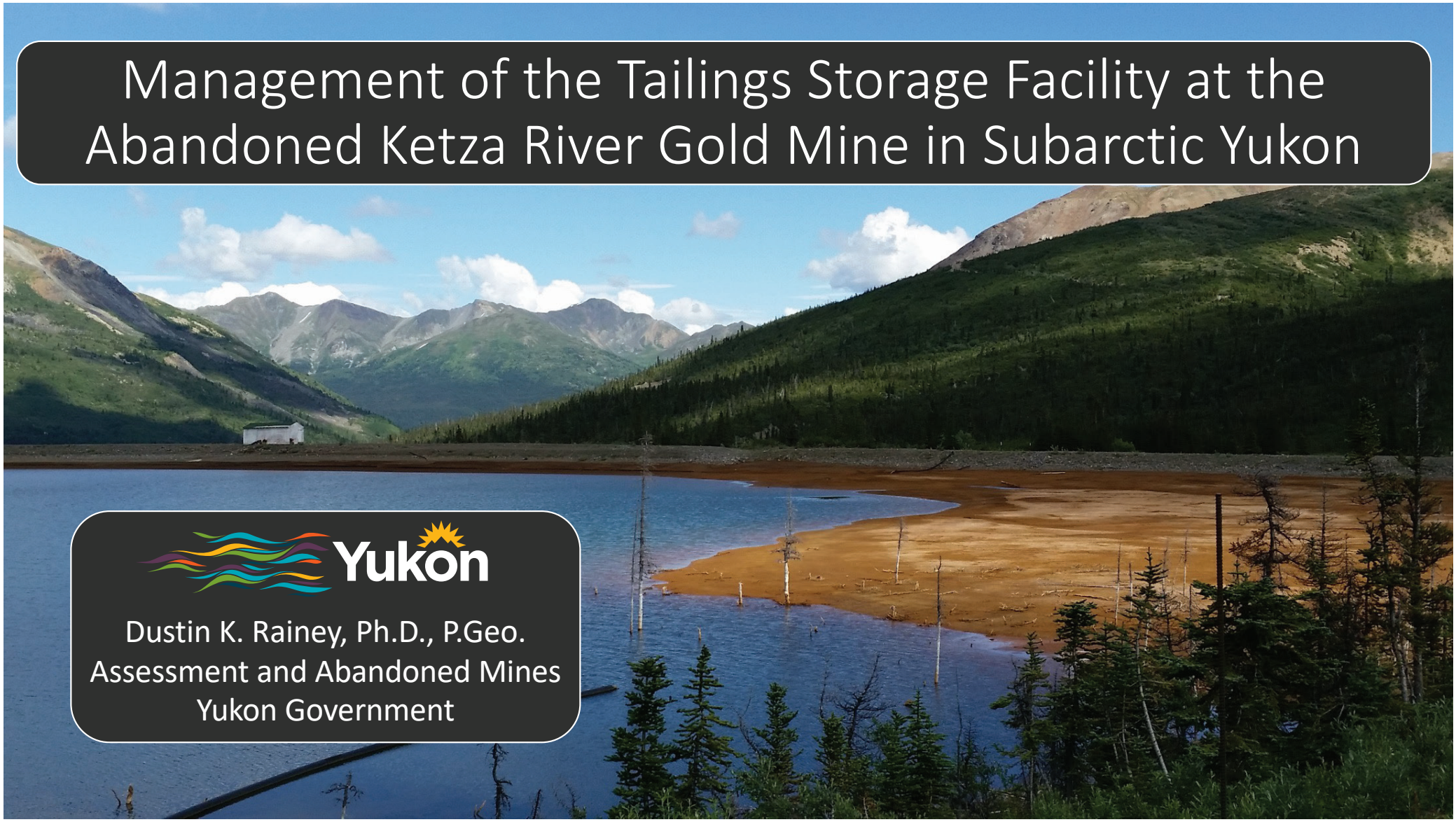
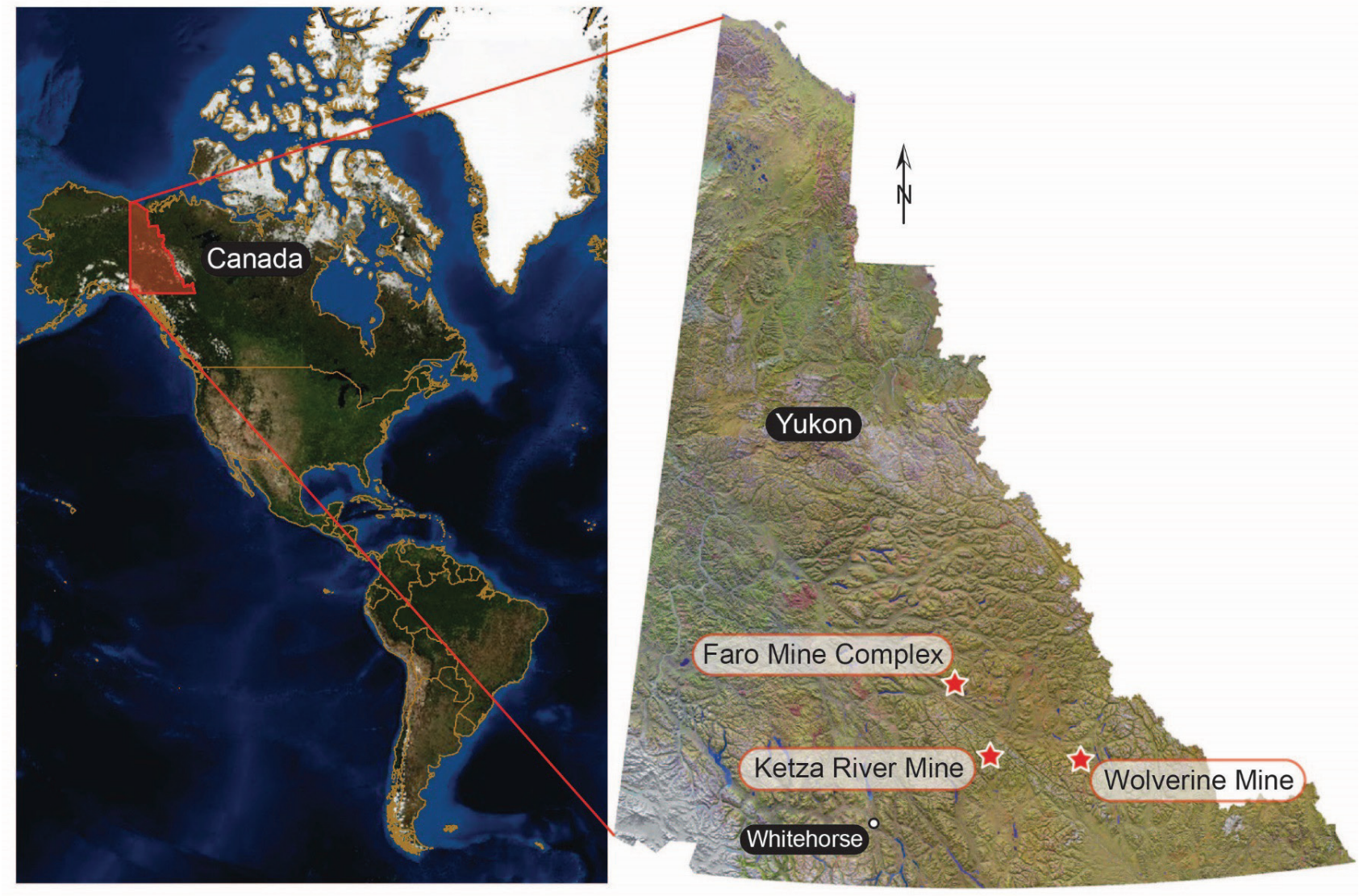
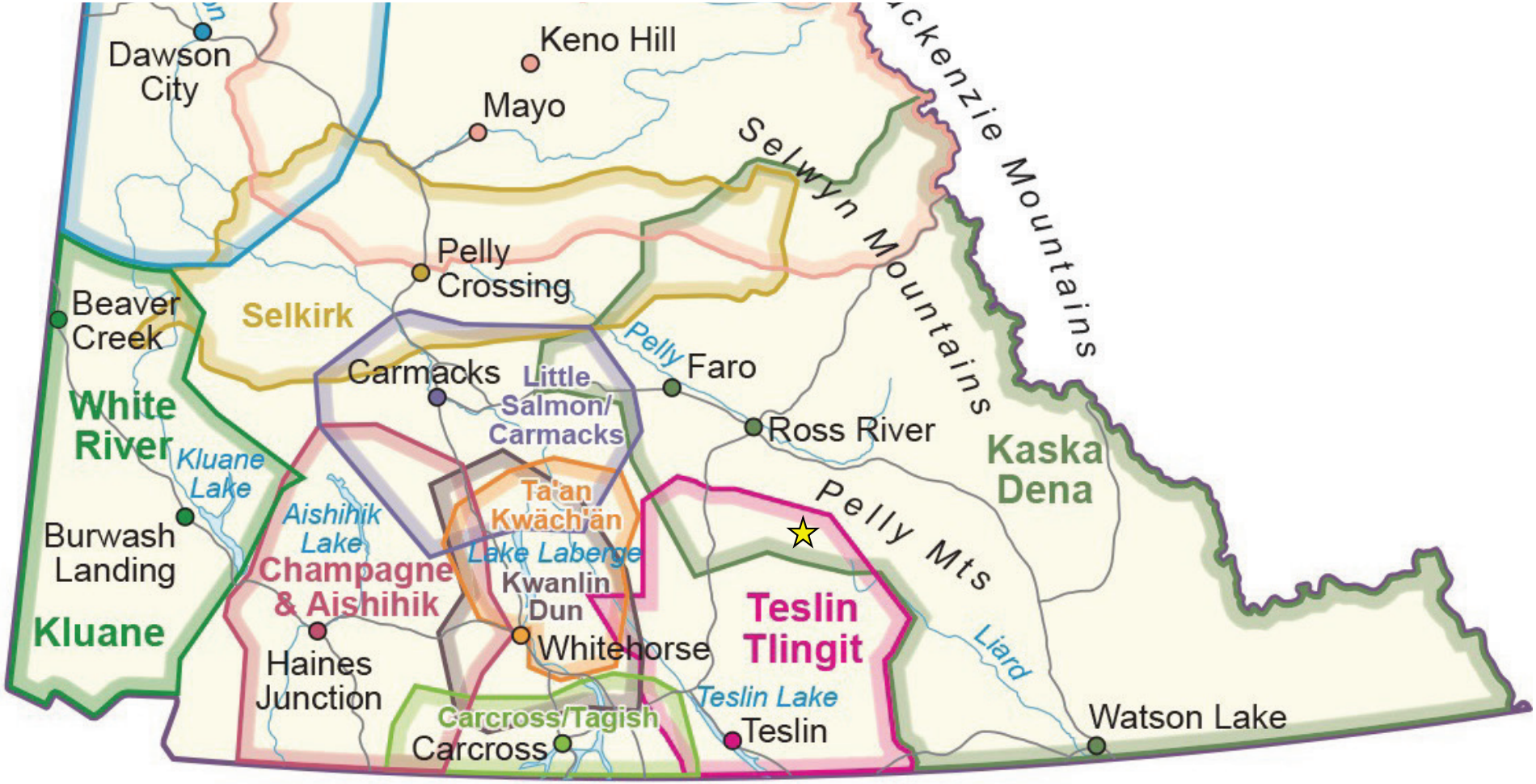
Management of the Tailings Storage Facility at the Abandoned Ketza River Gold Mine in Subarctic Yukon



Dustin K. Rainey, Ph.D., P.Geo.
Assessment and Abandoned Mines
Yukon Government


Canada
N
Yukon
Faro Mine Complex
Ketza River Mine
Wolverine Mine
Whitehorse


Dawson City
Keno Hill
Mayo
Selwyn Mountains
Mackenzie Mountains
Pelly Crossing
Beaver Creek
Selkirk
Pelly
Faro
Carmacks
Little Salmon/ Carmacks
White River
Kluane Lake
Ross River
Kaska Dena
Ta'an Kwäch'än
Aishihik Lake
Lake Laberge
Burwash Landing
Champagne & Aishihik
Kwanlin Dun
Pelly Mts
Kluane
Haines Junction
Whitehorse
Teslin Tlingit
Liard
Teslin Lake
Carcross/Tagish
Carcross
Teslin
Watson Lake

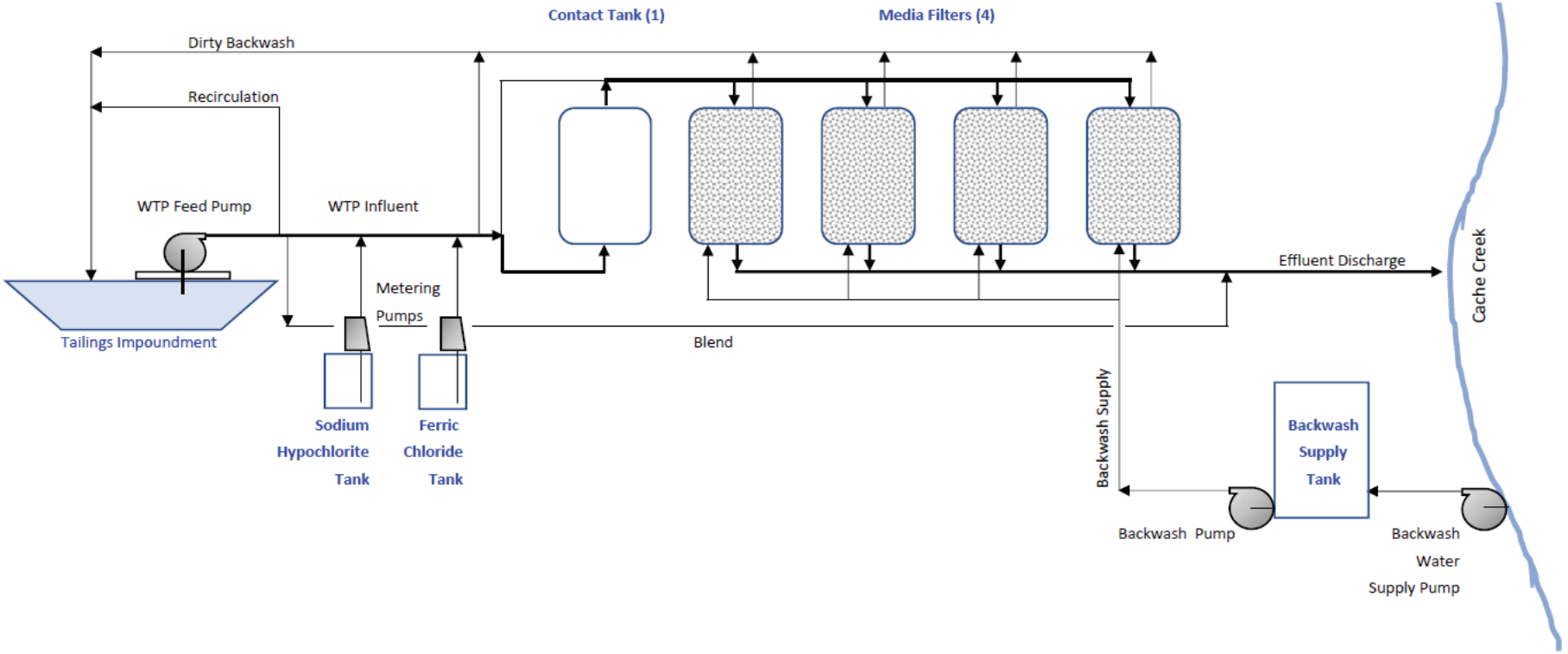

Camp, Office, Generators
Water Treatment Plant
Diversions
Diversions
Pumphouse
Exposed Tailings
Pond
North Dam
South Dam
Seepage Collection (off)
Emergency Spillway

Spring 2015
Site Abandonment

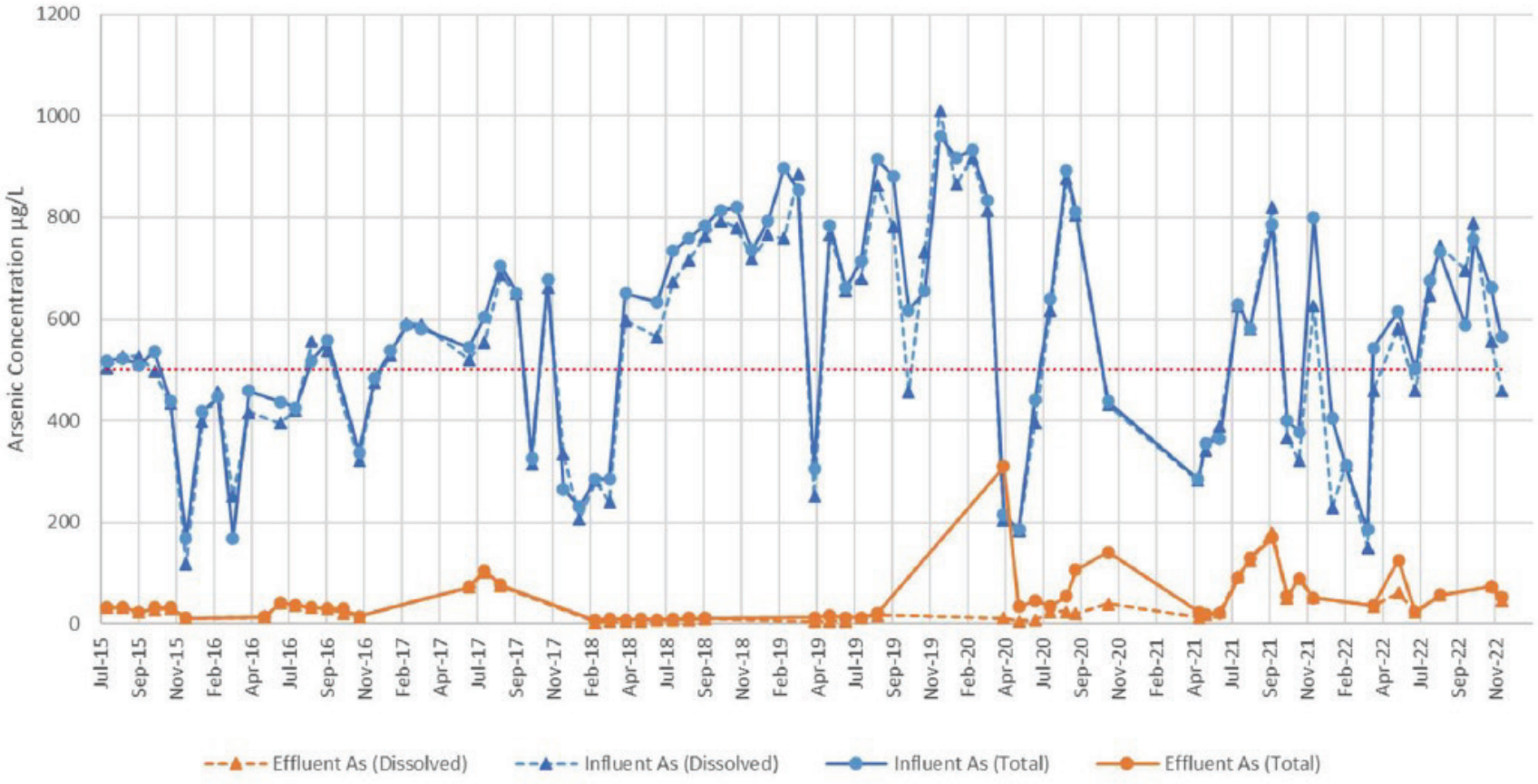
Site Operations


adedge
.clean water

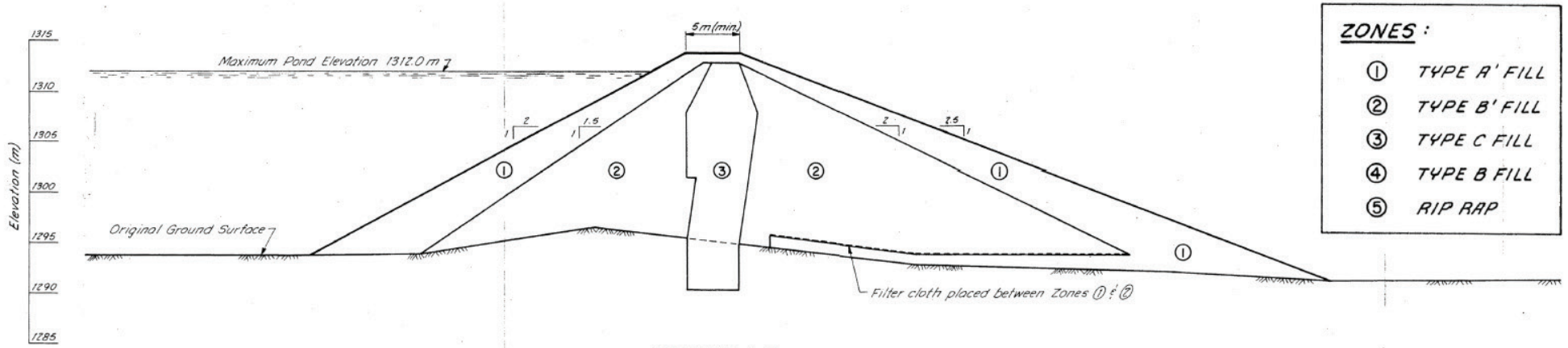
Arsenic water treatment plant process flow diagram



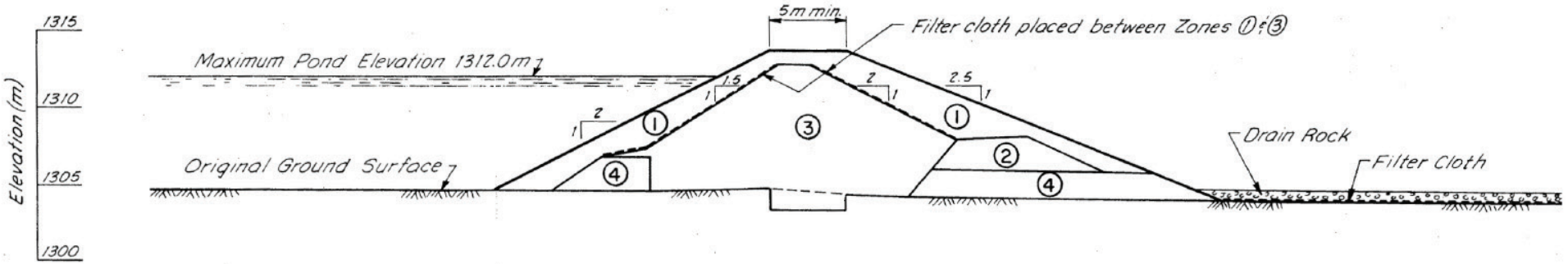
Concentration of arsenic in water treatment plant influent and effluent



Geotechnical Conditions



SECTION A-A
SCALE 1:250



SECTION B-B
SCALE 1:250

Appendix C - Project Risk Register

The consequence and likelihood criteria used to evaluate the risk class are from the National Contaminated Sites Program (NCSP) Integrated Risk Management Procedure as of November, 2018.

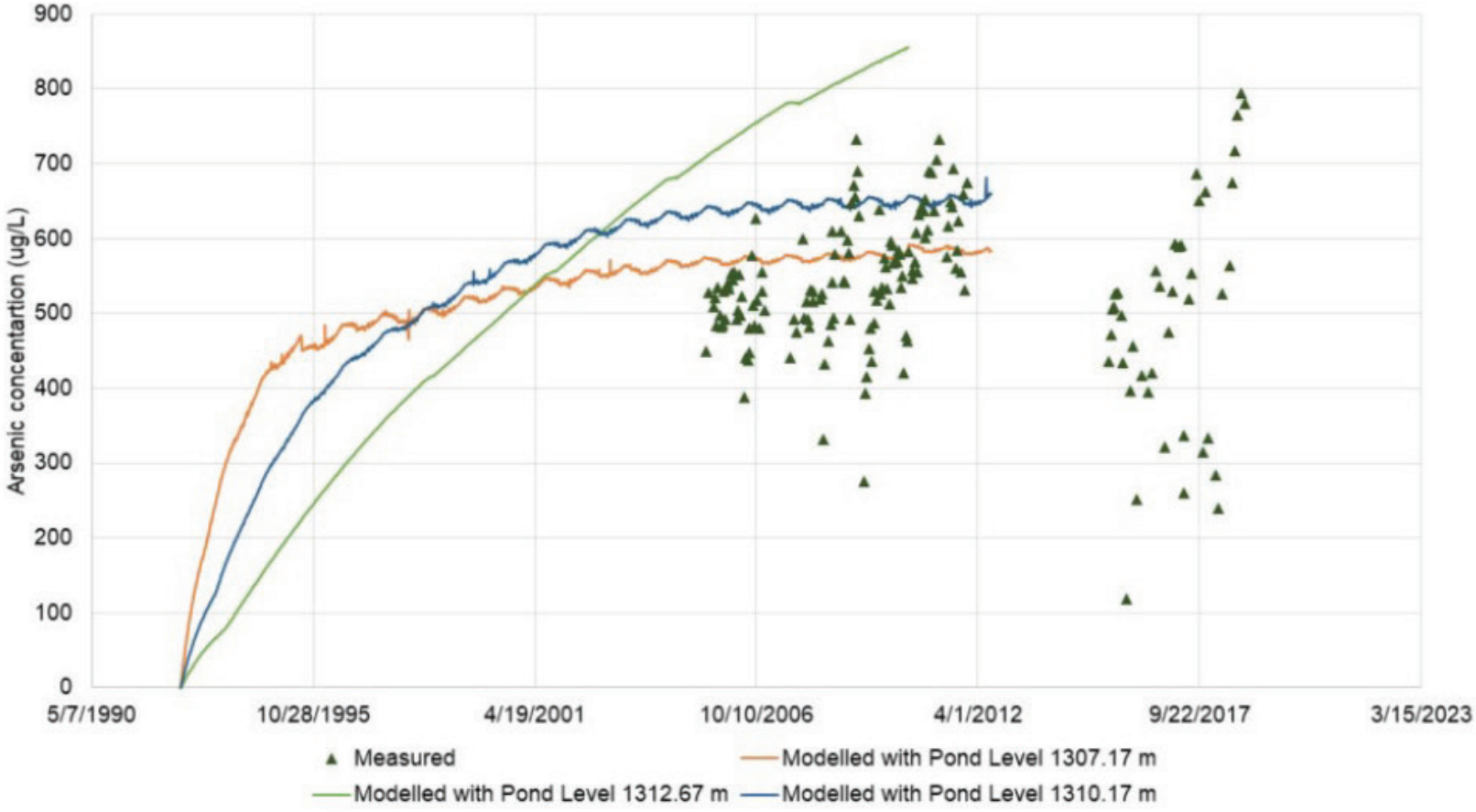
2020/2021 Risk Assessment Ketza River Mine Site										
Group Of Element Type	Group Of Element	Event	Current State Notes	General Mitigation	Measures to Consider	Consequence Type	Severity	Likelihood	Risk Class	Reference PWIPs
Tailings and Sediments										
	Tailings Impoundment Area									
		Birds and wildlife feeding on Tailings Storage Facility pond leads to animal fatality	- Tailings Impoundment Area is uncovered; however, ice covers the area for approximately 6 months/year. - YESAA 2010 Decision document "make best efforts to deter wildlife and birds from using water in the tailings pond or adjacent downward riparian area." Concerns were raised by YESAB about the limited available information to which wildlife and birds use the project area. - No studies have been done on animal mortality rates in the area.	- Care and maintenance contractor monitors tailings impoundment area daily and reports on wildlife. - Care and maintenance contractor has been asked to report on any wildlife (including birds) seen at the TSF to determine if there is a need for detterents.	- If significant birds are noted to be landing on and possibly feeding in pond, then discuss mitigation measures. - Study on animal mortality rates in the area	Environmental Impacts	Minor	Unlikely	Low	1.1
Open Pits										
	Open Pits									
		Rock fall in open pit leads to fatality.	- Eight historical open pits (Ridge, Break-Nu, QB, Knoll, Tarn, Gully, 1430E, 1430S). - Open pit stability is considered not to be a significant issue (EBA 2016).	- Monitoring open pits (specifically break nu) during geotechnical inspections - Signage at the beginning of the road discouraging access		Human Health & Safety	Critical	Very Unlikely	Moderately High	1.1
		Deterioration of Tarn Pit water quality leads to seepage/discharge of contaminated water.	- There is very little geochemistry data available characterizing the historical pit walls, associated waste rock piles and leachate produced from within the historical open pits (EBA 2016).	-Surface water monitoring -AMP is being developed	- Carry out a geochemical assessment of the pit walls and waste rock piles.	Environmental Impacts	Minor	Unlikely	Low	6.1; 6.3
						Consequence Costs	Low	Unlikely	Low	
Underground										
	Portals									
		Public access to openings leads to fatality.	- 1430, 1510 (2), 1550 Portals appear blocked off by plywood (EBA, 2016 pictures). - Two additional portals may be located in the Break-Nu but the specific portal locations are unknown.	- Mine site is monitored by care and maintenance contractor. - Access to portals is boarded up - Signage has been implemented - C&M Contractor inspects portals on a regular basis to check for intrusion and required repairs.		Human Health & Safety	Critical	Very Unlikely	Moderately High	1.1
		Drainage from adit leads to discharge of contaminated water into Subsidiary Creek.	- There is very little geochemical characterization data or water quality data available to allow for evaluation of leachate potential being generated from portals or underground workings (EBA 2016). - Most likely pathway is that this water would report to the TSF	- Monitoring was added to EDI's scope in 2018/2019 for flow rate and water quality from adit - Monitoring of water quality and flow rates.		Environmental Impacts	Minor	Unlikely	Low	6.1; 6.3

Emergency Spillway Inflow Design Flood Routing Analysis Results

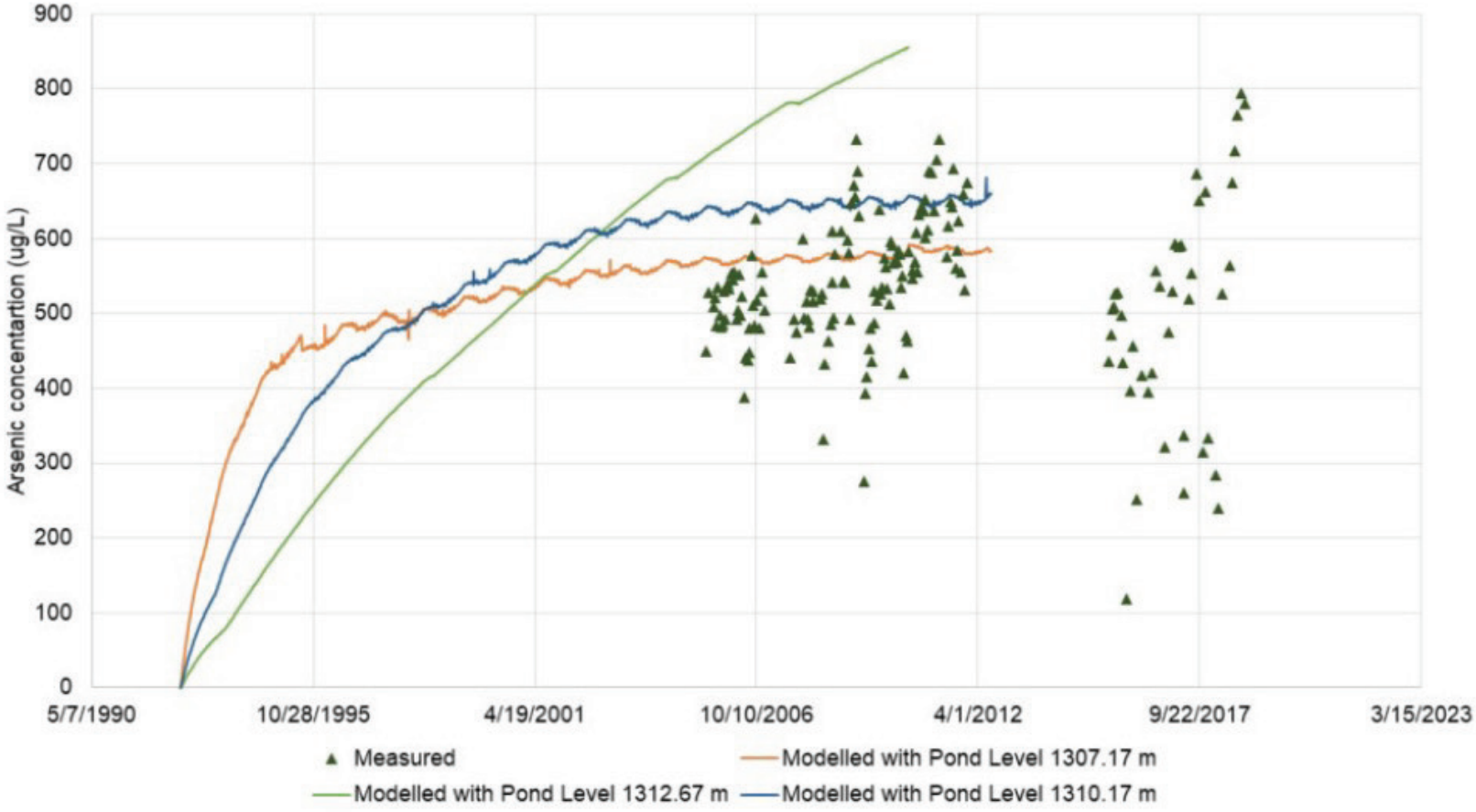
Parameter (Units)	Value
Inflow Design Flood Return Period	1/3 between 1/1,000 and probable maximum flood
Watershed Area (km^2)	6.9
Dam Crest Elevation (m)	1313.53
Spillway Width (m)	4
Spillway Invert Elevation (m)	1312.67
Initial Water Level (m)	1310.17
Peak Inflow (m^3/s)	32.7
Peak Outflow (m^3/s)	7.3
Spillway Surcharge Elevation (m)	1313.32
Water Depth Above Spillway Invert (m)	0.65
Freeboard Below Dam Crest (m)	0.21

Geochemical Conditions

TSF observed and modelled dissolved arsenic concentrations

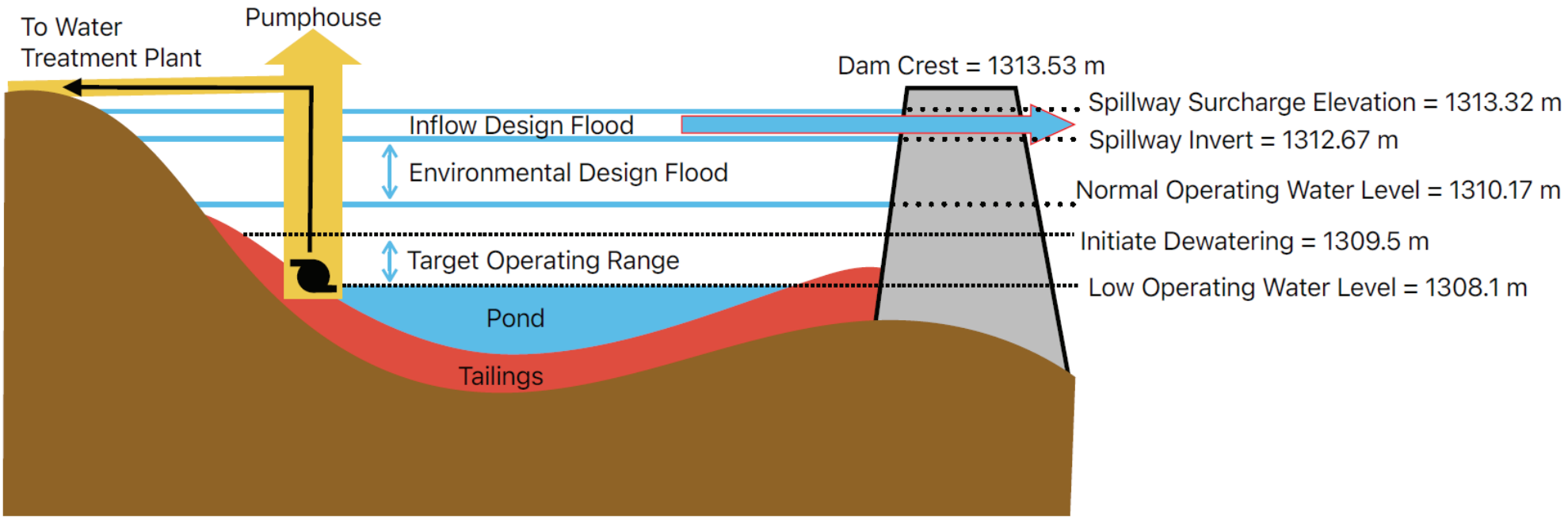


Studies indicated that the primary input of D-As was by fluctuation of the water levels at the surface of the exposed tailings. Fluctuation of the pond water levels increases dissolution and flushing of arsenic from tailings that were naturally oxidized prior to exploitation by mining. Due to the lack of sulphides in the tailings, restricting air entry into the surface of the tailings does not affect sulphide oxidation. Arsenic leaching is correlated to pond size, where a larger pond contacts a greater proportion of the tailings and can flush larger amounts of arsenic as the pond is seasonally lowered. By maintaining the pond at consistently lower elevations year-over-year, the smaller pond exhibits less fluctuation in water levels, therefore reducing the proportion of the tailings that are regularly flooded then exposed.

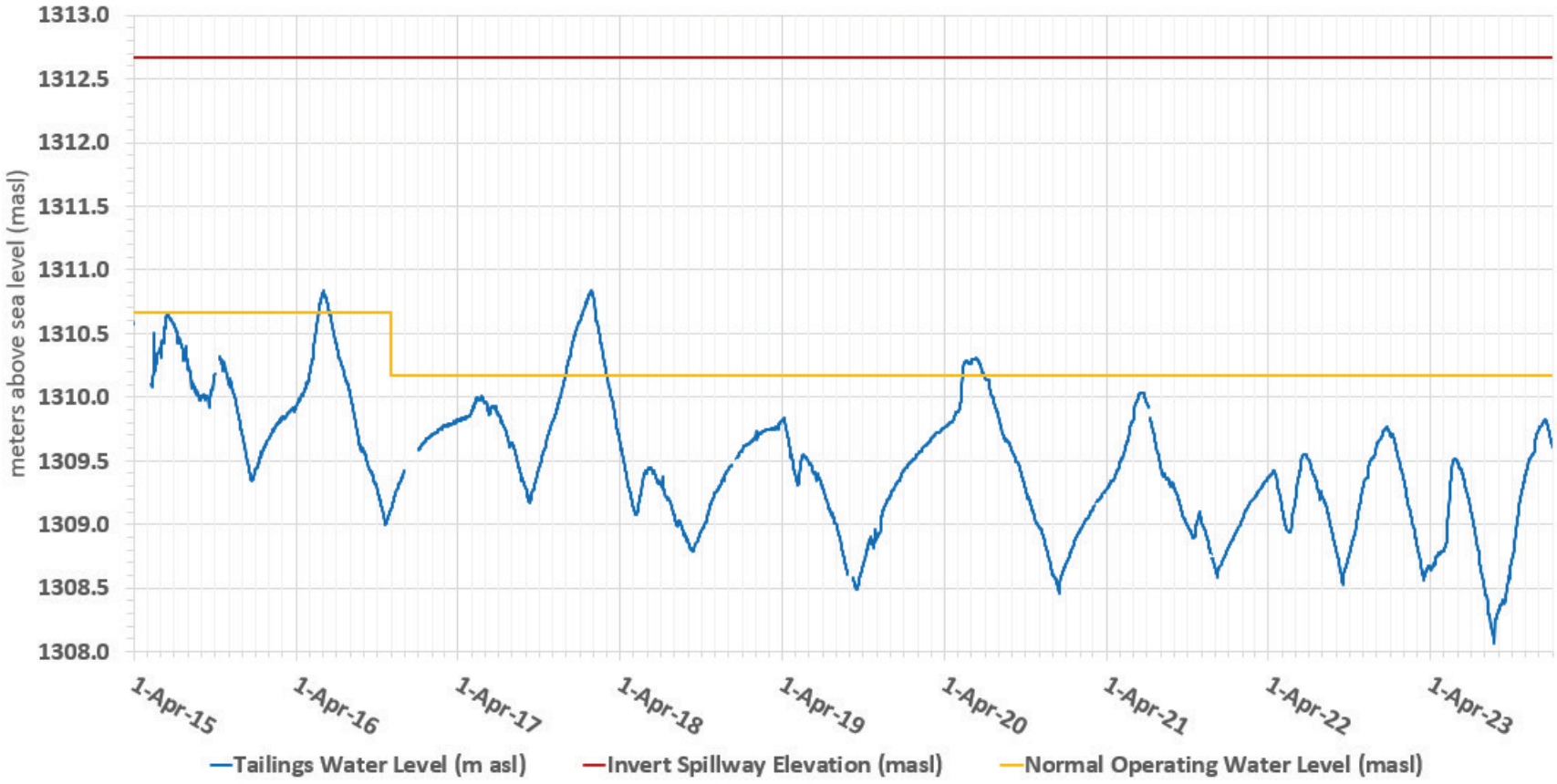


TSF Operating Conditions

Tailings Storage Facility Operations



Tailings Storage Facility pond water elevations




Yukon