

**JC Boyle Canal Rockslide Mitigation  
EA #OR-014-06-04**

PROJECT TITLE/TYPE: JC Boyle Canal Rockslide Mitigation

PROJECT LOCATION: Rockslide mitigation work would occur at Township 40 South-Range 6 East - Section 12-Southeast (See Figure 2).

BLM OFFICE: Klamath Falls Resource Area, Lakeview District

LEASE/SERIAL/CASE FILE #: N/A

APPLICANT (if any): PacifiCorp Energy

CONFORMANCE WITH APPLICABLE LAND USE PLAN: This proposed action is subject to one or more of the following land use plans.

- Klamath Falls Resource Area Record of Decision and Resource Management Plan (KFRA ROD/RMP) (June 1995).
- Final Klamath Falls Resource Area Management Plan and EIS (KFRA FEIS) (September 1994).

PURPOSE and NEED FOR ACTION:

On December 2, 2005, a sudden failure of the uphill slope above the JC Boyle Canal resulted in a rockslide and deposition of rock and other earthen debris in the upper canal access road, the JC Boyle Canal and along the west bank of the Klamath River directly below the slide location. In addition, the rockslide resulted in the closure of the upper canal access road (a road used by the public to access recreational sites below the JC Boyle Powerhouse), damaged a section of the JC Boyle Canal, and left the remaining portion of the uphill slope unstable and prone to potential sudden catastrophic failure. The rockslide initiated on BLM administered land and impacted land located within a Federal Energy Regulatory Commission (FERC) project boundary (Figures 1 and 2).

To mitigate the effects of the slide and reduce the potential for further sudden failure of the slope, PacifiCorp proposed a plan that would implement "Emergency Stabilization" methods to structurally stabilize the remaining rock wall on the uphill side of the slide. Because parts of the Emergency Stabilization efforts will occur on BLM administered land, BLM must satisfy requirements for an Environmental Assessment (EA), as stipulated under the National Environmental Policy Act (NEPA) and described in BLM's National Environmental Policy Act Handbook in H-1790-1<sup>1</sup>.

Interagency guidance and BLM policy, as stated in H-1790-1, the Interagency Emergency Stabilization and Rehabilitation (ES&R) Handbook and draft Emergency Stabilization and Burned Area Rehabilitation Handbook (July 1, 2005 - H-17421), provide for "emergency

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<sup>1</sup> PacifiCorp has proposed a plan to revegetate the disturbed area located above the west bank of the Klamath River. This area is located within the FERC boundary and will not require a BLM Right-of-Way Permit and NEPA analysis.

stabilization” and rehabilitation where fire has an adverse impact on vegetation, soils, and watersheds and also to minimize other adverse changes to the extent practicable. By definition, Emergency Stabilization is defined as “Planned actions to stabilize and prevent unacceptable degradation to natural and cultural resources, to minimize threats to life and property resulting from the effects of a fire, or to repair/replace/construct physical improvements necessary to prevent degradation of land or resources. Emergency Stabilization actions must be taken within one year following containment of a wildland fire.” (Department of Interior, Departmental Manual, 620 DM3).

Further proposed revisions to the BLM policy for managing the NEPA process broaden the definition of emergency stabilization to address other common categories of natural process events). The natural events covered are wildfire, flood, strong weather, earthquake, and landslip. In addition, the timeframe in which stabilizing treatments must occur is limited to within a year of the event [(71 Federal Register 4159 (2006)].

This EA analyzes the benefits and risks of implementing Emergency Stabilization actions at the site of the previous failure as compared to a no action alternative. These stabilization actions are intended to reduce the risk of further, unexpected, catastrophic failure of the rock wall and mitigate the potential for imminent threat to the public, environmental resources and JC Boyle Canal at the site of the original slide location.

Decisions resulting from information provided in this EA include the stabilization and mitigation measures that would be implemented at the site of the rockslide. Internal scoping of issues relevant to the Emergency Stabilization actions identified the need to ensure that the stabilization activities are conducted in a manner that promotes attainment of desired future conditions subsequent to the rock slide and meets management objectives for special status species, riparian and upland vegetation, watershed processes, and cultural resources presented in the land use plan.

The level of controversy of potential stabilization actions to be implemented is low due to its mitigative nature. No other federal, state or local government is involved in this NEPA analysis of the proposed action, beyond issue identification, review, and comment on content of the document.

#### DESCRIPTION of PROPOSED ACTION:

The Klamath Falls Resource Area (KFRA) and PacifiCorp proposes to conduct Emergency Stabilization activities on less than 1 acre of BLM administered land at the site of a rock slide located along the slope above the JC Boyle Canal and upper canal access road (Figures 2 and 3).

The proposed stabilization methods include:

1. Hand scaling of the rock slope,
2. Cable lashing,
3. Installing draped cable nets,
4. Installing rock bolts,
5. Installing modified cable net fence

## **ALTERNATIVES:**

### **#1) NO ACTION -**

No emergency stabilization or rehabilitation activities would be completed. The site of the rockslide and the adjacent area directly below the slide would remain in its current condition. No monitoring of the slide area would occur beyond that scheduled prior to the slide.

### **#2) ALTERNATIVE 1 (PREFERRED ALTERNATIVE) -**

The stabilization measures, installation of structural controls and other related elements discussed below would be completed in accordance with Construction Plans and Specifications submitted to BLM by PacifiCorp and their engineering contractor Cornforth Consultants. PacifiCorp is contracting rockfall mitigation contractors for this work and will provide a Certified Engineering Geologist through Cornforth Consultants, to perform construction monitoring services during the stabilization project. A brief description of the work to be performed is presented below. A more detailed description of the stabilization activities are provided in the Plans and Specifications included in Exhibit A of this document<sup>2</sup>.

#### *Stabilization Methods and Structural Controls to occur within BLM Administered Lands*

1. **Scaling** - This work consists of removing loose blocks using hand tools. Scaling will occur on the slope above the upper canal access road for the entire height of the slope and for a length of roughly 150 feet.
2. **Cable Lashing** - Cable lashing will be installed to provide support during construction operations as well as long-term support of the larger blocks that comprise the north side of the rock outcrop. The cable lashing consists of wire ropes and anchors. The wire rope would be ¾-inch diameter, 6 x 19 woven wire rope (with an independent wire rope core made from extra improved plow steel and a minimum breaking strength of 50,000 pounds). Anchors would be grouted into 2½-inch nominal diameter, 76-inch deep holes drilled into competent rock. Anchors would be constructed from wire rope as shown in the typical drawings in the Plans and Specifications in Exhibit A. Wire ropes would be nominally tensioned against the rock block to preserve the existing block position without inducing movement of the block.
3. **Draped Cable Nets** - Draped cable nets would be installed the full height on the northern portion of the rock outcrop to provide passive protection against uncontrolled rockfalls and improve safety for construction workers (Figure 3). Approximately 288 square feet of draped cable nets will be required.
4. **Rock Bolting** - Approximately fifty-five (55) rock bolts are recommended to provide needed support to the outcrop. The rock bolting work would be done after the scaling operations are completed. Mechanically anchored, post-tensioned, grouted rock bolts with a design load of 33 kips (one kip is equal to 83.333 foot pounds of torque) would be

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<sup>2</sup> Due to the limited survey control, the quantities described are not precise.

used. The rock bolts lengths would include 10-foot to 30-foot long bolts depending on the thickness of the block that will be secured to the slope.

#### *Stabilization Methods and Structural Controls to occur within the FERC Boundary*

The activities described below are located within the FERC boundary and are not part of the affected environment, but are included in the description of mitigation activities for completeness purposes.

5. Modified Cable Net Catch Fence - A modified cable net catch fence, 165 feet long would be installed approximately 10 feet up the slope above the top of the road cut. The steel posts would be 10 feet tall and spaced approximately 30 feet apart and secured in grouted holes drilled into competent rock. The net panels will consist of wire rope panels with a grid size opening no larger than 8-inches. The net panel would include a layer of No. 9 gauge, zinc-coated gabion wire mesh fabric with a maximum mesh size approximately 4-<sup>3</sup>/<sub>4</sub> inches with a double twist selvage and hexagonal shape on the slope side. The cable nets would drape within 5 feet of a roadside ditch running parallel to the upper canal access road (Figure 3).

The stabilization activities and installation of structural controls will be conducted using a crane positioned along the upper canal access road. No new access roads or other surface disturbance, other than the activities described above, will be required to complete the work. No hazardous materials will be used during the installation of structural controls. Non toxic grout will be used to secure rock bolts, anchors and fence posts.

#### AFFECTED ENVIRONMENT:

The proposed project is within Klamath County, Oregon, and is located approximately 18.5 miles southwest of the City of Klamath Falls (Figure 1). The project site approximately two miles south of the JC Boyle Dam and is located within (river) Segment 1, between river miles 222 and 223. The rockslide area is situated along the western canyon wall of the Klamath River, adjacent to and upslope from the river, the JC Boyle Canal and the upper canal Access Road (Figure 2).

#### *Topography, Soils and Geology*

The topography at the proposed project site varies from gently sloping along the river benches to almost vertical at the canyon walls. The canyon rim's basalt cliffs rise to 1,000 feet above the river. The average river gradient in Segment 1 is 75 feet per mile. Geologic resources at the project site primarily consist of Quaternary-age volcanic flows, mostly basaltic and andesitic, which cap older volcanic deposits and Quaternary alluvium, colluvium, talus, lacustrine, and landslide deposits (BLM, 2003).

Soils in the vicinity of the proposed project site consist of Skookum and McMullin and Greystoke and Pinehurst series (BLM, 2003). These soils are generally shallow to deep and are well drained to somewhat excessively drained. The soils formed in material weathered from shale, sandstone, basic igneous and metamorphic rocks and from mixed colluvium and residuum weathered from extrusive igneous rock on mountainsides and hills (NRCS, 2006).

### *Climate and Air Quality*

Annual precipitation, most commonly in the form of rain, ranges from 15 to 20 inches during fall, winter, and spring. Summers are hot and dry with occasional thunderstorms developing in the late afternoon. In the winter, snow falls on the rim of the canyon, but only rarely accumulates on the canyon floor. Winter temperatures in the canyon drop into the low 20s (degrees Fahrenheit) and summer temperatures climb into the high 80s or 90s. Air quality is generally good within the canyon because it is far removed from population centers or industrialized areas.

### *Vegetation, Terrestrial Resources and Habitat*

The area is characterized by a mixture of conifer forest woodland, mixed shrub and open oak woodland on the uplands, and riparian vegetation along the river (BLM, 2003).

No threatened and endangered (T&E) species or Bureau sensitive species, and no suitable habitat for T&E and Bureau sensitive species have been identified at the project site (Personal Communication Don Hoffheins BLM to Diane Barr PacifiCorp, 2006). Because surveys of the affected area for Survey and Manage species (mollusks) would have required unacceptable safety risks, surveys were considered “not practical” and were not conducted. (Page 25 of the 2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage (S&M), Protection Buffer, and other Mitigation Measures Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents within the range of the Northern Spotted Owl)

### *Cultural Resources, Scenic Waterway/River Status, Critical Environmental Concern Designation*

No known cultural or historically significant resources have been identified at the project site (BLM, 2003).

The reach of the Klamath River in Segment 1 is not designated as a State Scenic Waterway or Federal Wild and Scenic River. The Project site is not within an area of Critical Environmental Concern (BLM, 2003).

### *Visual Resources*

The proposed project site is located within an area designated as Visual Resource Management Class (VRM) Class II (BLM, 2003), a management classification that permits management activities resulting in changes to the existing character of the landscape, provided that they do not attract the attention of the casual observer.

### *Roads and Recreational Resources*

The upper canal access road provides public access to recreational sites in Segment 2 located downstream from the JC Boyle Powerhouse. However, access to the west bank of the Klamath River in Segment 1 and at the location of the proposed project site is limited by the presence of the JC Boyle Canal.

ENVIRONMENTAL IMPACTS:

The potential environmental impacts resulting from the alternatives relative to the following critical resource values were evaluated as to whether they would be affected (beneficially or otherwise) by the proposed action. The following is a summary of the results:

Critical Element/ Resource Value	Affected		Critical Element/ Resource Value	Affected	
	Yes	No		Yes	No
Air Quality		X	T & E Species		X
ACEC/RNAs		X	Wilderness		X
Cultural Resources		X	Wild & Scenic Rivers		X
Farmlands, Prime/Unique		X	Hazardous Wastes		X
Floodplains		X	Water Quality		X
Native American Cultural/ Religious Concerns		X	Wetlands/Riparian Zones		X
Low Income/ Minority Populations		X	Noxious Weeds		X

DESCRIPTION of OTHER IMPACTS:

*Roads and Recreational Resources*

No Action - The upper canal access road provides public access to recreational sites in Segment 2, located downstream from the JC Boyle Powerhouse. The road is currently closed to the public due to the potential for imminent threat from unexpected, catastrophic failure of the remaining rock wall at the site of the original slide location. If no actions are taken to stabilize the remaining rock wall, the threat to human safety would remain and the road could be closed to the public indefinitely.

Preferred Alternative - Rock scaling and the installation of rock bolts, draped cable net and rock fence will reduce the potential for further, unexpected, catastrophic failure at the site of the stabilization work. The stabilization work will result in a beneficial impact by allowing the reopening of the upper canal access road and restoring public access to recreational sites

in Segment 2 below the JC Boyle Powerhouse (Figures 1 and 2).

#### *Visual Impacts*

No Action – There would be no additional impact to visual resources in the absence of stabilization activities.

Preferred Alternative - The draped cable net could be potentially visible within a narrow field of vision along the upper canal access road, along a small reach of the Klamath River below the site, and in the area directly across the river along the east canyon wall (Figures 2 and 4). However, manmade structures including the upper canal access road and the JC Boyle Canal, dominate the view in the potential location of the planned stabilization activities. Consequently, the draped cable net will be a subordinate element of the landscape and constitutes only a small fraction of the overall viewshed. Impacts on the aesthetic qualities of this area will be negligible and will not bring about a substantial change in the overall character and quality of the landscape seen from this area.

#### CUMULATIVE IMPACTS:

Potential cumulative impacts resulting from the implementation of the alternatives were evaluated relative to the abovementioned critical resource values. The evaluation of cumulative impacts indicated that impacts would be limited to visual resources resulting from the installation of the modified cable net catch fence located within the FERC boundary. A description of the visual resource cumulative impacts is provided below.

#### *Visual Impacts*

Similar to the draped cable net, the modified cable net catch fence will be a subordinate element of the landscape and constitutes only a small fraction of the overall viewshed (Figures 2 and 5). Cumulative visual impacts from the cable net fence (and the proposed action) on the aesthetic qualities of this area will be substantially similar to the draped cable net, i.e., impacts will be negligible and will not bring about a substantial change in the overall character and quality of the landscape seen from this area.

#### DESCRIPTION of MITIGATION MEASURES and RESIDUAL IMPACTS:

1. Silt fences or stacked hay bales will be installed in the road ditch down gradient from stabilization work. The silt fences or stacked hay bales will be used to trap sediment prior to the initiation of work activities. The road ditch will be reshaped and the sediment trapping devices will be kept in place through at least the first wet season after project completion. Trapped sediment will be removed from ditches and placed in stable locations (i.e., low relief areas not connected to watercourses).
2. The rockslide and subsequent canal water break resulted in the deposition of rock and other earthen debris along the west bank of the Klamath River and the discharge of sediment in the river. Rock scaling and installation of rock bolts, draped cable net and rock fence will reduce the potential for further rockslides and discharge of sediment in the river in the area directly below the site of the proposed stabilization work. In

addition, the proposed plan to revegetate the disturbed area located above the west bank of the Klamath River will stabilize loose soils and other slide debris and mitigate the potential for further discharge of sediment into the Klamath River.

3. Revegetation of the slide area above the west bank of the Klamath River will restore the vegetative cover in the area of the slide and reduce the visible evidence of recent slide activity.
4. The draped cable net and cable net fence will be constructed from non reflective zinc-coated steel, thus reducing its visibility within the surrounding viewshed.

#### REFERENCES:

U.S. Department of Agriculture-Forest Service and U.S. Department of Interior-Bureau of Land Management (USFS and BLM). 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents within the range of the Northern Spotted Owl.

U.S. Department of Agriculture Natural Resources Conservation Service, Official Soil Series Description View by Name webpage, <http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi> (accessed March 24, 2006).

U.S. Department of the Interior Bureau of Land Management, Klamath Falls Resource Area Record of Decision and Resource Management Plan. June 1995.

U.S. Department of the Interior Bureau of Land Management, Final Klamath Falls Resource Area Management Plan and EIS. September 1994.

U.S. Department of the Interior Bureau of Land Management, Draft-Upper Klamath River Management Plan Environmental Impact Statement and Resource Management Plan Amendments. April 2003.



Figure 1 - General Location Map

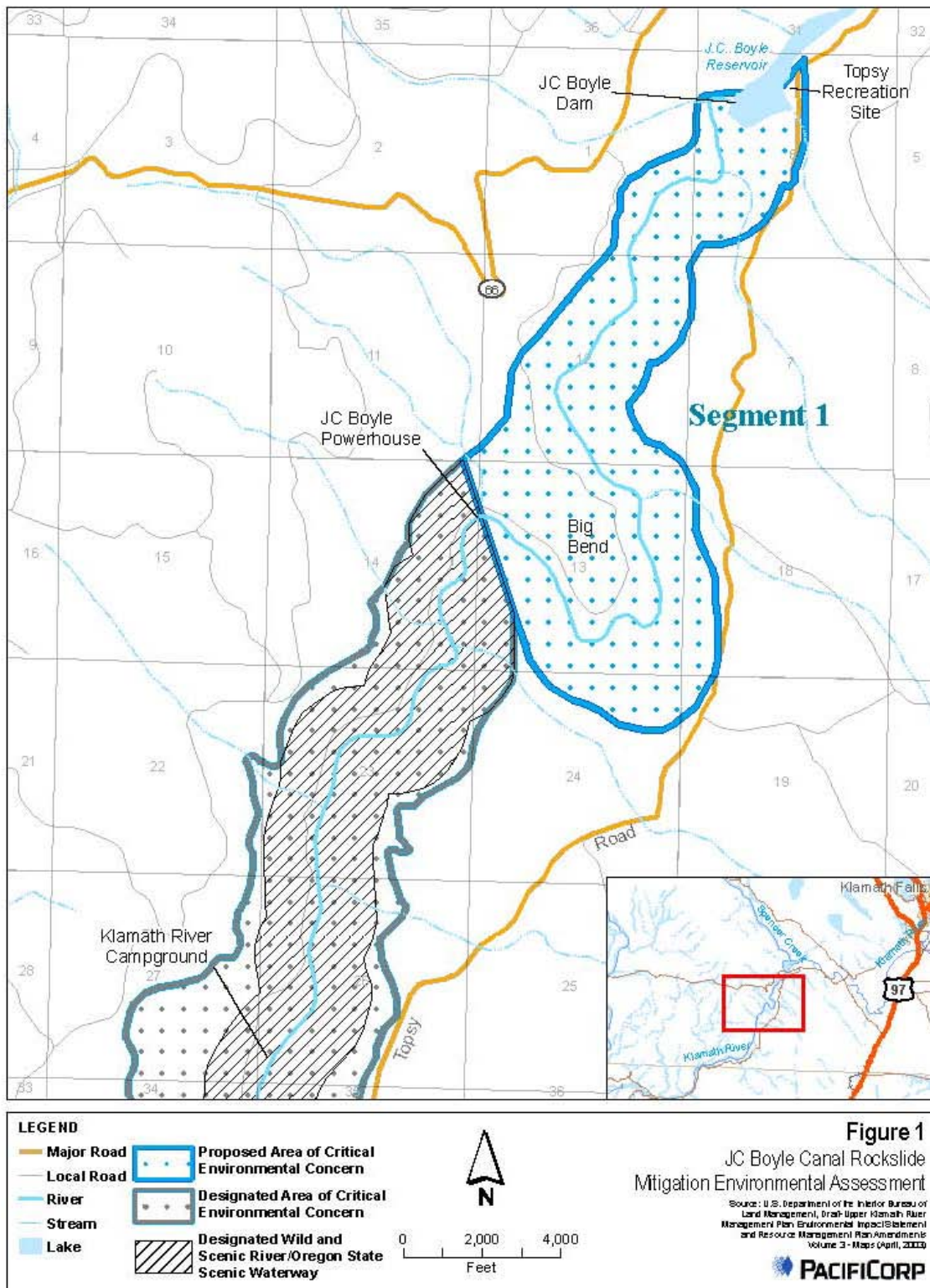


Figure 2 - Map of Proposed Stabilization Activities

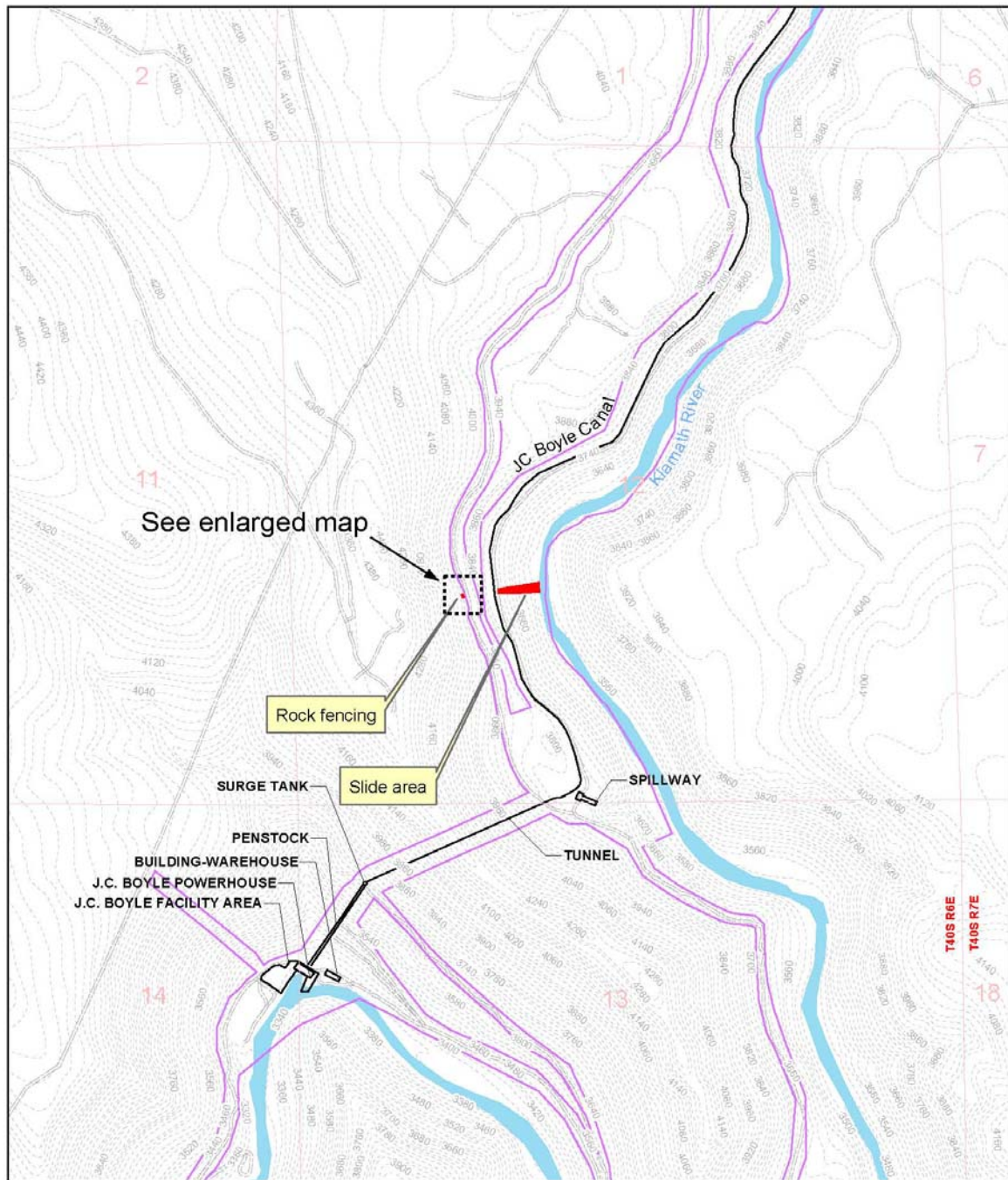


Figure 2  
**JC Boyle**  
**Rocksilde Area**

- Hydro Facilities
- Roads
- FERC Boundary
- River
- section polygon
- Topography
- JC Boyle Canal Repair Area



**PACIFICORP**  
 1/30/06

Figure 3 - J.C. Boyle Rock Fence

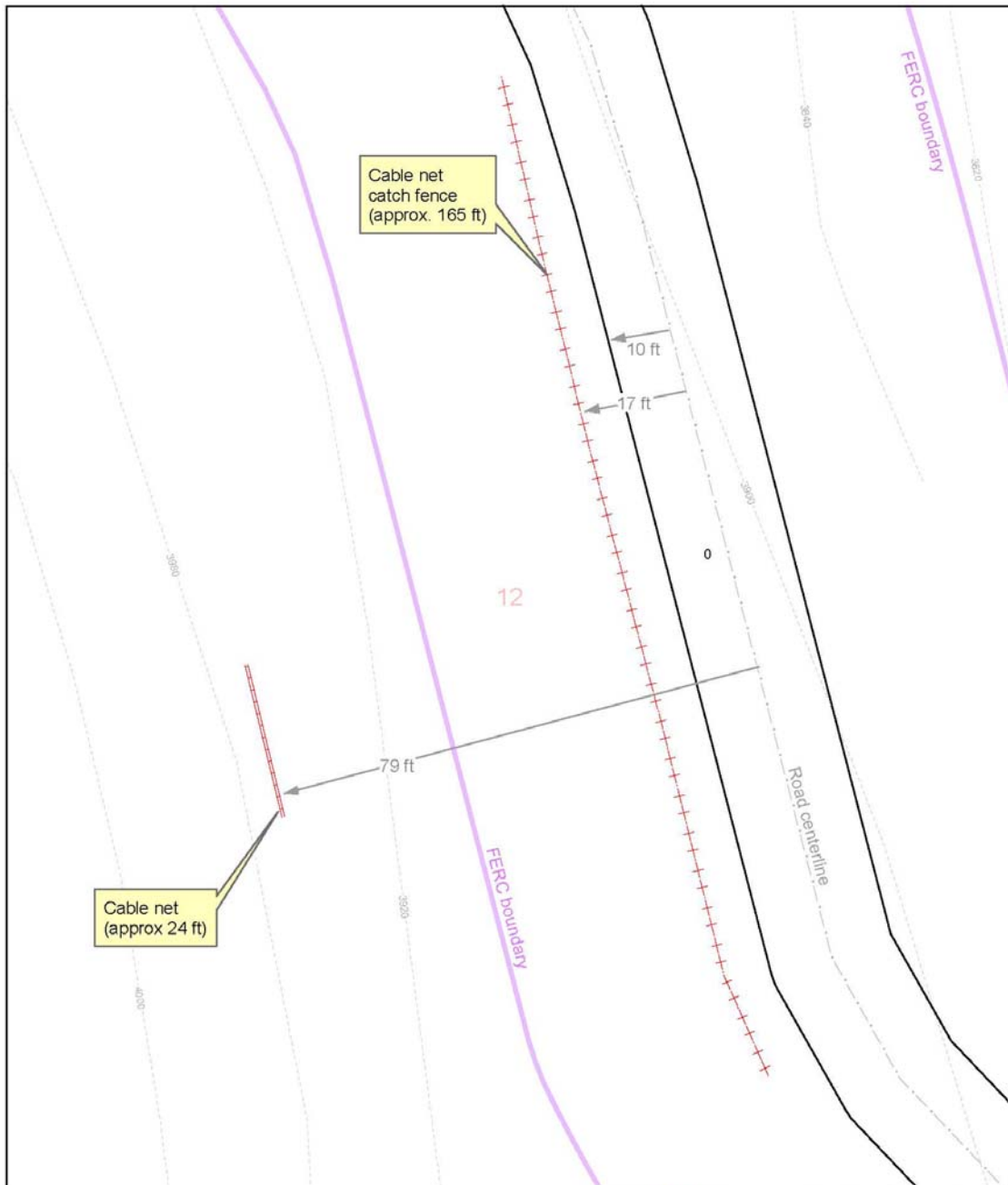
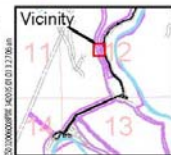


Figure 3  
**JC Boyle  
 Rockslide Area  
 Enlarged View**

- Modified Cable net catch fence location
- Rock bolt and cable net location
- ▭ Road edge
- - - Road\_centerline
- section polygon
- Topography
- FERC Boundary



Drawing not to exact scale

0 5 10 20 40 Feet

Scale 1:240

PACIFICORP  
 1/30/06

Figure 4 - Proposed Rock Bolt and Cable Locations

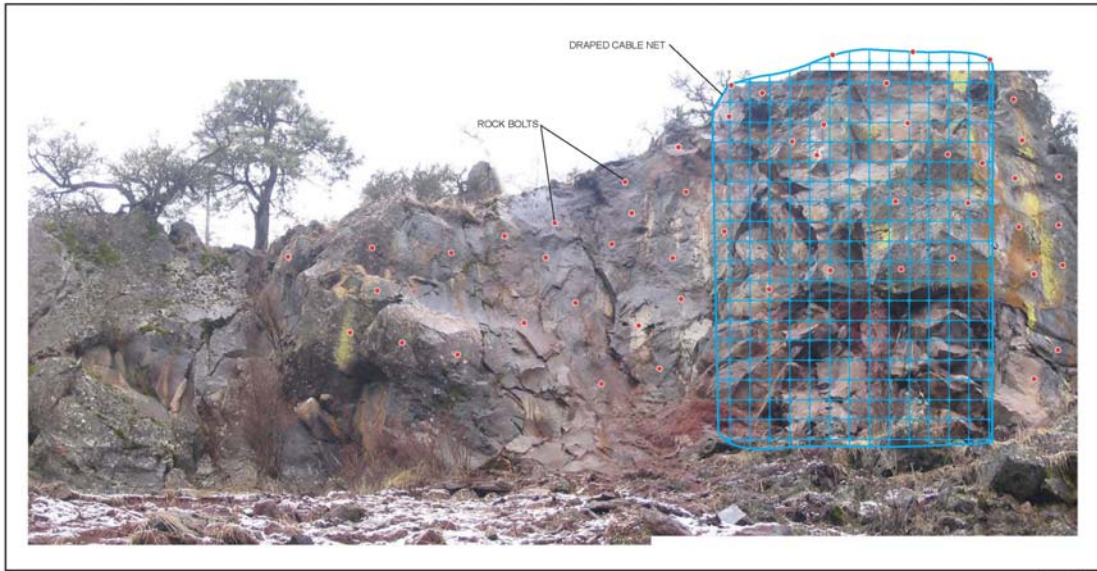


Figure 4  
Proposed Rock Bolt and Cable Net Locations

Source - Comforth Consultants

Figure 5 - Modified Cable Net Catch Fence



Figure 5  
Modified Cable Net Catch Fence

Source - Comforth Consultants

# Exhibit A

## Technical Memorandum

**Rockfall Mitigation Design – J.C. Boyle Project**



10250 S.W. Greenburg Road, Suite 111  
Portland, Oregon 97223  
Phone 503-452-1100 Fax 503-452-1528

## **TECHNICAL MEMO**

**To:** Mr. Will Shallenberger, P.E.  
PacifiCorp  
**From:** Brent A. Black, C.E.G.  
Cornforth Consultants, Inc.  
**Date:** January 6, 2006  
**Subject:** Rockfall Mitigation Design – J.C. Boyle Project

In accordance with your request, Cornforth Consultants, Inc. has performed an evaluation and design services to mitigate rockfall hazards associated with the J.C. Boyle Reservoir Project (see Figure 1). This package includes a summary of our recommended rockfall mitigation design elements and includes preliminary project Plans and Specifications.

Rockfall mitigation recommendations were developed during field and office studies. A meeting with Cornforth Consultants and PacifiCorp personnel was convened on January 2, 2006 and a decision was reached to advance a combination of specific mitigation measures through design as described below. Due to the limited survey control, the quantities described are not precise. The selected mitigation measures and related elements include:

- 1) Hand scaling of the rock slope,
- 2) Cable lashing,
- 3) Installing draped cable nets,
- 4) Installing rock bolts,
- 5) Installing modified cable net fence.

The mitigation measures and related elements discussed below should be completed in accordance with Construction Plans and Specifications. It is our understanding that PacifiCorp is currently contacting prospective rockfall mitigation contractors for this work and that we would provide a Certified Engineering Geologist to perform construction monitoring services during the construction project.

Scaling - This work consists of removing loose blocks using hand tools. Scaling is recommended for the entire height of the slope for a length roughly 150 feet above the upper road. The required scaling hours are estimated at 40 hours.

Cable Lashing - Cable lashing is recommended to provide support during construction operations as well as long-term support of the larger blocks that comprise the north side of the rock outcrop. The cable lashing consists of wire ropes and anchors (see typical drawing in Plans and Specifications). All wire rope should be ¾-inch diameter, 6 x 19 woven wire rope with an

independent wire rope core made from extra improved plow steel and a minimum breaking strength of 50,000 pounds. Anchors should be grouted into 2½-inch nominal diameter, 76-inch deep holes drilled into competent rock. Anchors should be constructed from wire rope as shown in the typical drawing. Wire ropes should be nominally tensioned against the rock block to preserve the existing block position without inducing movement of the block.

Draped Cable Nets – Draped cable nets should be installed the full height on the northern portion of the rock outcrop to provide passive protection against uncontrolled rockfalls and improve safety for construction workers. Approximately 288 square feet of draped cable nets is required.

Rock Bolting – Approximately fifty-five (55) rock bolts are recommended to provide needed support to the outcrop. The rock bolting work should be done after the scaling operations are completed. Mechanically anchored, post-tensioned, grouted rock bolts with a design load of 33 kips would be used. The rock bolts lengths would include 10-foot to 30-foot long bolts depending on the thickness of the block that will be secured to the slope.

Modified Cable Net Catch Fence - A modified cable net catch fence, 165 feet long should be installed approximately 10 feet up the slope above the top of the road cut (see Figure 2). The steel posts should be 10 feet tall and spaced approximately 30 feet apart. The net panels should consist of wire rope panels with a grid size opening no larger than 8-inches. The net panel would include a layer of No. 9 gauge, zinc-coated gabion wire mesh fabric with a maximum mesh size approximately 4-¾ inches with a double twist selvage and hexagonal shape on the slope side. The cable nets should drape within 5 feet of the ditch.



ROCK SLOPE AFTER ROCKFALL EVENT FROM UPPER ROAD



ROADWAY AFTER ROCKFALL EVENT



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1739/01 LJW

## PHOTOS

JC BOYLE FLUME ROCKFALL  
KENO, OREGON

JAN 2006

PROJ. 1739

FIG. 1



WEST

ROCK SLOPE TO BE SCALED  
AND ROCK BOLTED

CABLE NET  
ROCKFALL FENCE

UPPER  
ROAD

ROCK CUT SLOPE

FLUME



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1739\02 LJW

## CROSS-SECTION

JC BOYLE FLUME ROCKFALL  
KENO, OREGON

JAN 2006

PROJ. 1739

FIG. 2

## **PLANS AND SPECIFICATIONS**

## **ROCK SCALING**

### **Description**

- A. This work shall consist of the manual removal of loose blocks of rock from the slope. Scaling shall be performed across the full height and length of the rock face and as directed by the Company Representative. Tree removal if necessary to prepare the slope for the placement of the draped wire mesh shall be included as scaling. No tree removal or rock scaling shall be performed until the Pipeline Protection Measures are in place. The Contractor shall provide all materials, equipment, and labor necessary to perform this work.
- B. No scaled rock shall be allowed to enter the waterway. If scaled rock is observed entering the waterway, the Contractor shall take corrective measures to prohibit rock or debris from entering the waterway.

### **Submittals**

Prior to commencing rock scaling, the Contractor shall submit the following:

- A. The Contractor shall provide written evidence that the rock scaling foreman and the scalers have performed satisfactory work in similar capacities for sufficient length of time to be fully qualified to perform their duties. The foreman shall have not less than 1500 hours of demonstrated experience as a scaler. The scalers shall have demonstrated experience on similar projects.
- B. The Contractor shall submit a detailed work plan. The plan shall include:
  - 1. The proposed rock scaling sequence and schedule.
  - 2. The types of equipment and tools used.
  - 3. The number of rock slope scalers to be employed on the project.
  - 4. Removal and disposal plan for debris generated from scaling work.

Work shall not begin until the Company Representative has approved the appropriate submittal in writing.

### **Materials**

Scaling shall be performed using scaling bars. Other hand tools and mechanical means may be used provided they have demonstrated effectiveness to perform the required work and if they are approved by the Company Representative.

### **Construction Requirements**

- A. Scaling shall begin only after the Pipeline Protection Measures have been completed.

- B. Work shall proceed according to the approved work plan and as directed by the Company Representative. The crew size shall be maintained at all times. No scaling will be performed when the scaling foreman is absent.
- C. Rock scaling shall start at the top of the slope and proceed down slope, removing loose rock as the work progresses. Tree cutting within 15 feet above the crest of the slope, if necessary, and removal of cut trees shall be completed prior to performing other scaling work.
- D. The use of power equipment such as backhoes, etc. for scaling shall be permitted as described in the approved work plan or as approved by the Company Representative.
- E. The extent of scaling will be as directed by the Company Representative.
- F. Remove rock blocks that hang up on the slope during the scaling operation. The new face will be observed by the Company Representative to determine whether or not the rock scaling has been completed. If other rock blocks are identified that require removal, continue to scale the slope until the scaling has been completed to the satisfaction of the Company Representative.
- G. All rock and debris produced by the scaling operations shall be removed and disposed of in the area designated by the Company Representative.

#### **Measurement**

Scaling time will be measured on per scaler hour basis, which will include the presence of the qualified working foreman who will direct their activities. Measurement shall be for each scaler from the time they are equipped and begin to climb the slope until the scaler has descended the slope.

#### **Payment**

Payment performed under this Section made at the contract unit price per scaler hour for the pay item "Rock Scaling" will be payment in full for the scaling crew, all materials, equipment, tools, labor, access, scaled rock and debris removal and incidentals, including any other support personnel, necessary to complete the work. Payment also includes removal of scaled rock, debris and tress. Any additional rock scaling required and authorized by the Company Representative will be paid for at the unit price for "Rock Scaling."

## **CABLE LASHING**

### **Description**

The cable lashing is intended to preserve the current position of the rock block identified in the Plans during construction and in particular the rock bolting efforts.

### **Submittals**

Not less than two weeks prior to commencing the cable lashing, the Contractor shall submit in writing to the Engineer for approval:

1. The inclusive list and the manufacturer's data sheets of all components to be used for the cable lashing anchors and support system (i.e., anchor bars, grout, wire rope, clips, thimbles, ferrules, steel rings, fasteners, etc.)
2. The plan for installing the cable lashing system.

Work shall not begin until the Engineer has approved the appropriate submittals in writing

### **Materials**

#### **A. Grout in Anchors**

Cement grout, or epoxy or polyester resin grout shall be proven, non-shrink material capable of permanently developing the necessary bond and internal strength for the anticipated loads. Epoxy or polyester resin shall be within the shelf-life period stated by the manufacturer and the cartridge diameter shall be selected in accordance with the manufacturer's recommendations to insure complete encapsulation of the anchor and satisfactory in-hole mixing. Cement grout must be capable of attaining a minimum compressive strength of 3,300 p.s.i in 28 days.

If requested by the Engineer, a sample of the cement grout, or the epoxy or polyester resin grout shall be provided for testing.

#### **B. Wire Rope**

All wire rope shall be 3/4-inch diameter, 6x19 classification, galvanized wire rope with independent wire rope core (IWRC) and a minimum breaking strength of 50,000 pounds. All wire rope shall be galvanized conforming to the requirements of ASTM A 603 Class A with a minimum zinc coating of 0.20 oz per square foot on all wires.

#### **C. Hardware**

Use heavy wire rope thimbles and wire rope clips constructed for 3/4-inch diameter wire rope. Turnbuckles shall have a working load equal to or greater than the working load of the 3/4-inch diameter wire rope. Galvanize all hardware according to AASHTO M 232

(ASTM A 153), Class C, except casting shall be Class A, and forgings shall be Class B. Repair any damaged galvanizing.

**Construction**

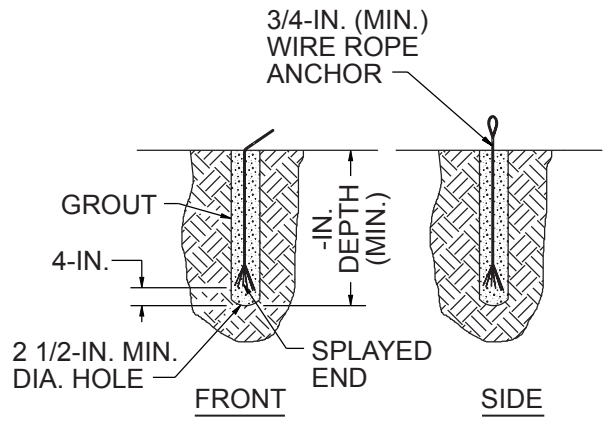
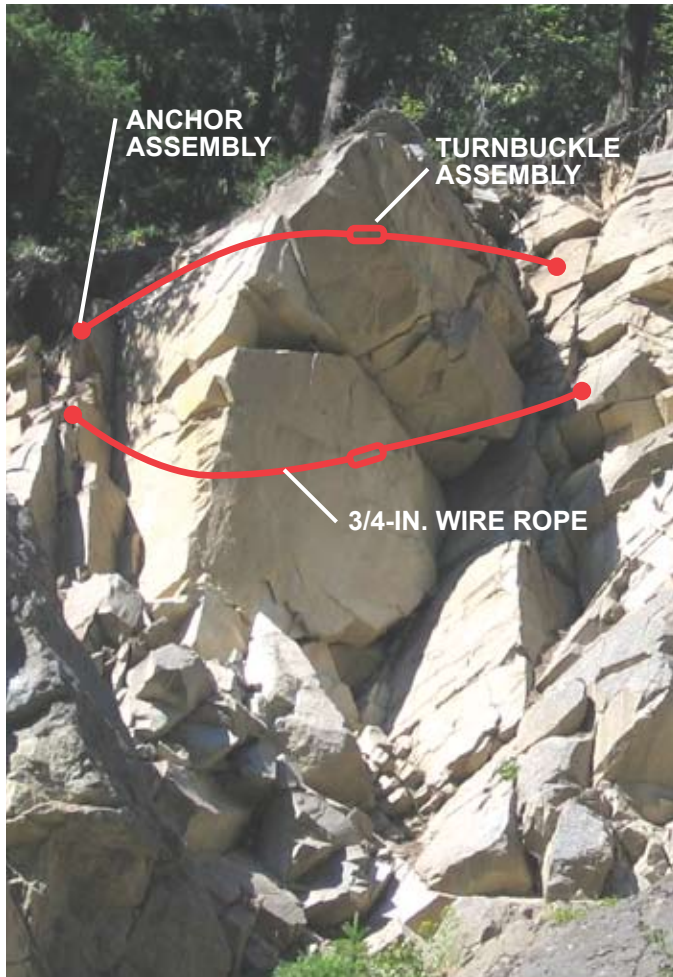
The cable lashing shall be constructed according to the approved plan at the locations shown on the Plans and as described below. The sequence for construction shall be to drill the anchor holes, install the anchors as specified by the manufacturer, and then install and tension the support cables forming the cable lashing. Cable lashing installation shall be completed before any other slope work except slope scaling is performed. Tensioning of the cables should not displace the block being supported. The amount of tension applied shall be nominally tight against the block to prevent movement of the block during subsequent rock bolting and draped mesh construction.

**Measurement**

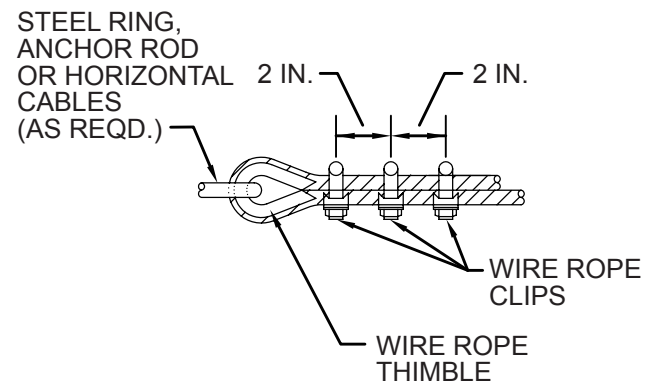
No specific unit of measurement will apply to the lump sum item for “Cable Lashing.”

**Payment**

The unit lump sum price for “Cable Lashing” is full payment for performing the work as specified. Payment represents full compensation for furnishing all labor, materials, equipment, supplies, or other incidentals necessary for task completion including accessing the slope to the cable lashing locations.

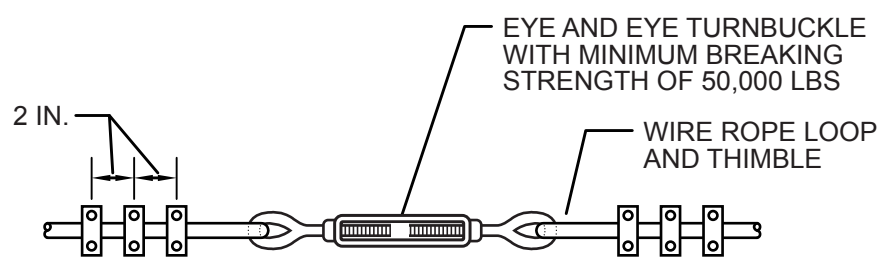


**ANCHOR DETAIL 1**



**ANCHOR DETAIL 2**

NOTE:  
WIRE ROPES SHOULD BE NOMINALLY  
TIGHTENED AGAINST THE ROCKBLOCK  
TO PRESERVE EXISTING BLOCK POSITION



**TURNBUCKLE ASSEMBLY DETAIL**

## **CABLE NET SLOPE PROTECTION**

### **Description**

This work consists of installing anchors and the placement of cable nets in accordance with these specifications and the details shown in the Plans.

### **Submittals**

Not less than two weeks prior to the placement of the cable net slope protection, the Contractor shall submit in writing to the Engineer for approval:

1. The proposed construction sequence and schedule.
2. The types of equipment and tools to be used.
3. The names and experience of workers that will be utilized on this project element.
4. The inclusive list and catalog cuts for the materials that will be used for the anchors, support system and cable net fasteners (i.e., anchor bars, grout, wire rope, clips, thimbles, ferrules, steel rings, fasteners, etc.)

Work shall not begin until the Engineer has received all required submittals and approved them in writing.

### **Materials**

Net materials used shall conform to those specified by the manufacturer. Net panels shall consist of either interlocking rings no larger than 12 inches in diameter or wire rope net panels. For interlocking ring nets, the rings shall be no larger than 12 inches in diameter. The wire rope net panels shall have a grid size no larger than 8 inch x 8 inch.

All wire rope shall be 3/4-inch diameter, 6x19 classification, galvanized wire rope with independent wire rope core (IWRC) and a minimum breaking strength of 50,000 pounds. The galvanizing shall conform to the requirements of ASTM A 603 Class A.

Hardware shall meet the manufacturer's recommendations for size, weight, number, and torque for a 3/4-inch diameter wire rope. Steel rings shall be 4 inches in diameter and made for 7/8-inch diameter, drop-forged steel (weldless) with a minimum working load of 10,000 lbf.

All hardware shall be galvanized in accordance with AASHTO M 232, Class C, except castings shall be Class A, and forgings shall Class B.

Lacing wire shall be manufactured of 9 gauge (minimum) steel wire meeting ASTM specification A-641 finish 5; medium hardness and tensile strength with a Class 3 coating.

Anchors shall be installed in rock and may consist of the following two types:



1. Anchors shall consist of a nominal 3/4-inch diameter wire rope conforming to the above specifications for wire ropes. The wire rope shall have a pressed ferrule at the distal end, and a pressed ferrule and a loop with a thimble at the exposed end.
2. Anchors shall consist of a solid, threaded, deformed steel bar conforming to AASHTO M31 Grade 60 with a minimum diameter of 3/4 inches (No. 6). Plates, nuts and anchor bars shall be products of a manufacturer regularly engaged in the manufacturing of materials for the construction of rock anchors. Corrosion protection paint shall conform to Section 9-08.2 for Formula A-9-73 - Galvanizing Repair Paint, High Zinc Dust Content.

Grout for anchors shall be Will-X cement grout or an approved equal.

### **Construction Requirements**

Cable net slope protection, net fastening, anchor spacing, and support rope lengths shall be installed in accordance with the Plans.

Anchors shall be located a minimum of 10 feet beyond the slope crest. The Engineer shall approve each anchor location. All anchors require a pullout capacity of 20,000 pounds and at a minimum, 25 percent of the anchors shall be proof tested. An anchor is acceptable if it sustains this load for 10 minutes with no loss of load. Anchors that fail this criterion shall be replaced and retested at the Contractor's expense. Testing shall be performed against a temporary yoke or load frame. No part of the yoke or load frame shall bear within 3 feet of the anchor.

All exposed parts of anchors shall meet the galvanized requirements specified above.

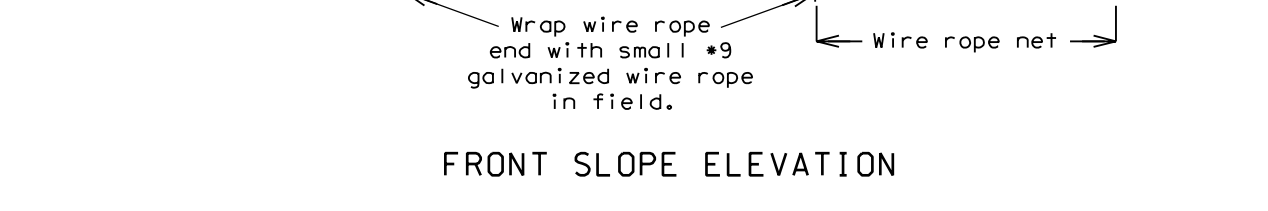
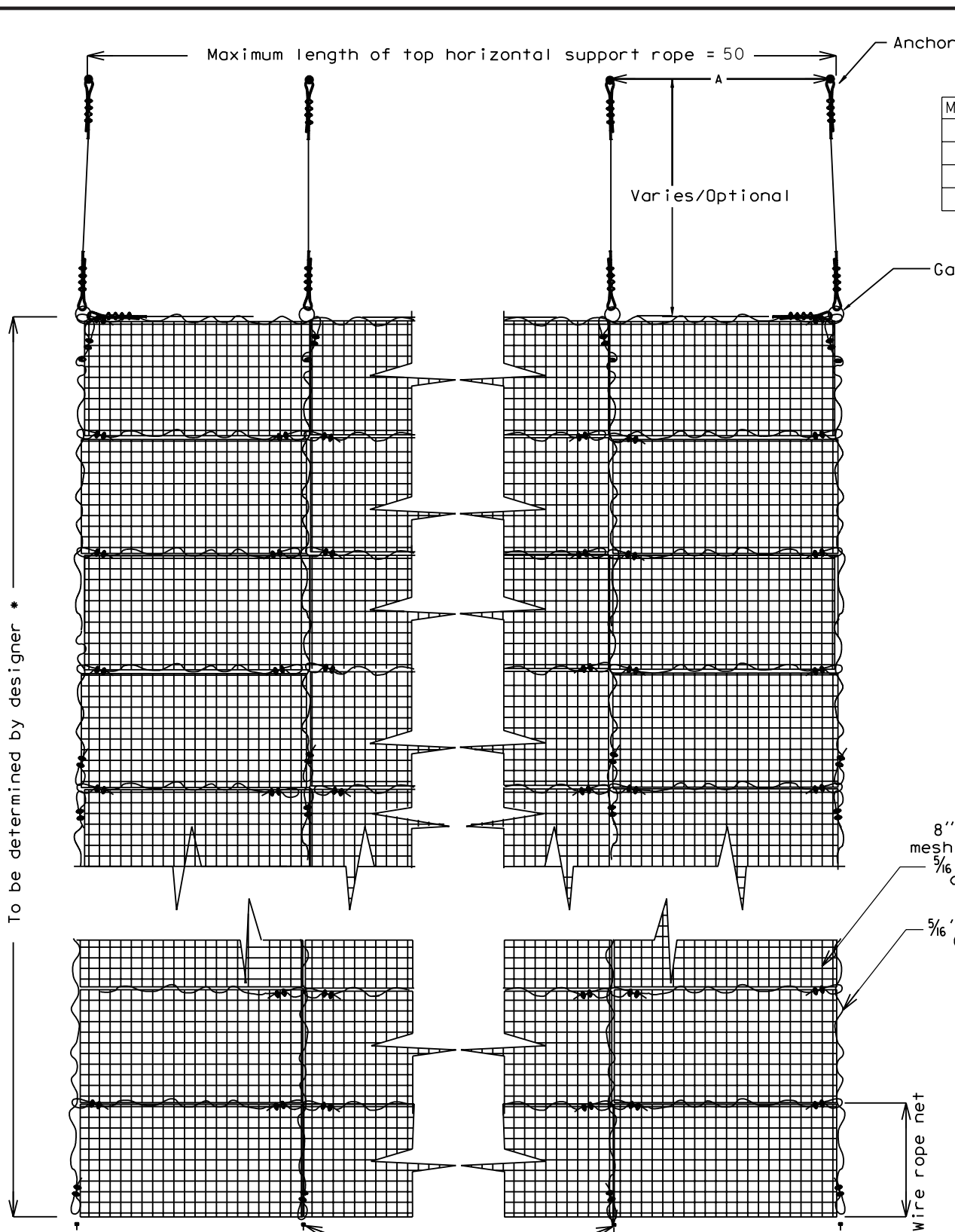
Cable net panels will be seamed together as shown in the plans.

### **Measurement**

Wire mesh slope protection will be measured by the square foot.

### **Payment**

The unit contract price per square foot for "Cable Net Slope Protection" shall be full pay to perform the work as specified. Any additional cable net authorized by the Engineer shall be paid for at the unit price for "Cable Net Slope Protection." Anchors, anchor grout, cables, mesh overlaps, hardware and accessing the work areas are considered incidental to the work and no separate or additional payment will be made.



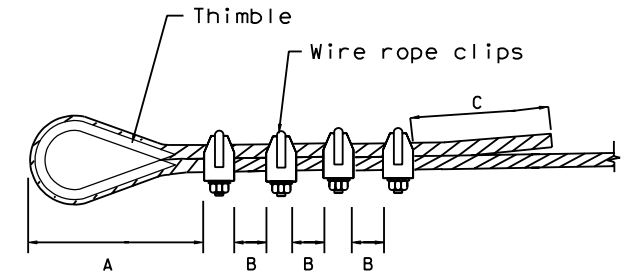
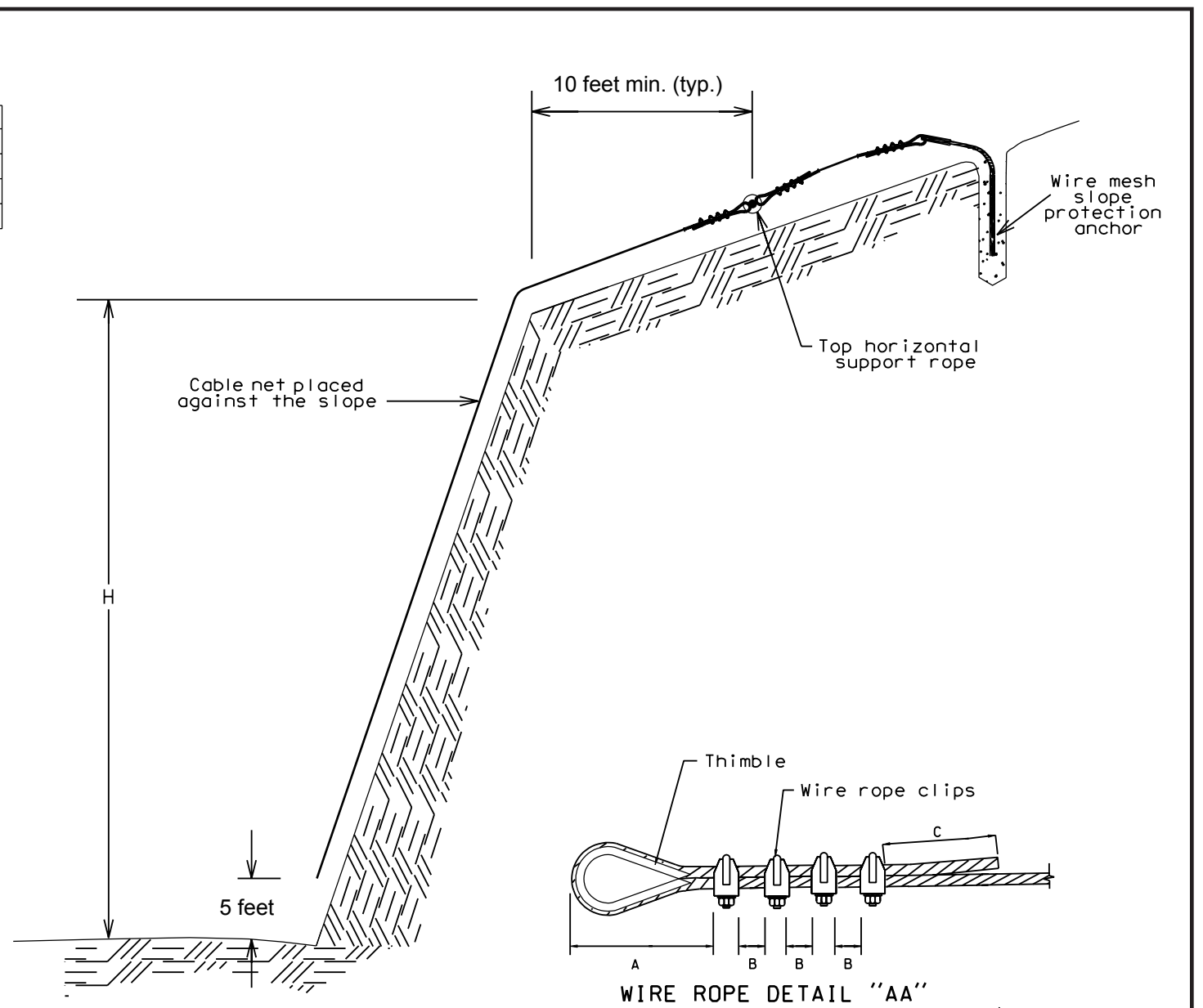
FRONT SLOPE ELEVATION

8" Net panels with mesh opening and with 5/16" (8 mm) \* mesh and border rope

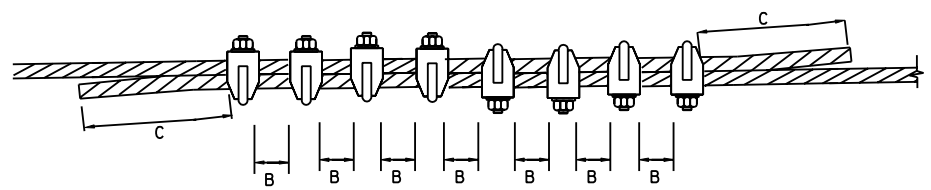
5/16" (8mm) \* Seam rope (See note 1 & 2).

NOTES

1. Maximum anchor spacing (A) for debris and impact loads required as per table for a minimum allowable anchor capacity of 20,000lbf. Systems subjected to snow loads may require narrower maximum spacing.
2. Net to be seamed with 5/16" wire ropes through each panel of net.
3. Ends of seam ropes are to be terminated with (2) 5/16" wire rope clips.
4. Chain link or hexagonal mesh backing must be fastened to the cable net prior to placement on the slope.



WIRE ROPE DETAIL "AA"  
Distances A,B,C and torque to comply with manufacturer's specifications

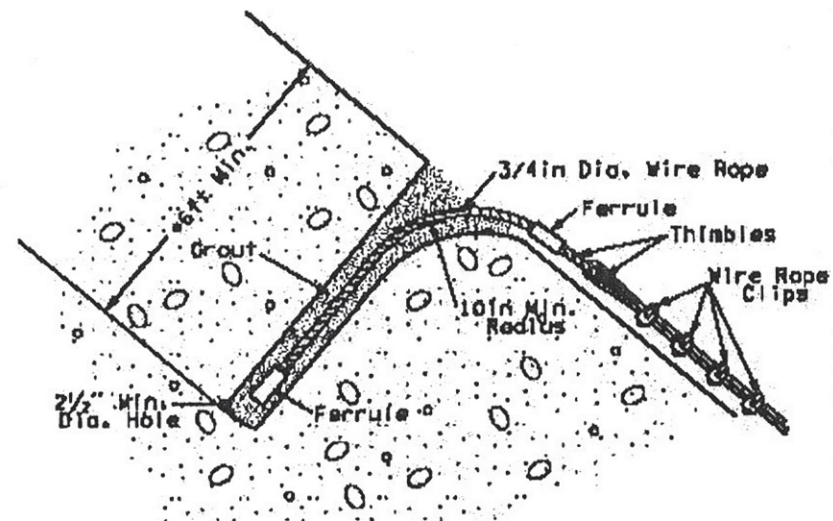


WIRE ROPE DETAIL "BB"  
WIRE ROPE SPLICING

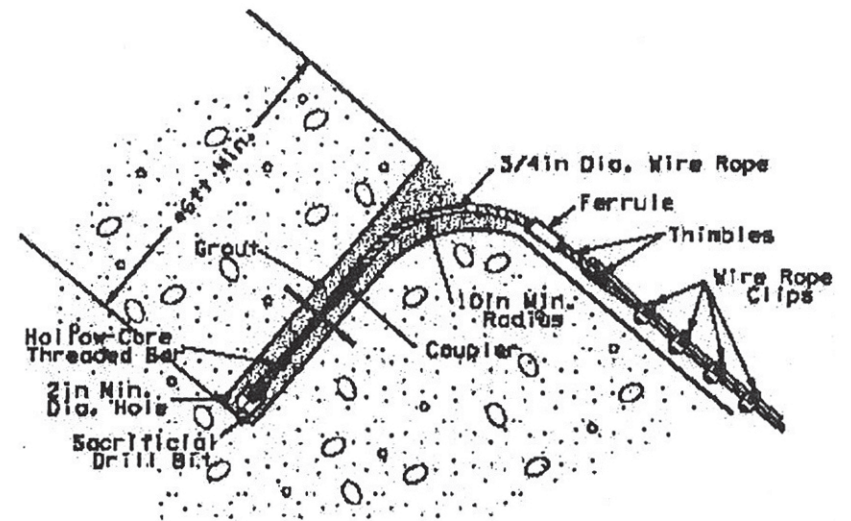
**CORNFORTH CONSULTANTS**  
10250 S.W. Greenburg Road, Suite 111  
Portland, Oregon 97223  
Main 503-452-1100 Fax 503-452-1528

**CABLE NET SLOPE PROTECTION DETAILS**  
JC BOYLE FLUME ROCKFALL  
KENO, OREGON

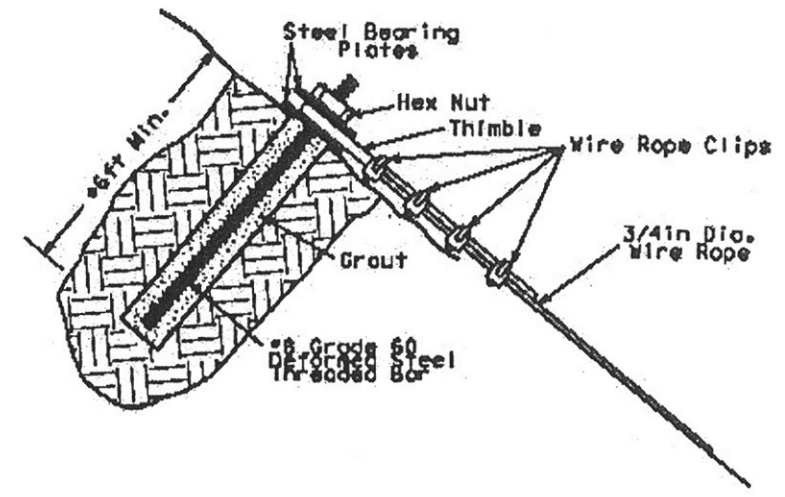
JAN 2006  
PROJ. 1739  
SHEET  
1 of 2



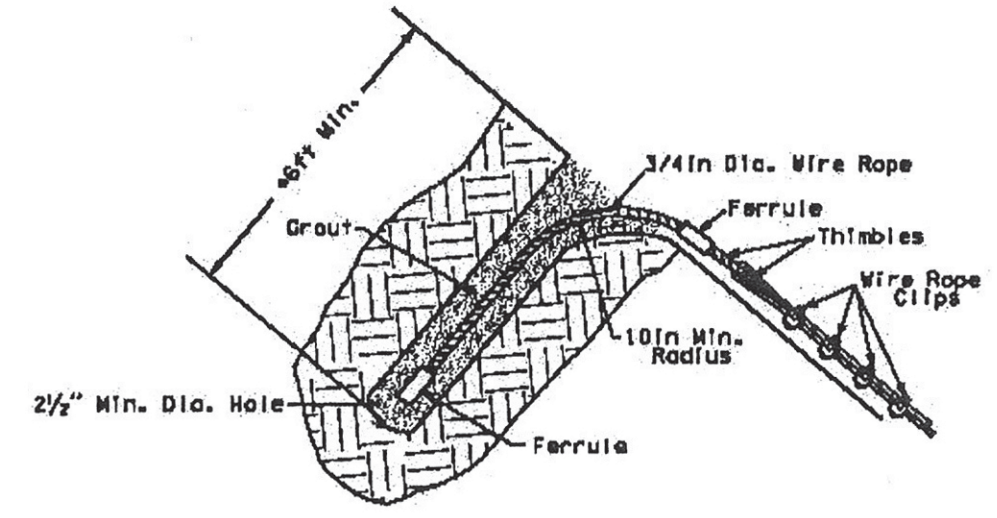
3/4" Wire Rope  
(for use in soil)



Drillable-Groutable  
(for use in soil)



Deformed Steel Threaded Bar  
(for use in rock)



3/4" Wire Rope  
(for use in rock)

## **MODIFIED CABLE NET CATCH FENCE**

### **Description**

This work item consists of installing modified cable net catch fence at the location shown on the Plans. The Contractor shall supply all necessary materials, equipment, and labor to install the catch fence. The cable nets shall be attached to the horizontal cable supported 10 feet above the ground by the “H-pile type” posts and allowed to drape down the slope to within approximately five feet of the ditch line. The cable panels shall be backed with 9-gauge, galvanized chain link or gabion mesh and shall not pass particles greater than 2 inches in size. The cable nets shall be constructed using ½-inch cables.

### **Submittal**

Not less than two weeks prior to commencing the fence installation, the Contractor shall submit in writing to the Engineer for approval the detailed plan for the construction of modified cable net catch fence that includes:

- The proposed construction sequence and schedule.
- The proposed foundation details for the support posts.
- The proposed tie-back and support cable ground anchors and the installation methods, materials and equipment necessary for their installation.
- A list and detailed description of the proposed system components shall be provided. Also provide the details for net-to-net connections, net-to-support rope connections, quick-release shackle and tie-back cable connections, and column posts.

Work shall not begin until the Engineer has approved the appropriate submittals in writing.

### **Materials**

Net panels shall consist of wire rope net panels comprised of ½-inch cables. The wire rope net panels shall have a grid size opening no larger than 8 inches. Fences relying solely on chainlink or gabion mesh for the restraining fabric will not be allowed.

### **Construction Requirements**

Install post foundations consisting of an approved “Brugg-type” post foundation based on the foundation conditions encountered (soil or rock). Install tieback and support cable “cable-type” anchors and install the support cable and tie back cables. Attach the chain link or gabion mesh to the uphill side of the cable nets before installing the cable nets. Attach the net panels to the support cable and connect adjoining panels. The bottom of the cable nets shall drape from the support cable to within five feet of the ditch line of the upper road.

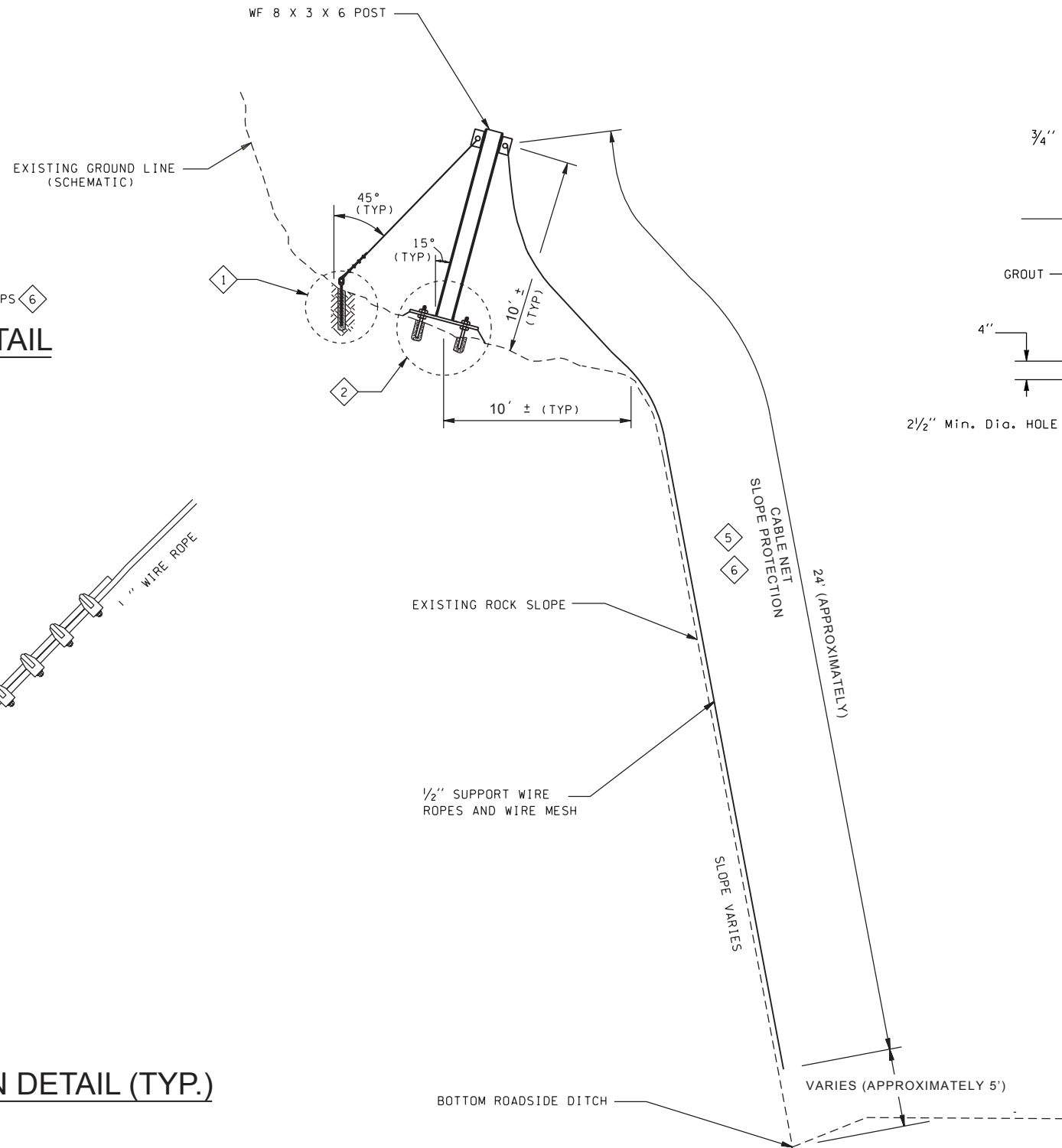
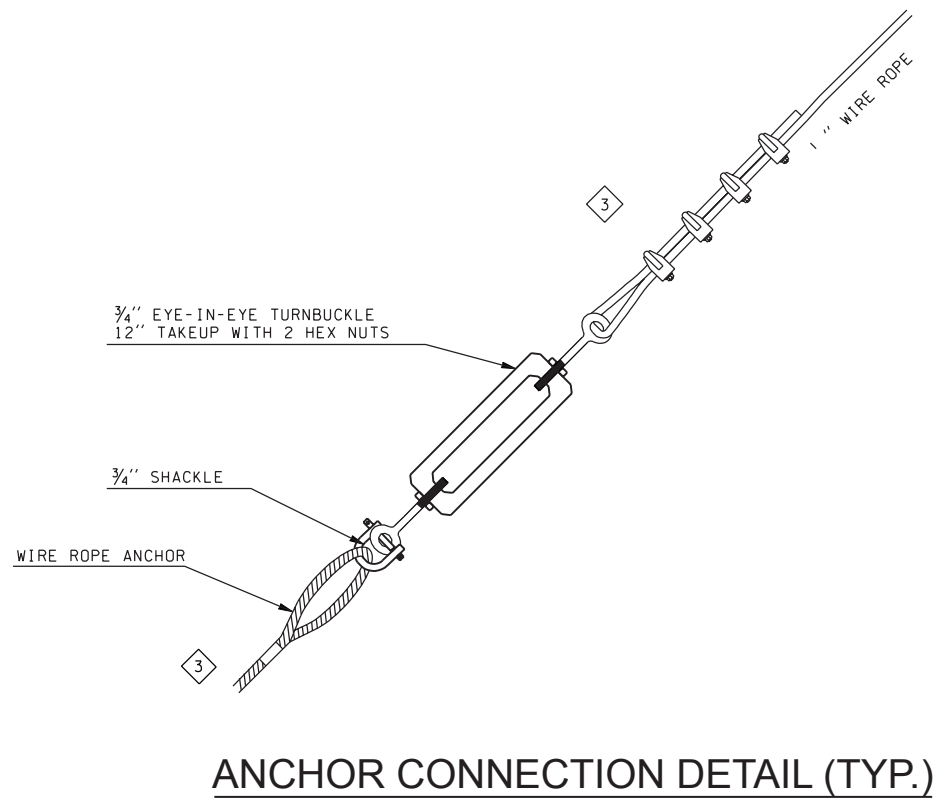
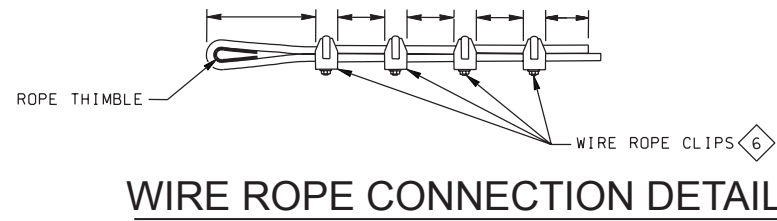
**Measurement**

Modified cable net catch fence will be measured by the square foot of cable panel installed and accepted.

**Payment**

The unit contract price per lineal foot for modified cable net catch fence shall be full payment for performing the work as specified.

DRAFT



- NOTES**
- 1 SEE ANCHOR DETAIL, THIS SHEET.
  - 2 SEE FOUNDATION DETAIL, REFERENCE SHEET 3.
  - 3 SEE WIRE ROPE CONNECTION DETAIL, THIS SHEET.
  - 4 WIRE ROPE CLIPS TO BE TIGHTENED TO 66 LBS.
  - 5 SEE SPECIAL PROVISIONS "WIRE MESH SLOPE PROTECTION".
  - 6 SEE STANDARD PLAN D-7.

ALL SLOPES ARE SHOWN AS V:H

**CORNFORTH**  
CONSULTANTS

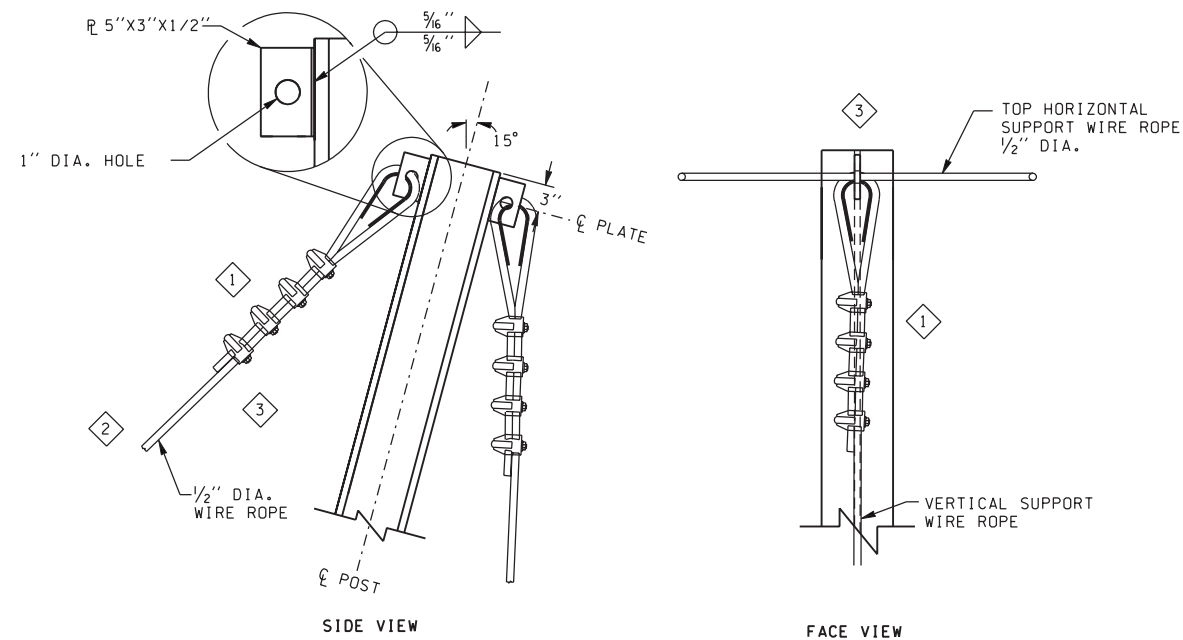
10250 S.W. Greenburg Road, Suite 111  
Portland, Oregon 97223  
Main 503-452-1100 Fax 503-452-1528

1739105a LJW

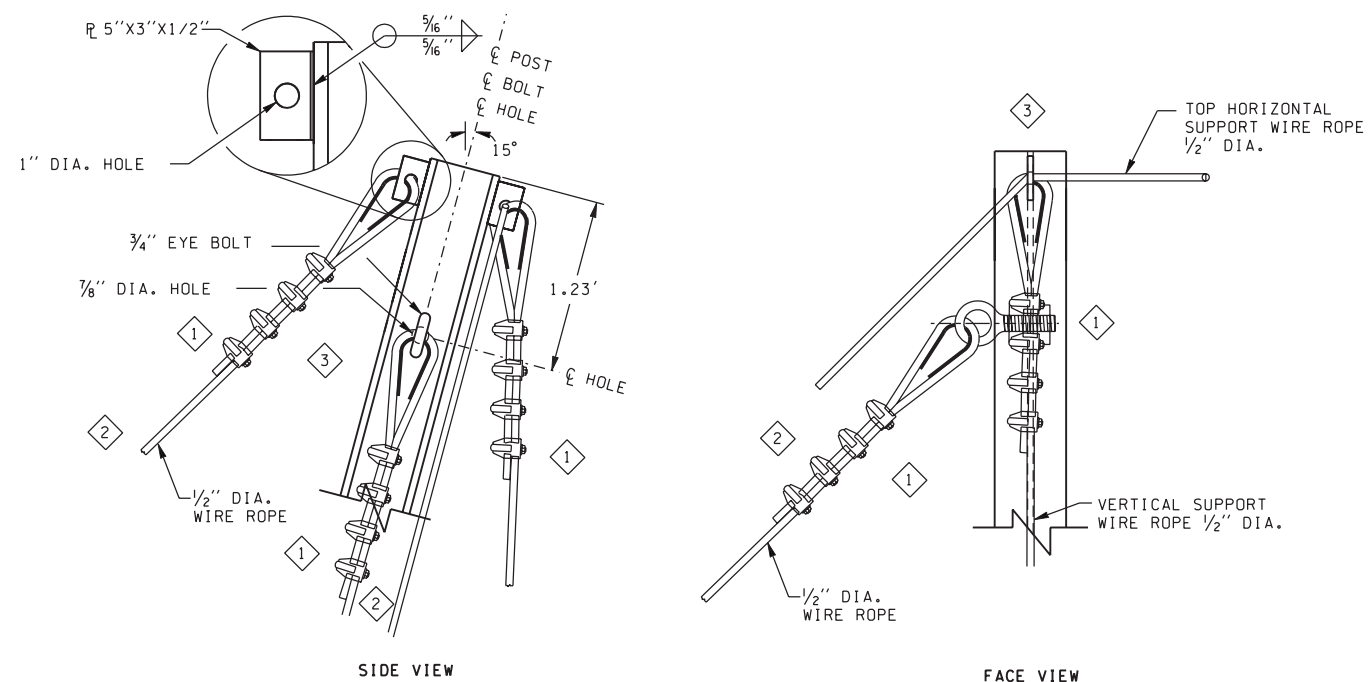
**MODIFIED CABLE NET  
CATCH FENCE**

JC BOYLE FLUME ROCKFALL  
KENO, OREGON

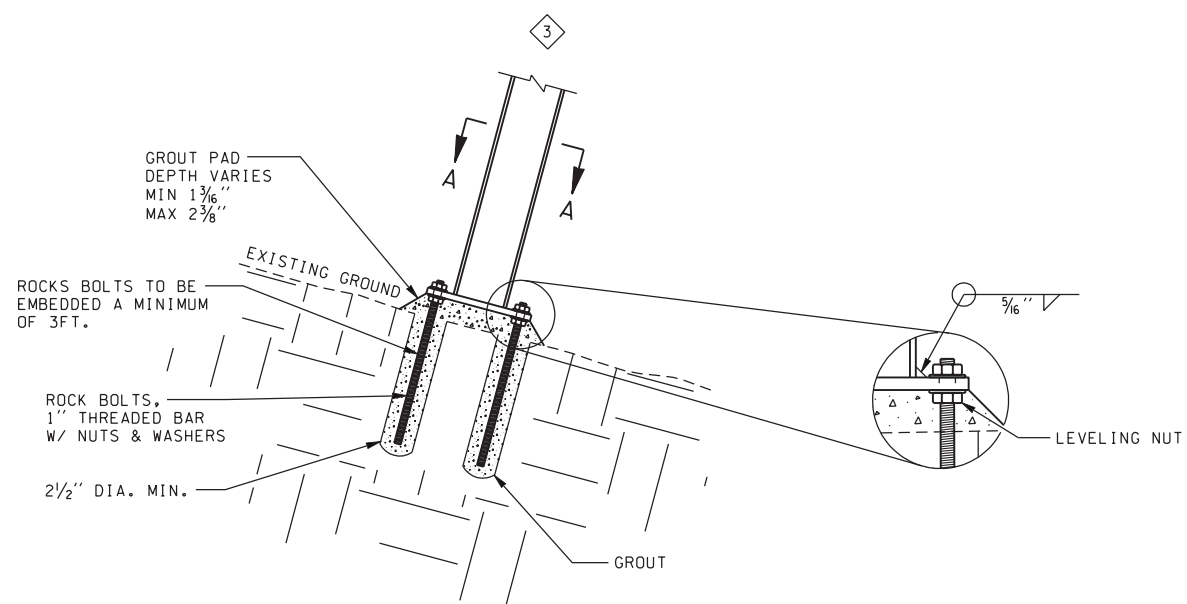
JAN 2006  
PROJ. 1739  
SHEET  
1 of 2



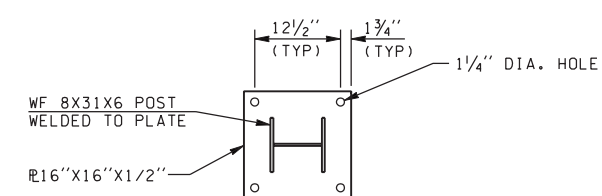
**INTERMEDIATE POST DETAIL**



**END POST DETAIL**



**FOUNDATION DETAIL**



**SECTION A-A**

**NOTES**

- ① SEE WIRE ROPE CONNECTION DETAIL, REFERENCE SHEET 2.
- ② SEE ANCHOR CONNECTION DETAIL, REFERENCE SHEET 2.
- ③ WF 8X31X6 POST

SEE SPECIAL PROVISION "WIRE MESH SLOPE PROTECTION".

## **ROCK BOLTING**

### **Description**

This work consists of furnishing and installing tensioned rock bolts with a design load of at least 33,000 pounds (33 kips) at locations shown on the Photographs or as directed by the Company Representative. Furnish and install rock bolts 10 and 15 feet long capable of the specified capacities.

Contractor shall furnish access to rock bolt locations, including on the work platform, to the Company Representative at any time. Supply all access, materials, equipment, and labor necessary to install the rock bolts at the locations shown in the Photographs.

### **Submittals**

Prior to commencing the Rock Bolting work, the Contractor shall submit a work plan to the Company Representative, which details the following:

#### **A. Qualifications of the Contractor's Personnel**

1. Provide written evidence that the rock bolt foreman and drill operator have performed satisfactory work in similar capacities elsewhere for a sufficient length of time to be fully qualified to perform their duties.
2. The foreman is required to have no less than three years of demonstrated experience as a rock bolting foreman. The drill operator is required to have at least two years of demonstrated experience on similar projects.
3. The Contractor must have at least two years experience installing rock bolts. The Company Representative may request a list of projects to verify the experience.

#### **B. Submit a detailed plan for the rock bolting that include the following:**

1. The proposed construction sequence and schedule.
2. The proposed method for accessing drilling equipment to the rock bolt locations.
3. The proposed drilling methods and equipment.
4. The proposed drill hole diameter.
5. The proposed rock bolts, couplers, bearing plate, mechanical anchor units, flat and beveled washers, and all hardware, including specifications and manufacturer's data sheets.
6. The proposed grout mix design specifications including manufacture's data sheets and the procedure for placing the grout.
7. The anticipated technique for forming and constructing bearing pads, if needed.
8. The proposed stressing equipment and stressing procedures.
9. Calibration data including a graph of torque versus tension for each torque wrench to be used as tested by an independent testing laboratory within 60 calendar days of the date submitted.



## **Materials**

### **A. Rock Bolts**

1. Provide rock bolts, anchorage assemblies, bearing plates, couplers, and other appurtenances produced by a manufacturer regularly engaged in the manufacture of materials for the construction of rock bolts.
2. Use mechanical anchorage rock bolts fabricated from deformed steel bars and capable of being post tensioned to a design load of 33,000 pounds. Bolts are to be high strength, hollow-core, groutable, "spin-lock" type complying with ASTM A-615. Thread at least 1-foot of each end of the bolt to accommodate the appropriate accessories.
3. The bolt rod may be coupled as long as the coupling does not interfere in any way with the flow of grout and the coupling is interconnected by threaded tubular connection of sufficient strength and thread engagement with the bolt rod sections to transfer the full working load of the rock bolt.
4. Use mechanical anchorage devices capable of developing 95 percent of the minimum guaranteed ultimate tensile strength of the rock bolt.

### **B. Bearings, Plates and Accessories**

Bearing plates for Tensioned Rock Bolts are required to be a minimum of 1-inch thick, flat, steel faceplates, providing not less than 7-inch x 7-inch area for each bolt conforming to ASTM A 36. All hardware, nuts, beveled and flat washers, and accessories must meet the requirements specified by the manufacturer.

### **C. Grout**

Use non-shrink, Type III Portland cement grout with a water to cement ratio between 0.3 and 0.4 by weight. Use an approved fluidifying agent as needed and add a commercial grade aluminum powder, or equal, to the grout in the proportion of 0.005% by weight of cement to inhibit shrinkage. Use fresh, clean, potable water in the mix. A grout capable of attaining a minimum unconfined compressive strength of 5,000 psi in not more than three days is required.

### **D. Tensioning Equipment**

Use equipment in accordance with the manufacturer's instructions and approved by the Company Representative to effectively seat and establish the anchorage in the hole, and tighten the bolt to the required tension. Provide and maintain, in good working condition, torque wrenches and related equipment necessary for installation of rock bolts and checking tension.

## **Execution**

- A. Safety of the work is the responsibility of the Contractor. Perform all work in a manner to minimize exposure to the public, construction personnel, and equipment to hazardous and potentially hazardous conditions. Temporary support of rock blocks, special designs or installation procedures that the Contractor deems necessary to safely install rock bolts are the

responsibility of the Contractor and will be implemented at the discretion of the Contractor at no additional expense to the Client.

- B. Drill, install, tension, and grout five (5) initial rock bolts as a test program before the remaining bolts are installed. The five (5) test rock bolts shall be part of the specified rock bolts. Address and rectify any deficiencies in the test rock bolt program to the satisfaction of the Company Representative before installing the remaining rock bolts.

### **Rock Bolts**

Handle and install rock bolts in such a manner as to avoid damage and corrosion. Heavy corrosion or pitting or damage to the rock bolts as a result of abrasions, cuts, nicks, welds, or weld splatter are causes for rejection. A light coating of rust on the steel is acceptable. Prior to installation, remove all mill scale, flaking rust, and grease from the steel. .

### **Installation**

The location of the Rock Bolts will be as shown in the Photographs and as directed by the Company Representative.

- A. Unless otherwise directed by the Company Representative, install rock bolts in a downward orientation, roughly perpendicular to the rock face. If the rock face is not close to being perpendicular to the axis of the rock bolt within the angle provided by the beveled washer or requires and upward inclined installation, construct a bearing pad as approved by the Company Representative so that the rock bolt is inclined downward and not bent when tension is applied.
- B. Drill holes to receive the rock bolts to the diameter recommended by the rock bolt manufacturer. Drill the holes deep enough to provide clearance for grout flow around the distal end of the rock bolt and the mechanical anchorage assembly when installed. Flush the drill holes of all drill cuttings and debris with compressed air prior to installing the rock bolt.
- C. Size the rock bolts so that the design load of 33 kips does not exceed 60 percent of the minimum guaranteed ultimate tensile strength of the rock bolt. Prior to grouting, tension each rock bolt to the specified design load.
- D. Initial tensioning up to 80% of the design load may be applied with either an approved, calibrated torque or impact wrench. Perform final tensioning with a torque wrench calibrated to the stress levels required in this specification. Do not apply grease of any kind to rock bolt threads or nuts.
- E. Proof test each rock bolt by holding the design load for 10 minutes. If no loss of load occurs, the rock bolt is accepted. If a rock bolt fails this test and the anchorage cannot be developed by resetting the mechanical anchorage or by any other means, replace the rock bolt with an additional bolt installed in a separate hole. No payment will be made for rock bolts that fail.
- F. After tensioning, lock the load off at 100 percent of the design load and fully grout the rock bolt. If more than ten minutes has elapsed between tensioning and the commencement of grouting,

recheck the tension in the bolt to confirm that the design load is still held. If necessary, retension the bolt and lock it off at 100 percent of the design load prior to grouting. Replace any rock bolt damaged to the extent that it cannot be properly tensioned or completely grouted as described above and as determined by the Company Representative.

- G. Prior to injection, mix the grout mixture for a minimum of three minutes by means of a high-speed mechanical agitator and sieved through a 0.045-inch cloth sieve. Use the grout as soon as possible after mixing all ingredients. If more than one-hour has elapsed since the addition of water to the cement, discard the grout.
- H. Grout the annular space around the rock bolt using low pressure grouting with sufficient pressure to overcome any hydrostatic head. Use the hollow core of the rock bolt as the grout injection tube on downward inclined rock bolts and the plastic de-air tube/keyhole of the bearing plate as a vent. Rock bolts are considered fully grouted when a full and continuous return of grout exits the de-air tube/keyhole. All grout pipes, tubes, and fittings must be clean and free from dirt, grease, hardened grout, or other contamination before grouting is commenced for any bolt. Flush all surplus water and diluted grout from all lines prior to injection. Replace any fitting that leaks before continuing with the grouting operation.

#### **Measurement**

Rock Bolts shall be measured by the linear foot of rock bolt installed, fully tensioned, grouted, and accepted by the Company Representative.

#### **Payment**

The unit contract price per linear foot for "Rock Bolts" is full payment for performing the work as specified. Any additional rock bolting required and authorized by the Company Representative will be paid for at the unit price for "Rock Bolts." Payment represents full compensation for furnishing all labor, equipment including any required drills, drilling platforms or spider baskets, rigging, cranes, tools, bearing pads, materials, or other incidentals necessary to access the site and complete the installation of the rock bolts.

**Long Cone  
w/ Flange**

**Shell**

**Thrust Ring**

**Hollow-Core Rebar**  
ASTM A-615 Deformation Pattern

**Slip Rings**

**Wil-X-Cement Grout**  
Portland Cement Grout  
ASTM C-845

**150 KSI All-Thread-Bar**  
Type II ASTM A-722-98  
AASHTO M275

**Unified  
Thread Form**

**Plastic Grout Tube**  
Low Density

**Bearing Plate**  
Keyhole Plate  
ASTM A-36  
AASHTO M183

**Hex Nut**  
ASTM A-194  
Grade 2H

**Hardened Washer**  
ASTM F-436 Type I  
AASHTO No. M293

