

Highland Uranium Mill Site



**License Amendment
Request - RAIs
August 14, 2012**

ExxonMobil

Environmental Services

Highland Mine License Amendment Request

Event Summary

- License Amendment Request (LAR) submitted May 12, 2011
- Safety Evaluation Report (SER) Request for Additional Information (RAIs) received May 29, 2012
- Environmental Assessment (EA) RAIs received June 25, 2012

Highland Mill Site – Summary of RAIs

A total of 35 RAIs received to date

Safety Evaluation Report (SER) RAIs

- Geological Site Conceptual Model (3)
- Site Hydrogeology (17)
- Site Geochemistry (5)
- Hazard Assessment (4)
- Corrective Actions (2)

Environmental Assessment (EA) RAIs

- Proposed Actions (1)
- Land Use (2)
- Wildlife (1)

Highland RAIs – General RAI Categories

- General types of RAIs:
 - Requests for additional information
 - Clarification/explanation of language
 - Explanation of data anomalies
 - Requests for clarification of conceptual model
 - ♦ Characterization of groundwater flow north of tailings
 - ♦ Pit Lake
 - ♦ SE Drainage

Highland RAIs – Meeting Focus

- Primary Focus
 - Geochemical data anomalies
 - Characterization of groundwater flow north of tailings
 - Hydrogeochemical site conceptual model
 - Previous groundwater modeling
- Additional Focus (time permitting)
 - Requests for additional information
 - ♦ Geo1, Geo2, Geo3, H3, H7, H8, GC-1, CA2, PA-1, LU-1 and LU-2
 - Clarification/explanation of language
 - ♦ HAZ-2 and HAZ-4

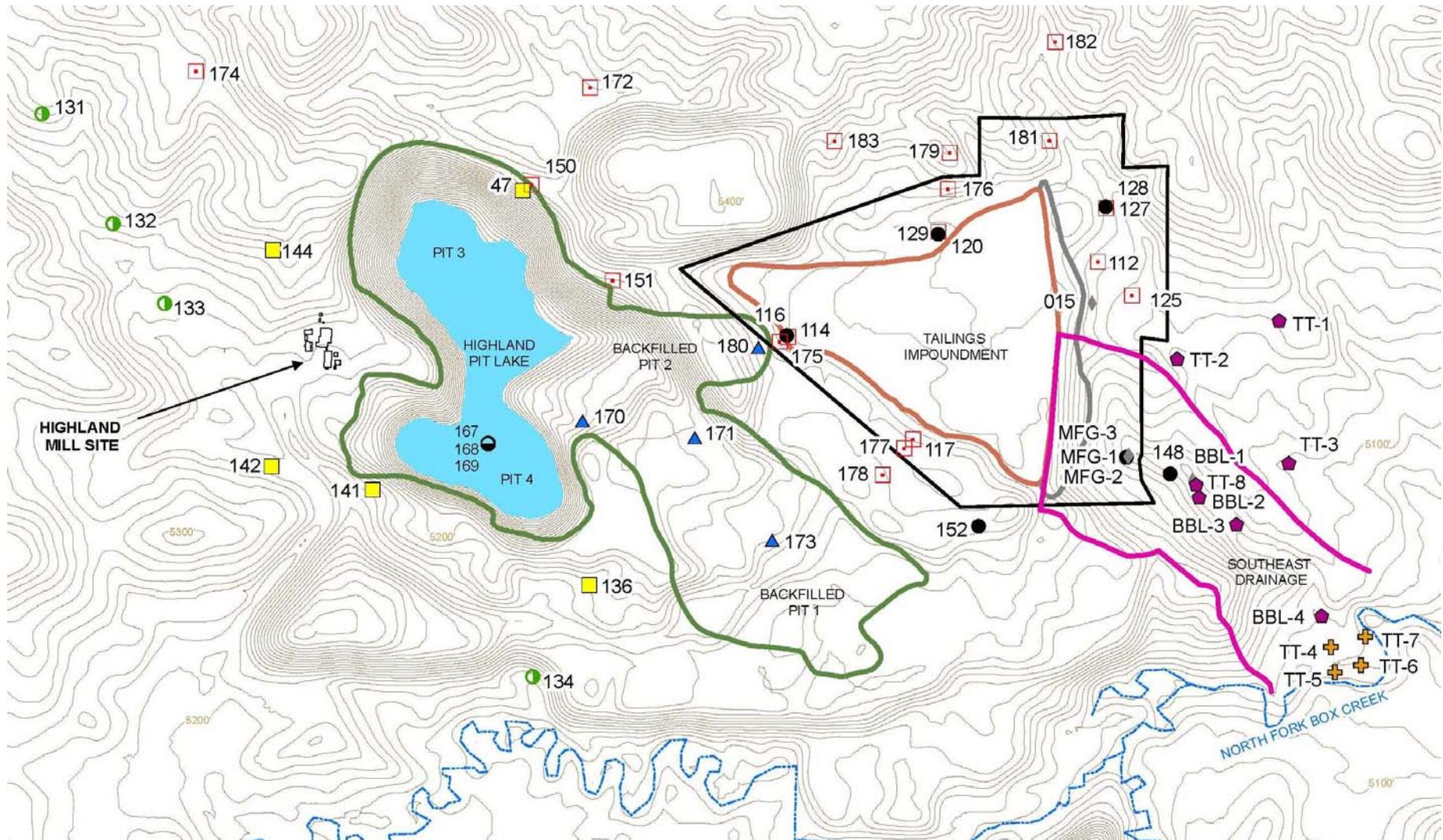
Highland RAIs – Data Anomalies

GC-2: Provide additional justification for selection of Well MFG-1 as the point of compliance well for the Southeast Drainage area.

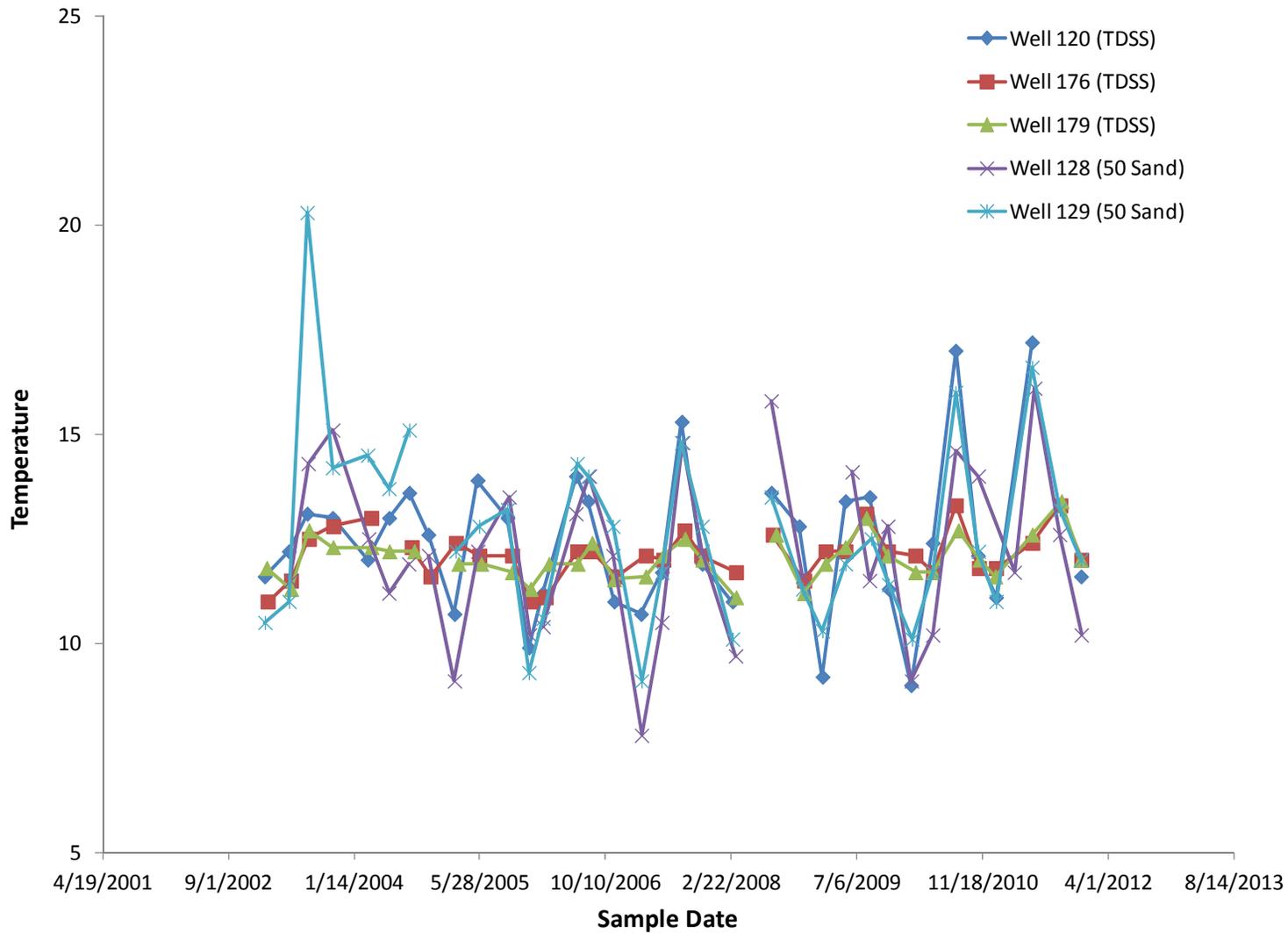
GC-4: Provide technical basis for variations in water temperature and solute concentrations in Wells 129 and 128.

- Slightly elevated constituents at wells downgradient of MFG-1; BBL-2 elevated selenium, BBL-3 elevated $^{226}\text{Ra} + ^{228}\text{Ra}$
 - Isolated occurrences, Se lower at MFG-1 and is very low or non-detectable at all downgradient wells
- Constituent trends vs. temperature in Wells 128, 129 in OBSS vs. 120, 176, and 179 in the TDSS
- Not a dynamic flow system

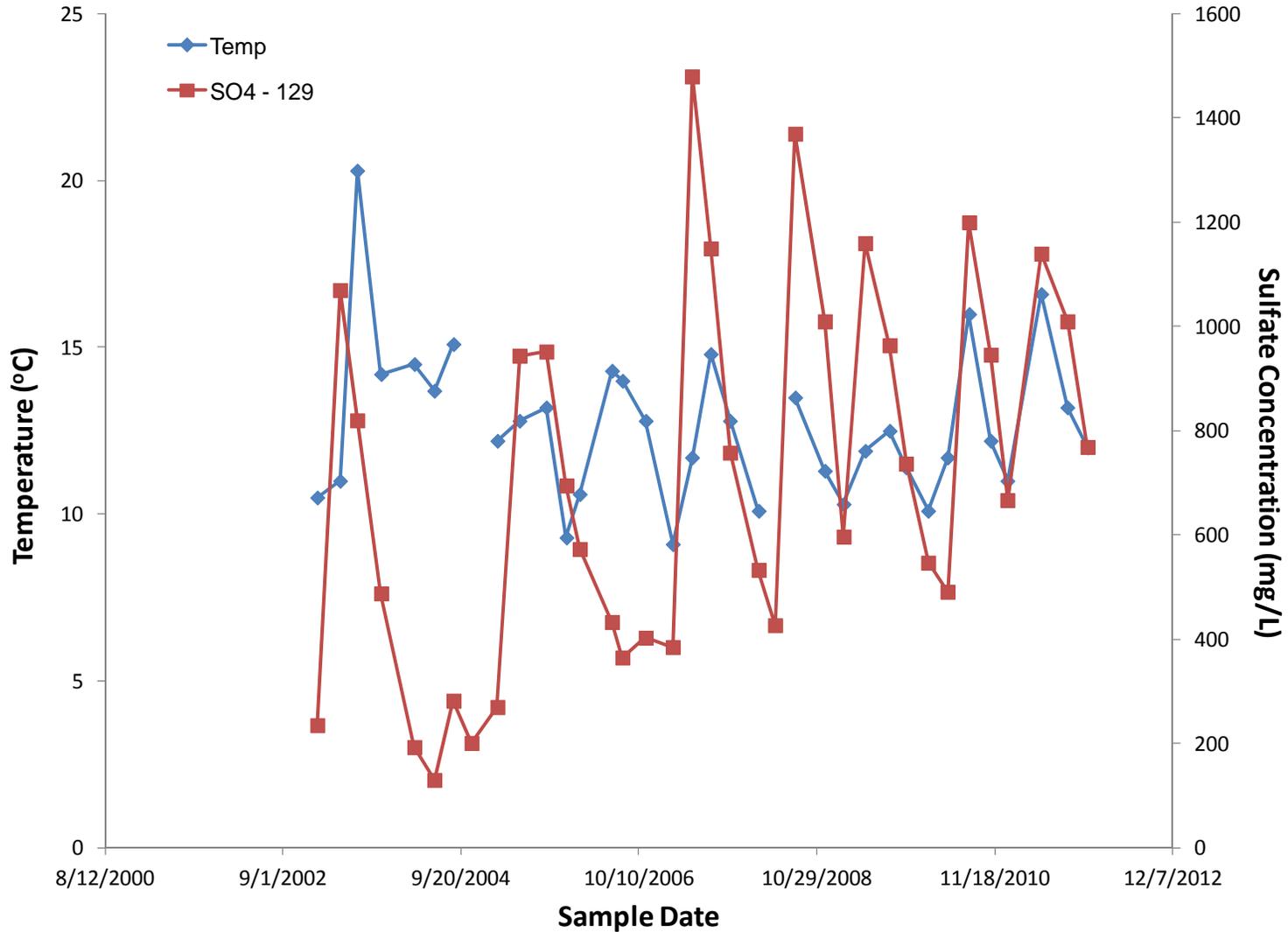
Highland RAIs – Well Location Map



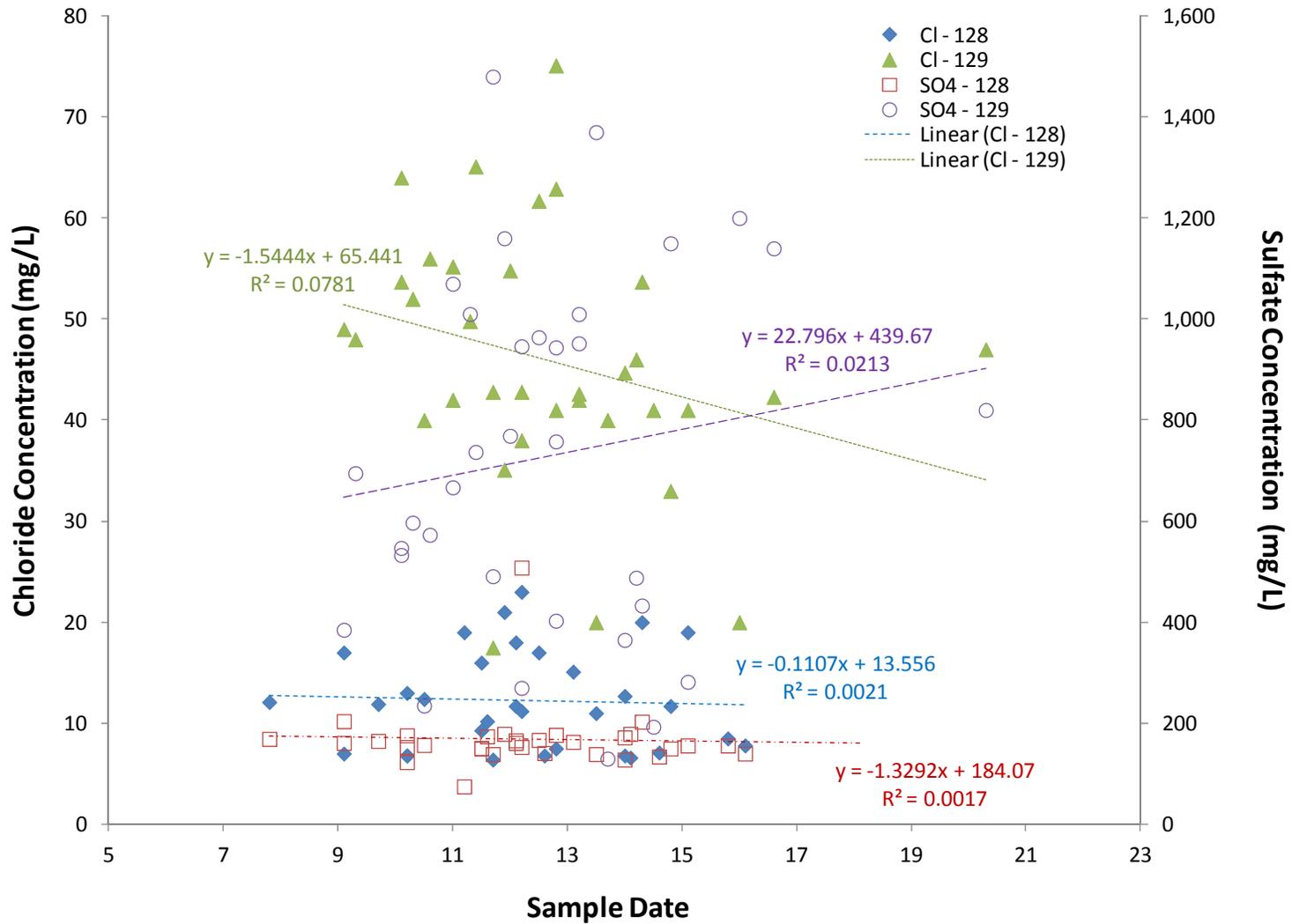
Highland RAIs – Temperature Anomalies



Highland RAIs – Temperature Anomalies



Highland RAIs – Temperature Anomalies

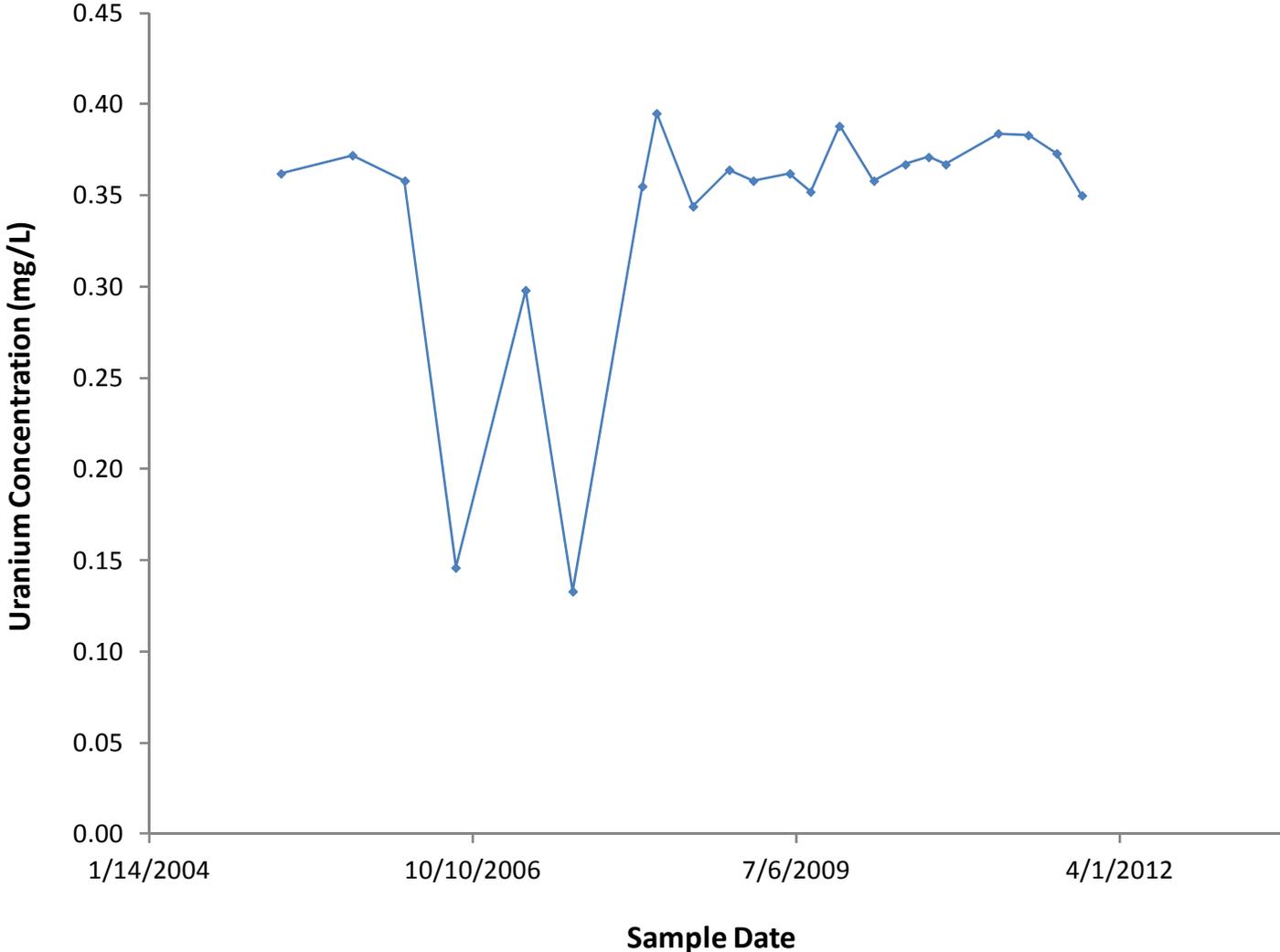


Highland RAIs – Geochemistry

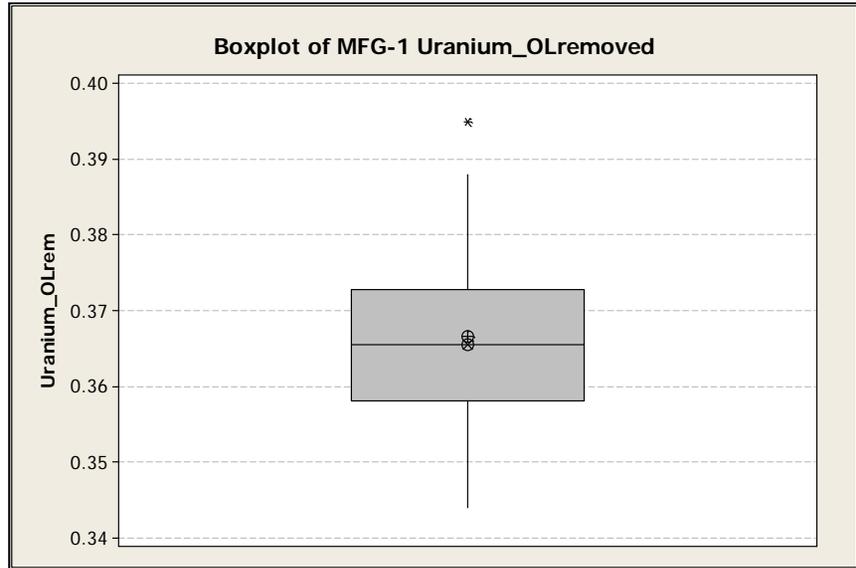
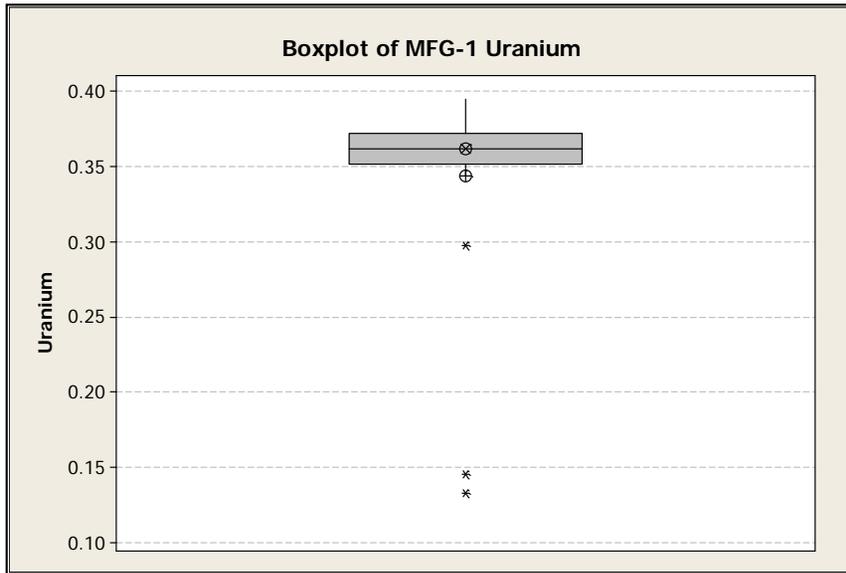
GC-3: Provide basis for conclusion that U concentrations in MFG-1 are not anticipated to increase.

- Trend analysis indicates no upward trend
- Trends in adjacent wells east of tailing (e.g. Well 125) show decreasing water levels and decreasing concentrations of major constituents
- Calculated Upper Prediction Limit (UPL) for 100 future observations is 0.423 mg/L

Highland RAIs – Geochemistry



Highland RAIs – MFG-1 Statistics

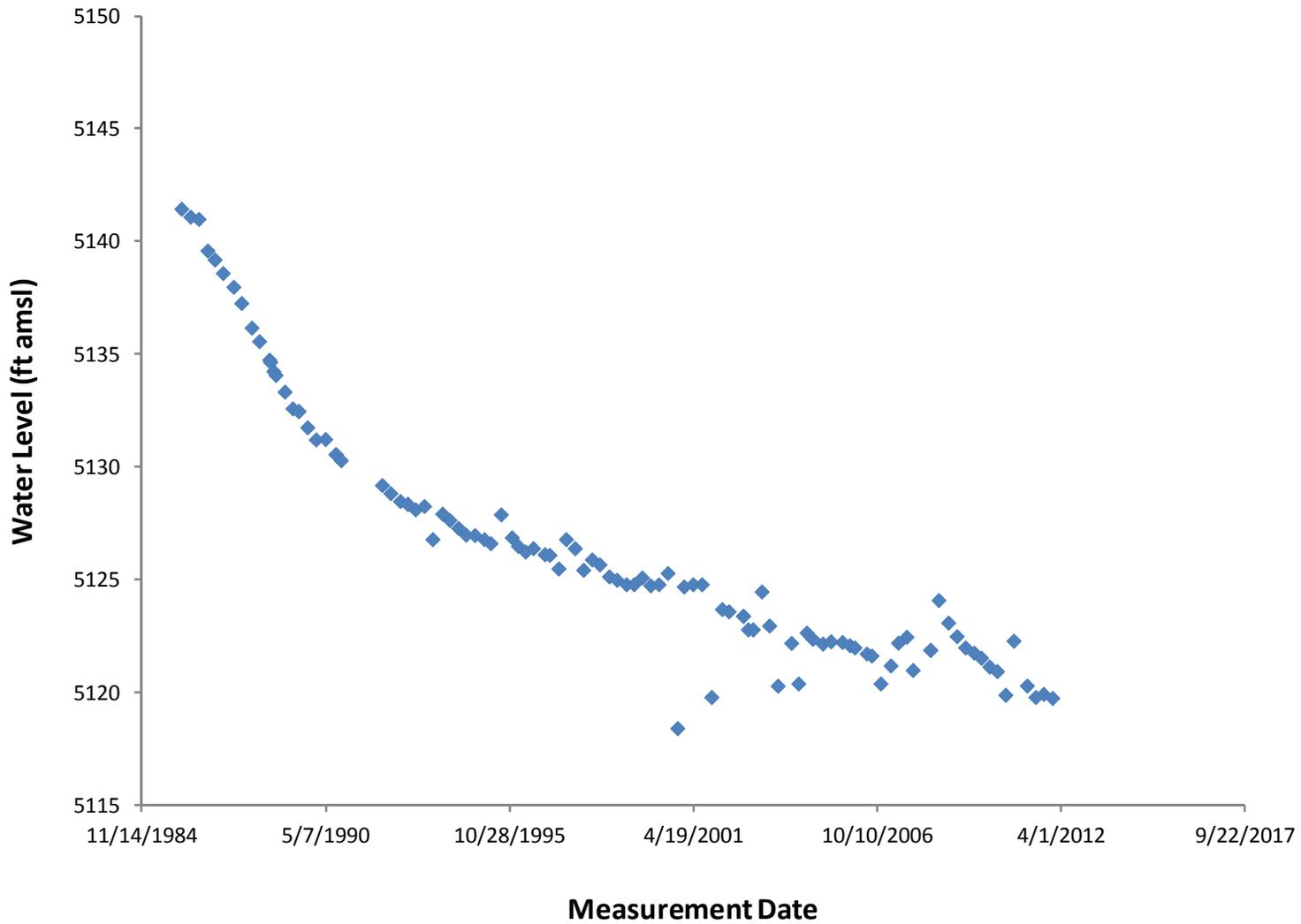


Descriptive Statistics Including 95% Upper Prediction Limits*

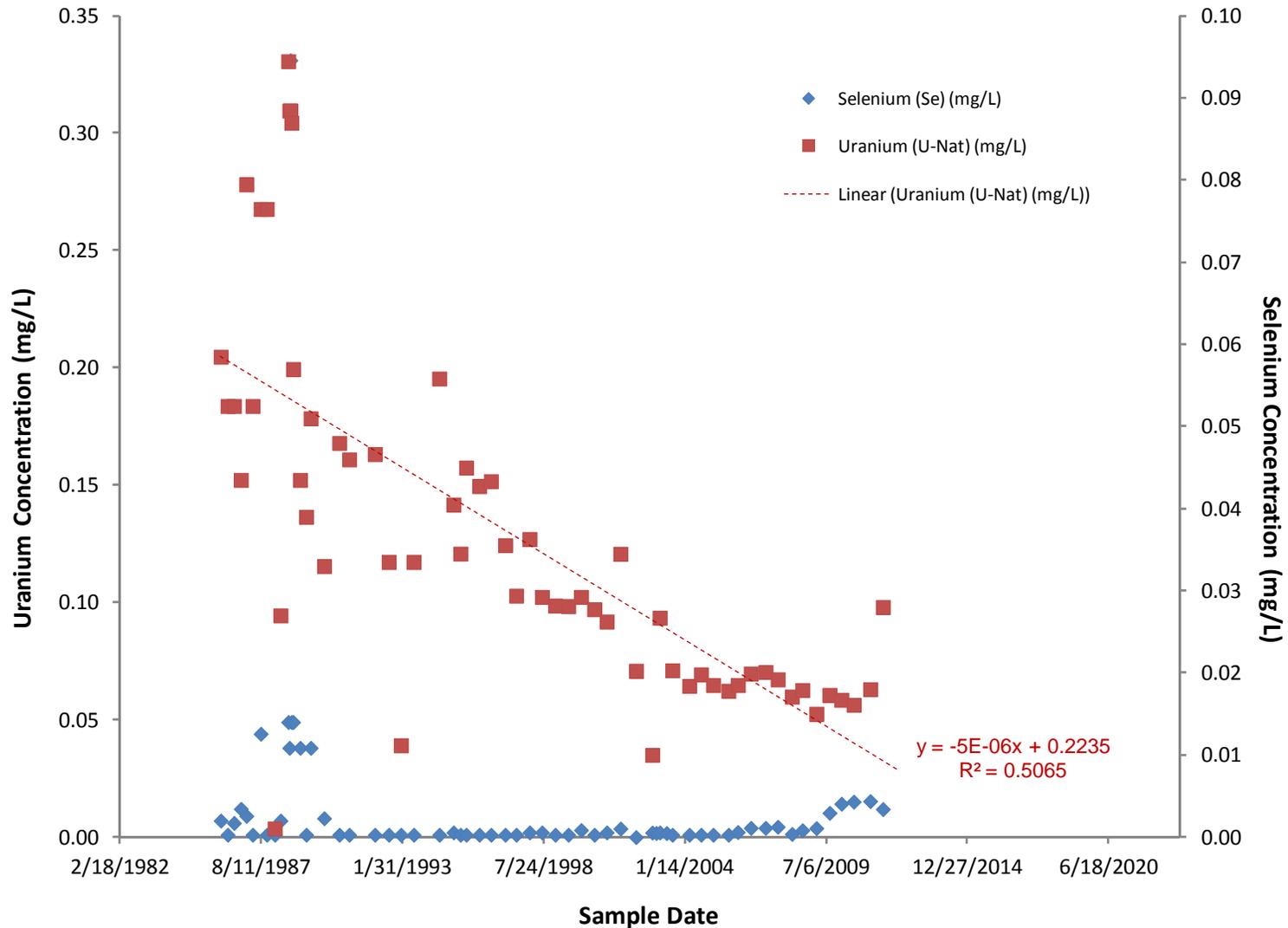
Variable	Distribution	N	Mean	StDev	Median	Min	Max	95UPL_1	95UPL_10	95UPL_100
Uranium	non-parametric	23	0.344	0.067	0.362	0.133	0.395	--	--	--
Uranium_OLrem	normal	20	0.367	0.013	0.366	0.344	0.395	0.395	0.410	0.423

*Number following UPLs indicate number of future observations

Highland RAIs – Water Level in Well 125



Highland RAIs – Uranium and Selenium in Well 125



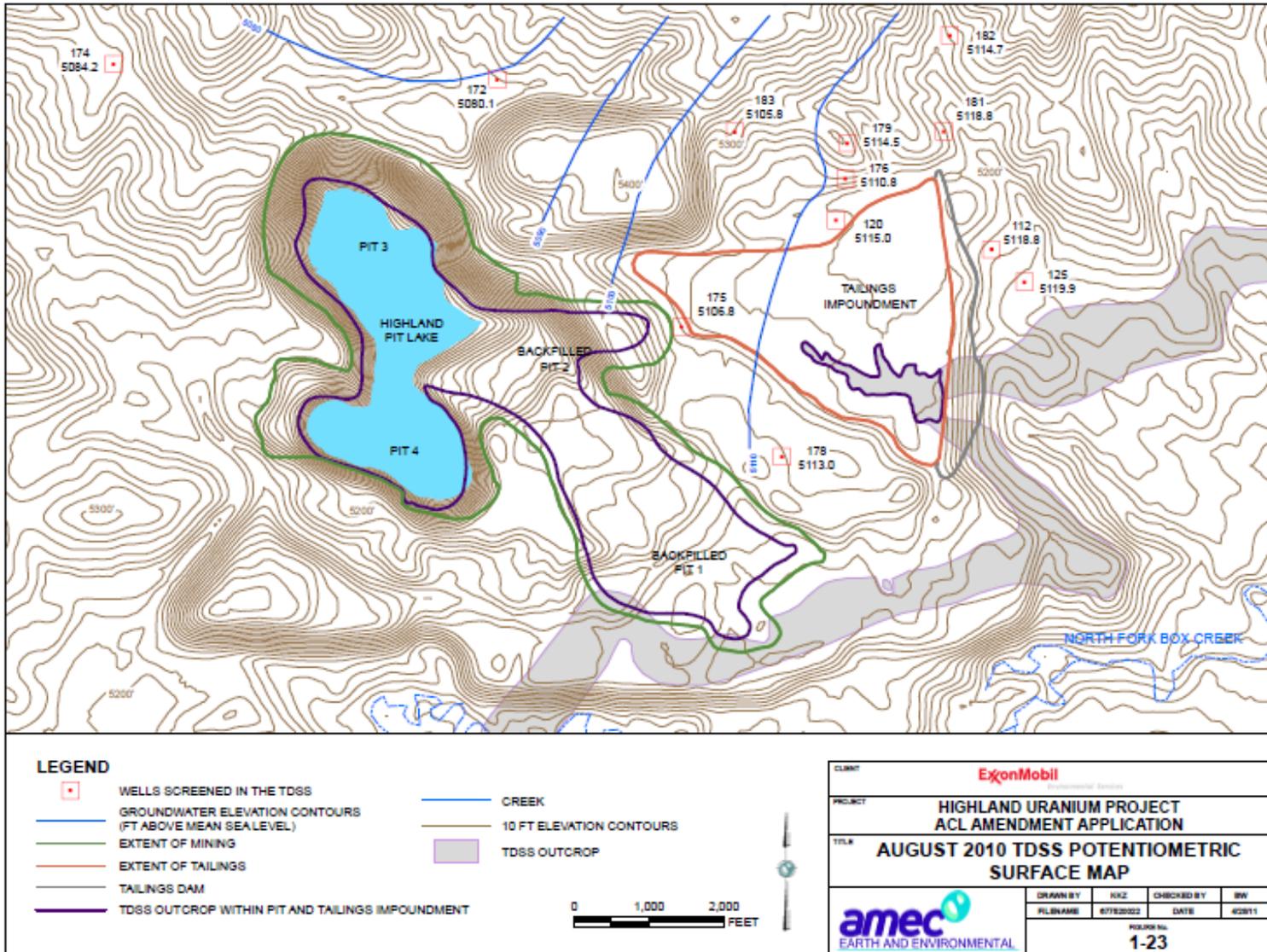
Highland RAIs – Groundwater Flow North of Tailings

H15: Provide technical justification for not evaluating a potential flow pathway north of the tailings dam.

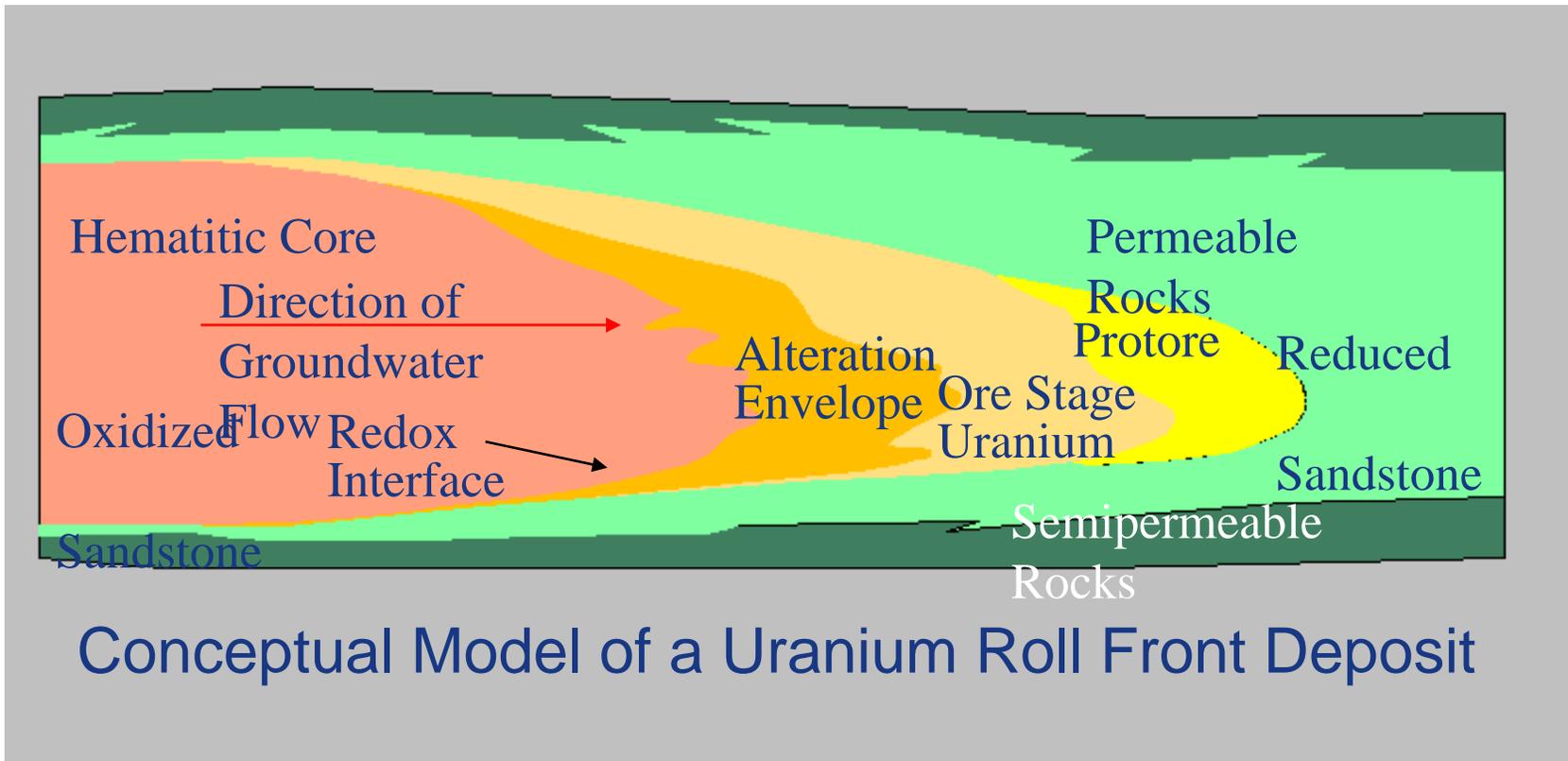
GC-5: Provide the technical bases for excluding a proposed point of compliance well located in the OBSS north of the tailings impoundment.

- It is recognized that data suggest a possible groundwater flow path in the TDSS to the north of the tailings impoundment
- Elevated chloride and sulfate levels in wells north of tailings
- Redox conditions will limit migration of hazardous constituents
- Groundwater flow path in OBSS is toward the lake, not to the north
- POC wells designated for the uppermost aquifer, which is the TDSS at the Highland site.
 - *“In practice, the POC will be located within a vertical surface representing the intersection of the down-gradient edge of the reclaimed tailings impoundments with the uppermost aquifer.” (Alternative Concentration Limits for Title II Uranium Mills – January 1996)*

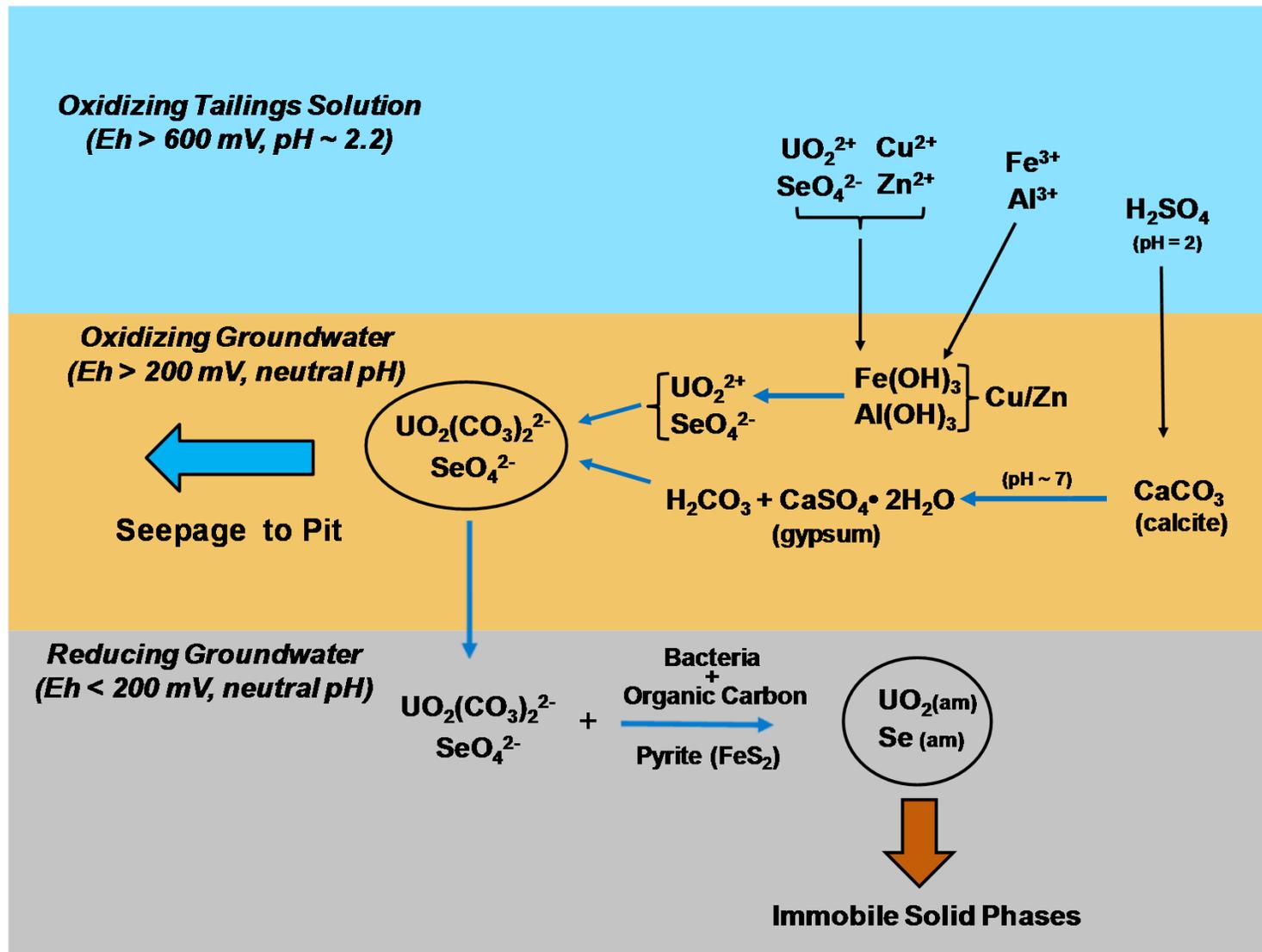
Highland RAIs – 2010 Potentiometric Surface



Highland RAIs – Uranium Roll-Type Deposits



Highland RAIs – Geochemical CSM



Highland RAIs – Highland Mineralization & Redox

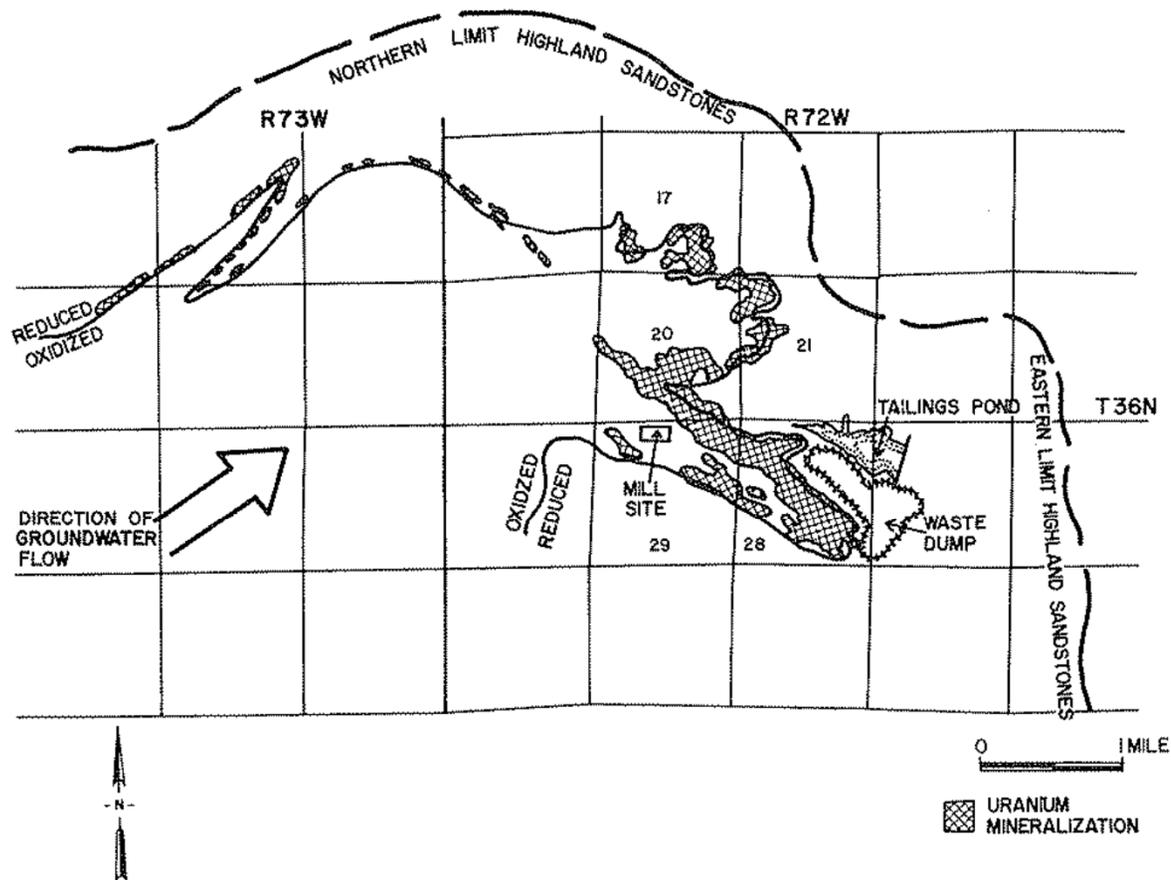
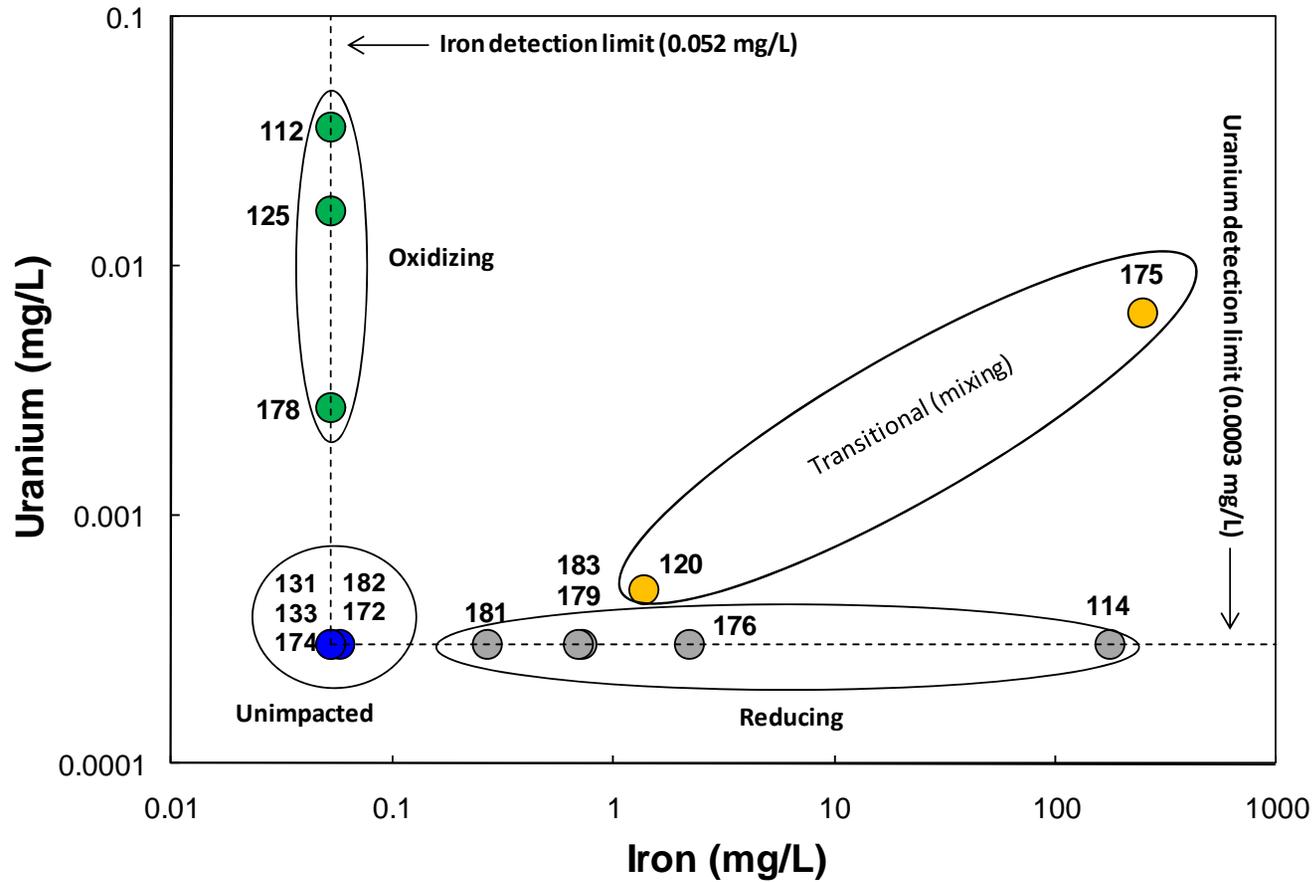


FIG. 8. Geological summary map of Highland Area showing relationship of uranium mineralization, limit of Highland sandstone unit, oxidation-reduction boundary and groundwater flow path.

Highland RAIs – Highland Site Current Redox Conditions



Highland RAIs – Geology and Hydrogeology

- Comments specific to the TetraTech 2007 flow model
- **RAIs: H5, H10, H11, H12, H13, H14, and H17**
 - ACL was developed based on a detailed review of all previous transport assessments (described in Appendix A)
 - Historical assessments reviewed against over 30 years of subsequent data
 - Various analytical and numerical models developed over time (1980, 1982, 1983, 1984, 1998, 2007)

Highland RAIs – Geology and Hydrogeology

- Comments specific to the TetraTech 2007 flow model
- **RAIs: H5, H10, H11, H12, H13, H14, and H17**
 - Each model assessment based on data and assumptions available at the time of model development
 - Each model presents a different assessment of seepage transport, pit lake development, and ultimate stable lake level
 - Current data suggests lake has not developed as fast as previously estimated

Highland RAIs – Geology and Hydrogeology

- Comments specific to the TetraTech 2007 flow model
- **RAIs: H5, H10, H11, H12, H13, H14, and H17**
 - ACL de-emphasizes numerical modeling results
 - ACL places greater emphasis on over 30 years of data collection at the site

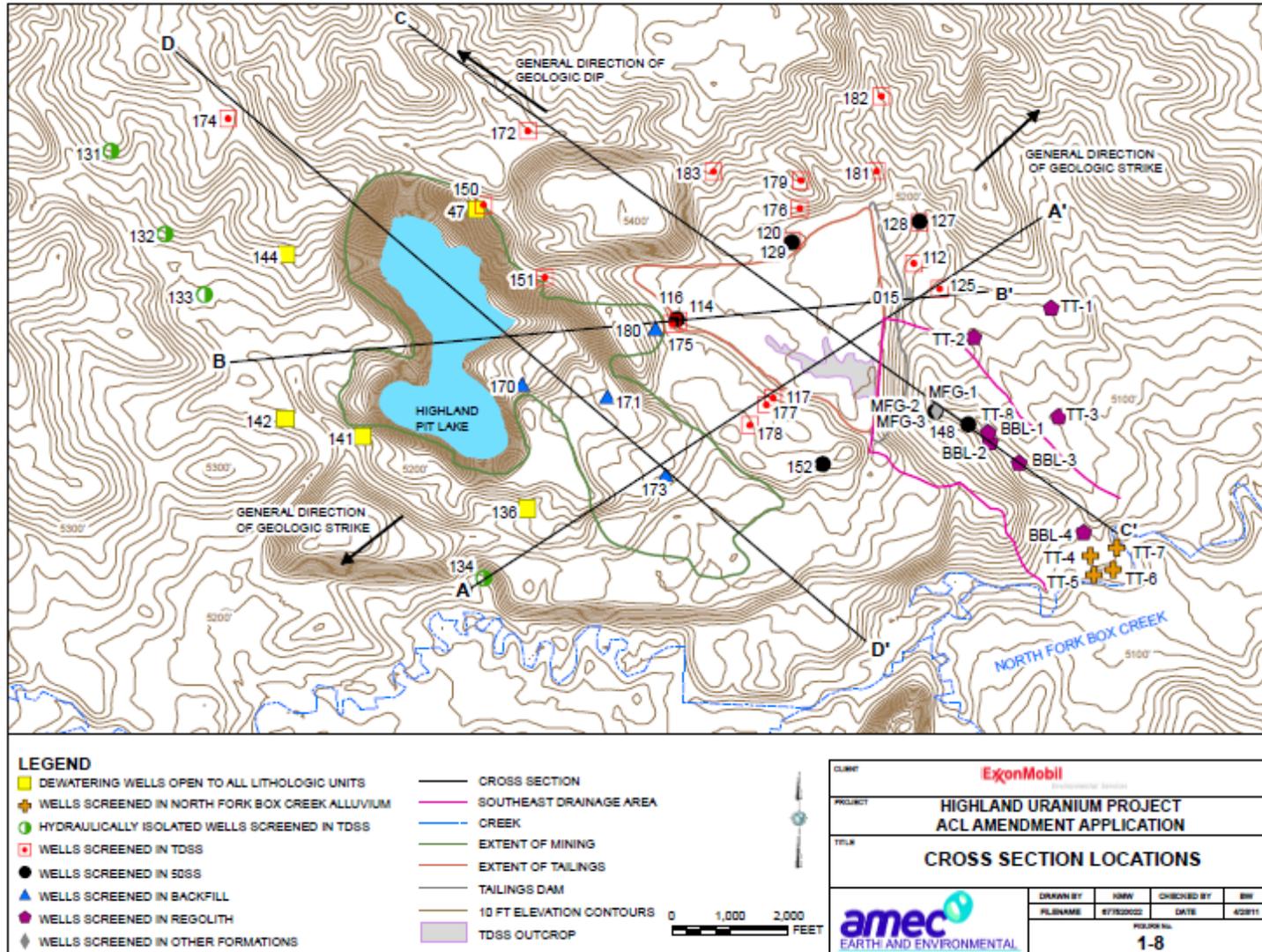
Highland RAIs – Geology and Hydrogeology

- Requests for clarification of the conceptual model
- **RAIs: H1, H2, H4, H6, H9, and H16**
 - Pre-mining hydrogeologic conditions
 - Historic mining
 - Local and regional ISL mining

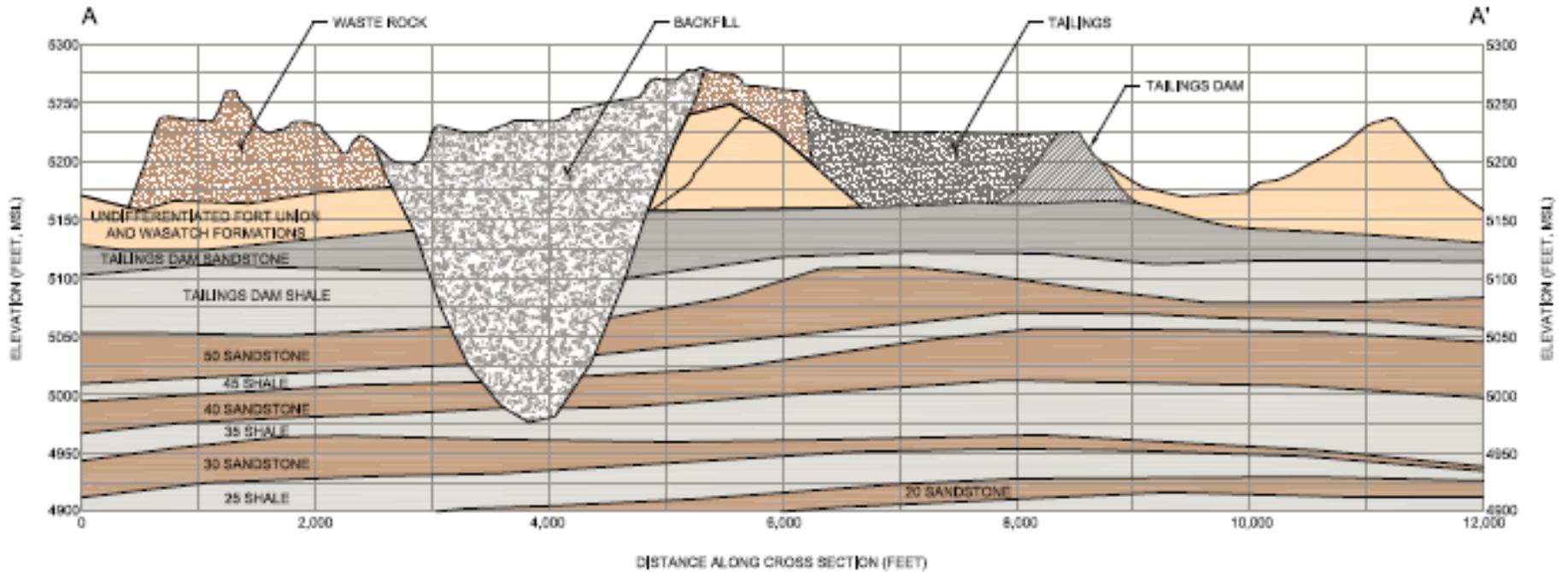
Highland RAIs - Highland Site Image



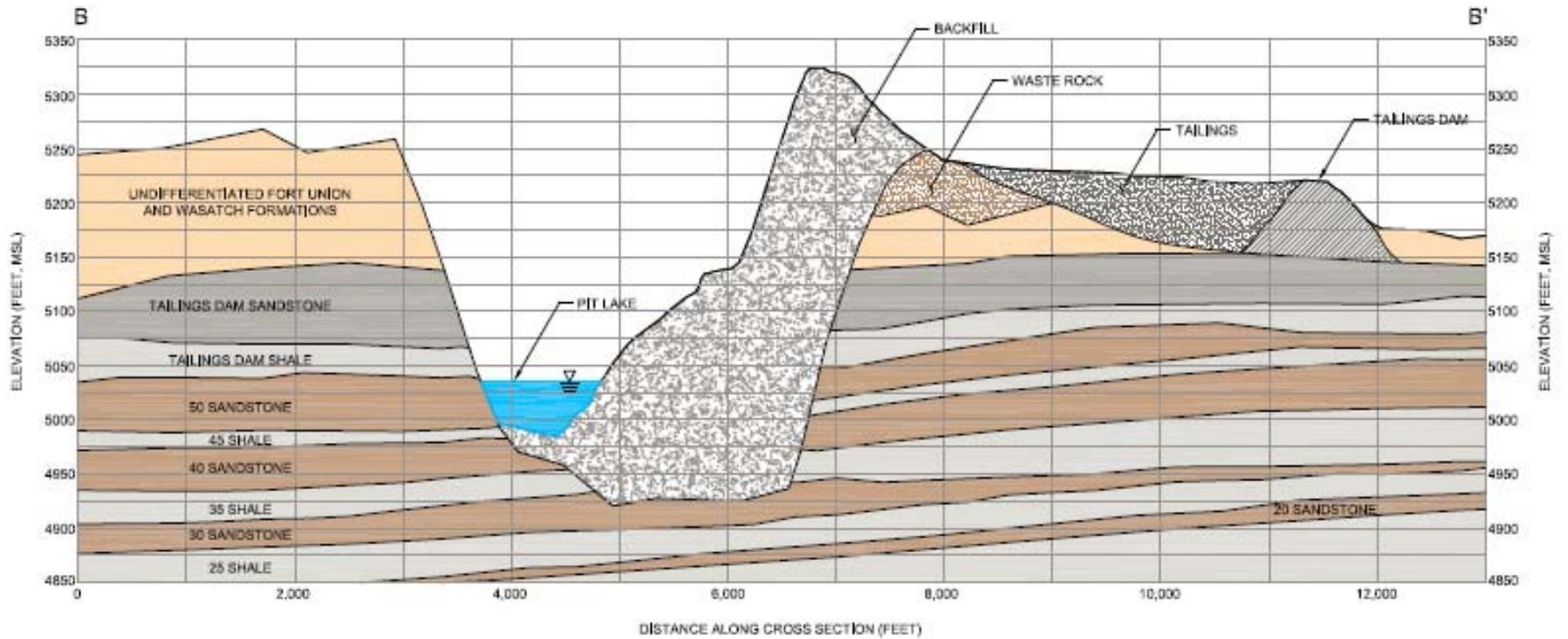
Highland RAIs – Location of Cross Sections



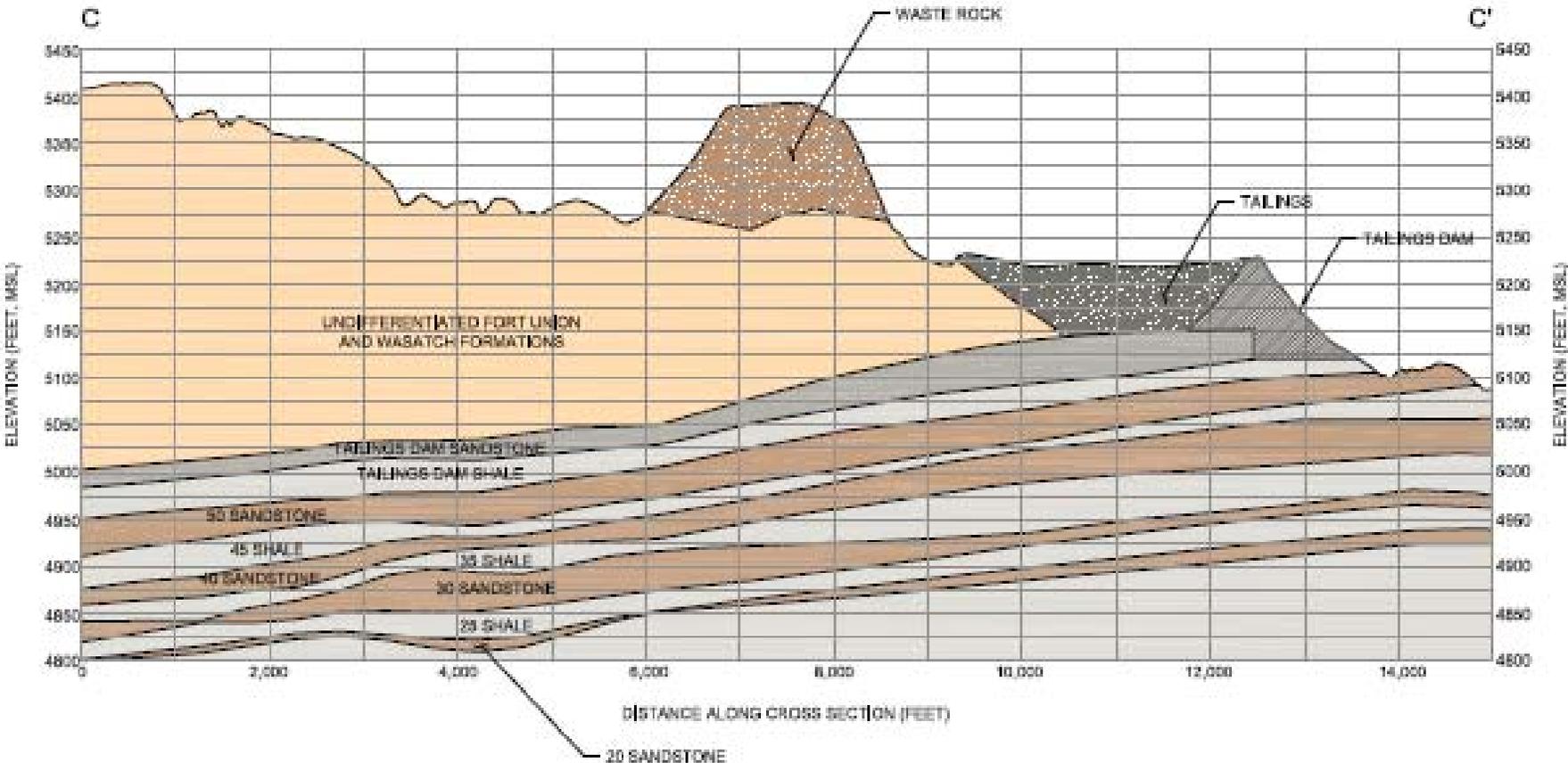
Highland RAIs – Cross Section A – A'



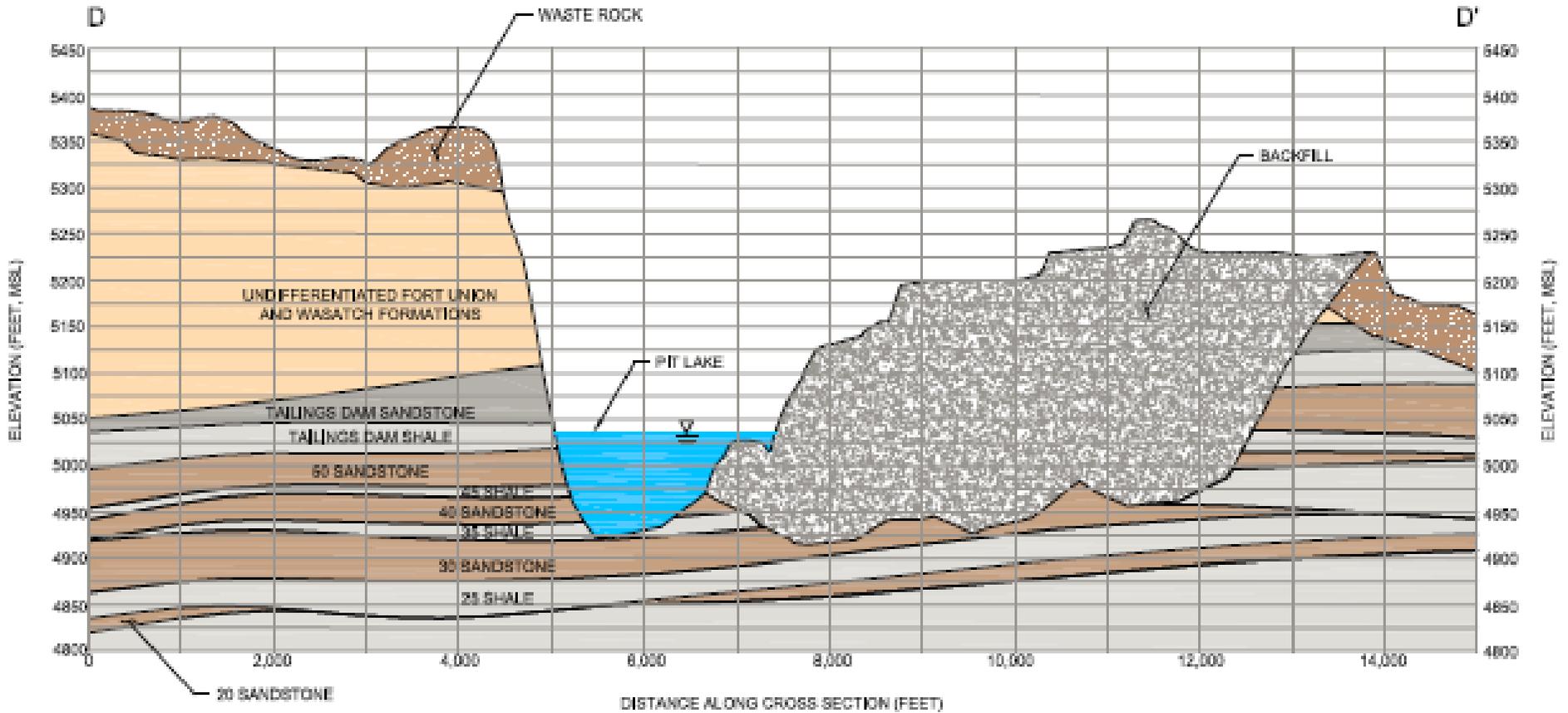
Highland RAIs – Cross Section B – B'



Highland RAIs – Cross Section C – C'



Highland RAIs – Cross Section D – D'



Highland RAIs – Groundwater Conceptual Model 1974

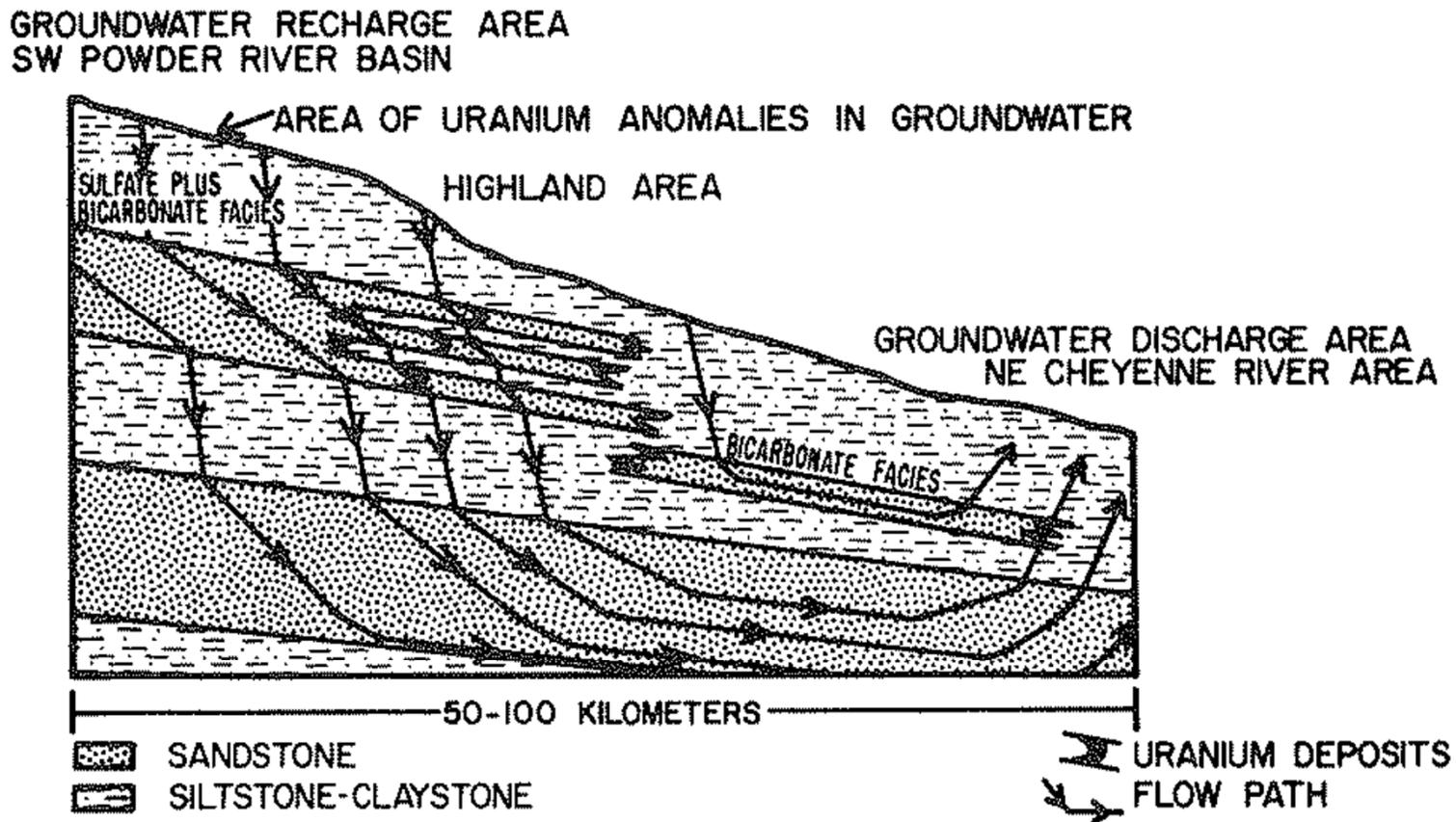
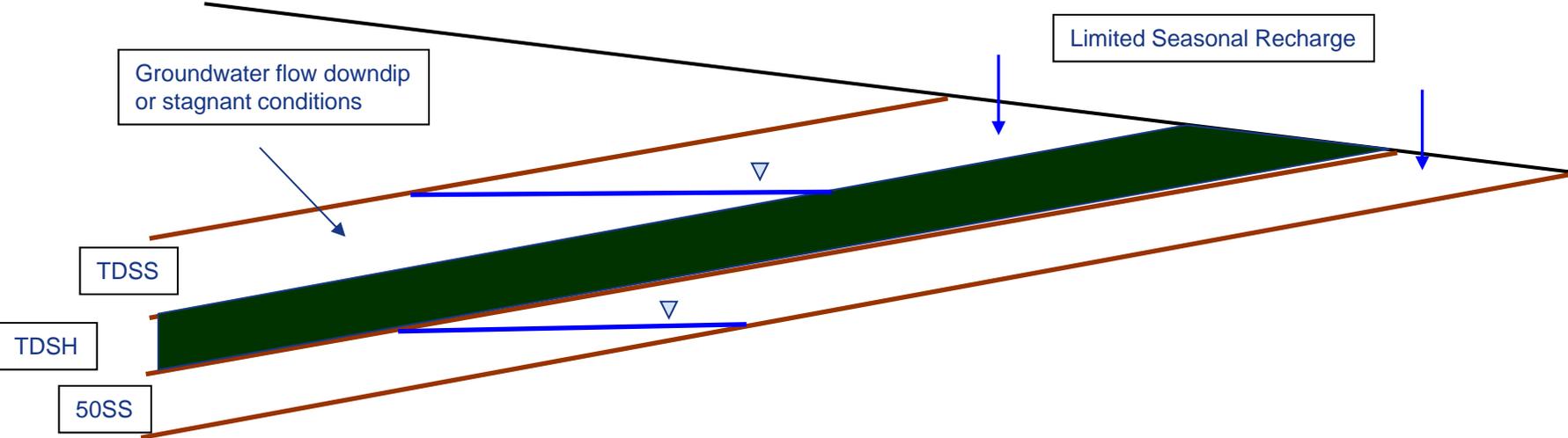
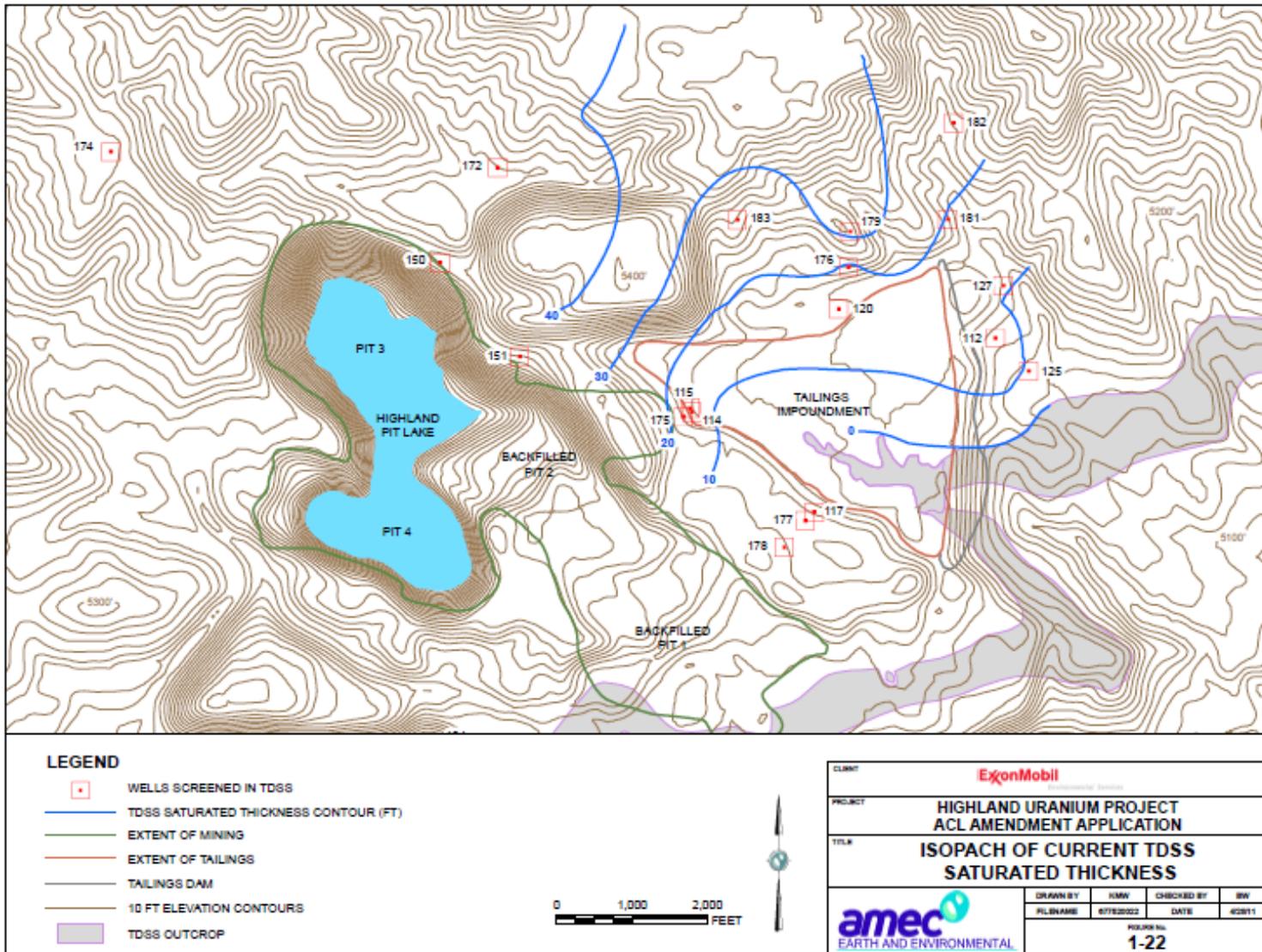


FIG. 5. Generalized diagram showing the chemical facies of the groundwater flow system in the Southern Powder River Basin and its relationship to the Highland uranium deposits. (Modified from Hagmaier [1].)

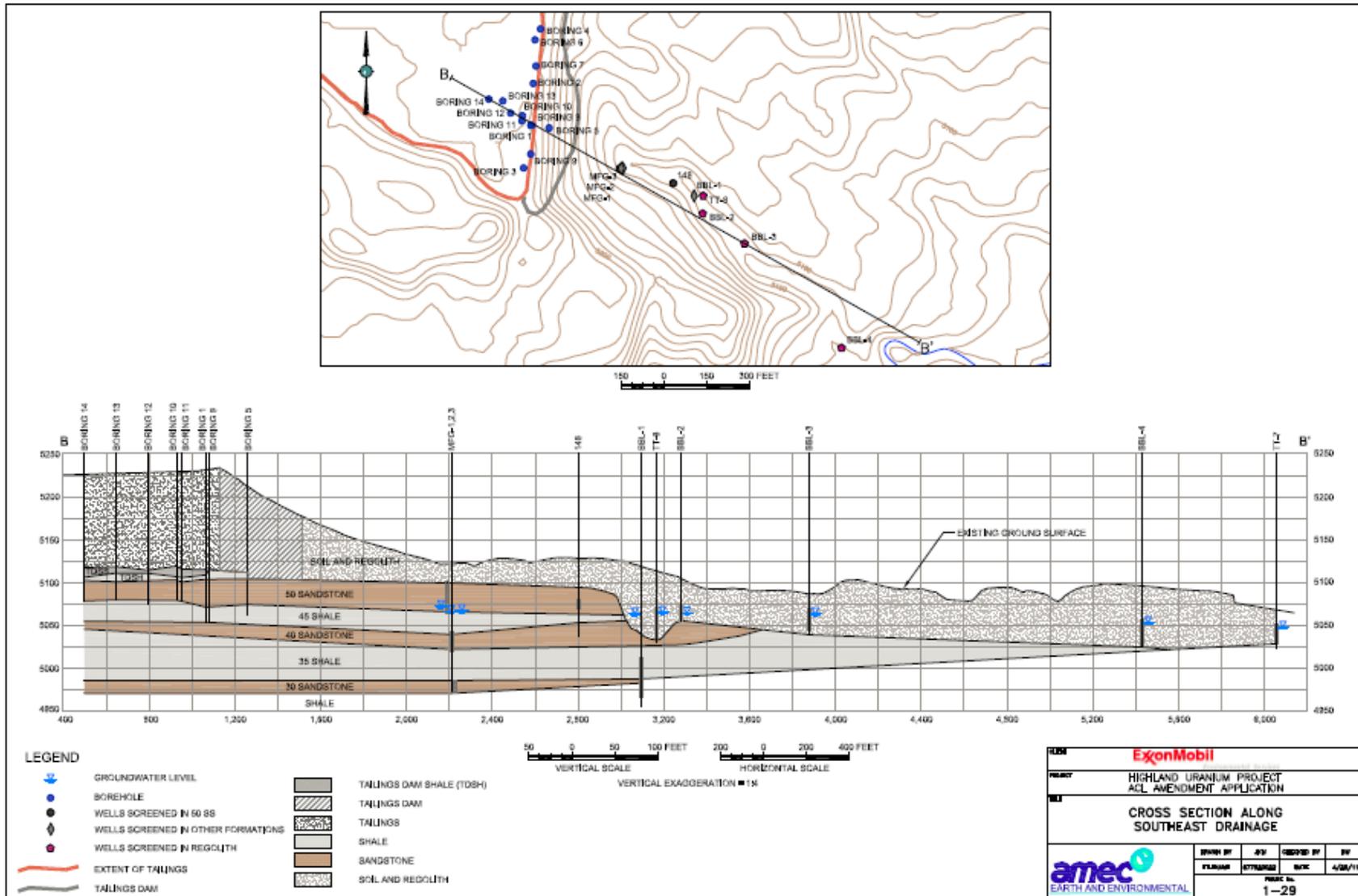
Highland RAIs – Pre-Mining Groundwater Conditions



Highland RAIs – Isopach of TDSS - 2010



Highland RAIs – Southeast Drainage Cross Section



Highland RAIs – Geology

Geo1: Provide additional information regarding the location of all “known” boreholes (wells and investigation boreholes) on the site and neighboring mine sites used to develop the geologic framework model discussed in the LAR (EMES 2011, Section 1.2.2.6). In addition, clarify whether the geologic framework model (EMES, 2011, Section 1.2.2.6) changed any previously assumed hydrostratigraphic conceptualizations that are used as inputs to other models. The licensee must also state whether the 3-dimensional (3D) geologic framework model provided any additional or new insights or a change in the understanding of the lateral extent and continuity of the strata in the LTSB. If so, these insights should be clearly described in the LAR. Additionally, the impact of these insights on the hydrogeological and geochemical processes should be discussed.

- All information used to develop the 3-D geologic model will be provided
- The model was not specifically intended to provide additional insight or changes in interpretations of hydrostratigraphic units, and was not used in this manner

Highland RAIs – Geology

Geo2: Provide northing and easting information in LAR Figure 1-8 (EMES, 2011).

Geo 3: Provide the location of the boreholes and well data in Figures 1-9 through 1-12 in the LAR (EMES, 2011).

- Northing and Easting information will be provided
- The cross sections presented in Figures 1-9 through 1-12 represent output from the MVS model. All information used to develop the MVS model will be provided, as noted in Geo1

Highland RAIs – Geochemistry

GC-1: Provide data and assumptions associated with modeling of surface reactions involving the sorption and desorption of uranium, selenium, nickel, and chromium. The data should include: (i) the reactions postulated; (ii) the equilibrium constants assumed and the basis for those constants; and (iii) the MINTEQ database used in the calculations.

- The Minteq.v4 database was used for all modeling calculations and the database will be provided on a CD submitted with the response to the RAIs
- The reactions postulated along with the associated thermodynamic constants will be provided along with a description of model assumptions

Highland RAIs – Hazard Assessment

HAZ1: Provide the bases for the characterization of the alluvial floodplain as ephemeral and that water quality is affected by biological fouling by giardia and fecal coliform bacteria.

- Verification microbiological sampling will be conducted



Highland RAIs – Hazard Assessment

HAZ2: Provide technical bases for the statements made in the LAR (EMES, 2011, Section 2.3.1) about potential future human water uses in the Southeast Drainage watershed that “...all other uses would continue to be protective...” ...and that “once it enters the North Fork Box Creek groundwater system, remains available for all appropriate uses,” and “...resource of the region is in no way impaired.”

HAZ4: Provide the basis for the statement that the proposed ACL for Well MFG-1 in the Southeast Drainage is protective for humans.

- Institutional controls limiting access the shallow alluvial aquifer as a drinking water supply will essentially remove the human exposure pathway

Highland RAIs – Hazard Assessment & Corrective Action

HAZ3: Clarify whether the bases for the proposed ACL for Well 175 included consideration of ecological hazards, and if so, provide the information or references that support the no environmental hazard determination for the proposed Well 175 ACL.

CA1: Provide additional information or bases for not evaluating corrective actions for the uranium exceedance at Well 175.

- Ecological hazards were considered in development of the proposed ACL for Well 175 (Section 4.2)
- Current uranium concentration at Well 175 = 0.037 mg/L
- Concentration in Highland Pit Lake ~3.3 mg/L
- Very low and decreasing flows from Well 175 into 3.9 billion gallons
- Ecological risk assessment concludes that the pit lake does not pose unacceptable risk to aquatic and nearby terrestrial biota

Highland RAIs – Corrective Actions

CA2: Provide the reference for the 2009 survey of land prices that supports the licensee's corrective action assessment.

- Letter from Gary T. Casper to Rebecca Bilodeau regarding land appraisal for Converse County, Wyoming is provided as Exhibit 7 in Appendix E of the 2011 LAR

Highland RAIs – Proposed Action & Land Use

PA-1: Provide additional characteristics of the area enclosed within the current and proposed long-term surveillance and monitoring (LTSM) boundaries.

LU-1: Clarify the current land subsurface ownership status and the land within the proposed LTSM boundary at the Highland site.

LU-2: Confirm site features and the locations of the nearest residence(s) from the Highland site.

- Clarification of 'site features'
- Requested information will be provided

Highland RAIs – Impact on Migratory Birds

LU-2 RAI: Impact of pit lake on migratory birds.

- RAI related to additional data needs to support risk assessment
- A work plan work will be submitted to collect additional data to further assess potential risks to migratory birds

Highland RAIs – Summary

Path Forward:

- General Responses
- Flow path to north
- Hydrogeology
- Migratory Birds
- Land Ownership