Public Works and Government Services Canada

Requisition No. EZ899-161618

MERX I.D. No. _____

SPECIFICATIONS
For
West Coast Trail Bridges Repair
Pacific Rim National Park, Vancouver Island, BC

Project No. R.064182.001 November 2015

PROVINCE OF BRITISH COLUMBIA
R. MASTSCHUCH
PROFESSIONAL ENGINEER
#27158
DESIGNATED STRUCTURAL ENGINEER

Nov. 02, 2015

APPROVED BY:

Regional Manager, A&E Services — Date: 2015-11-04

Construction Safety Coordinator — Date: 2015-11-05.

TENDER:

Project Manager — Date: 15/11/09

Real Property Services Branch, Professional and Technical Services, Pacific Region
#641 – 800 Burrard Street, Vancouver, B.C. V6Z 2V8

SPECIFICATIONS:

DRAWINGS:

Bound separately

1. Codes

.1 Perform work to CURRENT Codes, Construction Standards and Bylaws, including Amendments up to the TENDER closing date

2. Description of Work

.1 Work under this Contract covers a work on the following bridges and a crossing along West Coast Trail, Vancouver Island, B.C.:

.1 Cullite Cable Car Crossing - repair
.2 Bridge No. 92 – repair
.3 Cheewhat Suspension Bridge - repair

More exact locations of the bridges are shown on the key plan of the drawing S-1.

.2 Work to be performed under this Contract includes, but is not limited to, the following items covered further in the Contract documents:

.1 At Cheewhat Suspension Bridge: dispose and replace with new: main span, tower columns, cables and anchors out of site, as shown on the drawings. Install reinforced concrete pile caps at both ends and build a new reinforced concrete wall around the south crib. Excavate for foundations and pile caps and backfill with the same material. Install cable anchors or micro piles at each end of the bridge main cables and tension test the new anchors.

.2 Retain the geotechnical engineer Lewkowich Engineering Associates Ltd for Cheewhat suspension bridge for monitoring of installation and testing of new soil anchors and assessment of existing concrete anchor block, see Appendix B for further details.

.3 At Cullite Cable Car Crossing dispose and replace with new: East tower platforms and West platform, columns, boardwalks, ladders, bracing, sleepers and bracing. Install reinforced foundations and reinforced concrete frame at West platform. Excavate for foundations and anchor testing and backfill with the same material. Tension test existing rock anchors and anchors in the concrete block at each end. Retain the geotechnical services of Ryzuk Geotechnical for field review of the foundations and supervision of the existing anchor

testing, per Appendix A.

.4 At Bridge 92 dispose and replace with new: wood framing and steel components of and core/epoxy new anchor bolts at one end.

.5 Retain a Qualified Environmental Professional (QP) (See Clause 27).

.6 Retain a qualified archaeologist to assess, site monitor, report and coordinate works with First Nations during excavations. Refer to Clause 19 for more information.

.7 Retain services of testing agency for concrete mix design review and concrete testing per Section 033000 Cast in Place Concrete.

.8 Pay cost of helicopter transportation to the site of geotechnical, environmental and archaeological consultant's field reviews and monitoring (geotechnical companies retained by Departmental Representative that provided reports in Appendix A and B). Pay cost of helicopter for one field review of structural engineer of record.

.3 Adhere to waste reduction requirement for reuse or recycling of waste materials, thus diverting materials from landfill.

3. Contract Documents

.1 The Contract documents, drawings and specifications are intended to complement each other, and to provide for and include everything necessary for the completion of the work.

.2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the work.

4. Division of Specifications

.1 The specifications are subdivided in accordance with the current 6-digit National Master Specifications System.

.2 A division may consist of the work of more than 1 subcontractor. Responsibility for determining which subcontractor provides the labour, material, equipment and services required to complete the work rests solely with the Contractor.

.3 In the event of discrepancies or conflicts when interpreting the drawings and specifications, the specifications govern.

5. Time of Completion

.1 Complete the project, crossings ready for use within **12** weeks after Contract Award. Contract is anticipated to be awarded in the first week of January 2016.

.2 Contractor to be aware of Parks Canada opening season for West Coast Trail is between May 1st and September 30th each year and the repaired crossings shall be remained open or alternative crossing ladders and boardwalk to be provided by the contractor if work is delayed. No delays are anticipated due to in-stream work. The only work in river bed occurs at Cheewhat bridge South crib, which is to be done at low tide level, thus direct in-stream work is not anticipated in this contract.

.3 Contractor to be aware of the fact that all in-stream work must be completed in adherence with Fisheries and Oceans Canada general fisheries timing window for in-stream work on Vancouver Island (conduct work between June 15th - September 15th). Additional information is available online at http://www.env.gov.bc.ca/wsd/regions/vir/wateract/terms_conditions_vir.pdf

6. Work Schedule

.1 Carry on work as per indicated "PHASES" and as follows:

.1 Within 10 working days after Contract award, provide a "phasing bar chart" and a schedule showing anticipated progress stages and final completion of the work within the time period required by the Contract documents. Indicate the following:

.1 Submission of shop drawings, product data, MSDS sheets and samples.

.2 Commencement and completion of work of each section of the specifications or trade for each phase as outlined.

.3 Final completion date within the time period required by the Contract documents.

.2 Do not change approved Schedule - without notifying Departmental Representative.

.3 Interim reviews of work progress based on work schedule will be conducted as decided by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative.

7. Cost Breakdown

.1 Before submitting the first progress claim, submit a breakdown of the Contract lump sum prices in detail as directed by the Departmental Representative and aggregating Contract price with cost breakdown per each bridge.

8. Codes, Bylaws, Standards

.1 Perform work in accordance with the Canadian Highway Bridge Design Code CAN/CSA S6-06 and other codes and standards listed in the technical sections of the contract documents, Construction Standards and/or any other Code or Bylaw of local application.

.2 Comply with applicable local bylaws, rules and regulations enforced at the location concerned.

.3 Meet or exceed requirements of Contract documents, specified standards, codes and referenced documents.

.4 In any case of conflict or discrepancy, the most stringent requirements shall apply.

9. Documents Required

.1 Maintain 1 copy each of the following at the job site:

.1 Contract drawings.
.2 Contract specifications.
.3 Addenda to Contract documents.
.4 Copy of approved work schedule.
.5 Reviewed/approved shop drawings.
.6 Change orders.
.7 Other modifications to Contract.
.8 Field test reports.
.9 Reviewed/approved samples.
.10 Manufacturers' installation and application instructions.
.11 One set of record drawings and specifications for "as-built" purposes.
.12 CAN/CSA S6-06
.13 Current construction standards of workmanship listed in technical Sections.
.14 Building Safety Plan.
.15 Any issued Permits.

10. Regulatory Requirements

.1 Obtain and pay for - Building Permit, Certificates, Licenses and other permits required by regulatory municipal, provincial or federal authorities to complete the work.

.2 Provide inspection authorities with plans and information

required for issue of acceptance certificates.

.3 Furnish inspection certificates in evidence that the work installed conforms with the requirements of the authority having jurisdiction.

11. Contractor's Use of Site

.1 Use of site:
- .1 Exclusive and complete for execution of work.
- .2 Act as a Prime Contractor and assume responsibility for assigned premises for performance of this work.
- .3 Be responsible for coordination of all work activities on site, including the work of other contractors engaged by the Departmental Representative.

.2 Perform work in accordance with Contract documents. Ensure work is carried out in accordance with indicated phasing.

.3 Do not unreasonably encumber site with material or equipment.

12. Examination

.1 Recommended is to examine site and be familiar and conversant with existing conditions likely to affect work.

.2 Recommended is to provide photographs of surrounding properties, objects and structures liable to be damaged or be the subject of subsequent claims.

13. Existing Services

.1 Where work involves breaking into or connecting to existing services, carry out work at times directed by the authorities having jurisdiction.

14. Setting Out of Work

.1 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.

.2 Provide devices needed to lay out and construct work.

.3 Supply such devices as templates required to facilitate Departmental Representative's inspection of work.

15. Acceptance of Substrates

.1 Each trade shall examine surfaces prepared by others and job conditions which may affect his work, and shall report defects to the Departmental Representative. Commencement of work shall imply acceptance of prepared work or substrate surfaces.

16. Quality of Work

.1 Ensure that quality workmanship is performed through use of skilled tradesmen, under supervision of qualified journeyman.

.2 The workmanship, erection methods and procedures to meet minimum standards set out in the Canadian Highway Bridge Design Code CAN/CSA S6-06 and the Construction Standards listed in the contract documents.

.3 In cases of dispute, decisions as to standard or quality of work rest solely with the Departmental Representative, whose decision is final.

17. Works Coordination

.1 Coordinate work of subtrades:

.1 Designate one person to be responsible for review of contract documents and shop drawings and managing coordination of Work.

.2 Convene meetings between subcontractors whose work interfaces and ensure awareness of areas and extent of interface required.

.1 Provide each subcontractor with complete plans and specifications for Contract, to assist them in planning and carrying out their respective work.

.2 Develop coordination drawings when required, illustrating potential interference between work of various trades and distribute to affected parties.

.3 Facilitate meeting and review coordination drawings. Ensure subcontractors agree and sign off on drawings.

.4 Publish minutes of each meeting.

.5 Plan and coordinate work in such a way to minimize quantity of service line offsets.

.6 Submit copies of coordination drawings and meeting minutes to Departmental Representative for information purposes.

.3 Submit shop drawings and order of prefabricated equipment or rebuilt components only after coordination meeting for such items has taken place.

.4 Work cooperation:

.1 Ensure cooperation between trades in order to facilitate general progress of work and avoid situations of spatial interference.

.2 Ensure that each trade provides all other trades reasonable opportunity for completion of work and in such a way as to prevent unnecessary delays, cutting,

patching and removal or replacement of completed work.

.3 Ensure disputes between subcontractors are resolved.

.5 Departmental Representative is not responsible for, or accountable for extra costs incurred as a result of Contractor's failure to coordinate work.

.6 Maintain efficient and continuous supervision.

18. Approval of Shop Drawings, Product Data and Samples

.1 In accordance with Section 013300, submit the requested shop drawings, product data, MSDS sheets and samples indicated in each of the technical Sections.

.2 **Allow 1 week for the following:**

.1 Review of product data.
.2 Approval of shop drawings.
.3 Review of re-submission.
.4 Ordering of approved material and/or products - refer to Section 016110 Product Requirements and Sections of Divisions 02 to 06.

.3 **Allow 2 weeks for an in stream mitigation approval process:**

.1 Retaining of QP by contractor and preparation of ECO Plan (See Clause 26).
.2 Submission of ECO Plan to Departmental Representative for review and permit. (See Clause 26)

19. Relics and Antiquities

.1 Relics and antiquities and items of historical or scientific interest shall remain property of Department. Protect such articles and request directives from Departmental Representative.

.2 Give immediate notice to Departmental Representative if evidence of archeological finds are encountered during excavation/construction, and await Departmental Representative's written instructions before proceeding with work in this area.

.3 Retain services of the Archaeologist for excavation, let the Archaeologist to excavate, of the new bent and monitoring during the removal of existing bent.

.4 Provide proof of all the mandatory criteria for the Archaeologist outlined below:

.1 Proof that the archaeologist conducting this work has at one time held a BC Heritage Conservation permit from the BC Archaeology Branch in his/her own name

.2 Proof that the archaeologist conducting this work has completed a Bachelor of Art degree in archaeology, or anthropology with a specialty in archaeology.

.3 Examples of work conducted in BC Coastal archaeology in the last 5 years

.4 Obtain and pay for any permits, if required by jurisdictions and recommended by RPCA. Send copy of approvals, permits and reports to Departmental Representative.

.5 Allow for site monitoring by First Nation, retain representative of First Nation if required, in parallel with the monitoring of the Archaeologist.

20 Project Meetings

.1 Departmental Representative will arrange teleconference project meetings and assume responsibility for setting times and recording and distributing minutes.

21. Testing and Inspections

.1 Particular requirements for inspection and testing to be carried out by testing service or laboratory approved by the Departmental Representative are specified in the technical sections.

.2 The Contractor will appoint and pay for the services of testing agency or testing laboratory as specified, and where required for the following:

.1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.

.2 Inspection and testing performed exclusively for Contractor's convenience.

.3 Where tests or inspections by designated testing laboratory reveal work is not in accordance with the Contract requirements, Contractor shall pay costs for additional tests or inspections as the Departmental Representative may require verification of acceptability of corrected work.

.4 The Contractor shall furnish labour and facilities to:

.1 Notify Departmental Representative in advance of planned testing.

.5 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

.6 Pay costs for uncovering and making good work that is covered

before required inspection or testing is completed and approved by Departmental Representative.

.7 The Departmental Representative may require, and pay for, additional inspection and testing services not included in Paragraph 21.1.

.8 Provide Departmental Representative with 2 copies of testing laboratory reports as soon as they are available.

.9 Ensure that work to be inspected is complete at the time of inspection and in accordance with the contract documents. Additional inspections required due to the incomplete work or poorly executed work, as judged by the departmental representative, as well as additional design or remedial work caused by deviations from these drawings, may be charged to the contractor.

.10 A minimum 72 hours' notice shall be given to the departmental representative by the contractor for any inspection to be carried out.

.11 The contractor to provide weekly electronic photos showing progress of work.

22. As-Built Documents

.1 The Departmental Representative will provide 2 sets of drawings, 2 sets of specifications, and copies of the original AutoCAD files for "as-built" purposes.

.2 As work progresses, maintain accurate records to show all deviations from the Contract documents. Note on as-built specifications, drawings and shop drawings as changes occur.

23. Cleaning

.1 Daily conduct cleaning and disposal operations. Comply with local ordinances and anti-pollution laws. Refer to Section 017411 – Cleaning.

.2 **Ensure cleanup of the work areas each day after completion of work.**

.3 Keep bridge areas clean and continue cleaning on an as-needed basis until bridge is sufficiently completed or ready to be open to the public.

.4 In preparation for interim and final inspections:

.1 Examine all sight-exposed surfaces.

.2 Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight surfaces.

24. General Requirements For Waste Management And Disposal

.1 All debris and deleterious substances generated during project activities shall be contained in the immediate work area, collected and appropriately disposed of in accordance with all applicable legislation, guidelines, and best management practices or as prescribed in the list of mitigation measures.

.2 At no time shall any waste material be allowed to enter any watercourse associated with the works.

.3 The Contractor/Operator shall be responsible for assuring that all reasonable efforts are implemented to eliminate or minimize waste production.

.4 At work sites and camping locations all food wastes and discarded food items shall be stored in closed, leak-proof storage containers that prevents access by wildlife. All material which can be recycled, such as paper and cardboard products, glass bottles and plastic and metal containers will be recycled where possible. The Contractor/Operator is responsible for the proper collection, storage and transportation of garbage and recyclable waste to disposal facilities. (e.g., Tofino landfill and appropriate recycling facilities).

.5 Open burning of waste is strictly prohibited, unless authorized by regulating bodies. For burning of untreated wood in metal containers, see Section 017411 – Cleaning.

25. Dust Control

.1 Provide temporary dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of work and public.

26. Environmental Protection

.1 Prevent extraneous materials from contaminating air beyond construction area, by providing temporary enclosures during work.

.2 Do not dispose of waste or volatile materials into water courses, storm or sanitary sewers.

.3 Ensure proper disposal procedures in accordance with all applicable territorial regulations.

.4 As a minimum, adhere to Parks Canada regulations and guidelines for wildlife available online,

Living with Wildlife:
http://www.pc.gc.ca/eng/pn-np/bc/pacificrim/visit/visit9.aspx#cont

Bare Campsite Program:
http://www.pc.gc.ca/eng/pn-np/bc/glacier/visit/visit17.aspx

and the following Fisheries and Oceans Canada Pacific Region Operational Statements:

1. Standards and Best Practices for Instream Works
2. Temporary Ford Stream Crossing
3. Bridge Maintenance
4. Maintenance of Riparian Vegetation in Existing Rights-of-way
5. Clear Span Bridges

.5 Adhere to the document Summary of Environmental Mitigation in Appendix C.

27. Mitigation Measures for Work in Streams

.1 Retain a Qualified Environmental Professional (QP) to provide an Environmental and Construction Operations plan (ECO) for mitigation methods, timing, work plan and monitoring of in-stream works. Before commencing work, submit the ECO plan to Departmental Representative for approval and issuance of permit. Follow any permit issued for the project, issued by provincial and federal environmental authorities.

.2 The mitigation methods provided by QP shall include the following components:

.1 Full time monitoring by QP during the in-stream work and sensitive activities

.2 Schedule of works to adhere to regional reduced risk timing windows to avoid works when species at risk are present

.3 Prevent the release of silt, sediment, sediment-laden water, raw concrete, concrete leachate or any other deleterious substance into water course or ravine

.4 Prevent release of concrete or cement into water course or ravine. Isolate cast-in-place concrete for min. 48 hours after pouring from water course or ravine.

.5 Emergency mitigation and clean-up measures.

.6 Isolation of work area from any flowing water.

.7 Salvage of fish and wildlife

.8 Erosion and sediment control

.9 Vegetation Management

.10 Site restorations

.11 Temporary diversions if applicable

.3 Immediately report any spills of sediments, debris, concrete fines, wash or contact water of reportable quantities to the Provincial emergency program Environmental Emergency management plan Incident Reporting hotline 1-800-663-3456 and DFO's Observe, Record and Report Hotline 1-800-465-4336. Implement emergency mitigation and clean-up measures.

28. Access, Delivery, Staging and Accommodation

.1 Approval from Parks Canada and Departmental Representative is required for access and delivery to the West Coast Trail

.1 Maintain for duration of Contract.

.2 Staging areas/truck access roads are recommended to use at the following locations:

Cheewhat suspension bridge, Cullite cable car crossing and Bridge #92:

- On logging road up what is known as "Big Ugly" above Camper Creek outside of the park boundary.
- Accessibility is by way of logging road that is fairly well maintained. There is a gate for entry to the logging road with a key that can be obtained by the contractor.
- May require a fuel drop for helicopter at the staging area depending on contractor's work schedule.

.3 Accommodations for construction crew is suggested at the following locations:

Cheewhat suspension bridge:

- Contractor can use the yard that surrounds Cheewhat cabin for contractor camping.
- Contractor must provide their own accommodations, food and approved "Bear cache" food lockers.

Cullite cable car crossing:

- Contractor can use Cullite Cove Tent Campsite at kilometer 58 at the beach near the cable car or beach access "A" for contractor camping.
- Contractor must provide their own accommodations, food and approved "Bear cache" food lockers.
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.4 See below coordinates of the bridges, staging areas and suggested camp

sites and their air distance from the bridges. The below provided coordinates and elevations are approximate.

Bridge (WCT location)	Longitude (W)	Latitude (N)	Site	Air distance from bridge (km)
Cullite Cable Car (57.7 km)	124° 35.855' 124° 35.89' 124° 33.26"	48° 34.029' 48° 33.95' 48° 35.33'	Bridge Location Accomod: Cullite Camp (km 58) Staging: Big Ugly	0.2 SE 4.7 N
Bridge No. 92 (58.4 km)	124° 35.401' 124° 35.89' 124° 33.26"	48° 33.966' 48° 33.95' 48° 35.33'	Bridge Location Accomod: Cullite Camp (km 58) Staging: Big Ugly	0.8 W 2.9 NE
Cheewhat Suspension Bridge (35.9km)	124° 48.720' 124° 44.995' 124° 33.26'	48° 39.795' 48° 39.073' 48° 35.33'	Bridge Location Accomod: At Cheewhat Cabin Staging: Big Ugly	29.0 E 5.0 E

29. Storage Facilities .1 Storage space will be limited to the area of construction in the locations approved by Departmental Representative. No storage facility is available along the West Coast Trail.

30. Power .1 Electrical power and lighting along the West Coast Trail is not available. Contractor is to provide his own source of power generators. Type and the locations to be approved by Departmental Representative.

31. Water Supply .1 Fresh water supply along West Coast Trail is very limited and it is available only at some areas along the trail. Use of local fresh water from the streams for construction purposes is only allowed if approved by Departmental Representative.

32. Sanitary Facilities .1 Existence of washroom facilities along the trail is limited. Existing designated washroom facilities - Outdoor compost toilets are available. Crew must bring wood shavings, toilet paper etc. Clean and stock washrooms daily and before final completion. Contractor is allowed to bring portable washrooms that shall be located in approved locations by Departmental Representative.

33. Scaffolding, Temporary Bracing and Shoring .1 Construct and maintain scaffolding in rigid, secure and safe manner. Contractor is responsible for design and construction of all temporary shoring, scaffolding and bracing during construction that shall be designed by a Professional Engineer registered in British Columbia retained by the contractor.

34. Additional Drawings

.1 The Departmental Representative may furnish additional drawings for clarification at additional cost. These additional drawings have the same meaning and intent as if they were included with plans referred to in the Contract documents.

.2 Should more than 2 sets of documents be required the Departmental Representative will provide them at additional cost.

35. Payment

.1 **Monthly progress payments per contract.**

36. Familiarization with Site

.1 Before submitting tender, recommended is a site visit - as indicated in tender documents and becoming familiar with all the conditions likely to affect the cost of the work. The sites are located in remote areas accessible partially by a helicopter, and with no cell phone access.

37. Site Conditions, weather

.1 The contractor is to assume all the risk related to, and to pay for any costs caused by delays or material, transportation and equipment losses due to weather or site conditions. These costs will not be reimbursed by the Departmental Representative (any change orders due to weather or site conditions will not be approved).

38. Submission of Tender

.1 Submission of a tender is deemed to be confirmation of the fact that the Tenderer has analyzed the Contract documents and inspected the site, and is fully conversant with all conditions.

END OF SECTION

1. Approvals

.1 Approval of shop drawings and samples: refer to Section 011155, Clause 18.

2. General

.1 This Section specifies general requirements and procedures for the Contractor's submissions of shop drawings, product data, samples and other requested submittals to Departmental Representative for review. Additional specific requirements for submissions are specified in individual technical sections.

.2 Present shop drawings, product data and samples in SI Metric units.

.3 Where items or information is not produced in SI Metric units, converted values are acceptable.

.4 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submissions.

.5 Notify Departmental Representatives in writing at time of submission, identifying deviations from requirements of Contract documents and stating reasons for deviations.

.6 Contractor's responsibility for deviations in submission from requirements of Contract documents is not relieved by Departmental Representative's review of submission unless Departmental Representative gives written acceptance of specific deviations.

.7 Make any changes in submissions which Departmental Representative may require consistent with Contract documents and resubmit as directed by Departmental Representative.

.8 Notify Departmental Representatives in writing, when resubmitting, of any revisions other than those requested by Departmental Representative.

.9 Do not proceed with work until relevant submissions are reviewed and approved by the Departmental Representative.

3. Submission Requirements

.1 Coordinate each submission with the requirements of the work and the Contract documents. Individual submissions will not be reviewed until all related information is available.

.2 Allow two weeks for Departmental Representative's review of each submission, unless noted otherwise.

.3 Accompany submissions with transmittal letter, in duplicate, containing:
- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.

.4 Submissions shall include:
- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative, certifying approval of submissions, verification of field measurements and compliance with Contract documents.
- .5 Details of appropriate portions of work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions (including identified field dimensions) and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Selfweight.
  - .8 Relationship to adjacent work.

.5 After Departmental Representative's review, distribute copies.

4. Shop Drawings

.1 Shop drawings: original drawings or modified standard drawings provided by Contractor to illustrate details of portions of work which are specific to project requirements.

.2 Maximum sheet size: 850 x 1050 mm.

.3 Submit shop drawings in pdf format for each requirement

requested in the specification sections and/or as requested by the Departmental Representative.

.4 Cross-reference shop drawing information to applicable portions of the Contract documents.

5. Shop Drawings Review

.1 Review of shop drawings by the Departmental Representative is for the sole purpose of ascertaining conformance with the general concept.

.2 This review shall not mean that the Departmental Representative approves the detail design inherent in the shop drawings, responsibility for which shall remain with Contractor submitting same.

.3 This review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the construction and Contract documents.

.4 Without restricting the generality of the foregoing, the Contractor is responsible for:

.1 Dimensions to be confirmed and correlated at the job site.
.2 Information that pertains solely to fabrication processes or to techniques of construction and installation.
.3 Coordination of the work of all sub-trades.

6. Product Data

.1 Product data: manufacturers' catalogue sheets, MSDS sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products or any other specified information.

.2 Delete information not applicable to project.

.3 Supplement standard information to provide details applicable to project.

.4 Cross-reference product data information to applicable portions of Contract documents.

.5 Submit 6 copies of product data.

7. Samples

.1 Samples of submissions are not required.

8. Progress Schedule

.1 Submit work schedule and cost breakdown as required in Section 011155.

9. Test Results and Inspection Reports

.1 Submit test results and inspection reports in pdf format required by the following Sections:

03 20 00 – Concrete Reinforcing
03 30 00 – Cast-in-Place Concrete

05 12 33 – Structural Steel for Bridges
Appendix A and B

END OF SECTION

1. References

.1 Government of Canada.
- .1 Canada Labour Code - Part II
- .2 Canada Occupational Health and Safety Regulations.

.2 National Building Code of Canada (NBC):
- .1 Part 8, Safety Measures at Construction and Demolition Sites.

.3 Canadian Standards Association (CSA) as amended:
.1 CSA S269, Falsework for Construction Purposes
.2 CSA S269.2, Access Scaffolding for Construction
.3 CSA S350, Code of Practice for Safety in Demolition of Structures

.4 Fire Protection Engineering Services, HRSDC:
- .1 FCC No. 301, Standard for Construction Operations.
- .2 FCC No. 302, Standard for Welding and Cutting.

.5 American National Standards Institute (ANSI):
- .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.

.6 Province of British Columbia::
- .1 Workers Compensation Act Part 3-Occupational Health and Safety.
- .2 Occupational Health and Safety Regulation

2. Related Sections

.1 Refer to the following sections as required:

.1	General Instructions	Section 01 11 55
.2	Shop Drawings, Product Data and Samples	Section 01 33 00
.3	Health & Safety Requirements	Section 01 35 33
.4	Product Requirements	Section 01 61 10
.5	Cleaning	Section 01 74 11
.6	Structure Demolition	Section 02 41 16
.7	Concrete Forming and Accessories	Section 03 10 00
.8	Concrete Reinforcing	Section 03 20 00
.9	Cast-in-Place Concrete	Section 03 30 00
.10	Structural Steel for Bridges	Section 05 12 33
.11	Rough Carpentry	Section 06 10 00
.12	Earthwork	Section 31 0000.01

3. Workers' Compensation Board

Coverage

.1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.

.2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

4. Compliance with Regulations

.1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.

.2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

5. Submittals

.1 Submit to Departmental Representative submittals listed for review in accordance with Section 013300.

.2 Work effected by submittal shall not proceed until review is complete.

.3 Submit the following:

- .1 Health and Safety Plan.
- .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
- .3 Copies of incident and accident reports.
- .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
- .5 Emergency Procedures.

.4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 5 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

.5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.

.6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:

.1 Be construed to imply approval by the Departmental Representative.

.2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.

.3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

6. Responsibility

.1 Act as a Prime Contractor and be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

7. General Conditions

.1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.

.2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.

.1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.

.2 Secure site at night time as deemed necessary to protect site against entry.

8. Project/Site Conditions

.1 Refer to the drawing S-1 for project site locations and specific drawings for bridge deck elevations above streams. Refer to Section 011155 General Instruction for access and staging areas in order to develop Health and Safety Plan.

9. Regulatory Requirements

.1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.

.2 In event of conflict between any provisions of the above authorities, the most stringent provision will apply. Should a

dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

10. Work Permits

.1 Obtain specialty permits related to project before start of work.

11. Filing of Notice

.1 The General Contractor is to complete and submit a Notice of Project as required by provincial authorities.

.2 Provide copies of all notices to the Departmental Representative.

12. Health and Safety Plan

.1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.

.2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:

.1 Primary requirements:
- .1 Contractor's safety policy.
- .2 Identification of applicable compliance obligations.
- .3 Definition of responsibilities for project safety/organization chart for project.
- .4 General safety rules for project.
- .5 Job-specific safe work, procedures.
- .6 Inspection policy and procedures.
- .7 Incident reporting and investigation policy and procedures.
- .8 Occupational Health and Safety Committee/Representative procedures.
- .9 Occupational Health and Safety meetings.
- .10 Occupational Health and Safety communications and record keeping procedures.

.2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.

.3 List hazardous materials to be brought on site as required by work.

.4 Indicate engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.

.5 Identify personal protective equipment (PPE) to be used by workers.

.6 Identify personnel and alternates responsible for site safety and health.

.7 Identify personnel training requirements and training plan, including site orientation for new workers.

.3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.

.4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.

.5 Departmental Representative's review: the review of Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

13. Emergency Procedures

.1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:

.1 Designated personnel from own company.
.2 Regulatory agencies applicable to work and as per legislated regulations.
.3 Local emergency resources.
.4 Departmental Representative.

.2 Include the following provisions in the emergency procedures:

.1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
.2 Evacuate all workers safely.
.3 Check and confirm the safe evacuation of all workers.
.4 Notify the fire department or other emergency responders.
.5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
.6 Notify Departmental Representative.

.3 Provide written rescue/evacuation procedures as required for, but not limited to:

- .1 Work at high angles.
- .2 Work in confined spaces or where there is a risk of entrapment.
- .3 Work with hazardous substances.
- .4 Underground work.
- .5 Work on, over, under and adjacent to water.
- .6 Workplaces where there are persons who require physical assistance to be moved.

.4 Design and mark emergency exit routes to provide quick and unimpeded exit.

.5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

14. Hazardous Products

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

.2 Where use of hazardous and toxic products cannot be avoided:

- .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS.
- .2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when tenants have left the building.
- .3 Provide adequate means of ventilation.

15. Overloading

.1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

16. Falsework

.1 Design and construct falsework in accordance with CSA S269.1.

17. Scaffolding

.1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA –S269.2 and B.C. Occupational Health and Safety Regulations.

18. Powder-Actuated Devices

.1 Use powder-actuated devices in accordance with ANSI A10.3

only after receipt of written permission from the Departmental Representative.

19. Fire Safety and Hot Work

.1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.

.2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.

20. Fire Safety Requirements

.1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

21. Unforeseen Hazards

.1 Should any unforeseen or peculiar safety-related factor, hazard or condition become evident during performance of the work, immediately stop work and advise the Departmental Representative verbally and in writing.

22. Posted Documents

.1 Post legible versions of the following documents on site:

- .1 Health and Safety Plan.
- .2 Sequence of work.
- .3 Emergency procedures.
- .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshaling station, and the emergency transportation provisions.
- .5 Notice of Project.
- .6 Floor plans or site plans.
- .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
- .8 Workplace Hazardous Materials Information System (WHMIS) documents.
- .9 Material Safety Data Sheets (MSDS).
- .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.

.2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.

.3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

23. Meetings

.1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

24. Correction of Non-Compliance

.1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.

.3 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

END OF SECTION

1. Products/Material and Equipment

.1 Use NEW products/material and equipment unless otherwise specified. The term "products" is referred to throughout the specifications.

.2 Use products of 1 manufacturer for material and equipment of the same type or classification unless otherwise specified.

.3 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

.4 Notify Departmental Representative in writing of any conflict between these specifications and manufacturer's instructions. Departmental Representative will designate which document is to be followed.

.5 Provide metal fastenings and accessories in the same texture, colour and finish as base metal in which they occur.

- .1 Prevent electrolytic action between dissimilar metals.
- .2 Use hot dip zinc galvanized fasteners, anchors and spacers for securing exterior work.

.6 Fastenings which cause spalling or cracking are not acceptable.

.7 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.8 Use heavy hexagon heads, semi-finished unless otherwise specified.

.9 Bolts may not project more than 1 diameter beyond nuts.

.10 Types of nuts and washers as follows:

- .1 Plain type washers: use on structural steel-to-steel.
- .2 Double nut or lock nut: use on hangers and steel plates against wood.

.11 Deliver, store and maintain packaged material and equipment with manufacturer's seals and labels intact.

.12 Prevent damage, adulteration and soiling of products during delivery, handling and storage. Immediately remove rejected products from site.

.13 Store products in accordance with suppliers' instructions.

.14 Touch up damaged factory finished surfaces to Departmental Representative's satisfaction.

- .1 Use primer or enamel to match original.
- .2 Do not paint over nameplates.

2. Quality of Products

.1 Products, materials and equipment (referred to as products) incorporated into work shall be new, not damaged or defective, and of the best quality (compatible with the specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of the products provided.

.2 Defective products will be rejected regardless of previous inspections.

.1 Inspection does not relieve responsibility, but is precaution against oversight or error.

.2 Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Retain purchase orders, invoices and other documents to prove that all products utilized in this Contract meet the requirements of the specifications. Produce documents when requested by the Departmental Representative.

.4 Should any dispute arise as to quality or fitness of products, the decision rests strictly with the Departmental Representative based upon the requirements of the Contract documents.

.5 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the building.

.6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

3. Availability of Products

.1 Immediately upon signing the Contract, review product delivery requirements and anticipate foreseeable supply delays for any items.

.2 If delays in supply of products are foreseeable, notify Departmental Representative of such in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of the work.

.3 In event of failure to notify Departmental Representative at the start of work and should it subsequently appear that the work may be delayed for such reason, the Departmental Representative reserves the right to substitute more readily available products of similar character, at no increase in either the Contract price or the

Contract time.

4. Manufacturer's Instructions

.1 Unless otherwise indicated in the specifications, install or erect products in accordance with the manufacturer's instructions.

.1 Do not rely on labels or enclosures provided with products.

.2 Obtain written instructions directly from the manufacturer.

.2 Notify Departmental Representative in writing of conflicts between the specifications and the manufacturer's instructions so that the Departmental Representative may establish the course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Departmental Representative to require removal and re-installation at no increase in either the Contract price or the Contract time.

5. Contractor's Options for Selection of Products for Tendering

.1 Products are specified by "Prescriptive" specifications: select any product meeting or exceeding specifications.

.2 Products specified under "Acceptable Products": select any one of the indicated manufacturers, or any other manufacturer meeting or exceeding the Prescriptive specifications and indicated Products.

.3 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.

.4 Products specified to meet particular design requirements or to match existing materials: use only material specified Approved Product. Alternative products may be considered provided full technical data is received in writing by Departmental Representative in accordance with "Special Instructions to Tenderers".

.5 When products are specified by a referenced standard or by or Performance specifications, upon request of Departmental Representative obtain from manufacturer an independent laboratory report showing that the product meets or exceeds the specified requirements.

6. Substitution After

Contract Award

.1 No substitutions are permitted without prior written approval of the Departmental Representative.

.2 **Proposals for substitution may only be submitted after Contract award.** Such request must include statements of respective costs of items originally specified and the proposed substitution.

.3 Proposals will be considered by the Departmental Representative if:

.1 products selected by tenderer from those specified are not available;

.2 delivery date of products selected from those specified would unduly delay completion of Contract, or

.3 alternative product to that specified, which is brought to the attention of and considered by Departmental Representative as equivalent to the product specified, and will result in a credit to the Contract amount.

.4 **Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the project. Pay for design or drawing changes required as result of substitution.**

.5 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative, and the Contract price will be reduced accordingly.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 011155 - General Requirements

.2 Section 013533 - Health and Safety Requirements

1.2 Project Cleanliness

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Departmental Representative or other Contractors.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Burning of waste materials on site is prohibited, unless approved by Departmental Representative.

.3 All equipment used on site must be clean a free of contaminants.

.4 Equipment such as concrete mixers, wheel barrows, shovels, trowels and other tools used for cast in place concrete work shall only be cleaned in areas approved by engineer. Cleaning equipment in or directly adjacent to any watercourse or intertidal area is prohibited.

If concrete wash water is produced during clean-up activities, it shall be contained on site to allow sediment to settle out and to reach a neutral pH before being released to the environment (typically 48 hours).

.5 Open burning is strictly prohibited, unless authorized by regulating bodies.

.6 Burning of old bridge untreated wood components is permitted only off dry season and upon permission of Departmental Representative, provided the wood has not been treated in the past, and following the recycling of structurally sound wood. The fire should be built in a manner that doesn't require removal of ground cover vegetation to expose mineral soil or leave a fire ring scar. This can be accomplished by building the fire in the lid of a standard sized residential, metal garbage container or similar container. Cold ash may be disposed of on site.

.7 Clear snow and ice from access to bridges/crossings, bank/pile snow in designated areas only.

.8 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.9 Provide on-site leak proof containers for collection of waste materials and debris.

.10 See Section 011155 - General Requirements for waste and food containers.

.11 Provide and use marked separate bins for recycling. Refer to Section 011155 that includes General Requirements for Waste Management and Disposal.

.12 Use local disposal facilities for waste materials and debris (e.g. Tofino landfill) and appropriate recycling facilities for recyclable items.

.13 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.14 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

1.3 Final Cleaning

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris including that caused by Owner or other Contractors.

.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. See clauses 1.2.5. and 1.2.6 above for burning wood on site.

.6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.7 Broom clean walks, steps and surfaces; rake clean other surfaces of grounds.

.8 Remove dirt and other disfiguration from exterior surfaces.

.9 Remove snow and ice from bridges and access walkways.

.10

1.4 Waste Management and

Separate waste materials for recycling in accordance with Section 011155 that includes General Requirements for Waste Management and Disposal.

Disposal

1.5 Disposal of Treated Wood

.1 All cutting and other treated wood waste materials will be collected and disposed of at an approved landfill site in accordance with Provincial Waste Management and Environment Canada regulations. Burning of treated wood waste products is prohibited.

.2 Before use, all treated products must be visually inspected to ensure that excessive residual preservative is not present on the wood surface. Material with excessive residual product will not be used and will be removed from the work site at the earliest opportunity.

.3 Employ construction methods and purchase materials in sizes which minimize the number of timber saw cuts needing field treatment with wood preservative.

.4 If on-site treatment of wood is required, these activities will be conducted in a contained upland location when possible.

.5 All treated wood sawdust should be collected in a plastic bin (e.g. Rubbermaid) or tarpaulin and disposed of off-site.

.6 Sawing of treated wood should be avoided in locations that may expose workers, site staff and visitors to sawdust.

1.6 Products .1

Part 2 NOT USED

2.1 Execution

Part 3 NOT USED

3.1

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 01 35 33 – Health and Safety Requirements.

.2 Section 01 74 11 – Cleaning

1.2 References

.1 Reference standards:

.1 CSA International

.1 CSA S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

1.3 Quality Assurance

.1 Regulatory Requirements: Ensure Work is performed in compliance with applicable Provincial/Territorial and Municipal regulations.

1.4 Site Conditions

.1 Environmental protection:

.1 Ensure Work is done in accordance with Section 011155 General Instructions for Environmental Procedures.

.2 Ensure Work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution.

.3 Fires and burning of waste or materials is not permitted on site, except untreated wood in metal containers as noted in Section 017411 – Cleaning.

.4 Do not bury rubbish waste materials.

.5 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.

.1 Ensure proper disposal procedures are maintained throughout project.

.6 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.

.7 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance as directed by Parks Surveillance Officer.

.8 Protect trees, plants and foliage on site and adjacent properties where indicated.

.9 Prevent extraneous materials from contaminating air beyond application area, by providing temporary

enclosures during demolition work.

.10 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on all temporary roads.

1.5 Existing Conditions

.1 Structures to be demolished are based on their condition on date that tender is accepted.

.1 Remove, protect and store salvaged items as directed by Departmental Representative. Salvage items as identified by Departmental Representative. Deliver to Departmental Representative as directed.

Part 2 Products

2.1 Equipment

.1 Equipment and heavy machinery:

.1 On-road vehicles to: CEPA-SOR/2003-2, On-Road Vehicle and Engine Emission Regulations and CEPA-SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations.

.2 Off-road vehicles to: EPA CFR 86.098-10 and EPA CFR 86.098-11.

.2 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

Part 3 Execution

3.1 Preparation

.1 Temporary Erosion and Sedimentation Control:

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to: requirements of authorities having jurisdiction, specific to site.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work.

.2 Protection of in-place conditions:

.1 Work in accordance with Section 011155 General

Instructions for Environmental Procedures.

.2 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, adjacent grades, properties, parts of existing building to remain.

.1 Provide bracing, shoring and underpinning as required.

.2 Repair damage caused by demolition as directed by Departmental Representative.

.3 Support affected structures and, if safety of structure being demolished adjacent structures appears to be endangered, take preventative measures, stop Work and immediately notify Departmental Representative.

.4 Prevent debris from entering surrounding area surface drainage system.

3.2 Demolition

.1 Provide Temporary Barriers and Enclosures for demolition work in accordance with Parks Canada and Regional regulations.

.2 Blasting operations are not permitted.

.3 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.

.4 To permit construction as indicated.

.5 Remove obstacles where required.

.6 Demolish to minimize dusting. Keep materials wetted as directed by Departmental Representative.

.7 Remove parts of structural framing that is being replaced by new framing as shown on the structural drawings.

.8 Contain fibrous materials to minimize release of airborne fibres while being transported within facility.

.9 Remove and dispose of demolished materials except where noted otherwise outside national park and in accordance with authorities having jurisdiction.

.10 Use natural lighting to do Work where possible.

..1 Shut off lighting except those required for security purposes at end of each day.

3.3 Cleaning

.1 Waste Management: separate waste materials for recycling in accordance with Section 01 74 11 – Cleaning.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.2 Divert excess materials from landfill to site approved by Departmental Representative.

.3 Designate appropriate security resources / measures to prevent vandalism, damage and theft.

.4 Locate stockpiled materials convenient for use in new construction. Eliminate double handling wherever possible.

.5 Dispose of materials in accordance with applicable regulations.

.1 Written authorization from Departmental Representative is required to deviate from disposal facilities listed in Waste Reduction Workplan.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 03 20 00 - Concrete Reinforcing

.2 Section 03 30 00 - Cast-in-Place Concrete

.3 Section 01 74 11 - Cleaning

1.2 References

.1 Canadian Standards Association (CSA International)

- .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CSA-O86-09, Engineering Design in Wood.
- .3 CSA O121-08 Douglas Fir Plywood.
- .4 CSA O151-09, Canadian Softwood Plywood.
- .5 CAN/CSA-O325-07 Construction Sheathing.
- .6 CSA S269.1 1975 (R2003) Falsework for Construction Purposes.
- .7 CAN/CSA-S269.3 M92 Concrete Formwork, National Standard of Canada

.2 Underwriters' Laboratories of Canada (ULC).

1.3 Action and Informational Submittals

.1 Submittals in accordance with Section 01 33 00 – Shop Drawings, Product Data, and Samples.

1.4 Delivery, Storage and Handling

.1 Waste Management and Disposal:

- .1 Separate waste materials for recycling in accordance with 017411 Cleaning.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Divert wood materials from landfill to a recycling facility as approved by Departmental Representative.
- .4 Divert plastic materials from landfill to a recycling facility as approved by Departmental Representative.
- .5 Divert unused form release material from landfill to an official hazardous material collections site as approved by the Departmental Representative.

Part 2 Products

2.1 Materials

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121 and CAN/CSA-O86.

.2 For concrete exposed to view use smooth, square edged plywood panels to clause 6.5 CSA-A23.1.

.3 Use sealed formwork to eliminate contamination of river with fresh concrete.

.2 Form ties:

.1 Use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.

.3 Form liner:

.1 Plywood: medium density overlay, Douglas Fir to CSA O121, sanded grade, square edge, 17 mm thick.

.4 Form release agent: non-toxic, biodegradable, low VOC.

.5 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC; free of kerosene.

.6 Falsework materials: to CSA-S269.1.

Part 3 Execution

3.1 Fabrication and Erection

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

.2 Obtain Departmental Representative's approval for use of earth forms and framing openings not indicated on drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Fabricate and erect falsework in accordance with CSA S269.1 and WorkSafe BC regulations.

.5 Do not place shores and mud sills on frozen ground.

.6 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.7 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.

.8 Align form joints and make watertight.

.1 Keep form joints to minimum..

.9 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless noted otherwise on the drawings.

.10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.11 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.

.1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.12 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 Removal and Reshoring

.1 Leave formwork in place for following periods of time after placing concrete.

.1 As directed by shoring engineer retained by the contractor, but minimum 3 days.

.2 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 03 10 00 – Concrete Forming and Accessories.

.2 Section 03 30 00 – Cast-in-Place Concrete Short Form.

.3 Section 01 74 11- Cleaning

1.2 References

.1 CSA International

.1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A23.3-04 (R2010), Design of Concrete Structures.

.3 CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

.4 CSA-G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.3 Quality Assurance

.1 Allow for field reviews of reinforcing prior to pours by Departmental representative as per Section 011155 General Instructions.

.2 Mill Test Report: upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 2 weeks prior to beginning reinforcing work.

.3 Upon request submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

1.4 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with

manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan related to Work of this Section.

Part 2 Products

2.1 Materials

.1 Substitute different size bars only if permitted in writing by Departmental Representative.

.2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.

.3 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

.4 Mechanical splices: subject to approval of Departmental Representative.

.5 Do not use plain round bars, wire ties, wire fabric or welded wire mesh.

2.2 Fabrication

.1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Departmental Representative weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 Source Quality Control

.1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request inform Departmental Representative of proposed source of material to be supplied.

Part 3 Execution

3.1 Field Bending

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.

.2 When field bending is authorized, bend without heat, applying

slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.2 Placing Reinforcement

.1 Place reinforcing steel as indicated on placing drawings in accordance with CSA-A23.1/A23.2.

.2 Reinforcing to be free of grease, scale and other coatings, unless noted otherwise on structural drawings.

.3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.

.4 Ensure cover to reinforcement is maintained during concrete pour.

3.3 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 017411 -Cleaning.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 03 10 00 – Concrete Forming and Accessories

.2 Section 03 20 00 – Concrete Reinforcing

.3 Section 01 74 11 - Cleaning

1.2 References

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.

.2 CSA International

.1 CSA-A23.1/A23.2-2009, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.3 Canadian Council of Independent Laboratories (CCIL)

1.3 Action and Informational Submittals

.1 Provide submittals in accordance with Section 01 33 00 – Shop Drawings, Product Data, and Samples.

.2 At least 4 weeks prior to beginning Work, inform Departmental Representative of source of fly ash.

.1 Do not change source of fly ash without written approval of Departmental Representative.

.3 Retain services of concrete testing agency to review concrete mixes, to take samples of concrete poured on site for concrete testing and for laboratory testing of concrete. Send mix design and test reports for review by the testing agency and Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.

.4 Laboratories of the concrete testing agency to be certified by the Canadian Council of Independent Laboratories (CCIL). Personnel of the concrete testing agency to be certified by the Canadian Standards Association (CSA).

.5 Each mix design to conform to requirements listed in clause 2.4 below and to show area of use, strength, exposure class, max W/C, percentage of coarse aggregate, flyash and slump range, as a minimum.

.6 Concrete hauling time: provide for review by Departmental

Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.4 Quality Assurance

.1 Provide to Departmental Representative, 4 weeks minimum prior to starting concrete work, valid and recognized certificate from plant delivering concrete.

.1 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements.

.2 If concrete test results indicate concrete is not to the specified criteria, the owner to have rights as listed in CSA-A23.1 Clause 4.4.6.7.

1.5 Delivery, Storage and Handling

.1 Delivery and Acceptance Requirements:

.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching, unless concrete retardants approved by the concrete agency are used.

.1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.

.2 Deviations to be submitted for review by the Departmental Representative.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

.3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials in accordance with Section 017411 Cleaning and Appendix C.

Part 2 Products

2.1 Design Criteria

.1 Alternative 1 – Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 Performance Criteria

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 Materials

.1 Cement: to CSA A3001, Type HS for severe sulphate exposure.

.2 Supplementary cementing materials: As specified in section 2.4.1.2., below.

.3 Water: To clause 4.2.2 and to table 9 limits for chlorides and alkalis CSA A23.1/A23.2.

.4 Aggregate: normal density fine and coarse aggregate to clause 4.2.3 including clause 4.2.3.5 on deleterious reactions.

.5 Other concrete materials: to CSA A23.1/A23.2.

2.4 Mixes

.1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3.4 – Field Quality Control.

Provide concrete mix to meet following hard state requirements:

Cheewhat Suspension Bridge – pile caps and Cullite Cable Car foundation/grade beam/columns:

.1 Durability and class of exposure: S-3.

.2 Supplementary cementing materials: as per CAN/CSA A3001.

.3 Entrainment air of 4-7%.

.4 Maximum water / cement ratio of 0.5.

.5 Compressive strength at 28days: 30MPa minimum.

.6 Intended application: footings and cable protection.

.7 Aggregate size 20 mm maximum.

.8 Curing type 1- curing for 3 days $\geq$ 10°C as per table 20 of CSA A23.1

Cheewhat Suspension Bridge - pier crib:

.1 Durability and class of exposure: C-1 and S-3 (severe sulphate exposure) with chloride resistivity below 1000 Coulombs tested prior construction.

.2 Supplementary cementing materials: with

minimum 15% fly ash replacement, and 8% silica fume by mass of total cementitious materials to CAN/CSA A3001.

.3 Entrainment air of 5-8%.

.4 Maximum water/cement ratio of 0.4.

.5 Compressive strength at 28 day: 35 MPa minimum.

.6 Intended application: pier crib scour protection foundation crib wall.

.7 Aggregate size 20 mm maximum.

.8 Curing type 3- wet curing for 7 days (refer to Table 20 of CSA A23.1 for additional requirements)

.2 Concrete supplier's certification.

.3 Provide quality management plan to ensure verification of concrete quality to specified performance.

Part 3 Execution

3.1 Preparation

.1 Provide Departmental Representative 72 hours' notice before each concrete pour.

.2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 During concreting operations:

.1 Development of cold joints not allowed.

.2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Protect previous Work from staining.

.5 Clean and remove stains prior to application of concrete finishes.

3.2 Installation/ application

.1 Provide and have the Departmental Representative review mitigation measures as per Section 011155 when placing near river bed or stream

.2 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.

.3 Protect concrete: for hot weather conditions when air temperature is 27°C or higher as per clause 7.4.2.4. Protect concrete for cold weather conditions when air temperature is 5°C or lower (or likely

to fall below 5°C within 24 hours of placing) as per clause 7.4.2.5.

.4 Provide minimum concrete cover: over principal reinforcing steel unless noted otherwise on the structural drawings:

75mm poured against ground

50mm formed surfaces

.5 Horizontal wall reinforcing shall be continuous around corners and hooked at wall. Lap lengths are as follows:

bar size	vertical lap	horizontal lap
10M	500mm [20"]	650mm [26"]
15M	600mm [24"]	800mm [32"]
20M	750mm [30"]	1000mm[40"]
25M	1200mm [48"]	1550mm [60"]

.6 Sleeves and inserts:

.1 Cast in sleeves, ties, slots, anchors, reinforcement, frames, conduit, bolts, waterstops, joint fillers and other inserts required to be built-in.

.2 Sleeves and openings greater than 100 mm x 100 mm not indicated must be reviewed by Departmental Representative.

3.3 Finishes

.1 Formed surfaces exposed to view: smooth-form finish in accordance with CSA A23.1/A23.2.

3.4 Field Quality Control

.1 Concrete testing: to CSA A23.1/A23.2 by testing laboratory designated and paid for by General Contractor. Compression tests (sample taken at each pour) are required.

.2 Send electronic photos of completed work to Departmental Representative for review, as follows: reinforcing before pour and once a week send progress photos of completed concrete elements as a minimum.

.3 Schedule site visits:

.1 Upon completion of the Work, after cleaning is carried out.

3.5 Cleaning

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.2 Use trigger operated spray nozzles for water hoses.

.3 Designate cleaning area for tools to limit water use and runoff.

.4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 11 - Cleaning.

.1 Divert unused concrete materials from landfill to local facility after receipt of written approval from Departmental Representative.

.2 Provide appropriate area on job site where concrete trucks and be safely washed.

.3 Divert admixtures and additive materials from landfill to approved official hazardous material collections site after receipt of written approval from Departmental Representative.

.4 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 06 10 00 – Rough Carpentry.

1.2 References

.1 ASTM International

- .1 ASTM A325M-09, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength Metric.
- .2 ASTM A603 -98 (2014) Standard Specification for Zinc-Coated Steel Structural Wire Rope
- .3 ASTM F1145 - 05(2011) Standard Specification for Turnbuckles, Swaged, Welded, Forged

.2 CSA International

- .1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA S16-09, Design of Steel Structures.
- .4 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 CSA W59-03(R2008), Welded Steel Construction, (Metal Arc Welding).

1.3 Action and Informational Submittals

.1 Submit in accordance with Section 01 33 00 – Shop Drawings, Product Data, and Samples.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for structural steel and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 43 - Health and Safety Requirements.

.3 Shop Drawings:

- .1 Indicate shop and erection details including shop splices, cuts, copes, connections, holes, bearing plates, threaded fasteners and welds. Indicate welds by CSA W59, welding

symbols.

.2 Proposed welding procedures to be stamped and approved by Canadian Welding Bureau.

.3 Submit description of methods, temporary bracing and strengthening, sequence of erection and type of equipment proposed for use in erecting structural steel.

1.4 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.1 Ensure Departmental Representative has delivery schedules 7 days minimum prior to shipping.

.3 Storage and Handling Requirements:

.1 Provide protective blocking for lifting, transportation and storing.

.1 Exercise care during fabrication, transportation and erection of girders, beams and trusses.

.2 Do not notch edges of members.

.3 Do not cause excessive stresses.

.2 Mark mass on members weighing more than 590kg (1300lbs).

.3 Ensure that no portion of steel comes into contact with ground.

.1 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 017411 Cleaning.

1.5 Quality Assurance

.1 Preconstruction Testing:

.1 Provide suitable facilities and cooperate with inspection organization and Departmental Representative in carrying out inspection and tests required.

Part 2 Products

2.1 Materials

.1 Structural steel: to CSA G40.20/G40.21, grade and types 300W,

wire rope per ASTM A603-6x19 with steel core, Class C coating, unless noted otherwise on structural drawings. For rope braking strength in kN, see drawings. For micro-pile specification see Appendix B.

.1 Hot dip zinc galvanize all steel and connection material including threaded rods, wire ropes and rope hardware, lag screws, bolts, nuts and washers.

.2 Wire rope hardware per ASTM F1145 - 05(2011):

Thimbles: cold rolled zinc galvanized to fit the cable diameter
Eye bolts and eye nuts, shackles, U bolt clips, turnbuckles: forged, size to suit cable, strength to match cable ultimate (breaking) strength

.2 Steel-to-steel bolts, nuts and washers: to ASTM A325M

.3 Bolts through wood, nuts and washers: to ASTM A307

.4 Anchor bolts, lag screws, threaded rods, washers and nuts: to CSA G40.20/G40.21, grade 300W or grade A36 to ASTM F1554.

.5 Welding electrodes: E49XX to CSA W48 series.

.6 Hot dip galvanizing: to CAN/CSA G164, minimum zinc coating of 600 g/m², except rope zinc coating as per ASTM A603.

.7 Field applied paint is prohibited, unless approved in writing by the Departmental Representative. Field applied paint to achieve galvanic protection, the dry extract to have a zinc concentration of at least 95%. The paint to resist expansion and shrinking once applied to the metal due to temperature variations. Paint to be approved by Departmental Representative.

2.2 Source Quality Control

.1 Steel producer qualifications: certified in accordance with CSA G40.20/G40.21.

.2 Submit Departmental Representative 2 copies of certified test reports for Charpy V-notch test.

.3 Provide suitable facilities and co-operate with inspection organization and Departmental Representative in carrying out inspection and tests required.

Part 3 Execution

3.1 Examination

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are

acceptable for structural steel installation in accordance with manufacturer's written instructions.

.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 Preparation

.1 Clean steel surfaces as directed by Departmental Representative when staining or defacing occurs.

.2 Verify location of substructure units, elevations of bearing seats and location of anchor bolts before erection of structural steel; report discrepancies to Departmental Representative.

.3 Work near river banks or embankments in accordance with written instructions from Departmental Representative.

.4 Restrict drifting during assembly to minimum required to bring parts into position without enlarging or distorting holes, and without distorting, kinking or sharply bending metal of any unit.

.1 Enlarge holes if necessary by reaming only after receipt of written approval from Departmental Representative.

.2 Ensure reamed holes are 2 mm maximum larger than bolt size used.

.5 Place anchor lag screws at elevations and locations indicated.

3.3 Installation

.1 Do falsework in accordance to CSA S269.1.

.2 Do fabrication and erection of structural steel in accordance with CAN/CSA S6, Design of Highway Bridges.

.3 Do welding in accordance with CSA W59, except where specified otherwise.

.1 For CSA G40.20/G40.21, grade 350AT steel, deposited weld metal to have Charpy V-Notch value not lower than that of steel.

.2 Do welding in shop unless otherwise permitted by Departmental Representative.

.3 Weld only at locations indicated.

.4 High strength bolting: in accordance with CAN/CSA S6. Use 'turn-of-nut' tightening method.

.5 Finish: members true to line, free from twists, bends, open joints, sharp corners and sharp edges.

.6 Allowable tolerance for bolt holes:

.1 Matching holes for bolts to line up so that dowel 2 mm less in diameter than hole passes freely through assembled members at right angles to such members.

.2 Finish holes not more than 2 mm in diameter larger than diameter of rivet or bolt unless otherwise specified by Departmental Representative.

.3 Centre-to-centre distance between any two holes of group to vary by not more than 1 mm from dimensioned distance between such holes.

.4 Centre-to-centre distance between any two groups of holes to vary not more than maximum of the following:

Centre-to-Centre distance in metres	Tolerance in plus or minus mm
less than 10	1
10 to 20	2
20 to 30	3

.5 Correct mispunched or misdrilled members only as directed by Departmental Representative.

.7 Span length tolerances:

.1 Girders and beams: plus or minus 6 mm

.2 Centre-to-centre of bearing stiffeners and bearing plates: plus or minus 3 mm.

.8 Shop splices:

.1 Use complete joint penetration groove welds finished flush.

.2 Details of butt joints to CSA W59.

.3 Use only as approved by Departmental Representative.

.9 Shop erection:

.1 Support each girder on its bearing points and measure and record deflection at same points indicated for measurement of camber.

.2 Measure deflections in plane of girder web.

.3 Submit diagram to Departmental Representative showing deflection measurements for each girder or truss before delivery.

.4 Shop erection is not required for single span girders with

no field splices.

.10 Mark members in accordance with CSA G40.20/G40.21.

.1 Do not use die stamping.

.2 Place marking at locations hidden when viewed from exterior after erection when steel is to be left in unpainted condition.

.11 Match marking: shop mark bearing assemblies and splices.

.12 Paint field welds or field cut ends with zinc rich paint, see 2.1.6. Grind galvanized area off the connection before welding.

3.4 Field Quality Control

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, protecting and cleaning of steel.

.2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Ensure manufacturer's representative is present before installation, during critical periods of installation and during construction of field joints and testing.

.4 Send electronic photos of completed work to Departmental Representative for review once a week as a minimum.

.5 Schedule site visits:

.1 Upon completion of the Work after cleaning is carried out.

3.5 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 011155. Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 05 12 00 – Structural Steel for Bridges

.2 Section 01 74 11 – Cleaning

1.2 References

.1 ASTM International

.1 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 CSA International

.1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.2 CSA O121-08, Douglas Fir Plywood.

.3 CSA O141-05(R2009), Softwood Lumber.

.4 CSA O86-09 Engineering Design in Wood

.5 CSA O325-07, Construction Sheathing.

.3 National Lumber Grades Authority (NLGA)

.1 Standard Grading Rules for Canadian Lumber 2010.

1.3 Action and Informational Submittals

.1 Submit in accordance with Section 01 33 00 – Shop Drawings, Product Data, and Samples.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 Quality Assurance

.1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood in accordance with CSA and ANSI standards.

1.5 Delivery,

.1 Deliver, store and handle materials in accordance with Section

Storage and Handling

01 60 10 - Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect wood from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 017411 Cleaning.

.5 Packaging Waste Management: remove for and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 11 55.

Part 2 Products

2.1 Framing Structural And Panel Materials

.1 Lumber: Natural Untreated Red Cedar, NLGA No. 1 or better grade for bent and guardrail posts and stringers and No.2 or better grade for other lumber; Yellow Alaskan Cedar No 1 for suspended bridge and cable car round poles; S4S, moisture content 19% (S-dry) or less in accordance with following standards:

.2 CSA O141.

.3 NLGA Standard Grading Rules for Canadian Lumber.

.2 Douglas fir plywood (DFP): to CSA O121, standard construction.

.3 Canadian softwood plywood (CSP): to CSA O151, standard construction.

2.2 Accessories

.1 Nails and spikes: to CSA B111. Nails to be common nails. Gun nails to be the same size as common nails, with round heads (no notches). Staples or furring nails are not acceptable.

.2 Bolts (steel-to-wood and wood-to-wood): 19 mm diameter unless indicated otherwise, complete with double nuts and washers, to ASTM A307.

.3 Lag screws: 12 mm diameter unless noted otherwise, to CSA B34.

.4 Self-drilling wood screws to be 6mm diameter 100 mm long with hexagonal heads, unless noted otherwise.

.5 Fastener Finishes:

.1 Galvanizing: to ASTM A123/A123M, use hot dip zinc galvanized fasteners.

.6 Wood Preservative: untreated.

Part 3 Execution

3.1 Examination

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative

3.2 Installation

.1 Install members true to line, levels and elevations, square and plumb.

.2 Construct continuous members from pieces of longest practical length.

.3 Install spanning members, if warped, with "crown-edge" (not "cup-edge") up.

.4 Select exposed framing for appearance. Install panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.

.5 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.

.6 Install sleepers as indicated.

.7 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.8 Countersink bolts only where shown on the structural drawings.

Pre-drill holes in the timbers for lag screws. Make hole diameters 70% of the lag screw shank diameter. Hole/shank to be as follows: 9mm/13mm,

12mm/16mm and 14mm/19mm. Counterbore hole for smooth shank portion of lag screw of 100% of shank diameter.

3.3 Field quality control

.1 Send electronic photos of completed work to Departmental Representative for review, as follows: framing and connections before covering up but once a week as a minimum.

.1 Schedule site visits:

.1 Upon completion of the Work, after cleaning is carried out.

3.4 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 1155.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by rough carpentry installation.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Appendix A - Geotechnical report for Cullite Cable Car

.2 Appendix B - Geotechnical report for Cheewhat Suspension Bridge

1.2 References

.1 ASTM International

.1 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN-m/m^3).

.2 CSA International

.1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CSA A3000-08, Cementitious Materials Compendium.

.4 Section 01 74 11 - Cleaning

1.3 Action And Informational Submittals

.1 Site Quality Control Submittals: submit in accordance with Section 013300 Shop Drawings, Product data and Samples.

.1 Submit condition survey of existing conditions to Departmental Representative.

.2 Submit testing and inspection reports as described in PART 3.4 - FIELD QUALITY CONTROL.

.2 Sustainable Design Submittals:

.1 Erosion and Sedimentation Control: submit erosion and sedimentation control plan in accordance with authorities having jurisdiction.

.2 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements..

Part 2 Products

2.1 Materials

.1 Use excavated site inorganic soil as a foundation and sleeper backfill, only where shown on drawings and where acceptable by in-stream work mitigation guidelines.

.2 Retain services of micro piles installation per specification and instructions of the geotechnical report in Appendix B and

structural drawings. Micro piles material properties, length and size to be design built to achieve tension and compression loads shown on the structural drawings (performance specification).

Part 3 Execution

3.1 Examination

.1 Evaluation and Assessment:

.1 Before commencing work verify requirements for relocation of plants, if required by the environmental assessment, and as directed by Departmental Representative.

3.2 Preparation

.1 Temporary erosion and sedimentation control:

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent area and stream, according to the mitigation measures in Section 011155.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

.2 Protection of in-place conditions:

.1 Protect excavations from freezing.

.2 Keep excavations clean, free of standing water, and loose soil.

.3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative's approval.

.4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.

.5 Protect buried services that are required to remain undisturbed.

.3 Removal:

.1 Remove trees, stumps, logs, brush, shrubs, bushes, vines, undergrowth, rotten wood, dead plant material, exposed boulders and debris within areas designated on drawings.

3.3 Excavation

.1 Shore and brace excavations, protect slopes and banks and perform work in accordance with Provincial regulations.

.2 Strip topsoil over areas to be covered by new construction, over areas where grade changes are required, and so that excavated material may be stockpiled without covering topsoil.

.1 Stockpile topsoil on site for later use.

.3 Excavate as required to carry out work per structural drawings and geotechnical reports in Appendix A and B.

.1 Do not disturb soil or rock below bearing surfaces.

.2 Extend underside of foundation to dense native mineral soil or intact bedrock.

.3 Notify Departmental Representative when excavations are complete.

.4 If bearings are unsatisfactory, additional excavation will be authorized in writing and paid for as additional work.

.5 Excavation taken below depths shown without Departmental Representative's written authorization to be filled with approved compacted granular material at Contractor's expense.

3.4 Field Quality Control

.1 Not later than 72 hours before installing micro piles, pouring concrete foundations, pile caps or placing timber sleepers, notify Departmental Representative to have soil conditions and bearing capacity site reviewed and site test micro piles. Bearing conditions, existing anchor testing for Cullite Cable Car Crossing and bearing conditions, and micro pile testing for Cheewhat Suspension Bridge to be site reviewed by a geotechnical engineer retained by Departmental Representative (refer to Appendix A and B for geotechnical reports). Minimum allowable soil bearing pressure capacity and micro pile capacity to be as recommended in the Appendix A and B and based on loads shown on the structural drawings.

.2 Footings to be backfilled with the original material found on site.

3.5 Backfilling

.1 Remove snow, ice, construction debris, organic soil and standing water from spaces to be filled.

.2 Lateral support: maintain even levels of backfill around structures as work progresses, to equalize earth pressures.

.3 Compaction of subgrade: compact existing subgrade under sleepers and foundations to same compaction as fill.

.1 Fill excavated areas with selected subgrade material or gravel and sand, compacted as specified for fill.

.4 Placing:

.1 Place backfill, fill and base course material in 150 mm lifts: add water as required to achieve specified density.

.5 Compaction: compact each layer of material to following densities for material to ASTM D698:

.1 To underside of base courses: 95%.

.2 Base courses: 100%.

.6 Against foundations: excavated material or imported material with no stones larger than 200 mm diameter within 600 mm of structures.

.7 Backfilling any excavations with concrete is acceptable only where shown on drawings and concrete to be poured into watertight membrane, spillage of fresh concrete onto the ground is prohibited.

3.6 Grading

.1 Grade so that water will drain away from walls to disposal areas approved by Departmental Representative.

3.7 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Dispose of cleared and grubbed material off site daily.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 1155.

END OF SECTION

GEOTECHNICAL REPORT FOR CULLITE CABLE CAR

BY RYZUK GEOTECHNICAL ENGINEERING

RYZUK GEOTECHNICAL
Engineering & Materials Testing

28 Crease Avenue, Victoria, BC, V8Z 1S3 Tel: 250-475-3131 Fax: 250-475-3611 www.ryzuk.com

October 27, 2015
File No: 7148-2

Public Works & Government Services Canada
219-800 Burrard Street
Vancouver, BC
V6Z 0B9

Attn: Tom Dunphy, Senior Project Manager

Re: Cullite Cable Car Geotechnical Assessment
West Coast Trail - Pacific Rim National Park, BC

1. INTRODUCTION

As requested, and further to our email proposal of June 24, 2015 and our recent temporary work at the referenced site, we attended site on August 13, 2015, to complete a detailed assessment of Cullite Creek. Our scope was to evaluate the hydrologic conditions as such affects the stability of the existing cable car structure in the long term, identify possible options for mitigation, and provide plans and specifications for the favored option. Our work has been undertaken in accordance with, and is subject to, the attached Terms of Engagement.

2. BACKGROUND

Cullite Creek is located near kilometer marker 58 of the West Coast Trail and the study area is situated in a generally steeply dipping bedrock controlled ravine. The entire watershed has a basin area of about 20 km^2 while the creek itself discharges to the marine foreshore at Cullite Cove within the Strait of Juan de Fuca. The existing cable car crossing as part of the West Coast Trail is located roughly 250 m upstream of the mouth of the creek. During the last winter season, significant erosion of the channel bank was observed involving lateral migration of the channel towards the western platform of the existing cable car structure. In addition, water flow down the existing trail alignment contributed to erosion around the platform foundation elements. Due to the above, we were retained this spring to design a mechanically stabilized earth (MSE) wall to temporarily protect the platform from erosion for the remainder of the summer hiking season.

The MSE wall was determined to be insufficient to protect platform in the long term, and accordingly we were retained to complete a more detailed hydrological assessment of the channel to provide feasible long term solutions to protect the platform from future erosional hazards.

The following outlines our observations, analysis and results of our assessment as well as our recommendations for remediation.

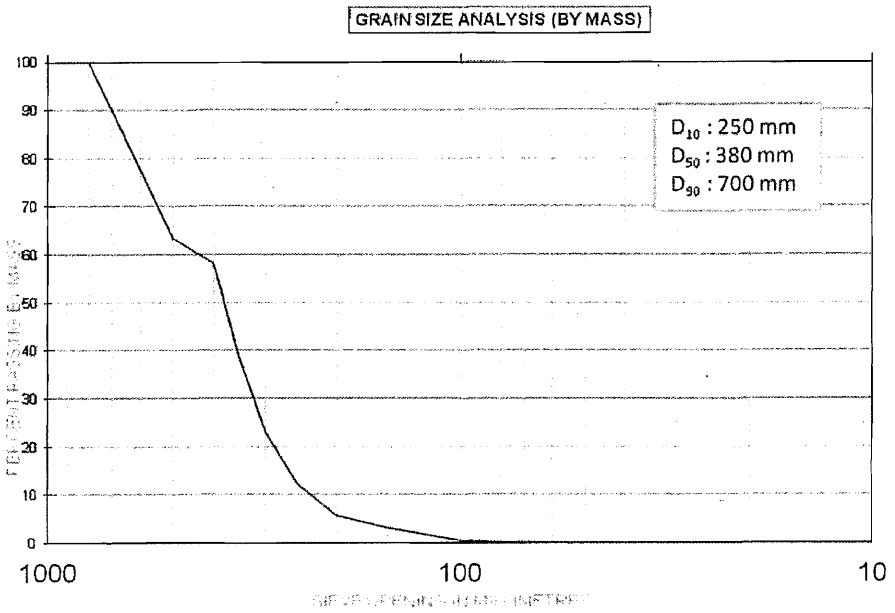
3. INVESTIGATION AND OBSERVATIONS

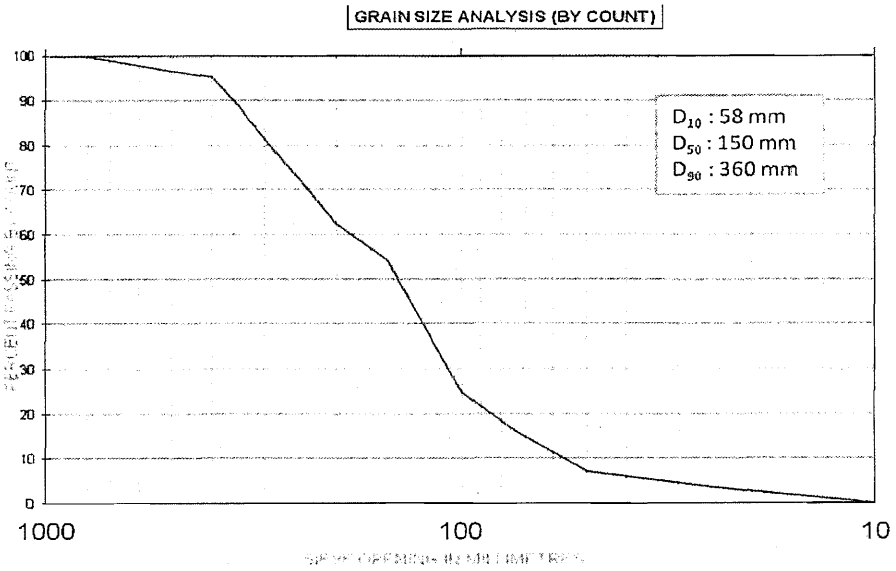
Our site investigation consisted of a visual assessment of the existing channel morphology at the location of the crossing as well as up and downstream of the cable car crossing. In addition we collected cross-sectional measurements of the stream bed, profiles along the thalweg, and measured particle size within the channel bed. The channel geometry is critical for understanding the past fluvial hydrologic regime that has resulted in lateral instability and erosion of the channel, while the bedding size can be utilized to determine the flow velocity and associated energy of the river system.

The cross sectional profile along the cable car crossing alignment was measured by stretching a level (horizontal) 30 m tape across the channel and measuring the distance from the tape to the bottom of the channel along the width of the channel. The attached drawings consist of 8-7184-2-1 Plan View, 8-7148-2-2 Section, and 8-7148-2-3 Logitudinal Plan View. These respectively show the location of the crossing; the cross section profile of the stream bed along the alignment of the crossing; and the longitudinal layout of the river channel above and below the cable car crossing.

The longitudinal channel of the creek can generally be divided into shorter segments or "reaches" sharing similar characteristics as defined by the localized hydromorphology. In general, the portion of Cullite Creek analyzed can be classified as an intermediate sized channel (20-30 m wide) with relatively low stability dominated by a riffle-pool morphology. A riffle pool morphology consists of alternating reaches of flatter and steeper segments containing slightly more tranquil pools followed by faster moving, more turbulent water. The cable car crossing is located within a riffle reach and the stream channel was observed to be a gradient of roughly 7% within the segment. At the time of our assessment the water levels were noted to be extremely low with a max depth of roughly 0.3 m along the cable car alignment.

The size distribution of the stream bed material was determined by non-random measurement of the intermediate size of the gravel/cobbles/boulders along the stream bed. The distribution of the stream bed sediment size is shown below both by mass and by count, including the determined D_{10}, D_{50} and D_{90} values for each. The weight of each clast was estimated by assuming a spherical shape of diameter equal to the intermediate length of the clast and assuming a density of 2650 kg/m^3.





Based on the large size of the channel bedding and from evidence of imbrication of cobbles/boulders, it is clear that much higher flow rates are evident during heavy rainfall in the winter season. Imbrication, also coined shingling, is a sediment dispositional feature in which cobbles/boulders or even gravel of various sizes are observed to stack on top of each other with their longer, flatter plane oriented in the direction of river flow, typically with an upstream dip. This depositional feature is indicative of a channel where the sediment supply and transport is

dominated by bedload, which involves the rolling, bouncing or sliding of sediment along the bed of the channel. However, it is likely that during high flow events there is also a high portion of suspended sediment load.

4. INTERPRETATION AND ANALYSIS

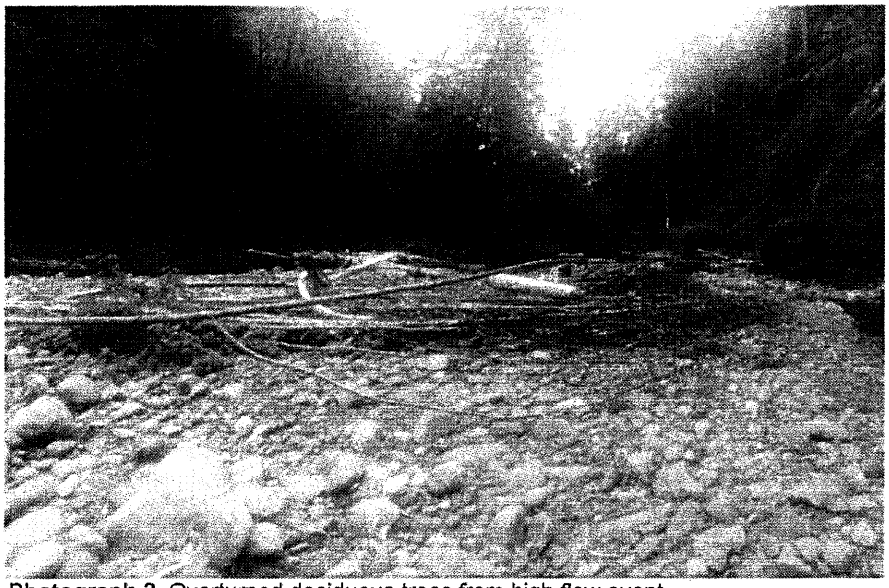
4.1. Bankfull Condition

The channel forming discharge or bankfull discharge of a fluvial system is the high flow event which fills the channel to capacity and generally defines the characteristics of a channel. Based on our observations and measurements onsite, the hydrological characteristics of this event can be predicted, which can then be used to assess the long term stability and potential erosional tendencies of the channel.

Our observations indicate that the creek has an extremely variable seasonal flux. Based on our assessment the channel forming discharge appears to have a high water elevation near the base of the existing MSE wall at the crossing location, with the deepest portion of the channel being over 2 m during this event. Evidence confirming this elevation was seen in sandy deposits and woody debris observed at this approximate elevation just downstream of the crossing as shown in the following picture.

Photograph 1. Woody/sandy deposit.

Further evidence suggests that the bankfull discharge occurs every 2-4 years and that such an event occurred last winter season. This is evident by the size of recently overturned deciduous trees on higher sediment bar in the middle of the channel located upstream of the crossing, which were toppled due to the higher and faster moving water.



Photograph 2. Overturned deciduous trees from high flow event.

4.2. Peak Discharge and Maximum Velocity

The computer program FlowMaster by Haestad was utilized to determine the hydraulic characteristics of the channel during the bankfull discharge event. Flowmaster uses Manning's formula to calculate the discharge and average peak velocity of the creek during the bankfull discharge. The input parameters consist of the cross-sectional measurements, the measured bedding size distribution (Manning's roughness coefficient was estimated from the D_{50} of the bedding size), along with the channel gradient. The peak discharge and average channel velocity was estimated to be 140 m^3/s and 4.1 m/s, respectively, in the location of the cable car crossing.

4.3. Changing Conditions

Localized channel obstructions or stressors can cause rapid changes to the lateral and vertical channel alignment. Obstructions within the channel can create shear forces and introduce turbulence into the flow which locally modifies the flow pattern and sediment transport. Based on discussions with the construction contractor that has completed recent remediation work at this location over the past 2 seasons, we understand that the large log (up to 1.5 m diameter) observed in the drawing 8-7148-2-1 was previously located further upstream and closer to the western bank of the channel. We suspect that the large log is likely a contributing factor to the

more rapid erosion towards the existing cable car crossing platform that has been experienced in the past year or two.

Obstructions can also locally increase the water elevation due to development of velocity head. Velocity head is an elevated water level caused by a phenomenon where fast flowing water encounters an obstruction forcing the water to flow upward and around the object. Intuitively, the height of velocity head is directly related to the velocity of the water flow at the point of impact. Based on the calculated flow velocity of 4.1 m/s this could amount to a velocity head of up to 0.8 m as a result of large obstructions in the channel. In addition, a similar phenomenon called super elevation occurs due to meanders or bends in a channel as a result of centrifugal force. Based on the arc of the meander near the cable car crossing a super elevation of up to 0.75 m could occur during peak flow. The above combined with an obstruction such as the noted log can lead to rapid downcutting, erosion and channel avulsion.

The ravine slopes upstream of the crossing consist of exposed relatively soft sandstone bedrock, with recent signs of instability observed involving rock fall. There was also evidence of shallow landslips involving mobilization of mature trees and vegetation from the crest of the ravine that are likely associated with periodic regression of the gully wall as rockfalls occur. Where the above instabilities/debris enter the stream, the channel morphology could be affected at the location and downstream of the failure.

In addition, we expect the creek to have a relatively fast recharge during heavy precipitation due to the bedrock controlled gully and lack of soil absorption, potentially creating rapid water elevation and discharge variations.

4.4. Summary

Cullite Creek is an extremely dynamic and complex environment with high variation in seasonal flux. It should be expected that the channel morphology will change periodically due to ongoing lateral migration, possible larger scale channel avulsion due to obstructions and/or debris noted above, and potential changes in weather patterns.

We consider the western platform of the existing cable car to be inherently stable at the moment, and although such could potentially remain so for the next few years, there is also an equally high risk of further erosion in any given winter that compromises the foundations to the point of total collapse.

5. REMEDIATION

Several options have been considered to remediate the erosion to protect the western cable car platform in the long term. We have taken into account our prediction of reliability of the works

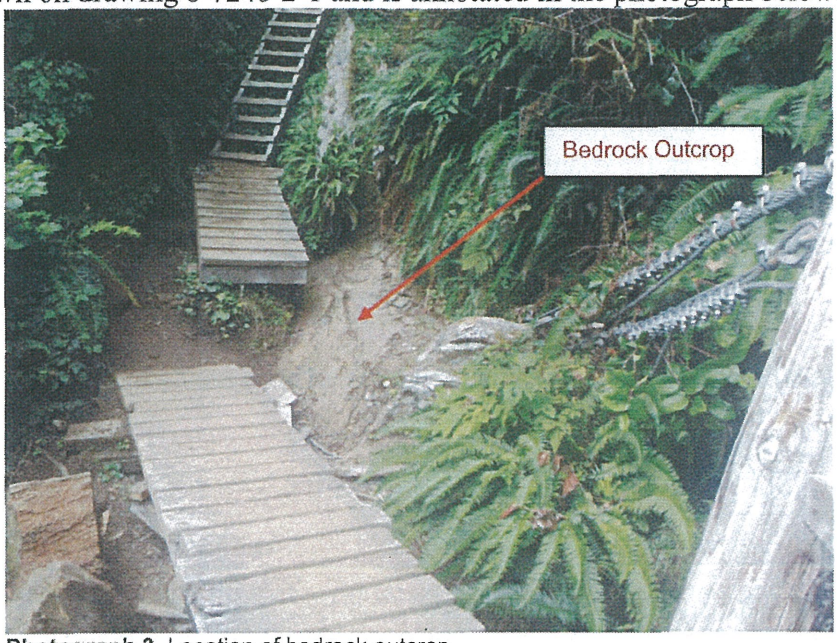
being effective over the long term, the ease of construction, as well as the anticipated magnitude of order costs. These options include the following:

- Moving western platform foundation elements back from existing channel edge and placing foundations directly on the observed sandstone bedrock
- Reinforced Pillow Rip-Rap revetment
- Gabion baskets
- Cast-in-Place concrete wall

The remoteness of the site, access for limited excavation equipment and difficulty getting materials to the site make construction challenging and potentially cost prohibitive. However, we do understand, based on discussions with the contractor who has done recent work on the site that a small tracked excavator is permitted for use during construction. The following subsections outline further details on each option, and our interpretation of construction feasibility.

5.1. Moving the Platform

We understand that next year the plans are to partially reconstruct the cable car platforms, however the existing cable and anchors are to be reused. Accordingly, we consider the most favorable option from a cost and constructability point of view would be to move the western platform foundation elements further back from the edge of the creek, lowering foundations directly onto and dowelled into sandstone bedrock, if possible. The location of the bedrock outcrop is shown on drawing 8-7248-2-1 and is annotated in the photograph below:



Photograph 3. Location of bedrock outcrop.

The exact depth to rock is unknown at the current tower location and there would be some risk associated with the possible depth of excavation. Based on the orientation of the bedrock outcrop observed, such could conceivably be up to as much as 5 m below grade, however we think that is unlikely and expect that it is more probable that bedrock be in the 2-3 m range. For design we recommend that the foundation is assumed to extend 2.0 m below existing grade and for contractual purposes any variation to this depth be covered by an add or deletion of work.

The attached drawing 8-7148-2-4 shows a sketch of the proposed solution and geotechnical requirements. The excavation should be completed while maintaining support to the existing MSE wall. For design purposes, foundation elements on the sandstone bedrock can be design assuming an allowable bearing capacity of 500 kN. The foundation should be pinned to the bedrock with two 20M steel dowels installed a minimum 450 mm into intact bedrock. The dowels should be epoxied or grouted with non-shrink grout into the bedrock.

In addition, we have analyzed the potential drag force on the concrete piers from water flowing around them if such an event were to occur. Assuming a worst case scenario where the piers are submerged by 1.0 m of water, the drag force acting on the piers was calculated to be 8 kN. Accordingly, we recommend that the piers be designed to handle this drag force.

5.2. Reinforced Pillows

The second option would be the use of a reinforced pillow system tied back toward the existing MSE. This system is similar to the Deltalock MSE wall constructed last year, but is much more robust as it utilizes high tensile steel mesh filled with angular imported crushed rock. The reinforced pillows would extend out past the existing near vertical scarp face. In order to prevent the potential for scouring, outflanking or undermining of the structure, the system would need to extend upstream roughly 15-20 m to an observed bedrock outcrop on the channel edge. This option would require a large amount of imported angular rock, however minimal excavation.

Some concept sketches of the proposed reinforced pillow structure including a section and plan view are shown on the attached drawing 8-7148-2-5, while the required rip-rap is shown on the attached Materials Specifications.

Initial estimates indicate that a total volume of blast rock of about 65 m^3 may be required. This equates to an approximate tonnage of about 165 metric tonnes (mt). Assuming a Sikorsky S-64 Skycrane is utilized, it has a lift capacity of about 8 mt, thereby requiring at least 20 loads. We have assumed that the specified 50 Kg Class quarry rock would cost about $14/mt for production, with the nearest quarry about 15 minutes flying time from the site.

Allowing sufficient time for load/unload at each end, we believe that the transport costs will approach $150,000 to get the materials to site. In addition, there will be mobilization and demobilization costs for the crew and equipment, as well as the cost of the high performance netting to construct the reinforced pillows. We have not spoken with any contractors regarding

the length of time for construction nor the costs, but we estimate that the work would take about 2 weeks in total and could have an associated cost of about $50,000. Therefore, we believe that a magnitude order budgetary figure for this option could be in the range of $200,000. The actual value would be governed by market conditions and the timing of the work. It must be stressed that work within the stream channel would only be possible during the low flow period of mid to late summer, and would be subject to Provincial/National regulations and permitting requirements.

Further details on such can be provided if this option is to be considered.

5.3. Gabion Wall

A gabion wall would involve the use of gabion mesh steel baskets filled with larger imported angular rock. In order to prevent the wall from scour or undermining the wall would also need to extend upstream to the noted bedrock outcrop similar to the reinforced pillows, and would need to have an embedment of at least twice the largest rock size (~0.8 m). Due to the extensive excavation required for this alterative and amount of imported material, this option is considered cost prohibitive and generally is not considered a feasible option.

5.4. Cast-In-Place Wall

Due to the required embedment of the wall, necessary length and amount of excavation and imported concrete/ rock material, this option is generally considered cost prohibitive. A cast in place concrete wall would also not be aesthetically pleasing considering the location and environment.

5.5. Existing Anchors

We understand that the steel cable has a maximum factored tension loading of 80 kN. The steel cable is supported by two existing rock anchors, and we understand that both work as a group to provide the 80 kN resistance. If testing of the existing rock anchors is required, each anchor should be tested to 40 kN in order to confirm capacity. Design drawings from the construction of the initial crossing suggest that the existing anchors for the western platform consist of Williams hollow core rebar rock bolts, with eye bolts and are embedded 0.9 m into rock.

The anchors on the eastern side appear to be connected to a 3.35 m x 1.8 m reinforced concrete deadman. The main support anchors appear to connect to the dead mean near the bottom base. Assuming that the dead man was constructed as per the construction drawings, we have determined that the deadman provides adequate passive pressure to support the noted load. To test the anchor connection, the cables could be tested from the surface using a jack and spreader beams to disperse the load over the ground.

6. CLOSURE

We have reviewed several options and consider moving the platform foundations further back and extending down to rock is to be the most favorable option, since it utilizes and maintains the already implemented Delta-lock protection wall. The use of a high tensile steel mesh reinforced pillow wrap system is considered to be the 2nd most favorable option given the dynamic conditions at the Cullite Creek cable car crossing.

We trust the preceding is suitable for your purposes at present. Please don't hesitate to contact our office if we can be of further assistance.

Yours very truly,
Ryzuk Geotechnical

Mat Mueller, EIT
Project Engineer

Shane Moore, P.Geo.
Senior Geoscientist / Principal

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA S. V. MOORE #30340 GEOSCIENTIST

Attachments
- Terms of Engagement
- Drawings 8-7248-2-1 through 5
- Materials Specifications

TERMS OF ENGAGEMENT

GENERAL

Ryzuk Geotechnical (the Consultant) shall render the Services, as specified in the agreed Scope of Services, to the Client for this Project in accordance with the following terms of engagement. The Services, and any other associated documents, records or data, shall be carried out and/or prepared in accordance with generally accepted engineering practices in the location where the Services were performed. No other warranty, expressed or implied is made. The Consultant may, at its discretion and at any stage, engage sub-consultants to perform all or any part of the Services.

Ryzuk Geotechnical is a wholly owned subsidiary of C. N. Ryzuk & Associates Ltd.

COMPENSATION

All charges will be payable in Canadian Dollars. Invoices will be due and payable by the Client on receipt of the invoice without hold back. Interest on overdue accounts is 24% per annum.

REPRESENTATIVES

Each party shall designate a representative who is authorized to act on behalf of that party and receive notices under this Agreement.

TERMINATION

Either party may terminate this engagement without cause upon thirty (30) days' notice in writing. On termination by either party under this paragraph, the Client shall forthwith pay to the Consultant its Charges for the Services performed, including all expenses and other charges incurred by the Consultant for this Project.

If either party breaches this engagement, the non-defaulting party may terminate this engagement after giving seven (7) days' notice to remedy the breach. On termination by the Consultant under this paragraph, the Client shall forthwith pay to the Consultant its Charges for the Services performed to the date of termination, including all fees and charges for this Project.

ENVIRONMENTAL

The Consultant's field investigation, laboratory testing and engineering recommendations will not address or evaluate pollution of soil or pollution of groundwater. The Consultant will cooperate with the Client's environmental consultant during the field work phase of the investigation.

PROFESSIONAL RESPONSIBILITY

In performing the Services, the Consultant will provide and exercise the standard of care, skill and diligence required by customarily accepted professional practices and procedures normally provided in the performance of the Services contemplated in this engagement at the time when and the location in which the Services were performed.

INSURANCE

Ryzuk Geotechnical is covered by Professional Indemnity Insurance as follows:

1. $ 2,000,000 each and every claim
2. $ 4,000,000 aggregate
3. $ 5,000,000 commercial/general liability coverage

LIMITATION OF LIABILITY

The Consultant shall not be responsible for:

1. the failure of a contractor, retained by the Client, to perform the work required for the Project in accordance with the applicable contract documents;
2. the design of or defects in equipment supplied or provided by the Client for incorporation into the Project;
3. any cross-contamination resulting from subsurface investigations;
4. any Project decisions made by the Client if the decisions were made without the advice of the Consultant or contrary to or inconsistent with the Consultant's advice;
5. any consequential loss, injury or damages suffered by the Client, including but not limited to loss of use, earnings and business interruption;
6. the unauthorized distribution of any confidential document or report prepared by or on behalf of the consultant for the exclusive use of the Client
7. Subsurface structures and utilities

The Consultant will make all reasonable efforts prior to and during subsurface site investigations to minimize the risk of damaging any subsurface utilities/mains. If, in the unlikely event that damage is incurred where utilities were unmarked and/or undetected, the Consultant will not be held responsible for damages to the site or surrounding areas, utilities/mains or drilling equipment or the cost of any repairs.

The total amount of all claims the Client may have against the Consultant or any present or former partner, executive officer, director, stockholder or employee thereof under this engagement, including but not limited to claims for negligence, negligent misrepresentation and breach of contract, shall be strictly limited to the amount of any professional liability insurance the Consultant may have available for such claims.

No claim may be brought against the Consultant in contract or tort more than two (2) years after the date of discovery of such defect.

DOCUMENTS AND REPORTING

All of the documents prepared by the Consultant or on behalf of the Consultant in connection with the Project are instruments of service for the execution of the Project. The Consultant retains the property and copyright in these documents, whether the Project is executed or not. These documents may not be used on any other project without the prior written agreement of the Consultant.

The documents have been prepared specifically for the Project, and are applicable only in the case where there has been no physical alteration to, or deviation from any of the information provided to the Consultant by the Client or agents of the Client. The Client may, in light of such alterations or deviations, request that the Consultant review and revise these documents.

The identification and classification as to the extent, properties or type of soils or other materials at the Project site has been based upon investigation and interpretation consistent with the accepted standard of care in the engineering consulting practice in the location where the Services were performed. Due to the nature of geotechnical engineering, there is an inherent risk that some conditions will not be detected at the Project site, and that actual subsurface conditions may vary considerably from investigation points. The Client must be aware of, and accept this risk, as must any other party making use of any documents prepared by the Consultant regarding the Project.

Any conclusions and recommendations provided within any document prepared by the Consultant for the Client has been based on the investigative information undertaken by the Consultant, and any additional information provided to the Consultant by the Client or agents of the Client. The Consultant accepts no responsibility for any associated deficiency or inaccuracy as the result of a miss-statement or receipt of fraudulent information.

JOBSITE SAFETY AND CONTROL

The Client acknowledges that control of the jobsite lies solely with the Client, his agents or contractors. The presence of the Consultant's personnel on the site does not relieve the Client, his agents or contractors from their responsibilities for site safety. Accordingly, the Client must endeavor to inform the Consultant of all hazardous or otherwise dangerous conditions at the Project site of which the Client is aware.

The client must acknowledge that during the course of a geotechnical investigation, it is possible that a previously unknown hazard may be discovered. In this event, the Client recognizes that such a hazard may result in the necessity to undertake procedures which ensure the safety and protection of personnel and/or the environment. The Client shall be responsible for payment of any additional expenses incurred as a result of such discoveries, and recognizes that under certain circumstances, discovery of hazardous conditions or elements requires that regulatory agencies must be informed. The Client shall not bring about any action or dispute against the Consultant as a result of such notification.

FIELD SERVICES

Where applicable, field services recommended for the Project are the minimum necessary, in the sole discretion of the Consultant, to observe whether the work or a contractor retained by the Client is being carried out in general conformity with the intent of the Services. Any reduction from the level of services recommended will result in the Consultant providing qualified certifications for the work.

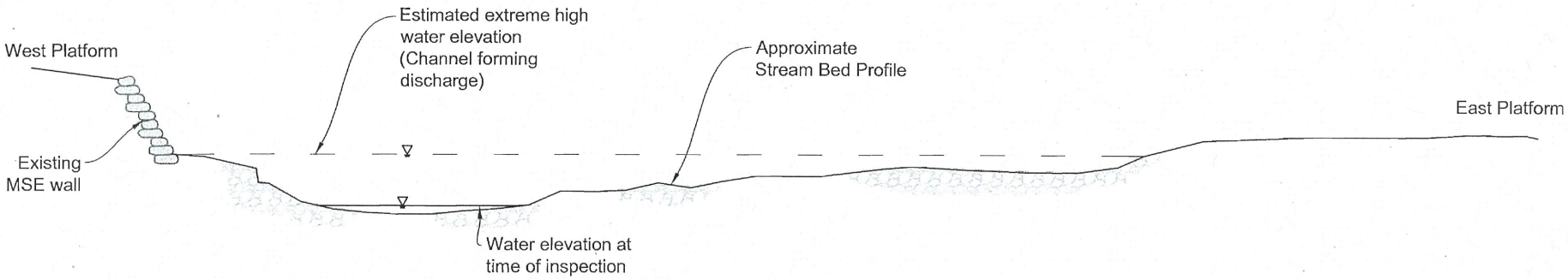
DISPUTE RESOLOUTION

If requested in writing by either the Client or the Consultant, the Client and the Consultant shall attempt to resolve any dispute between them arising out of or in connection with this Agreement by entering into structured non-binding negotiations with the assistance of a mediator on a without prejudice basis. The mediator shall be appointed by agreement of the parties. If a dispute cannot be settled within a period of thirty (30) calendar days with the mediator, the dispute shall be referred to and finally resolved by arbitration under the rules of the arbitrator appointed by agreement of the parties or by reference to a Judge of the British Columbia Court.

Notes:

1. Image taken on August 13, 2015 from helicopter looking roughly northeast

Parks Canada	DRAWN MGPM
PLAN VIEW	DATE October, 2015
Cullite Cable Car Geotechnical Assessment	APPROVED
West Coast Trail — Pacific Rim National Park, B.C.	SCALE NTS
RYZUK GEOTECHNICAL — Engineering & Materials Testing	DRAWING No. 8-7148-2-1



A / A' SECTION - Stream Profile Along Cable Car Alignment
Looking Upstream (North East)

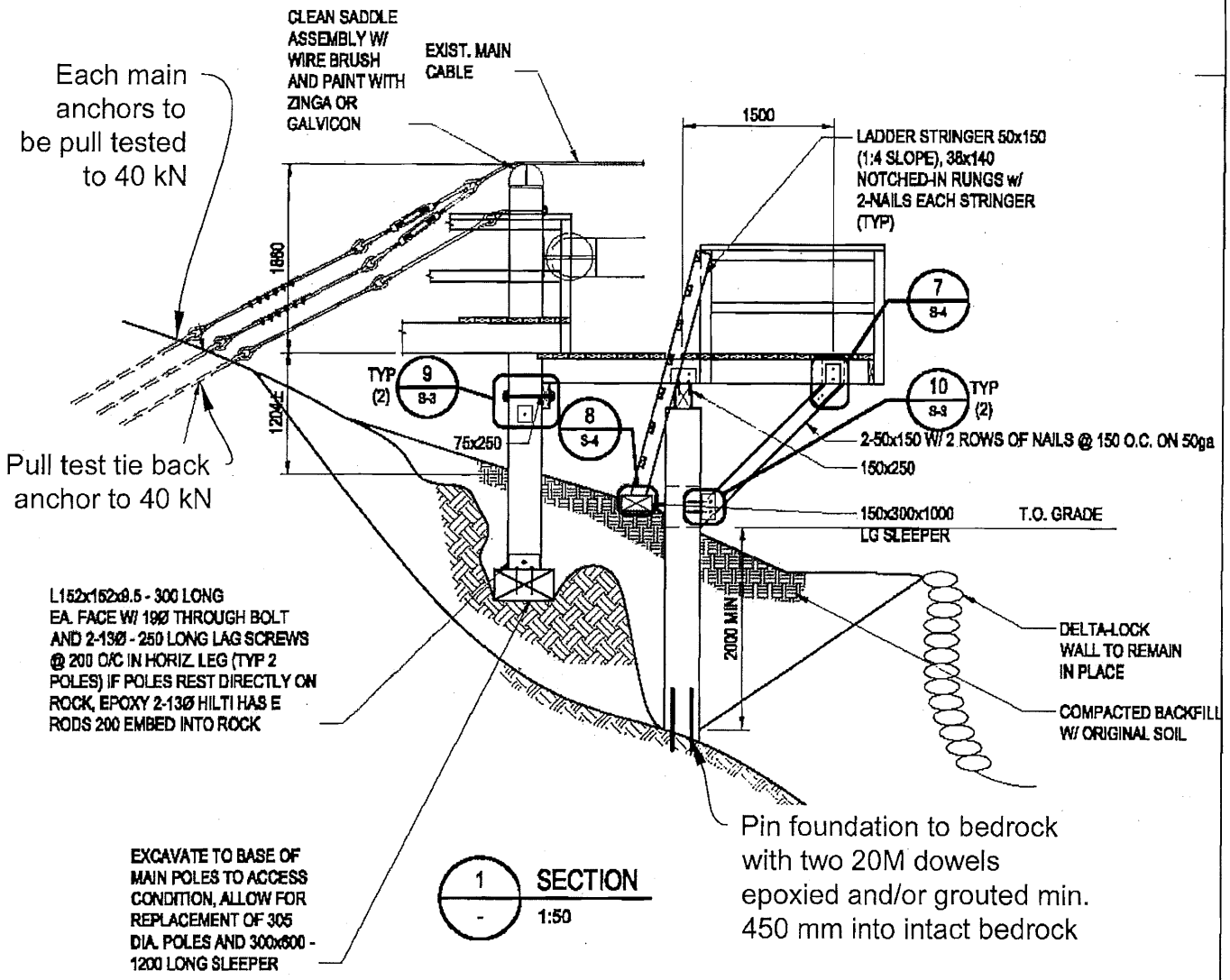
Notes:
1. Stream bed profile and water table elevation measured on August 13, 2015.
2. See drawing 8-7142-1 for plan view of section location.

Parks Canada		DRAWN MGPM
SECTION		DATE October, 2015
Cullite Cable Car Geotechnical Assessment		APPROVED
West Coast Trail	Pacific Rim National Park, B.C.	SCALE 1:125
RYZUK GEOTECHNICAL	Engineering & Materials Testing	DRAWING No. 8-7148-2-2

Direction of Water Flow

Notes:
1. Images taken on August 13, 2015 from helicopter.

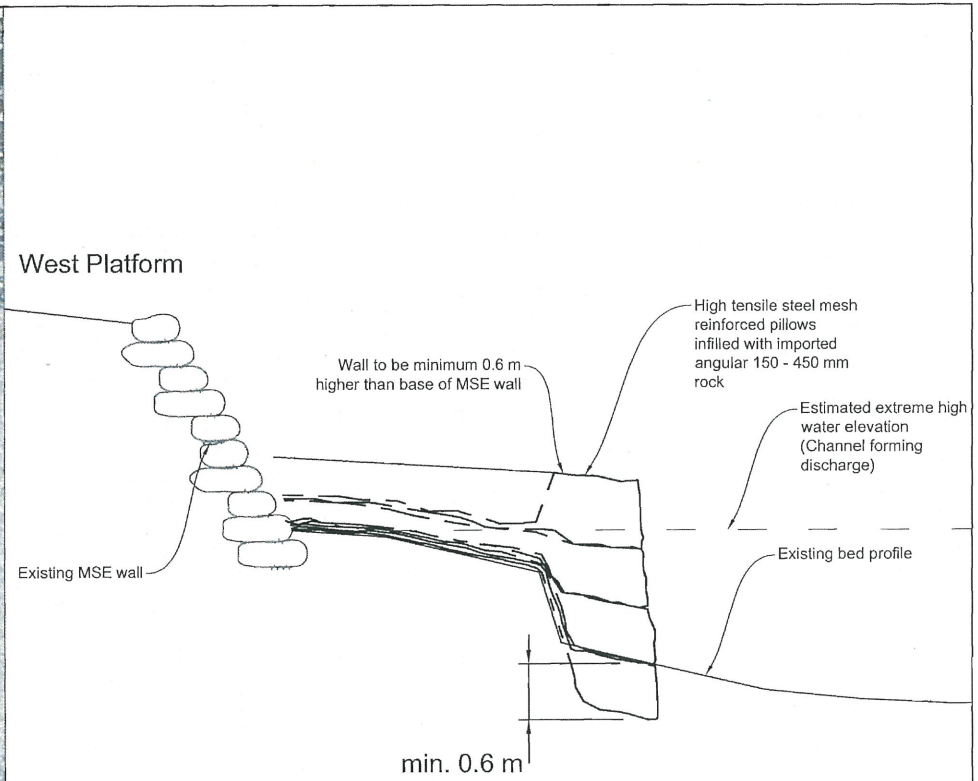
	Parks Canada	DRAWN MGPM
	LONGITUDINAL PLAN VIEW	DATE October, 2015
	Cullite Cable Car Geotechnical Assessment	APPROVED
	West Coast Trail — Pacific Rim National Park, B.C.	SCALE NTS
	RYZUK GEOTECHNICAL — Engineering & Materials Testing	DRAWING No. 8-7148-2-3



Notes:

1. Base plan taken from WSP Drawing S-2, Cullite Cable Car Crossing Repair: West Tower

	Parks Canada	DRAWN MGPM
	West Platform Foundation Details	DATE October, 2015
	Cullite Cable Car Geotechnical Assessment	APPROVED MM
	West Coast Trail Pacific Rim National Park, B.C.	SCALE 1:65
	RYZUK GEOTECHNICAL Engineering & Materials Testing	DRAWING No. 8-7148-2-4



Notes:
1. Images taken on August 13, 2015 from helicopter.
2. Details for concept/discussion only.

	Parks Canada	DRAWN MGPM
	REINFORCED PILLOW STRUCTURE DETAILS	DATE October 2015
	Cullite Cable Car Geotechnical Assessment	APPROVED
	West Coast Trail Pacific Rim National Park, B.C.	SCALE NTS
	RYZUK GEOTECHNICAL Engineering & Materials Testing	DRAWING No. 8-7148-2-5

MATERIAL SPECIFICATIONS

50 Kg. Class Rip-Rap

Rock Gradation:
Percentage Larger Than Given Rock Mass

85%	50%	15%
5 Kg	50 Kg	150 Kg

This indicates that 85% of the armour rock by mass will be larger than 50 Kg, 50% will be larger than 50 Kg, and 15% will be larger than 150 Kg. For visual comprehension only, the following indicates the approximate average dimension of an angular rock for each specified rock class mass.

5 Kg	50 Kg	150 Kg	250 Kg
100 mm	350 mm	500 mm	600 mm

The mean rock diameter is therefore approximately 350 mm.
The nominal thickness of rip-rap as measured perpendicular to slope is to be a minimum 1 m.

The rocks generally shall be evenly graded about the stipulated sizes. Each individual rock shall have a thickness greater than one third their length, and none shall have a mass greater than five times that of the specified class mass. The rock is to be angular and consist of durable particles of igneous origin.

Geotextile Filter Fabric

A heavy grade non-woven geotextile filter fabric (such as Amoco 4553, Terrafix 200 R or approved equivalent) should be placed on the existing fine grained soils beneath the rip-rap, where such is not removed. A minimum overlap of 300 mm is required along all joints.

GEOTECHNICAL REPORT FOR CHEEWHAT SUSPENSION BRIDGE

BY LEWKOWICH ENGINEERING ASSOCIATES, LTD

Lewkowich Engineering Associates Ltd.
geotechnical • health, safety & environmental • materials testing

Public Works and Government Services Canada
219-800 Burrard Street
Vancouver, BC
V6Z 0B9

File: F2696.01r6
November 12, 2015

Attention: Mr. Tom Dunphy

PROJECT: **CHEEWHAT RIVER BRIDGE REPAIR, WESTCOAST TRAIL, NITINAT, BC**

SUBJECT: **GEOTECHNICAL ASSESSMENT FOR DESIGN PURPOSES**

REFERENCE: **WSP Canada Inc. drawing titled, "*Pacific Rim National Park, Vancouver Island, B.C., West Coast Trail Bridges Repair,*" Project Number R.064182.001, Sheets S-7, S-8, & S-9 of 9, dated November 2, 2015;**

Indian and Northern Affairs drawing titled, *"Cheewhat River Bridge 1976 – Life Saving Trail – Pacific Rim National Park,"* Project Reference No. NWPR75/R33, dated December, 1975.

Dear Mr. Dunphy:

1. INTRODUCTION

As requested, Lewkowich Engineering Associates Ltd. (LEA) has carried out a geotechnical assessment for design purposes with respect to the above noted project. This report provides a summary of our findings and recommendations.

2. BACKGROUND

LEA understands the proposed project consists of repairs to the Cheewhat River suspension bridge cable anchoring system and support towers. We also understand the purpose of this assessment is to attain field information regarding the existing bridge and anchoring configuration to assist in determining the appropriate anchoring system upgrade, based on ground conditions and supplied design criteria.

3. ASSESSMENT OBJECTIVES

Our assessment, as summarized within this report, is intended to determine a suitable anchoring system to support the tension and compression loads of the existing suspension

bridge, based on existing ground conditions, as well as design criteria provided by WSP Canada Inc.

4. ASSESSMENT METHODOLOGY

a. The subsurface geotechnical investigation was carried out on August 6 & 7, 2015 using a Milwaukee Rotary Hammer Drill and auger set. A total of three (3) test pits (BH 15-01 to BH 15-03) were advanced at locations near the existing anchor points on the north and south sides of the bridge.

b. As requested, LEA attained measurements of the existing cable and anchoring configuration on the north and south sides of the bridge, including both support towers and cribs.

c. Also part of the field investigation was an inspection of the south crib bearing soils.

d. LEA conducted a review of the original design drawings, provided by WSP Canada Inc., as well as the current proposed structural drawings for the bridge repair.

e. A site plan with the location of the boreholes (Figure 1) is attached with this report.

5. SITE CONDITIONS

5.1. General

a. The Cheewhat River Suspension Bridge is located within the boundaries of the Pacific Rim National Park Reserve along the Westcoast Trail of Vancouver Island, north of Clo-oose, BC, approximately 32km northwest of Port Renfrew and 4.2km southwest of Cheewhat Lake.

b. The general area of the Cheewhat River Suspension Bridge is typical of westcoast terrain, with a long sandy beach and protruding bedrock outcrops near the river mouth, undulating trails, and westcoast vegetation comprised of dense underbrush, mature and immature coniferous and deciduous trees.

c. The Cheewhat River is subject to fluctuations with incoming tides and comprises a well-defined riverbed of predominantly sand and gravel alluvial deposits, as well as localized bars silt and sand. The subject site can be accessed via the Westcoast Trail.

d. The terrain of the trail at both the north and south sides of the bridge is generally level, approximately 1.8m to 2.5m above the current riverbed.

5.2 Soil Conditions

a. Consistent soil strata were encountered during the borehole investigation. Generally, these consisted of loose, medium to dark brown organic silt and sand, with organics, overlying loose, loamy, grey-brown, medium sand, overlying compact to dense, grey, medium to coarse sand, with a trace of gravel, or minor variations of.

b. The main strata are discussed below. Detailed descriptions of the subsurface conditions are provided on the attached borehole logs (BH 15-01 to BH 15-03).

c. Loose, damp, medium to dark brown, organic silt and sand, with some organic matter and roots, or minor variations of, was encountered in each of the boreholes, at depths ranging from 0.0m to 0.6m.

d. Loose, moist, grey-brown, loamy (to 0.9m), medium sand, was encountered in each of the boreholes, at depths ranging from 0.5m to 1.5m.

e. Compact, moist, grey to grey-brown, medium sand, with a trace of gravel, was encountered in each of the boreholes, at depths ranging from 1.5m to 2.4m.

f. Compact, moist to wet, grey to dark grey-brown, medium to coarse sand, with a trace of gravel, was encountered in each of the boreholes, at depths ranging from 2.4m to 3.3m.

g. Compact to dense, wet, grey, coarse sand, with trace gravel, or minor variations of, was encountered in BH 15-01 and BH 15-02, at depths ranging from 3.3m to 4.5m.

h. Dense to very dense, unidentified material, possibly bedrock, glacial till, or cobbles, was encountered in BH 15-03, at depths ranging from 2.4m to 2.7m (refusal at 2.7m).

i. A hand-dug test hole at the south end crib revealed dense, wet, grey, coarse sand, with a trace of gravel and occasional boulders, within the exposed riverbed.

j. Depths are referenced to the existing ground surface at the time of our field investigation. Soil classification terminology is based on the Modified Unified classification system. The relative proportions of the major and minor soil constituents are indicated by the use of appropriate Group Names as provided in ASTM D2487 Figures 1a, 1b, and 2. Other descriptive terms generally follow conventions of the Canadian Foundation Engineering Manual.

5.3 Groundwater

a. Light groundwater seepage, and minor sloughing conditions were observed during the borehole investigation, at depths ranging from 2.5m to 3.0m.

b. Groundwater levels can be expected to fluctuate seasonally with cycles of precipitation. Groundwater conditions at other times and locations can differ from those observed at the time of our assessment. It is expected groundwater levels will be close to the ground surface during the height of the rainy season.

5.4 Existing Anchoring System

a. Based on our field review, the anchoring system at the south end of the bridge appeared to consist of anchors installed in proximity to a large diameter tree stump. LEA also encountered remnants of a large diameter cable around the stump that has since failed.

b. Also based on our field review, the north end anchoring system consisted of cable anchors encased in a large concrete block.

c. Following a later review of archive drawings and pictures taken during our field

investigation, we believe the south end bridge cables are likely anchored within a large, buried, concrete block, beyond the above mentioned tree stump. A review of the archive drawings also revealed the location and configuration of the existing north end anchoring system (cable anchors encased in large concrete block) were representative in the field. LEA also noted corrosion of the subsurface bridge cables at this location.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 General

To provide the required tension and compression load resistance, LEA recommends one of two anchoring system methodologies. Alternative 1 consists of the installation of Chance® SS150 Hubbell helical piles for the proposed north and south end anchoring system upgrades (see attached specifications for Chance® SS150 Helical Piles). A second anchoring method (Alternative 2) would consist of the installation of steel thread bar anchors through the existing concrete block (see structural drawings for details).

6.2 Anchor Design Information

a. Based on design information outlined in the structural drawings provided by WSP Canada Inc., LEA understands the bridge main cable has a minimum breaking strength (Tu) of 467kN, and factored resistance (Tr) of 257kN, which results in the tension anchor forces (Tu = 607kN, Tr = 334kN), and compression anchor force of Tu = 281kN, Tr = 155kN (see details on structural drawings).

b. The SS150 Hubbell helical piles have an Ultimate Load rating of 70kips (312kN), based on a Torque Factor (K_t) of 10, including a Factor of Safety of two (2).

c. We estimate that the installation of two anchor piles per angled tension cable and one anchor pile per vertical compression unit installed to the manufacturer's recommended minimum torque shall satisfy the loading requirements of the bridge anchor structure if installed to a minimum depth of 15' (4.5m). Based on the specific site conditions, the final

length and number of piles is to be finalized by the installer, through consultation LEA and the Structural Engineer. The anchoring system will be encased in reinforced concrete with appropriate dimensions to encompass all pile caps, approximately 3.0m (L) x 1.5m (W) x 1.2m (D). The angled tension cables shall enter the concrete block at the center of the sloped face to a minimum embedment depth of 150mm beyond the tension anchor pile caps (as per structural design drawings).

d. All tension anchor piles shall be installed within the center of the reinforced concrete block at a 45 degree angle, with a minimum spacing of 150mm between anchors (as per structural design drawings). Each anchor pile will also require a standard 6" (150mm) steel pile cap

e. The pile installer shall have a torque measuring device to indicate the torque value during the anchor's installation. LEA is required to be on site to observe and monitor the installation and testing of the anchor piles. Please note that the installation may encounter field conditions that could alter the estimated depth and/or configuration of the pile group. LEA, through consultation with the installer and the Structural Engineer, may make further recommendations in the field during installation.

f. The alternative anchoring system (Alternative 2) shall include coring through the existing concrete block and installing two new Hot Dip Galvanized (HDG) steel thread bar anchors for each cable end, utilizing the existing concrete blocks (see structural drawings for details).

g. LEA is required to inspect the condition and confirm the dimensions of the concrete blocks prior to employing this alternative, and to provide specific guidelines for the installation of the steel thread bar anchors.

h. During excavation for the concrete block, care shall be used to separate organic soils from inorganic, granular soils that may be re-used with the approval of LEA. Excavations should not exceed 1.2m (4') vertical, as per WCB requirements, and shall be sloped or benched to maintain an overall 1H:1V slope.

i. Backfill materials shall consist of inorganic granular sand and gravel compacted to a

minimum 95% of Modified Proctor maximum dry density (ASTM D1557). Compaction of fill shall include moisture conditioning as needed to bring the soils to the optimum moisture content and compacted using vibratory compaction equipment in lift thickness appropriate for the size and type of compaction equipment used. Due to the remote location of the site, LEA recommends a maximum lift thickness of 150mm compacted using a jumping jack. A 150mm lift of organic soils may be used at the surface. Compaction test reports are to be provided for review by LEA, as per specification 310000.01 Earthwork.

6.3 Seismic Issues

a. No compressible or liquefiable soils were encountered during the borehole investigation.

b. Based on the 2012 British Columbia Building Code, Division B, Part 4, Table 4.1.8.4.A, "Site Classification for Seismic Site Response," the soils encountered during the borehole investigation would be "Site Class "D", Stiff Soil.

7. GEOTECHNICAL ASSURANCE AND QUALITY ASSURANCE

To provide Geotechnical Assurance services for construction of this nature, LEA shall be retained by the contractor to review the geotechnical components of the plans and supporting documents, and to provide letters of assurance for field reviews of these components during construction/installation.

8. ACKNOWLEDGEMENTS

Lewkowich Engineering Associates Ltd. acknowledges that this report has been prepared solely for, and at the expense of Public Works and Government Services Canada.

9. LIMITATIONS

The conclusions and recommendations submitted in this report are based upon the data obtained from a limited number of subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction or further

investigation. The recommendations given are based on the subsurface soil conditions encountered during the field investigation, current construction techniques, and generally accepted engineering practices. No other warrantee, expressed or implied, is made. Due to the geological randomness of many soil formations, no interpolation of soil conditions between or away from the boreholes has been made or implied. Soil conditions are known only at the borehole locations. If other soils are encountered, unanticipated conditions become known during construction or other information pertinent to the structures become available, the recommendations may be altered or modified in writing by the undersigned.

10. CLOSURE

Lewkowich Engineering Associates Ltd. appreciates the opportunity to be of service on this project. If you have any comments, or additional requirements at this time, please contact us at your convenience.

Respectfully Submitted,
Lewkowich Engineering Associates Ltd.

Applied Science Technologists and Technicians of British Columbia 27806 PAUL FRASER CTech

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C. M. HUDEC # 29249

Paul Fraser, B.A., CTech
Technician

Chris Hudec, M.A.Sc., P. Eng.
Senior Project Engineer

Attachments: Borehole Logs (BH 15-01 to BH 15-03), Borehole Site Plan (FIGURE 1)
Chance® Helical Piles Specifications

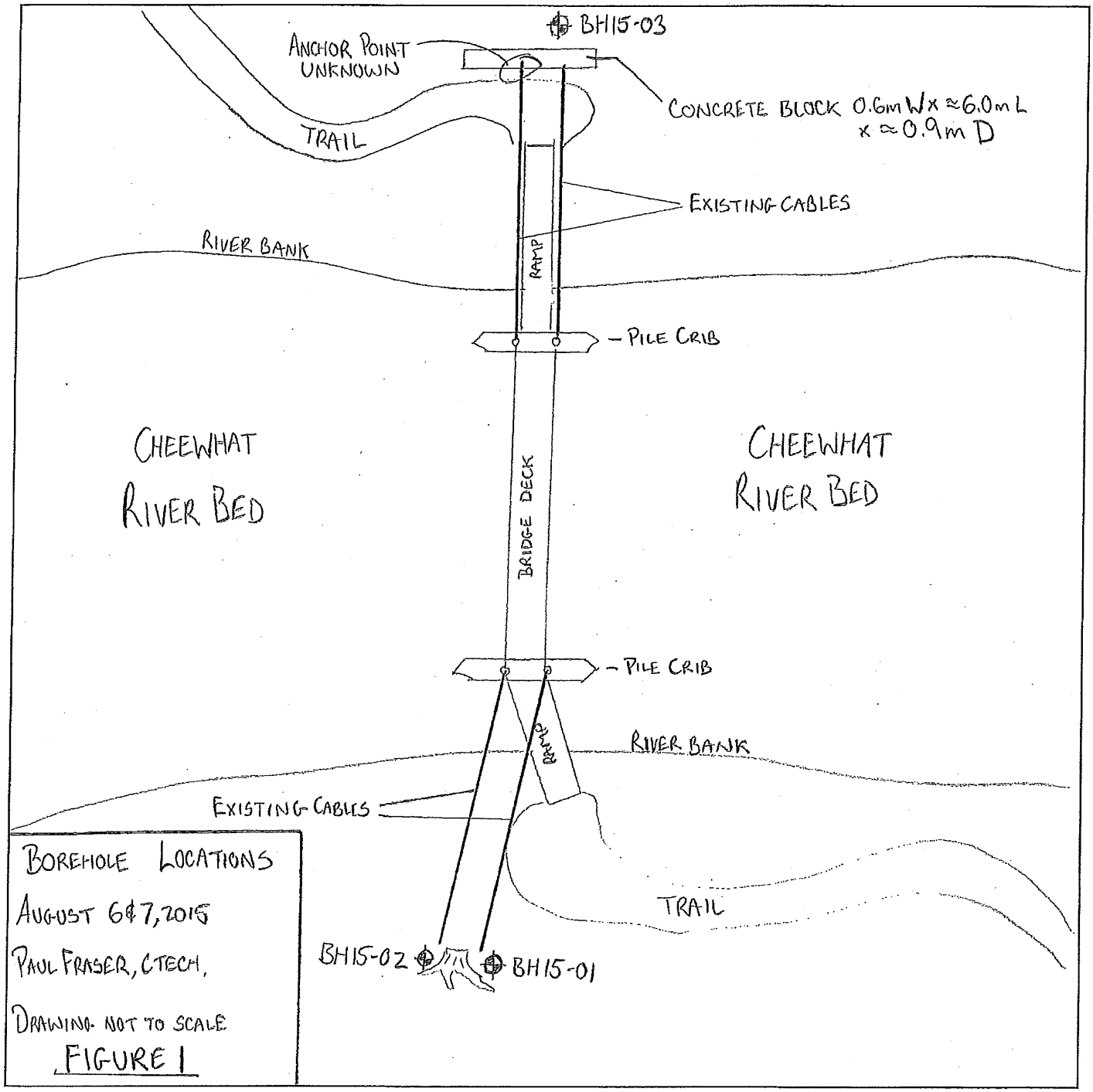
Lewkowich Engineering Associates Ltd.

Suite A - 2569 Kenworth Road Nanaimo, B.C., Canada V9T 3M4

Client: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project: CHEEWHAT SUSPENSION BRIDGE REPAIRS Made by: PF Job No: F2696

Site Address: NITINAT, BC - WESTCOAST TRAIL Page: 1 of 1 Date: AUGUST, 27-2015



BOREHOLE LOCATIONS
AUGUST 6&7, 2015
PAUL FRASER, CTECH.

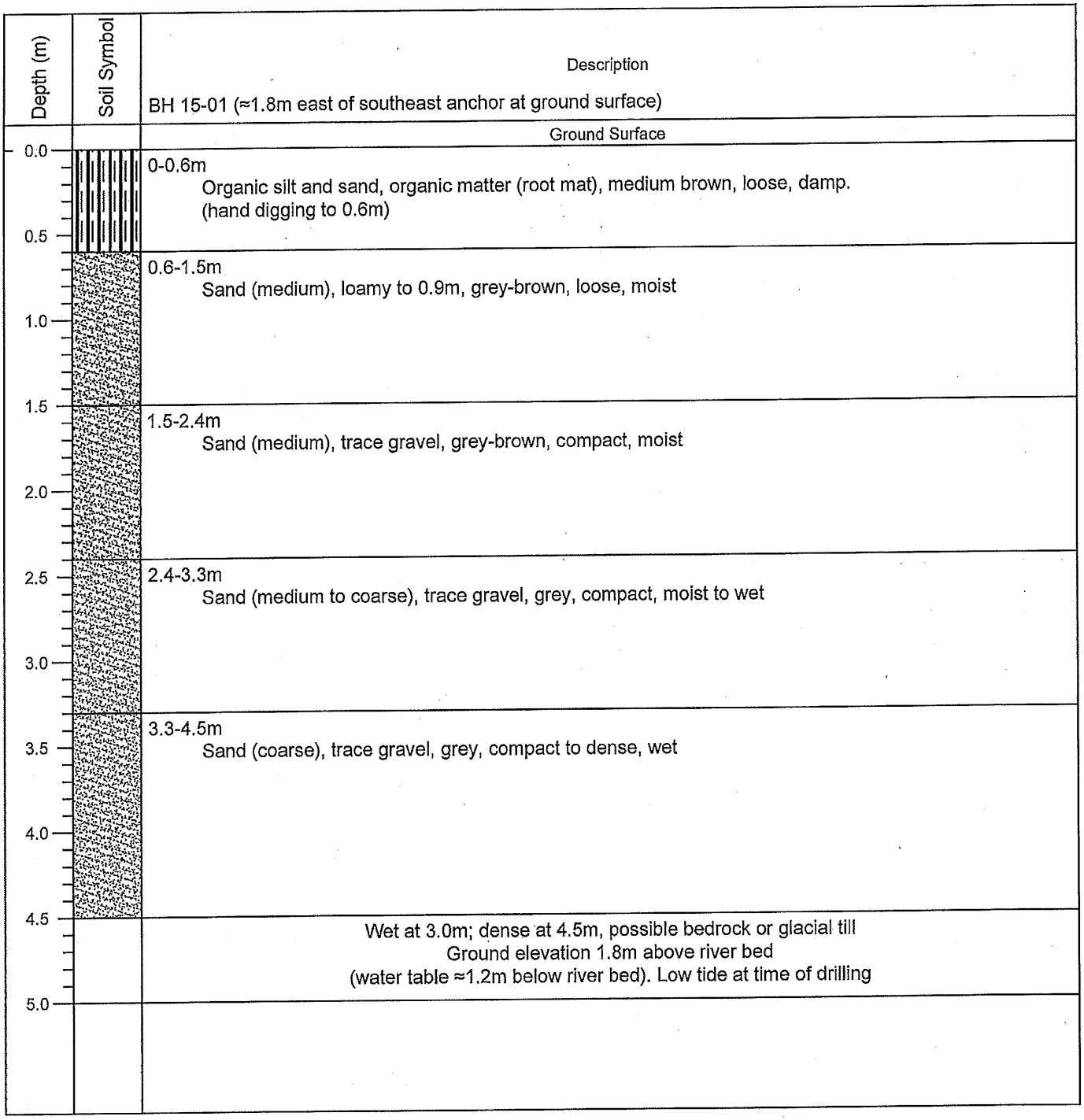
DRAWING NOT TO SCALE

FIGURE 1

BORE HOLE LOG

Lewkowich Engineering Associates Ltd.

File Number: F2696 BH15-01
Project: Cheewhat River Bridge Repair
Location: Westcoast Trail, Nitinat, BC



Logged By: Paul Fraser, CTech
Reviewed By: Darron G. Clark, P.Eng.
Digging Method: 2" Flighted Auger

Date: August 6, 2015
Sheet: 1 of 1

Suite A - 2569 Kenworth Road
Nanaimo, British Columbia, V9T 3M4
Phone: (250) 756-0355
Fax: (250) 756-3831
Email: geotech@lewkowich.com

BORE HOLE LOG

Lewkowich Engineering Associates Ltd.

File Number: F2696 BH15-02
Project: Cheewhat River Bridge Repair
Location: Westcoast Trail, Nitinat, BC

BH 15-02 (≈0.6m west of west anchor at ground surface. Ground surface 0.6m lower than at BH 15-01)

Depth (m)	Soil Symbol	Description
0.0		Ground Surface
		0-0.6m Organic silt and sand, organic matter (roots), medium brown, loose, damp
0.5		
		0.6-1.5m Sand (medium), loamy to 0.9m, grey-brown, loose, moist
1.0		
1.5		1.5-2.4m Sand (medium), trace gravel, grey-brown, compact, moist
2.0		
2.5		2.4-3.3m Sand (medium to coarse), trace gravel, grey, compact, moist to wet
3.0		
3.5		3.3-4.5m Sand (coarse), trace gravel, grey, compact, wet
4.0		
4.5		Wet at 3.0m; Ground elevation 1.8m above river bed (water table ≈1.2m below river bed). Low tide at time of drilling
5.0		

Logged By: Paul Fraser, CTech
Reviewed By: Darron G. Clark, P.Eng.
Digging Method: 2" Flighted Auger

Date: August 6, 2015
Sheet: 1 of 1

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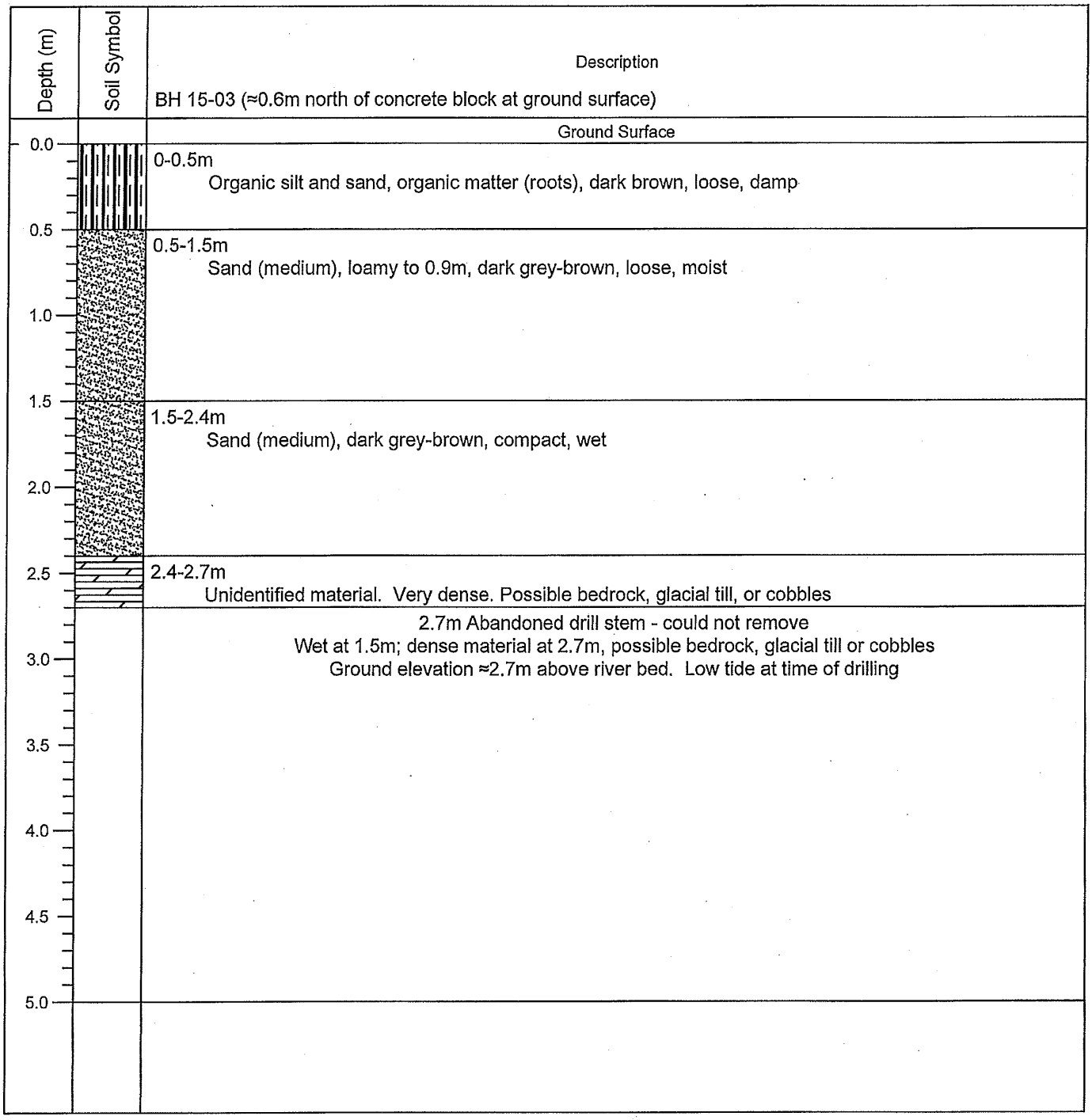
BORE HOLE LOG

Lewkowich Engineering Associates Ltd.

File Number: F2696 BH15-03
Project: Cheewhat River Bridge Repair
Location: Westcoast Trail, Nitinat, BC



Logged By: Paul Fraser, CTech
Reviewed By: Darron G. Clark, P.Eng.
Digging Method: 2" Flighted Auger

Date: August 6, 2015
Sheet: 1 of 1

Suite A - 2569 Kenworth Road
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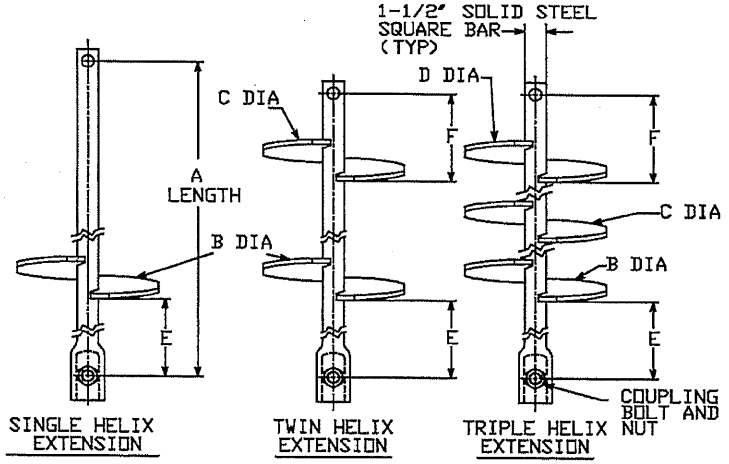
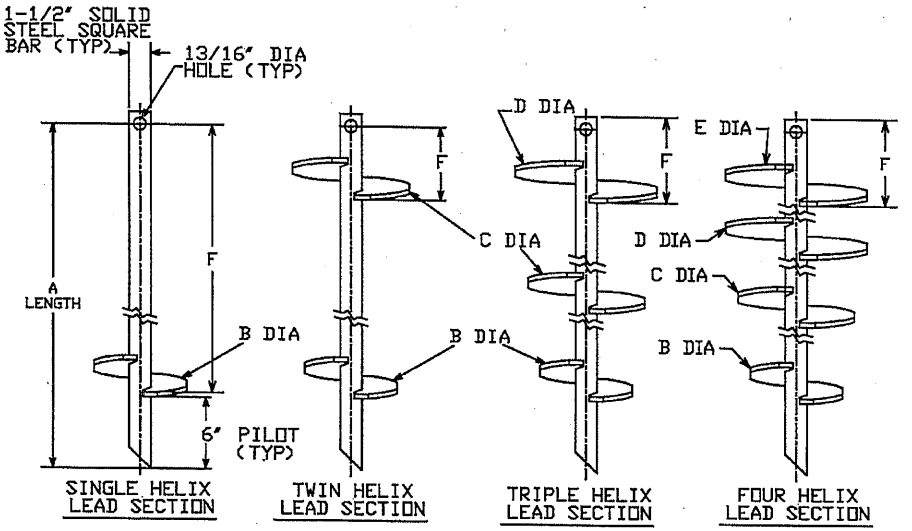
Phone: (250) 756-0355
Fax: (250) 756-3831
Email: geotech@lewkowich.com

SS150
HELICAL PIERS AND ANCHORS

TORQUE STRENGTH*RATING-7,000 FT-LB
ULTIMATE CAPACITY (TENSION/COMPRESSION)-70 KIP
* BASED ON A TORQUE FACTOR (K$_t$)=10
SINGLE HELIX ULTIMATE STRENGTH-40 KIP
ULTIMATE TENSION STRENGTH (COUPLING BOLT)-70 KIP





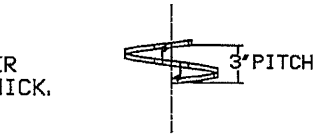
HELICAL EXTENSION SECTION						
CAT. NO.	A	B	C	D	E	F
C150-0176	47"	14"			37"	
C150-0177	81"	14"	14"		37"	8"
C150-0178	124"	14"	14"	14"	36"	8"
T150-0440	59"	14"			4"	

LEAD SECTION						
CAT. NO.	A	B	C	D	E	F
C150-0168	35"	8"	10"			6"
C150-0169	63"	8"	10"	12"		6"
C150-0170	123"	14"	14"	14"		33"
C150-0163	82"	10"	12"	14"		10"
C150-0400	82-1/4"	6"	8"	10"		34-1/4"
C150-0490	82"	8"	10"			52"
C150-0472	63"	8"	10"			33"
T150-0498*	59"	8"				56"
C150-0165	123"	8"	10"	14"	14"	10"
C1501261	35"	6"				29"
C1501029	82"	8"	10"	12"		22"

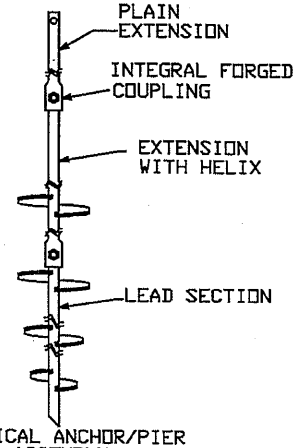
* HELIX MATERIAL 1/2" THICK

==NOTES==

1. HOT DIP GALVANIZED PER ASTM A153-(LATEST REVISION).
2. LEAD AND EXTENSION SECTION LENGTHS AND HELIX SPACINGS ARE NOMINAL.
3. SHAFT MATERIAL-HOT ROLLED ROUND-CORNERED-SQUARE (RCS) SOLID STEEL BARS PER ASTM A29; MINIMUM YIELD STRENGTH=90 KSI.
4. HELIX MATERIAL-HOT ROLLED LOW CARBON STEEL SHEET, STRIP, OR PLATE PER ASTM A656, OR A1018 GRADE 80; MINIMUM YIELD STRENGTH=80 KSI; 3/8" THICK.
5. COUPLING BOLTS: 3/4" DIAMETER X 3" LONG HEX HEAD PER ASTM A325 TYPE 1.
6. NOMINAL SPACING BETWEEN HELIX PLATES IS THREE TIMES THE DIAMETER OF THE LOWER HELIX.
7. MANUFACTURER TO HAVE IN EFFECT INDUSTRY RECOGNIZED WRITTEN QUALITY CONTROL FOR ALL MATERIALS AND MANUFACTURING PROCESSES.
8. ALL WELDING TO BE DONE BY WELDERS CERTIFIED UNDER SECTION 5 OF THE AWS CODE D1; 1.
9. REFER TO DRAWING SA150-0144 FOR PLAIN EXTENSIONS AND TERMINATIONS.



HELIX MUST BE FORMED BY MATCHING METAL DIE (SIDE VIEW OF TRUE HELICAL FORM)



TYPICAL ANCHOR/PIER ASSEMBLY

CHANCE® TOLERANCE CHART

HUBBELL® POWER SYSTEMS

TITLE: SS150 LEADS AND HELICAL EXTENSIONS

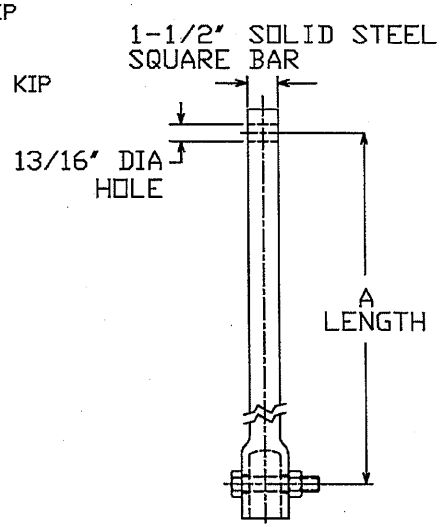
SIZE	DWG NO.	CAT / PART / ASSY NO.	REV
SC	SA150-10013	SEE CHART	J

DO NOT SCALE THIS DRAWING	DRN BY JWH	DATE 6/11/14	SHEET 1 OF 1

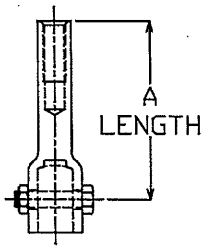
SS150
EXTENSIONS

TORQUE STRENGTH RATING-7,000 FT-LB
ULTIMATE CAPACITY*(TENSION/COMPRESSION)-70 KIP
* BASED ON A TORQUE FACTOR (K+)=10
SINGLE HELIX ULTIMATE STRENGTH-40 KIP
ULTIMATE TENSION STRENGTH (COUPLING BOLT)-70 KIP

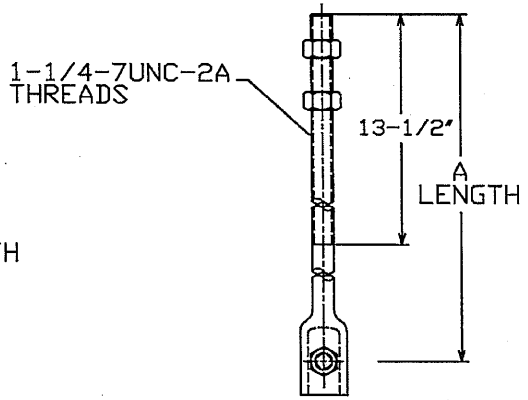
EXTENSION SECTION	
CAT. NO.	A
C150-0144	38"
C150-0145	59"
C150-0146	81"
C150-0175	124"
C150-0032	20"
C114-0009	11"
C110-1078	7"



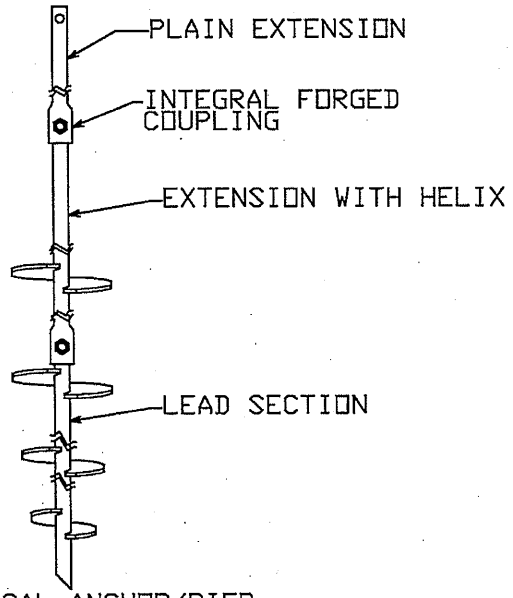
PLAIN EXTENSION



1" DYWIDAG ADAPTER
C114-0009 AND C110-1078
FOR 1-1/2" SHAFT



THREADED ADAPTER
C150-0032 FOR 1-1/2" SHAFT



TYPICAL ANCHOR/PIER
ASSEMBLY

==NOTES==

1. HOT DIP GALVANIZED PER ASTM A153-(LATEST REVISION).
2. LEAD AND EXTENSION SECTION LENGTHS AND HELIX SPACINGS ARE NOMINAL.
3. SHAFT MATERIAL-HOT ROLLED ROUND-CORNERED-SQUARE (RCS) SOLID STEEL BARS PER ASTM A29; MINIMUM YIELD STRENGTH=90 KSI.
4. COUPLING BOLTS: 3/4" DIAMETER X 3" LONG HEX HEAD PER ASTM A325 TYPE 1.
5. MANUFACTURER TO HAVE IN EFFECT INDUSTRY RECOGNIZED WRITTEN QUALITY CONTROL FOR ALL MATERIALS AND MANUFACTURING PROCESSES.
6. ALL WELDING TO BE DONE BY WELDERS CERTIFIED UNDER SECTION 5 OF THE AWS CODE D1.1.
7. REFER TO SA150-10013 FOR LEAD SECTIONS AND HELICAL EXTENSIONS.

CHANCE

HUBBELL POWER SYSTEMS

TITLE: SS150 EXTENSIONS

SIZE	DWG NO.	CAT / PART / ASSY NO.	REV
SC	SA150-0144	SEE CHART	C

DO NOT SCALE THIS DRAWING	DRN BY JWH	DATE 6/11/14	SHEET 2/2

Helical Pile Specification

Referenced codes and standards:

ASTM International

- ASTM A29/A29M Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished.

- ASTM A36/A36M Structural Steel.

- ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

- ASTM A193/A193M Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service. 2.1.7 ASTM A252 Welded and Seamless Steel Pipe Piles.

- ASTM A320/A320M Alloy-Steel Bolting Materials for Low Temperature Service.

- ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes. 2.1.10 ASTM A572 HSLA Columbium-Vanadium Steels of Structural Quality.

- ASTM A618 Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.

- ASTM A656 Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability.

- ASTM A1018 Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High- Strength, Low-Alloy, Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability

- Deep Foundations Institute (DFI): Guide to Drafting a Specification for High Capacity Drilled and Grouted Micropiles for Structural Support, 1st Edition, Copyright 2001 by the Deep Foundation Institute (DFI).

CSA International

- CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- CSA W59-03(R2008), Welded Steel Construction, (Metal Arc Welding).

General:

The Contractor is responsible for the design and construction of the helical piles (Performance Specification). The helical piles shall by capacity and other required performance meet or exceed loads shown on structural drawings and requirements in this geotechnical report. The capacity of the piles shall be demonstrated by testing. Tested values to be submitted to the Departmental Representative for approval. The contractor shall submit shop drawings for the helical piles sealed by a Professional Geotechnical Engineer registered in British Columbia retained by the contractor. The Geotechnical Engineer shall be responsible and shall submit letters of assurance for the design and performance of the piles. Helical micropile material, installation and testing is the responsibility of the contractor. The contractor shall use the appropriate product components per manufacturer's standards and recommendations. The contractor shall follow manufacturer's standards and recommendations for installation and testing of the helical piles.

Corrosion protection:

All the steel components of the helical piles system to be hot dip zinc galvanized. Hot dip galvanizing: to CAN/CSA G164, minimum zinc coating of 600 g/m^2

Submittals:

1. The helical micro pile (further pile) shop drawings shall include the following:
   - All the pile components including attachment of the pile to pile cap
   - Number of piles, location, inclination, geometry in the concrete pile cap and pattern by assigned identification number

- Design loads, required minimum effective installation torque
- Type and size of central shaft
- Displacement plates/centralizers and their location
- Minimum overall length and top of pile plate elevation
- Central steel shaft ultimate strength, yield strength, % elongation and chemistry composition
- Corrosion protection

2. Copies of calibration reports for each torque indicator and load test equipment. The calibration tests shall have been performed within one year of the date submitted. Pile installation and testing shall not proceed until the Departmental Representative has received the calibration reports. The calibration reports shall include, but not limited to, the following information:
   - Name of project and Contractor
   - Name of testing agency
   - Identification (serial number) of device calibrated Description of calibrated testing equipment Date of calibration
   - Calibration data

   Work shall not begin until all the submittals have been received and approved by the Departmental Representative. The Contractor shall allow the Departmental Representative a 1 week to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

3. Installation Records: The Contractor shall provide the Departmental Representative copies of HPM installation records within 24 hours after each installation is completed. Formal copies shall be submitted on a weekly basis. These installation records shall include, but are not limited to, the following information.
   - Name of project and Contractor

- Name of Contractor's supervisor during installation
- Date and time of installation
- Name and model of installation equipment
- Type of torque indicator used
- Location of pile by assigned identification number
- Actual pile type and configuration – including lead section (number and size of helical plates), number and type of extension sections (manufacturer's SKU numbers)
- HPM installation duration and observations
- Total length of installed piles
- Cut-off elevation
- Inclination of HPM
- Installation torque at one-foot intervals for the final 3 meters
- Grout quantities pulled-down on a per section basis
- Actual grout column diameter and length
- Comments pertaining to interruptions, obstructions, or other relevant information
- Rated load capacities

4. Testing procedure:

The Contractor shall submit for review and acceptance the proposed pile load testing procedure. The pre-production test proposal shall be in general conformance with ASTM D1143 and/or D-3689, and shall provide the minimum following information:

- Type and accuracy of load equipment
- Type and accuracy of load measuring equipment
- Type and accuracy of pile-head deflection equipment
- General description of load reaction system, including description of reaction anchors
- Calibration report for complete load equipment, including hydraulic jack, pump, pressure gauge, hoses, and fittings.

- Test protocol with incremental loading

5. Test Reports: The Contractor shall provide the Departmental Representative copies of field test reports within 24 hours after completion of the load tests. Formal copies shall be submitted within a reasonable amount of time following test completion. These test reports shall include, but are not limited to, the following information:

   - Name of project and Contractor
   - Name of third party test agency, if required
   - Name of Contractor's supervisor during installation
   - Date, time, and duration of test
   - Location of piles by assigned identification number
   - Type of test (i.e. tension or compression)
   - Description of calibrated testing equipment and test set-up
   - Actual pile type and configuration – including lead section, number and type of extension sections (manufacturer's SKU numbers)
   - Steps and duration of each load increment
   - Cumulative pile-head movement at each load step
   - Comments pertaining to test procedure, equipment adjustments, or other relevant information signed by third party test agency rep., registered professional engineer, or as required by local jurisdiction

6. Closeout Submittals
   - Warranty Period: 10 years commencing on date of Substantial Completion
   - Manufacturer's Warranty: Submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.

Manufacturer's warranty is in addition to, and not a limitation of, other rights the Departmental Representative may have under Contract Document.

Execution:

- Mark mass on members weighing more than 590kg (1300lbs)
- Prior to commencing pile installation, the Contractor shall inspect the work of all other trades and verify that all said work is completed to the point where HPMs may commence without restriction.
- The Contractor shall verify that all piles may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.
- In the event of a discrepancy, the Contractor shall notify the Departmental Representative. The Contractor shall not proceed with HPM installation in areas of discrepancies until said discrepancies have been resolved. All costs associated with unresolved discrepancies shall be the responsibility of the Departmental Representative.

Pile Testing:

Load tests shall be performed to verify the suitability and capacity of the proposed pile, and the proposed installation procedures prior to installation of production piles. The load tests shall follow the approved submitted test loading procedure.

GUIDE TO MODEL SPECIFICATION
CHANCE® Civil Construction

HELICAL PILES FOR STRUCTURAL SUPPORT

TYPES OF SPECIFICATIONS

The three types of specifications that are used for Helical Pile projects are:

Open Specifications: The Contractor is given the responsibility for the scope and design of the Helical Pile installation. In addition, the construction, capacity, and performance of the Helical Pile are the sole responsibility of the Contractor. This specification assumes that the Owner or Designer has provided the required structural loads. This specification type is most common for securing bids on temporary projects, and is not recommended for permanent applications.

Performance Specifications: The Contractor is given the responsibility for certain design and/or construction procedures, but must demonstrate to the Owner through testing and/or mutually agreed upon acceptance criteria that the production Helical Piles meet or exceed the specified performance parameters. This specification assumes that the location and the required loads of the Helical Pile have been specified. The Contractor and Owner share the responsibility for the work.

Prescriptive Specifications: The Owner has the sole responsibility for the scope and design of the Helical Pile installation and specifies the procedures that must be followed. Prescriptive specifications mandate the Owner to be responsible for the proper performance of the Helical Piles. The Contractor is responsible for fulfilling the obligations/details as specified in the construction documents.

Performance specifications are the most common and allow Contractors to use their unique installation methods and experience for any given site conditions. Owners receive the benefit of value engineering, which can result in lower costs.

The Owner, Designer, and Contractor will be jointly responsible for the design, installation, acceptance, and performance of Helical Piles. The installation of a Helical Pile requires specialized equipment, techniques, and trained work crews. Every detail of the work cannot be specified, and every potential problem cannot be anticipated. Therefore, a contractor trained in the proper methods of design and installation of Helical Piles must be selected.

A list of the major tasks to be performed on a Helical Pile project is shown in Table-1 of the Model Specifications. The Owner or his representative should select the type of specification and procurement method. The responsible party for each task must be identified and mutually agreed upon at the earliest point in the contracting process. The completed Table-1 should be included in the construction documents.

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The process of continuous communication between all the parties involved is essential to achieve a satisfactory result. Clear communication and close cooperation are particularly important in the start-up phase and in testing. In addition, a timely preparation and review of all submittals is critical.

This model specification can be adapted to each of the three types of specifications. However, it is primarily written for the performance type. The identity of the "Contractor" and the "Owner" is always well defined, unlike that of the "Designer" or "Engineer". For example, the "Engineer" may be an employee(s) of the Contractor, or a third party consultant hired to secure a lower cost alternative during the bidding process. In contrast, the "Engineer" may be the Owner, an employee(s) of the Owner, or a representative hired by the Owner. It is recommended that the Engineer be a third party agency employed by the Owner to serve in the owner's best interests during the various stages of the contract.

For purposes of this Model Specification, the subject is a high capacity Helical Pile manufactured by CHANCE® Civil Construction. At present, maximum working or design loads range between 12.5 and 50 tons. The Helical Pile consists of one or more helical bearing plates attached at the tip of a high strength central steel shaft. The central steel shaft consists of either a solid square shaft of various sizes, or hollow pipe shaft of various diameters and wall thickness. The steel shafts are typically 1-1/2" to 8 inches in diameter and will accept load directly axially and/or laterally to provide structural support.

It is suggested that the specification writer accurately and completely modify this model to suit his/her particular case.

Items in italics as such may be considered as "Commentary" and as such may be deleted or retained to suit the needs of the specification writer.

The following is list of general references that will provide additional background to Helical Pile technology:

A. B. Chance Company, *HELICAL PIER® Foundation Systems, Technical Manual*, Bulletin 01-9601, Copyright 2000 Hubbell, 210 North Allen St., Centralia, MO 65240

A. B. Chance Company, *Helical Screw Foundations – Design Manual for New Construction*, Copyright 2003 A.B. Chance Company, 210 North Allen St., Centralia, MO 65240

Atlas Systems, Inc., *Technical Manual, 2005*, Copyright 2004 – Atlas Systems, Inc, 1026-B South Powell Road, Independence, MO 64056

"BOCA Research Report 94-27", Copyright 1996, BOCA Evaluation Services, Inc., Country Club Hills, IL 60478

Goen, J. Lee, *Compression Load on HELICAL PIER® Foundation Systems Anchors – Design and Construction*, Bulletin 01-9304, Copyright 1998 Hubbell/Chance, 210 North Allen St., Centralia, MO 65240

Hargrave, R. L. and Thorsten, R. E., 1992. Helical Piers in Expansive Soils of Dallas, Texas. *Proceedings 7th International Conference on Expansive Soils, Session 24*, Bulletin 01-9311, Copyright

1993 A. B. Chance, 210 North Allen St., Centralia, MO 65240

Hoyt, R.M. and Clemence, S.P., 1989. Uplift Capacity of Helical Anchors in Soil. *Proceedings of the 12th International Conference on Soil Mechanics and Foundation Engineering*, Vol. 2, pp. 1019-1022.

"ICBO Evaluation Report - ER-5110", Copyright 2001, ICBO Evaluation Service, Inc., Whittier, CA 90601

Pack, J. S., 2000. Design of Helical Piles for Heavily Loaded Structures. *New Technological and Design Developments in Deep Foundations*, ASCE Geotechnical Special Publication, pp. 353- 367.

"SBCCI Report No. 9504B", Copyright 1999, SBCCI Public Safety Testing and Evaluation Services Inc., Birmingham, AL 35213

Seider, Gary L., "*Versatile Steel Screw Anchors*", Structural Engineer Magazine, March 2000; Volume 1, Number 2, ppgs. 42-46.

Wesolek, Dana A., Schmednecht, Fred C., and Seider, Gary L. "Helical Piers/Anchors in the Chicago Building Code", Proceedings of the DFI 30th Annual Conference on Deep Foundations, Chicago, IL pp. 193-204.

Model Specification Table of Contents:

CHANCE® Civil Construction
HELICAL PILES

MODEL SPECIFICATION

1. GENERAL

1.1 Purpose of Specification

The purpose of this specification is to detail the furnishing of all designs, materials, tools, equipment, labor and supervision, and installation techniques necessary to install Helical Piles as detailed on the drawings, including connection details. This shall include provisions for load testing that may be part of the scope of work

Specifier Note: This specification may require modification to account for unusual and/or unforeseen site and subsurface conditions and the particular circumstances of the project.

1.2 Scope of Work

This work consists of furnishing all necessary engineering and design services (if required), supervision, labor, tools, materials, and equipment to perform all work necessary to install the Helical Piles, at (location, City, State/Province) for (Company, State or Private Authority) per the specifications described herein, and as shown on the drawings. The Contractor shall install a Helical Pile that will develop the load capacities as detailed on the drawings. This may also include provisions for load testing to verify Helical Pile capacity and deflection, if part of the scope of work. The responsibilities and duties of the respective parties for this project are summarized in Table-1.

Table-1. Tasks and Responsibilities to be Allocated for Helical Pile Work

	TASK	RESPONSIBLE PARTY*
1	Site Investigation, Geotechnical Investigation, Site Survey, and potential work restrictions	
2	Type of specification, requirement for a pre-contract testing program, and procurement method	
3	Obtaining easements	
4	Overall scope of work, design of the Helical Pile structure – including design loads (vertical, horizontal, etc.), pile locations, and pile spacing and orientation	
5	Definition and qualification of safety factors	
6	Calculation/estimation of allowable structural and/or Helical Pile movement in service (acceptance criteria)	
7	Definition of service life (temporary – months or permanent - years) and required degree of corrosion protection based on site conditions	

8	Type and number of tests (pre-contract, pre-production and production)	
9	Minimum total Helical Pile length, depth to bearing stratum	
10	Helical Pile components and details	
11	Details of corrosion protection, if required	
12	Details of pile connection to structure (e.g., for static and seismic conditions)	
13	Preparation of Drawings and test reports	
14	Evaluation of test results	
15	Construction methods, schedule, sequencing, and coordination of work	
16	Requirements of field production control, including logging of installation torque vs. installed depth	
17	Supervision of work	
18	Long-term monitoring	

* To be filled in by specification writer.

1.3 Qualifications of the Helical Pile Contractor

The Helical Pile Contractor shall be experienced in performing design and construction of Helical Piles and shall furnish all materials, labor, and supervision to perform the work. The Contractor shall be trained and certified by CHANCE Civil Construction in the proper methods of design and installation of Helical Piles. The Contractor shall provide names of on-site personnel materially involved with the work, including those who carry documented certification from CHANCE Civil Construction. At a minimum, these personnel shall include foreman, machine operator, and project engineer/manager.

The Helical Pile Contractor shall not sublet the whole or any part of the contract without the express written permission of the Owner.

1.4 Related Project Specifications

To be determined by the specification writer.

1.5 Definitions

A partial list follows. *The Owner may wish to add other specific, project-related items.*

Contractor: The person/firm responsible for performing the Helical Pile work.

Coupling: Central steel shaft connection means formed as integral part of the plain extension shaft material. For Type SS & RS Helical Piles, couplings are internal or external sleeves, or hot upset forged sockets.

Coupling Bolt(s): High strength, structural steel fasteners used to connect Helical Pile segments together. For Type SS segments, the coupling bolt transfers axial load. For Type RS segments, the coupling bolts transfer both axial and torsional forces.

Helical Extension: Helical Pile foundation component installed immediately following the lead or starter section, if required. This component consists of one or more helical plates welded to a central steel shaft of finite length. Function is to increase bearing area.

Helix Plate: Generally round steel plate formed into a ramped spiral. The helical shape provides the means to install the helical pile, plus the plate transfers load to soil in end bearing. Helix plates are available in various diameters and thickness.

HELICAL PULLDOWN® Micropile: A small diameter, soil displacement, cast-in-place Helical Pile, in which most of the applied load is resisted by the central steel shaft and steel reinforcement, if installed. Load transfer to soil is both end bearing and friction.

Helical Pile: A bearing type foundation element consisting of a lead or starter section, helical extension (if so required by site conditions), plain extension section(s), and a pile cap. A.k.a. helical screw pile, screw pile, helical screw foundation.

Installation Torque(T): The resistance generated by a Helical Pile when installed into soil. The installation resistance is a function of the soil type, and size and shape of the various components of the Helical Pile.

Lead Section: The first Helical Pile foundation component installed into the soil, consisting of single or multiple helix plates welded to a central steel shaft. A.k.a. Starter Section.

Pile Cap: Connection means by which structural loads are transferred to the Helical Pile. The type of connection varies depending upon the requirements of the project and type of Helical Pile material used.

Round Shaft (RS): Round steel pipe central Shaft elements ranging in diameter from 2-7/8" to 10". A.k.a. Hollow Shaft (Type HS), Type T/C, Type PIF.

Plain Extension: Central steel shaft segment without helix plates. It is installed following the installation of the lead section or helical extension (if used). The segments are connected with integral couplings and bolts. Plain extensions are used to extend the helix plates beyond the specified minimum depth and into competent load bearing stratum.

Safety Factor: The ratio of the ultimate capacity to the working or design load used for the design of any structural element.

Square Shaft (SS): Solid steel, round-cornered-Square central Shaft elements ranging in size from 1-1/4" to 2-1/4". A.k.a. Type SQ.

Torque Strength Rating: The maximum torque energy that can be applied to the helical pile foundation during installation in soil, a.k.a. allowable, or safe torque.

1.6 Allowable Tolerances

The tolerances quoted in this section are suggested maximums. The actual values established for a particular project will depend on the structural application.

1.6.1 Centerline of Helical Piles shall not be more than 3 inches from indicated plan location.

1.6.2 Helical Pile plumbness shall be within 2° of design alignment.

1.6.3 Top elevation of Helical Pile shall be within +1 inch to –2 inches of the design vertical elevation.

1.7 Quality Assurance

1.7.1 Helical Piles shall be installed by authorized CHANCE Civil Construction certified Contractor. These Contractors shall have satisfied the certification requirements relative to the technical aspects of the product and installation procedures as therein specified. Certification documents shall be provided upon request to the Owner or their representative.

1.7.2 The Contractor shall employ an adequate number of skilled workers who are experienced in the necessary crafts and who are familiar with the specified requirements and methods needed for proper performance of the work of this specification.

1.7.3 All Helical Piles shall be installed in the presence of a designated representative of the Owner unless said representative informs the Contractor otherwise. The designated representative shall have the right of access to any and all field installation records and test reports.

1.7.4 Helical Pile components as specified therein shall be manufactured by a facility whose quality systems comply with ISO (International Organization of Standards) 9001 requirements. Certificates of Registration denoting ISO Standards Number shall be presented upon request to the Owner or their representative.

1.7.5 CHANCE Civil Construction provides a standard one-year warranty on materials and workmanship of the product. Any additional warranty provided by the Contractor shall be issued as an addendum to this specification.

1.7.6 Design of Helical Piles shall be performed by an entity as required in accordance with existing local code requirements or established local practices. This design work may be performed by a licensed professional engineer, a certified CHANCE Civil Construction Contractor, or designer depending upon local requirements or practices.

1.8 Design Criteria

1.8.1 Helical Piles shall be designed to meet the specified loads and acceptance criteria as shown on the drawings. The calculations and drawings required from the Contractor or Engineer shall be submitted to the Owner for review and acceptance in accordance to Section 3.1 "Construction Submittals".

1.8.2 The allowable working load on the Helical Piles shall not exceed the following values:

1.8.2.1 For compression loads:

$$P_{allowc} = 0.4 * f_{yshaft} * A_{shaft}$$

Where: P_{allowc} = allowable working load in compression (kip)
f_{yshaft} = minimum yield strength of central steel shaft (ksi)
A_{shaft} = area of central steel shaft (with corrosion allowance if required) (in.^{2})

The minimum yield strength of the central steel shaft is as follows: Type SS5: 70 ksi; Type SS125, SS1375, SS150, SS175, SS200, SS225: 90 ksi; Type RS2875, RS3500, RS4500: 50 ksi.

These allowable working loads may be reduced by the allowable load capacity per helix plate(s). It is recommended to use the allowable helix capacities per helical pile type as published by CHANCE Civil Construction (shown in Table-1 of the Appendix).

1.8.2.2 For tension loads:

$$P_{allowt} = S_{ut} / FS$$

Where: P_{allowt} = allowable working load in tension (kip)
S_{ut} = Min. ultimate tensile strength of central steel shaft segment (at coupling joint) (kip)
FS = factor of safety suitable for application, i.e. temporary or permanent structures

For permanent applications, it is recommended to use a factor of safety of two (2). For temporary applications, factor of safety typically ranges between 1.25 and 1.5.

It is recommended to use the minimum ultimate tensile strengths as published by CHANCE Civil Construction (shown in Table-1 of the Appendix). The ultimate tensile strength may be reduced by the ultimate capacity per helix plate(s) – depending on the number of helix plates specified and type of shaft family used. The ultimate tensile strength may also be reduced by the torque limited ultimate capacity – depending on the type of shaft family used.

1.8.3 The ultimate structural capacity shall be determined as:

1.8.3.1 For compression loads:

$$P_{ultc} = f_{yshaft} * A_{shaft}$$

Where: P_{ultc} = ultimate structural capacity in compression (kip)
f_{yshaft} = minimum yield strength of central steel shaft (ksi)
A_{shaft} = area of central steel shaft (with corrosion allowance if required) (in.^{2})

The minimum yield strength of the central steel shaft is as follows: Type SS5: 70 ksi; Type SS125, SS1375, SS150, SS175, SS200, SS225: 90 ksi; Type RS2875, RS3500, RS4500: 50 ksi.

The ultimate structural capacity may be reduced by the ultimate load capacity per helix plate(s). It is recommended to use the ultimate helix capacities per helical pile type as published by CHANCE Civil Construction (shown in Table-1 of the Appendix).

1.8.3.2 For tension loads:

$$P_{ultt} = S_{ut}$$

Where: P_{ultt} = Ultimate structural capacity in tension (kip)
S_{ut} = Minimum ultimate tensile strength of central steel shaft (kip)

It is recommended to use the minimum ultimate tensile strengths as published by CHANCE Civil Construction (shown in Table-1 of the Appendix). The ultimate tensile strength may be reduced by the ultimate capacity per helix plate(s) – depending on the number of helix plates specified and type of shaft family used. The ultimate tensile strength may also be reduced by the torque limited ultimate capacity – depending on the type of shaft family used.

1.8.4 Helical Pile capacity in soil shall not be relied upon from the following soil layers as defined in the geotechnical reports:

_____

_____

The overall length and installed torque of a Helical Pile shall be specified such that the required

in-soil capacity is developed by end-bearing on the helix plate(s) in an appropriate strata(s).

It is recommended that the theoretical end-bearing capacity of the helix plates be determined using HeliCAP® Engineering Software or equal commercially available software. The required soil parameters (c, ϕ, γ, or N-values) for use with HeliCAP® or equal shall be provided in the geotechnical reports. The Owner shall determine the allowable response to axial loads.

Helical Piles are not suited for solid, competent rock, but the helix plates can penetrate into dense bearing soils. It is recommended that HELICAL PILES be installed to a specified minimum torque and depth to ensure the helical plates are terminated in bearing soils. Appropriate and repeatable installation techniques and Helical Pile termination criteria must be identified and verified in the field.

1.8.5 Lateral Load and Bending: Where Helical Piles are subjected to lateral or base shear loads as indicated on the plans, the bending moment from said loads shall be determined using lateral load analysis program such as LPILE or equal commercially available software. The required soil parameters (c, ϕ, γ, and k_s) for use with LPILE or equal shall be provided in the geotechnical reports. The Owner shall determine the allowable response to lateral loads. The combined bending and axial load factor of safety of the Helical Pile shall be as determined by the Owner.

Helical Piles are slender foundation elements, i.e. the shafts range from 1-1/4" to 4-1/2" in diameter. As such, vertically installed Helical Piles generally require enlarged shaft sections or pile caps to adequately resist lateral load. The lateral load analysis as detailed in Section 1.8.5 of the specification can be used to determine the required diameter and length of the enlarged shaft section or pile cap.

It is recommended to list below each load combination and required factor of safety for this specific project.

1.8.6 Critical Buckling Load: Where Helical Piles are installed into low strength soil, the critical buckling load shall be determined using lateral load analysis program such as LPILE or equal commercially available software, or various other methods. The required soil parameters (c, ϕ, γ, and k_s) for use with LPILE or equal shall be provided in the geotechnical reports.

Research shows that buckling, either elastic or nonelastic, is of practical concern only for long Helical Pile shafts in the softest soils. This is in agreement with past findings regarding conventional pile foundations.

1.8.7 Expansive Soils: Helical Pile used in areas where expansive soils are present may require the use of special construction methods to mitigate possible shrink/swell effects. Helical Pile shafts should be isolated from the concrete footing if said footing is in contact with the expansive soil.

1.8.8 Down-Drag/Negative Skin Friction: Type SS and Type RS Helical Piles are slender shaft foundation elements and are not practically affected by down-drag/negative skin friction. If Helical Piles with central steel shafts >4" in diameter are used in areas where compressible or decomposing soils overlie bearing stratum, or where expansive or frozen soils can cause pile jacking, Helical Pile shafts should be provided with a no-bond zone along a specified length to prevent load transfer that may adversely affect pile capacity. Alternately, Helical Piles can be provided with sufficient axial load capacity to resist down drag/negative skin friction forces.

1.8.9 The Helical Pile attachment (pile cap) shall distribute the design load (DL) to the concrete foundation such that the concrete bearing stress does not exceed those in the ACI Building Code and the stresses in the steel plates/welds does not exceed AISC allowable stresses for steel members.

1.8.10 Corrosion Protection

This section is optional (see below). Provisions of this section and Section 4.6 below may not be required in the Specification. If this section is not used, then Section 4.6 should likewise be deleted. The degree and extent of corrosion protection must be specified by the Owner (Table-1).

Corrosion protection is a function of structure type, service life, and the overall aggressiveness of the project soils. The need for corrosion protection of Helical Piles must be carefully determined and specified as necessary.

Corrosion resistant coatings (i.e. epoxy, plastic sheath) on the lead/starter section are impractical due to abrasive action wearing off the coating as the soil flows over the helix plates and around the central steel shaft. Hot dip galvanization is the only practical means to provide a corrosion resistant coating capable of withstanding the rigors of installation. Extension sections are typically hot-dip galvanized, but other coatings can be specified.

The following requirements are typical. The specifier should review and edit as appropriate for the project.

Structure Type: _____ (e.g. temporary, permanent*) with a temporary structure being defined within a specified time frame (i.e. months rather than years). In general, permanent structures have a service life greater than 24 months.*

Temporary structures do not require corrosion protection.

Service Life: _____(years) *a typical service life of 50 years should be used unless otherwise specified. If the service life of a temporary Helical Pile is likely to be extended due to construction delays, it should be considered permanent.*

For a service life of less than 20 years in non-aggressive soil, corrosion protection is not recommended.

Corrosion protection requirements for the various Helical Pile elements shall be provided meeting the requirements of Table-2 in the Appendix for:

Soil: _____ Aggressive or Non-Aggressive *with optional location and elevation limits defined by the Specifier.*

For guidance on aggressiveness classification, see Table-2 in the Appendix. It is recommended to retain the services of a corrosion design professional for very aggressive soils.

TABLE-2

CORROSION PROTECTION				
LOADING	**TENSION**		**COMPRESSION**	
SOIL	**AGGRESSIVE[1]**	**NON-AGGRESSIVE**	**AGGRESSIVE[1]**	**NON-AGGRESSIVE**
CENTRAL STEEL SHAFT (Lead Section)	a. Galvanization OR b. Minimum 1/8" corrosion loss on outside	a. Bare steel OR b. Galvanization OR c. Minimum 1/8" corrosion loss on outside	a. Galvanization OR b. Minimum 1/8" corrosion loss on outside	a. Bare steel OR b. Galvanization OR c. Minimum 1/8" corrosion loss on outside
CENTRAL STEEL SHAFT (Extension Section)	a. Galvanization OR b. Epoxy coating OR c. a. or b. + Grout cover[2] The Specifier may elect to use a grout case.	a. Bare steel OR b. Galvanization OR c. Epoxy coating	a. Galvanization OR b. Epoxy coating OR c. a. or b. + Grout cover[2] The Specifier may elect to use a grout case.	a. Bare steel OR b. Galvanization OR c. Epoxy coating
STEEL PILE CAP	a. Galvanization OR b. Epoxy coating	d. Bare steel OR e. Galvanization OR f. Epoxy coating	c. Galvanization OR d. Epoxy coating	g. Bare steel OR h. Galvanization OR i. Epoxy coating

NOTES:
Lettered items are options.
For guidance on aggressiveness classification, see Table-2 of the Appendix.
1. Corrosion protection shall extend 15'-0 below corrosive material.
2. Minimum 1" in soil. If protective coatings (galvanization, epoxy) are provided in compression, minimum cover may be 0.25" in soil. Grout column can be installed using the HELICAL PULLDOWN® Micropile method.

The most critical area to protect from corrosion is at or near the ground line – if the surficial soils have been disturbed. Undisturbed soils are deficient in oxygen a few feet below ground line or below the water table zone. Undisturbed soils typically result in steel piling not being appreciably affected by corrosion.

1.9. Ground Conditions

The Geotechnical Report, including logs of soil borings as shown on the boring location plan, shall be considered to be representative of the in-situ subsurface conditions likely to be encountered on the project site. Said Geotechnical Report shall be the used as the basis for Helical Pile design using generally accepted engineering judgement and methods.

If soil borings are not available, it is suggested to install a Helical Pile at various locations on the project site. Using the well-known installed torque vs. capacity attribute of helical piles, a presumptive soil profile can be generated.

The Geotechnical Report shall be provided for purposes of bidding. If during Helical Pile installation, subsurface conditions of a type and location are encountered of a frequency that were not reported, inferred and/or expected at the time of preparation of the bid, the additional costs required to overcome such conditions shall be considered as extras to be paid for.

All available information related to subsurface and general site conditions should be made available to all bidders at the time of bid preparation. It is not reasonable to expect bidders to conduct supplemental site investigations at their own risk and cost prior to bidding, unless the specific contract requirements call for it (Table-1) and provide for appropriate compensation. A mandatory site visit and pre-bid meeting should be held so that the details of the project and the specifications can be thoroughly discussed. These steps will help avoid technical and contractual problems developing during the execution of the work, and will help all parties manage their respective risk.

2 REFERENCED CODES AND STANDARDS

Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation. In case of conflict, the particular requirements of this specification shall prevail. The latest publication as of the issue of this specification shall govern, unless indicated otherwise.

2.1 American Society for Testing and Materials (ASTM):

2.1.1 ASTM A29/A29M Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished.
2.1.2 ASTM A36/A36M Structural Steel.
2.1.3 ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
2.1.4 ASTM A153 Zinc Coating (Hot Dip) on Iron and Steel Hardware.
2.1.5 ASTM A252 Welded and Seamless Steel Pipe Piles.
2.1.6 ASTM A775 Electrostatic Epoxy Coating
2.1.7 ASTM A193/A193M Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.
2.1.8 ASTM A320/A320M Alloy-Steel Bolting Materials for Low Temperature Service.
2.1.9 ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
2.1.10 ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
2.1.11 ASTM A513 Standard Specification for Electric Resistance Welded Carbon and Alloy Steel Mechanical Tubing.
2.1.12 ASTM A536 Standard Specifications for Ductile Iron Castings
2.1.13 ASTM A572 HSLA Columbium-Vanadium Steels of Structural Quality.
2.1.14 ASTM A618 Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.
2.1.15 ASTM A656 Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability.
2.1.16 ASTM A958 Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Wrought Grades.
2.1.17 ASTM A1018 Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability.

2.1.18 ASTM D1143 Method of Testing Piles Under Static Axial Compressive Load.
2.1.19 ASTM D3689 Method of Testing Individual Piles Under Static Axial Tensile Load.

2.2 American Welding Society (AWS):
2.2.1 AWS D1.1 Structural Welding Code – Steel.
2.2.2 AWS D1.2 Structural Welding Code – Reinforcing Steel.

2.3 American Society of Civil Engineers (ASCE):
2.3.1 ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations.

2.4 Deep Foundations Institute (DFI):
2.4.1 *Guide to Drafting a Specification for High Capacity Drilled and Grouted Micropiles for Structural Support*, 1st Edition, Copyright 2001 by the Deep Foundation Institute (DFI).

2.5 Society of Automotive Engineers (SAE):
2.5.1 SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners.

3 SUBMITTALS

3.1 Construction Submittals
3.1.1 The Contractor or Engineer shall prepare and submit to the Owner, for review and approval, working drawings and design calculations for the Helical Piles intended for use at least 14 calendar days prior to planned start of construction (but note also Paragraph 3.1.8). All submittals shall be signed and sealed by a Registered Professional Engineer currently licensed in the State/Province of _____.

3.1.2 The Contractor shall submit a detailed description of the construction procedures proposed for use to the Owner for review. This shall include a list of major equipment to be used.

3.1.3 The Working Drawings shall include the following:

3.1.3.a Helical Pile number, location and pattern by assigned identification number
3.1.3.b Helical Pile design load
3.1.3.c Type and size of central steel shaft

Type SS125 1-1/4" RCS, Type SS1375 1-3/8" RCS, SS5/SS150 – 1-1/2" RCS, Type SS175 – 1-3/4" RCS, Type SS200 – 2" RCS, Type SS225 – 2-1/4" RCS, Type RS2875 – 2-7/8" OD, Type RS3500 – 3-1/2" OD Pipe, Type RS4500 – 4-1/2" OD Pipe.

3.1.3.d Helix configuration (number and diameter of helix plates)
3.1.3.e Minimum effective installation torque
3.1.3.f Minimum overall length
3.1.3.g Inclination of Helical Pile
3.1.3.h Cut-off elevation
3.1.3.i Helical Pile attachment to structure relative to grade beam, column pad, pile cap, etc.

If the number of helix plates per Helical Pile required for the project is not shown on the Working Drawings, the Contractor shall have the option of performing subsurface tests using methods subject to the review and acceptance of the Owner. The data collected along with other information pertinent to the project site shall be used to determine the required helix configuration.

3.1.4 The Contractor shall submit shop drawings for all Helical Pile components, including corrosion protection and pile top attachment to the Owner for review and approval. This includes Helical Pile lead/starter and extension section identification (manufacturer's catalog numbers).

Shop drawings for Helical Pile components, including pile top attachments, can be obtained from CHANCE Civil Construction, their certified Distributors and Installing Contractors, or directly from www.abchance.com or www.atlassys.com.

3.1.5 If required, the Contractor shall submit certified mill test reports for the central steel shaft, as the material is delivered, to the Owner for record purposes. The ultimate strength, yield strength, % elongation, and chemistry composition shall be provided.

3.1.6 The Contractor shall submit plans for pre-production (optional) and production testing for the Helical Piles to the Owner for review and acceptance prior to beginning load tests. The purpose of the test is to determine the load versus displacement response of the Helical Pile and provide an estimation of ultimate capacity.

It is the responsibility of the structural engineer of record to establish acceptance criteria for Helical Pile verification tests, which can be incorporated into the project specific specification. Load testing also provides the means to verify the empirical ratio between the ultimate capacity and the average installing torque of the Helical Pile for a specific project site.

3.1.7 The Contractor shall submit to the Owner copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within forty five (45) working days of the date submitted. Helical Pile installation and testing shall not proceed until the Owner has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:

3.1.7.a Name of project and Contractor
3.1.7.b Name of testing agency
3.1.7.c Identification (serial number) of device calibrated
3.1.7.d Description of calibrated testing equipment
3.1.7.e Date of calibration
3.1.7.f Calibration data

Load test equipment includes load cylinders, pressure gauges, and load transducers. A. B. Chance Mechanical Dial Torque Indicator (SKU C303-1340) is calibrated prior to final assembly. Its torsion bar design eliminates the need for annual re-calibration.

3.1.8 Work shall not begin until all the submittals have been received and approved by the Owner. The Contractor shall allow the Owner a reasonable time to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

3.2 Installation Records

The Contractor shall provide the Owner copies of Helical Pile installation records within 24 hours after each installation is completed. Records shall be prepared in accordance with the specified division of responsibilities as noted in Table-1. Formal copies shall be submitted on a weekly basis. These installation records shall include, but are not limited to, the following information.

3.2.1 Name of project and Contractor
3.2.2 Name of Contractor's supervisor during installation
3.2.3 Date and time of installation
3.2.4 Name and model of installation equipment
3.2.5 Type of torque indicator used
3.2.6 Location of Helical Pile by assigned identification number
3.2.7 Actual Helical Pile type and configuration – including lead section (number and size of helix

plates), number and type of extension sections (manufacturer's SKU numbers)

3.2.8 Helical Pile installation duration and observations

3.2.9 Total length of installed Helical Pile

3.2.10 Cut-off elevation

3.2.11 Inclination of Helical Pile

3.2.12 Installation torque at one-foot intervals for the final 10 feet

3.2.13 Comments pertaining to interruptions, obstructions, or other relevant information

3.2.14 Rated load capacities

3.3 Test Reports

The Contractor shall provide the Owner copies of field test reports within 24 hours after completion of the load tests. Records shall be prepared in accordance with the specified division of responsibilities as noted in Table-1. Formal copies shall be submitted within a reasonable amount of time following test completion. These test reports shall include, but are not limited to, the following information (note Section 6 – Helical Pile Load Tests).

3.3.1 Name of project and Contractor

3.3.2 Name of Contractor's supervisor during installation

3.3.3 Name of third party test agency, if required

3.3.4 Date, time, and duration of test

3.3.5 Location of Helical Pile by assigned identification number

3.3.6 Type of test (i.e. tension or compression)

3.3.7 Description of calibrated testing equipment and test set-up

3.3.8 Actual Helical Pile type and configuration – including lead section, number and type of extension sections (manufacturer's SKU numbers)

3.3.9 Steps and duration of each load increment

3.3.10 Cumulative pile-head movement at each load step

3.3.11 Comments pertaining to test procedure, equipment adjustments, or other relevant information

3.3.12 Signed by third party test agency rep., registered professional engineer, or as required by local jurisdiction

3.4 Closeout Submittals

3.4.1 Warranty: Warranty documents specified herein

3.4.1.a Project Warranty: Refer to Conditions of the Contract for project warranty provisions

Coordinate the warranty period stated herein with the project warranty as stated in the Contract documents.

Warranty Period: (*Specify Term*) years commencing on date of Substantial Completion

3.4.1.b Manufacturer's Warranty: Submit, for Owner's Acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under Contract Document.

4 PRODUCTS AND MATERIALS

4.1 Central Steel Shaft:

The central steel shaft, consisting of lead sections, helical extensions, and plain extensions, shall be Type SS (Square Shaft) or RS (Round Shaft) or a combination of the two (SS to RS Combo Pile) as manufactured by CHANCE Civil Construction (Centralia and Independence, MO).

4.1.1 *SS5 1-1/2" Material*: Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting dimensional and workmanship requirements of ASTM A29. The bar shall be modified medium

carbon steel grade (similar to AISI 1044) with improved strength due to fine grain size.

4.1.1.a Torque strength rating = 5,500 ft-lb
4.1.1.b Minimum yield strength = 70 ksi

4.1.2 *SS125 1-1/4"; SS1375 1-3/8"; SS150 1-1/2"; SS175 1-3/4; SS200 2"; SS225 2-1/4" Material*: Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting the dimensional and workmanship requirements of ASTM A29. The bar shall be High Strength Low Alloy (HSLA), low to medium carbon steel grade with improved strength due to fine grain size.

4.1.2.a Torque strength rating: SS125 = 4,000 ft-lb; SS1375 = 5,500 ft-lb; SS150 = 7,000 ft-lb; SS175 = 11,000 ft-lb; SS200 = 16,000 ft-lb; SS225 = 23,000 ft-lb
4.1.2.b Minimum yield strength = 90 ksi

4.1.3 *Type RS2875 2-7/8" OD Material*: Structural steel tube or pipe, welded or seamless, in compliance with ASTM A500 or A513. Wall thickness is 0.165", 0.203" or 0.262".

4.1.3.a Torque strength rating: RS2875.165 = 4,500 ft-lb; RS2875.203 = 5,500 ft-lb; RS2875.262 = 7,500 ft-lb.
4.1.3.b Minimum yield strength = 50 ksi

4.1.4 *Type RS3500 3-1/2" OD Material*: Shall be structural steel tube or pipe, seamless or straight-seam welded, per ASTM A53, A252, ASTM A500, or ASTM A618. Wall thickness is 0.300" (schedule 80).

4.1.4.a Torque strength rating = 13,000 ft-lb
4.1.4.b Minimum yield strength = 50 ksi

4.1.5 *Type RS4500 4-1/2" OD Material*: Shall be structural steel tube or pipe, seamless or straight-seam welded, per ASTM A500 or A513. Wall thickness is 0.337" (schedule 80).

4.1.5.a Torque strength rating = 23,000 ft-lb
4.1.5.b Minimum yield strength = 50 ksi

4.1.6 *SS to RS2875 Combo Pile Material*: Shall be Type SS and RS2875 material as described above with a welded adapter for the transition from SS to RS2875.

4.1.7 *SS to RS3500 Combo Pile Material*: Shall be Type SS and RS3500 material as described above with a welded adapter for the transition from SS to RS3500.

4.1.8 *SS to RS4500 Combo Pile Material*: Shall be Type SS and RS4500 material as described above with a welded adapter for the transition from SS to RS4500.

4.2 Helix Bearing Plate:

Shall be hot rolled carbon steel sheet, strip, or plate formed on matching metal dies to true helical shape and uniform pitch. Bearing plate material shall conform to the following ASTM specifications.

4.2.1 *SS5 Material*: Per ASTM A572, or A1018, or A656 with minimum yield strength of 50 ksi. Plate thickness is 3/8".
4.2.2 *SS125 and SS1375 Material*: Per ASTM A572 with minimum yield strength of 50 ksi. Plate thickness is 3/8" or ½".
4.2.3 *SS150 and SS175 Material*: Per ASTM A656 or A1018 with minimum yield strength of 80 ksi. Plate thickness is 3/8" or ½".
4.2.4 *SS200 and SS225 Material*: Per ASTM A656 or A1018 with minimum yield strength of 80 ksi. Plate thickness is ½".
4.2.5 *RS2875 Material*: Per ASTM A36, or A572, with minimum yield strength of 36 ksi. Plate thickness is 3/8" or ½".

4.2.6 *RS3500 Material*: Per ASTM A36, or A572, or A1018, or A656 depending on helix diameter, per the minimum yield strength requirements cited above. Plate thickness is 3/8" or ½".

4.2.7 *RS4500 Material*: Per ASTM A572 with minimum yield strength of 50 ksi. Plate thickness is ½".

4.3 Bolts:

The size and type of bolts used to connect the central steel shaft sections together shall conform to the following ASTM specifications.

4.3.1 *SS125 1-1/4" Material*: 5/8" diameter bolt (2 per coupling) per SAE J429 Grade 8.

4.3.2 *SS1375 1-3/8" Material*: ¾" diameter bolt (2 per coupling) per SAE J429 Grade 8.

4.3.3 *SS5 and SS150 1-1/2" Material*: ¾" diameter bolt per ASTM A320 Grade L7 or ASTM A325.

4.3.4 *SS175 1-3/4" Material*: 7/8" diameter bolt per ASTM A193 Grade B7.

4.3.5 *SS200 2" Material*: 1-1/8" diameter bolt per ASTM A193 Grade B7.

4.3.6 *SS225 2-1/4" Material*: 1-1/4" diameter bolt per ASTM A193 Grade B7.

4.3.7 *RS2875 2-7/8" OD Material*: ¾" diameter bolts (2 or 4 per coupling) per SAE J429 Grade 5 or 8.

4.3.8 *RS3500 3-1/2" OD Material*: ¾" diameter bolts (3 or 4 per coupling) per SAE J429 Grade 5 or 8.

4.3.9 *RS4500 4-1/2" OD Material*: ¾" diameter bolts (4 per coupling) per SAE J429 Grade 8.

4.4 Couplings:

For type SS5, SS150, SS175, SS200, and SS225 material, the coupling shall be formed as an integral part of the plain and helical extension material as hot upset forged sockets. For Type SS125 and SS1375 material, the coupling shall be a cast steel sleeve with two holes for connecting shaft sections together.

For Type RS2875, RS3500, and RS4500 material, the couplings shall either be formed as an integral part of the plain and helical extension material as hot forge expanded sockets, or as internal sleeve wrought steel connectors. The steel connectors can be either tubing or solid steel bar with holes for connecting shaft sections together.

4.5 Plates, Shapes, or Pile Caps:

Depending on the application, the pile cap shall be a welded assembly consisting of structural steel plates and shapes designed to fit the pile and transfer the applied load. Structural steel plates and shapes for HELICAL PILE top attachments shall conform to ASTM A36 or ASTM A572 Grade 50.

4.6 Corrosion Protection (Optional)

The corrosion protection requirements, if any, are identified in Section 1.8.10. The Specifier may elect to delete this section entirely if no corrosion protection materials are required such as for compression Helical Piles in non-aggressive ground.

4.6.1 Epoxy Coating: If used, the thickness of coating applied electrostatically to the central steel shaft shall be 7-12 mils. Epoxy coating shall be in accordance with ASTM A775. Bend test requirements are not required. Coupling bolts and nuts are not required to be epoxy coated.

4.6.2 Galvanization: If used, all Hubbell Power Systems, Inc./A. B. Chance Type SS material shall be hot-dipped galvanized in accordance with ASTM A153 after fabrication. All Hubbell Power Systems, Inc./A. B. Chance Type RS material shall be hot-dipped galvanized in accordance with ASTM A153 or A123 as specified after fabrication.

5 EXECUTION

5.1 Site Conditions

5.1.1 Prior to commencing Helical Pile installation, the Contractor shall inspect the work of all other trades and verify that all said work is completed to the point where Helical Piles may commence without restriction.

5.1.2 The Contractor shall verify that all Helical Piles may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.

5.1.3 In the event of a discrepancy, the Contractor shall notify the Owner. The Contractor shall not proceed with Helical Pile installation in areas of discrepancies until said discrepancies have been resolved. All costs associated with unresolved discrepancies shall be the responsibility of the Owner.

5.2 Installation Equipment

5.2.1 Shall be rotary type, hydraulic power driven torque motor with clockwise and counter-clockwise rotation capabilities. The torque motor shall be capable of continuous adjustment to revolutions per minute (RPM's) during installation. Percussion drilling equipment shall not be permitted. The torque motor shall have torque capacity 15% greater than the torsional strength rating of the central steel shaft to be installed.

Helical Piles should be installed with high torque, low RPM torque motors, which allow the helical screw plates to advance with minimal soil disturbance.

5.2.2 Equipment shall be capable of applying adequate down pressure (crowd) and torque simultaneously to suit project soil conditions and load requirements. The equipment shall be capable of continuous position adjustment to maintain proper Helical Pile alignment.

5.3 Installation Tooling

5.3.1 Shall consist of a Kelly Bar Adapter (KBA) and Type SS or RS drive tools as manufactured by CHANCE Civil Construction and used in accordance with the manufacturers written installation instructions.

Installation tooling should be maintained in good working order and safe to operate at all times. Flange bolts and nuts should be regularly inspected for proper tightening torque. Bolts, connecting pins, and retainers should be periodically inspected for wear and/or damage and replaced with identical items provided by the manufacturer. Heed all warning labels. Worn or damaged tooling should be replaced.

5.3.2 A torque indicator shall be used during Helical Pile installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. Torque indicators are available from CHANCE Civil Construction.

5.3.2.a Shall be capable of providing continuous measurement of applied torque throughout the installation.

5.3.2.b Shall be capable of torque measurements in increments of at least 500 ft-lb

5.3.2.c Shall be calibrated prior to pre-production testing or start of work. Torque indicators which are an integral part of the installation equipment, shall be calibrated on-site. Torque indicators which are mounted in-line with the installation tooling, shall be calibrated either on-site or at an appropriately equipped test facility. Indicators that measure torque as a function of hydraulic pressure shall be calibrated at normal operating temperatures.

5.3.2.d Shall be re-calibrated, if in the opinion of the Owner and/or Contractor reasonable doubt exists as to the accuracy of the torque measurements.

5.4 Installation Procedures

5.4.1 *Central Steel Shaft: (Lead and Extension Sections)*

5.4.1.a The Helical Pile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project.

5.4.1.b The lead section shall be positioned at the location as shown on the working drawings.

Battered Helical Piles can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required batter angle shall be established. The Helical Pile sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 20 RPM's. Extension sections shall be provided to obtain the required minimum overall length and installation torque as shown on the working drawings. Connect sections together using coupling bolt(s) and nut torqued to 40 ft-lb.

5.4.1.c Sufficient down pressure shall be applied to uniformly advance the Helical Pile sections approximately 3 inches per revolution. The rate of rotation and magnitude of down pressure shall be adjusted for different soil conditions and depths.

5.5 Termination Criteria

5.5.1 The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.

5.5.2 The minimum installation torque and minimum overall length criteria as shown on the working drawings shall be satisfied prior to terminating the Helical Pile installation.

5.5.3 If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:

5.5.3.a Terminate the installation at the depth obtained subject to the review and acceptance of the Owner, or:

5.5.3.b Remove the existing Helical Pile and install a new one with fewer and/or smaller diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.

It is generally not recommended to re-use Type SS Helical Pile shaft material after it has been permanently twisted during a previous installation. Likewise, it is generally not recommended to re-use Type RS Helical Pile shaft material after the coupling bolt holes have been noticeably elongated during a previous installation.

5.5.4 If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length, and there is no maximum length constraint, the Contractor shall have the following options:

5.5.4.a Install the Helical Pile deeper using additional extension sections, or:

5.5.4.b Remove the existing Helical Pile and install a new one with additional and/or larger diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.

5.5.4.c De-rate the load capacity of the Helical Pile and install additional Helical Pile(s). The de-rated capacity and additional Helical Pile location shall be subject to the review and acceptance of the Owner.

5.5.5 If the Helical Pile is refused or deflected by a subsurface obstruction, the installation shall be terminated and the pile removed. The obstruction shall be removed, if feasible, and the Helical Pile re-installed. If the obstruction can't be removed, the Helical Pile shall be installed at an adjacent location, subject to review and acceptance of the Owner.

5.5.6 If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to proper positioning of the last plain extension section relative to the final

elevation, the Contractor may remove the last plain extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut said extension shaft to the correct elevation. The Contractor shall not reverse (back-out) the Helical Pile to facilitate extension removal.

5.5.7 The average torque for the last three feet of penetration shall be used as the basis of comparison with the minimum installation torque as shown on the working drawings. The average torque shall be defined as the average of the last three readings recorded at one-foot intervals.

The average torque can be empirically related to the Helical Pile's ultimate capacity in end-bearing. This well-known attribute of helical piles can be used as a production control method to indicate the Helical Pile's end-bearing capacity.

6 HELICAL PILE LOAD TESTS

6.1 Pre-Production Tests (Optional)

Load tests shall be performed to verify the suitability and capacity of the proposed Helical Pile, and the proposed installation procedures prior to installation of production helical piles. _____ sacrificial test helical piles shall be constructed immediately prior to the start of work on the production piles. The Owner shall determine the number of pre-production tests, their location, acceptable load and movement criteria, and the type(s) of load direction (i.e., tension, compression, or both). Additional purpose of pre-production tests is to empirically verify the ultimate capacity to the average installing torque of the Helical Pile for the project site.

Pre-production Helical Pile installation methods, procedures, equipment, and overall length shall be identical to the production Helical Piles to the extent practical except where approved otherwise by the Owner.

The Contractor shall submit for review and acceptance the proposed Helical Pile load testing procedure. The pre-production test proposal shall be in general conformance with ASTM D1143 and/or D-3689, and shall provide the minimum following information:

- Type and accuracy of load equipment
- Type and accuracy of load measuring equipment
- Type and accuracy of pile-head deflection equipment
- General description of load reaction system, including description of reaction anchors
- Calibration report for complete load equipment, including hydraulic jack, pump, pressure gauge, hoses, and fittings.

The following test procedure shall be considered to meet the minimum requirements. It is not intended to preclude local building codes, which may mandate other requirements, such as full 24-hour load tests.

If the pre-production test fails to meet the design requirements, the Contractor shall modify the Helical Pile design and/or installation methods and retest the modified anchor, as directed by the Owner. *For prescriptive specifications, the Engineer will define the appropriate modifications.*

6.1 Load Test Equipment

6.1.1 The load test equipment shall be capable of increasing or decreasing the applied load incrementally. The incremental control shall allow for small adjustments, which may be necessary to maintain the applied load for a sustained, hold period.

6.1.2 The reaction system shall be designed so as to have sufficient strength and capacity to distribute the test loads to the ground. It should also be designed to minimize its movement under load and to prevent applying an eccentric load to the pile head. Test loads are normally higher than the design loads on the structure. The direction of the applied load shall be co-linear with the Helical Pile at all times.

6.1.3 Dial gauge(s) shall be used to measure Helical Pile movement. The dial gauge shall have an accuracy of at least +/-0.001-in. and a minimum travel sufficient to measure all Helical Pile movements without requiring resetting the gauge. The dial gauge shall be positioned so its stem is parallel with the axis of the Helical Pile. The stem may rest on a smooth plate located at the pile head. Said plate shall be positioned perpendicular to the axis of the Helical Pile. The dial gauge shall be supported by a reference apparatus to provide an independent fixed reference point. Said reference apparatus shall be independent of the reaction system and shall not be affected by any movement of the reaction system.

6.1.4 The load test equipment shall be re-calibrated, if in the opinion of the Owner and/or Contractor reasonable doubt exists as to the accuracy of the load or deflection measurements.

6.2 Testing Program

6.2.1 The hydraulic jack shall be positioned at the beginning of the test such that the unloading and repositioning of the jack during the test shall not be required. The jack shall also be positioned co-axial with respect to the pile-head so as to minimize eccentric loading. The hydraulic jack shall be capable of applying a load not less than two times the proposed design load (DL). The pressure gauge shall be graduated in 100 psi increments or less. The stroke of the jack shall not be less than the theoretical elastic shortening of the total Helical Pile length at the maximum test load.

6.2.2 An alignment load (AL) shall be applied to the Helical Pile prior to setting the deflection measuring equipment to zero or a reference position. The AL shall be no more than 10% of the design load (i.e., 0.1 DL). After AL is applied, the test set-up shall be inspected carefully to ensure it is safe to proceed.

6.2.3 Axial compression or tension load tests shall be conducted by loading the Helical Pile in step-wise fashion as shown in Table-3 to the extent practical. Pile-head deflection shall be recorded at the beginning of each step and after the end of the hold time. The beginning of the hold time shall be defined as the moment when the load equipment achieves the required load step.

6.2.4 Test loads shall be applied until continuous jacking is required to maintain the load step or until the test load increment equals 200% of the design load (DL) (i.e., 2.0 DL), whichever occurs first. The observation period for this last load increment shall be 10 minutes. Displacement readings shall be recorded at 1, 2, 3, 4, 5 and 10 minutes (load increment maxima only).

6.2.5 The applied test load shall be removed in four approximately equal decrements per the schedule in Table-3. The hold time for these load decrements shall be 1 minute, except for the last decrement, which shall be held for 5 minutes.

This cyclic loading method will permit the analyses of the total, elastic, and net movements, since they can be separated and studied. For special test piles not to be used later in service, further load cycles may be conducted to provide an estimation of the ultimate capacity.

Table-3. Steps for Pre-Production Load Testing

LOAD STEP	HOLD TIME (MINUTES)
AL	1.0 Min.
0.20 DL	2.5 Min.
0.40 DL	2.5 Min.
0.60 DL	2.5 Min.
0.80 DL	2.5 Min.
1.0 DL	2.5 Min.
0.75 DL	1.0 Min.
0.50 DL	1.0 Min.
0.25 DL	1.0 Min.
AL	1.0 Min.
0.5 DL	1.0 Min.
1.0 DL	1.0 Min.
1.2 DL	2.5 Min.
1.4 DL	2.5 Min.
1.6 DL	2.5 Min.
1.8 DL	2.5 Min.
2.0 DL	10.0 Min.
1.5 DL	1.0 Min.
1.0 DL	1.0 Min.
0.5 DL	1.0 Min.
AL	5.0 Min.

AL = Alignment Load; DL = Design Load

6.3 Acceptance Criteria for HELICAL PILE Verification Load Tests

Both of the following criteria must be met for approval:

1. The Helical Pile shall sustain the compression and tension design capacities (1.0 DL) with no more than ____ in. (mm) total vertical movement of the pile-head as measured relative to the top of the Helical Pile prior to the start of testing.
2. Failure does not occur at the 2.0 DL maximum compression and tension test loads. The failure load shall be defined by one of the following definitions – whichever results in the lesser load:
   - The point at which the movement of the Helical Pile tip exceeds the elastic compression/tension of the pile shaft by 0.08 B, where B is defined as the diameter of the largest helix. *(Note that tension loads are limited to the minimum ultimate tensile strength of the coupling joint(s) of the central steel shaft. It is recommended to use the minimum ultimate tensile strengths as published by Chance Civil Construction (shown in Table-1A & 1B of the Appendix).*
   - The point at which the slope of the load versus deflection (at end of increment) curve exceeds 0.05 inches/kip.

The Contractor shall provide the Owner copies of field test reports confirming Helical Pile configuration and construction details within 24 hours after completion of the load tests. Formal copies shall be

submitted as per Section 3.3. This written documentation will either confirm the load capacity as required on the working drawings or propose changes based upon the results of the pre-production tests.

When a Helical Pile fails to meet the acceptance criteria, modifications shall be made to the design, the construction procedures, or both. These modifications include, but are not limited to, de-rating the Helical Pile load capacity, modifying the installation methods and equipment, increasing the minimum effective installation torque, changing the helix configuration, or changing the Helical Pile material (i.e., central steel shaft). Modifications that require changes to the structure shall have prior review and acceptance of the Owner. The cause for any modifications of design or construction procedures shall be decided in order to determine any additional cost implications.

6.1 Production Helical Pile Testing (This may be the only type of load test conducted, depending on project conditions.)

The Contractor shall perform proof tests on a minimum of ___% of the total production Helical Piles. The Helical Piles to be tested will be selected by the Owner. At the Contractor's suggestion, but with the Owner's permission, tension tests may be performed in lieu of compression tests up to 1.00 DL for Helical Piles with sufficient structural tension capacity. *The requirements of Table-4 may be regarded as a minimum, however, it is not recommended to test production Helical Piles to values of up to 2.0 DL unless the Helical Pile's failure load is significantly higher than 2.0 DL. The maximum production Helical Pile test load shall be determined by the Owner. For example, ASTM D1143 stipulates testing to 2.0 DL.*

The test sequence shall be as shown in Table-4 to the extent practical.

Table-4. Steps for Production Load Testing

LOAD STEP	HOLD TIME (MINUTES)
AL	0 Min.
0.20 DL	2.5 Min.
0.40 DL	2.5 Min.
0.60 DL	2.5 Min.
0.80 DL	2.5 Min.
1.00 DL	5 Min.
0.60 DL	1 Min.
0.40 DL	1 Min.
0.20 DL	1 Min.
AL	5 Min.

AL = Alignment Load; DL = Design Load

The acceptance criteria for production Helical Piles shall be per Section 6.4 Item 1.

If a production Helical Pile that is tested fails to meet the acceptance criteria, the Contractor shall be directed to proof test another Helical Pile in the vicinity. For failed Helical Piles and further construction of other foundations, the Contractor shall modify the design, the construction procedure, or both. These modifications include, but are not limited to, installing replacement Helical Piles, modifying the installation methods and equipment, increasing the minimum effective installation torque, changing the helix configuration, or changing the Helical Pile material (i.e., central steel shaft). Modifications that

require changes to the structure shall have prior review and acceptance of the Owner. Any modifications of design or construction procedures shall be at the Contractor's expense.

6.2 Lateral Testing

If required, lateral load tests shall be conducted in accordance with ASTM D3966. If a production Helical Pile is to be lateral load tested, care must be taken not to cause permanent damage – which can reduce its axial load capacity. The acceptance criteria as selected by the Owner, typically expressed as a maximum total movement at a specific load, must be realistic in its magnitude so as not to potentially damage the structure. It is suggested that lateral loads be resisted through some other means, such as soil anchors, battered piles, or enlarged concrete pile caps/grade beams.

7 MEASUREMENT AND PAYMENT

Helical Pile work can be paid for in different ways, reflecting the relative risk to be accepted by the Owner and the Contractor. However, the following items are common and standard.

QUANTITY	DESCRIPTION	UNIT
1	Mobilization/Demobilization	Lump sum
As required	Conduct pre-production test program of declared scope	Lump sum
As required	Test Production Helical Piles	Per foundation
-	Obstructions	Per hour or Force Account
As required	Helical Pile Installation	As below

- *Per Unit Length*: Helical Piles meeting the design capacity shall be paid for per lineal foot below grade.
- *Per Helical Pile*: Helical Piles meeting the design capacity shall be paid for on a "per foundation" basis (no allowance for changes in length relative to that originally bid).
- *Per Helical Pile with Add/Deduct*: Helical Piles meeting the design capacity shall be paid for on a "per foundation" basis, with a predetermined length, and an add/deduct amount per lineal foot to accommodate field changes.
- *Lump Sum*: The whole Helical Pile project shall be paid for on a "lump sum" basis (no allowance for changes due to additional Helical Pile length relative to that originally bid).

END OF SPECIFICATION

APPENDIX

TABLE-1A

CHANCE® Civil Construction

MECHANICAL STRENGTH RATINGS – Type SS HELICAL PILES

RATING TYPE	CENTRAL STEEL SHAFT PRODUCT FAMILY						
	SS125 1-1/4" RCS	SS1375 1-3/8" RCS	SS5 1-1/2" RCS	SS150 1-1/2" RCS	SS175 1-3/4" RCS	SS200 2" RCS	SS225 2-1/4" RCS
Torque Strength Rating (ft-lb)	4,000	5,500	5,500	7,000	11,000	16,000	23,000
Ultimate Strength Per Helix (kip) (Tension/Compression)	*30	*35	*40	*40	*50	60	60
Uplift/Compression Capacity Limit[1] (kip)	40	55	55	70	110	#150	#200
Ultimate Tension Strength[2] (kip)	60	75	70	70	100	150	200

* For 14" Dia. 3/8" Thick Helix Plates, Reduce the Ultimate Capacity by 20%

1 - Based on torque rating – Uplift/Compression Capacity Limit = Torque Rating x Kt
"Default" Kt for Type SS = 10

2 – Based on mechanical strength of coupling

- Based on mechanical strength of coupling bolt

NOTE: Actual installed capacities are dependent on site specific soil conditions.

TABLE-1B

CHANCE® Civil Construction

MECHANICAL STRENGTH RATINGS – Type RS HELICAL PILES

RATING TYPE	CENTRAL STEEL SHAFT PRODUCT FAMILY				
	RS2875.165 2-7/8" OD Pipe Shaft	RS2875.203 2-7/8" OD Pipe Shaft	RS2875.262 2-7/8" OD Pipe Shaft	RS3500.300 3-1/2" OD Pipe Shaft	RS4500.337 4-1/2" OD Pipe Shaft
Torque Strength Rating (ft-lb)	4,500	5,500	7,500	13,000	23,000
Ultimate Strength Per Helix (kip) (Tension/Compression)	*40	*40	*40	50	60
Uplift/Compression Capacity Limit[1] (kip)	36	44	60	91	138
Ultimate Tension Strength[2] (kip)	50	60	100	120	140

* For 14" Dia. 3/8" Thick Helix Plates, Reduce the Ultimate Capacity by 20%

1 - Based on torque rating – Uplift/Compression Capacity Limit = Torque Rating x Kt
"Default" Kt for Type RS2875 Series = 8, for Type RS3500.300 = 7, for Type RS4500.337 = 6

2 – Based on mechanical strength of coupling

NOTE: Actual installed capacities are dependent on site specific soil conditions.

APPENDIX

TABLE-2

GUIDANCE OF GROUND AGGRESSIVENESS CLASSIFICATION

Soil tests may be performed to measure the aggressiveness of the soil environment, especially if field observations indicate corrosion of existing structures. The most common and simplest tests are for electrical resistivity, pH, chloride, and sulfates. The designation for these tests and the critical values defining whether an aggressive soil environment exists, are as shown below. Per FHWA-RD-89-198, the ground is considered aggressive if any one of these indicators shows critical values.

Property	Test Designation	Critical Values
Resistivity	ASTM G 57 AASHTO T-288	below 2,000 ohm-cm
pH	ASTM G 51 AASHTO T-289	below 5
Sulfate	ASTM D 516M ASTM D 4327	above 200 ppm
Chloride	ASTM D 512 ASTM D 4327 AASHTO T-291	above 100 ppm
Organic Content	AASHTO T-267	1% max

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CENTRALIA, MISSOURI USA

WEST COAST TRAIL BRIDGE AND STRUCTURES RECAPITALIZATION PROJECTS: 2014-2015

PACIFIC RIM NATIONAL PARK RESERVE OF CANADA

LIST OF ACRONYMS

BMP	Best Management Practice
CDC	Conservation Data Centre
CEAA	Canadian Environmental Assessment Act (the Act)
CEAR	Canadian Environmental Assessment Registry (the Registry)
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DFO	Department of Fisheries and Oceans
EA	Environmental Assessment
EC	Environment Canada
EI	Ecological Integrity
FA	Federal Authority
FN	First Nation
HADD	Harmful Alteration, Disruption, or Destruction (of fish habitat)
PMP	Park Management Plan
PRNPR	Pacific Rim National Park Reserve
RA	Responsible Authority
SAR	Species at Risk
SARA	Species at Risk Act
The Act	The Canadian Environmental Assessment Act
The Agency	The Canadian Environmental Assessment Agency
VEC	Valued Ecosystem Component
WCT	West Coast Trail

MITIGATIONS

APPENDIX C

SUMMARY OF
ENVIRONMENTAL MITIGATIONS
2015-10

Mitigations are those measures identified as a means of eliminating, reducing or controlling adverse environmental effects resulting from project activities. The replacement of bridge structures on the WCT has environmental effects that can be avoided or minimized using proven mitigation measures. Mitigation measures that should be incorporated into a project were identified to eliminate, reduce or control potential adverse environmental effects on identified VECs. Adherence to the following mitigation measures will eliminate or significantly reduce the potential environmental effects. All work practices will adhere to the requirements set out in Federal and Provincial best management practices, operational guidelines and policy directives including the following*:

- Canada National Parks Act and Regulations (CNPA)
- Parks Canada Guidelines for the Use, Handling and Disposal of Treated Wood (2009)
- Canadian Environmental Protection Act (CEPA)
- Species at Risk Act (SARA)
- Canadian Federal Fisheries Act
- DFO Standard Mitigation Measures for Bridge Repair or Replacement (Version 1.0)
- DFO operational statements for instream works, clear span bridges, bridge maintenance

* Where the standards differ the more stringent mitigations will be applied. Parks Canada applies a "meet-or-beat" approach to applying directives and legislation.

- The contractor must make contact with the in-park project representative from Parks Canada in advance of crews arriving in the national park. The contractor must confirm the timing of the projects, when workers will be arriving, staying and departing the construction work sites and camping locations.
- Parks Canada may send an on-site monitor to confirm that mitigations are being applied and are effective.

GENERAL

- Keep the footprint of worksite disturbance as small as possible (E.g. Clear minimum area necessary. Where possible leave roots and stumps in place).
- No Additional clearing of vegetation will be permitted for campsites or cooking areas.
- Clearly mark work area with stakes, flagging tape or other means to identify areas that are off limits. Clearly flag one area where construction materials will be stored to minimize disturbance.
- As much as possible, use existing roadways, trails or disturbed areas to access and travel within the site.
- As much as possible, use existing roadways, trails or disturbed areas to access and travel within the site.

- Schedule noisy construction activities to minimize impacts to wildlife and visitors.
- On site project surveillance will be conducted to ensure that prescribed mitigation measures are implemented and achieving the expected results.
- Work crews will be briefed upon the importance of adhering to the mitigation measures at a pre-construction meeting.
- A copy of the mitigation measures will be kept at the work site.
- Pacific Rim National Park should provide pre-trip and on-site arrival information stating that construction activities will be taking place at this site.
- All equipment used on the job must be clean and free from contaminants.
- Equipment will be run at low idle or shutdown when not in active use to reduce noise levels and levels of particulate matter from exhaust emissions.
- Operate equipment carefully to avoid damaging surrounding vegetation.
- Excavated material should not be placed so it damages or buries intact vegetation.

CONSTRUCTION TIMING

- All in-stream work must be completed in adherence with Fisheries and Oceans Canada general fisheries timing window for in-stream work on Vancouver Island (conduct work between June 15th - September 15th). Additional information is available at http://www.env.gov.bc.ca/wsd/regions/vir/wateract/terms_conditions_vir.pdf

DEMOLITION

- Demolition and removal of the existing bridge structures will be undertaken in a manner that minimizes the impacts to the environment in which it is located.
- All components of the old bridge will be either salvaged for re-use as appropriate, burnt on site (see conditions for burning in Garbage and General Waste section below), or removed from the site (treated wood, chemicals, paints).

AQUATIC RESOURCES, EXCAVATION AND SEDIMENT CONTROL

- Minimize changes to the ground surface and vegetation that affect its infiltration and runoff characteristics.
- Make all responsible efforts to minimize extent and duration of work within the creek channel and bank areas.
- Assess site for erosion control requirements and implement control measures as required (e.g. tarps, straw bales, erosion blankets, silt fencing) to prevent the dispersal of sediments outside

the construction zone and to protect fish from detrimental effects of gill abrasion due to sediment-laden water.

- Periodically inspect erosion control structures for effectiveness. If not operating effectively, adjust or replace with different mitigation measure.
- Place stockpiled (covered) materials a minimum of 2 m from water bodies.
- Refuel at least 30 m from all water bodies (including wetlands).
- Restore riparian areas to preconstruction conditions to the extent possible.
- Areas requiring excavation (new bridge abutment) must be clearly marked with stakes, flagging tape or other means prior to commencement of digging.
- Where possible, halt activities on exposed soils during periods of high rainfall and runoff.
- If clearing is required on steep slopes, hand clear whenever possible.

CAST IN PLACE CONCRETE

- Raw or uncured waste concrete must not be disposed of on site.
- If pour-in-place concrete work is required, it will be completely contained so that raw concrete cannot enter fish habitat.
- Equipment such as concrete mixers, wheel barrows, shovels, trowels and other tools used for cast in place concrete work should only be cleaned in areas pre-approved by Parks Canada environmental assessment representative.
- Cleaning equipment in or directly adjacent to any watercourse or intertidal area is prohibited.
- If concrete wash water is produced during clean-up activities, it should be contained on site to allow sediment to settle out and to reach a neutral pH before being released to the environment (typically 48 hours).

TREATED WOOD

In this project, treated wood is not used in the new construction. However, treated wood is present in the existing bridges that are to be demolished and removed.

The use of treated wood on a project within a National Park will be in compliance with the national policy (See Parks Canada Guidelines for the Use, Handling and Disposal of Treated Wood, 2009). As per the Parks Canada directives on use of treated wood (Parks Canada, 2009):

- Employ construction methods and purchase materials in sizes which minimize the number of timber saw cuts needing field treatment with wood preservative.
- Treated wood sawdust has a high surface area to volume ratio and is the most direct means of introducing treated wood contaminants (typically heavy metals) into the receiving environment. Good housekeeping practices must be employed to minimize the amount and

distribution of treated wood sawdust. All treated wood sawdust should be collected in a plastic bin (e.g. Rubbermaid) or tarpaulin and disposed of off-site.

- Sawing of treated wood should be avoided in locations that may expose workers, site staff and visitors to sawdust.

APPLICATION OF PAINT

- Plastic drip tarps will be placed to ensure paint drips and spray does not contaminate the stream or surrounding stream banks.
- All transfer of paint or other sealants from storage and mixing containers into application containers or devices shall be conducted in a location that minimizes the risks of accidentally spilled product entering the receiving environment.
- Secondary containment vessels with minimum holding capacity of 120% of the paint containing vessel are an effective means of minimizing the risk of spillage.
- Cleaning of painting equipment will be conducted in a secure upland or other location which minimizes the risk of paint and solvents entering the receiving environment.
- All waste paint and paint - solvent solutions must be disposed of in accordance with applicable federal, provincial, and municipal legislation. No disposal of waste paint or solvent - paint mixtures is permitted at the project site.
- If paint will be applied by spray, equipment must be adjusted to minimize spray drift.
- Workers will carry minimum quantities of paints and solvents in the work area.
- Contractor and sub-contractor staff must be trained in spill response and reporting procedures including containment methods.
- Enough spill cleanup equipment should be available on-site to adequately handle potential spill volumes and types.

FUEL STORAGE AND FUELLING OPERATIONS

- Fuelling of equipment such as chainsaws and portable generators will be conducted in a manner which restricts the potential release of petroleum products into a watercourse, or the receiving environment.
- A spill contingency response capability including an adequate amount of absorbent material and berms to contain the volume of stored fuel will be available on site.

GARBAGE AND GENERAL WASTE

- All debris and deleterious substances generated during project activities shall be contained in the immediate work area, collected and appropriately disposed of in accordance with all

applicable legislation, guidelines, and best management practices or as prescribed in this list of mitigation measures.

- At no time shall any waste material be allowed to enter any watercourse associated with the works.
- The Contractor/Operator shall be responsible for assuring that all reasonable efforts are implemented to eliminate or minimize waste production.
- At work sites and camping locations all food wastes and discarded food items shall be stored in closed, leak-proof storage containers that prevents access by wildlife. All material which can be recycled, such as paper and cardboard products, glass bottles and plastic and metal containers will be recycled where possible. The Contractor/Operator is responsible for the proper collection, storage and transportation of garbage and recyclable waste to disposal facilities (e.g., Tofino landfill and appropriate recycling facilities).
- Open burning of waste is strictly prohibited, unless authorized by regulating bodies.
- Burning of old bridge wood components is permitted (but must be approved in advance by PCA staff), provided the wood has not been treated in the past, and following the recycling of structurally sound wood. The fire should be built in a manner that doesn't require removal of ground cover vegetation to expose mineral soil or leave a fire ring scar. This can be accomplished by building the fire in the lid of a standard sized residential, metal garbage container or similar container. Cold ash may be disposed of on site.

SANITARY WASTES

- At overnight camping locations project staff will have access to the sanitary facilities (composting privies) provided by Parks Canada.
- Plans for providing sanitary facilities for project staff at worksites occupied for a week or longer should be pre-approved by Parks Canada trail crew staff. Where possible small portable chemical toilets may be used, provided they have sufficient capacity to contain all produced wastes and are managed so as to not permit discharge of wastes to the receiving environment at the project site. Where permitted by PCA staff, the contractor may install pit privies for temporary use.

WILDLIFE

- Species at risk to be protected as per site specific environmental assessment mitigation procedures
- No foodstuffs or food wastes will be left unattended and/or accessible to wildlife.

- Food and food preparation materials must at all times, be stored in a secure location that prevents animals accessing these items. (Food and food preparation items must be stored inside bear proof bins – not in soft sided tents or tent trailers).
- Report any wildlife encounter, especially if it involves large carnivores – Bears Cougars Wolves, to the Parks Canada project contact as soon as possible.
- Report any bird nest, wildlife den site or other areas of wildlife habitation within the project footprint to the Parks Canada Contact, or Project Manager immediately.

CULTURAL RESOURCES

- On-site project staff will be required to attend the safety start up meeting and receive a briefing on cultural resources in PRNPR.
- If any black greasy, shell-bearing sediment or any culturally modified trees are encountered, development will be immediately halted and the materials subject to more detailed archaeological assessment.
- Work will stop immediately if cultural resource materials are uncovered and will only recommence upon the instruction of an archaeologist or other cultural resource expert.
- The collection or disturbance of artifacts of possible historic significance by project employees is strictly prohibited under the Canada National Parks Act and Regulations.

RESTORATION

- Disturbed surfaces outside the trail tread should be planted with native vegetation as soon as feasible to prevent soil erosion and/or establishment of weed species.

END OF APPENDIX C

ARCHAEOLOGICAL IMPACT ASSESSMENT
WEST COAST BRIDGE IMPROVEMENTS
PACIFIC RIM NPR

BILL PERRY, TERRESTRIAL ARCHAEOLOGY, HCCD
OCTOBER 2015

Archaeological Impact Assessment
West Coast Trail Bridge Improvements
Pacific Rim NPR

Bill Perry, Terrestrial Archaeology, HCCD
October 2015

Introduction

Terrestrial Archaeology received a request from Pacific Rim NPR to conduct an archaeological overview assessment of proposed plans to improve bridge facilities at three locations along the West Coast Trail. These locations included the south bank of the Cheewhat River crossing, Cullite Crossing and Bridge 92 (located just to the east) . The Cheewhat River Crossing had received previous archaeological assessment in 2014 when the north bridge abutment at Cheewhat was upgraded (Cordillera 2014-see attachment). These areas were examined for potential conflict between proposed plans and cultural resources to determine whether an archaeological impact assessment (AIA) will be required to mitigate proposed construction related impacts. The staging areas for these projects were also indicated on maps provided by project personnel. The activities proposed for these areas offered no subsurface impacts so were not included in this overview.

The project is planned to start construction by the end of March 2016. A range of construction activities that will cause subsurface disturbance were proposed and are outlined for each area below. Those activities having the potential to impact cultural resources are discussed below.

Assessment

The archaeological overview assessment conducted for this project comprises a record search and map search of available archaeological and environmental information for the project areas. In addition, these areas are assessed against previous archaeological work conducted in the area and region as well as the landform is evaluated for the potential to hold archaeological resources.

<u>Cheewhat River Bridge Repair-South tower and anchor block replacement.</u>

Plans call for:

- Replacement of the main cables
- Replacement of the main span of the bridge
- Building of a concrete wall around south crib
- excavate 600mm into river bed
- Drill new helical anchors (6 tension anchors and 4 compression anchors) at south end of main cables (well above and away from the river bed in the forest)
- Excavate and build a concrete pile cap at the new anchors.

The installation of a new reinforced concrete pier on the south shore of the river and the excavations at the anchors will involve potentially digging to a 6 foot depth. Both activities occur on previously disturbed soils as the proposed work is replacing existing structures.

Two archaeological resource sites lie in close proximity to the project, site 331T and 288T. A third site, 1096T, is an isolated find from a shipwreck located in the riverbed south of the bridge structure, Although this site is not specifically within the project are, it is important to know of its existence as additional finds may come to light. Site forms and associated maps are attached to this overview in the appendices.

Archaeological site 331T is located on both sides of the bridge. Most of the archaeological assessments conducted to date have been on the north shore of the river. The south side has archaeological deposits that have not been extensively studied. The site in general contains a shell midden, a water logged component that has potential for holding important archaeological remains, a fish trap within the Cheewhat River and ceremonial/spiritual features. The majority of these archaeological features are located on the north shore.

Archaeological site 288T is located 10m south of the bridge's south end and is comprised of a small shell midden. At the time of the last site visit in 1991, the site's dimensions were noted as 36m by 8m and located just 6m from the West Coast Trail. It is unknown whether this site if related to site 331T located on the other side of the river.

Recommendations

This archaeological overview assessment of construction activities associated with the proposed bridge improvements has determined that proximity to a known midden, 288T and an important village site, 331T- located directly across the river argues for **preconstruction testing and archaeological monitoring during construction with the cooperation and/or presence of local First Nations representatives.**

The 2014 assessment on the north abutment of this same bridge was productive in discovering intact cultural deposits relating to the midden site of 331T and a scattering of surface finds along the river bank (Cordillera 2014). **Recommendations from this assessment included consultation with the Local First Nations and Parks Canada cultural resource specialists. These recommendations are brought forward and endorsed for this overview.**

In addition, the presence of artifacts found eroding from the river banks and a known fish trap and shipwreck remains in the river bottom indicates both the presence of artifacts and the potential for additional finds exists for this area. **Project construction taking place on the river bank should be made aware of the high potential for additional finds and project activities should stay out of the river banks and river bottom as much as possible.** Further, an **accidental finds protocol** was recommended by the 2014 assessment (see appendix to this overview) which would provide guidance to onsite personnel if archaeological finds occur during the project.

Cullite Cable Car Crossing

Plans call for:

- Replace north tower platform
- Replace South tower platform
- Reduce size of North tower, build a concrete foundation (two- 350mm diameter piles) 2m deep, 1.7m north of existing wood posts (move footing closer to the rock away from river)
- Test existing anchors in tension at South and North end

Both areas are on a steep slope. The archaeological potential of these previously disturbed landforms is low.

Recommendations

As the plans for the upgrade to the east and west cable car towers are taking place in previously disturbed soils with low potential for archaeological resources, **no further work is required.**

Bridge 92 (Sandstone)

Plans call for:

- Replace wood south portion of bridge – deck and guardrails (steel main girders remain in place)
- Drill new anchors through base plates at south end
- Replace bolts in 4 splice connections along steel girder

Site 1092T is located 60m downstream in the river bottom and is comprised of a single piece of pipe from a shipwreck. This site is not expected to be impacted by proposed project construction. Its proximity, however, may indicate additional finds are possible nearby so PC managers and construction personnel are asked to be aware of this potential and to follow the attached Accidental finds protocol if this happens.

Recommendations

Plans for Bridge 92 upgrades are for replacement of above surface bridge elements only. No subsurface disturbance is anticipated. **No further archaeological concerns are warranted. If additional archaeological finds are noted in the river, project personnel are referred to the protocols outlines in the Accidental finds section of this overview report.**

Departmental Contacts regarding Archaeological Resource management:

Field Unit:

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Archaeology and History Branch
Heritage Conservation and Commemoration Directorate

Parks Canada
BrianJ.Smith@pc.gc.ca
Telephone (204) 984-2962

Figure 1. Project locations along West Coast Trail Unit, Pacific Rim National Park Reserve.

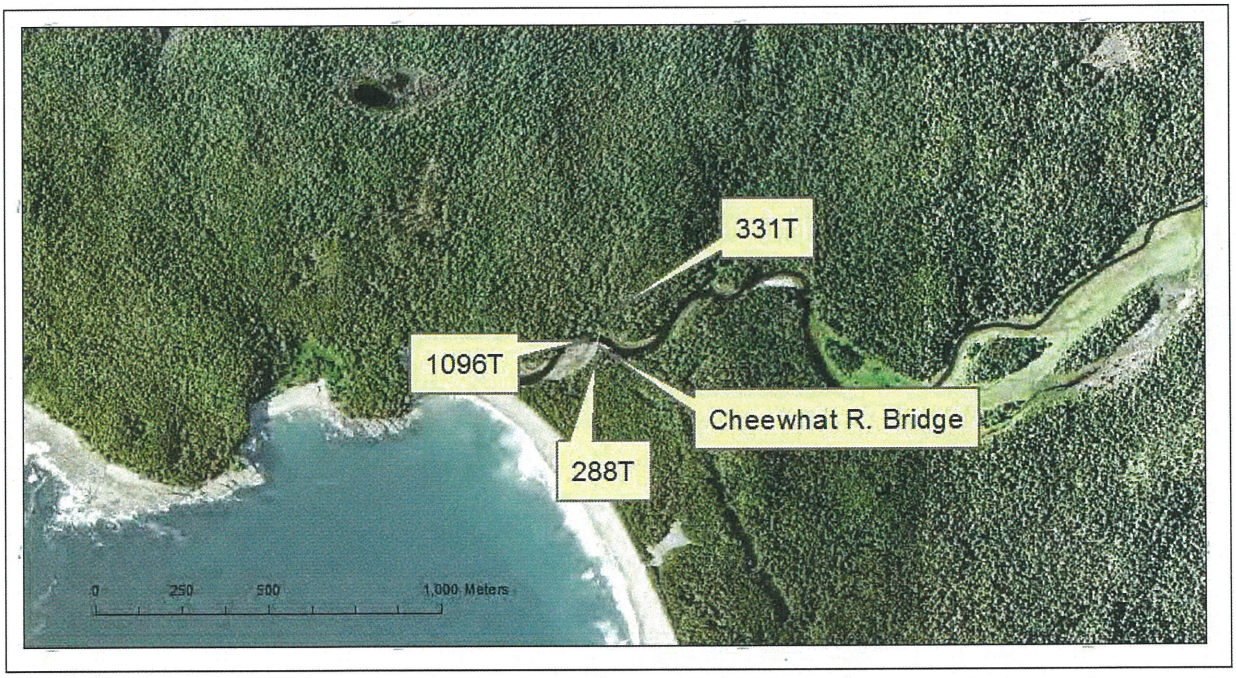


Figure 2. Location of Cheewhat River bridge and location of archeological sites.

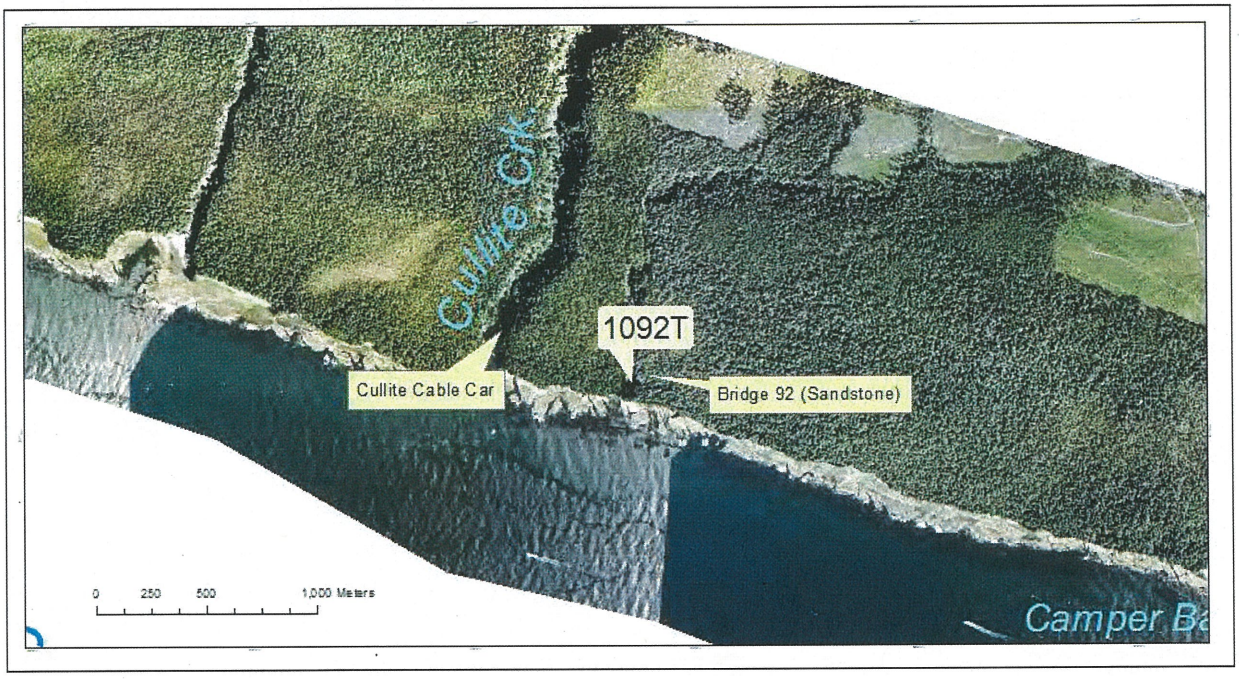


Figure 3. Location of Cullite Cable Car and Bridg 92 as well as location of archaeological site 1092T.

Accidental finds:

If artifacts or archaeological features (including historic structures or objects) are encountered by a construction contractor or Parks Canada representative, whether an archaeologist is onsite or not, construction should be **stopped**, the Pacific Rim NPR Cultural Resource Manager or Environmental Surveillance Officer or contract archaeologist (whichever is applicable) should be notified who will contact Parks Canada's Terrestrial Archaeology Section for further guidance. In order to assess the situation, documentation should include, what was seen, the location of where the material was encountered, what the surrounding soil looked like, how deep it was from the ground surface, or if it was at ground surface. If possible, a photograph should be taken and sent along with the description information to the Field Unit representative who will pass the information on to a Terrestrial Archaeologist. Preferably, artifacts should be left in place until a Parks Canada archaeologist has been consulted.

Both First Nations and historic structures and objects are included in this recommendation.

This guidance is only for the location of the archaeological find. Construction can proceed normally in other areas of the project.

Attachments

Site form for 331T

Site map for 331T

Site form for 288T

Site map for 288T

Site form for 1092T

Cordillera Assessment on north end of Cheewhat bridge

Parks Canada Parcs Canada

WESTERN AND NORTHERN SERVICE CENTRE
CULTURAL RESOURCE SERVICES

ARCHAEOLOGICAL SITE VISIT FORM

SITE NUMBER: 331T PARK_CODE: PRNPR RECORDER: Haggarty; Eldridge; Sieber; Fedje; I. Sumpter & F. Sieber; Sumpter & Knighton; Mason

NUMBER: 331 CODE: T OP_FEATURE: 0 VISIT_DATE: 06/09/1983; 00/00/1987; 04/00/1991; 09/26/1991; 09/07/1993; 08/00/1994; 06/06/1995; 09/27/01; 08/15/07; 08/30/07

BORDEN: DdSe SEQUENCE: 11

PARK: Pacific Rim National Park Reserve PERMIT: BC83-8; BC91-100; WRA93-2 VISITS: 12

NAME: chaaxwiit midden II NOTE:

SITE_TYPE: General Activity area, Material Culture, Wet Site, Fish trap, Ceremonial/Spiritual

ABO: 1

NONABO:

*Edited by Shi 11/08/13

LATITUDE: 48°39'50" MAP: 92C/10

LONGITUDE: 124°48'35" OTHER_MAP: CHS 3602, 3606,3460

EASTING: 366640 GRID: NAD83

NORTHING: 5391640 ELEVATION: 1

NAD_27: NAD_83:

EVIDENCE: 2004 observed: shell midden, intertidal fbr scatter, vertebrate fauna (2 sea mammal bones), 1 sandstone bar abrader; 2007 observed: 3 midden exposures

LOCATION: LEGAL: DL: L58 TRADITIONAL: Ditidaht

Renfrew Land District Lot 58, West Coast Trail Unit. Site is located at the mouth of the Cheewaht River, N side, both sides of the Cheewaht suspension bridge. Access by boat, on a calm day from either the Cheewaht R or the Clo-oose Bay beach. By foot along the WCT. The deposit is visible along the river bank from the N end of the bridge. Large quantities of FBR on shoreline.

LEVEL: revisited; exposed; excavated; 2001: recorded

TESTS:

DESCRIPTION: auger testing and excavation of 2 tests, detailed mapping, sample

REFERENCES: Sumpter 1992, 1994; Sumpter & Sieber 1994; Haggarty and Inglis (1985); Sumpter and Perry (1988); Eldridge (1992); Sumpter and Fedje (1996, 2001), Sumpter, Fedje and Sieber

	collection,surface inspection		(1996, 1997, in prep); Mason (2008)
PHOTOS:	25W 95Roll2M:1-17 (331T1M-11M); 25W 95Roll2W:4-21 (331T3W-17W); Mil 91:Roll 3 1-5,14-18; 2007: 331T8E-13E; none taken in 2001	AIR_PHOTO:	

GEOGRAPHY:		SHORE_ZONE:	
ENVIRO_ZONE:		NATURAL_FEATURES:	terrace: 0m; open grassland/meadow: 50m; shore: 0m; beach: 0m; spit/peninsula: 300m; ocean: 0m; lake: 900m; river: 0m; stream: 0m; marsh: 0m; inlet/bay: 300m
VEGETATION:	Salal, Vetch, Thimbleberry, Alder, Salmonberry, False Lily		

AGE:	450 yr bp to early 20th c	COMPON1:		COMPON5:	
DATE:		COMPON2:		COMPON6:	
AREA:	2625	COMPON3:		COMPON7:	
STRATIFIED:		COMPON4:		COMPON8:	

DISTURBANCE:	High stream erosion, slumping, fluvial displacement; 2007: high stream erosion, high trail use	CONDITION:	10

RECOMMENDED:

No additional mitigative measures are warranted at site 331T. Periodic monitoring of erosional zones along the site's front and rear to salvage exposed artifacts is recommended.
2001: Periodic inspections of areas vulnerable to erosion should be carried out for the purpose of mapping and/or collecting significant cultural items.

2007: Trail use along the crest of the north river embankment (7.6 m west of the bridge crossing) should be discouraged. A short, undercut section of embankment with shell midden deposits and tree roots is deteriorating and represents a public safety concern. Also, a small midden exposure at the base of the tree-fall root-ball immediately west of the bridge approach should be covered with soil. Future archaeological fieldwork should consider collecting a sample of cultural sediments from the remaining strip of shell midden for interpretation studies before the last remnant of midden deposit is lost to river erosion. Inspections of the intertidal zone fronting the site should be continued for the recovery of displaced artifacts.

SCHEDULE:	annually (1996)
THEME:	
UNIQUE:	
SIGNFICANCE:	
CRM_STATUS:	

COMMENTS:

DIAGRAM:

2007: On August 30, 2007, site 331T revisited by Golder archaeologist Andrew Mason. His observations (2008:6) included: "Three midden exposures associated with site 331T were observed in the WCT approximately 15 m from the bridge crossing the Cheewhat River (north side). A GPS signal was not available."

2007: Site revisited by Ditidaht band member Frankie Knighton and Sumpter on Aug 15, 2007. Observations included:
- once standing 2-m diam spruce on north river bank, west side of bridge approach has fallen into river (fell in 2005). As a result, shell midden (including 2 to 3 small clumps of intact charcoal rich matrix, 2 cm thick), has been pushed down onto riverfront beach surface (4 m x 1.5 m area). Shell species include California mussel, barnacle, rock scallop, and sea urchin.
Small midden exposure on embankment edge - covered with logged debris and collapsed spruce. A small patch of midden is visible in rootball, not much to worry about.
Collapsed spruce has resulted in north bridge access being moved. Minor change to trail.

2004 (I. Sumpter, A. Suski-Armstrong, S. Milliken, F. Knighton): Site 331T (DdSe-11) is a largely disturbed shell midden with a wet site component. A post-contact cultural occupation is indicated by the presence of broken bottle glass, window glass, and ceramics. The site is located on the north shore of the Cheewhat River, approximately 300 m upstream from its outlet into Clo-oose Bay. Site 331T was first recorded in 1983 (Haggarty and Inglis 1985), and later revisited in 1987 (Sumpter and Perry 1988), 1991 (Sumpter 1994; Eldridge 1992), 1993 (Sumpter and Fedje 1996), 1994 (Sumpter, Fedje, and Sieber 1996), 1995 (Sumpter, Fedje, and Sieber 1997), 2000 (Sumpter and Fedje 2001), 2001 (Sumpter, Fedje, and Sieber 2003), and 2004.

Initial site investigations in 1983 revealed a small, disturbed midden deposit (20 m long by 2 m wide) following the river shoreline at the north end of the Cheewhat River bridge crossing. Recent site inspections however have revealed that significant amounts of shell-rich sediments have since washed away by flooding and river erosion, leaving behind only a remnant of in-situ midden and isolated, thin, intact pavements of fire-cracked rock.

In 1991, Eldridge (1992) found four wooden stakes at three locations on or near a creek mouth, indicating that fishing once took place on the eastern portion of the site. A ground slate knife blank and a wooden stake with non-metal tool marks found in 1991 suggest that the procuring and processing of salmon on-site pre-dates European contact. In 1995 Ditidaht cultural specialist Fred Sieber and Parks Canada archaeologists located and mapped exposed and buried scatters and concentrations of fire-broken rock along the beachfront for a distance of 75 m, over the eastern part of the site, and in a creek bed flowing behind the site. Exploratory shovel testing uncovered intact, waterlogged, perishable items in the north bank of the rear channel. Three radiometric dates were collected and processed yielding dates ranging 240 to 480 years before present.

In 2004, an examination of trail surfaces and shoreline erosion at the bridge yielded three midden exposures:
1) A 1.9- by 0.57-m midden exposure situated on the trail, 7.6 m west of the bridge. This patch was first encountered in 2001 and represents the west margin of the midden remnant. Since, this section of trail surface and underlying cultural sediments have slumped, dropping vertically approximately 50 cm due to severe embankment undercutting by stream erosion. It appears that a ~1-m-wide by 5-m-long section of midden has likely been lost to shoreline attrition and subsequent slumping. Inspections of undercut embankment exposures (~ 1 m high, 1 m deep) west of the bridge approach show only fluvial sands. No intact shell-bearing cultural sediments were observed along this section of section of embankment;
2) A patch (0.3 by 0.1 m) occurs on the crest of the embankment, 30 cm north of the bridge approach;
3) A midden exposure measuring 60 cm tall parallels the upper section of the vertical river cut for a distance of 2.45 m. It lies adjacent to and beneath the bridge. This exposure is likely where the old bridge abutments sat. Beneath the bridge crossing is a 30 by 50 cm hole that reveals an approximately 50-cm-thick, intact section of shell midden deposit. Predominant shell species included California mussel.

It is estimated that intact midden deposits at the site are limited to a ~2-m-wide, 15-m-long strip that parallels the trail. An inspection of the narrow beach surface fronting the site encountered dense concentrations of fire-cracked rock west of the bridge approach and abundant quantities of fragmented mussel shell east of the approach. Two sea mammal bone fragments and a sandstone bar abrader were also found east of the bridge. The abrader measured 13 cm long, 5 cm wide, and 1 cm thick. All items were left in place.

Site 331T may have been associated with families from one or all three nearby village groups who exploited food resources on the Cheewat River: the chaaxwiit, 7itsiitsawada7s, or tluu7uus (Clo-oose) (Kennedy and Bouchard 1994:20, 24). Eldridge reports that Mrs. Ordway, a recent longtime Clo-oose resident, remembered Ditidaht families "living on both sides of the Cheewhat River as far upriver as the bridge" (1991 site form). Ethnographic information suggests that the stream flowing behind the site was likely used for ceremonial/spiritual purposes. Kennedy and Bouchard state that "A little stream comes into the Cheewhat River from the north side, just upstream from the bridge, and Jimmy Chester used to bathe a little ways up this tributary creek. Both [Ernie Chester] and his father bathed here as well, as part of uusibch `training for power'" (1994:23).

2001: Site 331T (DdSe-11) is a largely disturbed shell midden with a wet site component. A post-contact occupation component is represented by broken bottle glass, window glass, and ceramics. The site is located on the north shore of the Cheewhat River, approximately 300 m upstream from its outlet into Clo-oose Bay. Past site investigations have revealed that most of the shell-rich deposits has been washed away by flooding and river erosion, thus leaving behind only a remnant of in-situ midden and isolated, thin, intact pavements of fire-cracked rock. Scatters and concentrations of fire-broken rock parallel the beachfront for a distance of 75 m and also occur in the creek bed flowing behind the site.

In 2001 work focussed on examining erosional cuts along the front and rear of site area. Areas along the rear of the site, currently subject to stream erosion, were remeasured and the site map revised. No wet site materials were observed in the rear stream cuts. However, a small medicinal bottle was found here. Markings on the container revealed that it once held "Dr. S.N. Thomas Eclectric Oil", manufactured by "Northrop & Lyman Co. Limited, Toronto Ont."

An examination of trail surfaces and shoreline erosion at the front of the midden yielded three midden exposures. Two sandstone abraders were found on the beach fronting the midden erosional cuts. Abundant quantities of fire-broken rock are present on the sandy beach.

1995: Archaeological investigations were carried out at this largely disturbed midden site as part of the '95 Threatened Site Program. The one-week field study involved a detailed mapping of the site, systematic auger testing, and the excavation of two units (1x1 m, 0.5x0.5m). The shell midden portion of the site was determined to have been largely eroded away. There remains a narrow 9 m long strip at the north end of the river's bridge crossing. The midden remnant measures between 1 to 4 m wide, and has been undercut or is slumping onto the beachfront. The midden extends 20 to 45 cm below ground surface, capped by a humic, organic-rich, soil. Scatters and concentrations of fire-broken rock parallel the beachfront for a distance of 75 m, and were also observed in the creekbed at the rear of the site. At the north end of Transect Line #6 (60 m E on datum line), an intact pavement of fbr was found exposed in south bank of the rear creek channel. The fbr layer is extensive, measures 5 cm in thickness, and is capped by 50 cm of sand. It is eroding out at a fairly rapid rate, as large quantities of fbr are found along its streambed. The field assessment involved the excavation of two small units in concert with an exploratory, systematic soil augering program over the site. An 80-m long baseline was placed parallel to the beachfront and holes augered along a series of transects spaced 10 m apart perpendicular to the baseline. Intact shell midden deposits were encountered in three auger tests, Operations 331T1, 2, and 3. Shell midden exposures were also encountered in eroded areas and bank slump adjacent to the crossing's northearn approach. Two small block excavations, a 1x1m unit (331T4) and a 0.5m2 unit (331T5) were carried out adjacent to an eroding backchannel some 35 m northeast of the bridge abutment. Excavation Unit 331T4 revealed a 45-cm thick layer of fire-broken rock overlying a charcoal lens on a

buried landsurface at 105 cm dbd. A small quantity of melted and broken bottle glass were found in association wiwth the fbr layer, but no shell midden or traditionally manufactured artifacts were recovered. Test unit 331T4 was terminated at a depth of 148 cm dbd (ca 140 cm dbs). Excavation Unit 331T5 was positioned on the north bank of the rear channel for the purpose of recovering intact, water-logged, perishable items. It was excavated to a depth of approximately 1 m below ground surface, approximately 15 cm below creek level. A possible piece of culturally modified yew was collected from a depth of 69 cm dbs. During the 1995 investigations, the following samples were collected: 331T1 (auger hole #1): midden between 20 - 50 cm bs; 331T2 (auger hole #2): midden and c14 samples from 23 - 60 cm bs; 331T3 (auger hole #3): midden sample from 50 - 60 cm bs; 331T4 (1x1 m EU): soil/charcoal stain samples from Lots/layers 3 and 4, a small quantity of European manufactured refuse; 331T5 (50 cm2 test): one piece if modified yew wood. Soil profiles included:

Auger test 331T3: 0 - 50 cm bs. sand with some fill; 50 - 70 cm bs. black soil with small quantity of fbr (no shell); 70 - 100 cm bs. sand
Auger Test, Transect Line 30 m E, 10 n M: 0 - 20 cm Ah horizon; 20 - 40 cm oxidized sand; 40 - 80 cm red oxidized sand; 80 - 160 cm yellow oxidized sand; 160 - 250 cm grey oxidized sand
Auger test, Transect Line 40 m E, 10 m N: 0 - 20 cm humus/silt; 20 - 50 cm oxidized sand; 50 - 60 cm oxidized sand with fire altered rock; 60 - 110 cm oxidized sand; 110 - 130 cm ashy sand with fire altered rock; 130 - 220 cm coarse grey sand
Auger test, Transect Line 60 m E, 10 m N: 0 - 140 cm oxidized sand; 140 - 160 cm saturated grey sand

1994: This site continues to be threatened by water erosion and flooding. Insufficient time in the field did not allow for more detailed testing of midden.

1993: Site 331T is a small, disturbed shell midden deposit eroding along the north shoreline of the Cheewhat River on both sides of the Cheewhat suspension bridge. The site comprises a black organic matrix with fire broken rock, charcoal, and mostly crushed California mussel, paralleling the river bank for approximately 40 metres. A large amount of the midden has eroded and large quantities fire cracked rock can be observed along the river beach with less denser amounts noted 15 m up a creek near the site's east end. The site was first recorded in 1983 by Haggarty and Inglis (1985) and later revisited in 1991 (Sumpter 1992; Eldridge 1992). The 1991 fieldwork by Eldridge found that the site was much larger than initially recorded. Furthermore, Eldridge identified a wet site component, consisting of fish weir stakes upstream of the suspension bridge. Also, Eldridge observed a ground slate knife blank upriver of the bridge, but was not collected. Site reconnaissance in 1993 reveals that severe shoreline attrition continues at the locale, exposing shell midden deposits in the riverbank and depositing large quantities of fire-cracked rock and some sea mammal bone along the shoreline. A possible sandstone fishnet weight was noted immediately east of the bridge's north abutment.

1991 Eldridge: see site form.

1991 Sumpter: see site form.

1987: see Sumpter and Perry 1988.

1983: see site form.

Old UTM: 10UCJ - E366700, N5391420

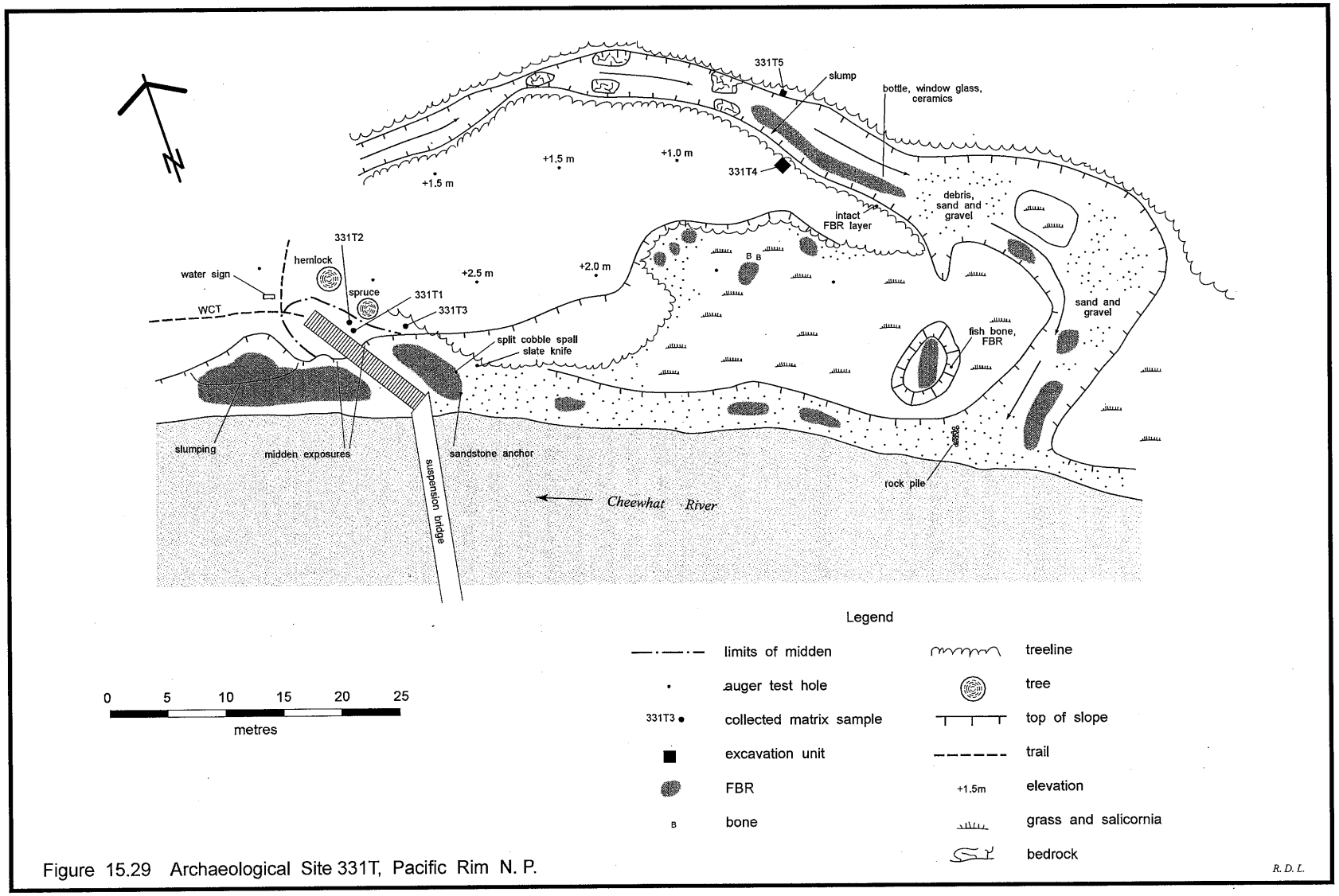


Figure 15.29 Archaeological Site 331T, Pacific Rim N. P.

R. D. L.

Parks Canada Parcs Canada

WESTERN AND NORTHERN SERVICE CENTRE
CULTURAL RESOURCE SERVICES

ARCHAEOLOGICAL SITE VISIT FORM

SITE NUMBER: 288T
PARK_CODE: PRNPR
RECORDER: Haggarty; Sumpter; Eldridge

NUMBER: 288
CODE: T
OP_FEATURE: 0
VISIT_DATE: 06/09/1983; 00/00/1987; 09/26/1991

BORDEN: DdSe
SEQUENCE: 10

PARK: Pacific Rim National Park Reserve
PERMIT: 1990-100
VISITS: 2

NAME: Cheewhat Campsite I
NOTE:

SITE_TYPE:
midden

ABO: 1
NONABO:

LATITUDE: 48°39'45"
LONGITUDE: 124°48'40"
EASTING: 366540
NORTHING: 5391530
NAD_27:

MAP: 92C/10
OTHER_MAP: CHS 3602, 3606, 3460
GRID: NAD83
ELEVATION: 2.35
NAD_83:

EVIDENCE:
observed firecracked rock; observed shell

LOCATION:
LEGAL:
TRADITIONAL: Ditidaht

West Coast Trail, mouth of the Cheewhat River, S side, 5m SW from the trail which runs parallel to the river bank; on Cheewhat IR4A.

LEVEL:
TESTS:
DESCRIPTION:
PHOTOS: PRAP 1983 at BCPM

REFERENCES:
Sumpter & Perry 88

AIR_PHOTO:

ARCHAEOLOGICAL SITE VISIT FORM

GEOGRAPHY:		SHORE_ZONE:	
ENVIRO_ZONE:		NATURAL_FEATURES:	shore:999m; ocean:5m; river:999m
VEGETATION:	Spruce, salal, Red Huckleberry, False Lily, Sword Fern, False Azaelea, Salmonberry, Hemlock, Bracken		

AGE:		COMPON1:		COMPON5:	
DATE:		COMPON2:		COMPON6:	
AREA:	288	COMPON3:		COMPON7:	
STRATIFIED:		COMPON4:		COMPON8:	

DISTURBANCE:		CONDITION:	

RECOMMENDED:

SCHEDULE:	
THEME:	
UNIQUE:	

SIGNFICANCE:

CRM_STATUS:

COMMENTS:

DIAGRAM:

1991: Size revised from 1983 dimensions of 36m NE-SW x 8m EW. Site found to continue to privy at E end of site, 6m from trail. Midden thins rapidly beside privy, but unlikely that privy caused any disturbance to deposits. At the W end of site, a few small pockets of shell were located ca. 15m SW of revised site boundary.

1987: Site 288T, recorded in 1983 (Haggarty and Inglis 1985), is a largely intact Native (aboriginal) shell midden. It is situated 5m east of the Cheewat River and 10m south of the river's bridge crossing. The midden deposit encompasses an area of approximately 288 square metres, and its cultural matrix is less that 1.0m deep (Haggarty and Inglis 1985). Positioned on fluvial sediments, the site's vegetation cover is chiefly spruce, salal, red huckleberry, fern, salmonberry, and hemlock. Whereas the midden has been subjected to historic disturbance, for example, Euro-Canadian homesteading and trails, no visible impact is evident. Situated ca. 30m north of the Cheewat River Campsite on I.R. 4A, archaeological concerns at site 288T are not warranted at this time.
It is recommended that site 288T be revisited every ten years by the Archaeological Research Services Unit to monitor potential disturbance.

1983: Elevation 2 - 2.35. Elevation from mean high tide. Historic occupation noted by informant.
A small midden in flat forested area ca. 20m SW from the WCT board walk on the S bank of the Cheewhat River. A second midden deposit (DdSe-11) was found on the opposite river bank near the Cheewat bridge base. Mrs. Ordway remembers when Nitinat families were living on both sides of the Cheewhat River as far upriver as the bridge.

Old UTM: 10UCJ - E366700, N5391300

Parks Canada Parcs Canada

WESTERN AND NORTHERN SERVICE CENTRE
CULTURAL RESOURCE SERVICES

ARCHAEOLOGICAL SITE VISIT FORM

SITE NUMBER:	1096T	PARK_CODE:	PRNPR	RECORDER:	Pickard; Sumpter; Sieber
NUMBER:	1096	CODE: T	OP_FEATURE: 0	VISIT_DATE:	07/22/1989; 04/04/1991; 06/00/1994
BORDEN:	DdSe	SEQUENCE:	33		
PARK:	Pacific Rim National Park Reserve			PERMIT:	VISITS: 3

NAME: Raita

NOTE:

SITE_TYPE:
shipwreckage

ABO:

NONABO: 1

LATITUDE:	48°39'49"	MAP:	92C/10	EVIDENCE:
LONGITUDE:	124°48'40"	OTHER_MAP:		
EASTING:	366570	GRID:	NAD83	
NORTHING:	5391640	ELEVATION:	0	
NAD_27:		NAD_83:		

LOCATION:

LEGAL:

TRADITIONAL: Ditidaht

In the mouth of the Cheewat R. below the point where the WCT crosses the river, 10 m S of suspension bridge. Access by boat at high tide or on foot on WCT.

LEVEL:	recorded; recorded; exposed	REFERENCES:	
TESTS:		Sumpter 1991; Sumpter & Sieber 1994	
DESCRIPTION:	surface examination		
PHOTOS:	none taken in 1994	AIR_PHOTO:	

Parks Canada Parcs Canada

WESTERN AND NORTHERN SERVICE CENTRE
CULTURAL RESOURCE SERVICES

ARCHAEOLOGICAL SITE VISIT FORM

GEOGRAPHY:		SHORE_ZONE:	
ENVIRO_ZONE:	semi-exposed	NATURAL_FEATURES:	terrace: 20m; flood plain: 0m; dune: 500m; open grassland/meadow: 1000m; shore: 300m; beach: 300m; spit/peninsula: 200m; ocean: 300m; river: 0m; spring: 50m; stream:0m; inlet/bay:300m; estuary:350m
VEGETATION:			

AGE:		COMPON1:		COMPON5:	
DATE:	1890	COMPON2:		COMPON6:	
AREA:	25	COMPON3:		COMPON7:	
STRATIFIED:		COMPON4:		COMPON8:	

DISTURBANCE:	water erosion: low; general decay: low; area use: low	CONDITION:	

RECOMMENDED:

no further work

SCHEDULE:	N/A
THEME:	

Parks Canada Parcs Canada

WESTERN AND NORTHERN SERVICE CENTRE
CULTURAL RESOURCE SERVICES

ARCHAEOLOGICAL SITE VISIT FORM

SITE NUMBER:	1092T	PARK_CODE:	PRNPR	RECORDER:	Pickard
NUMBER:	1092	CODE: T	OP_FEATURE:	0	VISIT_DATE: 06/06/1989
BORDEN:	DdSd	SEQUENCE:	2		
PARK:	Pacific Rim National Park Reserve			PERMIT:	WRA-89-49
VISITS:	1				

NAME:

NOTE:

SITE_TYPE:
shipwreckage

ABO:

NONABO: 1

LATITUDE:		MAP:	92C/10	EVIDENCE:	observed metal
LONGITUDE:		OTHER_MAP:			
EASTING:	382710	GRID:	NAD83		
NORTHING:	5380230	ELEVATION:	4		
NAD_27:		NAD_83:			

LOCATION:

LEGAL:

TRADITIONAL: Pacheedaht

60 m upstream from the mouth of Sandstone Ck.

LEVEL:	recorded	REFERENCES:	
TESTS:			Pickard/Fedje 89
DESCRIPTION:			
PHOTOS:		AIR_PHOTO:	

Parks Canada Parcs Canada

WESTERN AND NORTHERN SERVICE CENTRE
CULTURAL RESOURCE SERVICES

ARCHAEOLOGICAL SITE VISIT FORM

GEOGRAPHY:		SHORE_ZONE:	
ENVIRO_ZONE:		NATURAL_FEATURES:	beach:999m; ocean:60m; stream:0m
VEGETATION:			

AGE:		COMPON1:		COMPON5:	
DATE:		COMPON2:		COMPON6:	
AREA:	5	COMPON3:		COMPON7:	
STRATIFIED:		COMPON4:		COMPON8:	

DISTURBANCE:	water erosion: high	CONDITION:	

RECOMMENDED:

no further work

SCHEDULE:	N/A
THEME:	
UNIQUE:	
SIGNFICANCE:	

ARCHAEOLOGICAL SITE VISIT FORM

CRM_STATUS:

COMMENTS:

DIAGRAM:

1989: Site consists of a 4.7 m long riveted iron pipe 50 cm in diameter. Exact function is unknown. The association to a specific shipwreck is unknown.

Old UTM: 10UCJ - E382750, N5379950

Parks Canada Parcs Canada

WESTERN AND NORTHERN SERVICE CENTRE
CULTURAL RESOURCE SERVICES

ARCHAEOLOGICAL SITE VISIT FORM

UNIQUE:

SIGNFICANCE:

CRM_STATUS:

COMMENTS:

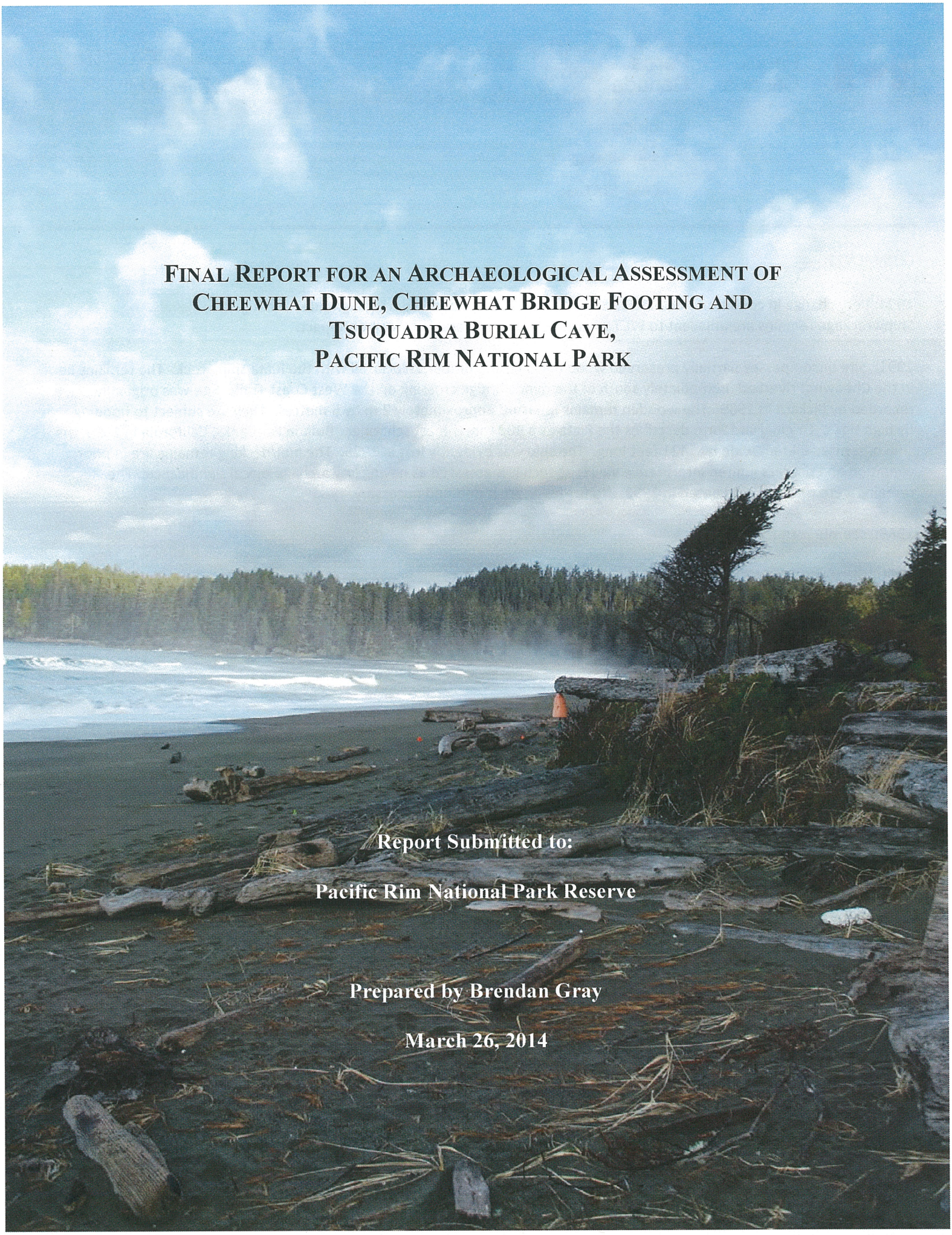
DIAGRAM:

1994: Very change in condition since 1991. Site continues to be flooded during high tides and high river levels. Shipwreckage remains are adjacent to WCT area as such are vulnerable to visit or impact.

1991: Site encompasses partially preserved wood decking/hull timber associated with the Riata shipwreck. The remains lie in the Cheewhat riverbed, immediately south of the river's bridge crossing on the West Coast Trail. Site was originally recorded by Pickard in 1989. The wooden remains measure approximately 2 m by 5 metres. They are subject to flooding by high tides. Original site form describes the Riata as a 309 ton, 3-mast schooner. Built in Fairbanks, California in 1890, the ship measured 34 feet wide by 1421 feet long. The ship was evidently lost in 1925. The hull/decking remains are in poor condition and possess limited interpretive value; as such it is assessed as having low archaeological significance. The remains were photo-documented in 1991. No further work is deemed necessary.

1989: see site form.

Old UTM: 10UCJ - E366700, N5391370



FINAL REPORT FOR AN ARCHAEOLOGICAL ASSESSMENT OF CHEEWHAT DUNE, CHEEWHAT BRIDGE FOOTING AND TSUQUADRA BURIAL CAVE, PACIFIC RIM NATIONAL PARK

Report Submitted to:

Pacific Rim National Park Reserve

Prepared by Brendan Gray

March 26, 2014

Management Summary

Cordillera Archaeology was contracted by Parks Canada to undertake archaeological assessments of three areas on the West Coast Trail, within Pacific Rim National Park.

1) A dune feature at Cheewhat (which will be stripped of vegetation) was assessed for archaeological potential, including a surface inspection and subsurface testing (25 auger tests). No archaeological materials were identified and this work is unlikely to affect archaeological resources.

2) The north footing of the Cheewhat Bridge will be reinforced. This footing is adjacent to site 331T. Visual inspection revealed two artifacts near the bridge footing and midden eroding from the bank onto the intertidal shoreline of the river beside the footing. Two auger tests and a shovel test reveal cultural lenses within the fluvial deposits; however these originated from the slumping midden in the bank and are not thought to be *in-situ*. Archaeological monitoring should be undertaken at this location during the bridge footing upgrade.

3) Inspection of the Tsuquadra Burial Cave (290T)was also undertaken, and moderate to severe impacts as a result of wave/tidal action pushing driftwood into the cave and up against the protective grill were observed.

A detailed list of recommendations on how to minimize impacts to archaeological resources is provided at the end of this report.

Cover Photo: Looking north towards Clo-oose. Cheewhat dune in the foreground to the right.

Credits

Field Crew	Terry Nookemus (Ditidaht First Nation) John Knighton (Ditidaht First Nation) Caron Olive (PACRIM National Park Reserve) Brendan Gray (Cordillera Archaeology)
Report Author	Brendan Gray (Cordillera Archaeology)
Report Editing	Duncan McLaren (Cordillera Archaeology) Caron Olive (PACRIM QA review)

Acknowledgements

Caron Olive is acknowledged for facilitating this project on behalf of the Pacific Rim National Park Reserve. She is also thanked for her help during the field portion of this project, and for helping to map auger tests on Cheewhat Dune Feature.

From the Ditidaht First Nation, John Knighton and Terry Nookemus are thanked for their work during the field component of this project.

Cheewhat Bridge Footing

Development

The footing of the Cheewhat Bridge will be reinforced by adding a new concrete section around the circumference of the existing footing. Assessment is required to determine if archaeological deposits associated with archaeological site 331T will be impacted by the proposed development.

Field Methods

Both surface and subsurface methodologies were employed for this work. At the Cheewhat Bridge, the north side of the bridge to the east and west around the footing was thoroughly inspected. Any surface archaeological features or artifacts were recorded in notes, supplemented by location data (site map sketches, GPS points), and photographs. All exposures located were examined for evidence of cultural remains (lithics, bone, etc.). Areas within the Cheewhat River intertidal zone were also inspected for wet-site archaeological remains (weir stakes, baskets, other organic materials).

Testing at this location was undertaken in order to identify any paleosols, cultural lenses or layers, features, or artifacts. Two augers tests were conducted at each end of the footing. In addition to auger testing, a single shovel test pit (STP) was excavated at the Cheewhat bridge footing, and measured approximately 40 x 40 cm. Material from each test pit and auger test was wet-screened through 3 mm mesh. All subsurface tests were mapped with GPS, recorded in field notes, with significant tests and finds being documented using photographs.

All data recorded for this project (field notes, GPS points, photographs) will be catalogued according to Parks' Canada recording standards and submitted with a final copy of the report in order to archive all of the information associated with this project.

Results

The bank at the north end of Cheewhat Bridge is a known archaeological site (331T). Previous work (see Parks Canada records for specific details) here has identified a midden component in the bank, artifacts eroding on to the intertidal river bed of Cheewhat River and a wet-site component on a slough to the NE of the bridge.

Surface inspection around the footing of the bridge for the current project revealed that intact deposits are still eroding from the bank onto the intertidal river bed. Figure 8 shows some of the intact midden within the bank, and Figure 7 shows the resulting erosion of midden onto the intertidal riverbed. Surface inspection identified two artifacts nearby the bridge footing: a sandstone abrader and an unknown ground nephrite object which may be a chisel or an awl (Figure 4, for their locations in relation to the footing, see Figure 9). Dimensions for the unknown object are approximately 8.5 x 2 x 2 cm. It is tapered at both end and widest in the middle. One end has been ground smooth (presumably the proximal

end), while other end (possibly the distal or working end) has been slightly battered or broken. The abrader is of irregular shape, and roughly 12 x 8 x 2 cm in size.

Neither of these objects were collected, but were instead placed ~5m upriver on top of the bank, so that they would not be impacted by the proposed bridge footing development.

Figure 4. Artifacts observed near the bridge footing, including a groundstone object which is possibly an awl or chisel, (left, and in-situ on the bottom), and abrader fragment (right). Neither artifact was collected.

Figure 5. Green flag and scale arrow showing the location of the groundstone awl/chisel in relation to the bridge piling. Note also logs that will have to be removed prior to footing upgrade.

Figure 6. Shovel test S1.

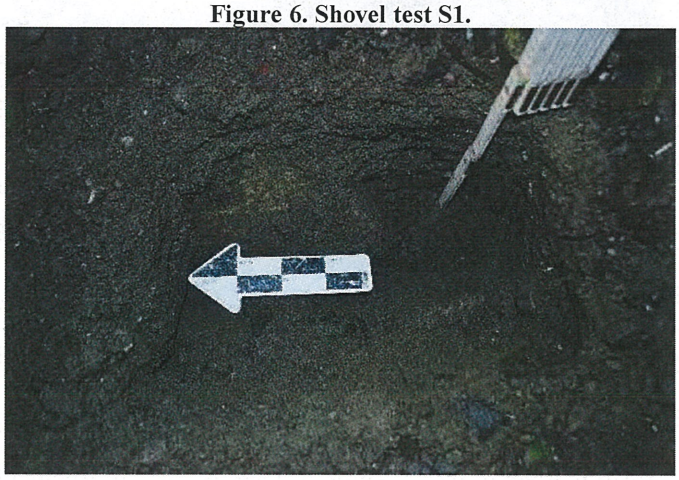


Figure 7. Eroding midden deposited on intertidal riverbed, including shell and fire altered rock. A piece of metal is also visible to the left of the scale arrow.

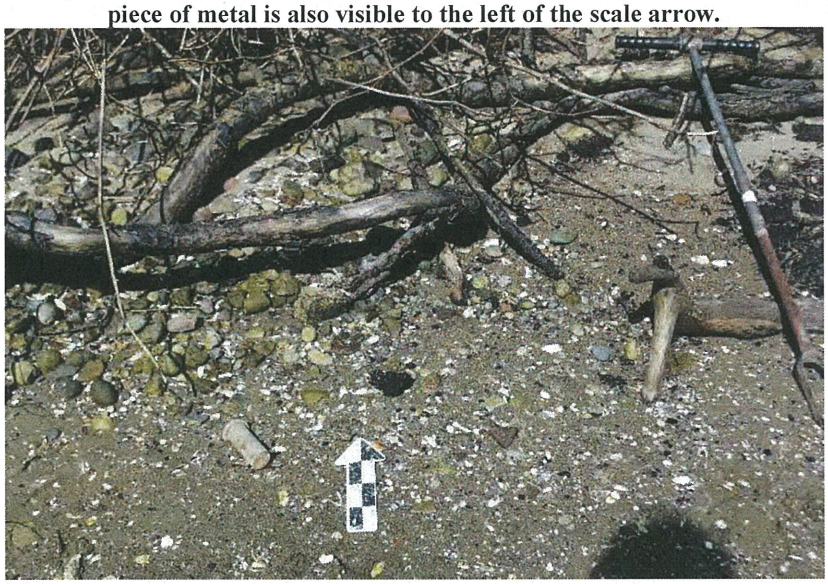
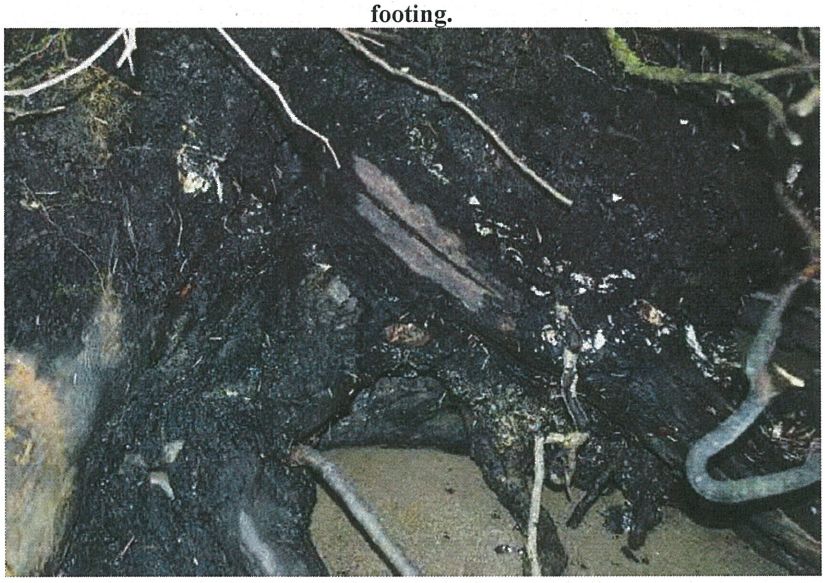
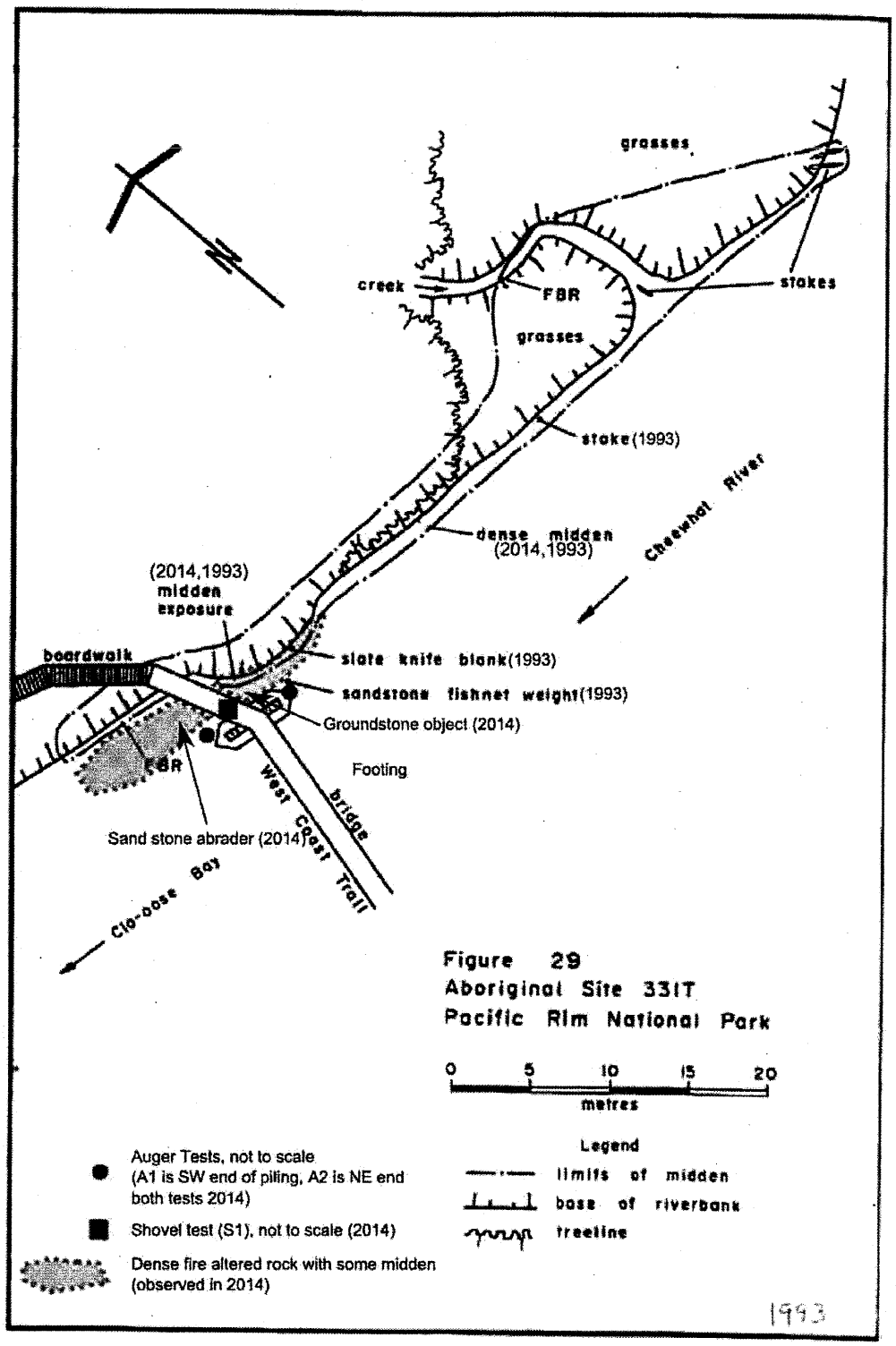


Figure 8. Midden held intact by tree root system. This exposed, in-situ midden is ~3 m from the bridge footing.



Subsurface testing at this location consisted of two auger tests and one shovel test (see Figure 9 for locations, and Figure 6 for shovel test photo). The auger test at the SW end of the footing (A1) was dug to 30 cm before bottoming out on the river cobble. The second auger test on the NE end of the footing (A2) was dug to 70 cm. The shovel test (S1) was dug to 30 cm before bottoming out on a large cobble. All tests contained fluvial river sand, with disturbed (ephemeral) lenses of cultural material which have slumped down from the bank and then been buried by fluvial/tide action. Shell midden (primarily mussel shell) and fire broken rock were observed in the screen. No artifacts were observed or collected. Figure 9 below shows the location of surface collected finds, subsurface tests and other relevant site observations.

Figure 9. Map of 331T and footing of Cheewhat Bridge. Map modified from a 1993 map of the site. Artifacts noted in 1993 were not observed on this visit.



Impact Assessment

There is ongoing impacts to this site as a result of tidal and river water movements. Areas of intact midden were observed eroding from the bank. The proposed bridge footing has the potential to impact artifacts which may erode onto the area beside the footing and then be destroyed/broken during the ongoing work. Any impact to the bank (e.g., use of a ladder to access bottom of the footing) has the potential exacerbate the erosion of intact deposits within the bank.

Evaluation of Research

At Cheewhat Bridge footing, intact archaeological deposits (part of 331T) were observed in the bank and eroded deposits observed slumped onto the intertidal area beside the footing. The work conducted at 331T for this project indicates a similar state as in previous Parks Canada assessments: minimal intact deposits remaining, and these are being heavily eroded by river/tidal action, the result being archaeological site materials strewn across the river bed and intertidal area below the bank. Artifacts uncovered include an abrader (likely for manufacturing ground bone tools, and possibly ground slate knives), and a nephrite artifact which may be a chisel or an awl.

Recommendations

- It is recommended that all impact management strategies that are adopted be done in consultation with, and with input from Ditidaht First Nation and a Parks Canada Cultural Resource Management Advisor and/or Parks Canada Archaeologist.
- All fieldworkers should be made aware of archaeological sites in the vicinity of the work area, as well as the protocols to follow should any suspected archaeological material be uncovered. These protocols include making a note (GPS point, photograph, etc.) of any suspected archaeological finds (e.g. artifacts) and moving them out of the impact area. If intact archaeological soils or features are observed, then a Ditidaht First Nation and a Parks Canada Cultural Resource Management Advisor and/or Parks Canada Archaeologist should be contacted.
- Care should be taken to avoid impacting the remaining intact deposits of 331T, i.e., the bank above the bridge footing. Any ladders/ramps/trails from the top of the bank to the river should minimize erosion and disturbance to soil.
- If disturbance of the bank is necessary for this project, archaeological mitigation of the areas to be disturbed will have to be undertaken prior to the proposed development.
- A Ditidaht member with archaeological experience should survey the intertidal area between the bank and the footing prior to the development. Material excavated to place the concrete footing should be inspected and/or screened to ensure no further artifacts have eroded from the cut bank to the midden. If a Ditidaht member with archaeological experience is not available, then an archaeologist should inspect the area and monitor the developments.

- Plywood or other protective materials should be placed on top of the work area (including access path) to minimize the impacts of foot traffic.

Appendix A. Shovel Test Pit Locations and Stratigraphy

Test Location 1

ID	Easting	Northing	Depth (cm)	Comments
1	5390957	366713	0-208	All loose grey sand. Minor gravel component.
2	5390960	366709	0-176	All loose grey sand with minor gravel component.
3	5390964	366706	0-183	All loose grey sand, glass (modern) found in bucket #5, approximately 60 cm below surface.
4	5390971	366700	0-150	All loose sand.
5	5390949	366703	0-167	All loose grey sand.
6	5390956	366699	0-164	All loose grey sand, some tiny fragments of shell in low concentration. Beach sand.
7	5390965	366694	0-165	All grey sand.
8	5390973	366691	0-143	All grey sand.
9	5390982	366686	0-151	Same as above.
10	5390993	366683	0-153	Same as above.
11	5391001	366678	0-159	Same as above.
12	5391012	366673	0-148	All grey sand, bottomed out on decomposing wood, suspected driftwood.
13	5390977	366701	0-40	All sand to bottom. Attempted 2 auger tests here, both bottomed out on driftwood.
14	5390983	366714	0-45 45-160	Organic material (duff: roots, leaves, decomposing organic material). All grey sand.
15	5390991	366725	0-90	All grey sand, then very compact sand.
16	5390971	366721	0-5 5-80	Organic material (duff) Grey sand, then very compact sand.
17	5390997	366706	0-10 10-127	Organic material (duff). All grey sand.
18	5391012	366698	0-10 10-153	Organic material (duff). All grey sand.
19	5391023	366689	0-10 10-80 80-163	Organic material (duff). All grey sand, very loose, no compaction. Compact grey sand.
20	5391015	366681	0-10 10-118	Organic material (duff). All grey sand.
21	5390991	366696	0-10 10-30	Organic material (duff). All grey sand, two attempts, bottomed out on roots.
22	5391002	366694	0-90	All grey sand.
23	5390970	366730	0-145	All grey sand.
24	5391012	366713	0-150	All grey sand.
25	5391023	366702	0-10 0-283	Organic material (duff) All grey sand.