDFG-107</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>45 mi</td>
<td>$20,338 ($452/mi) - road inventory</td>
<td>CDFG-136</td>
</tr>
<tr>
<td>HumboldtCnty</td>
<td></td>
<td>7 mi</td>
<td>$2011 ($287/mi) - road inventory</td>
<td>CDFG-140</td>
</tr>
<tr>
<td>HumboldtCnty</td>
<td></td>
<td>10.3 mi</td>
<td>$11,387 ($1106/mi) - road inventory</td>
<td>CDFG-141</td>
</tr>
<tr>
<td>RussianR</td>
<td>02-03</td>
<td>20 mi</td>
<td>$16.1K ($805/mi) - road inventory</td>
<td>CDFG-046</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>100 mi</td>
<td>$60K ($600/mi) - sediment assess</td>
<td>CDFG-077</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>8 mi</td>
<td>$2.7K ($333/mi)</td>
<td>CDFG-106</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>9 mi</td>
<td>$3.0K ($329/mi)</td>
<td>CDFG-125</td>
</tr>
<tr>
<td>HumboldtBay</td>
<td></td>
<td>35 acres</td>
<td>$29.9K ($853/acre) - estuary rehab plan</td>
<td>CDFG-169</td>
</tr>
<tr>
<td>HumboldtCnty</td>
<td></td>
<td>76.9 acres</td>
<td>$242,785 ($3157/acre) - erosion/hab rest</td>
<td>CDFG-227</td>
</tr>
<tr>
<td>SanFranCnty</td>
<td></td>
<td>66 mi</td>
<td>$70,786 ($1072/mi)</td>
<td>CDFG-279</td>
</tr>
<tr>
<td>StaCruz</td>
<td></td>
<td>153 mi</td>
<td>$142,812 ($933/mi) - erosion</td>
<td>CDFG-332</td>
</tr>
<tr>
<td>Dnorte/Humb/MendoCnties</td>
<td></td>
<td>65 stream crossings</td>
<td>$42,246 ($650/crossing)</td>
<td>CDFG-327</td>
</tr>
<tr>
<td>EelR</td>
<td>03-04</td>
<td>50 mi</td>
<td>$38.1K ($763/mi) - sediment assess</td>
<td>CDFG-266</td>
</tr>
<tr>
<td>SalmonCrk</td>
<td>04-05</td>
<td>50 mi</td>
<td>$48,621 ($972/mi) - road inventory</td>
<td>CDFG-047</td>
</tr>
<tr>
<td>MattoleR</td>
<td></td>
<td>40 mi</td>
<td>$23,128 ($578/mi) - road inventory</td>
<td>CDFG-062</td>
</tr>
<tr>
<td>GualalaR</td>
<td></td>
<td>22 mi</td>
<td>$16,756 ($762/mi) - road inventory</td>
<td>CDFG-112</td>
</tr>
<tr>
<td>MendocinoCnty</td>
<td></td>
<td>140 mi</td>
<td>$145,175 ($1037/mi) - sediment assess</td>
<td>CDFG-197</td>
</tr>
<tr>
<td>SLO Cty</td>
<td></td>
<td>130 mi</td>
<td>$124,269 ($956/mi) - sediment assess</td>
<td>CDFG-210</td>
</tr>
<tr>
<td>EelR</td>
<td></td>
<td>110 mi</td>
<td>$131,023 ($1191/mi) - sediment assess</td>
<td>CDFG-238</td>
</tr>
<tr>
<td>MadR</td>
<td></td>
<td>49.1 sqmi (31424 ac)</td>
<td>$329,810 ($11/acre)</td>
<td>CDFG-255</td>
</tr>
<tr>
<td>SmithR</td>
<td></td>
<td>6.7 sqmi (4288 ac)</td>
<td>$55,828 ($13/acre)</td>
<td>CDFG-256</td>
</tr>
<tr>
<td>NavarroR</td>
<td></td>
<td>22 mi</td>
<td>$22,771 ($1035/mi, sediment assess)</td>
<td>CDFG-271</td>
</tr>
</tbody>
</table>
Table OR-1 includes organizational support projects funded by CDFG’s Fisheries Restoration Grant Program during the three most recent fiscal years. These can be roughly divided into two categories:

(1) database maintenance, costed at $135K-$152K/project/year. Data requiring maintenance include the California Habitat Restoration Project Database (CHRPD)(04-05 CDFG-033 & 05-06 CDFG-023), passage assessment data (04-05 CDFG-039 & 05-06 CDFG -031), and stream inventory reports (05-06 CDFG-033);

(2) watershed coordination/outreach, costed at $24K-$259K/project. The low end of this range range ($24K, 04-05 CDFG-219) pertains to support of a part-time watershed coordinator, while the high end ($259.1K, 05-06 CDFG-076) pertains to organizational work by a southern California non-profit. CDFG’s Coho Recovery Strategy assumes $60K per educational/technical assistance program (CDFG’04, p.1.33).

Table OR-1. Organizational Support and Assistance - $/project

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>04-05</td>
<td>1 project</td>
<td>$134.3K - maintenance of CHRPD</td>
<td>CDFG-033</td>
</tr>
<tr>
<td>CA</td>
<td>04-05</td>
<td>1 project</td>
<td>$196.7K - passage assessment database</td>
<td>CDFG-039</td>
</tr>
<tr>
<td>SmithR</td>
<td>04-05</td>
<td>1 project</td>
<td>$52.0K - watershed coordinator</td>
<td>CDFG-120</td>
</tr>
<tr>
<td>HumboldtCnty</td>
<td>04-05</td>
<td>1 project</td>
<td>$95.9K - RCD org support to landowners</td>
<td>CDFG-211</td>
</tr>
<tr>
<td>LindsayCrk</td>
<td>04-05</td>
<td>1 project</td>
<td>$24.1K - parttime watershed coordinator</td>
<td>CDFG-219</td>
</tr>
<tr>
<td>ShastaValley</td>
<td>04-05</td>
<td>1 project</td>
<td>$137.3K - RCD outreach coordinator</td>
<td>CDFG-230</td>
</tr>
</tbody>
</table>
PM - PROJECT MAINTENANCE FOLLOWING PROJECT IMPLEMENTATION

Weaver/Hagans suggest $275/mile/year for culvert maintenance. Dupont estimates culvert life of 10-30 years, although his estimates pertain to Idaho (not California).

Table PM-1. Culvert maintenance - $/culvert/year

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2004</td>
<td>typical</td>
<td>$275/mile/year</td>
<td>WH, p101</td>
</tr>
<tr>
<td>Idaho</td>
<td>2004</td>
<td>typical</td>
<td>Culvert Type: Iron fish ladder - $10/yr (30 yrs) Block fish ladder - $10/yr (10 yrs) Baffled culvert - $20/yr (30 yrs) Drop structure - $40/yr (30 yrs)</td>
<td>Dupont-T5 (p62), T6 (p63)</td>
</tr>
</tbody>
</table>

Maintenance of 50 screens on Scott River cost $1.4K/screen/year. These are probably fairly small screens. Maintenance costs may be higher for larger screens.

Table PM-2. Fish Screen Maintenance - $/screen/year

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>ScottR</td>
<td>01-02</td>
<td>50 screens</td>
<td>$68,896 ($1378/screen/year)</td>
<td>CDFG-034</td>
</tr>
</tbody>
</table>
Weaver/Hagans suggest $25/mile/year for maintenance of forest roads. Estimates for other types of roads could not be found.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2000</td>
<td>typical</td>
<td>Maintenance inspection forest roads: $25/mi/yr</td>
<td>WH, p101</td>
</tr>
</tbody>
</table>

The only plant thinning example found was specific to farmland. Costs were contingent on the method of thinning (mechanical, hand, chemical).

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Units</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA farmland</td>
<td>FY07</td>
<td>typical</td>
<td>Forest Stand Improvement-Thinning Mechanical: $850/acre Hand, 15-30%slope, 40-60%cover: $900/acre Hand, 30-50%slope, 60-90%cover: $1200/acre Chemical: $150/acre</td>
<td>NRCS CA</td>
</tr>
</tbody>
</table>

RE - COOPERATIVE FISH REARING

Flagg and Nash (1999) make a number of recommendations regarding operation of conservation hatcheries - e.g., select broodstock using appropriate genetic protocols, maintain broodstock on natural photoperiod and water temperatures, provide incubation and rearing environments that mimic conditions in the wild (e.g., overhead cover, instream structures/substrates), reduce rearing densities, vary water-flow velocities, provide “natural” diet composition and feeding rates, provide bottom feed delivery systems, rear fish in water from the intended return location, release hatchery smolts at sizes similar to wild smolts, provide for volitional releases that do not exceed carrying capacity, have multiple broodstock facilities to protect against local disasters (e.g., equipment failure), establish appropriate monitoring and evaluation strategies. They conclude that “Implementation of such [conservation hatchery] programs would require significant capital expenditure, with increased hatchery operating costs and reduced fish production. Some increased costs would be offset by conservation hatcheries releasing smaller numbers of highly adaptable fish.”
Construction and operational costs of a conservation hatchery depend on a variety of factors - e.g., whether the hatchery is newly constructed or a modification of an existing hatchery, which of the Flagg/Nash recommendations are implemented at the hatchery and the particular facilities and protocols needed for such implementation, scale of hatchery production, the particular species at the hatchery (since rearing time varies among species).

The Kingfisher Flat Hatchery on Big Creek operates an artificial propagation program to supplement depressed wild coho runs. The hatchery receives about $95K/year from the CDFG Fisheries Restoration Grants Program (Table RE-1). The extent to which the $95K reflects the cost of the hatchery’s coho conservation program is difficult to determine, given that (1) the hatchery engages in other activities as well (e.g., chinook rearing), (2) the hatchery relies heavily on volunteer labor and also receives funding from other sources, (3) the SWFSC Santa Cruz’s captive broodstock program provides gametes to the Kingfisher facility to increase coho genetic diversity (at no cost to the hatchery).

Table RE-2 describes capital and operating costs for a number of Columbia River hatcheries that are larger than Kingfisher Flat. While some of these hatcheries engage in some conservation activities, they are largely production hatcheries. Information provided in Table RE-2 is intended to give a very rough idea of hatchery costs.

<table>
<thead>
<tr>
<th>Table RE-1. Hatchery Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
</tr>
<tr>
<td>Kingfisher Flat Hatchery</td>
</tr>
<tr>
<td>Kingfisher Flat Hatchery</td>
</tr>
<tr>
<td>Name/Operator</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>Spring Creek/USFWS</td>
</tr>
<tr>
<td>Clatsop Econ Development Council/ClatsopCnty</td>
</tr>
<tr>
<td>NezPerce/tribe</td>
</tr>
<tr>
<td>Yakima/tribe</td>
</tr>
<tr>
<td>Leavenworth/USFWS</td>
</tr>
<tr>
<td>PriestRapids/WDFW</td>
</tr>
<tr>
<td>Irrigon/ODFW</td>
</tr>
<tr>
<td>McCall/Idaho DFW</td>
</tr>
</tbody>
</table>

* Annual capital costs, calculated as the original construction cost amortized over 50 years at 3%.
WILDLIFE MANAGEMENT

The average cost per pikeminnow harvested in the Columbia River bounty program is $6.05/fish. Whether this cost estimate would be similarly applicable to a California eradication program would depend on the nature and scale of the program and the extent of angler interest and success in harvesting pikeminnow.

Table WM-1. Invasive Aquatic Species (e.g., pike minnow eradication)

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Cost Per Unit</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>ColR</td>
<td>2005</td>
<td>Annual program cost (rewards+tags): $1,546,232</td>
<td>Porter, p41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avg $6.05/fish (=$1,460,724 total rewards/241,357 total fish harvested)</td>
<td></td>
</tr>
</tbody>
</table>

RES - RESEARCH - productivity research (life cycle monitoring/analysis), spatial structure (fish distribution surveys), genetic diversity (laboratory analysis of tissue samples), and abundance estimates

Columns 2-3 of Table RES-1 describe start-up and annual costs of monitoring activities identified by CDFG/NMFS in several recent workshops. Several caveats in interpreting the cost estimates: (1) The estimates pertain only to coastal salmonids (i.e., exclude Central Valley), (2) the estimates are incremental in that they represent what is needed over and above what is currently being spent for coastal salmonid monitoring, and (3) the estimates assume that all labor is paid (no volunteers).

Monitoring costs are provided here because monitoring data are essential to conducting research on VSP (viable salmon population) attributes. Columns 4-7 of Table RES-1 identify which types of data are relevant to evaluating which VSP attribute. Because some of the data requirements relate to multiple VSP attributes, it is impractical to devise separate costs for each attribute.

As reflected in Table RES-1, the monitoring program is intended to follow different strategies in northern and southern areas. The northern area is defined as the Oregon border to Aptos Creek (five ESUs); the southern area is defined as the Pajara River southward (two ESUs). The boundaries of the two monitoring areas do not coincide with the boundaries of the recovery domains. However, it may be possible to allocate monitoring costs among domains (e.g., on the basis of proportion of total salmonid stream miles within each domain).

The costs noted in Table RES-1 are incomplete with regard to overall coastal salmonid research needs. Other activities mentioned in Boydstun and McDonald (2005) include: (1) habitat condition monitoring, (2) augmented samples for genetic monitoring, (3) other biological monitoring (e.g., otoliths, adult gender, length-weight samples), and (4) laboratory and computer analysis of data.
### Table RES-1. Monitoring Activities and Costs as They Relate to Specific VSP Attributes

**Source:** Boydstun & McDonald 2005 - pp 54-55 & Table8/p 58.

<table>
<thead>
<tr>
<th>Monitoring Activity</th>
<th>Estimated Cost</th>
<th>VSP Attribute</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Startup</td>
<td>Annual</td>
<td>Abundance</td>
</tr>
<tr>
<td>Northern spawner survey (OR border-Aptos Creek)</td>
<td>$566K</td>
<td>$2,545K</td>
<td>X</td>
</tr>
<tr>
<td>Southern steelhead monitoring (PajaroR southward)</td>
<td>$65K</td>
<td>$541K</td>
<td>X</td>
</tr>
<tr>
<td>Life cycle monitoring stations (2 stns per coastal recovery domain)</td>
<td>$1,036K</td>
<td>$1,370K</td>
<td></td>
</tr>
<tr>
<td>Juvenile salmonid surveys</td>
<td>$177K</td>
<td>$1,307K</td>
<td>Cutthroat only*</td>
</tr>
<tr>
<td>25% hatchery fish marking (additional marking needed @ Iron Gate &amp; Rowdy Creek only)</td>
<td>$0</td>
<td>$69K</td>
<td></td>
</tr>
<tr>
<td>Angler creel survey SmithR-SLO Creek, except Klamath/Trinity chinook/coho (already monitored by CDFG)</td>
<td>$14K</td>
<td>$369K</td>
<td></td>
</tr>
<tr>
<td>Administrative/ special studies</td>
<td>$36K</td>
<td>$789K</td>
<td></td>
</tr>
</tbody>
</table>

* Assume monitoring from Eel River to Smith River and 30 miles inland.
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