Report of the Independent Review Panel

Design Document for Expansion of Yankee Doodle Tailings Impoundment

Montana Resources, LLP
Butte Montana

November 20 2017

Panel Members:

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1. INTRODUCTION

1.1 Panel Charge

To obtain approval for expansion of the Yankee Doodle Tailings Impoundment (YDTI), the Montana Code Annotated (MCA) requires the owner Montana Resources LLP to appoint an Independent Review Panel (IRP) to undertake a review of the Design Report prepared for the expansion. The Montana Department of Environmental Quality (DEQ) approved the membership of the Independent Review Panel prior to the start of the review. The charge of the Panel is to provide an evaluation indicating whether the proposed YDTI expansion is designed, and will be operated, monitored, and closed using the most applicable, appropriate, and current technologies and techniques practicable, given site-specific conditions and concerns.

Section 82-4-377 of MCA requires that the Panel review the design document, the underlying analysis and assumptions for consistency with code requirements. The Panel is also to assess the practicable application of current technology in the proposed design. The Panel has formed its opinions on the basis of: (i) consideration of the design concepts as presented in the Design Report, (ii) site investigations undertaken to further the understanding of the geologic, geotechnical and hydrogeologic conditions of the surficial and bedrock units in the area, (iii) site investigations undertaken to further characterize the geotechnical properties of the existing YDTI embankments and tailings deposit, (iv) analyses undertaken to demonstrate the expansion will meet the required factors of safety for embankment stability for both static and ground motion due to earthquake loading conditions, and (v) measures to be implemented in the expansion to contain process waters and tailings. The Panel has evaluated the reasonableness of the concepts, assumptions, and assessments contained in the Design Report, but it was considered outside the scope of the Panel to independently reproduce design calculations.

In accord with the Design Report, elevations referenced in this report are based on the ACC (Anaconda Copper Company) datum. The raise of the North-South embankment and the East-West embankment of the YDTI to El. 6450 ft. has been previously authorized. The permit amendment application being submitted by MR is requesting approval to construct the West Embankment to El. 6450 ft. and to operate the West Embankment Drain (WED). Construction of the WED has already proceeded under separate authorization. The raise to El. 6450 ft. will provide for approximately 12 additional years of mine life (to year 2031), storing an additional 300 Mt of tailings. The IRP takes the view, consistent with that envisioned in the Design Report, that the Panel review must include consideration of the YDTI as a single structure and not just the elements requiring permit amendments to proceed. An approved plan exists for the management of waste rock to be produced through this time period.

In this report, MCA code requirements are indicated by “red square bullets” while “black circular bullets” are used to identify Panel observations. IRP requests that follow on from the review of the Design Report are highlighted in italic.

1.2 Activities of the Panel

Montana Resources LLP (MR) made a decision to engage with the IRP while site characterization and data analysis was ongoing to support the preparation of the Design Report. The Panel favored this approach; as it provided the opportunity for discussion of site investigation requirements, findings from the site investigation, design concepts, and alternative tailings management strategies with the design team prior to completion of the Design Report.

Four meetings were held during the course of the Panel's activities. Participants included Montana Resources LLP, Knight Piesold (KP), Hydrometrics (hydrogeological consultant to MR), and the Panel. Mr. Ken Brouwer of KP is the Engineer of Record for YDTI (since 2015) and Design Consultant for the proposed expansion of the facility.

Meeting one was held in Butte Montana from July 6 - 9, 2015. The visit afforded the opportunity to view the YDTI (embankments, tailings operations, water management, hydrogeologic setting and seepage) and Continental Pit, and to receive a series of technical presentations covering site history, proposed designs for the expansion, site investigation plans and early results, and hydrogeology. Representatives of the Montana Department of Environmental Quality (DEQ) attended the closeout meeting.

Meeting two was held in Vancouver, British Columbia from November 23 - 25, 2015. The intent of this meeting was to provide the opportunity for the Design Consultant to present to the IRP a progress report on the development of the various components of the Design Report, and to review findings from site investigation programs related to the existing embankments and foundations, the tailings properties, and West Ridge hydrogeology.

Meeting three was held in Butte Montana from May 10 - 13, 2016. Presentations were given by KP and Hydrometrics to update the IRP on progress toward completion of the Design Report. This visit also enabled the Panel to return to the West Ridge to discuss the on-going drilling program occurring there to refine the understanding of the structural features and groundwater flow system in the bedrock that forms the ridge. It was also possible to inspect the initial stages of construction of the West Embankment Drain. Representatives of the DEQ joined this field tour.

An initial draft of the Design Report (Rev. 0 encompassing 10 separate reports) was distributed to the Panel over the period from December 23 2016 to January 27 2017. The Rev. 0 Design Report envisioned an embankment crest of El. 6500 ft.

Meeting four was held in Vancouver on January 31 2017, where the Panel presented its observations and preliminary conclusions on the content of the Design Report. Montana Resources LLP, KP, Hydrometrics, and DEQ (by Webex) attended the meeting. Also in attendance were representatives of Atlantic Richfield Company (ARCO), owners of the YDTI prior to Montana Resources LLP. A number of the design reports were re-issued as Rev. 1 documents in response to information requests from the IRP at the January meeting.

Subsequent to the January 2017 meeting, Montana Resources made a decision to re-cast the Design Report to support a permit amendment to operate the YDTI to an embankment crest elevation of 6450 ft. The Panel received the Rev. 2 documents that presented that design in the period between June 30 and September 7, 2017. The Panel also received a letter report that KP prepared in response to comments made by consultants engaged by ARCO and Remediation Management Service Company (referenced here as the ARCO report) to evaluate environmental conditions and risks associated with the YDTI for an embankment crest at the 6500 ft. level. A copy of the ARCO report was included with KP's Design Report. The Panel prepared its final report from September to November 2017.

1.3 Organization of the IRP Report

The IRP report is structured in terms of the nine KP reports and one report by Hydrometrics that, taken together, constitute the Design Document. The last section of this report includes IRP comments on KP's response to the ARCO report.

- Alternatives Assessment
- Design Basis Report
- Site Characterization
- Stability Assessment
- Water Management
- Hydrogeology of West Ridge
- Design of West Embankment Drain
- Construction Management Plan
- Dam Breach Risk Assessment
- Reclamation Overview
- Engineer of Record Response to ARCO Report

2. ALTERNATIVES ASSESSMENT

Tailings management at MR is based upon discharge of slurry tailings to the YDTI. A single point discharge located near the southeastern corner of the East-West Embankment (Station 8+00 West) has been in place for much of the past YTDI operations. When examining alternative tailings strategies, the Panel considers it important that the long history of operating experience at YDTI be acknowledged as an important factor in the evaluation (construction beginning in 1963). In addition, the average annual water deficit at the site, and the availability of fresh water imports from Silver Lake on an as-needed basis, are viewed as important factors to consider in the evaluation of tailings management alternatives.

The MCA requires an evaluation indicating:

- The proposed tailings storage facility will be designed, operated, monitored and closed using the most applicable, appropriate and current technologies and techniques practicable, given site specific conditions and concerns.

KP undertook a broad-based study of tailings alternatives. The approach adopted is similar to other alternative assessments that members of the IRP have reviewed for other mine projects. For each tailings alternative, a five-factor rating system was adopted to rank the alternative. The factors considered were safety, technical execution, environmental impacts, economic factors, and closure considerations. The Panel accepts as reasonable this suite of factors for evaluation of the alternatives and the scoring system.

KP set out a train of logic for the alternative assessment that can be summarized as a five-step evaluation (A-E below). The highest-ranked alternative at each decision point (as ranked by KP) is highlighted in bold text.

A	B	C	D	E
Location	Tailings type	Beach development	Seepage control	West Embankment Dam design
on site	**slurry**	single point		no zonation
off site	thickened tailings	**multipoint**	**West Ridge**	core/cutoff
	filtered tailings			**drain (WED)**
	Berkeley Pit			

The Panel observes:

- The most viable option for additional tailings storage is a site located in the catchment within which YDTI is located. Importantly, sites located off-site would require substantial disturbance of land currently undisturbed, in comparison to on-site options.

- No advantage is apparent to the Panel in the use of thickened tailings at the MR operation, with placement in the YDTI, when compared to slurry tailings. Significant costs are added without substantive off-setting benefits.

- MR does not own a sufficient land area in the catchment upslope from YDTI to develop a filtered tailings storage facility large enough to meet project requirements. A stack of filtered tailings (eventually up to 550 feet high), located between the existing YDTI and Continental Pit, and in close proximity to the rim of Berkeley Pit, is not viewed by the Panel as a suitable location for filtered tailings storage. Tailings produced from mining the Continental Pit are potentially acid generating, which would require engineering controls to reduce rates of sulfide mineral oxidation and seepage controls to manage contact waters.

- It is understood there would be complex environmental and legal issues involved in obtaining agreements and permits for disposal of tailings in Berkeley Pit. The Panel expects there would be considerable uncertainty in developing a firm time line for resolving these issues. Additional tailings storage capacity is required by 2020 to allow uninterrupted mining operations in Continental Pit.

- With respect to an expansion of the existing tailings facility, multipoint spigot discharge enables better beach formation that will result in the water pond located well away from the embankments, reducing geotechnical risks associated with pond contact with the embankments. A multi-spigot system provides for much greater control of pond location relative to the single-point discharge system used in the past. This strategy also adds benefit in reducing seepage flows to the WED and enhancing hydrodynamic containment, by creation of a wide beach in front of the West Embankment.

- The West Embankment Drain is the most applicable and appropriate technology for controlling seepage at the West Ridge. This design emphasizes source control (hydrodynamic containment) rather than the other alternatives considered; which rely upon interception of contact water using extraction wells.

The Panel agrees with the analysis at each decision point (A to E) in the selection process, leading to the conclusion that the most viable alternative for the additional volume of tailings storage required is to raise the YDTI from El. 6400 ft. to 6450 ft.

3. DESIGN BASIS REPORT

The Design Basis Report presents the key criteria that underpin the design of a raise of the YDTI to a crest elevation of 6450 ft. The current crest elevation is 6400 ft., with the pond elevation in September 2017 at elevation 6345 ft. The Design Basis Report includes consideration of issues related to the local climate, the design of the embankment raise, including freeboard requirements, and selection of the design earthquake.

3.1 Climate

MCA requires consideration of a design storm event for operation and closure conforming to current engineering best practice for the type of facility proposed. In particular, the MCA requires:

- A rationale for the selection of the design storm event
- The magnitude of the design storm event
- The magnitude of the runoff generated by the design storm event
- Consideration of the dynamic nature of climatology.

The design basis for the existing YDTI, and the operational plan for the proposed embankment raise, is to provide the capacity to contain the PMF and meet freeboard requirement. The Panel's focus in reviewing the selection of the inflow design flood is on the total runoff volume and not the critical runoff flow rate obtained from the runoff hydrograph.

The Panel observes:

- Procedures used for estimation of site precipitation, sublimation of the snowpack, and evapotranspiration are based on common practice and local data.

- Procedures used for estimation of extreme 24-hour precipitation events (for 2 year to 1000 year return periods) are based on a standard statistical approach (Log-Pearson Type III frequency distribution), using the long rainfall record for Butte. The rainfall estimates for the different return periods were compared with a regional analysis of extreme precipitation events in Montana, published by the USGS (1997). The higher of the two values for each return period was selected for design. The Panel accepts the basis for selection of the design storm event.

- The Panel concurs with the decision to adopt the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) professional practice guideline when accounting for the influence of climate change in flood assessments, which is to increase the estimated precipitation totals for each return period by 15%.

3.2 Extreme Precipitation Events

MCA requires consideration of a design storm event for operation and closure conforming to current engineering best practice for the type of facility proposed, that includes:

- Determination that the proposed expansion meets the minimum requirements in MCA to manage storm or flood events. The minimum storage requirement is based on the maximum operating water level, plus the PMF, with sufficient freeboard for wave action.

MR chose to adopt the code requirements for evaluation of a new tailings facility, rather than the option applicable for a facility expansion. The Panel concurs with this approach.

The Panel observes:

- Estimates of the magnitude of the PMP event were derived from PMP maps provided in Hydrometeorological Report No. 57 (Pacific Northwest States), an accepted approach in Montana for PMP estimation for high hazard dams. Consideration was given to recommendations contained in the recent report by

the Montana Extreme Storm Study Group (2016). That report accepts HMR57 for use at existing dams and suggests consideration be given to development of a site specific PMP for a new facility. KP concluded that derivation of a site-specific PMP was not warranted, as the estimated volume based on HMR57, in combination with a site-specific snowmelt event, is already an extremely large event. For closure, a spillway will be constructed to manage extreme runoff events.

- An extreme value probability distribution was applied for estimation of the snow water equivalent of the annual maximum snowpack. Snowpack data for the Moulton Reservoir Snow Survey Station, in the YDTI drainage, was used to estimate the water equivalent snowpack for a range of return periods. The Panel accepts this approach as a reasonable basis for the estimate.

- The Panel concurs with the selection of the PMF event as the 24-hour PMP, with the assumptions of 100% runoff in catchment, the PMP event coincident with melt of a 1:100 year snowpack, and failure of the Moulton Reservoir located in the same catchment as the YDTI. The snowpack was assumed to yield all its water over the same 24-hour period as the rainfall event (25% in first 8 hours, 50% in the next 8 hours, and 25% in the last 8 hours). The magnitude of the PMP event (14.4 inches) is similar to the 100-year return period annual maximum snowpack water equivalent (14.6 inches). Sufficient sensitivity studies on anticipated runoff volumes were conducted to assess the range in uncertainty in runoff volume and support the selection of the PMF event (19,000 acre-ft. during operations).

- The Panel concurs with the decision to adopt the APEGBC recommendation to account for effects of climate change in flood assessments, which is to increase the estimated PMF rainfall volume by 15% for the closure period. This yields an inflow design flood of 20,000 acre-ft. for the PMF for post-closure conditions. The PMF rainfall total was increased to account for climate change, with the 1:100 year snowpack estimate held at the value used for the operational period.

- The Panel accepts the view that, for the twelve year operational period of the proposed expansion, it is not necessary to adjust the estimate of the volume of the PMF for impacts of climate change.

- The Panel accepts the analysis indicating that the design, construction, and operating plan for the YDTI meets the minimum storage requirements for management of extreme flood events during operations.

- The Panel is strongly supportive of the decision to incorporate a post-closure spillway in the design for the YDTI to manage extreme events.

3.3 Design Earthquake

MCA requires:

- An analysis showing that the seismic response of a new tailings storage facility does not result in the uncontrolled release of impounded materials or other undesirable consequences when subject to the ground motion associated with the 1 in 10,000-year seismic event, or the maximum credible earthquake, whichever is larger.

- Adoption of either of the following for an existing tailings storage facility:
  - An analysis showing the proposed embankment configuration meets the minimum design requirements for a new tailings storage facility (the above requirements).
  - An analysis showing the proposed embankment configuration does not reduce the original design factors of safety and seismic event design criteria.

For their analyses, KP developed an analysis based on the minimum design requirements for a new facility and engaged Linda Al Atik and Nick Gregor in 2016 to perform site-specific probabilistic and deterministic seismic hazard analyses for the YDTI. Their report is included in Appendix B of the Site Characterization Report – Rev 2. As described in that report, two significant fault sources are in close proximity to the site; the Continental fault, which intersects the site and has an estimated maximum magnitude (M_{max}) of 6.5, and the Rocker fault located within 10 km of the site with M_{max} of 7.0.

Al Atik and Gregor's deaggregation analyses of the mean seismic hazard data for the YDTI site for the Peak Ground Acceleration (PGA) for the 10,000-year return period found the Continental Fault to be the main contributor. The calculated median and 84th percentile response spectra for the deterministic analysis for the Continental Fault were significantly larger than that for the Rocker Fault. In addition, the deterministic Maximum Credible Earthquake (MCE) spectra exceeded those for the probabilistic 1-in-10,000-year event. Accordingly, the Continental Fault MCE was selected as the design earthquake for analyses. Peak Ground Accelerations (PGAs) were calculated for the North-South Embankment, where the fault is adjacent to the structure (0.1 km distance) and for the maximum section of the East-West Embankment (1.2 km distance). KP summarized the MCE parameters in the following table:

	Probabilistic UHS PSA (g)				Deterministic PSA (g) R_{rup} = 1.2 km		Deterministic PSA (g) R_{rup} = 0.1 km	
Return Period (Years)	475	1,000	2,475	10,000	Median	84th Percentile	Median	84th Percentile
PGA	0.08	0.12	0.20	0.37	0.42	0.78	0.45	0.84

NOTES:
1. Peak ground accelerations are for rock site conditions (Vs_{30} – 760 m/s).
2. Source: Table 6-2 of Al Atik, L. and Gregor, N., 2016 included as Appendix B.

Al Atik and Gregor (2016) also calculated the potential displacement along the Continental fault as a consequence of the MCE event. Median and 84th percentile values for the average displacement on the Continental fault were estimated as 0.51 and 1.44 m, respectively.

The Panel observes:

- MR has chosen to meet the minimum design requirements for evaluation of a new tailings facility, rather than the option applicable to an expansion of a facility. The Panel concurs with this approach.

- KP engaged well-qualified seismic experts to perform the seismic hazard study.

- Although there is uncertainty regarding the potential activity of the Continental Fault, the Panel considers it prudent engineering to assume it is active and agrees with KP's decision to design the YDTI expansion to withstand such an event.

- The Panel accepts the methodology used by Al Atik and Gregor (2016) to develop the design earthquake parameters.

- The Panel accepts the selection of the deterministic MCE as the design earthquake, with the design parameters as: Magnitude Mw = 6.5, median PGA = 0.45 g, 84th percentile PGA = 0.84 g.

- The Panel accepts the estimated displacements along the Continental Fault as: median = 0.51 m and 84th percentile = 1.44 m.

3.4 Embankment Design

The MCA requires:

- A description of the tailings storage facility capacity over time and the estimated ultimate capacity.

- Specifications for impoundment construction, including the specifications for the foundation, abutments, embankment, means of containment and the borrow materials.

The enlargement of the YDTI embankments to crest elevation 6450 ft. will provide storage for an additional 12 years of mine life. The Design Basis Report contains tables that list the storage capacity with respect to time and indicate that at El. 6450 ft., the ultimate capacity will be approximately 860 million tons of tailings plus 25,000 acre-feet of pond capacity.

The Design Basis Report (Rev. 2, June 30, 2017) contains a number of representative design sections for the North-South Embankment, the East-West Embankment, and the

West Embankment. These sections provide details on the structure of both the historic construction of the North-South and East-West embankments, and the proposed raises. Since initial construction in 1963, a variety of methods were used to raise the embankments (downstream construction, centerline construction, a limited amount of upstream construction). More recent additions to the North-South Embankment and East-West Embankments have been raised using centerline construction methods. For the expansion, the East-West Embankment will continue to be raised using centerline methods, the North-South raise will use downstream construction, and the West Embankment will be built in one lift using the downstream method.

The capacity of the raise to El. 6450 ft. is based on a daily production of 50,000 short tons (18 million short tons per year). It is expected that the initial dry density of the deposited tailings will be 85 pcf.

The Panel observes:

- The filling schedule and capacity of the raises are based on experience gained over many years at YDTI. The volumetric capacity of the YDTI is sufficient for the period of design at the planned mine production (to 2031). Staging of embankment raises is expected to be reliable as it is based on considerable past experience.

- Foundation conditions have been adequately considered in developing the embankment design and construction plans.

- Construction materials for the embankments are sourced from the Continental Pit, as for previous raises. Specific controls are in place for the selection of zoned materials used in the West Embankment.

- Drain rock and filter materials were obtained from a quarry east of Butte. The Panel viewed these materials during a site visit and they are of good quality.

4. SITE CHARACTERIZATION

MCA requires:

- A site geotechnical investigation commensurate in detail and scope with the complexity of the site geology and proposed tailings storage facility design.

- The investigation must include a geological model of site conditions and a rationalization of the site investigation process.

4.1 Embankment Foundations

There have been several site investigations completed in the vicinity of the East-West and North-South Embankment, spanning five decades. The investigations were

completed by different engineering consultants using a variety of methods in coordination with the mine operator of the time. More than 30 drill holes were completed and sampled with testing to characterize the foundation materials prior to 2012 when KP became involved in geotechnical aspects of the YDTI. In 2015, KP drilled five sonic holes into the East-West Embankment and two sonic holes in the West Embankment area, all of which penetrated the foundation.

The West Ridge and West Embankment foundations were evaluated with a series of drill holes and test pits. A total of 19 monitoring wells, 21 drill holes, 33 test pits and 26 test trenches were advanced along the West Ridge over a series of hydrogeological and geotechnical site investigation programs conducted between 2012 and 2016.

Alluvium occurs at the bottom of the stream channels in the West Ridge area. It overlies bedrock that is composed of the Butte Quartz Monzonite, cut by many alaskite and aplite bodies of various sizes, shapes, alterations and textures. The bedrock consists of two distinct zones; a weathered or leached zone, and a competent zone. The weathered zone constitutes the uppermost portion of the bedrock immediately underlying the alluvium, where the alluvium is present. The competent zone underlies the weathered zone and is very hard rock.

The Site Characterization Report – Rev 2 contains maps of the locations of the drill holes and test pits and detailed sections that portray the foundation geological conditions as interpreted by KP.

The Panel observes:

- A comprehensive review of historic geologic and geotechnical foundation data was carried out and incorporated within the geologic model for the site.

- The Panel is satisfied with the scope of both past and present foundation investigations. This comment applies to both the field and laboratory investigations.

- The Panel concurs with the interpretation of the data with respect to geometry and characteristics of bedrock and surficial deposits.

4.2 East-West and North-South Embankment Conditions

Extensive drilling, sampling, and testing have been completed to investigate the East-West and North-South embankments, with the most recent being in 2017 when four sonic holes were advanced through the East-West Embankment (three on Section 0+00 and one on Section 12+00W). Based on their review of historic investigation data, and their interpretation of site observations and review of drill logs, KP characterized the embankments as obliquely stratified heterogeneous rockfill structures, and that the

drilling and monitoring confirms the presence of localized perched water levels within the largely unsaturated rockfill embankment.[1]

KP provided preliminary data to the Panel from one of the sonic drill holes completed in 2017 (DH17-01 near the toe of the embankment along Section 0+00) and the referenced drawing was used to illustrate the varied, angular fabric of the structure (Figure 1). Based on their review of the historical construction sequences, KP interpreted the complex orientations of the layers in the embankments as being further amplified by the construction of multiple embankments with upstream and downstream sloping layers and basal layers of cobbles and boulders. The 2017 site investigation program incorporated downhole geophysical testing (P-wave and S-wave suspension logging). Future site investigation programs may incorporate this technique provided the 2017 data is valuable. Complete results from the 2017 site investigation program are anticipated to be available before the end of the year. MR plans to install another set of boreholes on a second transect through the East-West Embankment in 2018.

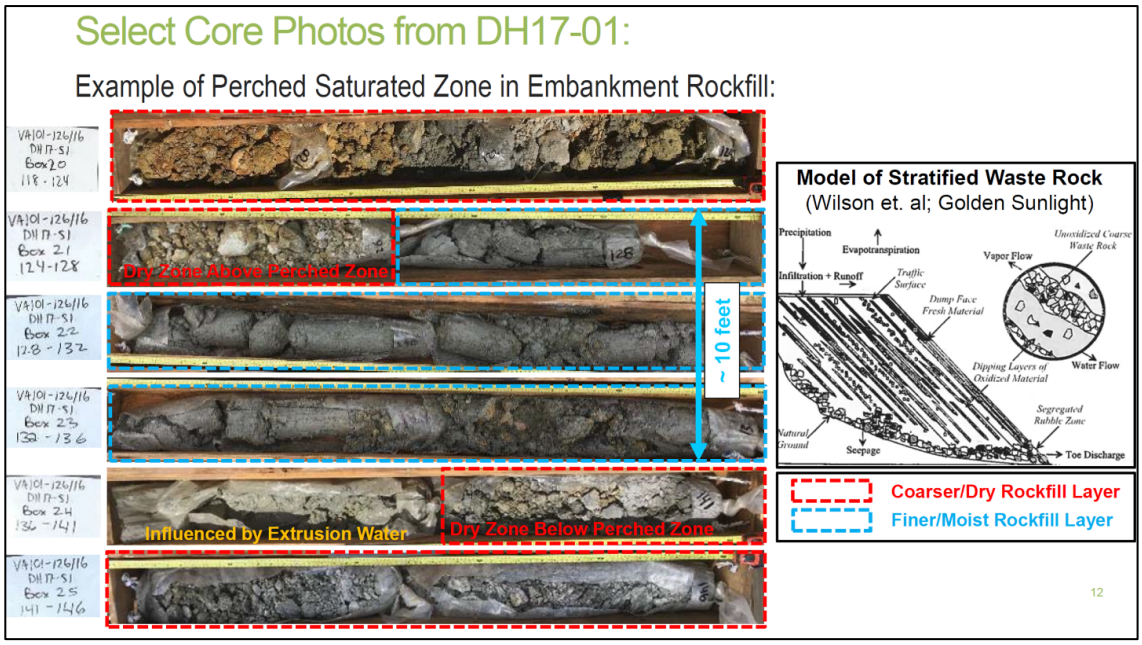

Figure 1- Core exemplifying the complex nature of the YDTI embankments

[1] In this report, the Panel adopts the term "unsaturated rockfill" to be consistent with terminology used in the Design Report, but notes that this term indicates the water present in the rockfill is held in tension (negative pressure) rather than indicating an absence of water in the pore spaces of the rockfill.

The Panel observes:

- The Panel is satisfied that the scope of historic and current investigations is sufficient to properly characterize the geotechnical and hydrological aspects of the East-West and North-South embankments.

- The Panel agrees with KP's interpretation of the historic and current geologic, geotechnical, and hydrologic data with respect to the geometry and characteristics of the YDTI embankments.

- Recent drilling through the embankments has added significantly to the understanding of the distribution of materials, material properties, water table configuration and pore pressures in saturated zones.

- The Panel was informed that the preliminary results of the 2017 embankment investigation (three sonic boreholes on section 0+00 and one on section 12+00W through the East-West embankment) yielded observations consistent with the earlier drilling programs. The Panel considers the embankments have been characterized in sufficient detail to assess the incremental effect of the El. 6450 ft. dam raise on the stability of the embankments.

- *The Panel requests that the reports of the on-going site investigations be provided to the Panel as final results become available.*

4.2 Tailings

Tailings characterization between 2012 and 2015 consisted of cone penetration testing that was performed from specially constructed drilling platforms on the tailings beach, from a barge within the supernatant pond, and directly on the sandy tailings beach area where access was possible without drilling platforms. Initial testing focused on materials closer to the embankment. Some of these areas were subsequently loaded with rockfill to establish platforms for the centerline construction of embankment raises. Further testing was performed following the loading to obtain information on potential changes in tailings behavior as a result of the loading. Testing was also expanded to sites further along the tailings beach toward the pond to obtain information about these materials. A standard suite of seismic cone penetration testing has been carried out in all these locations. This information provides better understanding of the shear strength and consolidation behavior of the tailings. It also provided information about pore pressure, fluid flow, and liquefaction behavior.

The Panel observes:

- Recent in situ test of tailings has provided important new insights to the physical behavior of the deposit.

- The Panel concurs with the assessment of the strength and consolidation characteristics of the tailings, as well as their liquefaction potential.

5. STABILITY ASSESSMENT

MCA requires demonstration that:

- The tailings, embankment and foundation materials controlling slope stability are not susceptible to liquefaction or to significant strain weakening under the anticipated static or cyclic loading conditions, to the extent that the amount of estimated deformation under the loading conditions would result in loss of containment.

- A probabilistic and deterministic seismic evaluation for the area and assessment of peak horizontal ground acceleration.

The MCA prescribes the factors of safety to be not less than:

- 1.5 (static loadings under normal operations)
- 1.3 (static loading under construction)
- 1.2 (post earthquake static loading).

The analysis must include consideration of the anticipated ground motion frequency content, fundamental period and dynamic response, potential liquefaction, loss of material strength, settlement, ground displacement, deformation, and potential for secondary failure modes

KP prepared a summary of all previous stability evaluations and performed a significant number of laboratory and in situ tests to better characterize the shear strength parameters for the foundation, embankment and tailings materials. It was determined that the tailings could liquefy.

Slope stability analyses were conducted for five sections of upstream and downstream conditions as well as post liquefaction and undrained strength conditions. All factor of safety results exceed the requirements listed above. Deformation analyses were also considered.

The Panel observes that:

- The approach adopted for assessment of the critical failure surface (loss of containment) is accepted for both upstream and downstream failure modes.

- Post earthquake shear strengths and liquefied tailings were included in the stability and deformation analyses; this meets the MCA requirements for consideration of liquefaction and strain weakening.

- In consideration of both embankment construction methods, and the current indication that zones of saturation located above the main water table are not laterally continuous, it is considered unlikely that the embankment materials will liquefy. However, regular monitoring of pore pressures in key zones

throughout the structure is an important element of the embankment surveillance program.

- The proposed design satisfies the required factors of safety for all stability conditions.

- The Continental Fault passes beneath the North – South embankment. The Panel has concluded from the stability and deformation analyses presented that the anticipated ground motion in a seismic event is tolerable.

- The seismic deformation analyses are considered conservative. This is appropriate.

6. WATER MANAGEMENT

A comprehensive plan for management of process water and water inflows from the surrounding watershed, and seepage control, are key elements in tailings operations. MCA requires the identification and consideration of:

- A description of the chemical and physical properties of the materials and solutions stored in the tailings facility.

- A detailed water balance.

- Storm water controls.

- Water, seepage and process solution routing.

- Management plans for extreme storm events.

MR has a long period of operational experience to draw upon to update the water management strategy to accommodate the proposed expansion. In addition, there is considerable data on the seepage of water from the YDTI at Horseshoe Bend (1996 – 2015), with continuous mine operation and reliable monitoring in the period from 2007 – 2015.

The construction schedule requires raising the embankment at a rate that will contain the maximum operating pond level, the PMF, and honor freeboard requirements. The principal new features of the water management system are the West Embankment Drain and multi-spigot tailings discharge. The Panel considers multi-spigot tailings discharge a key element of the expansion plan, and notes MR has begun to implement this plan.

Fresh water imports from Silver Lake for use in the Concentrator are an integral part of the mine site water balance. Due to water quality constraints associated with ore processing, the operation cannot rely solely on recycle water from the YDTI. Figure 6.1 in Appendix B of the Water Management Report presents the base case used in the

water management model; projecting water volumes in the YDTI for the period from 2018 to 2082. This period includes the post-closure period. Uncertainty bounds on stored volumes are expressed in terms of 5% and 95% probability values for any given year. The Panel accepts this metric as a reasonable choice.

The base case prediction for the water volume held in YDTI has been calculated using the current requirement for fresh water import from Silver Lake of 2.0 Mgpd. At this rate, Figure 6.1 in the Water Management Report indicates that it is unlikely that MR will reach the stated objective of an operating pond volume of 15,000 acre-ft. during the operating life of the El. 6450 ft. facility. The Panel strongly supports the stated intent to reduce the operating pond volume from the current volume of 31,000 acre-ft. to 15,000 acre-ft. This condition will reduce the likelihood of water ponding against the embankments during extreme storm events, reducing the risk profile for internal erosion and piping in the embankments. It is understood that MR has initiated a program to reduce fresh water import requirements in the Concentrator plant.

The reduction in the current pond volume should proceed in a timely manner, recognizing that other factors such as dusting on the exposed beach also need to be controlled. *The IRP requires the water balance model for YDTI be updated on an annual basis during the operational period, and wishes to be informed of strategies and progress in reducing the fresh water import demand to the Concentrator.*

The post-closure water management plan incorporates pumping at the West Embankment Drain and construction of a closure spillway for extreme rainfall events. KP adopted the assumption that the effects of climate change in western Montana are anticipated to have a net-neutral effect on the current average annual deficit condition of the pond. This assumption is based on published literature for the region.

The Panel observes:

- The probabilistic water balance model KP developed, which is based on repeated cycling through the variability in rainfall incorporated within the 119-year precipitation record at Butte, is accepted. It is uncommon in water balance modeling for mining projects to have this long a precipitation record available for analysis. The Butte precipitation data has been extrapolated to the elevation of the YDTI using a conventional modeling technique.

- Runoff coefficients used in water balance modeling were calibrated using site catchment data from 2004 – 2015. This is considered an adequate calibration period.

- Estimates of parameter values in the water balance model for which data was not available, such as water losses due to sublimation, have been based on literature values and KP experience. The Panel considers the values adopted to be reasonable estimates.

- The water balance model appears to be reasonably calibrated (Water Management Report, Fig 5.1, Appendix B). The calibration is based on a

comparison of the calculation of the volume of water in the YDTI using the model with an estimate of pond volume derived from bathymetric survey data. This is a common approach to testing a water balance model for a mine site.

- Plans for surface water and seepage water routing at YDTI during operations and in the closure period are accepted, for average conditions and flood events.

- Management of the extreme storm event in the post-closure period is based on a spillway, directing flow to the Continental Pit. The Panel supports the technical basis for this concept. The design base for the spillway is a bedrock channel on the east side of the facility. The spillway would be operational only for extreme runoff events. The spillway capacity will be designed for the PMF. The Panel accepts this conceptual design case.

- During mine operations, future tailings properties and pond water chemistry are anticipated to be similar to current conditions, which are well characterized. All tailings to be sent to the YDTI will originate from mining of ore in Continental Pit.

- A simple load balance model was used to predict concentrations of select solutes in the YDTI pond for the period following the end of mine operations. Concentrations were predicted using mixing cell (load-balance) calculations without account for geochemical reactions. The tailings are classified as potentially acid generating, although some test samples fall in the "uncertain category". The water quality estimate for the post-closure pond is based on the assumption that there will be no long-term influence from sulphide minerals in the tailings. This assumption in turn is based on an estimated three-year time lag for the most reactive tailings before the onset of acidification (an assumption based on kinetic test data on samples collected over a number of years) and that the cover for closure will be placed within that 3-year period. It is also assumed that the placement of a dry cover will significantly reduce both the long-term oxidation of sulphide minerals in the tailings and reduce contact of runoff water with the tailings below the cover. *The Panel is concerned that this viewpoint may be overly optimistic and requests that MR undertake a more comprehensive evaluation of the projected chemistry of the post-closure pond, including an assessment of the sensitivity to assumptions made in the calculation. This task should be completed in time for the next update to the IRP (see Section 12).*

7. HYDROGEOLOGY AND IMPOUNDMENT SEEPAGE

The YDTI is located within the Silver Bow drainage basin. MCA requires:

- A detailed description of how undesirable constituents contained in the impoundment will be isolated from the environment.

A conceptual hydrogeologic model was developed to characterize groundwater flow in the watershed. Basin topography (high relief) creates natural hydrodynamic

containment on the northern and eastern sides of the YDTI. Two principle seepage pathways require assessment. One pathway is at Horseshoe Bend, which is expressed as outflows and zones of seepage in the Horseshoe Bend collection area and at the No. 10 seep located approximately 250 feet above the toe of the embankment slope. Water management and water quality in Horseshoe Bend is regulated under an alternate framework than MCA and is not in the scope of the Panel review. The second pathway is at West Ridge, which introduces a potential seepage pathway to a basin previously with no impact to groundwater or surface water from the YDTI operations.

7.1 Horseshoe Bend

The Panel observes:

- The Design Report adopts the assumption that there will be no significant change in seepage flows to Horseshoe Bend during the operational period as a consequence of the rising pond level. This assumption is based on the recorded flows at Horseshoe Bend, which have been stable the past 10 years, while the YDTI impoundment has been raised approximately 70 feet. Several factors influence any change in the seepage flux at Horseshoe Bend; including beach area, pond location, and spigot locations.

- For closure, KP assumes that the flow in the Horseshoe Bend area and the No. 10 seep will continue, but at a diminished rate.

- *The IRP requests that at an appropriate time, Montana Resources LLP provide a memo summarizing how the flow at Horseshoe Bend (both the main collection area and No. 10 seep) changes as the single-point spigot system is replaced by the multi-spigot system. In conjunction with that data, any changes in flow rates as the phreatic surface in the tailings deposit and East-West embankment evolve should be examined.*

7.2 West Ridge

A comprehensive field investigation was carried out on West Ridge in 2015 and 2016 (structural geology, hydrogeology). Through the course of the investigation, the IRP was apprised of results of the investigations and participated in discussions of potential modifications in the field program, test plans, and preliminary interpretations of the data. The Rev. 2 Hydrologic Evaluation Report by Hydrometrics incorporates water level data collected through June 2017.

The Panel concurs with the overall interpretation presented by Hydrometrics of the hydrogeological setting at West Ridge. A complex, structurally controlled groundwater flow system is present in the West Ridge. Key features of the system are: (i) a water table low in the central region of the ridge, where the hydraulic head is approximately 6380 ft., (ii) east-west striking shear zones acting to compartmentalize the flow system, and (iii) the presence of a deep fracture zone in the central area of the West Ridge with slightly lower hydraulic head values than in adjacent areas (the “deep isolated fracture system”).

Under current conditions, topographically controlled hydrodynamic containment prevents any pond water from seeping beneath West Ridge to the basin west of this ridge (pond at 6345 ft.). With expansion of the YDTI, the pond level will eventually rise above the elevation of natural hydrodynamic containment for a segment along the West Ridge, where the hydraulic head is approximately 6380 ft. The projected elevation of water table against West Embankment at final pond height has been estimated by Hydrometrics to be 6400 ft., in the absence of any means to manage the water levels other than maintenance of a wide beach in front of the embankment. This water level would create a zone, approximately 1500 to 2000 ft. in length along the ridge at final pond height, where natural hydrodynamic containment would not be met (ignoring potential increases in the West Ridge water table in response to the rising pond level). Consequently, control measures along the western margin of the YDTI are required to maintain hydrodynamic containment.

A large set of hydraulic conductivity data was collected at the West Ridge, indicating moderate to low hydraulic conductivity for the bedrock (approximately 10^{-7} m/s). These estimates were based on numerous packer tests in geotechnical boreholes, three shorter-term pumping tests, and a 14-day pumping test in the "deep isolated fracture system". Hydrometrics concluded the interpretation of the pumping tests favors a dual porosity model for fractured bedrock however this characteristic is not of prime importance for evaluation of hydrodynamic containment (although it is important in deriving estimates of the hydraulic conductivity of the bedrock). The deeper bedrock beneath West Ridge has been demonstrated to have a low specific storage. The deep isolated fracture system was indicated to be highly fractured based on observations of core, and in situ testing indicating a hydraulic conductivity about one order of magnitude higher than the surrounding rock mass.

The Panel observes:

- Agreement with the view that the West Embankment Drain can be anticipated to maintain hydrodynamic containment at the West Ridge as the pond level rises. There is precedent for this type of hydraulic control measure at a tailings facility. In conjunction with the hydraulic head values that will be established along the drain alignment, the eastward direction of the hydraulic gradient at the ridge crest due to local recharge is expected to preclude seepage of pond water to the valley located west of West Ridge.

- Sufficient redundancy is incorporated in the design of the West Embankment Drain.

- The contingency mitigation plan for the deep isolated fractured rock zone suggested by Hydrometrics appears viable, involving long-term augmentation of the deep isolated fracture system at a low flow rate (by gravity) to build hydraulic head and maintain hydrodynamic containment.

- Monitoring of the hydraulic head response in the West Ridge as the pond level rises will provide data that are key to verification of the current interpretation of

the groundwater flow system and the performance of the West Embankment Drain in maintaining containment. It will be about 4 - 5 years (from 2018) before natural hydrodynamic containment in West Ridge is challenged: (i) allowing MR to verify the current conceptual model of the hydrogeological system as groundwater levels in the ridge respond to the rising pond level and operation of the West Embankment Drain, and (ii) providing an opportunity to react to unforeseen conditions in a timely manner.

The Panel requires Montana Resources LLP, on an annual basis, to submit a memo summarizing changes in groundwater levels in the West Ridge, and to include a synthesis of these data in the context of the rising pond level in YDTI and operation of the West Embankment Drain.

7.3 West Embankment Drain Design

The design and construction of the West Embankment Drain (WED) has been proceeding under an authorization already held by Montana Resources LLP. The focus for the IRP centers on an evaluation of whether the drain will provide hydrodynamic containment at West Ridge as the pond level rises with the proposed expansion of YDTI.

The invert elevation of the WED starts at elevation 6,352 ft. on the north end and slopes at 0.25% along the drain alignment to the south. It drains into an extraction pond at its south end. The drain has been designed to convey 4,500 gpm, the 98th percentile of the historic seepage flows observed at Horseshoe Bend. Multiple lines of defense have been included in the WED system consisting of an Extraction Basin with bottom elevation of about 6,320 ft. from which another 4,500 gpm can be pumped, plus two drain pods that can be accessed in the future (if necessary) by drilling pumping wells to allow further redundant water recovery capacity.

The Panel observes:

- The location of the West Embankment Drain adjacent to the current western limit of the pond is appropriate. It provides the capacity to maintain low groundwater levels against the West Ridge and will thereby reduce the risk of seepage from the YDTI flowing through the Ridge.

- This alignment of the drain establishes the elevation of the head control (approximately El. 6348 ft. and lower) in the pond water interception system.

- The design capacity of the West Embankment Drain is based on the maximum flow rates observed in the historic seepage in Horseshoe Bend. This is an acceptable, if not conservative, approach.

- There will be a need to refine the PAG metric used for zone D1, once construction is underway. The report presenting the design of the West Embankment Drain indicates the most suitable rock available at time of lift construction will be used, and MR will measure the acid potential (AP) and neutralization potential ratio of placed rock. The selected material for the D1

zone will comprise a material with a relatively low AP. *The construction management plan indicates that a database will be developed to quantify the acceptable level for the AP. The IRP wishes to review this aspect of the construction management plan once the metric has been set in place.*

8. CONSTRUCTION MANAGEMENT PLAN

The MCA requires:

- A construction management plan that includes, at a minimum, parameters and levels of acceptability to be monitored during construction for quality control and quality assurance purposes. The frequency of sampling, the amount of oversight, the qualifications of the oversight personnel, and the role of the Panel during and after construction must be specified and agreed to by the Panel.

The construction management plan (CMP) is based on Montana Resources long experience constructing ongoing raises to the YDTI. The plan describes the organizational structure and the documentation that will be collected and developed during future lift construction. The Quality Control and Quality Assurance aspects for the embankments and other components have been described. A significant part of the construction management consists of the material specifications for the various materials that will be used for constructing the future raises of the YDTI.

The construction management plan considers the construction of each of the components of the YDTI expansion, including earthworks, geotextiles, concrete works, pipework and appurtenances, geotechnical instrumentation and reclamation. For each of these components, where appropriate, the CMP includes sections that:

- Complement the detailed design drawings (included in the Design Basis Report) by describing the technical specifications to which the YDTI is to be raised.
- Set the parameters and levels of acceptability to be monitored during construction for Quality Control (QC) and Quality Assurance (QA) purposes.
- Describes the testing specifications and frequency of quality control and assurance sampling and testing.
- Describes the collection and submittal of all required quality records to demonstrate the construction has been completed as per the design documentation.
- Describes the degree of oversight, responsibilities and qualifications of all the key parties.
- Describes the role of the Independent Review Panel (IRP) during and after construction.

The construction management plan follows standard engineering practice in presenting the various components. Further information on the levels of acceptability for parameter QA/QC purposes are not clearly stated and should be developed and provided in future annual reports.

Three potential method compaction specifications are proposed for zone D1. A test fill is proposed as part of the construction management plan. *The IRP would like to review the test fill report when available.*

The Panel observes that:

- The Construction Management Plan contains specifications for all components of the planned raise of the YDTI, including the specifications for the foundation, abutments, embankment, means of containment and the borrow materials. These provisions have been drawn from up-to-date, internationally accepted standards and, when followed, can be expected to result in the construction of a robust structure.

- The YDTI storage capacity curve with time appears to be reasonable. The elevation-area-capacity curves and the filling-time schedule have been established taking into account historical tailings production rates, settling densities of the tailings, and operating pond volumes.

- Expectations for rigor in the documentation of construction records, operational procedures, and lines of responsibility are increasing as a consequence of lessons learned from several recent failures of tailings dams in the Americas. The Panel is comfortable with the documentation requirements and QA/QC procedures that have been set down in the construction management plan.

- The future role of the Independent Review Panel is discussed in Section 12 of this report.

9. DAM BREACH RISK ASSESSMENT

The MCA requires the following with respect to a dam breach risk assessment:

- A dam breach analysis, a failure modes and effects analysis or other appropriate detailed risk assessment.

- An observational method plan addressing residual risk.

- A list of quantitative performance parameters for construction, operation, and closure of the tailings storage facility.

KP chose to conduct a detailed risk assessment of potential failure modes to meet the MCA requirements. The evaluation applies basic risk assessment components typical of a failure modes and effects analysis, however it is presented with more quantitative evaluations. The assessment examines foundation and embankment instability, overtopping, and internal erosion and piping. Loading considerations include those during maximum normal operating conditions, loading from seismic events, flood events, and malfunctions of the reclaim water and tailings distribution systems.

The Panel observes:

- The Panel accepts this approach for the purpose of the Amendment Application.
- The analyses of failure modes are considered sufficient.
- The risk assessment concludes that for the failure modes examined (foundation and slope instability, overtopping, internal erosion and piping), with operational controls in place, the likelihood of tailings release due to the embankment raise is very low.
- The proposed observational method introduced to address residual risk is adequate and it is foreseen that this will be refined during ongoing operations. It is the responsibility of the Engineer of Record for the tailings facility to assure the appropriate application of the observational method at YDTI. *The Panel will review the activity of the Engineer of Record in this regard as construction moves forward.*
- The Panel finds the list of quantitative performance parameters adequate.

10. RECLAMATION OVERVIEW

The Panel was interested in understanding the extent to which the closure plan for the El. 6450 ft. facility would need to be modified relative to the closure plan for the El. 6400 ft. facility. The reclamation strategy is based on re-grading embankment slopes, placement of an amended alluvial cap on the tailings facility, and re-vegetation. A closure scenario is planned for the northern portion of the tailings impoundment that includes a pond and surrounding wetland that will be inundated on a seasonal basis. The pond is estimated to hold a volume of approximately 500 acre-ft. of water approximately 40 years after closure.

A review of the closure plan for YDTI is not within the scope of the Panel; the focus is on evaluation of whether the additional requirements to be imposed on the reclamation plan due to the embankment raise have been given adequate consideration. The expansion creates the need for management of additional embankment and beach area. KP has quantified the size of these additional areas, which is largely expressed as the additional beach area that will need to be reclaimed. The area of open pond and wetlands are anticipated to decrease in comparison to closure of the El. 6400 ft. facility. The volumes of additional borrow material required for capping has been estimated.

MCA requires identification and consideration of:

- Design integration with a closure plan that maximizes maintenance-free closure to greatest extent possible.

- Post-closure monitoring, inspections, and reviews.

During development of the Design Report, several modifications were introduced that led to improvements in the Closure Plan: (i) a gravity drainage system for the West Embankment Drain was adopted for operations and in closure, and (ii) a post-closure spillway for extreme rainfall events was incorporated in the design to reduce the risks associated with water ponding against the embankments. The WED Extraction Pond will be lined and water reporting to that pond will require active pumping to the YDTI after closure, as long as necessary.

The Panel observes:

- The Panel accepts the reclamation concepts in the Design Report and considers they are consistent with existing closure requirements.

- The volume of water reporting to the West Embankment Drain during the closure period has not been quantified, but the Panel anticipates the flow to be significantly less than the flows that will occur during the operational period, given the absence of slurry discharge and the smaller water pond. MR has estimated that the WED will be required to provide hydrodynamic containment for about 20 years following closure, before drain-down of the tailings mass leads to a water table in the tailings below the elevation of the West Ridge potentiometric low. Observations of flow during the operational period will likely provide the best means for developing refined estimates of flow at closure. Local infiltration of precipitation will continue to yield water to the WED that must be managed.

- The Panel accepts the design criteria and conceptual layout presented for the closure spillway with a side channel weir intake. Water from the closed facility is intended to enter the spillway only under extreme, and rare, rainfall conditions. The invert of the spillway will be set so that a minimum 800 foot wide beach would separate the pond from the embankments. The Panel concurs with this logic in setting the invert elevation.

- A conceptual monitoring plan and site inspection plan for closure has been outlined, with the details pending completion of the reclamation program. The Panel concurs with this approach, and considers sufficient information has been provided at this time to define the scope of the program. In addition, the commitments to be undertaken during the closure period by Montana Resources LLP, the Engineer of Record for the facility, and the Independent Review Panel have been specified.

11. ENGINEER OF RECORD RESPONSES TO ARCO

To be included in the Design Report, MCA requires:

- Any other information, drawings, maps, detailed descriptions, or data to assist the Panel in determining if the new or expanded tailings storage facility protects human health and the environment should be provided.

In January 2017, ARCO engaged a group of consultants to evaluate environmental conditions and risks associated with the proposed YDTI enlargement. At the time of their review, it was planned to construct the embankments to El. 6500 ft. The consultants were Dr. Norbert Morgenstern and AECOM engineers Mr. Richard Davidson and Dr. Brian Hippley. They visited the site on 24 January 2017, took part in three meetings in February, March, and April 2017, with ARCO, MR, and KP and presented their comments in a report, "Final Report – Yankee Doodle Tailings Impoundment – Butte, Montana"; dated May 3, 2017.

KP undertook a detailed assessment of the ARCO report and in their letter report to MR, "Response by the Engineer of Record to Comments Submitted by Atlantic Richfield Company", dated September 8, 2017, they addressed 81 individual comments in text and in tabular form. Their response is included in the Design Report.

In the view of the Panel, the most significant ARCO comments and the corresponding KP responses can be sorted into seven major categories:

- Water and Seepage Conditions in the Embankment
- Geotechnical Characteristics of the Embankment Rockfill
- Faulting and Seismic Considerations
- Stability of Embankments
- Instrumentation
- Failure Consequences and Risk Mitigation

11.1 Water in the Embankment and Seepage

ARCO Comments and KP Responses:

ARCO comments that various perched water levels and a basal phreatic surface were observed in the embankment and constant seepage is observed at the toe and at Seep 10, some 250 feet above the toe of the embankment. This seepage supports their opinion that "significant zones of saturation exist within the embankment". In the April 2017 discussions, ARCO expresses the thought that "the saturated zone adopted for past stability studies is likely more complex than portrayed in the permit documents" and "additional studies should be performed".

KP responded that various perched water levels are expected in the obliquely stratified heterogeneous rockfill embankment and that the drilling and monitoring confirms the presence of localized perched water levels (saturated zones) within the largely unsaturated rockfill embankment. In the opinion of KP, previous and current embankment investigations and monitoring readings indicate that the saturated zone in the base of the East-West Embankment "exists in the bottom 50 to 120 feet of embankment rockfill". KP states that the constant seepage at the toe is to be expected as it is part of the designed embankment drainage system and that "relatively localized

perched seepage flows, such as those observed at Seep 10, are expected during operations". KP also states that the hydrogeological model will continue to be refined as additional investigation and monitoring data are obtained.

ARCO also comments that, "Lack of consistent seepage control measures (i.e. filter zone on upstream slope) has allowed the introduction of tailings fines into the embankment reducing the intended free-draining characteristic of the embankment."

KP describes incidents in their 2016 EOR Annual Inspection Report where water and tailings were observed to flow through the North-South Embankment along the coarse base zone of the structure. This was the result of the active tailings stream being at the same elevation as the coarse rock base zone. The inspection report indicates that this condition was corrected and that the design of the next stage includes a facing of alluvium to mitigate potential tailings migration.

The Panel observes:

- Based on site observations and review of the drill logs, the Panel agrees with KP's characterization of the East-West Embankment as an obliquely stratified heterogeneous rockfill embankment. A photo presented in Section 4.2 of the Site Characterization Report (see Figure 2 below) shows a cut into a nearby rockfill dump constructed at a similar time with similar methods as the YDTI embankments. The photo shows the angular fabric of the structure. The complex orientations of the layers was further amplified by the construction of multiple embankments with upstream and downstream sloping layers as indicated in Section 8+00W included in KP's August 2017 Site Characterization Report (see Figure 3 below).

- It is the Panel's opinion that the embankment composition pattern makes it unlikely that large-scale, continuous horizontal layers of saturated fine-grained materials exist within the embankments, at elevations above the basal water table.

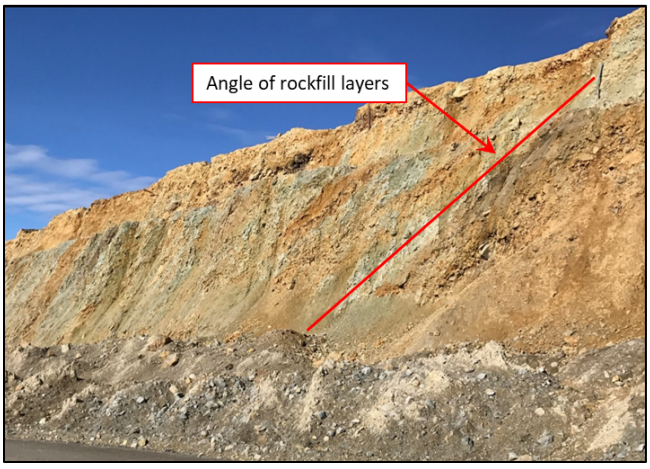

Figure 2 - Photo of cut in the nearby Great Northern Dump showing angular orientation of rockfill layers

- Based on review of piezometric data and drill logs, the Panel agrees with KP's interpretation of the East-West Embankment as being "relatively unsaturated" with several isolated perched saturated zones with downward gradients and a basal saturated zone in the bottom 50 to 120 feet of the structure, as shown in Figure 3. The Panel accepts as reasonable the KP interpretation that Seep 10 is due to the presence flow along an old haul road or pipe ramp that was incorporated in the downstream shell, and is therefore not an indicator of a large zone of saturation located well above the elevation of the basal saturated zone.

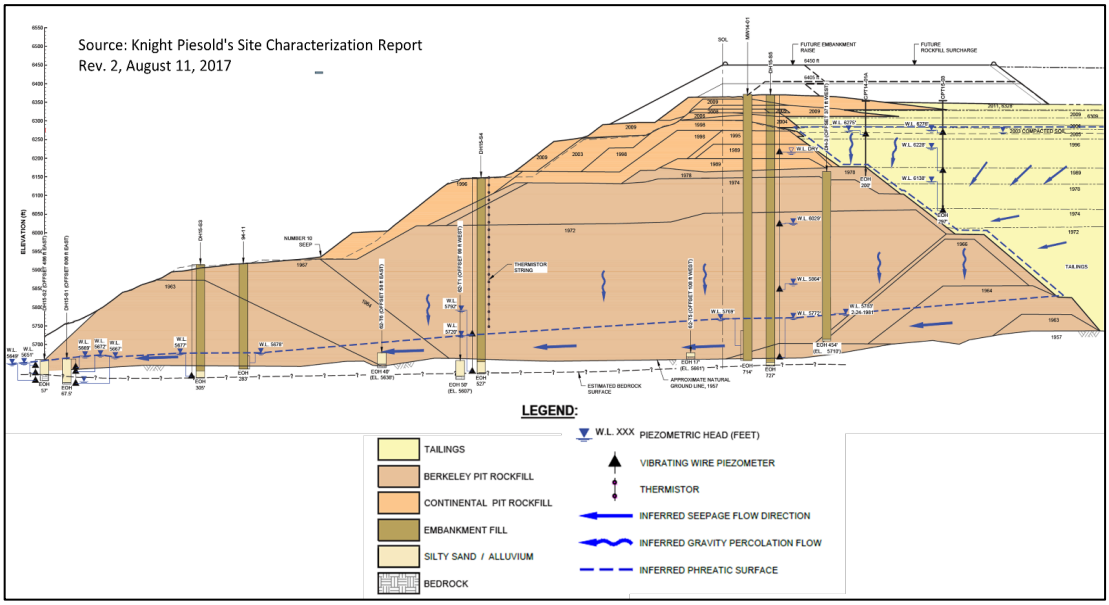

Figure 3 - East-West Embankment at Section 8+00W

- The Panel was informed that leaks of water and tailings through the North-South Embankment are not routine occurrences and that they have been appropriately repaired. However, it should be anticipated that some tailings sands and slimes of uncertain volume have entered the embankment over the years. KP has designed the next stage of all embankments with an alluvium-facing layer on the upstream slope to prevent any further migration of tailings into the structures. In the view of the Panel, this alluvial facing layer for the embankment raise to El. 6450 ft. is an essential element of the design.

- The design intent for the YDTI embankments is that they are free-draining structures. The uncertainty inherent in mapping the occurrence of perched zones in the highly heterogeneous materials forming the embankments, and the uncertainty in characterizing the volume of fine tailings that may have previously infiltrated into the embankment, leads the Panel to conclude that a diligent program to monitor evolving fluid pressures within the embankment is a key requirement for YDTI. As part of the site investigation program to support

the permit amendment to raise all the embankments to El. 6450 ft., MR has proceeded with a significant expansion of the embankment monitoring system.

11.2 Geotechnical Characteristics of the Embankment Rockfill

ARCO Comments and KP Responses:

ARCO commented that the rockfill appears to be prone to weathering that may result in reduced shear strength and that additional embankment height may accelerate the reduction in strength. ARCO also pointed out that "the waste rock has a history of being leached and that the EOR should determine whether the degraded rockfill is really free draining and if it possess a high enough degree of saturation and sufficient fines content to behave in an undrained manner near the base and elsewhere and be potentially vulnerable to the high seismic loading at the site."

KP responded by stating that they have "conducted extensive investigations and analyses to evaluate the nature and characteristics of the free draining rockfill as reported in the Site Characterization Report (Rev. 2), and (have) also considered site specific seismic loading and the potential for undrained conditions in the Stability Assessment Report (Rev. 2)."

The Panel observes:

- Review of the Site Characterization Report (Rev. 2) indicates that the drilling and sampling program and the monitoring of piezometers has established that the East-West Embankment is adequately free draining with only isolated perched water zones above the saturated drainage layer at the base.

- Based on a review of the Stability Assessment Report (Rev. 2) it is apparent that KP has considered lower bound undrained strengths that were seismically triggered along a continuous layer of saturated overburden and rockfill in the base of the embankment. Their analyses indicated that the embankment is expected to remain stable taking into account these conditions.

11.3 Faulting and Seismic Considerations

ARCO Comments and KP Responses:

ARCO stated "There are uncertainties regarding local faults that may have considerable effects on seismic loading of the tailings impoundment." ARCO pointed out that the Seismic Hazard Assessment study by Linda Al Atik and Nick Gregor recommended a fault study, which apparently was not done. Furthermore, "the precedent of assuming fault activity without field confirmation can lead to excessively conservative results"

and that "MR and their consultant have adopted the conservative position that the fault is active".

In response, KP indicated that it relied on information from the Montana Bureau of Mines and Geology and other pertinent investigations, which concluded that it could not be determined conclusively that the local Continental Fault and other nearby faults were either active or inactive. Therefore, KP chose to take the conservative approach and consider the faults to be potentially active. If future investigations determine that the Continental Fault was to be deemed inactive, KP would consider those implications in their designs.

The Panel observes:

- The Panel agrees with the approach that KP has taken regarding potential fault activity. The designs resulting from this assumption are considered to be practical.

11.4 Stability of Embankments

ARCO Comments and KP Responses:

ARCO performed "screening-level" analyses of stability based on information from KP's stability report issued in November 2016 (Rev. 0). The model that was used is shown in Figure 4 below.

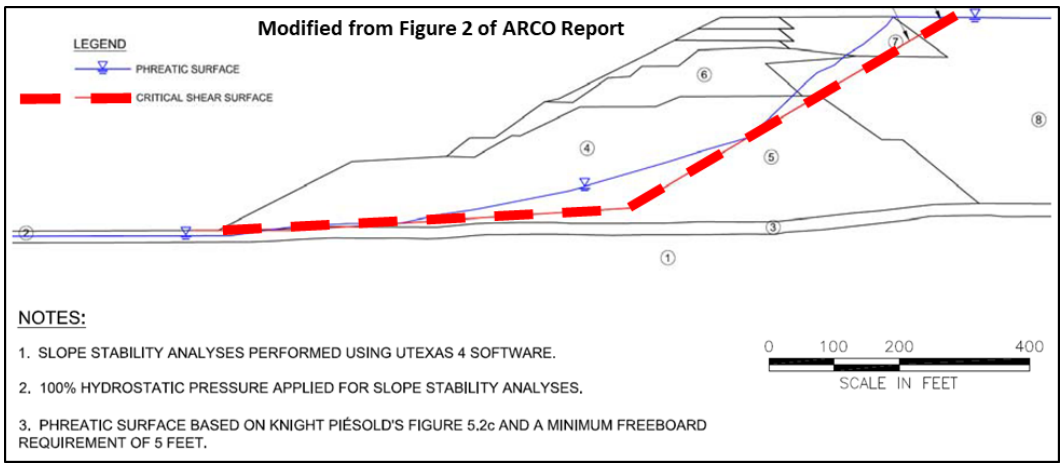

Figure 4 - Stability model used in ARCO's screening level analyses

These screening level analyses resulted in calculated Factors of Safety (FoS) ranging from 0.89 to 1.01, thereby not meeting required stability criteria. It is pointed out here that these analyses were conducted prior to the time that ARCO had additional information from KP that resulted in ARCO commenting that "the saturated zone

adopted for past stability studies is likely more complex than portrayed in the permit documents."

KP responds by remarking that the results of the analyses presented in Stability Assessment Report – Rev. 2, (using updated phreatic conditions) confirms the MCA FoS requirements for static loading are achieved for both current and future normal operating conditions. The YDTI embankments are stable with a FoS of 2.0 or greater. In recent discussions, KP states that the MCA requirement of a FoS of at least 1.2 for post-earthquake conditions is met; even if lower bound undrained strengths were assumed to exist. In addition, KP states that "selective and strategic placement of rockfill to further mitigate the very low risk associated with this condition should be considered while evaluating options for storage of excess rockfill produced during mining of the Continental Pit".

The Panel observes:

- It is the Panel's opinion that the stability analyses performed by KP as described in their August 15, 2017 Stability Assessment Report (Rev 2) are representative of the conditions as they are presently understood to exist at the YDTI facility and for the planned raise to El. 6450 m. Accordingly, it is believed that the MCA Factor of Safety requirements have been met or exceeded.

- It is anticipated that with the conversion to the multi-spigot tailings distribution system, there will be a reduced infiltration rate into the upper part of the upstream face of the East-West embankment, and a greater component of flow entering the embankment face at depth.

- The Panel agrees with KP's concept regarding the use of excess rockfill from the Continental Pit to further minimize risk of unstable conditions.

11.5 Instrumentation

ARCO Comments and KP Responses

ARCO comments that, "More instrumentation sections and monitoring devices are warranted to adequately monitor the facility in the future".

KP states that they concur with this recommendation. "A phased site investigation program began in 2015 and is presently underway to supplement the existing embankment monitoring network. The monitoring network will be progressively expanded as required to meet the monitoring and surveillance requirements as stipulated by the EOR with input from the Independent Review Panel (IRP)".

The Panel observes:

- The stability of the East- West and North-South embankments is dependent upon the rockfill remaining in a free draining condition. Therefore, monitoring of fluid pressures in the embankments, and confirmation of the elevation of the zone of continuous saturation, is a principal focus of the monitoring program going forward.

- MR is currently conducting a site investigation program that incorporates the installation of 4 additional boreholes along north-south transects through the East-West embankment (Sections 0+00 and 12+00W). Results from this program are anticipated to be available before the end of the year. *The Panel requests that the results from this site investigation be forwarded to the Panel when complete, and that any further additions or modifications to the existing instrumentation network be provided for review.*

11.6 Failure Consequences and Risk Mitigation

ARCO Comments and KP Responses

ARCO comments that "The water quantity currently retained within the embankment, combined with the infrastructure and activities downstream of the impoundment and in the town nearby, may result in severe consequences if a failure occurs". Additionally, "If a dam breach consequence report is not going to be prepared, information regarding the potential consequences of a breach is still needed to evaluate potential actions to mitigate the risk".

In response, KP points out that the Montana regulations require "development of a dam breach analysis, a failure modes and effects analysis or other appropriate detailed risk assessment, and an observational method plan addressing residual risk. A detailed dam breach risk assessment was considered the most appropriate and applicable approach for the YDTI facility amendment application. The Dam Breach Risk Assessment (Rev 2) is part of the YDTI Design Document package."

ARCO comments that short-term risk mitigation measures may be warranted including reduction of water in the tailings impoundment, development of alternative disposal locations, buttressing, and/or alternative disposal technologies.

KP responded by stating that the current reclamation strategy includes a capping layer over beaches and a reduction of the supernatant pond. Also "selective and strategic placement of rockfill to further improve embankment stability and to support reclamation objectives will be considered while evaluating options for storage of excess rockfill produced during mining of the Continental Pit."

The Panel observes:

- Based on a review of the KP Dam Breach Risk Assessment report, the Panel is satisfied that the MCA requirements for risk evaluation have been met.

- The Panel agrees that consideration of buttressing the embankments with waste rock from mining operations is an appropriate task. *The Panel wishes to be kept up to date on the progress of potential buttressing studies. As feasible, the Mine Plan should accommodate production of waste rock amenable for construction of an E-W embankment buttress as an important factor in the planning process.*

12. IRP ONGOING REVIEW

There are a number of ongoing activities at the YDTI that include construction, further drilling, installation of instrumentation, an updated deposition plan, and the like. The IRP consider that review of the progress of activities and especially updates of the monitoring results will be appropriate on an ongoing basis starting in the second quarter, or so, of 2018. A number of operating quantitative performance parameters and objectives are further described in the TOMS and the IRP would also propose to review those conditions.

13. IRP STATEMENT ON ADEQUACY OF THE DESIGN REPORT

In the view of the Independent Review Panel, the design document for expansion of the Yankee Doodle Tailings Impoundment addresses all MCA requirements. Based on the selection of appropriate parameters and sound technical evaluations, the IRP accept the adequacy of this design. Panel requirements for ongoing information updates that support this opinion have been highlighted in italic within the report.

Leslie Smith

James Swaisgood

Dirk van Zyl