SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

March 29, 2024

Mr. Brad Ryan
Municipality of Skagway
PO Box 415
700 Spring Street
Skagway, Alaska 99840

RE: PROPOSAL FOR RAILROAD DOCK SLOPE EVALUATION, SKAGWAY, ALASKA

Dear Mr. Ryan:

We are pleased to submit herein our proposal and estimated costs for providing slope hazard evaluation services for the above referenced project. Shannon & Wilson has provided various services over the last two years addressing the main slide feature on the north end of the White Pass & Yukon Route Railway (WPYR) Dock in Skagway, Alaska. We understand that a wider view of the slope risks along the slope above the WPYR Dock is desired. As such, we have prepared this proposed scope of services to conduct a hazard evaluation of the slope, outside of the limits of the existing active areas.

SCOPE OF SERVICES

In general, our scope of work includes fieldwork to conduct mapping and direct observation of the slope conditions, kinematic stability analyses, and rockfall analysis to support the development of a risk profile for the slope and facilities at the base of the slope. This scope of work has been developed in coordination with the Municipality of Skagway (MOS) and stakeholders at the base of the slope including WPYR and cruise operators. We have provided a draft scope outline for review by the MOS and the stakeholder geotechnical consultants Delve Underground (Delve) and Haley & Aldrich (H&A). This proposal addresses written comments provided by Delve and H&A and in our opinion is consistent with the local standard of practice.

TASK 1 – PRELIMINARY EVALUATION

We will conduct preliminary evaluations to establish a framework for the subsequent tasks. Existing information from the site will be reviewed to identify terrain and geologic conditions, and LiDAR-based topography will be reviewed to evaluate terrain features and site geometry that could create adverse rock fall and slope/rockfall conditions. We will also

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use the existing rock structure information that has been collected by Shannon & Wilson and others during prior efforts to establish an understanding of the likely controlling structures along the slope and conduct a preliminary kinematic analysis. High resolution aerial photography of the slope collected in the spring of 2023 will be used to evaluate vegetative cover and identify the presence and distribution of existing rock exposure.

We will use the above information to conduct a preliminary rockfall analysis along the slope. The purpose of the preliminary analysis will be to identify areas of increased interest on the slope for future mapping effort. We will also use the preliminary results to identify areas along the dock where significant rockfall hazard exists. We assume that no formal deliverables will be developed for this effort, but informal information will be provided to the MOS for distribution to Delve and H&A for review and comment. We assume that the provided discussion will help refine our planned data collection and analysis approach.

TASK 2 – FIELDWORK AND DATA COLLECTION

As stated above, our fieldwork and data collection effort will be based on the results of our preliminary analysis, but we have provided a level of effort in this proposal for scoping and budgeting purposes. Our data collection effort will be focused on the slope area between the Main Slide on the north end of the dock and the Half-South-South slide on the south end of the wide portion of the dock. The horizontal distance between these two features is approximately 600 feet.

Our data collection will largely consist of continuous geologic and structure mapping of rock exposure on fall-line transects spaced every 100 feet within the study area. A combination of structural rock mass cell mapping and scanline mapping techniques will be employed as appropriate for the site conditions. We will record structure orientation and type, as well as other important parameters to describe the distribution, persistence, and nature of the discontinuities. We will also record evidence of past rockfall events including location, apparent initiation point, and discernable rock size. We will identify potential rockfall sources based on existing exposure. In addition, drone based photogrammetry will be performed to capture high resolution imagery of the lowest cliff forming rock surfaces adjacent to the dock from the Main Slide to Half-South-South.

The information will be collected using a crew of four personnel including one Society of Professional Rope Access Technicians (SPRAT) Level 3 certified technician, two SPRAT Level 1 or higher technician and geologist, and one additional geologist. The SPRAT Level 3 technician will remain at the top of the slope maintaining radio communication with the on-

slope crew. The technician will also be responsible for setting anchors, managing ropes, crew safety, and emergency response in the event that is necessary. The SPRAT Level 1 or higher technician will accompany our SPRAT Level 1 or higher geologist on the slope to assist with on-slope rope management and accessing locations along the slope. Our SPRAT Level 1 or higher geologist will be responsible for all on-slope mapping activity, note taking, photographing conditions, and sample collection. Our geologist will remain on the top of the slope and will be in radio communication with the on-slope geologist to record dictated structure measurements and note taking.

Assuming a horizontal distance of 600 feet and a line spacing of 100 feet, we plan on performing mapping on a total of seven transects. Our transect lines will run the entire fall line of the slope and will include station mapping at the rock cliffs at the based of the slope adjacent to the dock. This will provide an overlap for confirmation of data collected via droned based photogrammetry. We have planned for three days of activity on each slope transect. Structure mapping data will be plotted on stereonets and notes will be recorded electronically for evaluation at the end of each day. The evaluation will be conducted with the goal of identifying data gaps that should be addressed in the subsequent day's activities. We assume that informal deliverables will be shared at the completion of our mapping activities to the MOS, Delve, and H&A.

TASK 3 – ROCKFALL ANALYSES

Upon completion of our fieldwork we will organize the data, notes, and photographs collected during the field effort. We will develop stereoplots of the observed structure based on transect line, geology type, elevation, and other identified categories. The exercise will support kinematic analyses for slope stability at identified rockfall sources, various geologic units, elevation bands, and along the transects. The kinematic analyses will in turn be used to establish parameters for rockfall analyses which will be conducted for the same subcategories as those used in the kinematic analyses. The rockfall analyses will be conducted using topography from LiDAR elevation contours collected during the spring of 2023 as well as surface and material properties developed during prior rockfall analyses (calibrated by actual rockfall event records) and informed by the surface observations made during our field effort. We assume that we will conduct rockfall analyses on up to seven slope cross sections.

The culmination of the rockfall analyses will be the classification of zones at the toe of the slope that will be impacted by rockfall. We assume that the current configuration of dock and barrier protection will be used in our analyses (i.e. we will not evaluate rockfall

protection alternatives). We assume that rockfall protection measures will be evaluated in a separate effort. The impacts at the toe of the slope will be described in terms of impact area/distribution as well as size and energy of rocks impacting those areas. We assume that informal deliverables will be shared at the completion of our mapping activities to the MOS, Delve, and H&A.

TASK 4 – LABORATORY TESTING

We will conduct laboratory testing on samples collected during our field effort. The testing will be focused on evaluating the intact rock strength, intact bulk density of the rock, and direct shear properties of the rock. Direct shear testing will be conducted on saw-cut prepared samples and actual joint shear strengths will be estimated using roughness estimates from field observations. We will conduct testing on a representative population of samples that reflect the geologic variability encountered during fieldwork. We assume that informal deliverables will be shared at the completion of our mapping activities to the MOS, Delve, and H&A.

TASK 5 – STABILITY ANALYSES

Stability analyses will be conducted for key features identified in our kinematic analyses. The stability analyses will be conducted using two-dimensional, limit equilibrium, pseudostatic approaches available for use in the RocScience suite of software for evaluating plane shear and wedge failure mechanisms. We will use the results of our kinematic analyses and on-slope observations to identify potential failure features and the geometric limits of these features for developing the analysis models. Additionally, we will perform stability analyses of identified rock blocks that are kinematically admissible from the photogrammetry of the lower rock cliff faces. The result of these analyses will be to identify the presence of features that may not meet acceptable stability criteria, assumed to be a factor of safety (FS) against sliding of 1.5 or higher for dry static and 1.1 for seismic. Note that these criteria are applicable to plane shear and wedge failures only. Potential toppling failure will be evaluated for potential only.

The results of the stability analyses will be used to identify impacts to the base of the slope due to larger scale slope failures. We will evaluate the location of potential failures and the volumes of material that could be released from them. We will also evaluate runout impacts of debris slides from slope failures based on empirical relationships presented in Runout Exceedance Prediction for Open Pit Slope Failures by John Russell Whittall (2015). We

assume that informal deliverables will be shared at the completion of our mapping activities to the MOS, Delve, and H&A.

TASK 6 – HAZARD ANALYSES

In order to create a hazard profile for the facilities at the base of the slope, we will use the Landslide Risk Management method presented by the Australian Geomechanics Society (Volume 42 No 1 March 2007) . The evaluation will consider the results of our rock fall and stability analyses and we will also consider the readily available historic rockfall activity on the slope. We will rely on public records for past slide and rockfall events and we will also conduct interviews with MOS and WPYR personnel who can provide anthropological accounts of past slope activity and event frequency. We anticipate that the hazard analyses, unless warranted from the field investigation results, will be subdivided into three regions; the Main Slide, the area between the Main Slide, and Half-South-South.

TASK 7 – RECOMMENDATIONS AND REPORTING

Upon the completion of the above tasks, we will prepare a report to formalize the results of our work. We will include all of the information reviewed during the preliminary efforts as well as generalized results of the preliminary evaluation. We will include all collected field information, notes in tabular format, and selected site photographs and describe general progression of our field work. Our report will include detailed results of our rockfall and stability analyses as well as lab testing results. The analyses descriptions will include a detailed presentation of input parameters and modelling assumptions as well as detailed narrative describing the analysis procedures and results. Our report will also include a detailed description of the results of our hazard analysis including analyses assumptions and event data used to establish frequency.

Recommendations included in our report will be generalized in nature. We will frame the recommendations with a general discussion of the risks posed to the base of the slope and the likely mitigation measures that can be undertaken to mitigate those risks. We envision that multiple options will be presented and that we will provide our opinion regarding the relative effectiveness, cost, feasibility of those options.

Our report will be conducted under the direct supervision of an engineer licensed in the State of Alaska and experienced in rock slope stability and rockfall mitigation. We will provide a draft version of our report for review and comment by the MOS, Delve, and H&A. We will submit a final report addressing comments provided by reviewers.

TASK 9 – PROJECT MEETINGS AND COORDINATION

We anticipate the need for a significant effort for meetings and coordination between the MOS and the stakeholder consultants (Delve and H&A). We have included meeting and coordination effort to accommodate weekly meetings between Shannon & Wilson and the MOS. We have also included effort for monthly meetings with Delve and H&A.

SCHEDULE

We are prepared to begin work on this project immediately upon receipt of notice to proceed. Preliminary analyses will take approximately six weeks to conduct and we assume that the fieldwork will follow during the summer months of 2024. The remainder of our analysis can be conducted over the following months and we estimate it can be completed by February 2025, assuming fieldwork is completed no later than September 2024. We will work with you continuously throughout our process and provide preliminary information as it is available.

ESTMATED COSTS AND CONDITIONS FOR SERVICES

Estimated costs for the work outlined above are included on the attached *Summary Cost Estimate.* We assume that this work will be conducted on a time and materials basis in accordance with a mutually agreed-upon contract for professional services. We will not exceed the maximum quoted value in our estimate without your prior approval. We assume that if changes to our approach are experienced, we will be able to work with you to negotiate the appropriate changes to our scope of work and fees. We will keep you appraised of our progress and inform you immediately if such changes are needed. We have attached *Important Information About Your Geotechnical Proposal* to help you understand the nature and limitations of our services.

Should you have questions or comments or wish to revise the scope of our services, please call the undersigned. We look forward to working with you on this project and appreciate the opportunity to be of service to you.

Sincerely,

SHANNON & WILSON

Kyle Brennan, PE

Digitally signed by Kyle Brennan, PE
Date: 2024.03.29 21:41:02 -08'00'

Kyle Brennan, PE
Vice President

Enc. Summary Cost Estimate (3 Sheets)
Important Information About Your Geotechnical/Environmental Proposal

SUMMARY COST ESTIMATE

GEOTECHNICAL SERVICES

1. Preliminary Evaluation							**$21,050**
Data Compilation and Review						$2,800	
Vice President (Kyle)	2	hrs. x	$250	/hr.	= $500		
Associate (Rex)	4	hrs. x	$200	/hr.	= $800		
Professional IV	12	hrs. x	$125	/hr.	= $1,500		
Rockfall Analysis						$14,500	
Vice President (Kyle)	2	hrs. x	$250	/hr.	= $500		
Associate (Rex)	20	hrs. x	$200	/hr.	= $4,000		
Professional IV	40	hrs. x	$125	/hr.	= $5,000		
HDR Support (Cross Section Generation)	1	x	$5,000		= $5,000		
Results Compilation and Informal Deliverable Package Development						$3,750	
Vice President (Kyle)	2	hrs. x	$250	/hr.	= $500		
Associate (Rex)	10	hrs. x	$200	/hr.	= $2,000		
Professional IV	10	hrs. x	$125	/hr.	= $1,250		
2. Fieldwork and Data Collection							**$231,438**
Field Work/Data Collection						$231,438	
Vice President (Kyle)	10	hrs. x	$250	/hr.	= $2,500		
Oversight	6						
Coordination	4						
Associate (Rex)	100	hrs. x	$200	/hr.	= $20,000		
Oversight	42						
Coordination	6						
Travel	16						
Onsight Time (3, 12-hour days)	36						
Sr. Professional III (Erik)	272	hrs. x	$185	/hr.	= $50,320		
Coordination/Prep	4						
Travel	16						
Onsight Time (21, 12-hour days)	252						
Professional IV	268	hrs. x	$125	/hr.	= $33,500		
Coordination/Prep	4						
Travel	12						
Onsight Time (21, 12-hour days)	252						
GRA Mobilization	1	x	$11,500	each	= $11,500		
GRA Onsite Time	21	days x	$4,129	/day	= $86,709		
Field Ependables	21	days x	$40	/day	= $840		
Drone Rental	2	days x	$150	/day	= $300		
Airfare (S&W)	3	x	$1,500	each	= $4,500		
Sample and Equipment Shipping (est.)	1	x	$750	each	= $750		
Lodging (total nights in Skagway for S&W and GRA)	85	nights x	$200	/night	= $17,000		
Perdiem (for S&W crew including travel days)	51	days x	$69	/day	= $3,519		
3. Rockfall Analysis							**$58,000**
Rockfall Analysis						$50,500	
Vice President (Kyle)	2	hrs. x	$250	/hr.	= $500		
Associate (Rex)	40	hrs. x	$200	/hr.	= $8,000		
Professional IV	280	hrs. x	$125	/hr.	= $35,000		
HDR Support (Cross Section Generation)	1	x	$7,000		= $7,000		
Results Compilation and Informal Deliverable Package Development						$7,500	
Vice President (Kyle)	4	hrs. x	$250	/hr.	= $1,000		
Associate (Rex)	20	hrs. x	$200	/hr.	= $4,000		
Professional IV	20	hrs. x	$125	/hr.	= $2,500		
4. Lab Testing							**$7,100**
Lab Coordiantion						$7,100	
Vice President (Kyle)	2	hrs. x	$250	/hr.	= $500		
Associate (Rex)	8	hrs. x	$200	/hr.	= $1,600		
Lab Subcontract (est.)	1	x	$5,000		= $5,000		
5. Kinematic Analysis							**$9,500**
Kinematic Analyses						$9,500	
Vice President (Kyle)	2	hrs. x	$250	/hr.	= $500		
Associate (Rex)	20	hrs. x	$200	/hr.	= $4,000		
Professional IV	40	hrs. x	$125	/hr.	= $5,000		

SUMMARY COST ESTIMATE

6. Stability Analysis							**$59,500**
Photogrammetric Analysis						$23,500	
Vice President (Kyle)	2	hrs. x	$250 /hr.	=	$500		
Associate (Rex)	40	hrs. x	$200 /hr.	=	$8,000		
Professional IV	120	hrs. x	$125 /hr.	=	$15,000		
Stability Analysis						$28,500	
Vice President (Kyle)	2	hrs. x	$250 /hr.	=	$500		
Associate (Rex)	40	hrs. x	$200 /hr.	=	$8,000		
Professional IV	160	hrs. x	$125 /hr.	=	$20,000		
Results Compilation and Informal Deliverable Package Development						$7,500	
Vice President (Kyle)	4	hrs. x	$250 /hr.	=	$1,000		
Associate (Rex)	20	hrs. x	$200 /hr.	=	$4,000		
Professional IV	20	hrs. x	$125 /hr.	=	$2,500		
7. Hazard Analysis							**$22,700**
Research and Interviews						$9,500	
Vice President (Kyle)	2	hrs. x	$250 /hr.	=	$500		
Associate (Rex)	20	hrs. x	$200 /hr.	=	$4,000		
Professional IV	40	hrs. x	$125 /hr.	=	$5,000		
Hazard Analysis						$13,200	
Vice President (Kyle)	4	hrs. x	$250 /hr.	=	$1,000		
Associate (Rex)	36	hrs. x	$200 /hr.	=	$7,200		
Professional IV	40	hrs. x	$125 /hr.	=	$5,000		
8. Recommendations and Reporting							**$54,000**
Engineering and Draft Report						$38,500	
Vice President (Kyle)	20	hrs. x	$250 /hr.	=	$5,000		
Associate (Rex)	80	hrs. x	$200 /hr.	=	$16,000		
Professional IV	140	hrs. x	$125 /hr.	=	$17,500		
Final Report						$15,500	
Vice President (Kyle)	8	hrs. x	$250 /hr.	=	$2,000		
Associate (Rex)	30	hrs. x	$200 /hr.	=	$6,000		
Professional IV	60	hrs. x	$125 /hr.	=	$7,500		
9. Project Meetings and Coordination							**$30,950**
Project Meetings (28 weeks project duration)						$20,700	
Vice President (Kyle)	36	hrs. x	$250 /hr.	=	$9,000		
Associate (Rex)	36	hrs. x	$200 /hr.	=	$7,200		
Professional IV	36	hrs. x	$125 /hr.	=	$4,500		
Project Management						$10,250	
Vice President (Kyle)	20	hrs. x	$250 /hr.	=	$5,000		
Associate (Rex)	20	hrs. x	$200 /hr.	=	$4,000		
Professional IV	10	hrs. x	$125 /hr.	=	$1,250		
					Project Total =		**$494,238**

Assumptions:

1 Effort is based on our understanding of the project and site conditions

2 We assume that adustments (including increases or decreases) to approach and level of effort will be negotiated as appropriate as the project evolves.

3 With the exception of the field activities and onsite meetings, all meetings and coorespondance will be conducted remotely via email, telephone, teleconference, and/or web meetings.

4 Labor rates are based on 2024 standard general hourly rates. We assume escalation rates will be negotiated for labor to occure beyond 2024.

5 If disruptions to commercial air or ferry service prevent our field crew from demobilizing from Skagway after field activities, we will bill at the unit rates included above.

6 Field activities will take place during the summer months when snow cover or frozen ground conditions do not exist at the site.

7 Billing will occure monthly on a time and expense basis. We will notify you immediately if we encounter issues or other circumstances that would require an adjustment to our scope.

8 Work will be performed under a mutually agreed upon contract for professional services.

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Attachment to and part of Proposal 109508-P8

Date: March 2024
To: Mr. Brad Ryan
Skagway Slope Evaluation

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL PROPOSAL

More construction problems are caused by site subsurface conditions than any other factor. The following suggestions and observations are offered to help you manage your risks.

HAVE REALISTIC EXPECTATIONS.

If you have never before dealt with geotechnical or environmental issues, you should recognize that site exploration identifies actual subsurface conditions at those points where samples are taken, at the time they are taken. The data derived are extrapolated by the consultant, who then applies judgment to render an opinion about overall subsurface conditions; their reaction to construction activity; appropriate design of foundations, slopes, impoundments, and recovery wells; and other construction and/or remediation elements. Even under optimal circumstances, actual conditions may differ from those inferred to exist, because no consultant, no matter how qualified, and no subsurface program, no matter how comprehensive, can reveal what is hidden by earth, rock, and time.

DEVELOP THE SUBSURFACE EXPLORATION PLAN WITH CARE.

The nature of subsurface explorations—the types, quantities, and locations of procedures used—in large measure determines the effectiveness of the geotechnical/environmental report and the design based upon it. The more comprehensive a subsurface exploration and testing program, the more information it provides to the consultant, helping to reduce the risk of unanticipated conditions and the attendant risk of costly delays and disputes. Even the cost of subsurface construction may be lowered.

Developing a proper subsurface exploration plan is a basic element of geotechnical/environmental design, which should be accomplished jointly by the consultant and the client (or designated professional representatives). This helps the parties involved recognize mutual concerns and makes the client aware of the technical options available. Clients who develop a subsurface exploration plan without the involvement and concurrence of a consultant may be required to assume responsibility and liability for the plan's adequacy.

READ GENERAL CONDITIONS CAREFULLY.

Most consultants include standard general contract conditions in their proposals. One of the general conditions most commonly employed is to limit the consulting firm's liability. Known as a "risk allocation" or "limitation of liability," this approach helps prevent problems at the beginning and establishes a fair and reasonable framework for handling them, should they arise.

Various other elements of general conditions delineate your consultant's responsibilities. These are used to help eliminate confusion and misunderstandings, thereby helping all parties recognize who is responsible for different tasks. In all cases, read your consultant's general conditions carefully and ask any questions you may have.

HAVE YOUR CONSULTANT WORK WITH OTHER DESIGN PROFESSIONALS.

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a consultant's report. To help avoid misinterpretations, retain your consultant to work with other project design professionals who are affected by the geotechnical/environmental report. This allows a consultant to explain report implications to design professionals affected by them, and to review their plans and specifications so that issues can be dealt with adequately. Although some other design professionals may be familiar with geotechnical/environmental concerns, none knows as much about them as a competent consultant.

OBTAIN CONSTRUCTION MONITORING SERVICES.

Most experienced clients also retain their consultant to serve during the construction phase of their projects. Involvement during the construction phase is particularly important because this permits the consultant to be on hand quickly to evaluate unanticipated conditions, to conduct additional tests if required, and when necessary, to recommend alternative solutions to problems. The consultant can also monitor the geotechnical/environmental work performed by contractors. It is essential to recognize that the construction recommendations included in a report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site.

Because actual subsurface conditions can be discerned only during earthwork and/or drilling, design consultants need to observe those conditions in order to provide their recommendations. Only the consultant who prepares the report is fully familiar with the background information needed to determine whether or not the report's recommendations are valid. The consultant submitting the report cannot assume responsibility or liability for the adequacy of preliminary recommendations if another party is retained to observe construction.

REALIZE THAT ENVIRONMENTAL ISSUES MAY NOT HAVE BEEN ADDRESSED.

If you have requested only a geotechnical engineering proposal, it will not include services needed to evaluate the likelihood of contamination by hazardous materials or other pollutants. Given the liabilities involved, it is prudent practice to always have a site reviewed from an environmental viewpoint. A consultant cannot be responsible for failing to detect contaminants when the services needed to perform that function are not being provided.

ONE OF THE OBLIGATIONS OF YOUR CONSULTANT IS TO PROTECT THE SAFETY, PROPERTY, AND WELFARE OF THE PUBLIC.

A geotechnical/environmental investigation will sometimes disclose the existence of conditions that may endanger the safety, health, property, or welfare of the public. Your consultant may be obligated under rules of professional conduct, or statutory or common law, to notify you and others of these conditions.

RELY ON YOUR CONSULTANT FOR ADDITIONAL ASSISTANCE.

Your consulting firm is familiar with several techniques and approaches that can be used to help reduce risk exposure for all parties to a construction project, from design through construction. Ask your consultant, not only about geotechnical and environmental issues, but others as well, to learn about approaches that may be of genuine benefit.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland