



SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

April 2014

Board of Consultants Meeting (#4)

Proposed 2014 Site Investigation Program

Geologic and Seismic Hazard Objectives

- Dam Site Area - Continue Characterization
 - Investigate and verify the fracture and shear zones, e.g., geologic features
 - Evaluate the potential of displacement in the foundation
 - Delineation of frozen ground and groundwater conditions
 - Abutment stability
- Seismic Hazard – Complete Evaluation of Crustal Seismic Sources, Lineament Mapping and Analysis
 - Fault rupture evaluation
 - Geochronology – Age dating

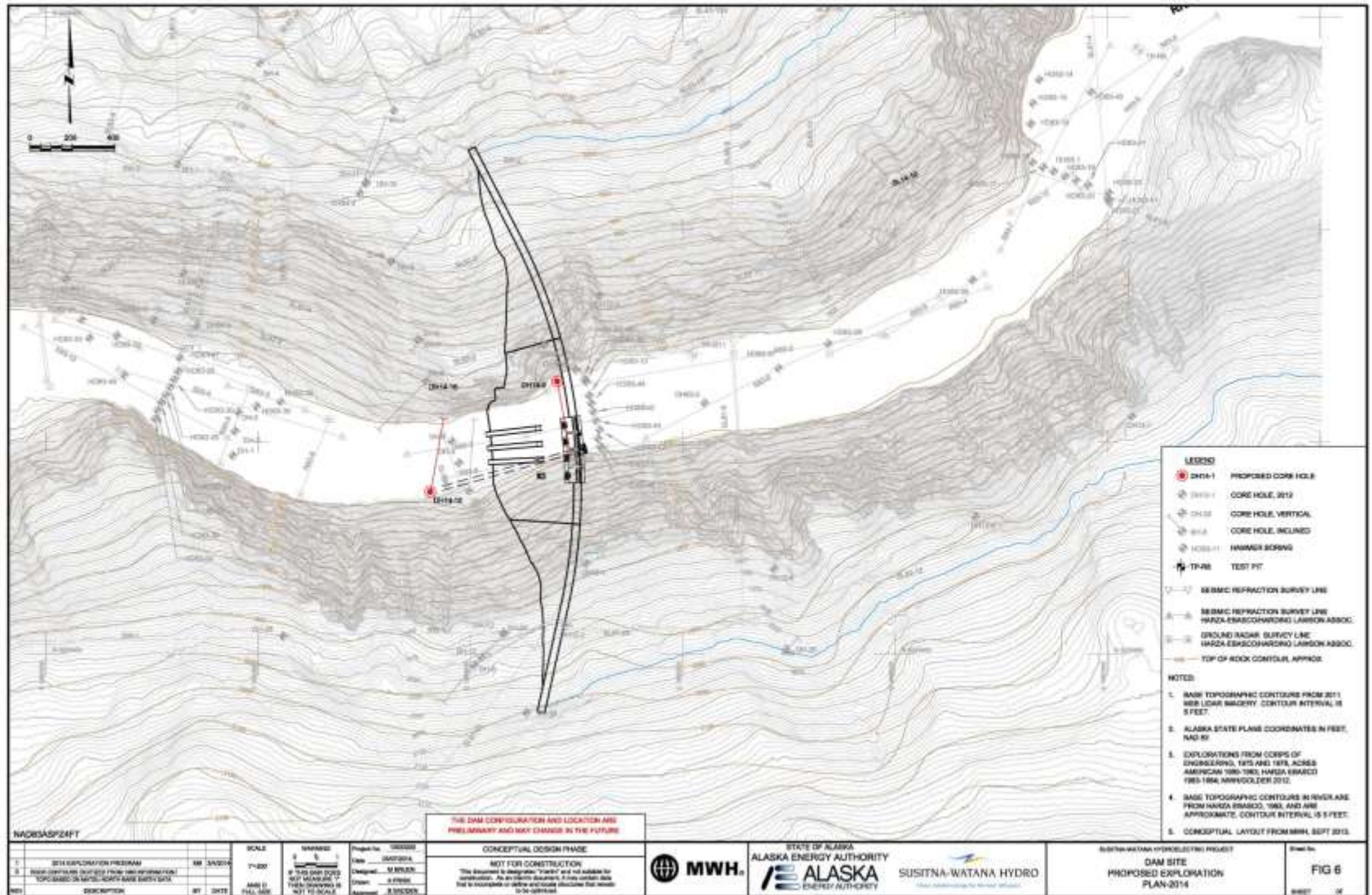
Site Investigations: 2014

- Site Investigations are contingent on land access
- Geological Investigations
 - Geo-Instrumentation
 - Drilling and In Situ Testing
 - Geologic Mapping
- Seismic Hazards
 - Lineament Mapping and Evaluation
 - Long-Term Seismic Monitoring

Geologic Investigations – Potential Fault Displacement

- Drilling and Testing Program – Investigate the foundation conditions beneath the river channel, assess whether there is a feature that has the potential for displacement
- Geologic Mapping (Winter, Spring) – Rock Structure, Feature Driven and Characterization; Potential Fault Displacement Evaluation in Dam Site

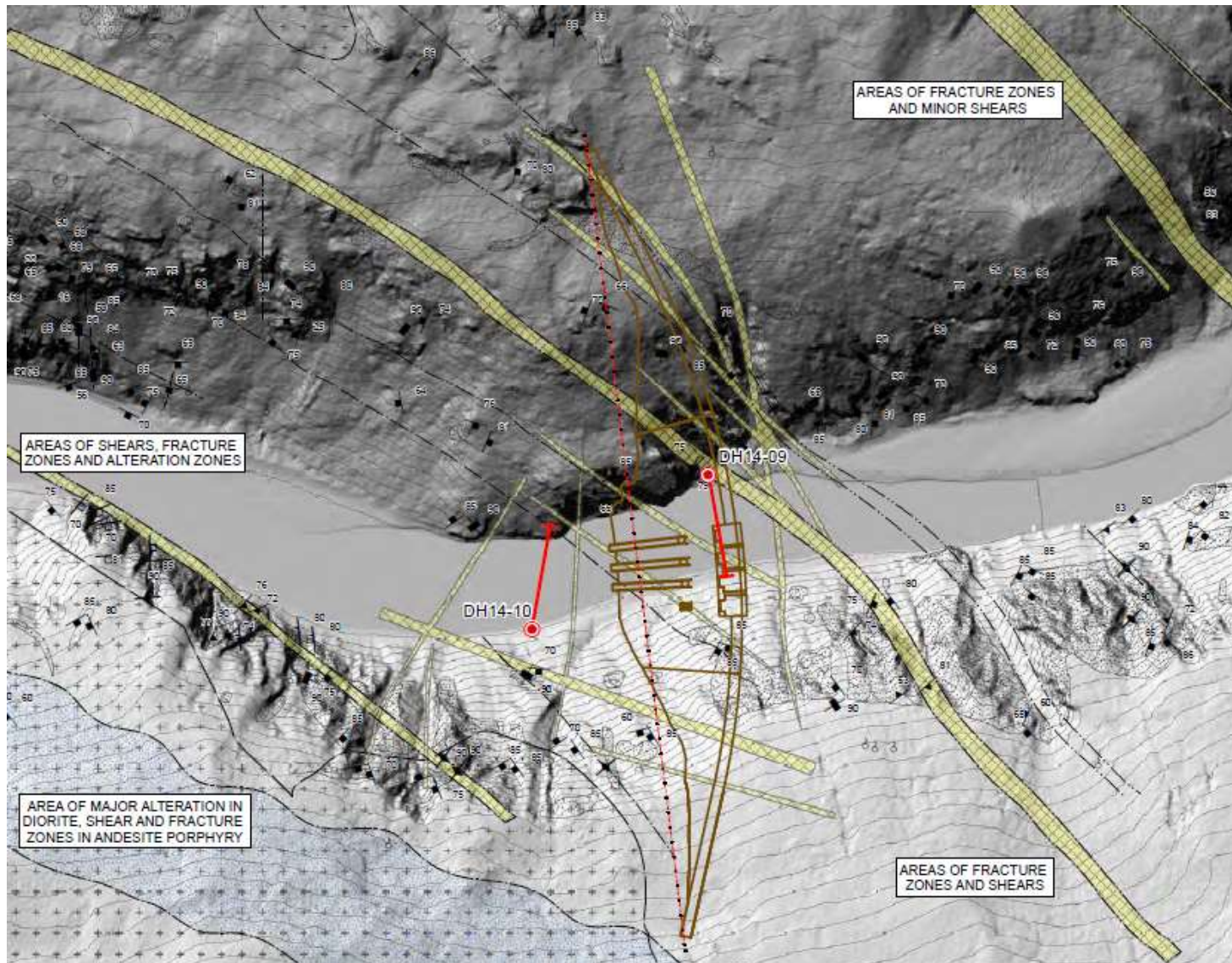
Drilling Program – Beneath the River Channel



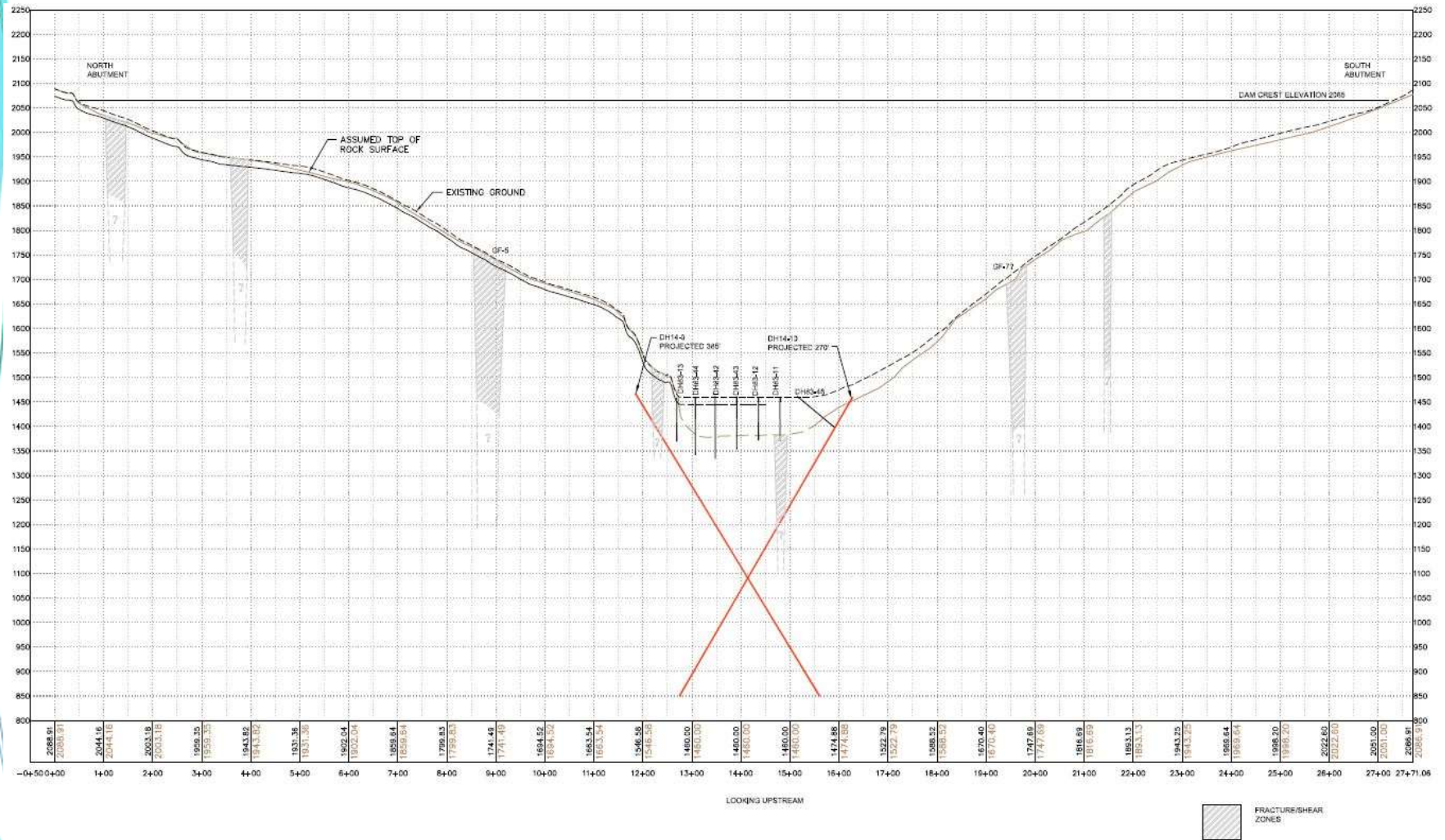
Drilling Program – Beneath the River Channel



Dam Site Bedrock Geology - Plan



Dam Site Section (Looking U/S)

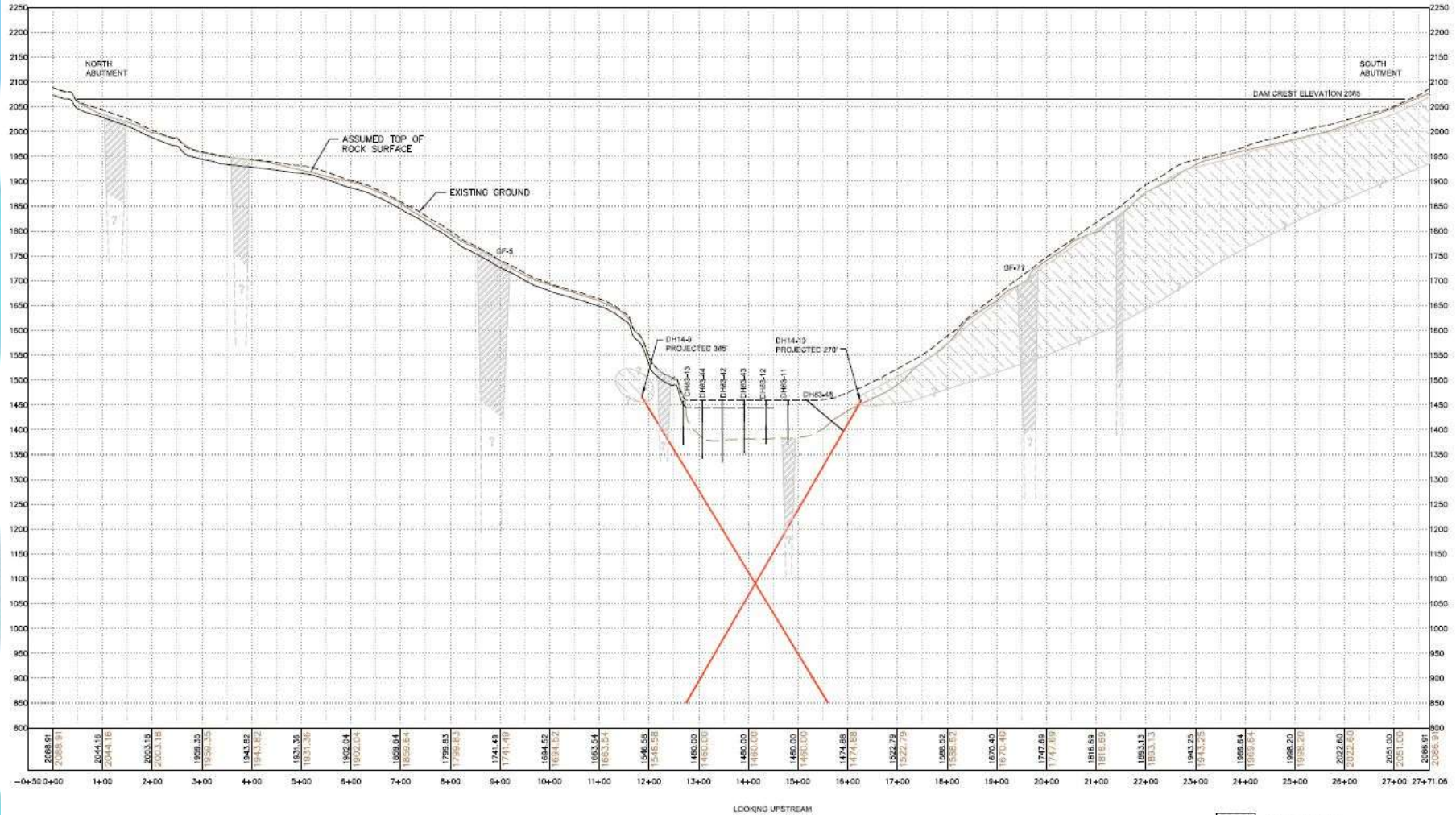




Geologic Investigations – Verify Extent of Frozen Ground

- Geo-Instrumentation – Re-Establish Data Collection of ground temperature and groundwater
- Install New Instrumentation in the Borings Beneath the River (River Bank Proper)

Delineation of the Extent of Possible Frozen Ground



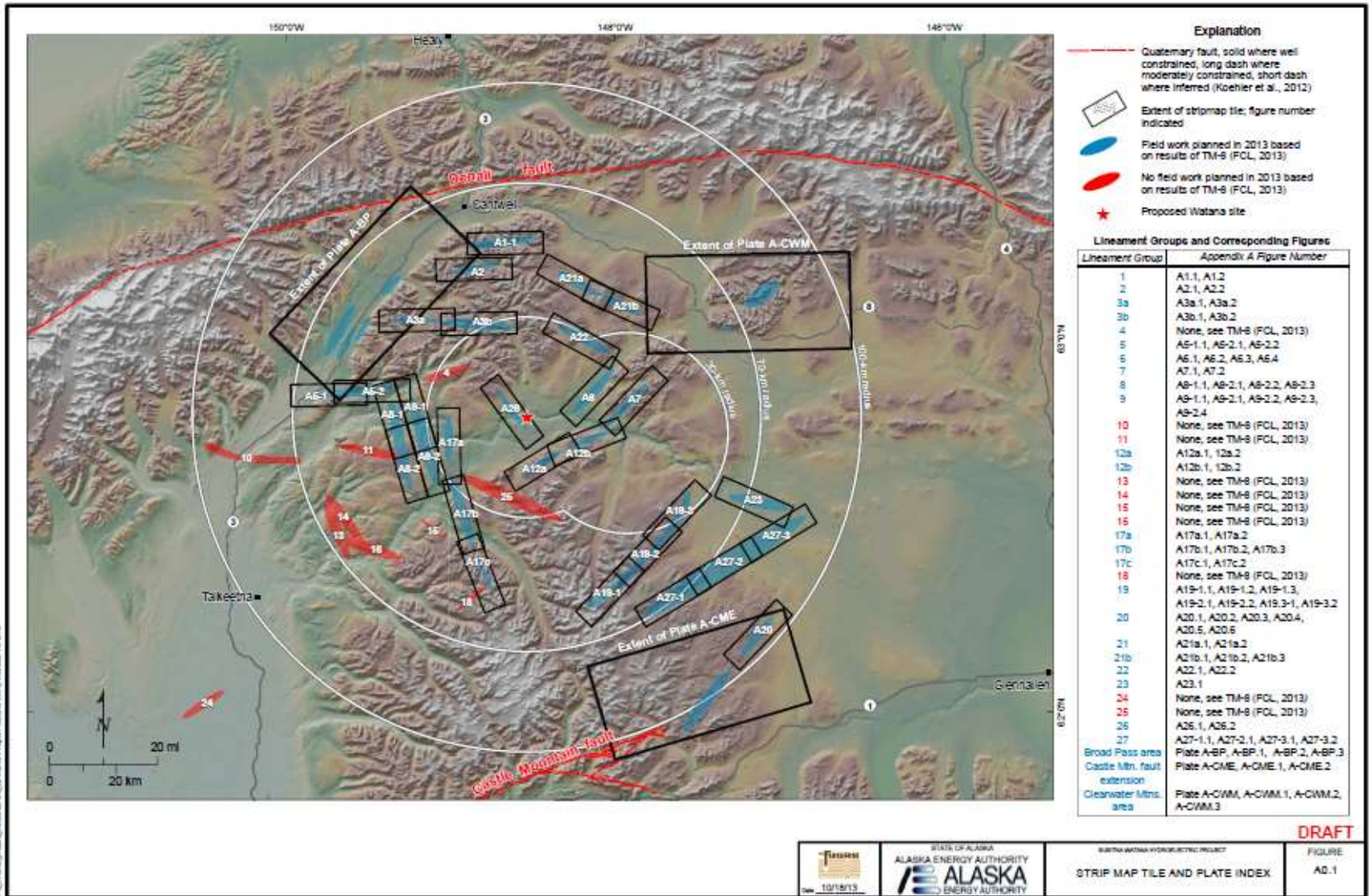
The dam configuration and location are preliminary and may change in the future.



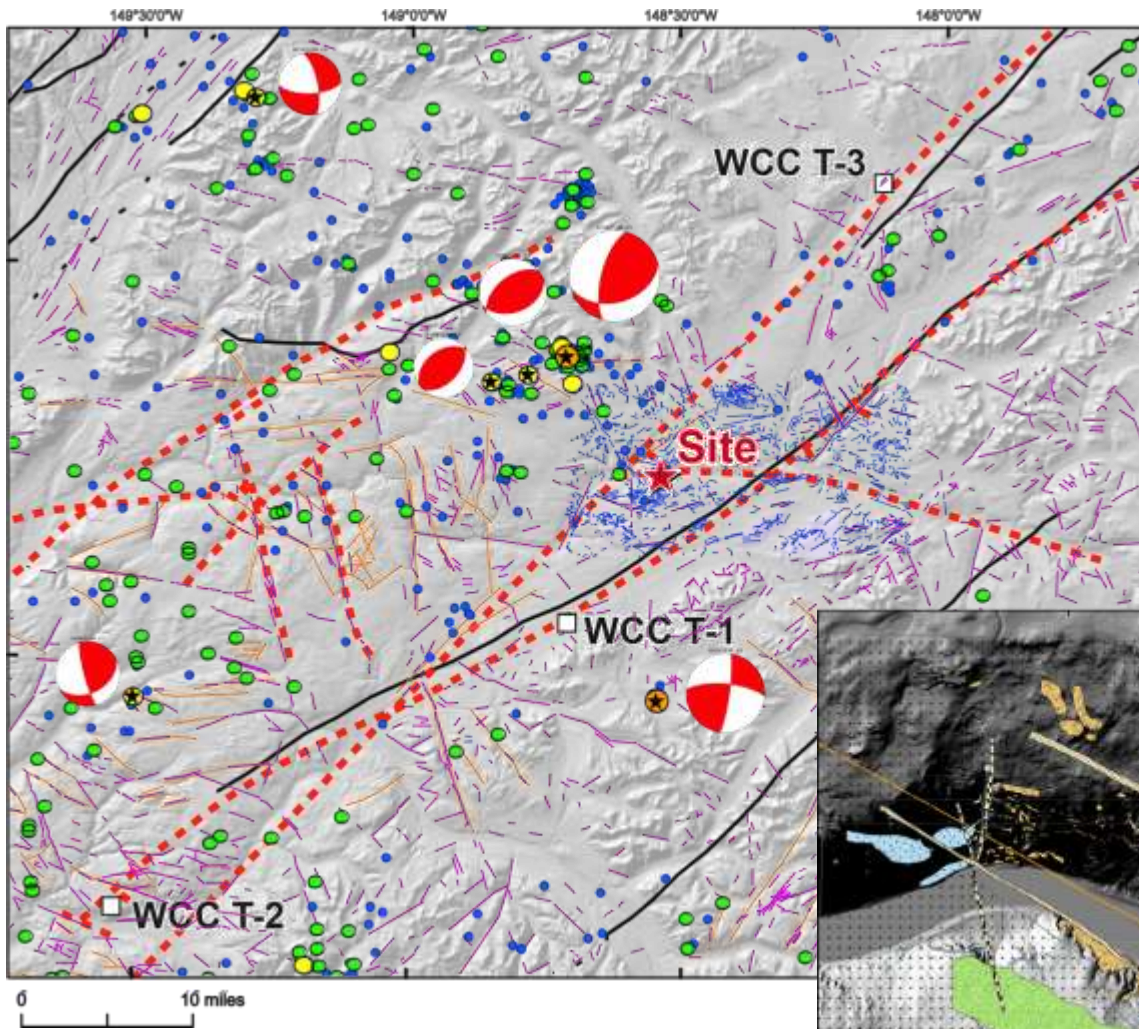
Geologic Verification for Feasibility

- Rock Mass Characterization at Depth
 - Rock discontinuity patterns and characteristics
 - Character of geologic features, fracture, shear and alternation zones at depth
 - Ice-filled discontinuities
- Abutment Stability Evaluation
- Mitigation Measures for Foundation Treatment
- Construction Cost Update, As Needed

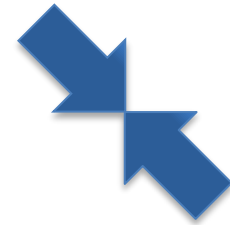
Lineament Mapping and Analysis: Continuation



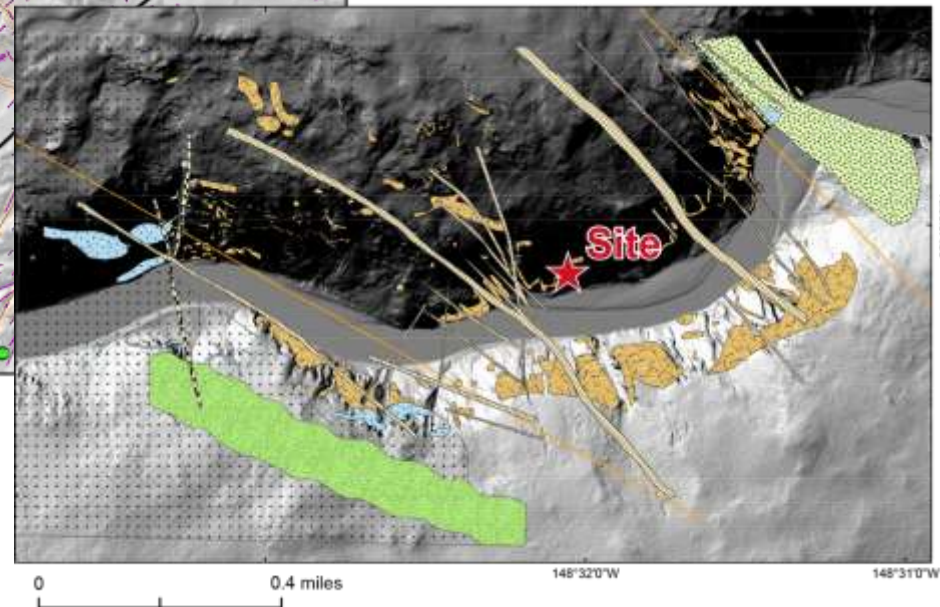
Crustal Lineaments, Faults, Earthquakes and 2013 Focal Mechanisms



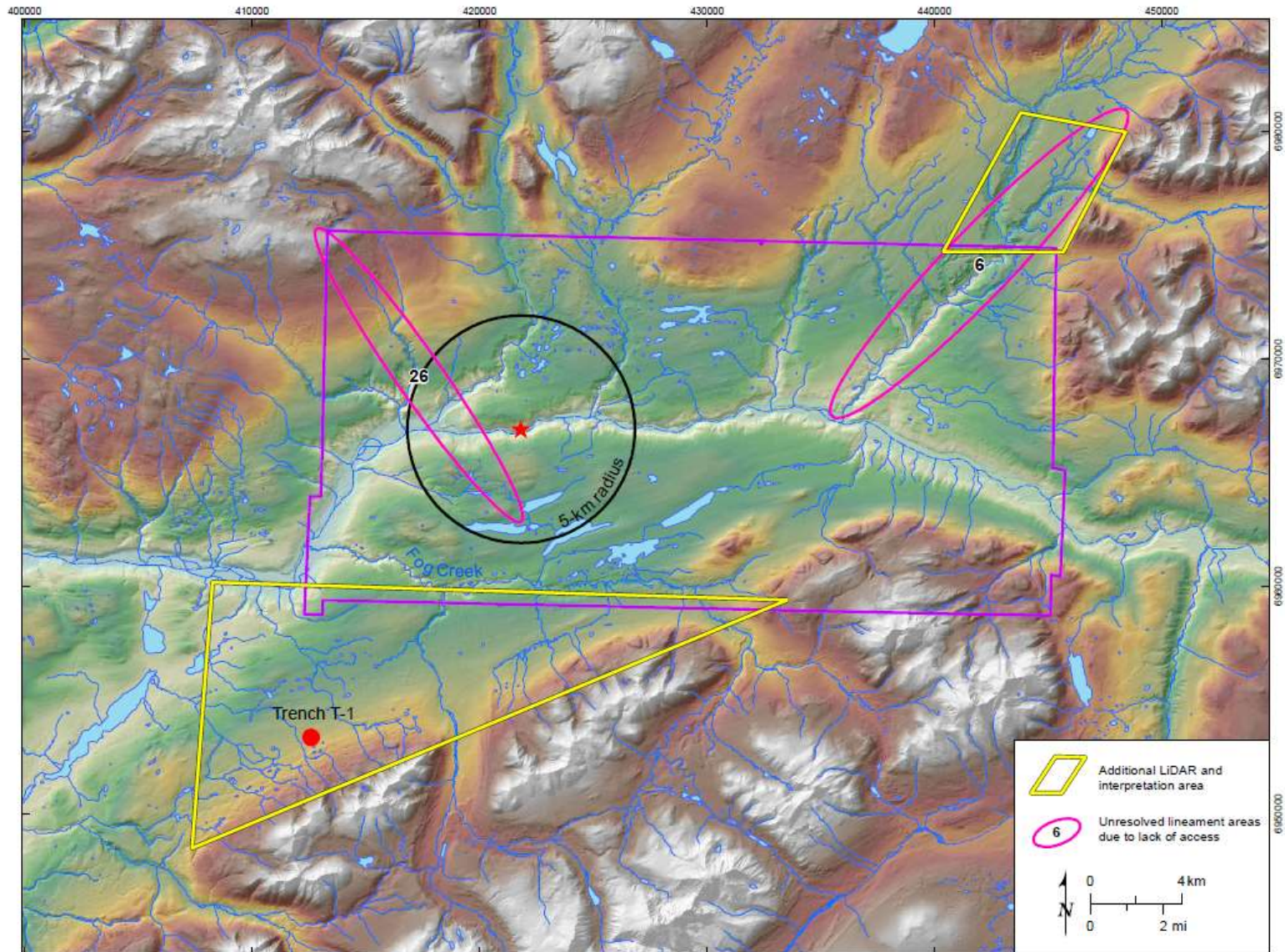
Focal mechanisms indicate crustal compressive stress in the NW-SE direction



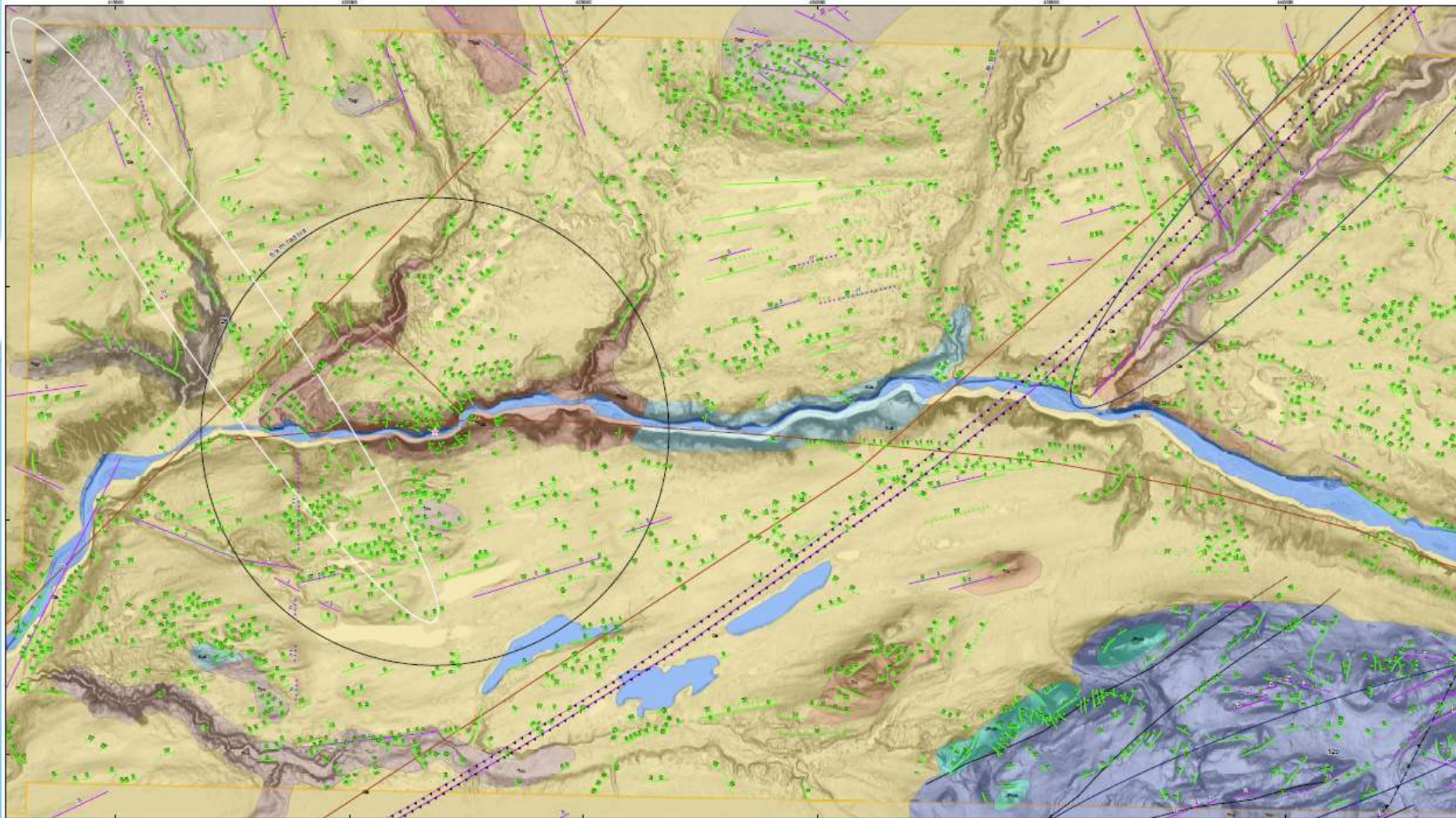
Dam site structures are dominantly NW-striking with moderate to steep dips



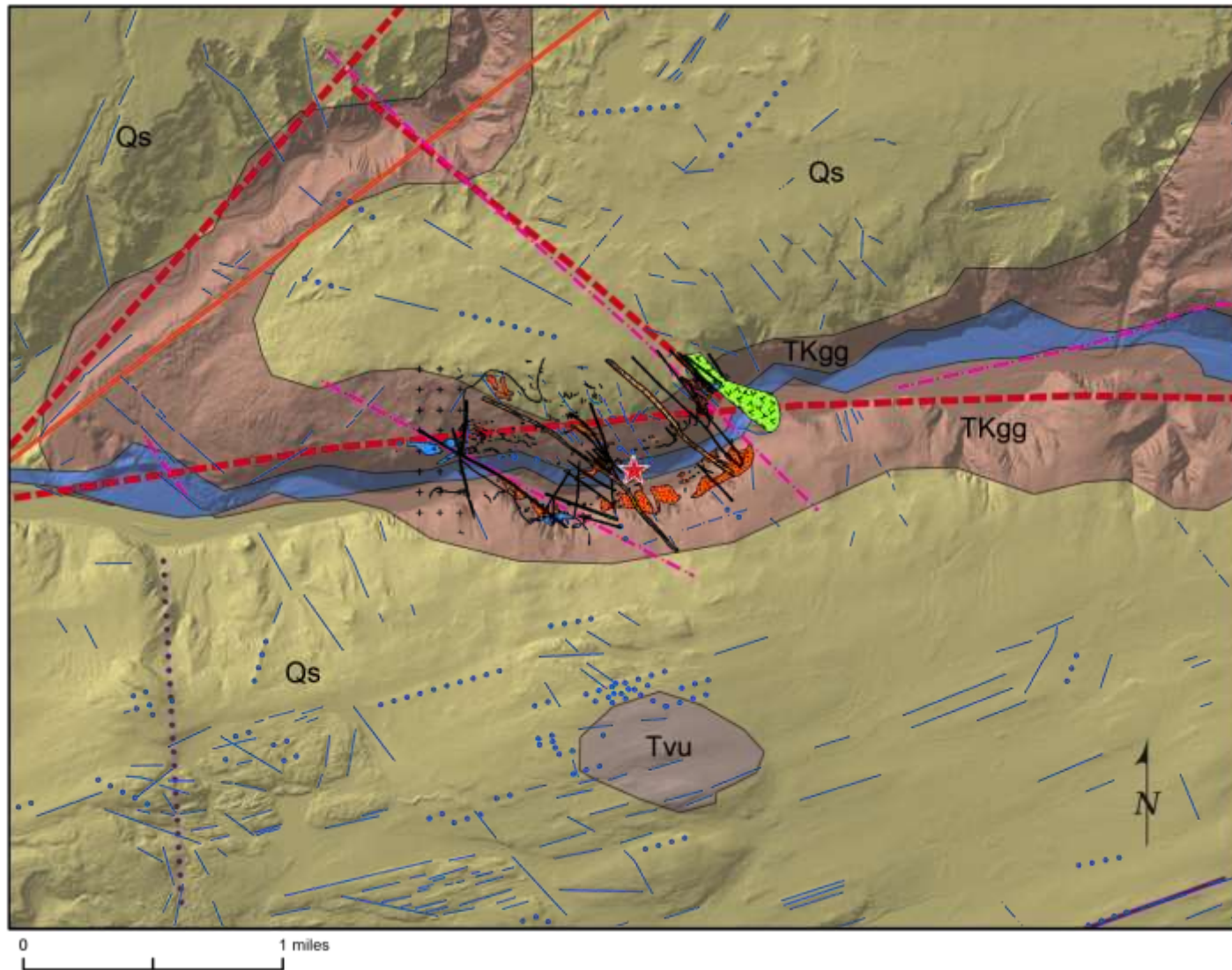
Lineament Mapping & Evaluation: Continuation



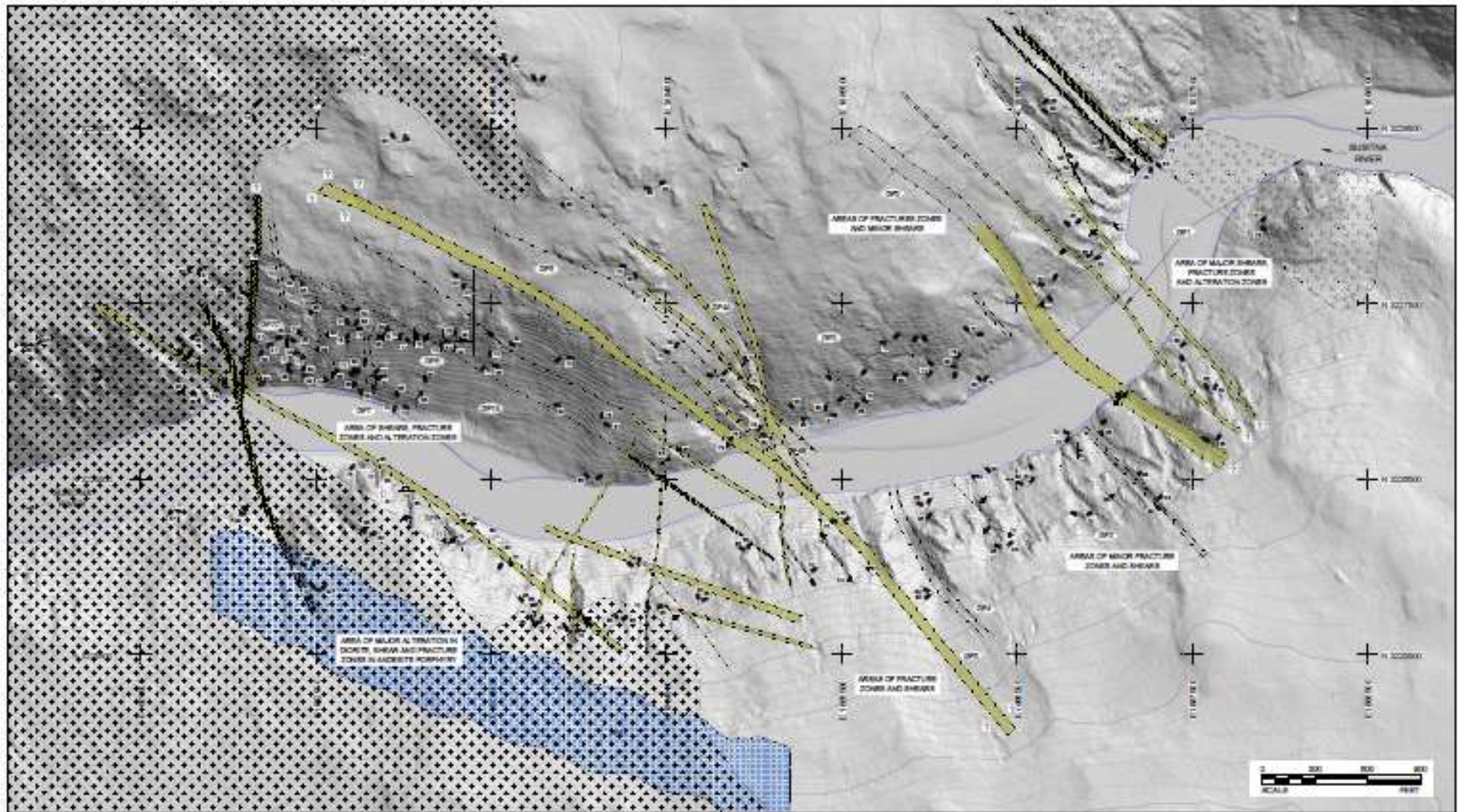
Lineament Mapping & Evaluation: Continuation



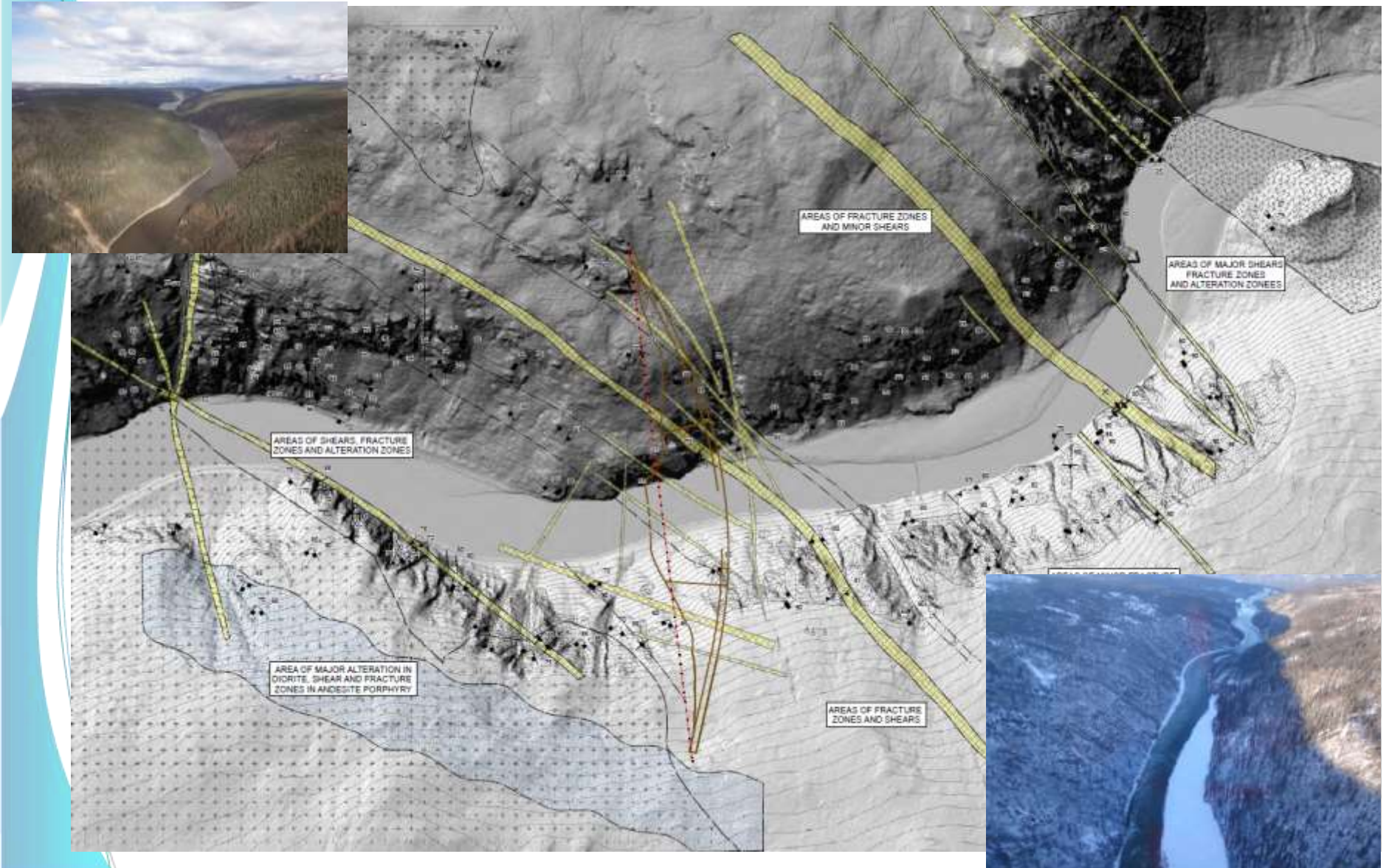
Site Area Geology and Lineaments



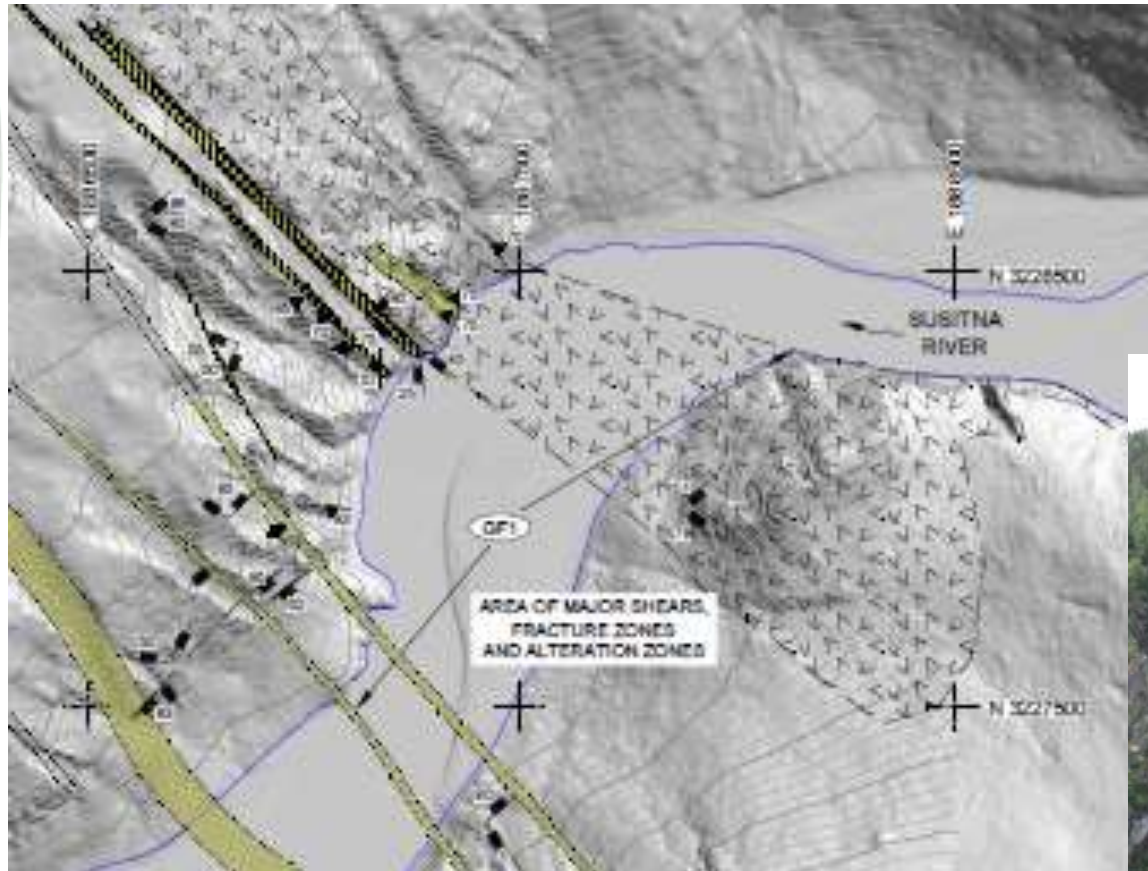
Bedrock Geology and Structure



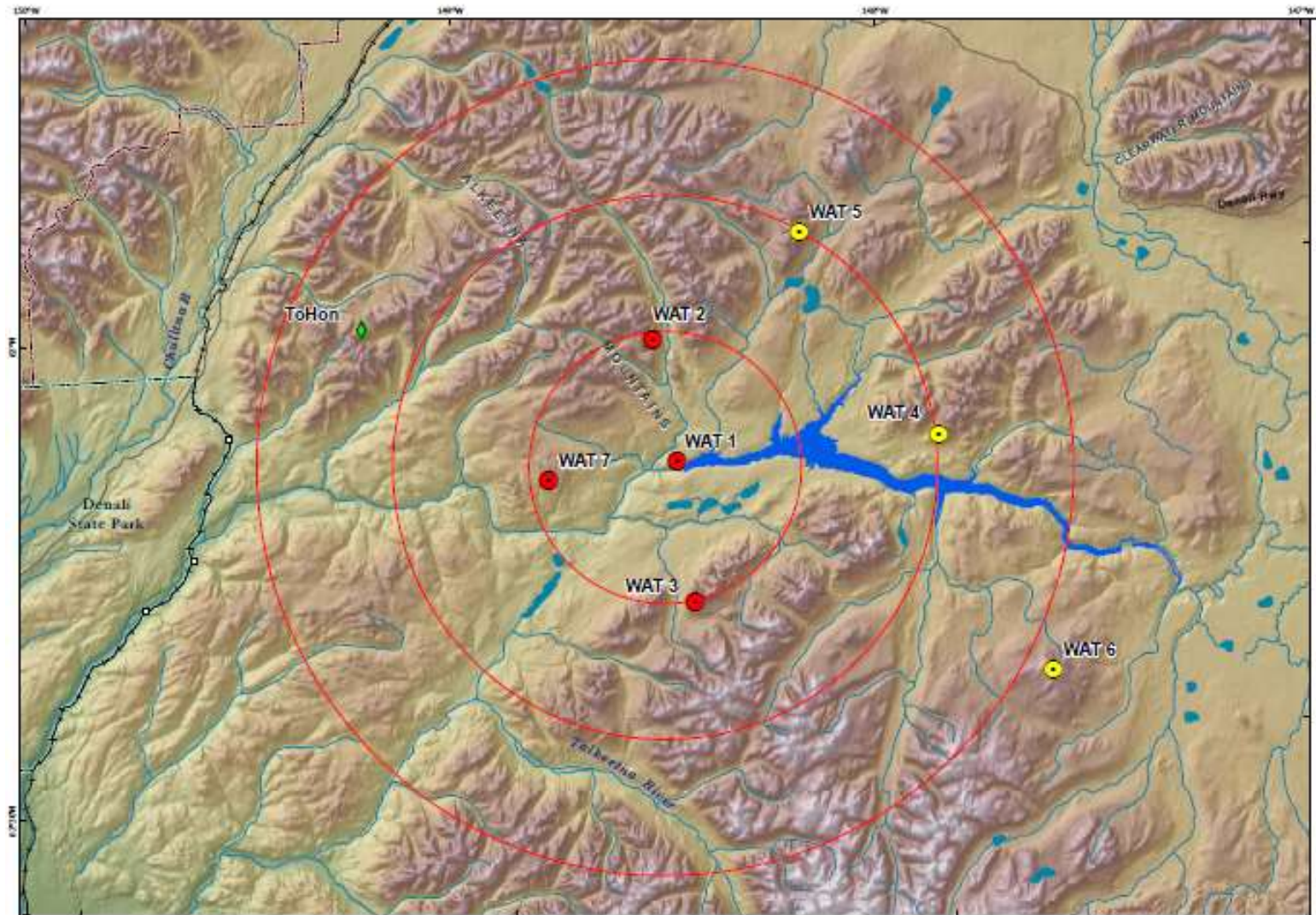
Dam Site Fault Evaluation Study



Dam Site Fault Evaluation Study



Long-Term Seismic Monitoring System: Data Gathering



Geologic Investigation - Future

- A “Work Plan” was developed that outlines the field program information that is needed for the applications
 - Assess the foundation conditions and stability relevant to a concrete dam
 - Locate, define geometry and determine the character of geologic features, fracture and shear zones relative to the dam and spillway foundations and diversion tunnel; confirm geologic features GF-4 and GF-5
 - Ice-filled discontinuities – evaluate potential for ice fillings and impacts to shear strength and abutment stability



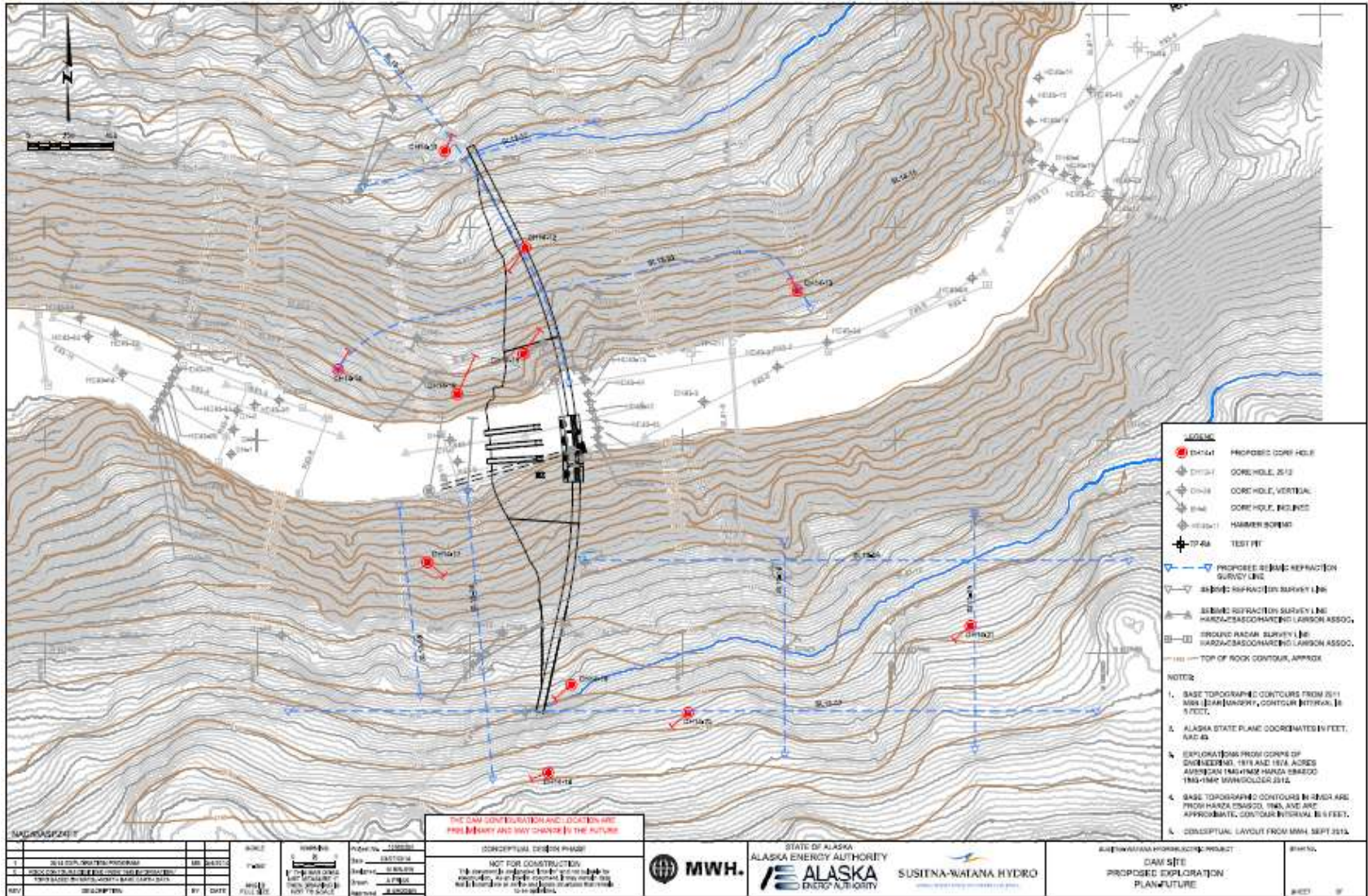
Geologic Investigations – Future

- Complete evaluation of mineral resource potential
- Delineate and characterize construction material sources for the dam and appurtenant structures, access road, transmission line, and construction camp
- Evaluate crustal seismic sources that may influence the design of the project
- Continue Long-Term Seismic Monitoring

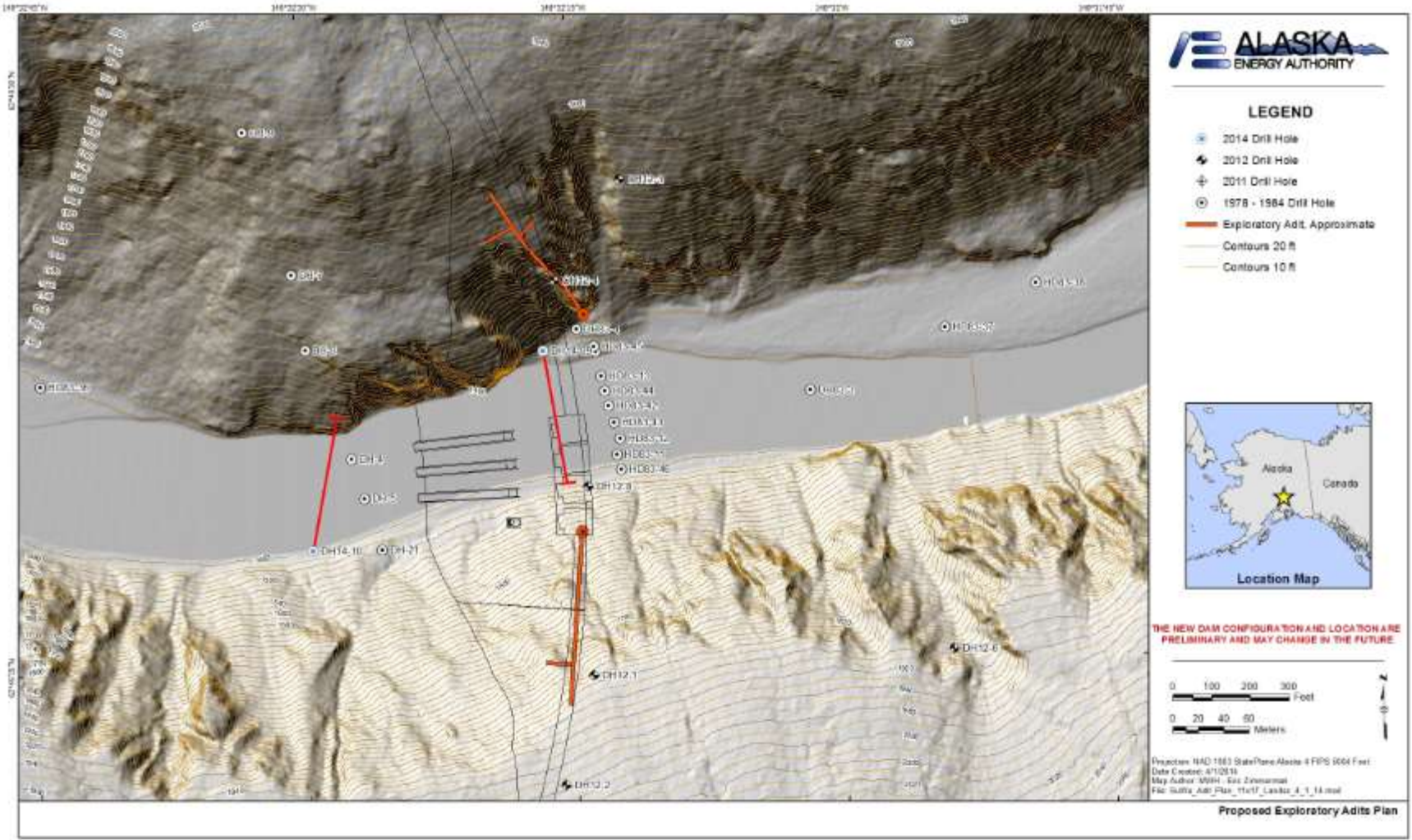
Geologic Investigations – Future

- Exploratory Adit in Left and Right Abutment
 - Vs30 Shear Wave Velocity Measurements
 - In Situ Rock Testing
- Geophysical Surveys of Dam Abutments, Relict Channel
- Drilling and In Situ Testing at Dam Site, Abutments and in the River
- Drilling and Sampling along the Preferred Corridors
- Trenching of Lineament / Potential Fault Features
- Instrumentation Monitoring

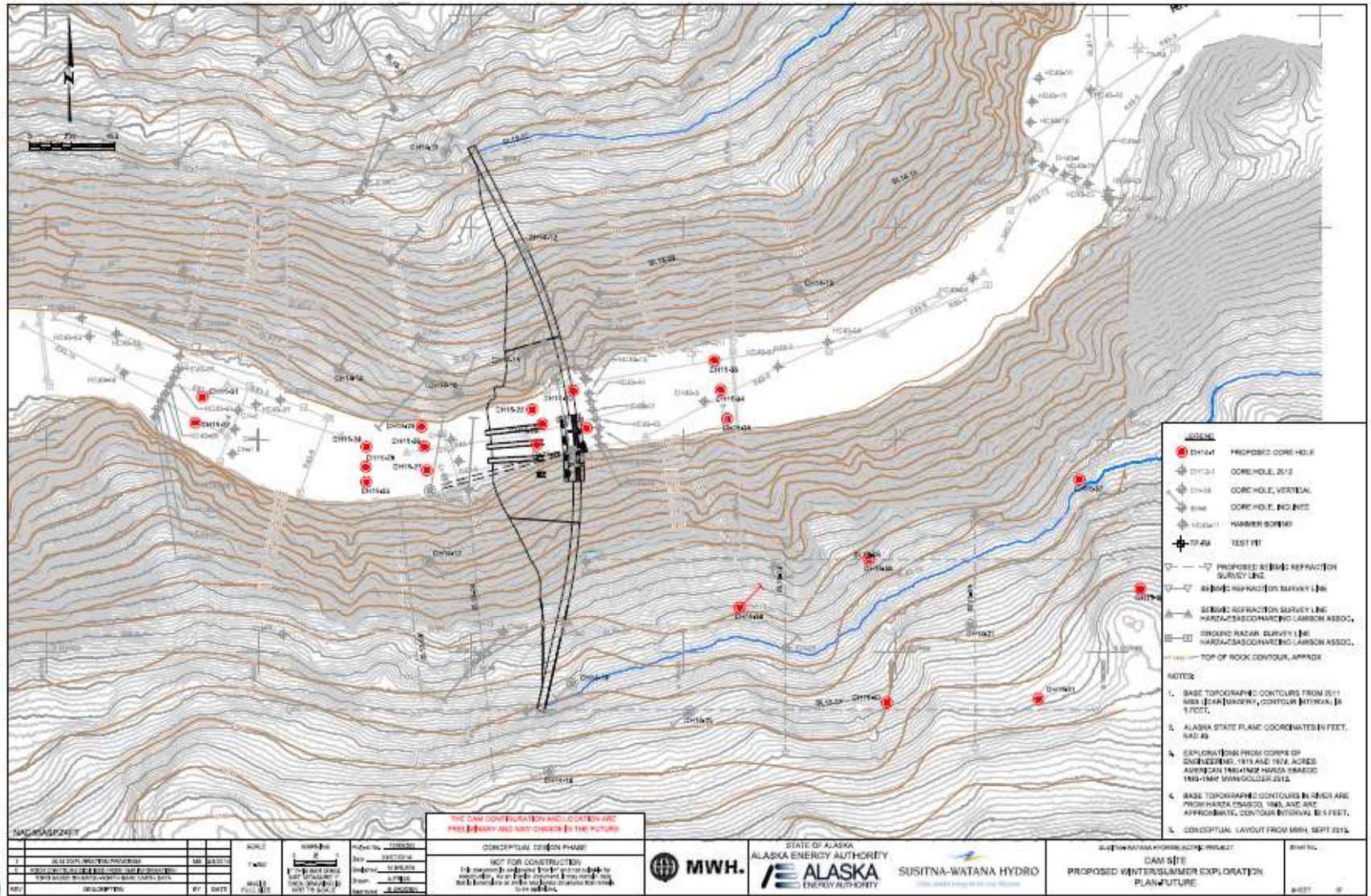
Future Exploration and Testing – Dam Site (1)



Future Exploration and Testing – Exploratory Adits



Future Exploration and Testing – Dam Site (2)



Future Studies

- Update Mineral Resources Assessment
- Update Reservoir Triggered Seismicity
- Probabilistic Seismic Hazard Analysis – including update velocity model and kappa study
- Annual Reporting:
 - Geo-Instrumentation
 - Seismicity