

Project 184
Groundwater Monitoring
Plan

January 10, 2006

This study plan is a collaborative effort and has been developed to satisfy the groundwater monitoring requirements set forth in the United States Forest Service (USFS) Final Terms and Conditions provided under 18 CFR Section 4.34 (b)(1) in connection with the Application for the relicense of the El Dorado Hydroelectric Project (FERC No. 184). The USFS 4(e) condition No. 65 requires a plan for minimizing groundwater seepage into and out of the Mill to Bull Tunnel.

The scope of this plan has been defined by the Tunnel Groundwater requirements set forth in the above document and has been agreed to by El Dorado Irrigation District (EID).

1.0 Background

EID owns and operates the El Dorado Project which includes a river diversion on the South Fork of the American River known as the El Dorado Diversion Dam, the El Dorado Canal, and the El Dorado Power Station. This project deals with El Dorado Canal which consists of approximately 22.5 miles of earthen canal, flume, siphon, and tunnel that conveys water between the El Dorado Diversion Dam and the El Dorado Forebay. The Mill Creek to Bull Creek bypass tunnel (Mill to Bull Tunnel) is approximately 1.95 miles long and extends from a tunnel intersection near the downstream portal of the El Dorado Tunnel.

Since 2002, EID has conducted groundwater monitoring of springs and seeps in the area of the Mill to Bull Tunnel on a quarterly basis during the construction of the tunnel and then on a monthly basis following completion of the tunnel. In 2004, the USFS approved a reduction in the monitoring frequency to a quarterly basis (USFS, 2004). All monitoring thus far has been in compliance with USFS 4(e) Condition No. 65. Following construction in 2003, EID continued monitoring the tunnel in anticipation of receiving license approval. The FERC license for Project 184 was issued in October 2006. EID will continue monitoring for an additional five years from license issuance to meet all license requirements. However, because the five years of monitoring has shown that the Mill to Bull Tunnel has little or no effect on the groundwater regime in the vicinity of the tunnel, EID proposes to reduce the quarterly monitoring of the springs and seeps to an annual frequency for the next five years. EID will also develop a comprehensive inspection of the tunnel to be performed on an annual basis for the next five years in compliance with Condition No. 65.

2.0 Study Plan Objectives

The following are the objectives of the Plan as specified by Condition No. 65:

1. A method for measurement of groundwater seepage into the Mill to Bull Tunnel following construction.

2. Identification of all visible seepage sources and corrective measures to address the seepage. The licensee shall implement the corrective measures upon approval of the measures by the FS.

3. An annual inspection that includes:

- a. Monitoring of the seepage sources identified in number 1, above, to ensure the corrective measures are effective. If the corrective measures are not effective, additional corrective measures will be identified and implemented upon approval by the FS.
- b. Monitoring to identify new seepage sources and implementation of corrective measures to address new sources after FS approval of the corrective measures.
- c. Monitoring of the springs and creeks for a minimum of five years after the license is issued. This period may be extended if sufficient water year types have not occurred within the first five years to adequately analyze effects on springs and creeks.
- d. A report that documents the results of the monitoring required in the annual inspections. The licensee shall also notify the FS of the date of the inspection in the event the FS wishes to participate.

The Groundwater Monitoring Plan consists of three methods for meeting objectives 1-3 and is split into specific summaries that address the tunnel or the springs and creeks separately.

3.0 Inspection

3.1 Tunnel

EID will coordinate an annual inspection with the USFS for a minimum of five years after the license is issued to visually observe the Mill to Bull Tunnel. Previously identified seepage sources will be examined to verify that all corrective measures remain effective. Additional corrective measures may be taken, if applicable. Additionally, the annual inspection will search for possible new seepage sources and provide appropriate corrective measures when necessary.

The tunnel is flowing almost year round and will provide only one opportunity for tunnel inspection. Therefore, the annual inspection will occur during the dewatering of the tunnel. Dewatering is usually done in late summer or early fall prior to the onset of icing conditions in the tunnel.

Static groundwater inflow to the tunnel was measured from March 2003 until June 17, 2003 at approximately 40 gallons per minute (gpm). Because the tunnel is misaligned, weirs cannot be used during dewatering events to measure groundwater inflow to confirm

the measured steady state inflow. Tunnel inspection is needed to ensure the hydrologic balance in the area has not been altered by the tunnel.

3.2 Springs and Creeks

Estimates of the seepage will be made at locations where previous seepage was observed following tunnel completion. However, many of the seepage zones have been shotcreted and no longer seep groundwater. Therefore, professional judgment will be used to reasonably assess steady state groundwater conditions.

Each year, after the snow melts, inspection of the springs and creeks will occur. The Bench will also be inspected for seepage sources. Visual field observations of the springs include amount of flow, color, floating material, and odor. New seeps and springs will be noted, as will the absence of pre-existing seeps and springs. Remedies for environmental and ecological impacts of groundwater seepage will depend on the exact field conditions and best mitigation measures will be utilized.

4.0 Monitoring

4.1 Tunnel

EID will monitor tunnel seepage sources identified in the MWH 2003 Management Plan that includes at least 35 rock shear zones with observed seepage ranging from slow seeps to flows of approximately 10 gallons per minute. EID will also visually monitor the corrective measures constructed in at least 18 locations/segments of observed seeps/shears.

4.2 Springs and Creeks

Sampling sites were selected adjacent to the alignment of the Tunnel. Site description and reasoning for selection are in Table 1.

4.2.1 Table 1

Site	Description	Coordination
S1	A wetted area with surface flow accessible for measurements. Hydrophytic vegetation present.	38° 46' 14.5" N 120° 23' 53.3" W
S2	Location where the El Dorado Canal bench intercepts flow in a bedrock fracture zone. The flow is channelized across the bench.	38° 46' 12.4" N 120° 23' 59.5" W
S3	Location near southeastern limit of a northeast trending bedrock shear zone structure.	38° 46' 12.9" N 120° 24' 05.9" W
S4	A wetted area with seepage from the toe of a landslide. Hydrophytic vegetation is present.	38° 46' 18.6" N 120° 24' 25.7" W
S5	Landslide toe-drain behind upslope canal support wall. Hydrophytic vegetation is present.	38° 46' 19.2" N 120° 24' 38.9" W
S6	A possible fault or closely jointed zone and wetted area. Hydrophytic vegetation is present.	38° 46' 11.4" N 120° 23' 27.7" W

EID has utilized existing aerial photographs to identify and map springs and creeks to be monitored in the area potentially affected by the Tunnel. These sites have been field verified and GPS located.

Reviewing five years of previous data, analysis has demonstrated that there is little to no connection between the water-bearing zone intersected by the Mill to Bull Tunnel and the shallow water-bearing zone directly connected to Mill and Bull Creeks, springs or seeps, wet areas, or other riparian habitats. EID will continue to monitor the springs and creeks annually during the spring months for the next five years to comply with the monitoring requirements.

The water year type will be monitored to provide a means of assessing the amount of water originating in this area and will adhere to the water year classification system published by the California Department of Water Resources. Various water quality field parameters will be measured at the spring and creek sampling sites on an annual basis using hand-held meters. The sampling parameters are temperature, pH, conductivity, dissolved oxygen, oxidation/reduction potential, and turbidity. Additionally, general mineral analysis will also be performed once annually and analyzed by a certified laboratory.

5.0 Reporting

5.1 Tunnel

As a result of tunnel misalignment, the method of measuring groundwater inflow after construction of the MBT is not precise. Over time, if changes to water quality, stream flows, or spring seepage occur and these occurrences can be linked to the operation of the Mill to Bull Tunnel, EID will report and provide recommendations for minimizing the impacts.

EID will identify possible new seepage sources, locate them according to current stationing marking and recommend appropriate corrective measure.

5.2 Springs and Creeks

Following the inspection, EID will provide a report including the annual water quality data, identified and addressed issues, study area with sampling locations, methods, laboratory report and QA/QC, analysis and results of water quality monitoring. A summary of results will include specific method detection limits for each parameter and analytical data reported along with discussion and conclusions that are appropriate to the results and supportive of the analyses.

6.0 Literature Cited

Carlton Engineering, Inc. 2002-2006. FERC Project 184 EID Mill Creek to Bull Creek Tunnel Biannual and Quarterly and Monthly Groundwater Monitoring Reports

Montgomery Watson Harza. 2003. El Dorado Irrigation District Groundwater Management Plan. Mill to Bull Creek Tunnel El Dorado County, California.

United States Forest Service (Hardy, Kathy - District Ranger). 2004. Letter addressing monitoring frequency. File Code # 2770.

United States Forest Service. 2003. Forest Service Final Terms and Conditions Provided Under 18 CFR 4.34(b)(1) In Connection With the Application for Relicensing of the El Dorado Hydroelectric Project (FERC No. 184). October 31, 2003

118 FERC ¶ 62,248

**UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION**

El Dorado Irrigation District

Project No. 184-117

**ORDER APPROVING TUNNEL GROUNDWATER PLAN PURSUANT
TO ARTICLE 401(a), 4(e) CONDITION NO. 65**

(Issued March 30, 2007)

On February 15, 2007, El Dorado Irrigation District (licensee) filed its Tunnel Groundwater Plan pursuant to section 4(e) Condition No. 65 under Article 401(a) of the license¹ for the El Dorado Hydroelectric Project (FERC No. 184). The project is located on the South Fork of the American River and its tributaries in El Dorado, Alpine, and Amador counties, California, and occupies federal lands administered by the U.S. Forest Service (USFS).

LICENSE REQUIREMENTS

Among other requirements listed under Article 401(a), the licensee is required to file for Commission approval a plan for minimizing groundwater seepage into and out of the Mill to Bull Creek Tunnel pursuant to USFS section 4(e) Condition No. 65. Commission No. 65 requires the licensee to file the tunnel groundwater plan with the USFS prior to filing with the Commission.

USFS section 4(e) Condition No. 65 requires that the tunnel groundwater plan include: (1) a method for measurement of groundwater seepage after tunnel construction; (2) identification of all visible seepage sources and corrective measures to address the seepage, which shall be implemented upon approval from the USFS; and (3) annual inspections. The annual inspections shall include monitoring of the seepage sources identified in number (1) above to ensure the corrective measures are effective, as well as monitoring to identify new seepage sources and implementation of corrective measures to address the new sources after receiving USFS approval. Monitoring of the springs and creeks shall be done for a minimum of five years after license issuance. A report documenting the monitoring results shall also be part of the annual inspections.

¹ 117 FERC ¶ 62,044, Order Issuing New License, issued October 18, 2006.

BACKGROUND

The licensee has conducted groundwater monitoring of springs and seeps in the area of the Mill to Bull Creek Tunnel since 2002 pursuant to USFS section 4(e) Condition No. 13 of the prior license as amended for the El Dorado Project.² USFS section 4(e) Condition No. 13 required the licensee to file with the Commission a plan approved by the USFS for managing groundwater inflow during the Mill to Bull Creek Tunnel construction and for groundwater monitoring. The Groundwater Management Plan, dated September 15, 2003, was approved by the USFS in a January 8, 2004 letter, and was filed with the Commission on March 12, 2004. The licensee performed monitoring on a quarterly basis during the construction of the tunnel and then on a monthly basis following completion of the tunnel in 2003. The USFS approved a reduction in the monitoring frequency to a quarterly basis in 2004, and the licensee has continued its tunnel monitoring program.

PROPOSED PLAN

In response to USFS section 4(e) Condition No. 65 of the El Dorado Project license, the licensee has submitted its Tunnel Groundwater Plan detailing how it will monitor and minimize groundwater seepage into and out of the Mill to Bull Creek Tunnel. The licensee's plan contains the following details:

1. Inspection

The licensee will coordinate an annual inspection with the USFS for a minimum of five years to visually observe the Mill to Bull Creek Tunnel. Previously identified seepage sources will be examined to verify that corrective measures are working, and additional corrective measures may be taken if necessary. The annual inspection will also identify new seepage sources and provide corrective measures as appropriate. The annual inspection will occur during the dewatering of the tunnel, which is usually done in late summer or early fall.

From March to June 2003, the licensee measured static groundwater inflow to the tunnel. Because of tunnel misalignment that occurred during construction, however, weirs cannot be used during the tunnel dewatering to measure groundwater inflow to confirm the measured steady state inflow. Tunnel inspection is needed to ensure that the hydrologic balance in the area has not been altered by the tunnel.

² 94 FERC ¶ 61,122, Order Amending License, issued February 8, 2001.

Estimates of seepage will be made at spring and creek locations where previous seepage was observed following tunnel completion. Because many of the seepage zones have been shotcreted and groundwater seepage no longer occurs, judgment will be used to assess groundwater conditions. The inspection of the springs and creeks will occur each year after the snow melts. Visual field observations of the springs will include flow, color, floating material, and odor. The absence of previously existing seeps and springs will be noted as well as any new seeps and springs. Remedial actions for environmental and ecological impacts of groundwater seepage will depend on the specific field conditions.

2. Monitoring

The licensee will monitor tunnel seepage sources as identified in the 2003 Groundwater Management Plan. Included in the Groundwater Management Plan are at least 35 rock shear zones with observed seepage ranging from slow seeps to flows of about 10 gallons per minute. The licensee will also visually monitor the corrective measures that are constructed in at least 18 locations of observed seeps.

Spring and creek sampling sites have been selected adjacent to the alignment of the tunnel. A table that lists the six selected sampling sites and provides site descriptions and reasoning for selection is included in the Tunnel Groundwater Plan. The licensee will measure water quality parameters by using hand-held meters at the spring and creek sampling sites on an annual basis. The sampling parameters include temperature, pH, conductivity, dissolved oxygen, oxidation/reduction potential, and turbidity. General mineral analysis will also be performed annually.

3. Reporting

As a result of tunnel misalignment, the method of measuring groundwater inflow after construction of the Mill to Bull Creek Tunnel is not precise. If changes occur to water quality, stream flows, or spring seepage and the occurrences can be linked to the operation of the Mill to Bull Creek Tunnel, the licensee will report and provide recommendations for minimizing the impacts.

Following tunnel inspections, the licensee will identify possible new tunnel seepage sources, locate them according to current stationing, and recommend appropriate corrective measures. Following the inspection of springs and creeks, the licensee will provide a report to the USFS and Commission. The report will include annual water quality data, identified and addressed issues, study area with sampling locations, methods used, laboratory reports and quality assurance/quality control, analysis, and results of water quality monitoring. Results will include specific method detection limits for each parameter along with discussion and conclusions.

DISCUSSION

As required under USFS section 4(e) Condition No. 65, the licensee submitted its Tunnel Groundwater Plan to the USFS for review and approval. By letter dated February 8, 2007, the USFS approved the licensee's plan. The licensee's filed Tunnel Groundwater Plan meets the requirements of article 401(a), 4(e) Condition No. 65, and should, therefore, be approved.

The Director orders:

- (A) El Dorado Irrigation District's Tunnel Groundwater Plan, filed February 15, 2007, pursuant to section 4(e) Condition No. 65 under license Article 401(a), is approved.
- (B) This order constitutes final agency action. Requests for rehearing by the Commission may be filed within 30 days of the date of issuance of this order, pursuant to 18 CFR § 385.713.



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