

***CHAPTER 1: EROSION CONTROL TREATMENTS AND CONCEPTS  
FOR LAKE CHELAN (USDA FOREST SERVICE)***

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## **SECTION 1: INTRODUCTION**

Lake Chelan has approximately 118.8 miles of shoreline, of which approximately 50 miles is managed by the U.S. Department of Agriculture Forest Service (USDA Forest Service), and 10 miles is managed by the National Park Service (NPS). A 1999 inventory conducted by Chelan PUD, USDA Forest Service, NPS and other members of the erosion working group<sup>1</sup> identified 112 sites, comprising 40,780 linear feet of USDA Forest Service shoreline undergoing erosion. More detailed information on shoreline erosion around the lake may be found in the Inventory of Shoreline Erosion, Lake Chelan and Bypass Reach Study Report (Chelan PUD, 2000).

The plan contained in this Chapter outlines the treatment and monitoring of 40 of the 112 identified USDA Forest Service sites. Of these 40 high priority sites, Chelan PUD will be responsible for the treatment of 35 sites, and the USDA Forest Service will be responsible for treatment of the remaining five sites. In determining the work to be completed within this Chapter, USDA Forest Service staff analyzed all sites on USDA Forest Service lands and sorted the sites into groups based on the reason they were of interest and on the severity of erosion:

- Group 1 sites are those related to recreational sites.
- Group 2 sites are related to sites of interest for historical or cultural reasons.
- Group 3 sites are those of interest for aesthetic reasons that met USDA Forest Service criteria for severity.
- Group 4 sites are those of interest primarily based on aesthetics, which did not meet the criteria for Group 3.

Some sites are included in more than one group. Details of this sorting process are explained in Protection, Mitigation, and Enhancement Measures Submitted by the US Forest Service for Chelan County Public Utility District Relicensing Project No. 637, Shoreline Erosion, May 3, 2001.

Groups 1 through 3 include 39 sites, of which 34 sites will be treated by Chelan PUD. Group 4 consists of 21 sites in need of some form of treatment, but not immediately critical. Of these, one site was selected for treatment by Chelan PUD on the basis of an opportunity to enhance riparian habitat. The total estimated length proposed for treatment by the Chelan PUD on the 35 selected sites is 9,325 feet, as shown in Table 1-1.

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<sup>1</sup> USDA Forest Service, National Park Service, and interested citizens participated through the alternative licensing process.

## ***SECTION 2: IMPLEMENTATION***

### **2.1 Responsibility**

Of the 40 high-priority USDA Forest Service sites, five are subject to easements (also known as damage waivers), whereby the landowner released Chelan PUD from liability for any damage to the property caused by Project operations. These five sites were in private ownership at the time that the easement was granted to Chelan PUD. The land was later acquired from the private landowner by the USDA Forest Service, subject to the easement. Consequently, Chelan PUD will be responsible to perform erosion control work, including erosion repairs, maintenance, and monitoring, only on the 35 sites for which no such easement exists.

Chelan PUD will be responsible for obtaining any necessary permits. In addition, Chelan PUD will be responsible for the collection, storage and placement of large woody debris (LWD) for use in the erosion control efforts at the 35 non-easement sites and for use as mitigation for the erosion control efforts, as described in Chapter 3.

Where this plan includes erosion work on Group 2 sites, Chelan PUD will provide coordination with the Lake Chelan Cultural Forum (LCCF) so that the affected cultural resources are addressed as defined in Chapter 10, the Historic Properties Management Plan. Chelan PUD will also perform erosion control work on sites in Group 2, regardless of easements, if required to protect cultural or historical resources from damage caused by shoreline erosion resulting from Project operations.

The USDA Forest Service plans to complete erosion control work on some sites with easements that are not in Group 2. These include site 41 (Moore Point), with 1,600 feet of shoreline erosion in Group 1, and sites 35, 35b, 36 and 42 in Group 3. These sites are not addressed in this Chapter, and are the responsibility of the USDA Forest Service.

### **2.2 Implementation Plan**

Chelan PUD will develop an erosion control plan acceptable to Chelan PUD and the USDA Forest Service that implements this Chapter. The plan will contain:

- An implementation schedule, including a breakdown of sites to be treated in three-to-five year intervals. Such a breakdown should provide the flexibility necessary to work with unpredictable weather and lake conditions.
- Designs for treatment of the sites proposed for treatment in the first three to five year period to a level of detail adequate for USDA Forest Service review and for use in permit applications. Designs will be generally based on commonly accepted best management practices for this type of work, will take relevant permitting requirements into account, and will allow for adjustment to suit unknown site conditions.
- A method to address identification of new or existing non-easement erosion sites requiring treatment.
- A process for treating in a timely manner non-easement sites identified as needing additional treatment or maintenance work.

### **2.2.1 Site Specific Implementation Plans**

Site-specific plans will be prepared by Chelan PUD and approved by USDA Forest Service for habitat and ground disturbing activities on National Forest System Lands required by the New License, including activities contained within resource management plans required by the New License that will be prepared subsequent to issuance of the New License. Site-specific plans for activities will be prepared two years in advance of required implementation dates.

Site-specific plans shall include:

1. A map depicting the location of the proposed activity.
2. A description of the USDA Forest Service land management area designation within the Forest Plan for the location of the proposed activity and the applicable standards and guidelines.
3. A description of locations, designs and mitigation measures considered, including implementation and effectiveness monitoring.
4. Data collected from surveys, biological evaluations or consultation as required by regulations applicable to ground or habitat disturbing activities on National Forest System lands in existence at the time the plan is prepared.
5. Noxious weed control measures included as part of mitigation.
6. An environmental analysis or other appropriate National Environmental Policy Act (NEPA) analysis of the proposed action that meets the USDA Forest Service requirements for implementing NEPA.

General concepts of LWD are discussed in Chapter 3 of the Comprehensive Plan, which describes beneficial uses, LWD characteristics, and general standards and placement concepts.

#### NEPA Analysis

Chelan PUD is responsible for conducting the environmental analysis necessary for site-specific projects including, but not limited to, scoping, site-specific resource analysis, and cumulative effects analysis sufficient to meet the criteria set forth in USDA Forest Service regulations for NEPA. Chelan PUD may refer to or rely on any previous NEPA analysis for the activity to the extent the analysis is not out of date as determined by USDA Forest Service. Any contractors selected by Chelan PUD to conduct the NEPA process shall be approved by USDA Forest Service in advance of initiating the work. Following scoping, Chelan PUD shall submit the scope of work for the environmental analysis, including, but not limited to, the range of alternatives that shall be addressed, to USDA Forest Service for review and approval prior to completion of the environmental analysis.

Chelan PUD shall be responsible for revising and updating the erosion control implementation and subsequent site-specific erosion control plans based on the results of monitoring, site-specific project implementation segments, or changed site conditions, at least every five years of the New License, until all of the prioritized sites are treated successfully. Permitting and NEPA processes are the responsibility of Chelan PUD. The USDA Forest Service will make every effort to assist in these processes. Chelan PUD will develop site-specific plans along with any updates or revisions in cooperation with the USDA Forest Service. The plan and updates are subject to approval by the USDA Forest Service, and will be filed with the FERC.

### **2.3 Monitoring and Maintenance Plan**

Chelan PUD will develop a monitoring and maintenance plan. The plan will address monitoring of USDA Forest Service shorelines to determine a) whether new sites should be added to the Project-caused erosion site inventory based on criteria described below, b) whether treated sites meet erosion control objectives and c), whether existing inventoried sites have moved into the high priority for treatment category based on the criteria described below and Figure 1-3. The plan and any updates will be subject to the approval of the USDA Forest Service, and Chelan PUD will file the plan and any updates with the FERC.

The goal of erosion control is to stabilize existing and new high priority erosion sites on USDA Forest Service lands affected by Project operations. A site will be considered successfully treated when:

- 90 percent of the eroding toe of the treated slope on the lakeshore is stabilized (placed rock or other materials remain as positioned between elevations 1,098 feet and 1,104 feet).
- Vegetation in the form of native grasses, forbs, and shrubs, will be established on 90 percent of the site between elevations 1,100 feet and 1,106 feet, such that it is similar in diversity and density to the vegetation on nearby undisturbed sites of similar aspect, slope and soil conditions. Specific ground cover objectives to be obtained within five years of treatment will be included in each site-specific plan.
- Noxious weed control has been completed within five years of treatment.
- Site-specific LWD measures have been implemented.

The monitoring portion of the plan will include all USDA Forest Service shoreline affected by Project operations, and will use the 1999 inventory (Chelan PUD, 2000) as a baseline, together with reference photographs from the 1982 inventory. The plan will include a schedule and process for monitoring and documentation, including:

- Monitoring and reporting on the success of re-vegetation and toe-slope stabilization on treated sites in years one, three, and five following treatment of each site.
- Once treated sites meet design goals, standards of stabilization and vegetation, monitoring sites at five-year intervals over the New License term, to determine that site treatment objectives continue to be met.
- Trend monitoring (erosion rate and other significant changes) at selected sites at five-year intervals. Non-treated sites for trend monitoring, selected on a preliminary basis, include sites 4, 13, 34, 40, and 53.
- Updating the inventory of USDA Forest Service sites contained in the 1999 study at 20-year intervals over the New License term, starting on the 20<sup>th</sup> anniversary of the effective date of the New License. These updates will include photo documentation and current site sketches using the same or otherwise approved methodology.
- Monitoring the effects (safety, site disturbances etc.) of storage of LWD on USDA Forest Service lands.
- Monitoring LWD placed as part of the erosion control work for continued safety and stability of the structures at five-year intervals.
- Success of noxious weed control at treated sites.

The maintenance portion of the plan will include provisions for Chelan PUD to perform additional structural, vegetation or noxious weed treatments on previously treated sites based on the following criteria:

- For LWD, any safety-related required maintenance is to be accomplished before the spring lake re-fill period.
- For rock, timing of maintenance depends on scale and workability in the drawdown zone.
  - If monitoring produces 100 feet of maintenance treatment needed during years of initial erosion control treatment by contractor or Chelan PUD crews, the maintenance should be added to the existing planned work.
  - If the initial erosion control treatments have been completed, the trigger for maintenance treatment by contractor or Chelan PUD crews shall be 200 feet of repair work needed.
- For vegetation plantings, timing is seasonal dependant with the fall planting season having the highest likelihood of success.
  - For the first two monitoring actions (years one and three) if greater than 50 percent of the plantings have failed, replanting will occur during the next fall planting period. This assumes initial planting occurs at 140 percent of the desired density and the goal is to be achieved by the 5th year after initial treatment.
  - The trigger for future monitoring years will be less than 75 percent of the baseline density and cover found on similar, undisturbed shoreline.
  - Trends in vegetation may be taken into account, based on consultation between Chelan PUD and the USDA Forest Service, so that replanting of a site meeting the above criteria may be delayed if a positive trend appears to exist in the vegetation at the site, and replanting may be accelerated if a negative trend exists.
- For noxious weeds, once noxious weeds introduced by the erosion control work are discovered, treatment shall be pursued before the plant can produce viable seed. Timing is dependant on seed viability or potential spread.

Chelan PUD will, following consultation with and approval by USDA Forest Service, implement additional measures to achieve erosion control objectives at previously treated sites that fail to meet treatment objectives five years after initial treatment, when retreatment costs are less than or equal to 25 percent of the original treatment costs. When retreatment cost will exceed 25 percent of the original treatment cost, Chelan PUD and USDA Forest Service will agree whether a) additional treatment of the existing site is warranted, or b) treatment of an equivalent linear footage of shoreline on another non-easement site will be performed in lieu of further treatment at the original site.

The monitoring and maintenance plan shall also include provisions for the treatment of new non-easement sites where erosion occurs due to Project operations. In particular, the USDA Forest Service may choose to add new or existing non-easement sites to the list of sites to be treated based on agreement between Chelan PUD and USDA Forest Service that they meet the

evaluation criteria used in the original analysis to select sites from Group 1 and Group 3 for treatment. Chelan PUD shall be responsible for implementation of erosion control measures on such sites. Details of this evaluation are explained in Appendix F of the Inventory of Shoreline Erosion (Chelan PUD, 2000). The criteria used for selection were an aesthetic erosion site (AES) ratio of 4.0 or greater and a cumulative scale ratio of 0.6 or greater.

#### **2.4 Preliminary Cost Estimates**

Given the variety of methods contemplated, the variety of site conditions to be treated, and the uncertainties of weather, lake conditions, and barge availability, costs for erosion control work around Lake Chelan have proven difficult to estimate and should be considered preliminary. The estimates below are based on a combination of experience and input from contractors and other vendors who work around the lake.

The USDA Forest Service's most recent contract for erosion repair, performed at Flick Creek in 1995, had an average cost of \$224.00 per linear foot. For purposes of this cost estimate, the USDA Forest Service adjusted this average cost for inflation and differences in the work. The differences in work included the use of mortar at Flick Creek, which is not anticipated for this work, and additional costs for vegetation, LWD habitat enhancement, NEPA review, and permitting. This yielded an estimated unit cost of \$281.72 per linear foot, which was rounded to \$282 per linear foot.

The estimate in Table 1-1 is based on an average unit cost of \$282 per linear foot. The estimate takes into account some areas where a "half-treatment" is used. The USDA Forest Service and Chelan PUD recognize that some techniques will cost more or less than \$282 per foot. This information is provided as an Estimated Cost, as defined in section 4.4 of the Agreement.

**Table 1-1: Estimated Costs and Lengths**

	<b>Quantity</b>	<b>Item</b>	<b>Unit price</b>	<b>Est. total</b>
Group 1	900'	Cribwall	282	253,800
	1,370'	std treatment	282	386,340
	830'	half-treatment	141	117,030
<b>Subtotal</b>	3,100'			
Group 2	600'	std treatment	282	169,200
Group 3	3,890'	std treatment	282	1,096,980
	1,545'	half-treatment	141	217,845
<b>Subtotal</b>	5,435			
Group 4	190'	half-treatment	141	26,790
NEPA process	as needed	NEPA	5%	113,399
Monitoring	Lump sum est.			53,000
Maintenance	yrs 5-20		2,400	36,000
	yrs 21-50		7,000	210,000
<b>Total</b>	9,325'			2,680,384

### ***SECTION 3: ANTICIPATED EROSION CONTROL MEASURES***

Chelan PUD and the USDA Forest Service intend to incorporate bioengineering techniques, exemplified by the techniques described in this Chapter, and fish enhancement measures to the extent feasible, at NFS sites treated. Details will be developed in each site-specific plan. If permits necessary to perform this work require mitigation (e.g. placement of LWD in the lake) this mitigation will be done at locations that do not create hazards for boaters and swimmers.

Currently anticipated erosion treatments include:

- Hand placed rock walls - most appropriate for trail applications, recreation areas
- Mortared placed rock walls - very limited application by USDA Forest Service adjacent to docks
- Enhanced placed rock (EPR) - general erosion or recreation sites
- Log cribwalls - trail areas and as retaining walls for placed fill
- Beach fill - limited application as recreation-enhancing option
- Vegetation Plantings – in conjunction with the above techniques
- LWD placement – usually in conjunction with the above techniques (Chapter 3, section 4)

Other treatments may be identified in site-specific plans or as work progresses.

These techniques can all be modified to some degree to include such features as joint plantings, rock piles for fish habitat, LWD structures, and upslope revegetation.

The standard treatment considered in the cost estimate in Table 1-1 is an “enhanced placed rock” (EPR) treatment, illustrated in Figure 1-1. This treatment consists of large rock riprap, fitted into place rather than dumped, and with vegetation and LWD incorporated to provide additional protection for the slope’s toe and for habitat.

Evaluation by the USDA Forest Service and Chelan PUD has led to the conclusion that many locations along the shoreline do not require a full treatment, but do require help in stabilizing the shoreline in the immediate vicinity of the high water line. Chelan PUD will treat these areas using a half-treatment that utilizes a single- or double-row rock placement (DRRP) using large rock, vegetation, and large woody debris treatments, as illustrated in Figure 1-2.

Site locations and proposed treatment for each site are included in Erosion Control Treatments and Concepts for Lake Chelan (Chelan PUD, 2001).

### **3.1 Group 1**

Group 1 sites are those related to recreation areas. The 14 USDA Forest Service sites proposed for treatment are listed in Table 1-2. Chelan PUD will perform treatment on the 13 non-easement sites in this group.

In addition to these 14 sites, minor sites related to recreation include a few sites affecting lakeside trails or having an aesthetic impact on a recreation site. Erosion sites along recreation trails were inventoried. Treatment is needed for site 15, located between Graham Harbor and Graham Harbor Creek. Some toe repair is also needed along the Lakeshore Trail at site 54, west of Prince Creek. This is shown in photograph CD21 Fr33 from the 1999 erosion inventory. Chelan PUD will address sites 15 and 54 when the nearest large recreation site is treated. Site 17, next to Graham Harbor Creek, and site 87, near Big Creek, are minor sites with a direct aesthetic impact on recreation sites. Chelan PUD will treat sites 17 and 87 when the affected recreation site is treated.

**Table 1-2: Group 1 Recreation Sites**

Recreation Site	Site No.	Length (ft)	Active (ft)	Cribwall (ft)	Treatment (ft)		
					EPR	DRRP	total
Big Creek CG	9	80	Prev. repair site	50	0	30	30
Domke Falls CG	24abc	234	100		55	95	150
Corral Creek CG	11	235	60	60	60	0	60
Graham Harbor CG	14	100	Prev. repair site	100	monitor		
Graham Harbor Creek CG	16	192	Prev. repair site	160	20	0	20
Refrigerator Harbor CG	25	800	260	90	260	0	260
Lucerne CG/ Guard Station	26	340	170	600	170	0	170
Lucerne	27	474	150		110	50	160
Elephant Rock	31	20			monitor		
Moore Point CG <sup>1</sup>	41	1,600	460	460	easement site		
Cascade Creek CG	47	688	290		170	190	360
Deer Point CG	58ab	530	20	110	140	80	220
Mitchell Creek CG	59	1,054	110	80	265	155	420
Prince Creek CG	55	1,320	190	90	120	230	350
Total	14	7,667 <sup>1</sup>		1,800	1370	830	2200

<sup>1</sup> Site 41 is a USDA Forest Service recreation site with easement and is not included in treatment length totals. Treatment includes replacement of 50 percent of the log cribwall, or 900 ft of cribwall. Totals to be treated by Chelan PUD include 900 ft of cribwall, 1,370 ft of EPR, and 830 ft of DRRP, out of 6,067 ft of shoreline in the 13 Group 1 non-easement sites.

**3.2 Group 2**

Six erosion sites are thought to have the potential for affecting cultural resources. Four of these are included in Group 1 for treatment. One is included in Group 3 for treatment. The remaining site entails an estimated 600 feet of treatment. It is not included on the preliminary schedule, but will be treated as necessary under Chapter 10 (the Historical Properties and Cultural Resources Management Plan). Chelan PUD will coordinate and manage any erosion control work on Group 2 sites in accordance with Chapter 10. In particular, work on these sites will require prior review and approval of plans by the LCCF, and examination of the proposed work area.

**3.3 Group 3**

There are 27 sites of interest due to aesthetic concerns. USDA Forest Service staff selected these sites based on an analysis of visual impact of the erosion. As explained in Appendix F of the Inventory of Shoreline Erosion (Chelan PUD, 2000), a "site rawness ratio" or aesthetic erosion site (AES) ratio was defined and plotted for each USDA Forest Service site to assess the existing visual impact from shoreline erosion and to index impacts on soils and vegetation. In addition, a cumulative scale ration was calculated that includes the effects of nearby sites.

The AES ratio was calculated by estimating the total area (in square feet) of actively eroding or non-vegetated (bare) soil slopes at each site and dividing by the site length. The bare area was estimated using the site sketch with a 10-foot grid, together with the site photograph. Markings representing raw areas were made on the sketches and then tallied. Slope areas with existing

visual screening, large woody debris, or otherwise visually “muted” areas were not included. The AES ratio takes into account the effects of variations in size and slope, including contrast and potential reflectivity. Reflectivity varied as the time of day and sun angle changed. Figure 1-3 provides an example of how the AES ratio was calculated.

The 27 sites selected for treatment represent the highest priority areas for addressing the full range of negative impacts of shoreline erosion, and are the sites expected to provide the highest ecological and visual return for the funds invested in treatment. Of the 27 sites, two (26 and 47) are already included in Group 1, one is included in Group 2, and five are covered by easements. These easement sites are not included in the summary of treatment of Group 3 sites shown in Table 1-3.

Group 3 is sorted into sub-groups, which are summarized, below, with their respective lengths. Easement sites are shown in bold and underlined. The “V” is used to designate groups of sites sorted based on visual impact. Non-easement sites, which will be treated by Chelan PUD as part of Group 3, include 9,979 feet of shoreline, of which 5,435 feet are proposed for treatment.

1) V1/V2 Sites - 9 sites with 2,170' of active toe erosion.

V1 sites 1, 2, 5, and 12

V2 sites 10, 29, 29b, **35b**, 45

2) V3/V4 Sites - 10 sites with 1,730' of active toe erosion.

V3 sites 8a, 8b, 23, 19, and **42**

V4 sites 10b, 13b, 26, 33, and 47

3) V5/V6 Sites - 8 sites with 1,950' of active toe erosion.

V5 sites 30, 37, and 50

V6 sites 5b, 20, **35, 36, and 41**

Site 41 is a recreational site with an easement that requires an estimated 550 feet of treatment. The USDA Forest Service will evaluate this site following any treatment which Chelan PUD may be required to perform under Chapter 10. Easement sites 35b, 42, 35 and 36 could be treated with shoreline LWD placements and other protective measures as USDA Forest Service funding allows.

### **3.4 Groups 4 through 6**

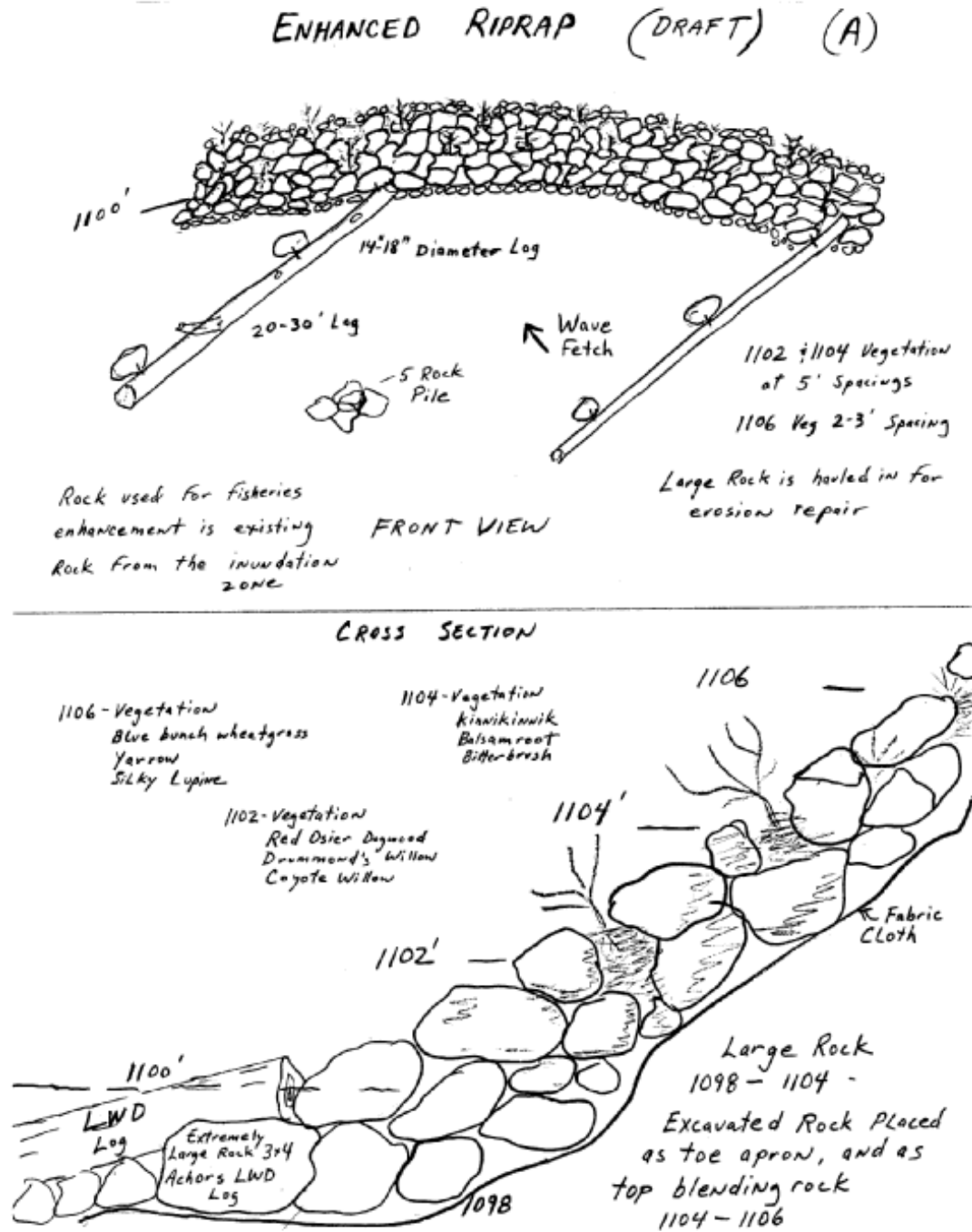
Sites in Groups 4 through 6 are smaller and have lower priority for treatment. With one exception, they are not listed here. Site 32 has been selected for intermittent treatment (treatment of selected, short stretches) to take advantage of shoreline seeps in an effort to enhance riparian habitat. Chelan PUD will perform this treatment. The anticipated treatment length is 190 feet, broken into several pieces. For details of the other sites, refer to the individual site descriptions and sketches in the Inventory of Shoreline Erosion (Chelan PUD, 2000). As noted above, if Chelan PUD and the USDA Forest Service decide that monitoring shows that non-easement sites not currently selected for treatment are deteriorating such that they meet the criteria used to select sites in groups 1 or 3, these sites could be added to the list of sites to be treated.

**Table 1-3: Group 3 Sites**

Site	Length (ft)	Active Toe (ft)	Treatment (ft)		
			EPR	DRRP	Total
1	210	90	100	40 <sup>1</sup>	140
2	410	175	200	190 <sup>1</sup>	390
5	1,075	225	150	260	410
5b	330	100	100	60	160
8a	30	10	10	30	40
8b	698	150	190	10	200
10	160	40	40	30	70
10b	140	50	70	10	80
12	820	525	470	50	520
13b	150	60	60	20	80
19	190	90	90	0	90
20	2490	550	640	260	900
23	580	370	300	70	370
29	445	230	190	110	300
29b	126	125	90	35	125
30	300	250	210	30	240
33	510	260	240	110	350
37	150	100	90	40	130
45	990	560	580	170	750
50	175	50	70	20	90
<b>Total</b>	<b>9,979</b>	<b>3,760</b>	<b>3,890</b>	<b>1,545</b>	<b>5,435</b>

<sup>1</sup> Field verified.

The proposed treatment in the table is based on review of photographs of group 3 sites. Sites in Group 1 and easement sites, are not included in the table.



**Figure 1-1: Enhanced Placed Rock; this example shows singular perpendicular LWD placement, rock piles and vegetation.**

### DOUBLE ROW ROCK PLACEMENT (DRRP)

FOR MINOR SPOTS - SHOWING SOME TOE STABILITY

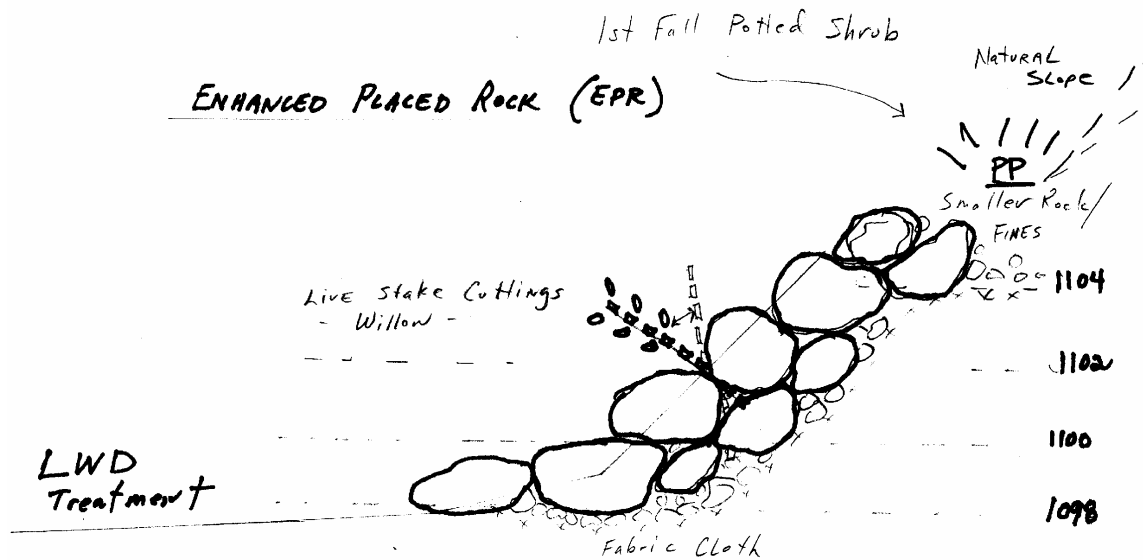
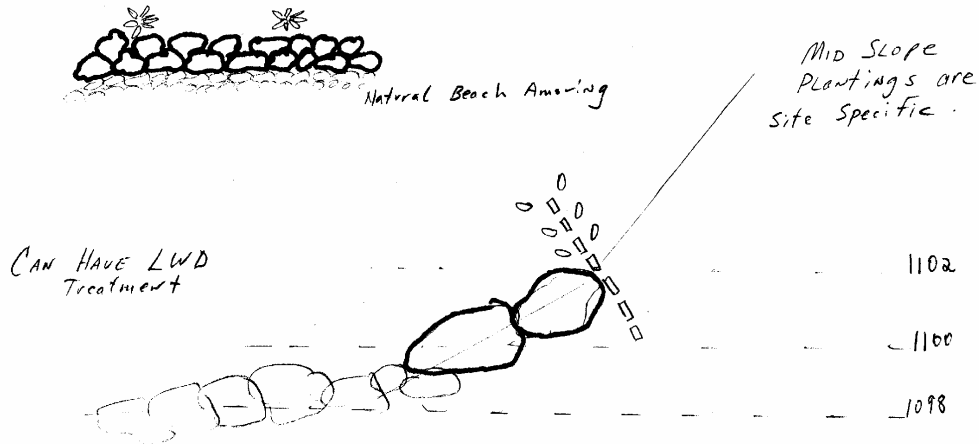


Figure 1-2: Double-row rock placement (DRRP) using large rock, vegetation and large woody debris treatments

**USDA Forest Service Erosion Sites**

**Table 1-4: USDA Forest Service Sites Prioritized for Treatment**

<b>Site</b>	<b>Group</b>	<b>Proposed Treatment Timeframes</b>
<b>1</b>	<b>3</b>	<b>2006-2011</b>
<b>2</b>	<b>3</b>	<b>2006-2011</b>
<b>5</b>	<b>3</b>	<b>2007-2012</b>
<b>5b</b>	<b>3</b>	<b>2012-2017</b>
<b>8b</b>	<b>3</b>	<b>2008-2013</b>
<b>8a</b>	<b>3</b>	<b>2008-2013</b>
<b>9 (87)<sup>1</sup></b>	<b>1</b>	<b>2012-2017</b>
<b>10</b>	<b>3</b>	<b>2008-2013</b>
<b>10b</b>	<b>3</b>	<b>2008-2013</b>
<b>11</b>	<b>1</b>	<b>2007-2012</b>
<b>12</b>	<b>3</b>	<b>2009-2013</b>
<b>13b</b>	<b>3</b>	<b>2020-2025</b>
<b>14</b>	<b>1</b>	<b>Monitor</b>
<b>16 (15, 17)<sup>1</sup></b>	<b>1</b>	<b>2005-2010</b>
<b>19</b>	<b>3</b>	<b>2017-2022</b>
<b>20</b>	<b>3</b>	<b>2023-2028</b>
<b>23</b>	<b>3</b>	<b>2018-2023</b>
<b>24abc</b>	<b>1</b>	<b>2004-2009</b>
<b>25</b>	<b>1</b>	<b>2010-2015</b>
<b>26</b>	<b>1</b>	<b>2011-2016</b>
<b>27</b>	<b>1</b>	<b>20011-2016</b>
<b>29</b>	<b>3</b>	<b>2014-2019</b>
<b>29b</b>	<b>3</b>	<b>2014-2019</b>
<b>30</b>	<b>3</b>	<b>2020-2026</b>
<b>31</b>	<b>1</b>	<b>Monitor</b>
<b>32</b>	<b>4</b>	<b>2006-2011</b>
<b>33</b>	<b>3</b>	<b>2013-2018</b>
<b>37</b>	<b>3</b>	<b>2022-2027</b>
<b>41</b>	<b>1</b>	<b>This is an easement site (addressed per LCCF).</b>
<b>45</b>	<b>3</b>	<b>2015-2020</b>
<b>47</b>	<b>1</b>	<b>2019-2024</b>
<b>50</b>	<b>3</b>	<b>2022-2027</b>
<b>55 (54)<sup>1</sup></b>	<b>1</b>	<b>2004-2009</b>
<b>58ab</b>	<b>1</b>	<b>2005-2010</b>
<b>59</b>	<b>1</b>	<b>2005-2010</b>

This draft schedule may change. Chelan PUD may accelerate this schedule. Schedule changes may be made after consultation and approval of both parties.

<sup>1</sup>Site numbers in parentheses are minor sites noted in section 3.1. These are not included in the number of sites or other totals. Parts of these sites will be treated together with adjacent sites.

**Table 1-5: USDA Forest Service Sites Proposed Timeframes**

<u>Approximate Timeframes</u>	<u>Sites</u>
2004 – 2009	55 (54) <sup>1</sup> 24abc
2005 – 2010	16 (15, 17) <sup>1</sup> 58ab 59
2006 – 2011	1 2 32
2007 – 2012	5 11
2008 – 2013	8ab 10 /10b
2009 – 2014	12
2010 – 2015	25
2011 - 2016	26 27
2012 – 2017	5b 9 (87) <sup>1</sup>
2013 – 2018	33
2014 – 2019	29
2015 – 2020	29b
2016 – 2021	45
2017 – 2022	19
2018 – 2023	23
2019 – 2024	47
2020 – 2025	13b
2021 – 2026	30
2022 – 2027	37
2023 – 2028	50
2024 – 2029	20

<sup>1</sup>Site numbers in parentheses are minor sites noted in section 3.1. These are not included in the number of sites or other totals. Parts of these sites will be treated together with adjacent sites.

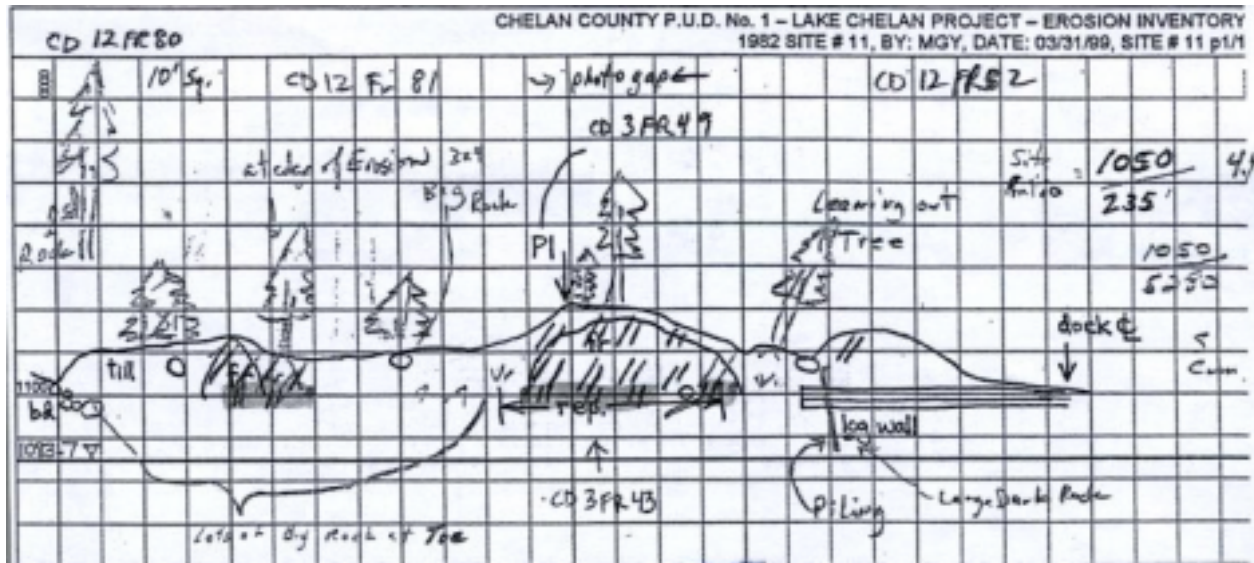


Figure 1-3: Aesthetic Site Ratio (AES) Example – Site 11

Site 11 modified sketch from USDA Forest Service/CPUD *Erosion Control Treatments and Concepts for Lake Chelan* (Chelan PUD, 2001)

Calculations:

The Aesthetic Erosion Site (AES) Ratio = (Square feet of bare area) ÷ (Site Length)

The sketch for site 11 shows 10.5 squares marked as bare soil, representing 1050 square feet. The site length is 235 feet. This gives an AES ratio of  $1050 \div 235 = 4.4$  for site 11.

The Cumulative Scale Ratio = (bare area of all sites within 1-mile viewshed) ÷ (5280 ft)  
To cover a 1-mile viewshed, the Cumulative Scale Ratio for site 11 includes sites 10 and 10b.

$$\begin{aligned} \text{Cumulative Scale Ratio} &= (\text{bare areas from sites 10, 10b, and 11}) \div (5280) \\ &= (1800 + 700 + 1050) \div (5280) = 0.67 \end{aligned}$$

Because the AES Ratio is greater than 4 and the Cumulative Scale Ratio is greater than 0.6, site 11 has been listed for treatment.

***SECTION 4: LITERATURE CITED***

Chelan PUD, 2000. Inventory of Shoreline Erosion, Lake Chelan and Bypass Reach Study Report – Final, Lake Chelan Hydroelectric Project No. 637. Chelan PUD, Wenatchee, Washington. September 1, 2000.

Chelan PUD, 2001. Erosion Control Treatments and Concepts for Lake Chelan, Okanogan and Wenatchee National Forests – Final, Lake Chelan Hydroelectric Project. FERC No. 637. Chelan PUD, Wenatchee, Washington. December 7, 2001.

USDA Forest Service, 2001. Protection, Mitigation, and Enhancement Measures Submitted by the US Forest Service for Chelan County Public Utility District Relicensing Project No. 637, Shoreline Erosion, May 3, 2001.