



To: **Sunshine Coast Regional District** Date: **January 24, 2024**
Attention: **Drew Brennan** Project No.: **33642**
Cc:
Reference: **Chaster Park Pedestrian Bridge and Revetement Wall Planning Options**
Cliff Gilker Park Bridges and Trail Recovery Options – REVISED MAY 22, 2024
From: **Richard Avedon-Savage and Janet Tong**

ISL Engineering and Land Services Ltd. (ISL) was retained by Sunshine Coast Regional District (SCRD) to prepare a conceptual options study for a new pedestrian bridge at Chaster Park, a condition inspection of the storm water revetment wall at Chaster Park, conceptual options study for the three pedestrian bridge at Cliff Gilker Park and assessment of 2.5km of trails within Cliff Gilker Park.

This memo summarizes the evaluation of existing trail and bridge conditions, reviews conceptual options and provides recommendations for bridge replacements and trail improvements.

1.0 Background

1.1 Chaster Park

The main access to Chaster Park was damaged by excessive flooding during the 2021 atmospheric river events. Damages include erosion behind the existing bridge North abutment and undermining and cracking along the face the concrete storm water management revetment wall. A preliminary engineering review assessment of the pedestrian bridge confirmed the foundation had been compromised and it was unsafe for public access. Consequently, Parks staff immediately closed Chaster Park, and blocked off access to the bridge. Subsequently, the Sunshine Coast Regional District (SCRD) provided an alternate access to the Park via a gravel driveway.

1.2 Cliff Gilker

The November 2021 atmospheric river flooding events caused significant damage to the trail system and bridge structures at Cliff Gilker Park. These include approximately 2.5 kilometers of recreational trails and three (3) pedestrian bridges.

2.0 Existing Conditions

A site visit was conducted by ISL on September 5, 2023 to gather information on the site and existing conditions.

2.1 Chaster Park

The existing bridge at Chaster Park is a clear span timber deck structure supported by steel girders. The steel girders rest on concrete abutments.

Table 1: Chaster Park Bridge - Existing Structure

| Superstructure | Substructure | Deck and Railing | Length (m) | Width (m) | Comments |
|---|------------------------|------------------|------------|-----------|--|
| Steel Girders with timber plank decking | Concrete abutment wall | Timber | 5.5 | 2.0 | Bridge superstructure in good shape, eroded backfill behind north abutment and undermined revetment wall on south side |



Chaster Park Bridge



Erosion behind North abutment



Crack in revetment wall upstream of bridge crossing



Undermining at revetement wall

2.2 Cliff Gilker Park

The three damaged bridges at Cliff Gilker Park include Upper Waterfall Bridge, Lower Waterfall Bridge and Zig Zag Bridge. All three bridges consist of a timber plank decking and timber railings. The Upper Waterfall and Zig Zag bridges have log stringers whereas the Lower Waterfall bridge has dimensional lumber stringers. The log stringers are founded directly on the existing grade or timber/log cribbage wall. Intermediate supports consist of timber posts anchored to bedrock or supported on rock filled gabion baskets. The red trail was reviewed and is a mixture of



timber boardwalk and dirt paths. Several sections of the trail have exposed tree roots as a result of soil erosion and flooding has been reported in several areas of the trail.

The existing bridges reviewed in Cliff Gilker Park are summarized below.

Table 2: Upper Waterfall Bridge - Existing Structure

| Superstructure | Substructure | In-stream Supports | Length (m) | Width (m) | Comments |
|---|------------------------------------|---|------------|-----------|---|
| Wooden log stringers with wood deck and wood railings | Pressure treated wood and concrete | 4x4 wood posts with framing anchors in bedrock within creek bed | 10 | 1.3 | Excessive vibration, Replacement recommended as soon as possible, high risk of failure without load limits enforced |

Should the SCRD want to keep the bridge open, it is recommended closing off access to the viewpoint, add additional stringers where possible and posting a sign to advise that a maximum of 2 people on the bridge at the same time.

Table 3: Lower Waterfall Bridge - Existing Structure

| Superstructure | Substructure | In-stream Supports | Length (m) | Width (m) | Comments |
|---|---|---------------------|------------------------|-----------|--|
| Wood 2-2 x12 stringers with wood deck and wood railings | Wood logs and riprap erosion protection | Rock gabion baskets | 20m total (2 segments) | 1.0 | East side partially washed away, west side in fair condition but high risk of further damage during high creek flows |

Table 4: Zig-Zag Bridge - Existing Structure

| Superstructure | Substructure | In-stream Supports | Length (m) | Width (m) | Comments |
|---|---|---|------------------------|-----------|--|
| Wooden log stringers with wood deck and wood railings | Wood logs and riprap erosion protection | Fallen log support @ midspan within creek bed | 25m total (2 segments) | 1.2 | Badly damaged, log stringers are extremely deteriorated, south side deck and railing in fair condition |



Upper Waterfall Bridge – Upstream view



Upper Waterfall Bridge - Instream supports



Lower Waterfall Bridge – View from north approach



Lower Waterfall Bridge – Damaged gabion abutment at Island



Zig Zag Bridge – view from south approach



Zig Zag Bridge - North abutment



Existing trail section that was flooded in November 2021



Existing trail section that was flooded in November 2021



Erosion of existing trail section



Existing timber planks to be removed



Existing geotextile to be removed



Existing boardwalk to be replaced

During the 2021 atmospheric event, portions of Lower Waterfall and Zig Zag bridges were damaged and washed away and sections of the trail system were flooded. Steeper sections of the trail became a river as heavy rains channeled through the trails. Heavy rains in October 2023 also caused significant flows in Clack Creek, resulting in additional flooding of the trail system.

Conditions at Cliff Gilker Park after a heavy rainfall event in October 2023 are shown below in photos provided by SCRD.



Upper Waterfall Bridge



Lower Waterfall Bridge



Zig Zag Bridge



Trail Flooding by Gorge Bridge

2.3 Existing Information

Existing information provided by SCRD include:

- Survey information of Chaster House Park
- Trail map of Cliff Gilker Park
- Mt. Elphinstone South Watershed Assessment: Phases 1&2 (Volume 1&2), Final Report, prepared by Polar Geoscience, dated July 2023
- Various site photographs during high creek flow events

Record drawings of the bridges, boardwalks and stormwater revetment wall were not available.



3.0 Project Design Criteria

The following design requirements and evaluation criteria were established with SCR D.

3.1 Design Requirements

Table outlines the engineering design requirements used to develop each concept.

Table 5: Design Requirements

| Requirement | Details |
|----------------------|---|
| Code | Canadian Highway Bridge Design Code (CHBDC), CSA S6-19 Pedestrian, Cycling and Multiuse Bridge Design Guideline, CSA S7-23 |
| Deck width | 1000 m (to match existing accessible ramp at Chaster House) |
| Users | Pedestrian, cyclists, wheelchair at Cliff Gilker and Chaster Park ATV use on Upper Waterfall bridge at Cliff Glier Park (optional) |
| Design Life (target) | 75 years per CHBDC |

3.2 Evaluation Criteria

Table outlines the criteria that were used to evaluate each concept.

Table 6: Evaluation Criteria

| Criteria | Details |
|---|--|
| Construction Cost / Lifecycle Cost | Design should be cost-effective, both in terms of up-front construction cost and overall lifecycle costs |
| Durability / Maintenance | Long life expectancy, suitable for climate and service conditions Low maintenance materials and finishes Resistant to vandalism |
| Constructability / Local Sourcing | Within local contractor abilities as far as possible. Available from Canadian sources, or preferably local suppliers where possible. |
| Sustainability (Global Warming Potential) | Consider the environmental impact of the greenhouse gases (CO ₂ and others) produced as a part of the material production and construction processes. |
| Aesthetics | Blends in with the environment (Cliff Gilker Park) Does not distract from the historic site or appear falsely historical (Chaster Park) |

4.0 Bridge Replacement Options and Repairs

4.1.1 Superstructure Options

There are various common bridge superstructure options. Based on the level of flows in Clack Creek during heavy rain events, clear span structures were selected for all bridge options (no in-stream piers). Although each type of bridge can be designed to accommodate any span length, there are certain ranges that are most cost-effective for each bridge type. A comparison of typical span lengths for each bridge type is shown in Table 5.

Table 7: Superstructure options for typical pedestrian bridges

| Item | Material | Typical Span |
|--------------|---|--------------------|
| Beam | Steel – rolled steel, plate girder, trapezoidal box Cast-in-place concrete beams Precast concrete – box section, double tees, I section, channel section Timber – log stinger, glu-lam, solid timber | Short (under 15m) |
| Truss | Aluminum, fiberglass, stainless steel, steel, timber | Short (under 25m) |
| Arch | Concrete, steel | Medium (under 40m) |
| Cable-stayed | Steel | Long (over 40m) |
| Suspension | Steel | Long (over 50m) |

4.1.2 Substructure/foundation Options

Bridge foundations are designed to suit the existing site conditions (soil properties, seismic conditions, constructability constraints) and design loading. The substructure options considered are assumed to be installed above top of bank to minimize environmental regulations. Options are summarized below in Table 8. Requirements for abutment armouring and bank protection, such as rip rap size and quantity, will be developed further in detailed design.

Table 8: Substructure options

| Substructure Type | Construction Process | Comments |
|--|--|---|
| Precast concrete blocks | Excavate to subgrade, compact, place blocks, backfill. Geogrid reinforcing for walls above 2 blocks high | Quick installation, readily available supply of blocks, requires excavator for installation, low cost |
| Cast-in-place concrete Spread footing or abutment wall | Excavate to subgrade, compact, install formwork, install reinforcing, place concrete, backfill | Good for difficult locations or challenging access, structural design required, medium cost |
| Deep foundations (steel piles) | Drill in piles, install pile cap | Quick installation, need good access points, medium sized equipment required, specialized skill/equipment |
| Gabion Wall – rock filled wire baskets with geotextile reinforcing | Excavate, place fill in lifts with geotextile layers anchored to wire baskets | Quick installation, requires excavator for installation, not as readily available |



| | | |
|----------------------------------|--|--|
| Pressure treated timber cribbing | Excavate, build cribbing in overlapping layers, backfill | Good for difficult locations or challenging access, abutment wall can be shaped to suit terrain, medium sized excavation footprint |
|----------------------------------|--|--|

4.2 Chaster Park

4.2.1 Entrance Bridge

The existing bridge abutment locations constrict the channel flow, resulting in insufficient freeboard during peak flow events. Table 5 below shows the options for access to Chaster Park and the bridge design would provide sufficient freeboard clearance above the 200 year return period peak flow levels. The options are also described in a plan drawing in Appendix A.

Table 9: Chaster Park Bridge Location Options

| Option 1: New bridge downstream of Chaster House | Option 2: New bridge at current Location | Option 3: Elevate and re-use existing bridge |
|---|--|---|
| <ul style="list-style-type: none"> New 12m long aluminum truss bridge Connect to yard on west side of Chaster House New piled foundations or spread footings. Elevated bridge to provide sufficient freeboard clearance for Q200 flows Requires tree removal Adjustments to existing gravel parking lot may require loss of one parking space | <ul style="list-style-type: none"> New 10m long aluminum truss bridge Connect to existing path east of Chaster House New piled foundations or spread footings Elevated bridge to provide sufficient freeboard clearance for Q200 flows Requires tree removal near Chaster House Requires work within MOTI Right-of-way | <ul style="list-style-type: none"> Removal and re-use of existing bridge for installation of foundations Elevated bridge to provide sufficient freeboard clearance for Q200 flows Additional ramp required near Chaster House Tree removal near Chaster House Requires work within MOTI Right-of-way Grading and retaining wall on north side |

Bridge Options 1 and 2 are proposed to overspan the channel to allow for increase channel width as well as avoiding significant instream works. The existing creek channel at the existing bridge location is approximately 5m. For Option 1 and 2 it is anticipated to increase the channel width to approximately 7m as this matches the creek channel upstream and downstream of the existing crossing. Instream works will be required for each option however instream works will be significantly less for Option 1 and 2.

Bridge abutment work will also require rip rap placement to protect the abutments from scour. The size and quantity of rip rap would be confirmed during detailed design but is anticipated to be approximately class 100kg.

A comparison for each of the options is presented in Table below;


Table 10: Chaster Park Bridge Comparisons

| Bridge Option | Location Benefit | Location Burden |
|---|--|---|
| Option 1 – New Bridge downstream of Chaster House | <ul style="list-style-type: none"> Bridge abutments and all proposed grading improvements on SCRD lands | <ul style="list-style-type: none"> Optional work to relocate existing wheelchair ramp at Chaster |



| | | |
|--|--|---|
| | <ul style="list-style-type: none"> • <i>Less complicated MOTI approval</i> • <i>Closest to existing parking</i> • <i>Construction work zones are furthest away from the building and will have least impact to ongoing programming or property access</i> | <ul style="list-style-type: none"> • <i>House to align better with bridge location</i> • <i>Regrading of lawn area on west side of Chaster House required</i> • <i>Shrub removal required adjacent to existing gravel parking area</i> |
| <p><i>Option 2- New Bridge at current location</i></p> | <ul style="list-style-type: none"> • <i>Close to same location as existing</i> | <ul style="list-style-type: none"> • <i>Tree removal required on east side of Chaster House</i> • <i>More complicated MOTI approval as the north abutment is on MOTI property and close proximity to existing bridge</i> • <i>Regrading and retaining wall required adjacent to vehicle travel lanes for bridge approach ramps</i> |
| <p><i>Option 3- Elevate and re-use existing bridge</i></p> | <ul style="list-style-type: none"> • <i>Most familiar and re-use of bridge saves bridge costs</i> | <ul style="list-style-type: none"> • <i>Most in-stream work required for bridge abutment on north side</i> • <i>Regrading and retaining wall required adjacent to vehicle travel lanes for bridge approach ramps</i> • <i>Requires additional ramp and sidewalk extension adjacent to Chaster House</i> |

An additional option was considered which would remove the need for a creek crossing and use the existing property access that is east of the creek. This is the least cost option and would restore the north creek bank and widen the existing creek channel to help reduce creek overtopping the existing revetment wall at Chaster House.

| | |
|---|---|
| Option 4: No creek crossing, use existing access east of vehicle bridge | |
| <ul style="list-style-type: none"> • Remove existing bridge and north abutment to widen channel • Improve existing property access on east side of vehicle bridge • Restoration of creek bank • Access to property requires crossing vehicle bridge • Least cost |  <p>View looking southwest towards Chaster House property</p> |

4.2.2 Storm Revetment Walls

There are localized areas of undermining along the south revetment wall. In addition, cracks and spalls were noted on the front face of the wall. The spalled sections of concrete should be locally demolished and patched with concrete or grout. Larger cracks should be filled with epoxy and sealed. The undermined sections of the wall should be filled with flowable concrete and protected with rock armouring at the foot of the wall.

4.3 Cliff Gilker Park

4.3.1 Upper Waterfall Bridge

Excessive vibration is noticeable to users crossing the bridge, indicating undersized or deteriorated stringers. Options to reduce vibrations include reducing the span length or strengthening/replacing the stringers. Based on recent photos of water flows in the park, instream piers are not recommended. Strengthening existing log stringers is difficult due to the varying diameter of the stringers. Therefore, ISL recommends replacing the bridge and Table 6 below shows options for the proposed bridge.

Table 11: Upper Waterfall Bridge

| Item | Option 1: Glulam Girder | Option 2: Steel Girder | Option 3: Truss |
|-------------------|---|---|---|
| Primary Structure | Glulam stringers Alaska Yellow Cedar | Steel stringers (weathering steel) | <ul style="list-style-type: none"> • HSS steel trusses (galvanized or weathering) • FRP • Aluminum |
| Railing | Dimensional lumber Alaska Yellow Cedar | Dimensional lumber Alaska Yellow Cedar | Rails integrated with truss elements |
| Deck | Alaska Yellow Cedar | Alaska Yellow Cedar | Alaska Yellow Cedar FRP |



4.3.2 Lower Waterfall Bridge

An atmospheric river event in 2021 destroyed the middle gabion supports that were on an "island" in the center of the creek. This resulted in the failure of the east span of the bridge. The west span is still in good shape. Visual inspection of the island showed few places for new pier supports. There are signs of erosion at the west span abutment. Table 11 below presents the options for the Lower Waterfall Bridge.

Table 12: Lower Waterfall Bridge

| Item | Option 1: Retrofit existing West Span, Remove East Span | Option 2: Clear Span Steel Truss | Option 3: Clear Span Suspension Bridge |
|-------------------|---|---|---|
| Primary Structure | Existing timber remains as is | HSS steel trusses (galvanized or weathering) FRP Aluminum | <ul style="list-style-type: none"> Galvanized steel cables Steel stringers (galvanized) |
| Guardrails | Repair existing | Railing integrated with truss elements | Steel railing |
| Deck | Repair existing | Alaska Yellow Cedar FRP | Alaska Yellow Cedar |

4.3.3 Zig Zag Bridge

The Zig Zag Bridge is located along the lower portion of the trail. The approaches to the bridge are prone to flooding. The bridge can be rehabilitated in its current location, however, it will remain susceptible to damage from future atmospheric river events. ISL reviewed two possible locations at higher elevations for a new bridge. Both locations are near the existing bridge location but will result in a longer span structure. Table 8 below show the options for the Zig Zag Bridge.

Table 13: Zig Zag Bridge

| Item | Option 1: Repair damaged Deck | Option 2: Clear Span Steel Truss | Option 3: Clear Span Suspension Bridge |
|-------------------|-------------------------------|---|---|
| Primary Structure | | HSS steel trusses (galvanized or weathering) FRP Aluminum | Galvanized steel cables Steel stringers (galvanized) |
| Guardrails | | Railing integrated with truss elements | Steel railing |
| Deck | | Alaska Yellow Cedar FRP | Alaska Yellow Cedar |

4.3.4 Trail Rehabilitation

Portions of the Red Trail inside Cliff Gilker Park are below the flood level. Other sections of the trail have experienced erosion and have created water toughs within the pathway. The affected areas are shown on the Park Map included in Appendix A. Options for trail rehabilitation are shown below.



Table 14: Trail Upgrade

| Item | Option 1: Maintain Existing | Option 2: Reroute Trail | Option 3: Elevated Boardwalk |
|-------------|-----------------------------|---|--|
| Description | Leave trail alignment as is | Construct new trail at higher elevation (above flood level) Will require vegetation/tree removal New trail retreat further from the creek | Construct new timber boardwalk (steel or timber foundations) Can include viewing areas, seating located along the creek |

5.0 Evaluation

The rehabilitation/replacement options were evaluated as summarized in following tables. Construction and lifecycle costs were ranked with \$ being the lowest and \$\$\$\$\$ being the highest.

5.1 Superstructure

Table 15: Superstructure options evaluation

| Criteria | Option 1: Repair | Option 2: Glulam Girder | Option 3: Steel Girder | Option 4: Truss | Option 5: Suspension Bridge |
|-----------------------------------|--|---|---|---|--|
| Construction Cost | \$ | \$\$ | \$\$\$ | \$\$\$ | \$\$\$\$\$ |
| Lifecycle Cost (incl. O&M) | \$\$\$\$ | \$\$ | \$\$\$ | \$ | \$\$\$\$ |
| Durability / Maintenance | <ul style="list-style-type: none"> Monitoring for erosion Inspection after each heavy rain event | <ul style="list-style-type: none"> Glulam requires re-coating, but AYC is naturally decay resistant Deck, railing require replacement | <ul style="list-style-type: none"> Weathering steel requires minimal/no maintenance Deck, railing require replacement | <ul style="list-style-type: none"> Weathering steel (incl guardrails) requires minimal/no maintenance Deck requires replacement | <ul style="list-style-type: none"> Weathering steel requires minimal/no maintenance Cables require monitoring Deck requires replacement |
| Constructability / Local Sourcing | <ul style="list-style-type: none"> Local assembly possible | <ul style="list-style-type: none"> Local assembly possible for most components | <ul style="list-style-type: none"> Local assembly of decking, guardrails | <ul style="list-style-type: none"> Limited possibility for local labour | <ul style="list-style-type: none"> Specialized |
| Aesthetics | <ul style="list-style-type: none"> Maintains existing look | <ul style="list-style-type: none"> Simple, natural materials | <ul style="list-style-type: none"> Simple, not distracting | <ul style="list-style-type: none"> Thinner / lighter than glulam or steel girder | <ul style="list-style-type: none"> Signature structure |

5.2 Substructure/Foundations



The three abutment options were evaluated as summarized in Table . Generally, a concrete lock block offers the best balance of durability and cost of the three options considered.

Table 16: Substructure/foundations options evaluation

| Item | Construction Cost | Durability / Maintenance | Constructability / Local Sourcing |
|--|-------------------|---|---|
| Concrete Lock Blocks | \$\$\$ | May experience some settling over service life, but should not require replacement | Crane required for lifting No specialized skills required |
| Cast-in-Place Concrete Spread Footing or Abutment wall | \$\$\$ | May experience some settling over service life, but should not require replacement | Concrete supplier and pump truck required No specialized skills required |
| Deep foundations (piles) | \$\$\$\$\$ | No settlement expected/low maintenance | Pile driving equipment required Specialized skills |
| Gabion Wall | \$\$ | Less settlement and erosion-prone than lock blocks | No specialized skills required |
| Timber Cribbing | \$ | Timber in ground contact has a short service life (<25 years typically) Not recommended | No specialized skills required |

5.3 Trail Rehabilitation

Table 17: Trail options

| Item | Option 1: Maintain Existing | Option 2: Reroute Trail | Option 3: Elevated Boardwalk |
|---------------------------------------|---|--|---|
| Construction Cost | \$ | \$\$ | \$\$\$ |
| Lifecycle Cost (incl. O&M) | \$\$ | \$ | \$\$\$ |
| Durability / Maintenance | Maintain after every flood Not usable during flood | Routine maintenance required | Timber replacement (30 yrs) |
| Constructability / Local Sourcing | No specialized skills required | No specialized skills required | Pile driving equipment Specialized skill |
| Environmental / Archaeological Impact | Negligible | Tree removal Minor ground disturbance | Ground disturbance |

5.4 Revetment Wall at Chaster House

Table 18: Wall options

| Item | Option 1: Replace | Option 2: Repair |
|------|-------------------|------------------|
|------|-------------------|------------------|



| | | |
|---------------------------------------|---|-----------------------------------|
| Construction Cost | \$\$\$\$\$ | \$\$ |
| Lifecycle Cost (incl. O&M) | \$ | \$\$ |
| Durability / Maintenance | New wall will have design life of 75 years | Routine maintenance required |
| Constructability / Local Sourcing | Local assembly possible Excavation/demolition equipment | Local assembly possible |
| Environmental / Archaeological Impact | Significant disturbance to grounds during construction Environmental permitting required | Environmental permitting required |

5.5 Cost Estimates

Class 'C' cost estimates are summarized below with quantity breakdowns provided in Appendix B for the various bridge options and trail rehabilitation works. Costs include contingency, and an estimate for anticipated engineering design and environmental monitoring. Construction costs are based on discussions with contractors/fabricators and unit rates from recent similar projects.

| Chaster House | |
|--|------------|
| Chaster House - Remove Existing Bridge and Restore Creek | \$ 39,200 |
| Chaster House - West Location | \$ 228,800 |
| Chaster House - Existing Location | \$ 281,600 |
| Chaster House - Reuse Existing | \$ 292,950 |
| Revetment Wall Replacement | \$ 767,250 |
| Revetment Wall Repair | \$ 248,000 |
| Cliff Gilker Park | |
| Upper Waterfall Bridge - Pedestrian only | \$ 240,000 |
| Upper Waterfall Bridge - ATV use | \$ 272,000 |
| Lower Waterfall Bridge | \$ 459,200 |
| Zig Zag Bridge | \$ 532,800 |
| Trail Rehabilitation | \$ 301,990 |



6.0 Summary and Closure

Based on the site conditions, constructability limitations and costs, ISL recommends trusses (aluminum or steel) for the bridge replacements. Truss bridges provide a good balance between durability, ability for local sourcing, and aesthetics.

6.1 Next Steps & Permitting

Additional information anticipated for detailed design of any bridge work will include the following;

- Selection of bridge replacement option and bridge location
- Geotechnical recommendations, including bearing resistance, subgrade preparation, and granular material specifications.
- Topographic survey, including stream centerline, normal high-water mark, flood high-water elevations, top and bottom of bank, and any other relevant topographic and site features.
- Confirmation of flood elevations at 1/50, 1/100 and 1/200 year return periods, flow rate, and scour protection requirements based on survey data.
- Environmental assessment and permit approvals

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Senior Structural Engineer

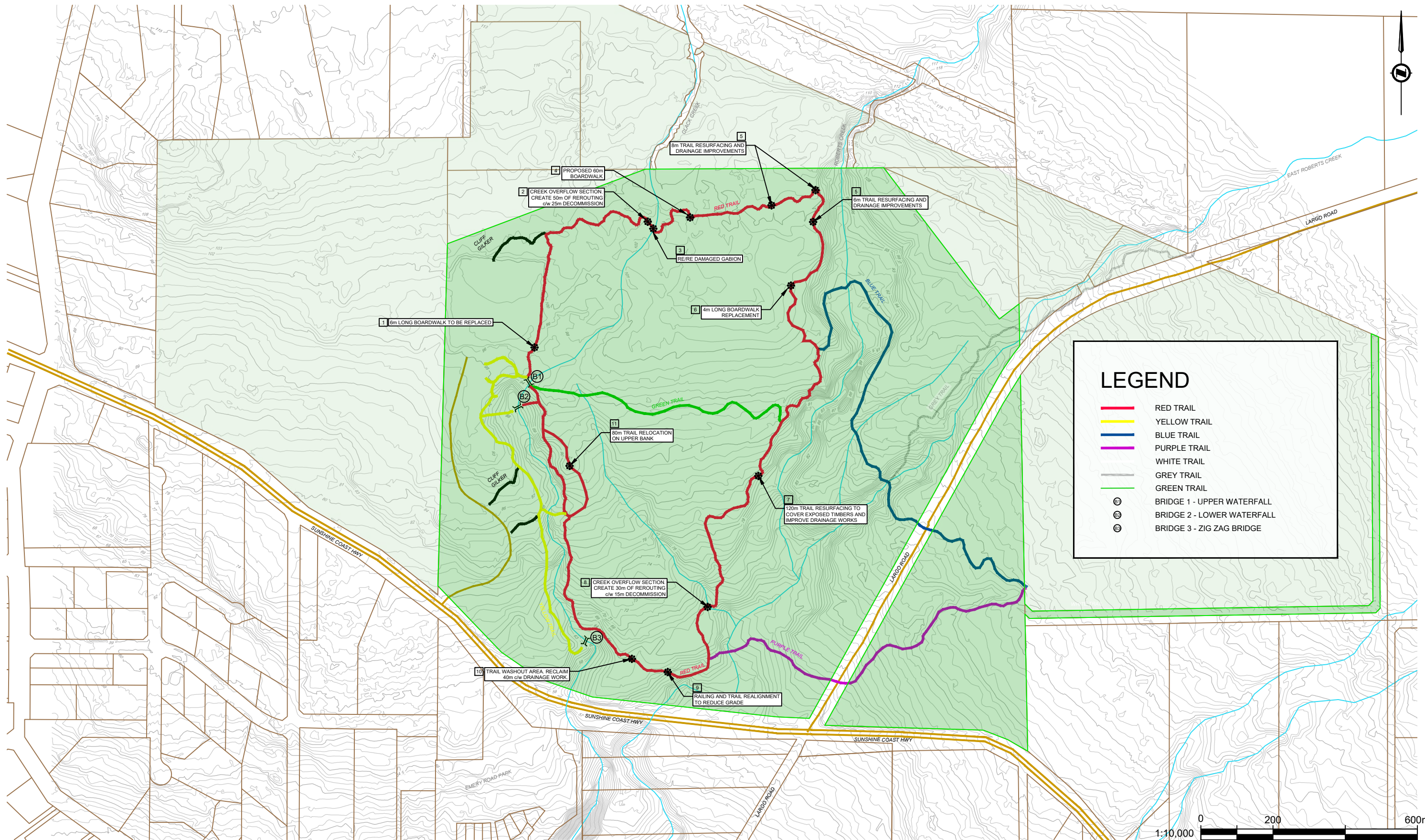


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Appendix A: Conceptual Drawings

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LEGEND

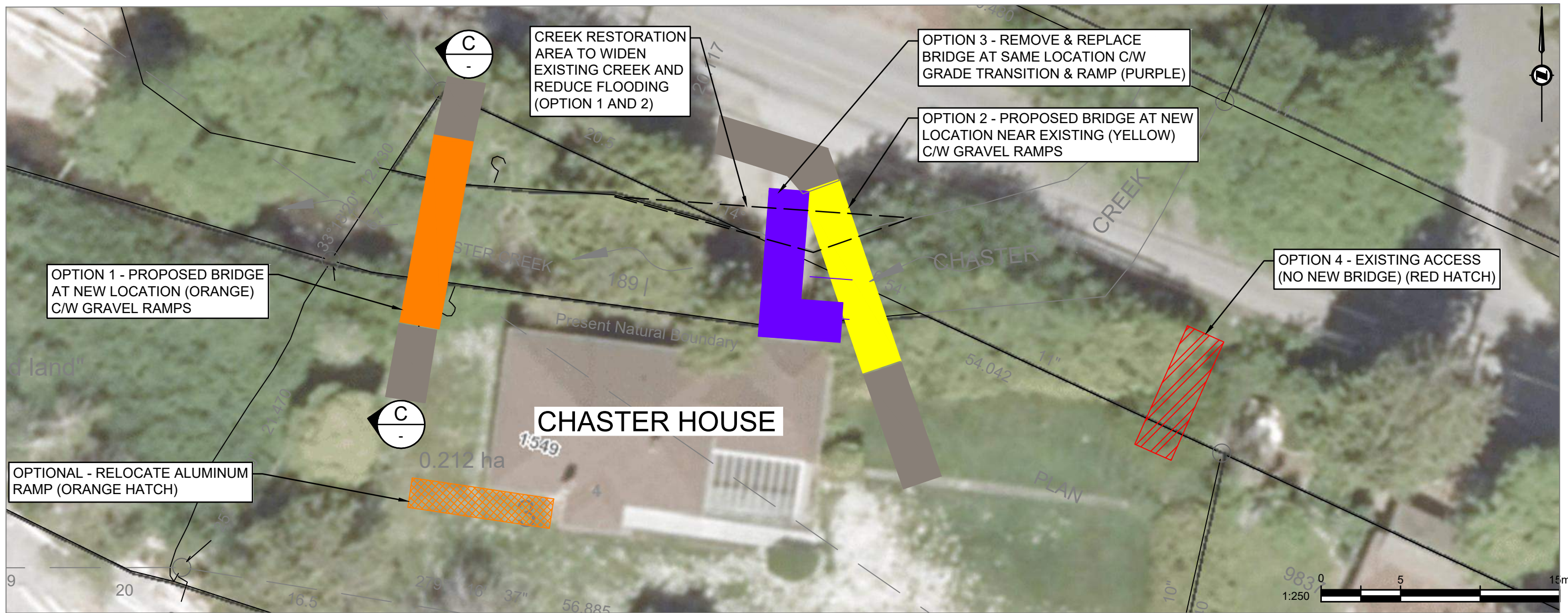
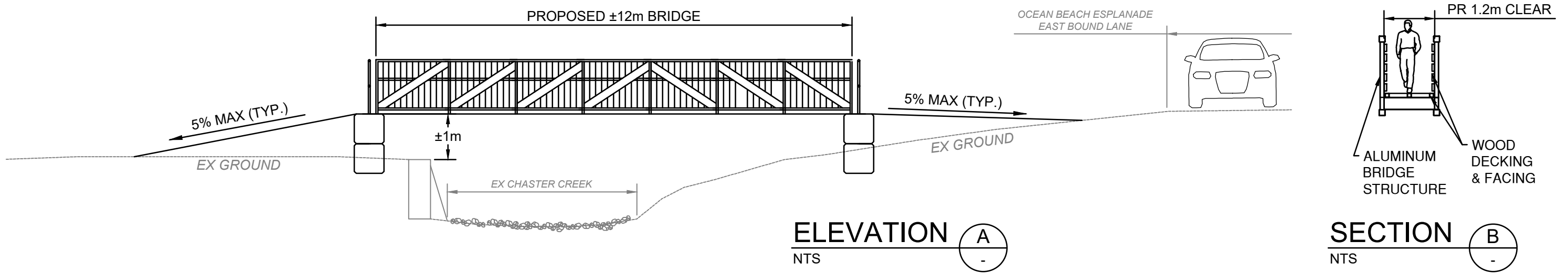
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- YELLOW TRAIL
- BLUE TRAIL
- PURPLE TRAIL
- WHITE TRAIL
- GREY TRAIL
- GREEN TRAIL
- BRIDGE 1 - UPPER WATERFALL
- BRIDGE 2 - LOWER WATERFALL
- BRIDGE 3 - ZIG ZAG BRIDGE



CLIFF GILKER TRAIL & BRIDGE RECOVERY PROJECT
 CLIFF GILKER PARK
 SUNSHINE COAST REGIONAL DISTRICT

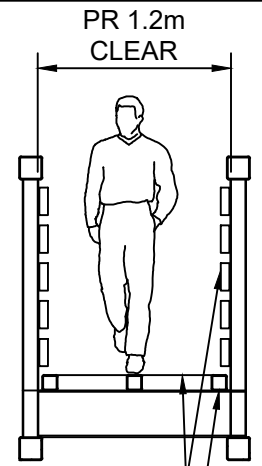
TOPOGRAPHIC MAP
RECLAMATION WORKS
 07/11/2023

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SECTION A UPPER WATERFALL

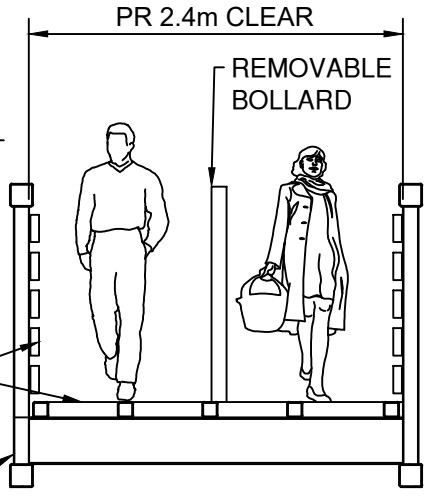


WOOD DECKING & FACING
ALUMINUM BRIDGE STRUCTURE

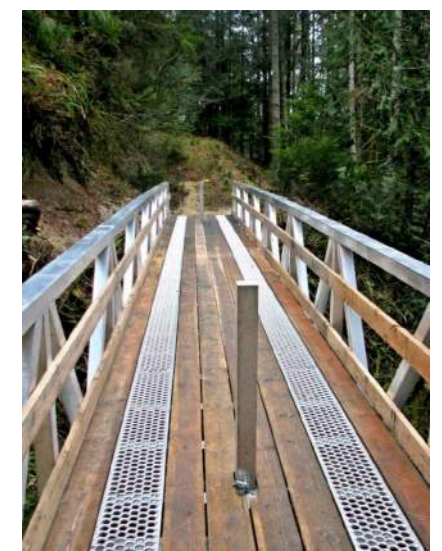


ALUMINUM TRUSS BRIDGE EXAMPLE

SECTION B UPPER WATERFALL



WOOD DECKING & FACING
ALUMINUM BRIDGE STRUCTURE



ALUMINUM TRUSS BRIDGE EXAMPLE
(W/ ATV ACCESS)

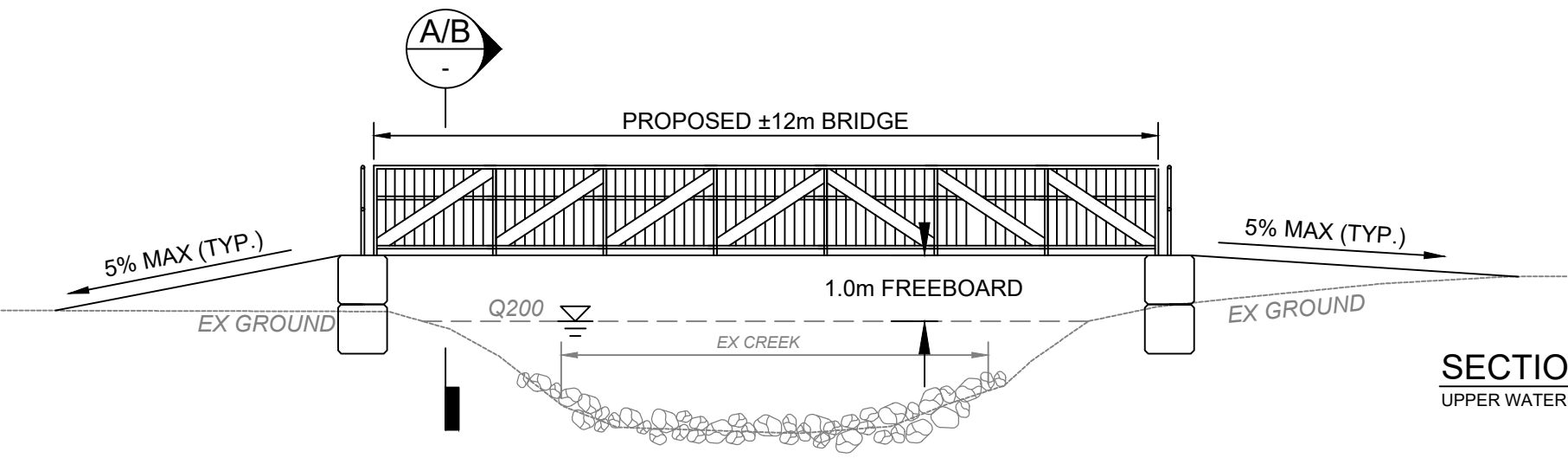
SECTION C LOWER WATERFALL / ZIG ZAG



STEEL FLOOR BEAM
WOOD DECKING

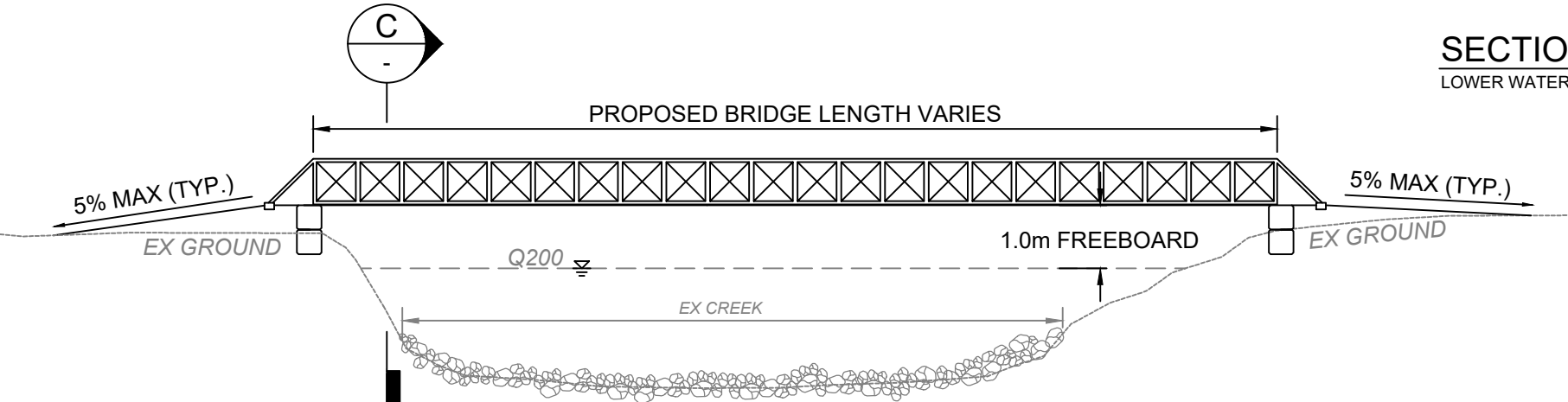


STEEL TRUSS BRIDGE EXAMPLE



UPPER WATERFALL - ALUMINUM TRUSS BRIDGE

SCALE 1:100



LOWER WATERFALL & ZIG ZAG - STEEL TRUSS BRIDGE

SCALE 1:200





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Appendix B: Cost Estimates



REVISED MAY 22, 2024

Summary of Options

| Chaster House | |
|--|------------|
| Chaster House - Remove Existing Bridge and Restore Creek | \$ 39,200 |
| Chaster House - West Location | \$ 228,800 |
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| Zig Zag Bridge | \$ 532,800 |
| Trail Rehabilitation | \$ 301,990 |



| Item | Description | Unit of Measure | Quantity | Unit Price | Total |
|---|---|-----------------|----------|------------|-------------------|
| Chaster House - Remove Existing Bridge and Restore Creek | | | | | |
| 1.01 | Demolition of existing structure and abutment (includes crane rental) | Lump Sum | 1 | \$ 15,000 | \$ 15,000 |
| 1.02 | Traffic Control | Lump Sum | 1 | \$ 3,000 | \$ 3,000 |
| 1.03 | Restoration - Creek channel at existing structure location | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| Subtotal | | | | | \$ 28,000 |
| Contingency @ 20% | | | | | \$ 5,600 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 5,600 |
| Total (not including GST) | | | | | \$ 39,200 |
| Chaster House - West Location | | | | | |
| 1.01 | 12m x 1.2m Aluminum truss fabricated bridge with decking (FOB gravel parking area) | Lump Sum | 1 | \$ 30,000 | \$ 30,000 |
| 1.02 | Foundation - Concrete abutment (incl. formwork, rebar, concrete) | Cubic Meter | 4 | \$ 4,000 | \$ 16,000 |
| 1.03 | Traffic Control | Lump Sum | 1 | \$ 12,000 | \$ 12,000 |
| 1.04 | Site Preparation - Clearing and grubbing, common ex, earthworks | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| 1.05 | Installation - Crane rental crew to set bridge in place | Lump Sum | 1 | \$ 15,000 | \$ 15,000 |
| 1.06 | Installation - Bridge approaches - grading, earthworks, and civil works | Lump Sum | 2 | \$ 10,000 | \$ 20,000 |
| 1.07 | Restoration - Creek channel and scour protection at bridge | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.08 | Installation - Final grading, surface restoration, trimming, signage, site cleanup | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| Subtotal | | | | | \$ 143,000 |
| Contingency @ 40% | | | | | \$ 57,200 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 28,600 |
| Total (not including GST) | | | | | \$ 228,800 |
| Chaster House - Existing Location | | | | | |
| 1.01 | 10m x 1.2m Aluminum truss fabricated bridge with decking (FOB gravel parking area) | Lump Sum | 1 | \$ 30,000 | \$ 30,000 |
| 1.02 | Foundation - Concrete abutment (incl. formwork, rebar, concrete) | Cubic Meter | 4 | \$ 4,000 | \$ 16,000 |
| 1.03 | Demolition of existing structure and abutment (includes crane rental) | Lump Sum | 1 | \$ 15,000 | \$ 15,000 |
| 1.04 | Traffic Control | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| 1.05 | Restoration - Creek channel at existing structure location | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.06 | Site Preparation - Clearing and grubbing, common ex, earthworks | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| 1.07 | Installation - Crane rental crew to set bridge in place | Lump Sum | 1 | \$ 15,000 | \$ 15,000 |
| 1.08 | Installation - Bridge approaches - grading, earthworks, and civil works | Lump Sum | 2 | \$ 10,000 | \$ 20,000 |
| 1.09 | Restoration - Creek channel and scour protection at bridge | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.10 | Installation - Final grading, surface restoration, trimming, signage, site cleanup | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| Subtotal | | | | | \$ 176,000 |
| Contingency @ 40% | | | | | \$ 70,400 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 35,200 |
| Total (not including GST) | | | | | \$ 281,600 |
| Chaster House - Reuse Existing | | | | | |
| 1.01 | Reuse bridge - Remove existing bridge and set aside (crane rental, preparation, crew) | Lump Sum | 1 | \$ 25,000 | \$ 25,000 |
| 1.02 | Foundation - Concrete abutment (incl. formwork, rebar, concrete) | Cubic Meter | 4 | \$ 4,000 | \$ 16,000 |
| 1.03 | Demolition of existing abutment | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.04 | Traffic Control | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| 1.05 | Restoration - Creek channel at existing structure location | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.06 | Site Preparation - Clearing and grubbing, common ex, earthworks | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| 1.07 | Installation - Crane rental crew to set bridge in place | Lump Sum | 1 | \$ 15,000 | \$ 15,000 |
| 1.08 | Installation - Re-install railings, minor adjustments and repairs | Lump Sum | 1 | \$ 8,000 | \$ 8,000 |
| 1.09 | Installation - Bridge approaches - grading, earthworks, and civil works | Lump Sum | 2 | \$ 10,000 | \$ 20,000 |
| 1.10 | Installation - Aluminum ramp at south end | Lump Sum | 1 | \$ 25,000 | \$ 25,000 |
| 1.11 | Installation - Final grading, surface restoration, trimming, signage, site cleanup | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| Subtotal | | | | | \$ 189,000 |
| Contingency @ 40% | | | | | \$ 75,600 |
| Engineering and Environmental Monitoring @ 15% | | | | | \$ 28,350 |
| Total (not including GST) | | | | | \$ 292,950 |



| Item | Description | Unit of Measure | Quantity | Unit Price | Total |
|--|--|-----------------|----------|------------|-------------------|
| Revetment Wall Replacement | | | | | |
| 1.01 | Demolition & Removal of Existing Revetment Wall (approx 36m) | Lump Sum | 1 | \$ 60,000 | \$ 60,000 |
| 1.02 | Site Preparation - Common ex, earthworks | Lump Sum | 1 | \$ 15,000 | \$ 15,000 |
| 1.03 | Site Preparation - Temporary Shoring | Lump Sum | 1 | \$ 75,000 | \$ 75,000 |
| 1.04 | Traffic Contol | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.05 | Water Bypass/Containment | Lump Sum | 1 | \$ 75,000 | \$ 75,000 |
| 1.06 | Cast in Place Retaining Wall | Lump Sum | 1 | \$ 200,000 | \$ 200,000 |
| 1.07 | Landscaping | Lump Sum | 1 | \$ 30,000 | \$ 30,000 |
| Subtotal | | | | | \$ 465,000 |
| Contingency @ 40% | | | | | \$ 186,000 |
| Engineering and Environmental Monitoring @ 25% | | | | | \$ 116,250 |
| Total (not including GST) | | | | | \$ 767,250 |
| Revetment Wall Repair | | | | | |
| 2.01 | Water Bypass | Lump Sum | 1 | \$ 25,000 | \$ 25,000 |
| 2.02 | Concrete Repairs | Lump Sum | 1 | \$ 105,000 | \$ 105,000 |
| 2.03 | Concrete Sealant | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 2.04 | Undermining Repair | Lump Sum | 1 | \$ 15,000 | \$ 15,000 |
| Subtotal | | | | | \$ 155,000 |
| Contingency @ 40% | | | | | \$ 62,000 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 31,000 |
| Total (not including GST) | | | | | \$ 248,000 |



| Item | Description | Unit of Measure | Quantity | Unit Price | Total |
|---|--|-----------------|----------|------------|-------------------|
| Upper Waterfall Bridge - Pedestrian only | | | | | |
| 1.01 | 12m x 1.2m Aluminum truss fabricated bridge with decking (FOB gravel parking area) | Lump Sum | 1 | \$ 30,000 | \$ 30,000 |
| 1.02 | Foundation - Concrete abutment (incl. formwork, rebar, concrete) | Cubic Meter | 5 | \$ 4,000 | \$ 20,000 |
| 1.03 | Demolition of existing structure and abutment (dry creek conditions) | Lump Sum | 1 | \$ 15,000 | \$ 15,000 |
| 1.04 | Site Preparation - Clearing and grubbing, common ex, earthworks | Lump Sum | 1 | \$ 25,000 | \$ 25,000 |
| 1.05 | Installation - Crane rental crew to set bridge in place | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.06 | Installation - Bridge approaches - grading, earthworks, and civil works | Lump Sum | 2 | \$ 10,000 | \$ 20,000 |
| 1.07 | Restoration - Creek channel and scour protection at bridge | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.08 | Installation - Final grading, surface restoration, trimming, signage, site cleanup | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| Subtotal | | | | | \$ 150,000 |
| Contingency @ 40% | | | | | \$ 60,000 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 30,000 |
| Total (not including GST) | | | | | \$ 240,000 |

| | | | | | |
|--|--|-------------|---|-----------|-------------------|
| Upper Waterfall Bridge - ATV use | | | | | |
| 1.01 | 12m x 2.4m Steel truss fabricated bridge with decking (FOB gravel parking area) | Lump Sum | 1 | \$ 50,000 | \$ 50,000 |
| 1.02 | Foundation - Concrete abutment (incl. formwork, rebar, concrete) | Cubic Meter | 5 | \$ 4,000 | \$ 20,000 |
| 1.03 | Demolition of existing structure and abutment (dry creek conditions) | Lump Sum | 1 | \$ 15,000 | \$ 15,000 |
| 1.04 | Site Preparation - Clearing and grubbing, common ex, earthworks | Lump Sum | 1 | \$ 25,000 | \$ 25,000 |
| 1.05 | Installation - Crane rental crew to set bridge in place (local firm) | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.06 | Installation - Bridge approaches - grading, earthworks, and civil works | Lump Sum | 2 | \$ 10,000 | \$ 20,000 |
| 1.07 | Restoration - Creek channel and scour protection at bridge | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.08 | Installation - Final grading, surface restoration, trimming, signage, site cleanup | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| Subtotal | | | | | \$ 170,000 |
| Contingency @ 40% | | | | | \$ 68,000 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 34,000 |
| Total (not including GST) | | | | | \$ 272,000 |

| | | | | | |
|--|--|-------------|---|------------|-------------------|
| Lower Waterfall Bridge | | | | | |
| 1.01 | 30m x 1.2m Steel truss fabricated bridge with decking (FOB gravel parking area) | Lump Sum | 1 | \$ 100,000 | \$ 100,000 |
| 1.02 | Foundation - Concrete abutment (incl. formwork, rebar, concrete) | Cubic Meter | 6 | \$ 7,000 | \$ 42,000 |
| 1.03 | Demolition of existing structure and abutment (includes crane rental) | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| 1.04 | Restoration - Creek channel at existing structure location | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.05 | Site Preparation - Clearing and grubbing, common ex, earthworks | Lump Sum | 1 | \$ 35,000 | \$ 35,000 |
| 1.06 | Installation - Crane rental crew to set bridge in place (local firm) | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| 1.07 | Installation - Bridge approaches - grading, earthworks, and civil works | Lump Sum | 2 | \$ 15,000 | \$ 30,000 |
| 1.08 | Restoration - Creek channel and scour protection at bridge | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.09 | Installation - Final grading, surface restoration, trimming, signage, site cleanup | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| Subtotal | | | | | \$ 287,000 |
| Contingency @ 40% | | | | | \$ 114,800 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 57,400 |
| Total (not including GST) | | | | | \$ 459,200 |

| | | | | | |
|--|--|-------------|---|------------|-------------------|
| Zig Zag Bridge | | | | | |
| 1.01 | 35m x 1.2m Steel truss fabricated bridge with decking (FOB gravel parking area) | Lump Sum | 1 | \$ 125,000 | \$ 125,000 |
| 1.02 | Foundation - Concrete abutment (incl. formwork, rebar, concrete) | Cubic Meter | 6 | \$ 8,000 | \$ 48,000 |
| 1.03 | Demolition of existing structure and abutment (includes crane rental) | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| 1.04 | Restoration - Creek channel at existing structure location | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.05 | Site Preparation - Clearing and grubbing, common ex, earthworks | Lump Sum | 1 | \$ 50,000 | \$ 50,000 |
| 1.06 | Installation - Crane rental crew to set bridge in place (out of town firm) | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| 1.07 | Installation - Bridge approaches - grading, earthworks, and civil works | Lump Sum | 2 | \$ 15,000 | \$ 30,000 |
| 1.08 | Restoration - Creek channel and scour protection at bridge | Lump Sum | 1 | \$ 10,000 | \$ 10,000 |
| 1.09 | Installation - Final grading, surface restoration, trimming, signage, site cleanup | Lump Sum | 1 | \$ 20,000 | \$ 20,000 |
| Subtotal | | | | | \$ 333,000 |
| Contingency @ 40% | | | | | \$ 133,200 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 66,600 |
| Total (not including GST) | | | | | \$ 532,800 |



| Item | Description | Unit of Measure | Quantity | Unit Price | Total |
|--|---|-----------------|----------|------------|------------------|
| 1. Boardwalk Replacement | | | | | |
| 1.01 | Demolition & Removal of Existing Boardwalk | Lump Sum | 1 | \$ 2,500 | \$ 2,500 |
| 1.02 | Site Preparation - Common ex, earthworks | Lump Sum | 1 | \$ 2,000 | \$ 2,000 |
| 1.03 | Boardwalk Installation - Including: Boardwalk, footings, grading, earthworks, and civil works | Lineal Meter | 6 | \$ 1,000 | \$ 6,000 |
| 1.04 | Boardwalk Installation - Final grading, surface restoration, site cleanup | Lump Sum | 1 | \$ 1,500 | \$ 1,500 |
| Subtotal | | | | | \$ 12,000 |
| Contingency @ 40% | | | | | \$ 4,800 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 2,400 |
| Total (not including GST) | | | | | \$ 19,200 |

| | | | | | |
|---|--|--------------|----|----------|------------------|
| 2. Trail Rerouting & Decommissioning | | | | | |
| 2.01 | Site Preparation - Organics removal, common ex, rough grading | Lump Sum | 1 | \$ 5,000 | \$ 5,000 |
| 2.02 | Trail Installation - Gravel supply & install, grading, compaction and site cleanup | Lineal Meter | 50 | \$ 200 | \$ 10,000 |
| 2.03 | Trail Decommissioning | Lineal Meter | 25 | \$ 50 | \$ 1,250 |
| Subtotal | | | | | \$ 16,250 |
| Contingency @ 40% | | | | | \$ 6,500 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 3,250 |
| Total (not including GST) | | | | | \$ 26,000 |

| | | | | | |
|--|---|----------|---|----------|-----------------|
| 3. Remove & Replace Damaged Gabion | | | | | |
| 3.01 | Removal - includes offsite disposal of existing gabion | Lump Sum | 1 | \$ 1,000 | \$ 1,000 |
| 3.02 | Supply and Install - Includes compaction, grading and all required material costs | Lump Sum | 1 | \$ 3,000 | \$ 3,000 |
| | Restoration | Lump Sum | 1 | \$ 1,000 | \$ 1,000 |
| Subtotal | | | | | \$ 5,000 |
| Contingency @ 40% | | | | | \$ 2,000 |
| Engineering and Environmental Monitoring @ 15% | | | | | \$ 750 |
| Total (not including GST) | | | | | \$ 7,750 |

| | | | | | |
|--|---|--------------|----|----------|------------------|
| 4. Boardwalk Install | | | | | |
| 4.01 | Site Preparation - Common ex, earthworks | Lump Sum | 1 | \$ 5,000 | \$ 5,000 |
| 4.02 | Installation - Including: Boardwalk, footings, grading, earthworks, and civil works | Lineal Meter | 60 | \$ 500 | \$ 30,000 |
| 4.03 | Installation - Final grading, surface restoration, site cleanup | Lump Sum | 1 | \$ 2,000 | \$ 2,000 |
| Subtotal | | | | | \$ 37,000 |
| Contingency @ 40% | | | | | \$ 14,800 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 7,400 |
| Total (not including GST) | | | | | \$ 59,200 |

| | | | | | |
|---|--|--------------|----|----------|------------------|
| 5. Trail Resurfacing and Drainage Improvements | | | | | |
| 5.01 | Trail Installation - Gravel supply & install, grading, compaction and site cleanup | Lineal Meter | 22 | \$ 200 | \$ 4,400 |
| 5.02 | Drainage Improvements - Includes required culverts and grading | Lump Sum | 3 | \$ 2,500 | \$ 7,500 |
| Subtotal | | | | | \$ 11,900 |
| Contingency @ 40% | | | | | \$ 4,760 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 2,380 |
| Total (not including GST) | | | | | \$ 19,040 |

| | | | | | |
|--|---|--------------|---|----------|------------------|
| 6. Boardwalk Replacement | | | | | |
| 6.01 | Demolition & Removal of Existing Boardwalk | Lump Sum | 1 | \$ 2,500 | \$ 2,500 |
| 6.02 | Site Preparation - Common ex, earthworks | Lump Sum | 1 | \$ 2,000 | \$ 2,000 |
| 6.03 | Installation - Including: Boardwalk, footings, grading, earthworks, and civil works | Lineal Meter | 4 | \$ 1,000 | \$ 4,000 |
| 6.04 | Installation - Final grading, surface restoration, site cleanup | Lump Sum | 1 | \$ 1,500 | \$ 1,500 |
| Subtotal | | | | | \$ 10,000 |
| Contingency @ 40% | | | | | \$ 4,000 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 2,000 |
| Total (not including GST) | | | | | \$ 16,000 |

| | | | | | |
|---|--|--------------|-----|----------|------------------|
| 7. Trail Resurfacing and Drainage Improvements | | | | | |
| 7.01 | Trail Installation - Gravel supply & install, grading, compaction and site cleanup | Lineal Meter | 120 | \$ 200 | \$ 24,000 |
| 7.02 | Drainage Improvements - Includes required culverts and grading | Lump Sum | 1 | \$ 6,000 | \$ 6,000 |
| Subtotal | | | | | \$ 30,000 |
| Contingency @ 40% | | | | | \$ 12,000 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 6,000 |
| Total (not including GST) | | | | | \$ 48,000 |

| | | | | | |
|--|--|--------------|----|----------|------------------|
| 8. Trail Rerouting & Decommissioning - Creek Overflow Section | | | | | |
| 8.01 | Site Preparation - Organics removal, common ex, rough grading | Lump Sum | 1 | \$ 5,000 | \$ 5,000 |
| 8.02 | Trail Installation - Gravel supply & install, grading, compaction and site cleanup | Lineal Meter | 30 | \$ 200 | \$ 6,000 |
| 8.03 | Trail Decommissioning | Lineal Meter | 15 | \$ 50 | \$ 750 |
| Subtotal | | | | | \$ 11,750 |
| Contingency @ 40% | | | | | \$ 4,700 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 2,350 |
| Total (not including GST) | | | | | \$ 18,800 |

| 9. Railing and Trail Realignment to Reduce Grade | | | | | |
|--|---|--------------|----|--------|------------------|
| 9.01 | Railing Installation - Including: Railing, footings, grading, earthworks, and civil works | Lineal Meter | 20 | \$ 600 | \$ 12,000 |
| 9.02 | Trail Installation - Gravel supply & install, grading, compaction and site cleanup | Lineal Meter | 30 | \$ 200 | \$ 6,000 |
| 9.03 | Trail Decommissioning | Lineal Meter | 10 | \$ 50 | \$ 500 |
| Subtotal | | | | | \$ 12,000 |
| Contingency @ 40% | | | | | \$ 4,800 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 2,400 |
| Total (not including GST) | | | | | \$ 19,200 |

| 10. Trail Reclamation and Drainage improvements | | | | | |
|---|--|--------------|----|----------|------------------|
| 10.01 | Site Preparation - Organics removal, common ex, rough grading | Lump Sum | 1 | \$ 5,000 | \$ 5,000 |
| 10.02 | Trail Installation - Gravel supply & install, grading, compaction and site cleanup | Lineal Meter | 40 | \$ 200 | \$ 8,000 |
| 10.03 | Drainage Improvements - Includes required culverts and grading | Lump Sum | 1 | \$ 2,000 | \$ 2,000 |
| Subtotal | | | | | \$ 15,000 |
| Contingency @ 40% | | | | | \$ 6,000 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 3,000 |
| Total (not including GST) | | | | | \$ 24,000 |

| 11. Trail Rerouting & Decommissioning - Creek Overflow Section | | | | | |
|--|--|--------------|----|----------|------------------|
| 11.01 | Site Preparation - Organics removal, common ex, rough grading | Lump Sum | 1 | \$ 8,000 | \$ 8,000 |
| 11.02 | Trail Installation - Gravel supply & install, grading, compaction and site cleanup | Lineal Meter | 80 | \$ 200 | \$ 16,000 |
| 11.03 | Trail Decommissioning | Lineal Meter | 80 | \$ 50 | \$ 4,000 |
| Subtotal | | | | | \$ 28,000 |
| Contingency @ 40% | | | | | \$ 11,200 |
| Engineering and Environmental Monitoring @ 20% | | | | | \$ 5,600 |
| Total (not including GST) | | | | | \$ 44,800 |

| | | | | | |
|-----------------------------|--|--|--|--|-------------------|
| Trail Rehabilitation | | | | | \$ 301,990 |
|-----------------------------|--|--|--|--|-------------------|

Appendix C: Structural Options - Reference Images



Glulam Girder – Canmore, AB



Steel Girder – Pitt Meadows, BC



Steel Truss – Grande Prairie, AB



Suspension Bridge – Pemberton, BC



Integrated Expertise. Locally Delivered.



Appendix D: Clarification Memos



To: **Sunshine Coast Regional District**

Date: **February 20, 2024**

Attention: **Drew Brennan**

Project No.: **33642**

Cc:

Reference: **Cliff Gilker and Chaster Bridge Q&A**

From: **Richard Avedon-Savage; Janet Tong**

Chaster House Bridge

Life Expectancy of Revetment Wall: Pros/Cons to Replacing vs Repair

Q1. If basic repair is conducted based on your suggestions, what would you predict the life expectancy be post repairs?

A1. – *This is difficult to quantify as we do not know the age of the existing structure. Generally, bridges and buildings are designed for 75 to 100 year design life. The actual service life of a structure depends on various factors (environmental conditions, quality of construction, quality of materials, damage, routine maintenance). For concrete repairs on the wall face, the repairs should be expected to last about 30 years. This cannot be applied to the entire wall as deterioration may progress at the unrepaired sections of the wall. A surface treatment such as waterproofing can be applied to the entire wall face as added protection against the elements.*

The service life of the undermining repair cannot be quantified because the actual cause of the erosion/undermining was not addressed. The areas that are repaired will be more robust than other areas, so it may cause erosion along other sections of the wall that have not been repaired.

Q2.If nothing was done, how long would you predict the revetment wall to last based on your site assessment?

A2.

Based on our visual inspection, total failure of the wall is not expected. If the wall is to remain in its current condition, localized failure would be expected i.e. spalling, settlement. We do not have access to information that would enable us to determine service life of the wall. This includes bridge drawings, geotechnical information, hydrotechnical information and historical rate of scour. Without this information, we are unable to estimate if and when the subgrade under the wall slab will entirely erode away leading to settlement of the ground above or rotation of the wall itself.

Bridge Location

Q3. Identify reasoning for bridge location preferences of the new bridges.

A3.

| <i>Bridge Option</i> | <i>Location Benefit</i> | <i>Location Burden</i> |
|--|---|---|
| <i>Option 1 – New Bridge downstream of Chaster House</i> | <ul style="list-style-type: none"> • <i>Bridge abutments and all proposed grading improvements on SCRDLands</i> • <i>Less complicated MOTI approval</i> • <i>Closest to existing parking</i> • <i>Construction work zones are furthest away from the building and will have</i> | <ul style="list-style-type: none"> • <i>Optional work to relocate existing wheelchair ramp at Chaster House to align better with bridge location</i> • <i>Regrading of lawn area on west side of Chaster House required</i> • <i>Shrub removal required adjacent to existing gravel parking area</i> |



| | | |
|---|---|--|
| | <i>least impact to ongoing programming or property access</i> | |
| <i>Option 2- New Bridge at current location</i> | <ul style="list-style-type: none"> • Close to same location as existing | <ul style="list-style-type: none"> • Tree removal required on east side of Chaster House • More complicated MOTI approval as the north abutment is on MOTI property and close proximity to existing bridge • Regrading and retaining wall required adjacent to vehicle travel lanes for bridge approach ramps |
| <i>Option 3- Elevate and re-use existing bridge</i> | <ul style="list-style-type: none"> • Most familiar and re-use of bridge saves bridge costs | <ul style="list-style-type: none"> • Most in-stream work required for bridge abutment on north side • Regrading and retaining wall required adjacent to vehicle travel lanes for bridge approach ramps • Requires additional ramp and sidewalk extension adjacent to Chaster House |

In Stream Works

Q4. In Section 4.2.1 Entrance Bridge, “The bridge options will over span the channel to allow for increase channel width as well as avoiding instream works.” When identifying that we will be avoiding instream works with the new bridge locations, are we not widening the creek leading to guaranteed instream works? Please explain.

A4. Yes, instream works are required for all options but only to perform the recommended removal of the existing north concrete abutment wall and restore the creek bank to widen the channel. The work to install the proposed bridges are proposed outside of the top of banks of the creek channel.

Q5. In 3 of your bridge placement locations, you have identified “Restoration - Creek channel at existing structure location.” Can you identify in your report what process will be occurring. We discussed riprap, but can you include in the report the rough dimensions you wish to increase the creek channel by, and in a map, identify current creek channel size, proposed increase size of creek channel and identify on a map, and identify the location where the property becomes MoTI property.

A5. The existing creek channel at the existing bridge location is approximately 5m. We anticipate increasing the channel width to approximately 7m as this matches the creek channel upsteam and downstream of the existing crossing. The area noted in red shows the approximate proposed channel widening/restoration within MOTI property.



Q6. Can you include the size of rocks for the riprap installation and provide documentation identifying that this plan would be approved by DFO, Working in And About a Stream, etc. Parks needs to ensure that these ideal options are acceptable by these entities before completing this planning phase.

A6. The anticipated rip rap size for bank stabilization and prevent scour is Class 100kg. Detailed design will be required for a submission to DFO once a bridge location is decided upon. The gradation of Class 100kg rip rap is shown in the table below

| Class of Riprap (kg) | Approximate Average Dimension (mm) | | | |
|----------------------|------------------------------------|------|------|-------|
| | 15% | 50% | 85% | <100% |
| 10 | 90 | 195 | 280 | 330 |
| 25 | 120 | 260 | 380 | 450 |
| 50 | 155 | 330 | 475 | 565 |
| 100 | 195 | 415 | 600 | 715 |
| 250 | 260 | 565 | 815 | 965 |
| 500 | 330 | 715 | 1030 | 1220 |
| 1000 | 415 | 900 | 1295 | 1535 |
| 2000 | 525 | 1130 | 1630 | 1935 |
| 4000 | 660 | 1425 | 2055 | 2440 |

Cliff Gilker Park

Q7. In your report you stated that the Upper Waterfall bridge is end of life. Can you further identify the issues with this bridge and whether there is a safety concern at this time to the public. (ie. is it mandatory to have this closed immediately?)

A7.

Ideally this bridge will be closed as there was excessive vibration when we crossed it. This indicates insufficient capacity in the log stringers. The in-stream supports appear undersized and are susceptible to debris impact during high water flows. There are also signs of erosion near the abutment.

Should the SCRD want to keep the bridge open, we recommend closing off access to the viewpoint, add additional stringers where possible and posting a sign to advise that a maximum of 2 people on the bridge at the same time.

Q8. Can you suggest methods of appropriately decommissioning the bridges that abide by DFO/ working within a stream protocol (containment, low flow removal, CMP).



A8. Decommissioning the bridges may only require 45 day DFO Notice. The process is generally anticipated to include disassemble railings, decking and needle beams beneath by hand release connecting bolts and lashings and cut the stringers while controlling sawdust/oil to creek. Using vegetable based oil in saws and machine is important along with minimizing disturbance to the creek bank and tree roots. Supervision by an qualified environmental professional is recommended.

Q9. Is a Glulam Girder weight bearing for ATV use (ie. Upper Waterfall Bridge)- what would the max weight load be for this bridge type?

A9. A 12m long bridge with glulam girders can be designed to support ATV use. The size and number of girders can be selected to support ATV loading. The maximum weight load will be dependent on the available section sizes. ISL has designed a 3 girder (glulam) bridge x 12m long that can support the CSA S6-19 maintenance vehicle with a gross load of 80kN.

Q10. Is Glulam not susceptible to high moisture locations (ie. Cliff Gilker)?

A10. Timber and Glulam sections can be treated for use in high moisture locations. They have been used in conveyors at Neptune terminals in North Vancouver and have held up fairly well. The Sunshine Coast and the Lower Mainland have similar climates (high moisture content with minimal freeze-thaw cycles) so design life should be similar.

Q11. I envisioned the Glulam bridge look (ie wood railings from Appendix C) for the Upper Waterfall Bridge, how can we incorporate this look into a bridge that best supports the upper waterfall location (ie ATV Steel truss bridge with this wood look?)

A11.

In addition to the Glulam bridge photo provided in Appendix C of the report, below are photos of a vehicle bridge we designed using timber plank decking and timber railings on steel girders



And more selected photos of steel bridges with wood elements





101-38026 Second Avenue, Squamish BC V8B 0C3, T: 604.815.4646 F: 604.815.4647

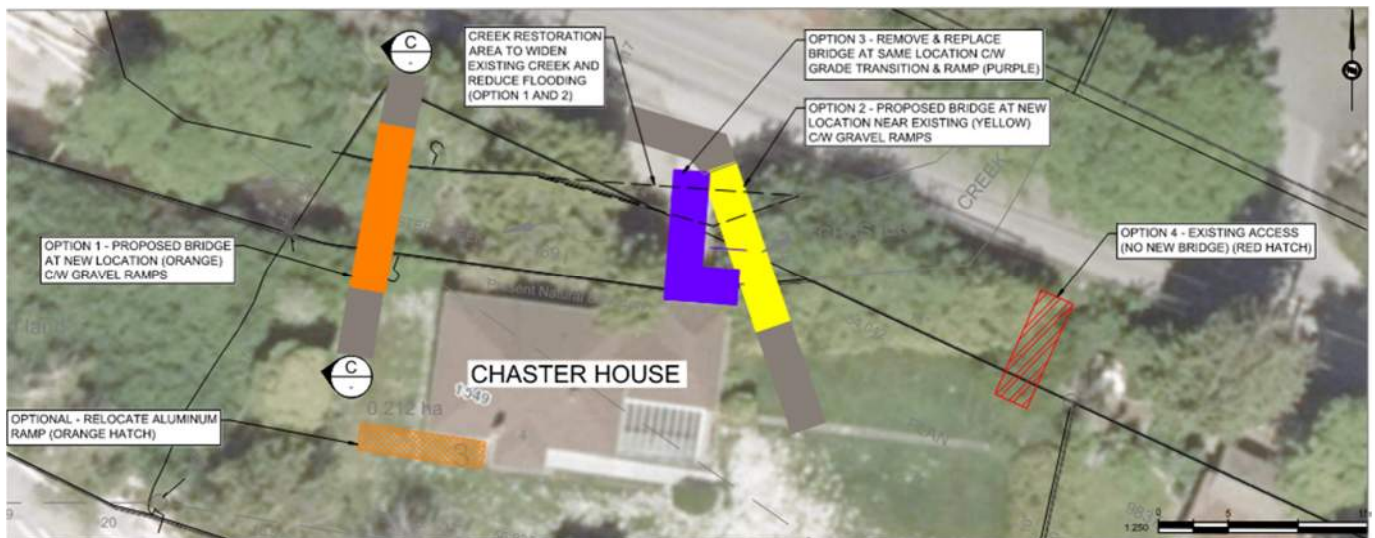
To: **Sunshine Coast Regional District**Date: **April 3, 2024**Attention: **Drew Brennan**Project No.: **33642**

Cc:

Reference: **Chaster House Bridge Q&A – MEMO2**From: **Richard Avedon-Savage; Janet Tong**

The Sunshine Coast Regional District (SCRD) submitted questions to ISL regarding the report and memo on the conceptual options study for a new pedestrian bridge at Chaster House and condition inspection of the revetment wall at Chaster House Park,

This memo summarizes our responses.



Q1a. Option 1 (Orange bridge) – With this area prone to impacts of king tides, the ground is saturated seasonally, will anything further be required in terms of abutment protection/ structural reinforcement vs the other bridge locations?

A1a. No additional protection is anticipated for Option 1 due to king tide events or ground saturation. Rip rap is anticipated on the north side of each option for scour protection of the proposed bridge abutments for all options. The south abutment will be located behind the existing revetment wall. The condition of the wall was not reviewed at the Option 1 location as there was vegetation covering the wall, however, the placement of the existing rocks in the creek bed appears to indicate less scouring than at the existing bridge location.

Q1b. Is there a likely chance that the abutments could be impacted due to land sloughing or unexpected movement/ stability due to the saturation of ground in this location for approximately 6 months of the year?

A1b. Detailed design would include review and recommendations for foundation settlement. It is anticipated however, that new spread footings would be founded with sufficient depth to be founded on well-graded and free-draining material. If a geotechnical investigation finds that there are poor foundation soils then the bridge may be founded on steel piles which would be less affected by the surrounding ground.

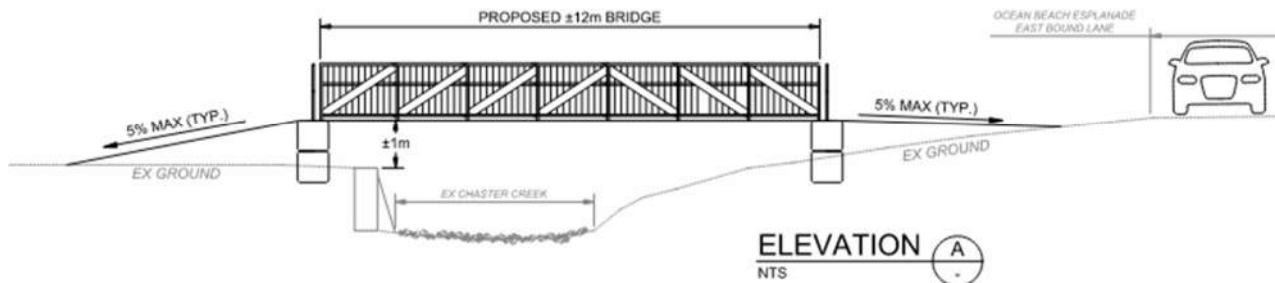


Q1c. Can you make sure that sloped ramps are included within your costing table breakdown for Option 1,2, and 3 to ensure that that the bridges accommodate wheelchair accessibility (I am thinking about the 1 meter increased height and ground connectivity to bridge- could you quickly explain.) I feel like the ramp should be mandatory for your preferred option 1 (orange bridge) due to the saturated ground in the area, but if you had another plan please let me know asap. You've identified the \$25,000 for the ramp in one option, can you include this in the other bridge costing tables unless you have a less expensive sustainable idea.

A1c. The cost of the ramps have been included in the cost estimate under items 1.08 for Option 1 and Option 2 and item 1.09 and 1.1 for Option 3. Options 1 and 2 have proposed gravel ramps at a maximum 5% slope to tie into existing ground. Option 3 includes an aluminum ramp on the south side as a gravel ramp will not be suitable.

Q2. We identified that the bridges would be raised 1 meter, is this 1 meter from the current height of the bridge, from the creek channel floor, high water level?

A2. The 1 meter additional height is from the top of the revetment wall as this is the anticipated height of flow during peak flow conditions. The elevation detail A on the drawing "Chaster House Bridge Options" provides some clarity.



Q3. How will the south facing side of this bridge accommodate for the 1 meter height increase down onto the concrete walkway?

A3. A gravel ramp with a maximum slope of 5% is proposed on the south side to transition from the proposed bridge deck down the existing ground. The drawing has been updated to show gravel ramps on the plan view.

Q4a). Also, for the revetment wall, is your proposed new replacement wall option at \$767,250 a "like for like" replacement as in a duplicate rebuild? There is no write up explaining any of this besides the high level 4.2.2 paragraph and the table.

A4a. The proposed new wall cost is for a retaining wall that generally matches the existing wall geometry ("like for like" structure).

Q4b). For the repairs noted as \$105k, are you suggesting pouring concrete behind, in front, increasing the height? This is also a very important fish bearing stream, please advise

A4b. The repair strategy is to patch any spalled concrete and cracking on the front face of the revetment wall as well as add foam or CDF fill at the undermined slab footing locations. In addition, new rip rap will be installed to prevent future scouring. The intent of the repair was to extend the service life, not increase the wall height.