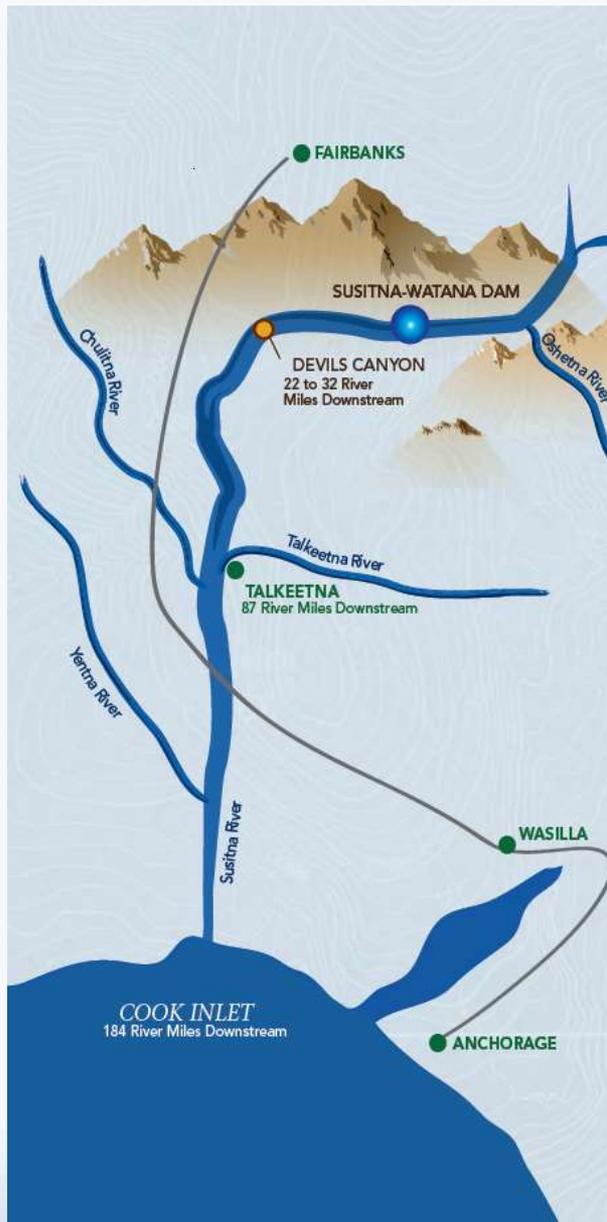


Initial Study Report Meeting

Study 4.5 Geology and Soils Characterization

October 22, 2014

Prepared by MWH



Study 4.5 Objectives

- Identify the existing soil and geology at the proposed construction site, reservoir area, and access road and transmission line corridors
- Determine the potential effects of Project construction, operation, and maintenance activities on the geology and soil resources (including mineral resources) in the Project area including identification and potential applicability of protection, mitigation, and enhancement (PM&E) measures
- Identify known mineral resources and mineral potential of the Project area
- Acquire soils and geologic information for the Project area for use in the preparation of a supporting design report that demonstrates that the proposed structures are safe and adequate to fulfill their stated functions

Study 4.5 Components

- **Review of Project Documentation** (ISR Part A, Section 4.1.1; pg 3)
- **Regional Geologic Analysis and Mineral Resources Assessment** (ISR Part A, Section 4.1.2; pg 3)
- **Geologic and Geotechnical Investigation and Testing Program Development** (ISR Part A, Section 4.1.3; pg 4)
- **Field Geologic and Geotechnical Investigations** (ISR Part A, Section 4.1.4; pg 4)
- **Reservoir-Triggered Seismicity** (ISR Part A, Section 4.1.5; pg 5)
- **Reservoir Slope Stability Study** (ISR Part A, Section 4.1.6; pg 5)
- **Long-Term Earthquake Monitoring System** (ISR Part A, Section 4.1.7; pg 6)
- **Geologic and Engineering Analysis** (ISR Part A, Section 4.1.8; pg 6)

Study 4.5 Variances

Land access restrictions in 2013 limited ground studies on Cook Inlet Regional Working Group (CIRWG) lands that were scheduled to be undertaken. This restriction largely impacted geologic mapping, geotechnical exploration and testing (e.g., drilling, geophysical surveys, geo-instrumentation monitoring), and the seismic hazard study. Consequently, the field exploration and testing program was deferred to 2014 and 2015 study seasons.

Study 4.5 Summary of Results in ISR

(ISR Study 4.5, Part A – Section 5)

- **Review of Project Documentation**
 - Existing geologic, geotechnical, and seismic documentation from 1970s and 1980s was brought into geo-referenced, geotechnical databases; review rock core availability
 - Data used in development of geologic model and site characterization
- **Regional Geologic Studies** – update geology and soil resources from previous studies (TMs)
 - Terrain Unit Mapping – update previous landform mapping using bare earth 3D LiDAR digital imagery
 - Reservoir Slope Stability Study, Preliminary – using terrain unit mapping and GIS tool, assess potential for major landslide, slope failure with construction of the Project.
 - Mineral Resources Assessment – partial assessment conducted to identify mineral resources, metallic and non-metallic, that may be affected by the construction of the Project.
 - Regional Geologic Mapping – develop regional geologic map, work-in-progress
- **Geologic and Geotechnical Field Investigation and Testing Program Development** – prepared work plan for data acquisition needed to support feasibility and licensing plan (TM)

Study 4.5 Summary of Results in ISR (ISR Study 4.5, Part A – Section 5)

- Field Geologic and Geotechnical Investigations – investigations have included geologic mapping, drilling and in situ testing, installation of geotechnical instrumentation, instrumentation monitoring, and laboratory testing of geologic materials of the proposed dam site area and potential quarry sources
- Geologic and Engineering Analyses – previous and newly obtained data has been used to characterize the geologic and foundation conditions, development of a geologic model for optimization of the general arrangement, development of foundation and underground designs, and prepare a preliminary assessment of abutment stability. Work-in-progress.

Study 4.5 Summary of Results in ISR (ISR Study 4.5, Part A – Section 5)

- Seismic Hazard Study (see 16.6 Study Plan)
 - Preliminary Site Specific Seismic Hazard Analysis; DSHA and PSHA ground motion estimates
 - Crustal seismic source evaluation of lineaments and potential faults within 100 km radius of dam site; partially completed
 - Preliminary reservoir triggered seismicity; max. magnitude 6.3 to 6.5
 - Long-term seismic monitoring system installed; seven stations; monitoring data

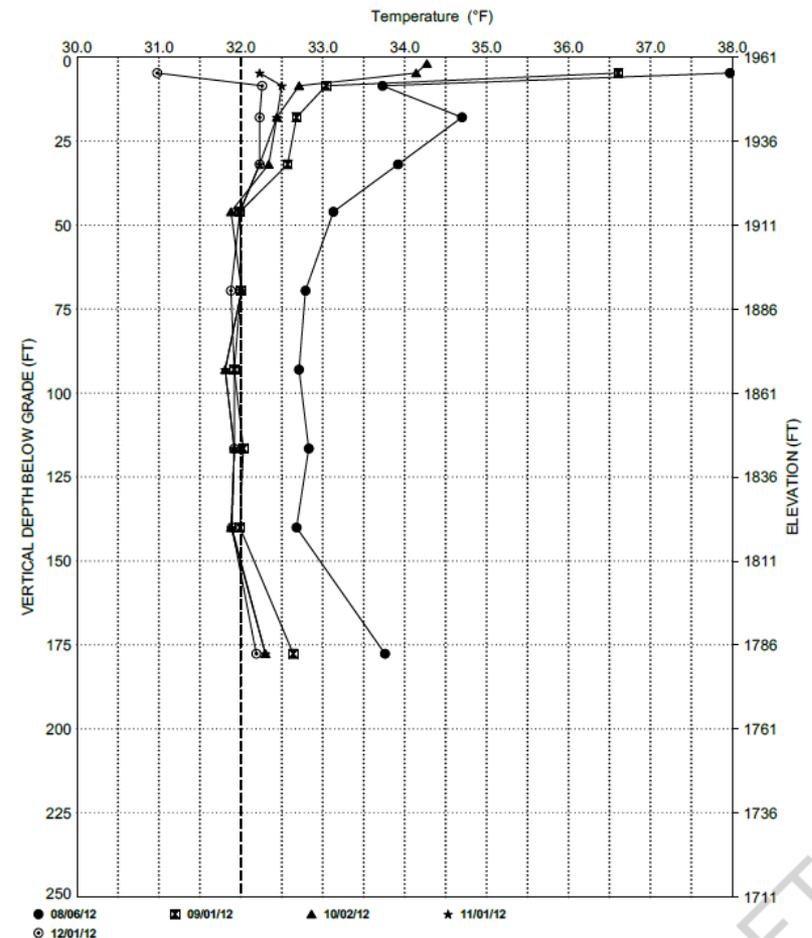
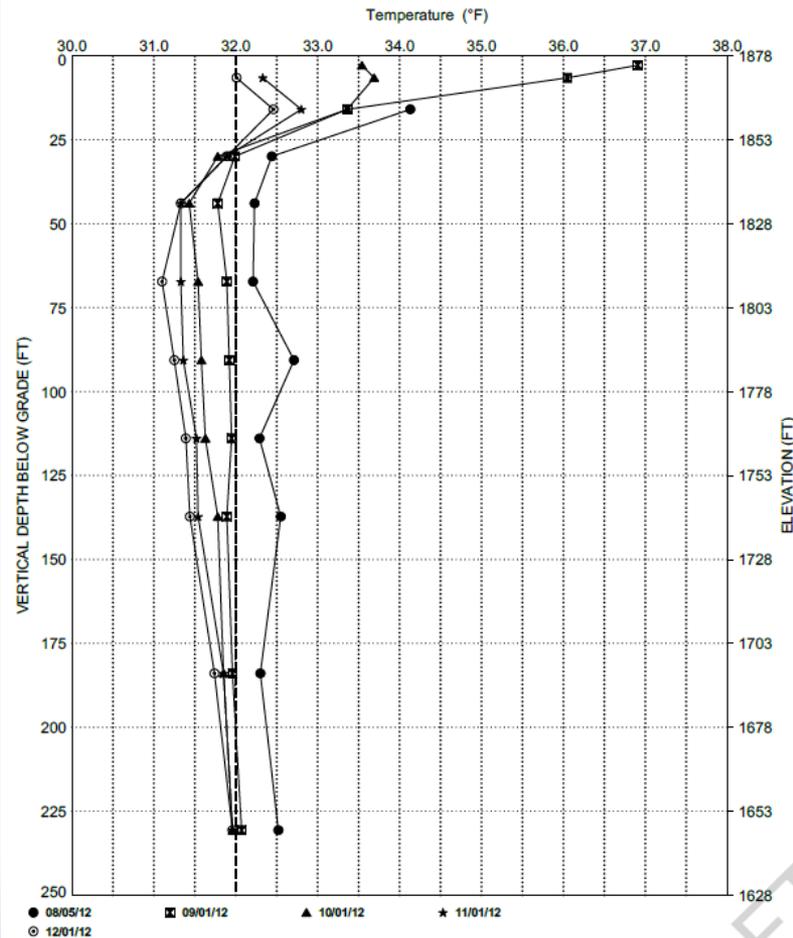
Study 4.5 Summary of Results since ISR

(Instrumentation Annual Report, 2014; Briefing Document-Permit Support)

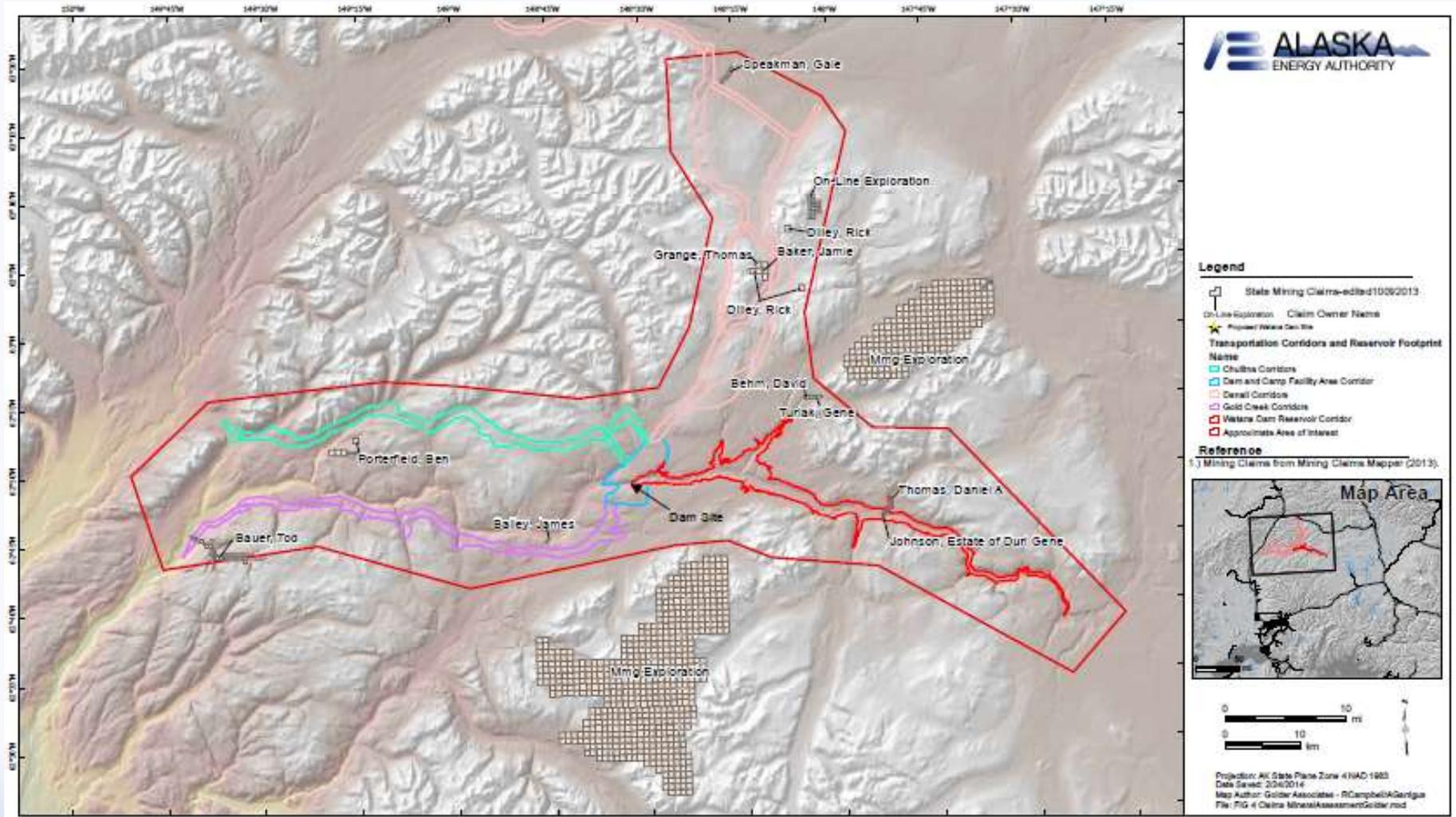
- Implementation of Field Investigations in 2014.
- Geotechnical instrumentation indicates that frozen ground is present in south abutment to depths of up to 230 feet.
- Top of bedrock isopach in river channel at dam site was updated .
- Selection of appropriate engineering properties of rock mass
- Prepared preliminary foundation characterization and made preliminary assessment of abutment stability
- Geologic Characterization – Based on additional investigations 2012-14, it appears that the geologic features previously mapped by others was a conservative interpretation. Recent investigations indicate that the geologic features are less significant, narrow zones, than has been indicated on geologic maps. Update planned.

Study 4.5 Summary of Results since ISR

(South Abutment Ground Temperature; 2014 Geo Instrumentation Annual Report)

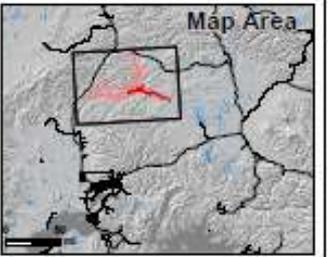


Study 4.5 Summary of Results since ISR (Mining Claims; Interim Mineral Resource Assessment Report, 2014)



- Legend**
- State Mining Claims-edited10062013
 - ★ On-Line Exploration Claim Owner Name
 - ★ Proposed Reservoir Site
 - Transportation Corridors and Reservoir Footprint Name
 - Chultha Corridor
 - Dam and Camp Facility Area Corridor
 - Denali Corridor
 - Gold Creek Corridor
 - Valera Dam Reservoir Corridor
 - Approximate Area of Interest

Reference
1.) Mining Claims from Mining Claims Mapper (2013).



0 10 mi
0 10 km

Projection: Al State Plane Zone 4 NAD 83
Date Saved: 2/24/2014
Map Author: Golder Associates - RCampbell@Golder
File: FIG 4 Claims MineralAssessmentGolder.mxd

STATE MINING CLAIMS

AEA Proposed Modifications to Study 4.5 in ISR (ISR Study 4.5, Part C – Section 7.1.2)

- To complete this study, the study team will implement the methods in the Study Plan with no modifications to methods.
- Study Area - the study area has changed from that described in the RSP (Section 4.5.3). As described in the ISR Overview and depicted in Figure 1, AEA has added the Denali East Option road and transmission line corridor to the study area as well as is proposing to drop further study of the Chulitna Corridor. The study team will collect relevant geologic information for this additional area to help ensure the geologic and soil conditions are adequate for construction of road and transmission facilities.
- Schedule - as noted in ISR Section 4.2, based on the approved study plan, the methods of field investigations and testing associated with this study plan were planned to begin in 2013 but have been rescheduled for 2014 and 2015 (refer to Exploration and Testing Work Plan, 2013).

New Modifications to Study 4.5 since ISR

- No modifications to the Study Plan methods are needed to complete the study and meet Study Plan objectives.
- The Chulitna Corridor was dropped from the study area in 2014.

Study 4.5 Summary of Results since ISR

- Completed the 2014 Field Investigation program – Drilling cross borings under the river and drilling to intersect geologic features on north abutment, In Situ testing
- Geologic mapping of the dam site abutments, with focus on geologic features, rock discontinuities
- Rock samples selected for laboratory testing and age-dating
- Re-installed data loggers on geotechnical instrumentation, resumed data acquisition.
- Maintenance of seismic monitoring station system
- Completed field assessment of crustal seismic sources and potential for fault displacement in dam site proximity.

Steps to Complete Study 4.5 (ISR Study 4.5, Part C – Section 7.1)

To complete this study, the study team will implement the methods in the Study Plan, with no modifications. To summarize, AEA will:

- Continue geologic mapping associated with regional geology development, mineral resources and claims, reservoir rim stability, and a continuation of geologic mapping as needed for lineaments and geologic features (potential fracture and shear zones) and evaluation of rock displacement or rupture in the dam site area;
- Continue geophysical surveys to identify top of rock surface and to characterize the general soil and rock conditions;
- Continue to investigate mineral resources and claims on those lands not accessed in 2013; select rock samples for testing; and identify aggregates sources along potential corridors;

Steps to Complete Study 4.5

(ISR Study 4.5, Part C – Section 7.1)

(continued)

- Continue geotechnical instrumentation monitoring with re-installation of data loggers for resuming the data collection for groundwater and ground temperature;
- Finalize reservoir slope stability analyses; and
- Complete geologic analyses of the road and transmission corridors.

Licensing Participants Proposed Modifications to Study 4.5?

- Agencies
- CIRWG members and Ahtna
- Public