

Alternative Technical and Development Framework for the Mendenhall GLOF Lake Tap Tunnel Project

Purpose: Independent Review and Alternative Development Concepts

Executive Summary

The Lake Tap Tunnel is the right solution to the Mendenhall Glacial Lake Outburst Flood (GLOF) problem. The unanimous stakeholder preference expressed at the December 2025 charrette was well-founded and this review does not challenge that conclusion. What this review does challenge is whether the current design and construction methodology assumptions represent the most cost-effective, technically sound, and community-beneficial approach to delivering that solution.

The USACE/AECOM charrette report was prepared by civil infrastructure engineers applying civil tunneling methodology to a problem that is, in its fundamental character, a mining engineering problem. This review applies a mining engineering perspective and identifies several significant opportunities to reduce cost, schedule risk, and construction complexity while simultaneously improving the long-term resilience and adaptability of the system.

Beyond the immediate engineering question, this review identifies a set of development synergies, hydropower generation, tourism infrastructure, and community development that could transform what is currently conceived as a pure cost center into a community asset generating long-term economic benefit for Juneau.

The window to influence the design is narrow. The preliminary design technical report is scheduled for completion in May 2026. The City of Juneau, as project sponsor with formal standing in the USACE process, should act now to ensure these alternatives are formally evaluated before design assumptions are locked in.

1. Context and Purpose

1.1 The Current Situation

Suicide Basin has produced escalating GLOF events since 2011, with recent events in 2023, 2024, and 2025 each setting new peak discharge records. In 2025, peak discharge reached approximately 51,000 cfs. Very little damage was done in 2025 due to the installation of HESCO

barriers along the river. In 2026, the HESCO barriers will be maintained and improved and an additional 4.1 miles of barriers will be installed. The City recognizes that maintenance will need to be performed on this system every year and that if the system fails the results are potentially catastrophic. The HESCO barrier system is a temporary measure, not a permanent solution. If HESCO barriers are seen as a medium to long term solution, the costs of the other options and those outlined below should be compared against HESCO maintenance costs and the eventuality of a HESCO breach and resulting community impacts.

The December 2025 multi-agency charrette unanimously selected the Lake Tap Tunnel as the preferred engineering solution. The concept involves an approximately 12,000-foot gravity drainage tunnel connecting Suicide Basin to Mendenhall Lake, designed to continuously drain the basin and prevent the catastrophic outburst events that have been escalating in severity.

1.2 The Cost Concern

The USACE/AECOM cost estimate — developed at 2-5% design with a 50% contingency — has generated concern about project viability and seems to be contributing to decision delay. The charrette report estimated total project costs in excess of \$600M across the alternatives evaluated, with the Lake Tap Tunnel as the lowest-cost preferred option. These figures have rightfully caused significant concern.

It is important to understand what the estimate is and is not. A Class 4 estimate at 2-5% design with 50% contingency is doing exactly what good estimating practice requires — acknowledging genuine uncertainty rather than presenting false precision. The estimate is not necessarily wrong. At this stage of design, with essentially no geotechnical data along the alignment, a wide uncertainty range is appropriate.

Historical data on civil tunnel projects supports this caution. Research by infrastructure economists consistently shows that early tunnel project estimates frequently understate final costs, with average overruns of 45% or more above final budgets, and final costs sometimes reaching two to three times initial estimates on projects where early estimates were artificially compressed. The USACE estimate, while large, reflects genuine uncertainty rather than a known problem.

However, there are legitimate questions about whether the construction methodology assumptions are optimal for this project. Those assumptions have significant cost implications and deserve formal evaluation before preliminary design is finalized.

2. Alternative Construction Methodology

2.1 Why Conventional Drill and Blast Rather Than TBM?

The charrette report assumes Tunnel Boring Machine (TBM) methodology for the main tunnel drive. This assumption should be formally re-evaluated for the following reasons.

Grade compatibility. The report specifies an approximately 8% tunnel grade — an uphill drive from the Mendenhall Lake portal toward Suicide Basin. Standard TBMs are designed for grades up to approximately 3-5%, with 6-10% considered challenging and requiring operational modifications. At 8%, standard TBM equipment faces significant operational complications on systems designed for near-horizontal operation. A steep-grade TBM would be required, likely at significant additional cost and procurement lead time. Conventional drill and blast with rubber-tired mining equipment handles 8% grades, or higher, as a matter of routine; local mines plan ramps at 12%. Conventional D&B tunneling can achieve grades up to approximately 15%, the practical limit for most underground mining equipment, opening up alignment options that could meaningfully reduce total tunnel length and therefore total project cost.

Mobilization and procurement. TBM procurement involves a custom machine, factory acceptance testing, months-long lead time, and specialized transportation to a remote barge-access-only site. Drill and blast mobilization is dramatically simpler and faster, drawing on equipment and expertise that is commonly used in Juneau today with parts vendors and expertise in the community.

Labor availability. The report explicitly identifies labor shortage as a major project risk. Alaska has a well-developed underground mining workforce with experience at operations including Greens Creek, Kensington, and Pogo, in addition to the contract mining companies that support them; Thyssen Mining, Redpath, Cementation, and others. These contractors are highly mobile, efficient, and self-sufficient with EPCM capability. TBM specialists are far scarcer, non-existent in Alaska, than experienced underground D&B miners and equipment operators.

Risk profile. A TBM breakdown in this remote setting, accessible only by barge across a lake that freezes in winter, represents a catastrophic schedule and cost event. The report lists TBM equipment breakdown as a major risk requiring specific mitigation. Drill and blast equipment is more readily maintained, repaired, and replaced, and the failure of any single piece of equipment does not stop the entire tunnel drive.

Simultaneous development from both ends. Conventional D&B allows two simultaneous headings, one from the Mendenhall Lake end and one from Suicide Basin, potentially cutting the tunneling schedule down. Given the annual GLOF construction window constraints the report emphasizes repeatedly, this schedule advantage could be critically important. A TBM single-drive approach cannot offer this flexibility but may offer faster advance rates than conventional tunneling. This would need to be understood.

Cost. Drill and blast tunneling in a hard rock mining environment runs approximately \$3,000-4,000 per foot for excavation. With targeted concrete lining and ground support the all-in tunnel cost is likely in the range of \$5,000-8,000 per foot — meaningfully lower than a TBM approach requiring a custom steep-grade machine.

The core question for USACE: Has a conventional drill and blast alternative been formally evaluated and documented? If not, why not, given that it addresses the most significant technical and cost risks identified in the charrette report?

2.2 Lining Specification

The report specifies reinforced concrete lining for the full tunnel length, driven primarily by concern about abrasion from high-velocity supercritical flows at approximately 40 feet per second.

This specification deserves examination. The tunnel traverses competent hard rock, metasedimentary, metavolcanic, and tonalite, that is structurally self-supporting in good ground conditions. The tunnel is a passive gravity drain with no overlying infrastructure to protect. The surrounding area is undeveloped wilderness. If the concrete lining gradually erodes over decades the rock itself remains intact and functional. The Mendenhall Glacier is already the dominant sediment contributor to this watershed, incremental sediment from tunnel wall erosion over time is genuinely inconsequential in that context. There are historic tunnels riddling the mountains around Juneau giving confidence to an open tunnel solution.

Norwegian and Swiss hydroelectric practice has successfully operated unlined or partially lined tunnels in similar hard rock types for decades. A more targeted lining approach, full treatment at portal zones, fault intersections, and the inlet and outlet structures, with systematic rock support but minimal lining through competent rock sections, could reduce tunnel cost by \$800-1,500 per linear foot while maintaining structural and hydraulic function.

Furthermore, if the tunnel is constructed at a shallower grade as discussed below, flow velocities are reduced significantly and the abrasion concern that is driving the full lining specification is substantially diminished.

The core question for USACE: What is the technical basis for full concrete lining throughout the tunnel, and has a partially lined alternative with systematic rock support been formally evaluated? There is substantial evidence in the mountains around Juneau that this would be unnecessary.

3. Alternative Tunnel Alignment and Basin Connection

3.1 Shallower Gradient Tunnel

The current 8% grade creates the TBM operability problem discussed above. If the tunnel is constructed at a shallower gradient — say 1-3%, which is completely standard for any construction method — several benefits follow simultaneously:

- Standard off-the-shelf equipment, whether TBM or D&B
- Lower flow velocities throughout the tunnel, reducing abrasion concern and allowing partial lining only where necessary
- Improved water management during construction — on an uphill drive, flow is away from the face in all cases
- More conventional and competitive contractor procurement

- Improved crew safety and equipment operability

A shallower gradient tunnel may be somewhat longer to reach the target elevation beneath the basin. However the cost saving from standard equipment, competitive procurement, and reduced lining specification likely more than offsets the additional footage. Detailed alignment optimization is warranted.

3.2 Alternative Basin Connection — Post-GLOF Breakthrough

The most technically challenging, schedule-constrained, and highest-risk element of the current design appears to be final tunnel breakthrough into Suicide Basin. The report devotes significant discussion to the risks of a wet TBM breakthrough, the need to time construction to coincide with post-GLOF low water levels, and the complexity of the surface intake structure in an extremely difficult glacial environment.

A mining engineering approach offers a fundamentally superior alternative, presented here as two related options.

Option A — Post-GLOF Uphole Blast Connection

The concept: Drive the main tunnel to a terminal chamber positioned beneath or adjacent to Suicide Basin. From this chamber, drill an array of upholes toward the basin floor. Fire the final blast remotely after a GLOF event, when the basin has drained to its lowest level, breaking through into dry or nearly dry rock above the residual water level.

Why this works: The report documents that Suicide Basin has drained almost completely to approximately elevation 900 feet in each of the 2023, 2024, and 2025 GLOF events. A tunnel terminal chamber positioned at a lower elevation, with upholes targeting breakthrough at elevation 950-1,000 feet, achieves a dry connection in conditions that occur predictably every year.

The critical insight: The GLOF cycle that the community rightly fears becomes, from a construction perspective, a predictable annual opportunity. The basin drains, monitoring confirms suitable conditions, and the prepared blast is fired remotely into dry rock. This approach is similar in timing logic to the TBM breakthrough concept, both depend on the post-GLOF low-water window, but the uphole blast from an underground chamber is a fundamentally more controlled and lower-risk operation than a TBM wet breakthrough.

Existing monitoring infrastructure supports this approach. The National Weather Service and USGS have been monitoring Suicide Basin water levels since 2018 with drone mapping, elevation-volume curves, and hydrographic instrumentation. This infrastructure provides precise real-time knowledge of basin water level, allowing the construction team to confirm conditions before committing to the blast. The basin typically drains within approximately 48 hours of GLOF initiation, and the low-water window persists for a meaningful period before refilling begins.

Multiple connection points provide redundancy and adaptability. Rather than a single intake at one elevation, multiple upholes fired from the terminal chamber create connection points at different elevations if necessary. Lower connections drain the basin continuously during normal filling. Higher connections activate if lower ones are temporarily blocked. If basin geometry changes as the glacier retreats, additional holes can be drilled from the same terminal chamber without any new tunnel construction. This directly addresses one of the report's identified long-term concerns about system adaptability.

Construction sequence:

1. Drive main tunnel to completion on standard grade — entirely independent of basin conditions and GLOF timing
2. Develop terminal chamber at leisure with no time pressure
3. Drill probe holes upward to confirm geology, distance to basin floor, and water level
4. Prepare uphole blast pattern with electronic detonators for remote firing
5. Monitor basin through existing NWS/USGS instrumentation
6. Immediately following next GLOF event, confirm dry conditions above residual water level
7. Fire blast remotely from safe location in tunnel
8. System begins functioning as basin refills — water rises until it reaches the connection elevation and drains continuously thereafter

This eliminates the most significant construction risks in the current design:

- No wet breakthrough under pressure
- No timing dependency on TBM progress relative to GLOF cycle
- No complex surface intake structure in an extremely difficult glacial location
- No single point of failure — multiple connections provide redundancy
- Controlled commissioning at a chosen moment rather than forced by construction schedule

This methodology is entirely standard in underground mining for vertical development. It has been used for dewatering and hydrogeological control and is commonly used for lake taps, such as at the Lake Dorothy hydro project south of Juneau. In that case, the basin was full of water when the final blast was initiated. It has been executed successfully at numerous mining operations worldwide. It is not novel or experimental; it is proven practice applied intelligently to a well-characterized hydrological system.

Option B — Partial Tunnel with Drill Hole Drainage Gallery

As a sub-alternative or complement to Option A, the tunnel need not necessarily reach all the way to the basin. If the tunnel is driven to within a reasonable distance of the basin, an array of long, potentially directionally-drilled, large-diameter holes from the tunnel terminus could target the basin at multiple elevations without requiring the tunnel to reach the basin floor zone. This approach:

- Further reduces total tunnel footage and cost
- Provides the same multi-elevation redundancy as the uphole blast approach
- Can be executed from a controlled underground position at any time, independent of basin water level
- Allows future additional holes to be drilled as basin geometry evolves
- Is routinely used in mining for exploration and service holes

The optimal approach — full tunnel with uphole blast, partial tunnel with drill hole gallery, or a combination — should be determined through detailed design once geotechnical conditions are better characterized.

4. Geotechnical Investigation Approach

4.1 Desktop Characterization First

The report acknowledges that essentially no geotechnical analysis had been completed along the tunnel alignment as of the December 2025 charrette. Before committing to an expensive drilling program, a relatively low-cost desktop characterization should be completed.

In a glacially scoured landscape, fault zones and structural weaknesses are expressed at surface as linear features, valleys, slope breaks, notches, and drainage anomalies that are clearly visible in LiDAR bare earth models. Glacial erosion is one of nature's most effective geological mapping tools — ice preferentially exploits structural weaknesses, leaving them expressed in the topography in ways that an experienced structural geologist can interpret with high confidence.

The regional fault system identified in the report — northeast-dipping thrust faults and shear zones — would almost certainly be identifiable in existing LiDAR data as linear features and slope anomalies. A competent structural geology interpretation of available LiDAR and satellite imagery could be completed in weeks at relatively modest cost and would:

- Identify the likely location and character of fault zones along the alignment
- Focus the subsequent drilling program on specific locations of highest uncertainty
- Provide early indication of whether the alignment needs adjustment to avoid the worst ground conditions
- Significantly improve the value of each drill hole by ensuring it targets the right location

The New Amalga Gold project have used LiDAR bare earth models to identify fault structures in very similar rocks north of the proposed tunnel and the Greens Creek Mine also uses LiDAR to identify fault structures. CBJ has performed LiDAR surveys of the Borough and this data is readily available.

Minimal on-the-ground work could be done to confirm the LiDAR analysis and gain structural orientation data to firm up the models as a solid starting point to more cost intensive geotechnical investigations.

4.2 Focused Geotechnical Program

With desktop characterization complete, the geotechnical drilling program can be designed to answer specific questions at specific locations rather than blind drilling. This is more efficient, less costly, and produces more useful information.

The program should specifically address:

- Ground conditions at fault zone and shear zone crossings identified from LiDAR
- Rock quality and groundwater conditions at the tunnel terminal chamber location
- Geology between the terminal chamber and the basin floor, the distance the final breakthrough efforts must pass through
- Basin floor depth and character — the ice-penetrating radar data referenced in the report should be incorporated when available

Investment in a well-designed geotechnical program is the single most effective way to narrow the project cost uncertainty band. The dominant uncertainty in the current estimate is subsurface conditions. A \$2-5M geotechnical program that resolves the key unknowns could reduce the construction cost contingency requirement by far more than its cost.

5. Development Synergies

5.1 Overview

The flood control tunnel is an opportunity disguised as a crisis. The same infrastructure that protects Mendenhall Valley from GLOFs has the potential to generate clean power, enable tourism expansion, and create lasting community infrastructure. Conceived broadly, this project could be the foundation of a generation of community development. Conceived narrowly as a pure flood control expenditure, it leaves transformative opportunities unrealized.

5.2 Hydropower Generation

The tunnel's characteristics, significant elevation head, substantial design flow, and long tunnel length, create meaningful hydropower potential.

At the Mendenhall Lake outlet end, a powerhouse could be sited to capture the energy of water descending from Suicide Basin. A back of the napkin assessment suggests significant generating potential depending on net head and flow assumptions, this requires detailed engineering analysis, but the order of magnitude warrants serious consideration.

The Juneau context makes this especially compelling:

- Juneau operates an isolated electrical grid with no transmission connection to the broader Alaska or North American grid
- The community relies on existing hydroelectric projects at Snettisham and Lake Dorothy
- Firm customer demand is increasing in Juneau and additional hydropower development is some years away and very costly. This could attract a public private partnership funding opportunity for interruptible customers.
- Additional local generation capacity has genuine community value and reduces vulnerability to single-source dependence
- A stakeholder at the charrette raised hydropower potential and it was noted as interesting but set aside as outside the current scope

The revenue stream from power generation could contribute to project financing and ongoing operations and maintenance costs. Rather than a pure cost center entirely dependent on federal appropriations, a project with hydropower revenue becomes partially self-funding. This fundamentally changes the project economics and could reduce the net federal investment required.

Tunnel diameter sizing, outlet structure design, and powerhouse siting should be considered in the preliminary design even if hydropower development proceeds as a separate subsequent project. The tunnel should not be designed in a way that forecloses this opportunity.

5.3 Tourism Infrastructure

The report notes that construction of the Lake Tap Tunnel requires a staging area, pier, and barge infrastructure on the southern shore of Mendenhall Lake. This construction infrastructure has direct reuse value as permanent tourism infrastructure.

A recent study on the future of tourism in the Mendenhall Glacier area identified boat access to the far side of the lake as a community development opportunity. Currently the glacier face and surrounding area are accessible only by water, but there is no permanent boat landing infrastructure on the far shore. The construction pier and staging area, designed with future tourism use in mind, becomes a permanent community asset at relatively modest additional cost over what is required for construction alone.

The tunnel outlet itself, particularly if a powerhouse is added, becomes a point of interest and an interpretive destination, the visible demonstration of how engineering solved a climate-driven community crisis. The story of the Lake Tap Tunnel is compelling to the environmental and adventure tourism market that Juneau serves, and infrastructure that tells that story adds to the visitor experience rather than detracting from it.

Once the glacier retreats and the basin flooding is no longer an issue, the tunnel could be repurposed for tourism.

5.4 Waste Rock Management

The tunnel excavation will generate approximately 60,000 cubic yards of broken rock. In the current design concept this material must be barged across Mendenhall Lake and disposed of elsewhere, a significant cost item.

Placement of tunnel muck within or adjacent to Mendenhall Lake, or within Suicide Basin if tunneling is also initiated from that end, would eliminate this cost. Regulatory acceptance could be challenging given the lake's status within the Mendenhall Glacier Recreation Area, fish habitat concerns, and the sensitivities of multiple stakeholders including USFS and Tlingit and Haida.

However, if waste rock placement is coordinated with tourism infrastructure and community development objectives, the conversation changes. A carefully designed rock fill peninsula or extended shoreline structure:

- Eliminates the barging and disposal cost
- Creates the physical foundation for the permanent tourism pier and boat landing
- Can be designed to avoid sensitive fish spawning areas
- Can incorporate habitat enhancement features
- Transforms from environmental liability to community asset

This requires early engagement with USFS, Tlingit and Haida, ADF&G, and the USACE Section 404 permitting process — but the conversation is fundamentally different when the proposal is deliberate community infrastructure rather than waste disposal.

An alternate but more expensive approach is the one outlined in the report where the rock would be barged back across the lake. In this scenario, it could be used on local projects. Unfortunately, mining industry experience with barging rock in Southeast Alaska indicates it would be a money losing venture and the rock should be utilized at the excavation site where possible to realize savings on the overall project.

5.5 The Integrated Vision

Pulling these elements together, what emerges is a coordinated community development program where multiple projects reinforce each other:

Infrastructure layer: Flood control tunnel protecting Mendenhall Valley, constructed at lower cost using mining methodology, with waste rock used productively as foundation for tourism infrastructure.

Energy layer: Hydropower generation at tunnel outlet providing new local generating capacity, revenue stream contributing to project financing, and long-term O&M partially self-funding through power sales.

Tourism layer: Construction infrastructure repurposed as permanent visitor access, new boat access to far side of lake, tunnel outlet and powerhouse as interpretive destinations, enhanced visitor experience expanding the Mendenhall tourism offer.

Community resilience layer: Flood protection providing certainty for property owners and developers, power generation improving energy security, tourism infrastructure supporting economic diversification, Indigenous community partnership in stewardship of a project that honors and enhances the cultural landscape.

The net federal investment required for the core flood control function could be substantially reduced by the revenue streams and co-investment from hydropower, tourism, and community development components. The charrette report estimated total costs in excess of \$600M across the alternatives evaluated, with the tunnel as the lowest-cost option. This review suggests that adopting a mining engineering methodology could reduce the tunnel project cost to the \$220-320M range — a difference that fundamentally changes the community's ability to move forward. A project that currently looks like an enormous federal expenditure could be reframed as a more manageable federal investment leveraging additional community development benefit.

6. The Role of Tlingit and Haida

The Central Council of the Tlingit and Haida Indian Tribes of Alaska holds co-stewardship of the Mendenhall Glacier Recreation Area and was identified as a primary decision-maker in the charrette process. Their participation is not simply a permitting requirement, it is a genuine partnership opportunity.

The concerns Tlingit and Haida expressed at the charrette — life safety, cultural identity, community connection to the land, environmental protection, and sustainable maintainable solutions — are all better served by the integrated vision described here than by the current single-purpose design concept.

A project that:

- Protects the community from floods
- Generates clean renewable energy
- Enhances rather than degrades the Mendenhall landscape
- Creates sustainable tourism infrastructure respecting the cultural significance of the area
- Provides long-term community economic benefit
- Is designed with adaptability and resilience rather than rigid single-use infrastructure

...is a fundamentally more compelling basis for partnership than a large civil engineering project with significant environmental impacts and no community benefit beyond flood risk reduction.

Early engagement of Tlingit and Haida in the broader integrated vision, not just the permitting process for the tunnel, creates a collaborative development partnership that benefits both the Indigenous community and the broader Juneau community for generations.

7. Summary of Recommendations

Immediate Actions (Before May 2026 Preliminary Design Completion)

- 1. Commission LiDAR-based structural geology interpretation.** Engage a qualified structural geologist to interpret existing LiDAR bare earth data along the tunnel alignment. This low-cost desktop work should precede the geotechnical drilling program and will significantly improve the efficiency and value of that program.
- 2. Formally request USACE evaluate conventional D&B methodology.** As project sponsor, the City should have standing to formally request that the preliminary design document a comparative evaluation of conventional drill and blast versus TBM methodology, including cost, schedule, risk, and labor availability analysis. This evaluation should specifically address the 8% grade compatibility issue and the availability of experienced underground contractors in Alaska.
- 3. Formally request evaluation of shallower gradient alignment options.** Request that alternative alignments at 1-3% grade be evaluated for constructability and cost, including the tunnel length and lining specification implications of reduced flow velocity.
- 4. Formally request evaluation of post-GLOF breakthrough methodology.** Request that the preliminary design address the post-GLOF uphole blast connection and the partial tunnel drill hole gallery concept as alternatives to the current TBM breakthrough and surface intake structure, including a comparative risk assessment of the approaches.
- 5. Request that preliminary design preserve future optionality.** Specifically request that tunnel diameter, outlet siting, and staging area design not foreclose future hydropower generation and tourism infrastructure development. This costs essentially nothing at the design stage and preserves enormous community optionality.
- 6. Formally request that the USACE provides a cost estimate for mid-long-term installation and maintenance of the HESCO barrier system.** If this is the path the USACE chooses in lieu of their costly civil tunneling project as currently proposed, by default, the HESCO's become the chosen solution and should be the basis for cost comparison for other options evaluated in the future.

Near-Term Actions (2026-2027)

- 7. Commission independent cost estimate of the tunnel using mining methodology assumptions.** Engage an EPCM underground mining contractor to develop a comparative cost estimate based on D&B construction methodology, targeted lining specification, and post-GLOF breakthrough approach. This provides the City with an independent reference point against the USACE estimate.
- 8. Commission independent cost estimate of civil works in support of the tunneling project.** Juneau has comparable infrastructure from marine construction that will guide the cost estimates.

9. Initiate hydropower feasibility assessment. Commission a preliminary hydropower feasibility study assessing the generating potential of the tunnel alignment, potential powerhouse siting, FERC licensing pathway, AIDEA financing options, and revenue projections. This work can proceed in parallel with tunnel preliminary design.

10. Engage tourism development stakeholders. Initiate conversations with CBJ tourism development, USFS, and private tourism operators about the potential for construction infrastructure to be designed for permanent tourism reuse, and about the boat access opportunity to the far side of Mendenhall Lake.

11. Continue engagement with Tlingit and Haida, focusing on the long term relationship and on the integrated vision. Move beyond the permitting relationship to a genuine partnership conversation about the community development potential of an integrated flood control, hydropower, and tourism project on lands of deep cultural significance.

8. Cost Perspective

While a refined estimate requires detailed design work, the following framework reflects the alternative methodology described in this review. Note that this estimate is also at a conceptual level — the same uncertainty that applies to the USACE estimate applies here. The intent is not to guarantee a lower number but to illustrate that a meaningfully different cost outcome is plausible if methodology assumptions are revisited.

Component	Range
D&B tunnel excavation (12,000 ft at \$3,500-5,000/ft)	\$42-60M
Targeted lining and ground support (\$1,500-2,500/ft)	\$18-30M
Terminal chamber and uphole connection program	\$5-10M
Outlet structure at Mendenhall Lake	\$5-8M
Staging areas and piers — two locations required, one at Mendenhall Lake and one to support the Suicide Basin end	\$25-35M
Geotechnical investigation and design	\$15-20M
Environmental, permitting, and owner's costs	\$20-30M
Construction management	\$25-35M
Contingency (50% on construction — consistent with USACE Class 4 approach at this design level)	\$65-95M
Total project estimate	\$220-323M

This range reflects a meaningful reduction from the USACE estimates while acknowledging that subsurface conditions remain the dominant uncertainty. It is not a guarantee. It is a planning framework that suggests the project is more affordable than current estimates indicate if construction methodology assumptions are revisited. The contingency has been kept at 50%

consistent with the USACE Class 4 approach, since this review is at an equivalent level of design development.

The most important message about cost is this: invest in geotechnical investigation now. The \$2-5M required for a well-designed subsurface investigation program is the highest-return investment available at this stage. It will narrow the uncertainty band, reduce the contingency requirement, and provide the information needed to optimize the design. Every dollar spent on geotechnical investigation before construction likely saves five to ten dollars in construction cost uncertainty.

9. Conclusion

The Lake Tap Tunnel will protect the Mendenhall Valley from the escalating GLOF threat, and the community needs to center on this solution as soon as possible. That outcome is not in question. What is in question is whether the community gets there at the cost levels suggested by the current civil engineering methodology approach, or at a meaningfully lower cost using mining engineering methodology applied directly to what is fundamentally a mining engineering problem, and whether the community captures the hydropower, tourism, and development opportunities that the project makes possible.

The difference between these outcomes is not technical. The engineering knowledge exists. The mining methodology is proven. Evidence of tunneling exists all around Juneau and is actively being done at two local mines. The synergies are real.

I encourage CBJ to actively question the current thoughts of the USACE. There are easier methods to the tunnelling they have proposed that will not cause the sticker shock their estimate has. The community that has endured a natural disaster for over a decade deserves not just protection from that disaster but the opportunity to build something lasting from the response to it.

This review reflects the independent technical perspective of an advisor with extensive underground hard rock mining experience in Southeast Alaska. It is intended to inform the City and Borough of Juneau's exercise of its role as project sponsor in the USACE planning process and provide an alternate view of how the enduring solution could be accomplished.