



**Public Works and
Government Services Canada**

Requisition No. EZ897-182060/A

MERX I.D. No. _____

SPECIFICATIONS
for
Colwood FOD North Area Remediation

CFB Esquimalt, Colwood, BC

Project No. R.089682.001 November 6, 2017

APPROVED BY:

[Signature] 2017-11-21
Regional Manager ES Date

[Signature] 2017-11-17
Construction Safety Coordinator Date

TENDER:

[Signature] 17 Nov 2017
Project Manager Date

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Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 31 19 - Project Meetings.
- .3 Section 01 35 00 06 - Special Procedures for Traffic Control.
- .4 Section 01 35 43 - Environmental Procedures.
- .5 Section 01 35 29.14 - Health and Safety for Contaminated Sites
- .6 Security requirements and procedures for accessing DND property.

1.2 GENERAL INFORMATION

- .1 Public Service and Procurement Canada (PSPC), on behalf of the Department of National Defence (DND), intends to remediate Colwood Fuel Oil Depot (FOD) North Area. The location of the lands to be remediated is at the CFB Esquimalt Colwood property in Colwood, British Columbia (Drawing 1).
- .2 All work will be carried out under contract to PSPC on behalf of DND. The PSPC Departmental Representative will be responsible for approving the final extent of materials to be removed, their destination, monitoring remediation progress, and assuring quality of the work.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises remediation of the COL FOD Site. The scope of work includes rock blasting and removal, soil excavation, stockpiling and management of petroleum hydrocarbon and metals contaminated soil, transport of the soil, off-site disposal of the soil at a provincially permitted landfill, and the restoration of the site. Handling and collection of impacted surface water may be required. Restoration includes placing imported clean fill to minimize slope instability and imported clean topsoil, and hydro seeding with a native grass mix. Specifically, the Contractor will be responsible for the following:
 - .1 Meet the requirements of Section 01 33 00 - Submittal Procedures, Section 01 31 19 – Project Meetings, Section 01 35 00 06 - Special Requirements for Traffic Control, Section 01 35 43 - Environmental Procedures, and Section 01 35 29.14 - Health and Safety for Contaminated Sites.
 - .2 Develop a Site Specific Health and Safety Plan for the remedial excavation program.
 - .3 Locate all utility lines within and immediately surrounding the work area and obtain the applicable “Dig Permit” from DND. A Site Location Map (Drawing 1) shows the location of the site. The site layout including site access, approximate excavation area, stockpile management area and Contractor staging area is shown on Drawing 2. Drawings provided include soil and groundwater analytical results, borehole locations, cross sections groundwater contour plan and proposed remedial limits.

- .4 Provide washroom facilities.
- .5 Make arrangements with and obtain all applicable permits from authorities having jurisdiction for blasting and off-site disposal of the soil.
- .6 Provide documentation from the proposed disposal facility for approval by Departmental Representative demonstrating the current license or permit to accept the contaminated soil removed from the site.
- .7 Provide all equipment and manpower necessary to excavate, load, and transport to an off-site permitted disposal facility 200 tonnes of petroleum hydrocarbon contaminated soil greater than the BC Contaminated Sites Regulation (CSR) Commercial land use standards (i.e., CSR CL+) and disposal of 2,000 tonnes of hydrocarbon impacted rock . All work must be conducted in compliance with all applicable federal and provincial standards and regulations.
- .8 The Contractor is responsible for the management and treatment of all water that is contained within, or enters the excavation. All water collected from the dewatering of the excavation must meet all applicable federal and provincial standards and regulations prior to discharge.
- .9 Noise, vibration and dust control measures will be the responsibility of the Contractor to meet Departmental Representative requirements.
- .10 Provide all equipment and manpower necessary to assist the Departmental Representative in collection of confirmatory soil samples from the footprint of the soil remedial excavation as deemed necessary by the Departmental Representative.
- .11 Provide all equipment, manpower necessary to transport, place and compact backfill at the site. The upper 0.15 m of backfill will consist of topsoil in preparation for planting (planting will be completed by others). It is anticipated that 2,250 tonnes of backfill will be required, which will include 2,000 tonnes of granular fill and 250 tonnes of topsoil. The site will be compacted to specifications as stated in Section 31 23 33.01 – Excavation, Trenching and Backfilling.
- .12 Provide all equipment, manpower necessary to grade, topsoil and seed the existing access road.
- .13 Provide all equipment, manpower necessary to hydro seed the site with a native grass mix.
- .14 Remove waste materials from site at end of each work-day.
- .15 Repair and restore all roadways used to the same condition or better as they were found prior to the start of work and as accepted by the Departmental Representative.

1.4 CONTRACT METHOD

- .1 Construct Work under unit price / lump sum contract.
- .2 Employ suppliers and subcontractors accepted by the Departmental Representative for the Work.

1.5 CONTRACTOR USE OF PREMISES

- .1 Coordinate use of premises under direction of the Departmental Representative.
- .2 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .3 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative
- .4 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.6 OWNER OCCUPANCY

- .1 During the entire remediation period, the site Owner will manage adjacent areas.
- .2 Co-operate with Departmental Representative in scheduling operations to minimize conflict and to facilitate Owner usage of adjacent areas. In the event of a conflict the Contractor must accommodate changes to their operations to minimize interference with Owner operations.

1.7 EXISTING SERVICES

- .1 Locate all utility lines within and immediately surrounding the work area. Completeness and accuracy of any available utility drawings are not guaranteed and the Contractor is responsible for confirming locations of all utilities.
- .2 Notify the Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .3 Minimize duration of interruptions, and where required, provide temporary services to maintain critical systems.
- .4 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hour's notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to pedestrian and vehicular traffic.
- .5 Provide alternative routes for personnel, pedestrian and vehicular traffic and provide traffic control services (flag persons) to direct traffic (if necessary).
- .6 Establish location and extent of service lines in area of work before starting Work and obtain the applicable "Dig Permit" from DND. Notify the Departmental Representative of findings.

- .7 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to Departmental Representative accepted schedule.
- .8 Where unknown services are encountered, immediately contact the Departmental Representative and confirm findings in writing.
- .9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner accepted the Departmental Representative and authorities having jurisdiction.
- .10 Survey locations of maintained, re-routed and abandoned service lines and provide CAD drawings to the Departmental Representative.
- .11 Contaminated soil and hydrocarbon impacted rock must be disposed of at a provincially permitted facility that accepts materials as containing petroleum hydrocarbon and metals concentrations greater than the BC CSR Commercial land use standards. Prior to initiation transport and disposal, the contractor must submit the proposed disposal facility(ies) including a copy of their current license or permit for approval by Departmental Representative.

1.8 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each document as follows:
 - .1 Utility Plans
 - .2 Contract Drawings.
 - .3 Specifications.
 - .4 Addenda.
 - .5 Change Orders.
 - .6 Other Modifications to Contract.
 - .7 Field Test Reports.
 - .8 Copy of Approved Work Schedule.
 - .9 Health and Safety Plan and Other Safety Related Documents.
 - .10 Daily records of on-site (within site) movement of soil.
 - .11 Daily records of all material movement onto and off the site, including records (manifests) of waste movement and disposition, and analytical records.
 - .12 Environmental Protection Plan.
 - .13 Other documents as specified by the Departmental Representative.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

1. PART 1 - GENERAL

1.1. Measurement Procedures

1.1.1. Not used.

1.2. Definitions

1.2.1. Not Used.

1.3. Action and Informational Submittals

- 1.3.1. Preconstruction Meeting Minutes: within 2 Working Days of the Preconstruction Meeting, Submit meeting minutes.
- 1.3.2. Progress Meeting Minutes: within 2 Working Days of a Progress Meeting, Submit meeting minutes. Submit revised minutes within 2 Working Days of receiving comments by Departmental Representative.
- 1.3.3. Information for Progress Meetings: at least 2 Working Days prior to scheduled Progress Meetings, Submit all information in accordance with the Contract for Progress Meetings. Include:
 - 1.3.3.1. Agenda for the proposed Progress Meeting.
 - 1.3.3.2. Updated Project Schedule.
 - 1.3.3.3. Copies of transport manifests and disposal receipts for all materials removed from Site.
 - 1.3.3.4. Other information as directed by the Departmental Representative or relevant to agenda for upcoming progress meeting.
- 1.3.4. Final Site Inspection: within 2 Working Days of the Final Site Inspection, Submit meeting minutes.
- 1.3.5. Closeout Meetings: within 2 Working Days of the Closeout Meeting, Submit meeting minutes.

1.4. Administrative

- 1.4.1. Schedule and administer project meetings throughout the progress of the Work weekly and at the call of the Departmental Representative.
- 1.4.2. Prepare agenda for meetings.
- 1.4.3. Submit written notice with agenda of each meeting 2 Working Days in advance of meeting date as directed by the Departmental Representative.
- 1.4.4. Provide physical space and make arrangements for meetings, or arrange for teleconference meetings, as directed by Departmental Representative.
- 1.4.5. Preside at meetings.
- 1.4.6. Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- 1.4.7. Maintain records of meeting minutes for a minimum of 2 years after Work is completed.
- 1.4.8. Representative of Contractor, Subcontractor(s) and Supplier(s) attending meetings must be qualified and authorized to act on behalf of party each represents.

1.5. Preconstruction Meeting

- 1.5.1. Within 5 Working Days after award of Contract, request a meeting of parties in Contract to discuss and resolve administrative procedures and responsibilities.
- 1.5.2. Departmental Representative, Contractor, Superintendent, major Subcontractor(s), field inspectors and supervisors must be in attendance.
- 1.5.3. Establish time and location of meeting subject to approval by Departmental Representative and notify parties concerned at least 3 Working Days before meeting.
- 1.5.4. Agenda to include:
 - 1.5.4.1. Appointment of official representative of participants in the Work, including Contractor's Superintendent and Departmental Representative.
 - 1.5.4.2. Schedule of Work.
 - 1.5.4.3. Schedule of Submittals.
 - 1.5.4.4. Requirements for temporary facilities.
 - 1.5.4.5. Site security.
 - 1.5.4.6. Change orders, procedures, approvals required, administrative requirements.
 - 1.5.4.7. Monthly Progress Payments, administrative procedures, hold backs.
 - 1.5.4.8. Appointment of inspection and testing agencies or firms.
 - 1.5.4.9. List of Subcontractor(s).

1.6. Progress Meetings

- 1.6.1. During course of Work schedule progress meetings weekly subject to approval by Departmental Representative.
- 1.6.2. Contractor, Superintendent, major Subcontractor(s) involved in Work, and Departmental Representative are to be in attendance.
- 1.6.3. Agenda to include:
 - 1.6.3.1. Review and acceptance of minutes of previous meeting.
 - 1.6.3.2. Review health and safety, including incidents, near misses, and corrective measures.
 - 1.6.3.3. Review Environmental Protection, including incidents, near misses, and corrective measures.
 - 1.6.3.4. Review contractual compliance.
 - 1.6.3.5. Review regulatory compliance.
 - 1.6.3.6. Review communications, problems or concerns with community.
 - 1.6.3.7. Review of Work progress since previous meeting.
 - 1.6.3.8. Field observations, problems, conflicts.
 - 1.6.3.9. Quantity results.
 - 1.6.3.10. Updated progress schedule detailing activities planned over next 2 week period. Include review of progress with respect to previously established dates for starting and stopping various stages of Work.
 - 1.6.3.11. Problems which impede construction schedule.
 - 1.6.3.12. Corrective measures and procedures to regain projected schedule.
 - 1.6.3.13. Revision to construction schedule.
 - 1.6.3.14. Progress schedule, during succeeding Work period.
 - 1.6.3.15. Review submittal schedules: expedite as required.
 - 1.6.3.16. Maintenance of quality standards.

- 1.6.3.17. Quantities of material transported, treated, and disposed.
- 1.6.3.18. Review proposed changes for effect on construction schedule and on Final Completion date.
- 1.6.3.19. Other business.
- 1.6.4. Submit draft Progress Meeting Minutes for review and comment by Departmental Representative. Incorporate comments into final Progress Meeting Minutes.

1.7. Toolbox Meetings

- 1.7.1. During the course of the Work, schedule daily toolbox meetings at the start of each Work shift. Multiple meetings are required if the Contractor works multiple shifts within a 24-hour period.
- 1.7.2. All on Site workers to attend, including Contractor, Superintendent, major Subcontractor(s), and environmental consultants. Departmental Representative may attend.
- 1.7.3. Agenda to include:
 - 1.7.3.1. Planned Work activities and environmental considerations for that shift.
 - 1.7.3.2. Coordination activities required between Contractor, Subcontractor(s), Departmental Representative, and other contractor(s) including environmental consultant.
 - 1.7.3.3. Health and Safety items.
 - 1.7.3.4. Environmental Protection items.

1.8. Final Site Inspection

- 1.8.1. Within 5 Working Days of completion of Site Works but prior to Demobilization, request a meeting on Site to review the Site.
- 1.8.2. Departmental Representative, Contractor, Superintendent, major Subcontractor(s), field inspectors and supervisors must be in attendance.
- 1.8.3. Establish time and location of meeting subject to approval by Departmental Representative and notify parties concerned at least 3 Working Days before meeting.
- 1.8.4. Agenda to include:
 - 1.8.4.1. Inspect removal of all temporary equipment, materials, supplies, and facilities.
 - 1.8.4.2. Inspect final surface grades.
 - 1.8.4.3. Inspect final vegetation.
 - 1.8.4.4. Inspect permanent facilities for performance and damage.
 - 1.8.4.5. Document all damage, deficiencies, missing items, and non-conformance.
- 1.8.5. If required, and in the opinion of the Departmental Representative, perform another Final Site Inspection after resolving all documented damage, deficiencies, missing items, and non-conformance.

1.9. Closeout Meeting

- 1.9.1. Within 10 Working Days of completion of the Work, request a meeting to review the project.
- 1.9.2. Departmental Representative, Contractor, Superintendent, major Subcontractor(s), field inspectors and supervisors must be in attendance.

- 1.9.3. Establish time and location of meeting subject to approval by Departmental Representative and notify parties concerned at least 3 Working Days before meeting.
- 1.9.4. Agenda to include:
 - 1.9.4.1. Review Certificate of Completion.
 - 1.9.4.2. Review final payment.
 - 1.9.4.3. Identify lessons learned.
 - 1.9.4.4. Perform Contractor Performance Evaluation Report Form.

2. PART 2 - PRODUCTS

2.1. Not Used

- 2.1.1. Not Used.

3. PART 3 - EXECUTION

3.1. Not Used

- 3.1.1. Not Used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart: graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original accepted plan (for project, work package, or activity), plus or minus accepted scope changes.
- .4 Working Days: Monday through Friday (excluding statutory holidays).
- .5 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar Chart submission.
- .6 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .7 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .8 Milestone: significant event in project, usually completion of major deliverable.
- .9 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .10 Project Planning, Monitoring and Control System: overall system operated by the Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Work hours are limited to 7:00 AM to 5:00 PM Monday to Friday unless otherwise accepted by the Departmental Representative.
- .3 Plan to complete Work in accordance with prescribed milestones and time frame.
- .4 Limit activity durations (between milestones) to maximum of approximately 10 working days, to allow for progress reporting.
- .5 Carry out Work in accordance with the Contract and as follows:

- .1 Do not change Schedule accepted by the Departmental Representative without approval from Departmental Representative.
- .6 Conduct interim reviews of Work progress based on Work schedule at Progress Meetings or as instructed by the Departmental Representative and schedule updated by Contractor as instructed by the Departmental Representative.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to the Departmental Representative Section 01 33 00 - Submittals within 10 working days of Award of Contract Bar Chart as Master Plan for planning, monitoring and reporting of project progress. Bar Chart to include:
 - .1 Dates of commencement and completion of Work for each Description of Work identified on the Unit Price Table as well as date of Contract Award, utility locates and kickoff meeting.
 - .2 Dates of Submittals including Health and Safety submittal, Environmental Protection Plan submittal, all other submittals required prior to project initiation as outlined in Section 01 33 00 - Submittal Procedures and close-out submittals as outlined in Section 01 33 00 - Submittal Procedures.
 - .3 Dates of receipt of all permits, authorizations, approvals, etc. as required for the work.
 - .4 Dates of inspection and testing.
 - .5 Dates of as-built survey and final inspection.
 - .6 Final Completion date within the time period in accordance with the Contract, including Amendments.
- .3 Submit Project Schedule to the Departmental Representative within 5 working days of receipt of acceptance of Master Plan.

1.4 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart.
- .2 The Departmental Representative will review and return revised schedules within 5 working days.
- .3 Revise impractical schedule and resubmit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.5 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
 - .1 Award.
 - .2 Pre-Mobilization Submittals.

- .3 Permits.
- .4 Mobilization.
- .5 Blasting.
- .6 Excavation.
- .7 Rock Management (disposal).
- .8 Soil Management (disposal).
- .9 Collection of Imported Backfill Material Quality Review, acceptance/rejection and contingency for finding a new source.
- .10 Backfilling and Site Grading.
- .11 Restoration.

1.6 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.7 PROJECT MEETINGS

- .1 Discuss Project Schedule at weekly site meetings as specified in Section 01 31 19 [Project Meetings]. Identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current accepted dates shown on Project Schedule.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete and accepted.
- .3 Present information in SI Metric units.
- .4 Notify the Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Ensure field measurements by quantity surveyor are coordinated with on-site Work.
- .8 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .9 Keep one reviewed copy of each submission on site.

1.2 SUBMISSIONS

- .1 Submit the following reports and documentation within 10 working days after date of Notice to Proceed and prior to mobilization to site:
 - .1 Project Schedule.
 - .2 Health and Safety Plan.
 - .3 Contractor's Environmental Protection Plan.
 - .4 Identification of the facility(s) that will be used to treat and/or dispose of each of the categories of materials identified. Evidence that they are authorized and/or licensed to accept, treat and dispose of the specific category of material.

Disposal Facility requirements:

 - .1 Be an existing offsite facility located in Canada.
 - .2 Be designed, constructed and operated to prevent any pollution from being caused by the facility outside the area of the facility from waste placed in or on land within the facility.
 - .3 Hold a valid and subsisting permit, certificate, approval, or any other form of authorization issued by a province or territory for the disposal of

- soil, sediment, general refuse, construction/demolition waste or other material requiring disposal.
- .4 Comply with applicable municipal zoning, bylaws, and requirements.
- .5 If proposed Disposal Facility is not acceptable to Departmental Representative, identify an alternate Disposal Facility that is acceptable.
- .5 Excavation Design.
- .6 Blasting Operation.
- .7 Blasting Design.
- .2 Submit the following reports / documentation daily.
 - .1 Daily work summaries.
 - .2 Meeting minutes.
 - .3 Schedule updates.
 - .4 Daily overburden and contaminated soil volumes as agreed upon with the Departmental Representative and daily weigh tickets at the end of the project.
- .3 Submit the following reports / documentation within 24 hours of occurrence.
 - .1 Incident and Accident Reports.
- .4 Allow 5 days for the Departmental Representative review of each submission.
- .5 Adjustments made on submissions by the Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Departmental Representative prior to proceeding with Work.
- .6 Make changes in submissions as the Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify the Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter 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.
- .8 Submissions 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 signature of 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:
- .9 The review of drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that Departmental Representative approves detail design inherent in drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 MANIFEST

- .1 A copy of all manifests and/or truck weigh scale documents for material brought onto or removed from the site are to be provided to the Departmental Representative.
- .2 Manifest and/or weigh scale documents are to be completed in accordance with applicable federal and provincial regulations.

1.4 PHOTOGRAPHIC DOCUMENTATION

- .1 Provide digital photos in “Joint Photographic Experts Group” (.jpg) format for Progress Photographs and Final Photos.
- .2 Digital photographs to have a minimum of 2,592x1,944 pixel (5 Megapixel) resolution.
- .3 Progress and Final Photographs to be submitted on a compact disc (CD).
- .4 Quantity: Provide sufficient number of photographs to adequately describe the work activities carried out during the reporting period.
- .5 Submit progress photographs weekly with last weekly report or as directed by the Departmental Representative.
- .6 Submit final photographs prior to final progress payment request.

1.5 CERTIFICATES AND TRANSCRIPTS

- .1 Notice of Project submitted to Departmental Representative prior to mobilization.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 29.14 - Health and Safety for Contaminated Sites.

1.2 REFERENCES

- .1 Manual of Uniform Traffic Control Devices (MUTCD) published by the Transportation Association of Canada (2014).

1.3 PROTECTION OF PUBLIC TRAFFIC

- .1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out Work or haul materials or equipment.
- .2 Protect traveling public from damage to person and property.
- .3 Develop and submit a traffic control plan as part of the Health and Safety plan as stipulated in Section 01 35 29.14 - Health and Safety for Contaminated Sites.
- .4 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by the Departmental Representative. At minimum one lane must be kept open for traffic flow at all times.
- .5 When working on travelled way:
 - .1 Place equipment in position to minimize interference and hazard to travelling public.
 - .2 Keep equipment units as close together as working conditions permit and preferably on same side of travelled way.
 - .3 Do not leave equipment on travelled way overnight.
- .6 Do not close any lanes of traffic without approval of the Departmental Representative. Before re-routing traffic, erect suitable signs and signalling devices in accordance with instructions contained in Part D of MUTCD.
- .7 Keep travelled way graded, free of potholes and of sufficient width for required number of lanes of traffic.
- .8 Provide and maintain access and egress to property fronting along Rosebank Road (roads to and from site and temporary stockpile area). Work under Contract and in other areas as indicated, unless other means of road access exist that meet approval of the Departmental Representative.
- .9 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .10 Traffic routes must be maintained at all times during the completion of the project Work. The Contractor shall provide access and temporary relocated roads as necessary to maintain traffic.

- .11 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .12 Maintain access and haul roads as necessary.
- .13 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners and dangerous cross traffic shall be avoided.
- .14 Provide necessary lighting, signs, barricades and distinctive markings for safe movement of traffic.
- .15 Dust control: adequate to ensure safe operation at all times.
- .16 Locations, grade, width and alignment of construction and hauling road: subject to approval by the Departmental Representative.
- .17 Remove, upon completion of work, any access and haul roads.

1.4 INFORMATIONAL AND WARNING DEVICES

- .1 Provide and maintain signs, flashing warning lights and other devices required to indicate construction activities or other temporary and unusual conditions resulting from Project Work which requires road user response.
- .2 Supply and erect signs, delineators, barricades and miscellaneous warning devices as specified in Part D, Temporary Conditions Sign and Devices, of MUTCD.
- .3 Place signs and other devices in locations recommended in MUTCD.
- .4 Meet with the Departmental Representative prior to commencement of Work to prepare a list of signs and other devices required for the project. If the situation on-site changes, revise the list to the approval of the Departmental Representative.
- .5 Continually maintain traffic control devices in use by:
 - .1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.
 - .2 Removing or covering signs which do not apply to conditions existing from day to day.

1.5 CONTROL OF PUBLIC TRAFFIC

- .1 Provide competent flag personnel, trained in accordance with, and properly equipped as specified in MUTCD, for situations as follows:
 - .1 When public traffic is required to pass working vehicles or equipment that block all or part of travelled roadway.
 - .2 When it is necessary to institute one-way traffic system through construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
 - .3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.
 - .4 Where temporary protection is required while other traffic control devices are being erected or taken down.

- .5 For emergency protection when other traffic control devices are not readily available.
- .6 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.
- .7 Delays to public traffic due to Contractor's operators: maximum 5 minutes.
- .2 The contractor will not block the roadway or otherwise cause traffic delays on existing roadways.

1.6 OPERATIONAL REQUIREMENTS

- .1 In the event of an emergency, the Contractor shall provide immediate access along Rosebank Road.
- .2 Maintain existing conditions for traffic throughout period of contract except that, when required for construction under contract and when measures have been taken as specified and accepted by the Departmental Representative to protect and control public traffic.
- .3 Maintain existing conditions for traffic crossing right-of-way.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1. PART 1 - GENERAL

1.1. Measurement Procedures

1.1.1. See 01 11 00.

1.2. Definitions

1.2.1. See 01 11 00.

1.3. Action and Informational Submittals

- 1.3.1. Submit to Departmental Representative Submittals listed for review.
- 1.3.2. Work affected by Submittal must not proceed until review is complete.
- 1.3.3. Submit the following:
 - 1.3.3.1. Health and Safety Plan.
 - 1.3.3.2. Copies of reports or directions issued by federal and provincial health and safety inspectors.
 - 1.3.3.3. Copies of incident and accident reports.
 - 1.3.3.4. Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by the 2015 Workplace Hazardous Materials Information System (WHMIS 2015) requirements.
 - 1.3.3.5. Emergency Procedures.
 - 1.3.3.6. Notice of Project.
- 1.3.4. 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 Working Days after receipt of the plan.
- 1.3.5. If changes are required, revise the plan as appropriate and resubmit to Departmental Representative within 5 Working Days.
- 1.3.6. Submittal of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It will not:
 - 1.3.6.1. Be construed to imply approval by the Departmental Representative.
 - 1.3.6.2. Be interpreted as a warranty of being complete, accurate and legislatively compliant.
 - 1.3.6.3. Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.4. References

- 1.4.1. Government of Canada:
 - 1.4.1.1. Canada Labour Code - Part II.
 - 1.4.1.2. Canada Occupational Health and Safety Regulations.
- 1.4.2. National Building Code of Canada (NBC):
 - 1.4.2.1. Part 8, Safety Measures at Construction and Demolition Sites.
- 1.4.3. Canadian Standards Association (CSA) as amended:
 - 1.4.3.1. CSA Z797-2009 Code of Practice for Access Scaffold.
 - 1.4.3.2. CSA S269.1-1975 (R2003) Falsework for Construction Purposes.
 - 1.4.3.3. CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures.
- 1.4.4. National Fire Code of Canada 2010 (as amended):
 - 1.4.4.1. Part 5 – Hazardous Processes and Operations and Division B as applicable and required.
 - 1.4.4.2. FCC No. 302, Standard for Welding and Cutting.
- 1.4.5. American National Standards Institute (ANSI):
 - 1.4.5.1. ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- 1.4.6. Province of British Columbia (as appropriate):
 - 1.4.6.1. *Workers Compensation Act* Part 3-Occupational Health and Safety.

- 1.4.6.2. Occupational Health and Safety Regulation.
- 1.4.7. Yukon Territory (as appropriate):
 - 1.4.7.1. Occupational Health and Safety Act.
 - 1.4.7.2. *Workers' Compensation Act*.
 - 1.4.7.3. Occupational Health and Safety Regulation

1.5. Regulatory Requirements

- 1.5.1. Comply with codes, acts, bylaws, standards and regulations applicable to the performance of the Work in accordance with the Contract to ensure safe operations at Site.
- 1.5.2. In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will direct on the course of action to be followed.

1.6. Worker's Coverage

- 1.6.1. Comply fully with the relevant *Workers Compensation Act*, regulations and orders made pursuant thereto, and any amendments up to the Final Completion of the Work.
- 1.6.2. Maintain Workers coverage as required by relevant acts and regulations during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

1.7. Compliance with Regulations

- 1.7.1. PSPC may terminate the Contract without liability to PSPC where the Contractor, in the opinion of PSPC, refuses to comply with a requirement of the *Workers Compensation Act* or the Occupational Health and Safety Regulations.
- 1.7.2. 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.

1.8. Responsibility

- 1.8.1. Assume responsibility as the Prime Contractor for Work under this Contract.
 - 1.8.1.1. Be responsible for health and safety of persons onsite, safety of property onsite and for protection of persons adjacent to Site and environment to extent that they may be affected by conduct of Work.
 - 1.8.1.2. Comply with and enforce compliance by employees with safety requirements of Contract, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.9. Health and Safety Coordinator

- 1.9.1. The Health and Safety Coordinator must:
 - 1.9.1.1. Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the Site to perform Work.
 - 1.9.1.2. Be responsible for implementing, daily enforcing, and monitoring the site-specific Health and Safety Plan.
 - 1.9.1.3. Be on Site during execution of Work.

1.10. General Conditions

- 1.10.1. Provide safety barricades and lights around Site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.

1.10.2. Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the Site:

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

1.11. Project/Site Conditions

1.11.1. Work at Site will involve contact with contaminants identified in Specifications and environmental reports. Asbestos-containing materials may be present on debris in the excavation areas, as noted in the Appendices.

1.12. Work Permits

1.12.1. Obtain specialty permits related to project before start of Work.

1.13. Filing of Notice

1.13.1. The Prime Contractor must complete and submit a Notice of Project as required by Provincial or Territorial authorities.

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

1.14. Health and Safety Plan

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

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

1.14.2.1. Primary requirements:

1.14.2.1.1. Contractor's safety policy.

1.14.2.1.2. Identification of applicable compliance obligations.

1.14.2.1.3. Definition of responsibilities for project safety/organization chart for project.

1.14.2.1.4. General safety rules for project.

1.14.2.1.5. Job-specific safe work procedures.

1.14.2.1.6. Inspection policy and procedures.

1.14.2.1.7. Incident reporting and investigation policy and procedures.

1.14.2.1.8. Occupational Health and Safety Committee/Representative procedures.

1.14.2.1.9. Occupational Health and Safety meetings.

1.14.2.1.10. Occupational Health and Safety communications and record keeping procedures.

1.14.2.2. 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.

1.14.2.3. List hazardous materials to be brought onsite as required by Work.

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

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

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

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

1.14.3. 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.

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

1.14.5. Departmental Representative's review: the review of Health and Safety Plan by Public Service and Procurement Canada (PSPC) will 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.

1.15. Emergency Procedures

- 1.15.1. 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:
 - 1.15.1.1. Designated personnel from own company.
 - 1.15.1.2. Regulatory agencies applicable to Work and as per legislated regulations.
 - 1.15.1.3. Local emergency resources.
 - 1.15.1.4. Departmental Representative and site staff.
- 1.15.2. Include the following provisions in the emergency procedures:
 - 1.15.2.1. Notify workers and the first-aid attendant, of the nature and location of the emergency.
 - 1.15.2.2. Evacuate all workers safely.
 - 1.15.2.3. Check and confirm the safe evacuation of all workers.
 - 1.15.2.4. Notify the fire department or other emergency responders.
 - 1.15.2.5. Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
 - 1.15.2.6. Notify Departmental Representative and Site staff.
- 1.15.3. Provide written rescue/evacuation procedures as required for, but not limited to:
 - 1.15.3.1. Work at high angles.
 - 1.15.3.2. Work in confined spaces or where there is a risk of entrapment.
 - 1.15.3.3. Work with hazardous substances.
 - 1.15.3.4. Underground work.
 - 1.15.3.5. Work on, over, under and adjacent to water.
 - 1.15.3.6. Workplaces where there are persons who require physical assistance to be moved.
- 1.15.4. Design and mark emergency exit routes to provide quick and unimpeded exit.
- 1.15.5. Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

1.16. Hazardous Products

- 1.16.1. Comply with requirements of Workplace Hazardous Materials Information System 2015 (WHMIS 2015) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.
- 1.16.2. Where use of hazardous and toxic products cannot be avoided:
 - 1.16.2.1. Notify Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS 2015 documents as required.
 - 1.16.2.2. Provide adequate means of ventilation as required.

1.17. Unforeseen Hazards

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

1.18. Posted Documents

- 1.18.1. Post legible versions of the following documents onsite:
 - 1.18.1.1. Health and Safety Plan.
 - 1.18.1.2. Sequence of Work.
 - 1.18.1.3. Emergency procedures.

- 1.18.1.4. Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
- 1.18.1.5. Notice of Project.
- 1.18.1.6. Floor plans or Site plans.
- 1.18.1.7. Notice as to where a copy of the *Workers Compensation Act* and Regulations are available on the Site for review by employees and workers.
- 1.18.1.8. Workplace Hazardous Materials Information System 2015 (WHMIS 2015) documents.
- 1.18.1.9. Material Safety Data Sheets (MSDS).
- 1.18.1.10. List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
- 1.18.2. Post all Material Safety Data Sheets (MSDS) onsite, 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.
- 1.18.3. 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 accepted by the Departmental Representative.

1.19. Meetings

- 1.19.1. Attend health and safety preconstruction meeting and all subsequent meetings called by the Departmental Representative.
- 1.19.2. Ensure all site personnel attend a health and safety toolbox meeting at the beginning of each shift, which must include:
 - 1.19.2.1. Sign-in of all attendees.
 - 1.19.2.2. Planned Work activities and environmental considerations for that shift.
 - 1.19.2.3. Hazards associated with these Work activities, including environmental hazards (e.g. potential for hypothermia, heat exhaustion, heat stroke).
 - 1.19.2.4. Appropriate job-specific safe work procedures.
 - 1.19.2.5. Required personal protective equipment (PPE).
 - 1.19.2.6. Appropriate emergency procedures.
 - 1.19.2.7. Review recent accidents on Site, including near misses.
- 1.19.3. Retain records of all health and safety meetings onsite during Work, and retain as corporate records for a minimum of 7 years after Work is completed.

1.20. Correction of Non-Compliance

- 1.20.1. Immediately address health and safety non-compliance issues identified by the Departmental Representative.
- 1.20.2. Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.
- 1.20.3. 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.
- 1.20.4. Correct non-compliance.

1.21. Hazardous Occurrence Investigation and Reporting

- 1.21.1. Hazard includes:
 - 1.21.1.1. Any source of potential damage, harm or adverse effects on life, health, property or environment at work. It refers to any biological, chemical, ergonomic, physical, psychosocial and safety factor that is reasonably likely to cause harm or damage to humans, other organisms, or the environment in the absence of its control. Sometimes a hazard is referred

to as being the actual harm or the health effect it caused rather than the hazard. For example the disease tuberculosis might be called a hazard by some but in general the tuberculosis-causing bacteria would be considered the “hazard” or “hazardous biological agent”.

Exposure to tuberculosis would be the hazardous incident. For types of Hazards refer to Annex 3 of the Standard on Hazard Prevention Program.

1.21.2. Hazardous Occurrence includes:

1.21.2.1. An event occurring at a PSPC managed building or worksite, or through the course of an employee's work that results in, or has the potential to result in, a fatality, injury, illness, exposure to a hazardous substance or property damage or an escapement of a hazardous material. For the purpose of investigating, recording and reporting hazardous occurrences, the following are included under this term: disabling injuries, minor injuries and near-misses.

1.21.3. Hazardous Occurrence Investigation and Reporting Procedures:

1.21.3.1. Includes information regarding the person involved and the basic circumstances surrounding the hazardous occurrence.

1.21.3.2. Provides a detailed and thorough description of the hazardous occurrence and the sequence of events.

1.21.3.3. Indicates corrective measures that have been taken since the occurrence.

1.21.3.4. Requires the appointment of a qualified investigator.

1.21.3.5. Provides recommendations for additional corrective measures, if required.

1.21.4. Fatal or Serious Accidents Procedures:

1.21.4.1. Call emergency number to advise the police organization having jurisdiction to secure the scene and investigate the matter.

1.21.4.2. Advise the Departmental Representative of the fatality or serious accident within 1 hour.

1.21.4.3. No investigation will be conducted at the scene until the police service having jurisdiction has released the scene.

1.21.4.4. Unless authorized to do so, do not allow anyone to remove or in any way interfere with or disturb any wreckage, article or thing related to the incident except to the extent necessary to: save a life, prevent injury or relieve human suffering in the vicinity; maintain an essential public service; or prevent unnecessary damage to or loss of property.

1.22. Utility Clearance

1.22.1. Contractor is solely responsible for utility clearance.

1.22.2. Contractor will not rely upon Drawings or other information provided with utility locations.

1.23. Personal Protective Equipment Program

1.23.1. Submit Personal Protective Equipment (PPE) program to the Departmental Representative addressing as appropriate:

1.23.1.1. Donning and doffing procedures.

1.23.1.2. PPE selection based upon Site hazards.

1.23.1.3. PPE use and limitations of equipment.

1.23.1.4. Work mission duration, PPE maintenance and storage.

1.23.1.5. PPE decontamination and disposal.

1.23.1.6. PPE inspection procedures prior to, during, and after use.

1.23.1.7. Evaluation of effectiveness of PPE program, and limitations during temperature extremes, and other appropriate medical considerations.

1.23.1.8. Medical surveillance requirements for personnel assigned to work at Site.

1.23.1.9. Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment.

- 1.23.1.10. Site control measures employed at Site including site map, site work zones, use of 'buddy system', site communications including site security, alerting means for emergencies, standard operating procedures or safe work practices, and identification of nearest medical assistance.
- 1.23.1.11. Decontamination procedures for both personnel and equipment.
- 1.23.1.12. Emergency response requirements addressing: pre-emergency planning, personnel roles, lines of authority and communication, emergency recognition and prevention, safe distances and places of refuge, site security and control, evacuation routes and procedures, decontamination procedures not covered under decontamination section, emergency medical treatment and first aid, emergency alerting and response procedures, critique of response and follow-up, PPE and emergency equipment, site topography, layout, prevailing weather conditions, and procedures for reporting incidents to local, provincial, or federal agencies.
- 1.23.1.13. Written respiratory protection program for project activities.
- 1.23.1.14. Procedures dealing with heat and/or cold stress.
- 1.23.1.15. Spill containment program if waste material is generated, excavated, stored, or managed onsite.

1.24. Offsite Contingency and Emergency Response Plan

- 1.24.1. Prior to commencing Work involving handling of hazardous materials, develop offsite Contingency and Emergency Response Plan.
- 1.24.2. Plan must provide immediate response to serious site occurrence such as explosion, fire, or migration of significant quantities of toxic or hazardous material from Site.

1.25. Personnel Health, Safety, and Hygiene

- 1.25.1. Training: ensure personnel entering Site are trained in accordance with specified personnel training requirements. Training session must be completed by Health and Safety Officer.
- 1.25.2. Levels of Protection: establish levels of protection for each Work area based on planned activity and location of activity.
- 1.25.3. Personal Protective Equipment:
 - 1.25.3.1. Ensure all site personnel are furnished with appropriate PPE.
 - 1.25.3.2. Unless identified otherwise in site-specific health and safety plan, minimum PPE to include: industrial protective headwear, high-visibility safety apparel, and protective footwear.
 - 1.25.3.3. Ensure that safety equipment and protective clothing is kept clean and maintained.
- 1.25.4. Develop protective equipment usage procedures and ensure that procedures are strictly followed by site personnel; include following procedures as minimum:
 - 1.25.4.1. Ensure industrial protective headwear is of appropriate CSA Standard and meets other appropriate standards.
 - 1.25.4.2. Ensure high-visibility safety apparel is of appropriate CSA Standard and meets other appropriate standards.
 - 1.25.4.3. Ensure protective footwear is of appropriate CSA Standard and meets other appropriate standards.
 - 1.25.4.4. Dispose of or decontaminate PPE worn onsite at end of each workday.
 - 1.25.4.5. Decontaminate reusable PPE before reissuing.
 - 1.25.4.6. Ensure site personnel have passed respirator fit test prior to entering potentially volatile contaminated work areas, as appropriate.
 - 1.25.4.7. Ensure facial hair does not interfere with proper respirator fit.
- 1.25.5. Respiratory Protection:

- 1.25.5.1. Provide site personnel with extensive training in usage and limitations of, and qualitative fit testing for, air purifying and supplied-air respirators in accordance with specified regulations.
- 1.25.5.2. Develop, implement, and maintain respirator program.
- 1.25.5.3. Monitor, evaluate, and provide respiratory protection for site personnel.
- 1.25.5.4. Ensure levels of protection as listed have been chosen consistent with site-specific potential airborne hazards associated with major contaminants identified onsite.
- 1.25.5.5. In absence of additional air monitoring information or substance identification, retain an industrial hygiene specialist to determine minimum levels of respiratory protection required.
- 1.25.5.6. Immediately notify Departmental Representative when level of respiratory protection required increases.
- 1.25.5.7. Ensure appropriate respiratory protection during Work activities. As minimum requirement, ensure that persons entering potentially contaminated work areas are supplied with and use appropriate respiratory protection.
- 1.25.6. Heat Stress/Cold Stress: implement heat stress or cold stress monitoring program as applicable and include in site-specific Health and Safety Plan.
- 1.25.7. Personnel Hygiene and Personnel Decontamination Procedures. Provide minimum as follows:
 - 1.25.7.1. Suitable containers for storage and disposal of used disposable PPE.
 - 1.25.7.2. Potable water and suitable sanitation facility.
- 1.25.8. Emergency and First-Aid Equipment:
 - 1.25.8.1. Locate and maintain emergency and first-aid equipment in appropriate location onsite including first-aid kit to accommodate number of site personnel; portable emergency eye wash; two 9 kg ABC type dry chemical fire extinguishers.
- 1.25.9. Site Communications:
 - 1.25.9.1. Identify, supply and implement appropriate dedicated communication devices for Site and post emergency numbers near dedicated devices.
 - 1.25.9.2. Ensure personnel use of "buddy" system and develop hand signal system appropriate for site activities.
 - 1.25.9.3. Provide employee alarm system to notify employees of site emergency situations or to stop Work activities if necessary.
 - 1.25.9.4. Furnish selected personnel with 2-way radios.
 - 1.25.9.5. Safety Meetings: conduct mandatory daily safety meetings for personnel, and additionally as required by special or Work-related conditions; include refresher training for existing equipment and protocols, review ongoing safety issues and protocols, and examine new site conditions as encountered. Hold additional safety meetings on as-needed basis.

2. PART 2 - PRODUCTS

2.1. Not Used

- 2.1.1. Not Used.

3. PART 3 - EXECUTION

3.1. Not Used

- 3.1.1. Not Used.

END OF SECTION

Part 1 General

1.1 FIRE DEPARTMENT BRIEFING

- .1 The Departmental Representative will co-ordinate arrangements for contractor for briefing on Fire Safety at pre-work conference by Fire Chief, if required, before work is commenced. The Colwood Fire Department will respond to calls to the Colwood Base.

1.2 REPORTING FIRES

- .1 Know location of nearest fire alarm box and telephone, including emergency phone number.
- .2 Report immediately fire incidents to Fire Department as follows:
 - .1 Telephone 911.
 - .2 Activate nearest fire alarm box.
- .3 Person activating fire alarm box will remain at box to direct Fire Department to scene of fire.
- .4 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify location.

1.3 INTERIOR AND EXTERIOR FIRE PROTECTION AND ALARM SYSTEMS

- .1 Fire protection and alarm system will not be:
 - .1 Obstructed;
 - .2 Shut-off; and
 - .3 Left inactive at end of working day or shift without authorization from Fire Chief.
- .2 Fire hydrants, standpipes and hose systems will not be used for other than fire-fighting purposes unless authorized by Fire Chief.

1.4 FIRE EXTINGUISHERS

- .1 Supply fire extinguishers, as indicated in Section 01 35 29.14 – Health and Safety for Contaminated Sites.

1.5 BLOCKAGE OF ROADWAYS

- .1 Advise Fire Chief of work that would impede fire apparatus response. This includes violation of minimum overhead clearance, as prescribed by Fire Chief, erecting of barricades and digging of trenches.

1.6 SMOKING PRECAUTIONS

- .1 Observe smoking regulations.

1.7 RUBBISH AND WASTE MATERIALS

- .1 Keep rubbish and waste materials at minimum quantities.
- .2 Burning of rubbish is prohibited.
- .3 Removal:
 - .1 Remove rubbish from work site at end of work day or shift or as directed.
- .4 Storage:
 - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
 - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove specified.

1.8 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handling, storage and use of flammable and combustible liquids governed by current National Fire Code of Canada.

1.9 QUESTIONS AND/OR CLARIFICATION

- .1 Direct questions or clarification on Fire Safety in addition to above requirements to the Departmental Representative.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 02 81 01 - Hazardous Materials.
- .3 Section 01 35 29.14 - Health and Safety for Contaminated Sites.

1.2 REFERENCES

- .1 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.
- .2 Reference Standards:
 - .1 British Columbia Environmental Management Act and related Regulations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.14 - Health and Safety for Contaminated Sites and 01 35 43 - Environmental Procedures.
- .3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by the Departmental Representative.
- .4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .5 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .6 Include in Environmental Protection Plan:
 - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of persons responsible for training site personnel.
 - .3 Descriptions of environmental protection personnel training program.

- .4 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .5 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
- .6 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.
 - .1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
- .7 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
- .8 Spill Prevention and Emergency Response Plan / Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .9 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .10 The EPP shall meet the requirements of Section 02 81 01 - Hazardous Materials.
- .11 The EPP shall meet the requirements of Section 31 23 16.26 – Rock Removal (noise and vibration management plan, blasting plan etc.).
- .12 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site and Dust Management Plan detailing measures to control dust onsite.
- .13 A Water Management and Treatment Plan is to be included by the Contractor. Identifies methods and procedures for management and/or discharge of waters which are directly derived from construction activities and dewatering of the site and excavation.
- .14 A Soil Management Plan to address how all materials will be handled, stockpiled or disposed of during the project, including proposed truck routes (Drawing 2). The plan should address site-specific measure to be taken if visual or olfactory observations during the remediation activities indicate that the materials may be contaminated. Stockpiled materials must be underlain by a rugged, impermeable material (e.g. 20 mil polyethylene or thick, pre-fabricated liner such as a 60 mil LLPDE liner) to minimize potential tearing and perforating from vehicle traffic and to ensure that excavated material does not come into contact with the underlying soils and that any water generated from the excavated material does not infiltrate the underlying soils. Material in the stockpile management area is to be covered with an impermeable cover (i.e. 6 mil polyethylene cover) nightly, during periods of work stoppage, during periods of high intensity or sustained rainfall, during periods when the stockpiled material is not being actively handled and as directed by the Departmental Representative. It is the Contractor's responsibility to ensure that the covers are not left off and are adequately weighted down to ensure the covers are not blown off the stockpiles (e.g. with tires). Excavation activities shall take place in stages to prevent the mixing of materials.

- .15 Policies for the reduction of vehicle emissions. Machinery on site shall be in good repair. Minimizing idling time and shut off machinery when not in use. Stockpiled materials shall be placed in the designated stockpile management area (Drawing 2).
- .16 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
- .17 Procedures for addressing animals which may enter the site and methods of reducing animal attractants, which includes not feeding animals, use of animal-proof containers for garbage, and daily removal of garbage from the site.
- .18 Provide address and description of proposed approved disposal sites for the disposal of contaminated and non-contaminated materials transported from the site.
- .19 Site Restoration Plan indicating materials and methods to complete the site restoration (backfilling, grading, seeding etc.).

1.4 DRAINAGE

- .1 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.5 SITE CLEARING AND PLANT PROTECTION

- .1 Obtain authorization from the Departmental Representative prior to work near mature trees or other significant natural features.
- .2 Protect trees and plants on site and adjacent properties as indicated.
- .3 Protect trees and shrubs adjacent to properties as indicated.
- .4 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
 - .1 Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .5 Minimize stripping of topsoil and vegetation.
- .6 Two mature trees, one Fir and one Cedar may need removal. If tree removal is required, Departmental Representative will be consulted and no tree removal will occur without approval by the Departmental Representative. Mature removed trees will be retained on DND property, within 350 m of the excavation.

1.6 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- .4 Maintain a spill kit within 20 metres of the work area. The spill kit contents must be contained in a weatherproof container, clearly labelled, and will contain, at all times, a minimum of the following items:

- .1 4 pairs nitrile gloves.
 - .2 4 pairs leather gloves.
 - .3 2-10' Oil Only Socks.
 - .4 15-Polypropylene Sorbent Pads 18"X18"X3/8" (Oil only).
 - .5 2-10 Quart Cellulose Sorbent Material.
 - .6 Oil Only, Barrier Tape-Yellow "Caution Do Not Enter".
 - .7 Spill Response Card.
 - .8 List of Kit Contents.
 - .9 Spill Response Plan.
- .5 Oil drip pans will be placed under all equipment when not in use at the site and at all times under stationary equipment (i.e. light standards, heaters, generators).
 - .6 Ensure no off-site migration of deconstruction materials/soil/dust or odours occur through tracking of soil/deconstruction materials in truck tires or materials handling on-site.
 - .7 Designate one fuelling area at the site that is acceptable to the Departmental representative and do not fuel equipment outside of that area. The fuelling area shall be > 30 metres away from any drain, watercourse or other pathway that could lead to contamination of a watercourse and on an impervious surface and with appropriate containment and spill control. The fuelling area shall be designated by the Contractor in the EPP for Departmental Representative approval.

1.7 HISTORICAL/ARCHAEOLOGICAL CONTROL

- .1 The Environmental Protection Plan must include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and the Departmental Representative. If any historical, archaeological and/or cultural resources are identified then the Contractor must stop work immediately and notify the Departmental Representative. Any historical, archaeological and/or cultural resources remain property of the Crown and must not be removed from the site.

1.8 WATER TREATMENT SYSTEM DESIGN REQUIREMENTS

- .1 Water Treatment Facilities:
 - .1 Design and Operating Criteria: design water treatment plant capable of treating water generated from dewatering excavations and work areas to meet the guidelines listed below. Capable of removing oil, suspended solids, particulates, LNAPL (light non-aqueous phase liquids), and dissolved phase petroleum hydrocarbons prior to discharge.
 - .2 Discharge from the water treatment plant will be into an onsite infiltration pond lined with coarse rock capable of infiltrating the necessary volume of water, at a location and at a flow rate as designated by the Departmental Representative.
 - .3 Ensure that discharged treated water from site is in compliance with applicable guidelines listed below. Any LNAPL will be collected and drummed (205 L closed-lid drum) for offsite disposal.
 - .4 Design water treatment operations consisting of a minimum of two water storage tanks that is capable of treating liquid/solid mixtures while not causing delay to dewatering operations.

- .5 The Contractor will be responsible for ensuring that the water treatment facility, infiltration pond and any piping are kept from freezing or damage and can operate on 24-hour basis if necessary.
- .2 Piping: suitable material type, of sufficient diameter, length and structural thickness for purpose intended.
- .3 Installation:
 - .1 Provide labour, materials, and equipment and do work required for setup and construction of water treatment plant.
 - .2 Following installation of system, implement initial operation test, in accordance with procedures developed by Contractor and submitted to Departmental Representative for review.
 - .3 Install piping in accordance with manufacturer's instructions and test for leakage prior to commencing dewatering, treating and filtering operations.
- .4 Initial Testing: analytical results of treated water will initially be compared to the following standards by Departmental Representative as follows, prior to discharge:
 - .1 Federal Interim Groundwater Quality Guidelines (Tier 2) for hydrocarbons;
 - .2 Canadian Council of Ministers of the Environment Aquatic Life Freshwater for hydrocarbons; and
 - .3 Total Suspended Solids are less than 100 mg/L.
- .5 Operation:
 - .1 On basis of analytical results obtained by Departmental Representative, make system modifications required for treated water to satisfy discharge criteria, or continue with normal dewatering operations as directed by Departmental Representative.
 - .2 Operate water treatment plant by experienced, qualified personnel in accordance with manufacturer's instructions and procedures submitted by Contractor and accepted by Departmental Representative.
 - .3 Operation of the system must continue in inclement weather and be kept from freezing.
- .6 Decommissioning/Dismantling:
 - .1 Decontaminate and remove salvageable components of water treatment plant including water filtering system, pumps, piping, and electrical equipment.
 - .2 Dispose of non-salvageable equipment and materials at accepted offsite disposal facility as directed by Departmental Representative. Decontaminate salvageable equipment within facility area as required prior to removal from site.

1.9 WASTEWATER STORAGE TANKS

- .1 Provide, operate, and maintain a minimum of two wastewater storage tanks to store wastewaters. These must be kept from freezing or being damaged.
- .2 Wastewater includes water, without the presence of LNAPL, collected from excavation dewatering operations and water collected from Equipment Decontamination Facility.

- .3 Discharges: comply with applicable discharge limitations and requirements; do not discharge wastewaters to site sewer systems that do not conform to or are in violation of such limitations or requirements; and obtain Departmental Representative's approval prior to discharge of wastewater.
- .4 Provide pumps and piping to convey collected wastewaters to designated wastewater storage tanks and treatment systems such that treated water quality can be analyzed and treated water quality accepted by Departmental Representative prior to discharge. All pumps and piping must be kept from freezing or being damaged.
- .5 Install wastewater storage tanks in locations as directed by Departmental Representative.
- .6 Connect pumps, piping, valves, miscellaneous items, and necessary utilities as required for operation of facilities; and protect tanks, valves, pumps, piping, and miscellaneous items from freezing or being damaged.
- .7 Do not operate wastewater storage tanks until inspected and accepted by Departmental Representative.
- .8 Once the initial treated water results indicate that the treated water meets applicable standards/guidelines as outlined above, treated water may be discharged. Follow-up sampling to confirm treated water quality will be required at the discretion of the Departmental Representative. The Departmental Representative will conduct water quality testing prior to discharge to ensure compliance with applicable regulations. The Contractor should provide contingency for up to 7 working days minimum water storage capacity to allow for testing, laboratory analysis, and communication of results.
- .9 Do not discharge additional liquids to the filled treated water tank following sampling by Departmental Representative.
- .10 Departmental Representative will determine appropriate disposition of wastewaters based on sample analysis.

1.10 DRUMS

- .1 Storage of LNAPL: 200 L steel drums meeting Transportation and Dangerous Goods Act, closable lids, complete with labels for marking contents and date filled.

1.11 NOTIFICATION

- .1 The Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform the Departmental Representative of proposed corrective action and take such action for approval by the Departmental Representative.
 - .1 Take action only after receipt of written approval by the Departmental Representative.
- .3 The Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
- .2 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.4 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location of site facilities (including washroom facilities), including avenues of ingress / egress.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.5 HOISTING

- .1 Provide, operate and maintain cranes required for moving of material and equipment.
- .2 Cranes to be operated by qualified operator.

1.6 CONSTRUCTION PARKING

- .1 Parking will be permitted on site provided it does not disrupt performance of Work. The designated Contractor parking/staging area is shown on Drawing 2.
- .2 Provide and maintain adequate access to project site.

1.7 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.8 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.9 CONSTRUCTION SIGNAGE

- .1 Provide and erect project sign during mobilization, in a location designated by the Departmental Representative.
- .2 Indicate on sign, name and contact information of Contractor.
- .3 No other signs or advertisements, other than warning signs, are permitted on site.
- .4 Signs and notices for safety and instruction to be posted as deemed necessary by the Departmental Representative.
- .5 Maintain approved signs and notices in good condition for duration of project, and dispose of off-site on completion of project or earlier if directed by the Departmental Representative.

1.10 OFFICES

- .1 Provide office lighted and ventilated, of sufficient size to accommodate site meetings and furnished with drawings laydown table.
- .2 Provide office space lighted, ventilated and with 110V power made available for the Departmental Representative to use as a work space, including at minimum a table and chair for the Departmental Representative's use.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices to Departmental Representative for approval.
- .4 Clean as outlined in Section 01 74 11 - Cleaning.
- .5 Maintain at site office one record copy of:
 - .1 General Conditions
 - .2 All Permits, Authorizations and Approvals for the proposed works.
 - .3 Utility Plans.
 - .4 Contract Drawings.
 - .5 Specifications.
 - .6 Addenda.
 - .7 Change Orders and other modifications to Contract.
 - .8 Reviewed shop drawings, product data, and samples.
 - .9 List of Outstanding Shop Drawings.
 - .10 One set of record drawings and Specifications for "as-built" purposes.
 - .11 Field and Laboratory Test Reports.
 - .12 Copy of Accepted Project Schedule.

- .13 Health and Safety Plan and Other Safety Related Documents including daily toolbox or tailgate meetings.
- .14 Daily work records to be completed by end of each shift which include:
 - .1 Quantities for each Description of Work identified in the Unit Price Table and Change Orders.
 - .2 Description of Work performed.
 - .3 Current Site conditions.
 - .4 General information including: date, time shift started and ended, Subcontractor(s) onsite, Health and Safety items, and Environmental Protection items.
 - .5 Records of on-site (within site) movement of soil.
 - .6 Records of all material movement onto and off the site, including records (manifests) of waste movement and disposition, and analytical records as need be.
 - .7 Records of discharged water (i.e. effluent) flow volumes.
 - .8 Signature of Superintendent and Departmental Representative.
- .15 Worksafe BC notice of project, also to be provided to Departmental Representative prior to mobilization to the site.
- .16 Environmental Protection Plan.
- .17 Reviewed and accepted submittals.
- .18 Manufacturers' installation and application instructions (as appropriate).
- .19 National Building Code of Canada (as appropriate).
- .20 Current construction standards of workmanship listed in technical Sections (as appropriate).
- .21 Final Meeting Minutes, Agendas and associated Attachments.
- .22 Other document as specified by the Departmental Representative.
- .6 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage. Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .7 Maintain record documents in clean, dry and legible condition in site office. Do not use record documents for construction purposes.
- .8 Keep record documents and samples available for inspection the Departmental Representative.

1.11 First Aid

- .1 Provide marked and fully stocked first aid case in a readily available location.

1.12 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain lockable storage for tools, equipment and materials.
- .2 Locate materials not required on site in manner to cause least interference with work activities.

- .3 Storage of any equipment, tools and materials at the site is at the discretion of the Contractor; Departmental Representative will not be responsible for damaged, vandalized or stolen items.

1.13 SANITARY FACILITIES

- .1 Provide and maintain sanitary facilities for work force in accordance with governing regulations and ordinances. Contractor is responsible for regular, scheduled removal and disposal of sanitary waste.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.14 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 43 - Environmental Procedures.

1.2 PROJECT CLEANLINESS

- .1 All equipment must arrive on-site in a clean condition, free of loose dirt and contaminants.
- .2 Provide and operate any cleaning equipment necessary to minimize tracking of soil, deconstruction materials and/or contaminants off of the site and along haul routes.
- .3 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by sub-contractors.
- .4 Remove waste materials from site (other than impacts soil or deconstructed materials) at daily regularly scheduled times or dispose of as directed by the Departmental Representative. Do not burn waste materials on site.
- .5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .6 Provide on-site containers for collection of waste materials and debris.
- .7 Provide and use marked separate bins for recycling.
- .8 Ensure off-site roadways are maintained in a clean condition so that off-site tracking of soil / deconstruction materials from the site is not evident. Complete daily street sweeping during periods of soil transport (off-site disposal or import of backfill) or as directed by the Departmental Representative.
- .9 Meet the requirements of Section 01 35 42 - Environmental Procedures.

1.3 FINAL CLEANING

- .1 Remove waste products and debris from the site on a weekly basis (with the exception of deconstruction materials and excavated materials).
- .2 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .3 Remove waste products and debris including that caused by sub-contractors.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Sweep and wash clean paved areas.
- .6 Clean all equipment prior to leaving the site to remove soil, deconstruction materials, and contaminants.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling when possible.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

1) General

1. RELATED SECTIONS

1. Section 01 33 00 - Submittal Procedures.
2. Section 01 35 00.06 - Special Procedures for Traffic Control.
3. Section 31 00 00.01 – Earthwork – Short Form
4. Section 31 23 16.26 – Rock Removal.
5. Section 31 23 33.01 – Excavating, Trenching and Backfilling.

2. SUMMARY

1. Work Includes.
 1. Provision and installation of materials and equipment necessary to complete site preparation activities, remediation and physical restoration.
 2. Completion of all activities in conjunction with and under the supervision of Environmental Monitors and the Departmental Representative.
 3. Identification of subsurface utilities, disconnection of utilities and temporary supply of utilities as required, and, reinstatement of all utilities and infrastructure following excavation.
 4. Implementation of safety work zones, site Health and Safety Plans and Emergency Response Plans, and Environmental Protection Plan.
 5. Construction of water control and recovery structures.
 6. Monitoring ground water quality to ensure that work has no negative impact.
 7. Excavation and stockpiling of contaminated and uncontaminated soil at the soil stockpile area for characterization (Drawing 2).
 8. Co-ordination and supervision of excavation of contaminated soil, including stockpiling for characterization.
 9. Allowing and assisting the Departmental Representative to collect soil samples from the excavations for characterization purposes to confirm that sufficient remediation has taken place.
 10. Stockpiling of materials in approximately 50 m³ piles, or pile sizes as directed by the Departmental Representative, in the designated area, and loading soil from stockpiles into trucks for off-site disposal.
 11. Preparation of site and temporary stockpile location, including surfacing of access and haul roads if required.
 12. Maintaining erosion and sediment control at the site, including covering stockpiles, and appropriately managing any excavation water.
 13. Traffic control where required to maintain a safe work or traffic area for DND staff and visitors.
 14. Management of contaminated waters generated during remediation work (soil and rock), including separation, recovery and elimination of free-phase hydrocarbons, light non-aqueous phase liquids (LNAPL).

15. Loading of, transportation to, and disposal of contaminated soil and hydrocarbon impacted rock at licensed and authorized off site treatment or disposal facilities for final disposal.
 16. Dismantling facilities following acceptance of final report by Departmental Representative.
 17. Backfilling of excavations and covering fill with layer of topsoil.
 18. Hydro seeding the excavation area with a native grass mix following backfilling.
 19. Grading, adding topsoil and hydro seeding the existing access road at the end of the project.
2. Unit Prices.
 1. Provide costs for soil remediation in the Unit Price Table form provided.

3. REFERENCES (Latest Edition)

1. British Columbia Contaminated Sites Regulation and Hazardous Waste Regulation.
2. CCME (Canadian Council of Ministers of the Environment) Contaminated Sites, Contaminated Soil and Groundwater, and Remediation of Contaminated Sites most current publications.

4. SUBMITTALS

1. Provide evidence of sufficient insurance to conduct the works described per contract.
2. Identify subcontractors and provide evidence of appropriate licensing if they are involved with transport of contaminated soils or Hazardous Waste.
3. Identify the facility(s) that will be used to treat and/or dispose of each of the categories of materials identified. Provide evidence that they are authorized and/or licensed to accept, treat and dispose of the specific category of material. Work will NOT proceed until the Departmental Representative is satisfied the receiving facilities are appropriately qualified and afford PSPC suitable liability protection.

5. DELIVERY, STORAGE, AND HANDLING

1. Stockpiles will be classified within 5 working days (upon receipt at the laboratory) for non-hazardous waste material. If additional testing is required to determine whether the material would be classified as Hazardous Waste then an additional 4 working days will be required. Once classified the soil can be loaded into trucks for transport to the disposal facility, or, if they are classified as non-contaminated, they will be used for backfilling (providing they are geotechnically suitable). If not suitable for geotechnical use on site, the stockpile location will be designated by the Departmental Representative.
2. The limits of excavation will be marked by the Contractors Surveyor as a starting point for the Contractor.
3. In the stockpile staging area the Contractor must:
 1. Install an impermeable liner (e.g. 20 mil polyethylene or 60 mil LLDPE) below the proposed stockpile area to prevent contact with underlying soil.
 2. Provide impermeable tarps (i.e. 6 mil polyethylene cover) capable of covering stockpiled material until Departmental Representative advises the contractor on handling procedure. The tarps must remain in place at all times and it will be the Contractors responsibility to ensure they are not left off or blown off the stockpiles.

4. Store non-contaminated soil excavated only on non-contaminated site surface areas. Ensure no contact between non-contaminated excavated soil and drainage or contaminated water or contaminated soil.

6. NEW MATERIALS AND EQUIPMENT

1. Ship, store and preserve in original packaging with manufacturer's seal and label remain intact.
2. Ensure materials and equipment are not damaged, altered or soiled during shipment, handling and storage.
3. Transport rejected equipment and materials from work site immediately.
4. Store materials and equipment according to manufacturer's and supplier's instructions.
5. Establish quality management system for materials and equipment.

7. PROJECT/SITE CONDITIONS

1. Existing Conditions.
 1. Review the excavation area on Drawings, Photographs and Appendices.

8. SEQUENCING

1. Obtain a non-contaminated source of fill prior to starting excavation. Adequate characterization of all materials must be completed and reported to the Departmental Representative prior to transport and placement at the site. Any non-compliant material will be excavated, loaded and transported off-site at the Contractor's cost.
2. All other work should be sequenced in consultation with the Departmental Representative.

9. EQUIPMENT

1. Trucks.
 1. Cleaned meticulously between loads of contaminated soil and clean fill.
 2. Cleaned meticulously at end of Work.
 3. Cover truck bodies with tarpaulins during transportation.
 4. Use watertight truck bodies for transporting contaminated soil.

10. PROTECTION

1. General Site Protection.
 1. Keep excavation sites water free throughout work and manage recovered water according to contamination levels.
 2. Protect excavation from rainwater.
 3. Provide temporary structures to divert flow of surface waters for excavation.

11. SOIL TRANSPORT

1. All soil within the identified contaminated zones that exceeds CCME Residential/Parkland Land Usage levels and hydrocarbon impacted rock must be removed from the site and be transported to a facility permitted to receive the material quality being disposed of or treated.

12. RESTORATION

1. Restore excavated portions with imported non-contaminated (i.e. must meet CCME Residential/Parkland soil quality guidelines) material and/or with excavated and stockpiled soil and rock classified as “not-contaminated”.
2. Re-instate surface grading at the site to give the site the same appearance as before remediation work.
3. Grade, topsoil and hydro seed the existing access road at the end of the project.
4. Clean permanent access roads of contamination resulting from project activity at request of Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.14 - Health and Safety for Contaminated Sites.
- .3 Section 01 35 35 - DND Fire Safety Requirements.
- .4 Section 01 35 43 - Environmental Procedures.
- .5 Section 31 23 16.26 – Rock Removal.

1.2 REFERENCES

- .1 Definitions:
 - .1 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.
 - .2 Hazardous Material: product, substance, or organism used for its original purpose; and is either dangerous goods or material that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.
 - .3 Hazardous Waste: hazardous material no longer used for its original purpose and that is intended for recycling, treatment or disposal.
- .2 Reference Standards:
 - .1 Canadian Environmental Protection Act,1999 (CEPA 1999)
 - .1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).
 - .2 British Columbia Environmental Management Act, 2003 (BC EMA 2003)
 - .1 British Columbia Contaminated Sites Regulation, 1996 (BC CSR 1996)
 - .2 British Columbia Hazardous Waste Regulation, 1988 (BC HWR 1988)
 - .3 Department of Justice Canada (Jus)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDG Act) [1992], (c. 34).
 - .2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2001-286).
 - .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .5 National Research Council Canada Institute for Research in Construction (NRC-IRC)
 - .1 National Fire Code of Canada-[2005].

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Product Data:
 - .1 Submit one copy of WHMIS MSDS in accordance with Section 01 35 29.14 - Health and Safety for Contaminated Sites and 01 35 43 - Environmental Procedures to the Departmental Representative for each hazardous material required prior to bringing hazardous material on site.
 - .2 Submit hazardous materials management plan to the Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.
 - .3 Submit photocopy of shipping documents and waste manifests to the Departmental Representative, when shipping hazardous waste off-site.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.
- .2 Storage and Handling Requirements:
 - .1 Co-ordinate storage of hazardous materials with the Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.
 - .2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.
 - .3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.
 - .4 Smoking is prohibited at the site.
 - .5 Storage requirements for quantities of hazardous materials and wastes:
 - .1 Store hazardous materials and wastes in closed and sealed containers.
 - .2 Label containers of hazardous materials and wastes in accordance with WHMIS.
 - .3 Store hazardous materials and wastes in containers compatible with that material or waste.
 - .4 Segregate incompatible materials and wastes.
 - .5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.
 - .6 Store hazardous materials and wastes in secure storage area with controlled access.
 - .7 Maintain clear egress from storage area.
 - .8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.
 - .9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment as specified in Section 01 35 43 - Environmental Procedures.
 - .10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.

- .11 When hazardous waste is generated on site:
 - .1 Co-ordinate transportation and disposal with the Departmental Representative.
 - .2 Comply with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.
 - .3 Use licensed carrier authorized by provincial authorities to accept subject material.
 - .4 Before shipping material obtain written notice from intended hazardous waste treatment or disposal facility it will accept material and it is licensed to accept this material.
 - .5 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.
 - .6 Only trained personnel handle, offer for transport, or transport dangerous goods.
 - .7 Provide photocopy of shipping documents and waste manifests to the Departmental Representative.
 - .8 Track receipt of completed manifest from consignee after shipping dangerous goods. Provide photocopy of completed manifest to the Departmental Representative.
 - .9 Report discharge, emission, or escape of hazardous materials immediately to the Departmental Representative and appropriate provincial authority. Take reasonable measures to control release.
- .12 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.
- .13 Report spills or accidents immediately to the Departmental Representative. Submit a written spill report to the Departmental Representative within 24 hours of incident.

Part 2 Products

2.1 MATERIALS

- .1 Description:
 - .1 Bring on-site only quantities hazardous material required to perform Work.
 - .2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section [01 33 00 - Submittal Procedures].
- .2 Section [31 23 16.26 – Rock Removal].
- .3 Section [31 23 33.01 Excavating, Trenching and Backfilling].

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/ft³) (600kN-m/m³).
- .2 Master Municipal Construction Documents (MMCD).
- .3 CSA International
- .4 DFO Land Development Guidelines for the Protection of Aquatic Habitat (1993).

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Co-ordination: arrange with authority having jurisdiction for relocation of buried services that interfere with execution of work.
 - .1 Pay costs of relocating services.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide, to appropriate geotechnical testing agency, a sample of backfill proposed for use, no later than two weeks before backfilling or filling work. Submit results of testing to the Departmental Representative for review and approval for use on site no later than one week prior to backfilling.

Part 2 Products

2.1 MATERIALS

- .1 Topsoil will be imported to the site by the Contractor. Topsoil quality shall meet the ASTM D5268 - 07 Standard Specification for Topsoil Used for Landscaping Purposes. The topsoil must be thermally treated to prevent the importing of invasive species.
- .2 “Crushed Granular Sub-base” backfill, as defined by the MMCD Section 02226, will be imported to the site by the Contractor. Do not begin backfilling or filling without approval of the Departmental Representative.
- .3 All fill material imported to the site by the contractor will meet the relevant federal soil quality standards and/or guidelines for Residential/Parkland Land Use.

2.2 FILL CHARACTERIZATION AND DOCUMENTATION

- .1 Prior to import of any material used for surfacing, backfilling or any other use requiring fill material the Contractor will provide sufficient documentation, as agreed on by the Departmental Representative, to ensure that the imported material meets the Canadian Council of Ministers of the Environment (CCME) Residential/Parkland Land Usage Soil Quality Guidelines and the regional background soil quality estimates for Vancouver Island outlined in the BC Ministry of Environment Protocol 4 for Contaminated Sites – Determining Background Soil Quality. Sufficient documentation is a letter, no less than six months from the date of import, indicating the material is suitable. Letter must be stamped and sealed by an appropriate licensed Professional, as agreed on by the Departmental Representative.
- .2 Environmental characterization of fill material must be conducted in accordance with the following:
 - .1 British Columbia, Ministry of Environment, Technical Guidance Document #1 - Site Characterization and Confirmation Testing.
- .3 Prior to import of any material the Contractor must inform the Departmental Representative of the proposed fill source(s) and identify the nature of current and historical activities conducted at the source.
- .4 The Departmental Representative reserves the right to request additional testing of imported material at the source and at the deposit site to satisfy their requirements. All testing will be done at the Contractor's cost.
- .5 All materials brought to the site that does not meet the CCME Residential/Parkland guidelines/standards will be removed from the property immediately at the Contractor's cost.

Part 3 Execution

3.1 EXAMINATION

- .1 Evaluation and Assessment:
 - .1 Examine the Drawings, Photographs and Appendices.
 - .2 Before commencing work establish locations of all buried services on and adjacent to site.

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 properties and walkways, according to the sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during the Work.

- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Protection of in-place conditions:
 - .1 Keep excavations clean, free of standing water, and loose soil.
 - .2 Where soil is subject to significant volume change due to change in moisture content, cover and protect to the Departmental Representative's approval.
 - .3 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. There is potential for hand excavation around trees to remain and immediate covering of exposed roots.
 - .4 Protect buried services that are required to remain undisturbed.
- .3 Removal:
 - .1 Remove logs, brush, shrubs, bushes, vines, undergrowth, rotten wood, dead plant material, and debris within the excavation footprint. Remove trees only with the Departmental Representative's approval.

3.3 EXCAVATION

- .1 The depth of the excavation is anticipated to encounter the water table and surface water may enter the excavation. The Contractor will be responsible for the management (treatment and disposal) of any excavation water, including surface water entering the excavation.
- .2 Excavate as required to carry out work.
 - .1 Excavation taken below depths shown without Departmental Representative's written authorization to be filled with compacted backfill material as required by the Departmental Representative at Contractor's expense.

3.4 FIELD QUALITY CONTROL

- .1 Testing of materials and compaction of backfill will be carried out by the Contractors third party sub-contractor accepted by the Departmental Representative.
- .2 Submit to appropriate geotechnical testing agency a 5 kg sample of backfill proposed for use, no later than two weeks before backfilling work. Submit results of testing to Departmental Representative for review and approval for use on the site no later than one week prior to backfilling.
- .3 Do not begin backfilling or filling operations until material has been accepted for use by the Departmental Representative.
- .4 Not later than 48 hours before backfilling or filling with accepted material, notify the Departmental Representative to allow for verification of compaction tests to be carried out by the Departmental Representatives Geotechnical Engineer.

3.5 BACKFILLING

- .1 Backfill in accordance with Section 31 23 33.01 Excavation, Trenching and Backfilling.

3.6 GRADING

- .1 The final grade of the site will follow the natural contours of the native non-impacted soil and bedrock at the site, and backfill will be placed to provide a maximum slope of 1 Horizontal: 1 Vertical as accepted by the Departmental Representative.
- .2 Current site drainage and seepage in the project area flows north toward the property boundary, and then east. Following completion of the excavation, the contractor will grade the site to maintain the current surface water flow regime.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Section [01 33 00 - Submittal Procedures].
- .2 Section [01 35 29.14 - Health and Safety Requirements].
- .3 Section [31 00 00.01 – Earthwork – Short Form].
- .4 Section [31 23 33.01 - Excavating, Trenching and Backfilling].

1.2 ALLOWANCES

- .1 Not Used.

1.3 MEASUREMENT PROCEDURES

- .1 The Contractor will be required to retain a qualified land Surveyor registered in BC to complete quantity survey work.
- .2 Rock Excavation – Rock Excavation will be measured by the Cubic Metre by the Contractors Surveyor.
- .3 The excavation backslope will be included and paid at the Contract Unit Price per cubic metre for Rock Excavation.
- .4 Payment for Rock Excavation will be at the Contract Unit Price per Cubic Metre and will be authorized by the Departmental Representative after submittal of all documentation required in this Section. The Unit Price will be considered full compensation for the requirements of this Section.
- .5 Trimming will be included and paid at the Contract Unit Price per cubic metre for Rock Excavation.
- .6 All costs associated with blasting test sections and any revised methods necessary to produce acceptable results shall be included in the Contract Unit Price per cubic metre for Rock Excavation.
- .7 Additional drilling, blasting and excavation required to construct subgrade to the required tolerances and excavating, loading, hauling, placing and compacting backfill material for blast craters and drainage trenches to subgrade level shall be included in the Contract Unit Price per cubic metre for Rock Excavation.
- .8 All costs associated with monitoring shall be included in the Contract Unit Price Lump Sum.
- .9 Payment for excavation backslope will be included and paid at the Contract Unit Price per cubic metre for Rock Excavation meeting the geometric tolerances for excavation backslope in this Section. Geometric tolerances to be met include hole location tolerance, hole deviation, offset between lifts and deviation of excavation backslope geometry. Scaling of loose material disturbed by blasting including removal and disposal of overbreak shall be included and paid at the Contract Unit Price per cubic metre for Rock Excavation.

1.4 DEFINITION

- .1 Rock: any solid material in excess of 0.25 m³ and which cannot be removed by means of heavy duty mechanical excavating equipment. Frozen material not classified as rock.

.2 PPV: peak particle velocity.

1.5 SUBMITTALS

.1 Blasting Operation

.1 Submit to Departmental Representative and local authorities having jurisdiction (if applicable) for approval, written proposal of operations for removal of rock by blasting, in accordance with Section 01 33 00 - Submittal Procedures.

.2 Blast Design

.1 The Contractor shall provide and follow a blast design, 10 days after award and not less than one week prior to commencing drilling and blasting operations and a minimum of one day before the Contractor proposes to implement any changes to the previously utilized drilling or blasting methods. The design may be prepared by the blaster, but shall be reviewed and accepted by the Contractor. The design shall contain full details of the drilling and blasting patterns and controls (including delays) that the Contractor proposes to use for controlled blasting.

.3 Pre-Blast Survey

.1 The Contractor shall conduct a pre-blast survey a minimum of one day before blasting operations commence. The pre-blast survey shall include a complete description of the existing condition of any nearby buildings, structures, wells and utilities that potentially may be damaged by blasting operations. The survey method used shall be acceptable to the Contractor's insurance company.

.4 Vibration Control Records

.1 As required, the Contractor shall provide all seismograph records of vibration monitoring and interpretation of results within one day after each blast to the Departmental Representative.

.5 Submit records to Departmental Representative at end of each shift. Maintain complete and accurate record of drilling and blasting operations.

1.6 QUALIFICATIONS

.1 Retain licensed explosives expert to program and supervise blasting work and to determine precautions, preparation and operations techniques.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 11 - Cleaning].

.2 Collect and separate plastic, paper packaging, corrugated cardboard, etc.

.3 Place materials defined as hazardous or toxic in designated containers.

.4 Ensure emptied containers are sealed and stored safely.

1.8 BLASTING SURVEY AND MONITORING

.1 Departmental Representative and Contractors Engineer will visit property holders of adjacent buildings and structures to determine existing conditions and describe blasting and seismic recording operations.

.2 Seismographic monitoring will be conducted by the Contractor during entire progress of blasting operations.

1.9 BLASTING AND VIBRATION CONTROL

- .1 The Contractor shall employ a qualified vibration specialist to establish the safe vibration limits.
- .2 Peak particle velocity, accelerations and frequency shall not be allowed to exceed the safe limits of the nearest structure subject to potential vibration damage. Obtain required criteria from Contractors soils Consultant/licensed explosive expert.
- .3 Reduce ground vibrations to avoid damage to structures or remaining rock mass.
- .4 In general, vibration from blasting not exceed 25 mm/s at distance of 100 m.

2 Products

2.1 MATERIALS

- .1 All products and materials used for any blasting operations shall be products of a company regularly engaged in the manufacture of explosives and related products.
- .2 Explosives with an expired shelf life shall not be used.
- .3 Water resistant explosives may be required for the work.

3 Execution

3.1 PROTECTION

- .1 Prevent damage to surroundings and injury to persons. Erect fencing, post guards, sound warnings and display signs when blasting to take place.

3.2 ROCK REMOVAL

- .1 Co-ordinate this Section with Section 01 35 29.14 - Health and Safety Requirements.
- .2 Permits and Regulations
 - .1 The Contractor shall obtain all necessary permits and shall comply fully with the laws, rules and regulations of Municipal, Provincial and Federal agencies in connection with the use, transportation, storage and safe handling of all explosives, including those regulations contained in the Industrial Health and Safety Regulations (IHSR) published by the Worker's Compensation Board (WCB) of British Columbia.
- .3 Supervision
 - .1 The Contractor shall ensure that all persons conducting blasting operations have a valid blaster's certificate issued by the WCB or is under the direct supervision of a certificate holder.
- .4 Safety
 - .1 The Contractor shall meet all WCB regulations. All work shall be performed in a manner that prevents injury or harm to any personnel employed in the rock excavation area. Warning signs shall be posted and readily recognizable audible warning signals shall be used. The perimeter of the area affected by blasting operations shall be patrolled and controlled by direct voice communication. The Contractors Engineer or Departmental Representative shall stop the work if the safety of the public is being jeopardized by the Contractor's blasting operations.

- .5 Flyrock Control
 - .1 Before the detonation of any blast in areas where flying rock or other debris may result in personal injury or damage to property, the area within the excavation limits shall be covered with suitable blasting mats, soil or other equally serviceable material to prevent flyrock.
- .6 Other Damage
 - .1 The Contractor shall be responsible for any damage resulting from blasting. Occupants of local buildings shall be notified by the Departmental Representative, prior to the commencement of the blasting, as to the timing, size of blasts, types of warning and other signals.
- .7 Blasting Test Section(s)
 - .1 All requirements for full scale blasting shall also apply to test sections unless otherwise authorized by the Departmental Representative. Prior to commencing full-scale blasting operations, the Departmental Representative may require the Contractor to demonstrate the adequacy of the proposed blast design by drilling, blasting, and excavating short test sections, up to 30 m in length, to determine which combination of method, hole spacing, timing, and charge yields acceptable results. The length of the blast test section shall be as specified in the blast design.
 - .2 The Contractor shall not drill beyond the test section until it has been excavated and the results reviewed and accepted by the Departmental Representative.
 - .3 If either the Contractors Engineer or Departmental Representative determines that the results of the test section are unsatisfactory, then notwithstanding the Contractors Engineer or Departmental Representative prior review of such methods, the Contractor shall adopt such revised methods as are necessary to achieve the required results.
 - .4 If at any time during the progress of the work the methods of drilling and blasting do not produce the required excavation backslope geometry within the tolerances specified for backline holes, then the Contractor will be required to drill, blast and excavate short sections, not exceeding 30 m in length, until a technique is achieved that will produce the desired results.
- .8 Backline and Production Holes
 - .1 The upper portion of all holes between the topmost charge and the hole collar shall be stemmed. Stemming materials shall be sand or other inert angular granular material with similar specific gravity, passing a 9.5 mm sieve.
 - .2 Before placing charges, the Contractor shall determine that the hole is free of obstructions for its entire depth. All necessary precautions shall be exercised so that the placing of the charges will not cause spalling of material from the walls of the holes.
 - .3 All production holes shall be drilled downward unless otherwise specified in the blast design and authorized by the Departmental Representative. In general, slash holes (horizontal, near horizontal or fanned out holes) shall not be drilled along the excavation backslope or on pioneering routes excavated to provide access for backline hole drilling, unless authorized by the Departmental Representative.
 - .4 Explosive materials shall not be inserted into the holes until the blast design has been reviewed and accepted by the Departmental Representative.

- .5 For each blast, the line of backline holes shall extend 10 m to 20 m beyond the limits of the production holes to be detonated or to the end of the specified excavation backslope, as applicable.
 - .6 Backline holes shall be drilled within 75 mm of the staked collar location.
 - .7 Backline holes shall not deviate from the plane of the specified excavation backslope by more than 150 mm as measured perpendicular to the slope. Backline holes shall not deviate more than 150 mm as measured within the plane of the excavation backslope.
 - .8 The backline holes shall be 50 mm to 75 mm in diameter, or as recommended by the blasting consultant and authorized by the Departmental Representative. Trim blast holes may be as small as 25 mm diameter.
 - .9 The length of backline holes for any individual lift shall not exceed 8 m unless the Contractor can demonstrate to the Departmental Representative that the Contractor can stay within the tolerances and produce the required excavation backslope geometry.
- .9 Offset Between Lifts
- .1 When the cut height requires more than one lift, a maximum 0.5 m offset between lifts is permitted to allow for drill equipment clearances. The Contractor shall begin the backline hole drilling at a point on the top lift which will allow for necessary offsets and shall adjust at the start of lower lifts to compensate for any drift which may have occurred in the upper lifts.
- .10 Presplit Blasting
- .1 Unless otherwise specified in the blast design and authorized by the Departmental Representative, presplit blasting shall be conducted for all blasting to the excavation backslope.
 - .2 Drill hole conditions may vary from dry to filled with water. The Contractor shall use explosives and blasting accessories appropriate for the drill hole conditions encountered to accomplish the specified results. Only standard explosives manufactured for presplit blasting shall be used in backline holes, unless otherwise specified in the blast design and authorized by the Departmental Representative. Bulk ammonium nitrate and fuel oil (ANFO) shall not be loaded into the backline holes.
 - .3 Explosives shall be evenly distributed and decoupled to the maximum extent possible.
 - .4 The maximum spacing of pre-split backline holes is 750 mm.
 - .5 The bottom charge of backline holes may be larger than the remaining charges but shall not be large enough to cause overbreak. The top charge of backline holes shall be placed far enough below the collar and be sufficiently small to avoid overbreak and heaving of rock beyond the excavation backslope.
 - .6 The Contractor may detonate the backline holes before drilling production holes, provided satisfactory excavation backslopes are obtained. If required to reduce ground vibrations or noise, backline holes may be delayed, provided the effective hole-to-hole delay time is not more than 25 ms.
 - .7 Excavation Backslope Geometry – The excavation backslope shall not deviate more than 150 mm from a plane passing through adjacent drill holes except where the character of the rock is such that, as determined by the Contractors Engineer and Departmental Representative, irregularities are unavoidable. The 150 mm tolerance shall be measured

perpendicular to the plane of the slope. In no case shall any portion of the slope encroach on the ditch.

.11 Vibration Control and Monitoring

- .1 The Contractor shall use blasting methods designed to limit the intensity of ground vibrations originating within the excavation limits. When blasting near buildings, structures, wells, utilities or other works that may be subject to damage from blast induced ground vibrations, the ground vibrations shall be controlled using properly designed delay sequences and allowable charge weights per delay.
- .2 Allowable charge weights per delay shall be based on vibration levels that will not cause damage. The Contractors Engineer or Departmental Representative may monitor vibration levels at the blast site by requesting trial blasts to determine actual vibration levels reached during blasting.
- .3 Monitoring shall meet the International Society of Rock Mechanics (ISRM) standards. Whenever vibration damage to adjacent structures is possible, the Contractor shall monitor each blast with approved seismograph(s) located between the blast area and the closest structure(s) subject to potential blast damage. The geophone shall be placed as close as possible to the structure(s) but not directly above the structure(s). The seismograph(s) shall be set to record particle velocity, accelerations, and frequency in the range generally found with controlled blasting. The peak particle velocity shall be calculated as the maximum vector sum of three mutually perpendicular components of vibration. All components and peak particle velocity shall be recorded.

.12 Excavation Backslope Stabilization

- .1 The excavation backslope shall be stabilized as recommended by the Contractors Engineer and Departmental Representative, during or upon completion of the excavation of each lift. Unless otherwise authorized by the Departmental Representative, drilling of the next lift shall not proceed until stabilization has been completed. Drilling of the next lift shall not proceed until all concerns about stability raised by the Departmental Representative are addressed by the stabilization work. Stabilization shall be completed before any base material is placed upon the subgrade. Stabilization shall be at the Contractor's expense.
- .2 Stabilization methods include scaling, trimming, the application of rock bolts, shotcrete, slope mesh, drains or other stabilization techniques recommended by the Contractors geotechnical engineer and authorized by the Departmental Representative.

3.3 ROCK DISPOSAL

- .1 Hydrocarbon impacted rock is to be transported to a permitted, Departmental Representative accepted, disposal facility for final disposal.
- .2 Do not dispose removed hydrocarbon impacted rock into quarry.
- .3 Clean rock is to be retained in the designated stockpile area for reuse onsite as backfill, or as directed by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.14 - Health and Safety for Contaminated Sites.
- .3 Section 01 35 43 - Environmental Procedures.
- .4 Section 02 61 00.01 - Soil Remediation.
- .5 Section 31 00 00.01 - Earthwork – Short Form.
- .6 Section 31 23 16.26 – Rock Removal.

1.2 MEASUREMENT PROCEDURES

- .1 Excavated materials will be measured in accordance with the following procedure:
 - .1 For offsite disposal of contaminated soil, the truck will be weighed at a certified weigh scale station and the weigh scale records will form the weight of measure for the measure of payment.
 - .2 For backfill materials imported to the site that are subsequently placed and compacted to restore site conditions, each distinct type of material imported will be weighed at a certified scale prior to delivery to the site and the weigh scale records will form the weight of measure for the measure of payment. Backfilling to authorized excavation limits will be measured in tonnes for each type of material specified.
 - .3 For excavated material that will be stockpiled and reused, for each distinct type of material excavated and then stockpiled the Contractor will:
 - .1 Fill a truck and/or truck and pup to an agreed upon fill level that represents a specific volume of material.
 - .2 The truck and/or truck and pup will then transport and deposit the fill in the stockpile management area. The same volume will be placed in the truck and/or truck and pup and the procedure will be repeated until approximately 50 m³ have been placed in a stockpile. The Departmental Representative will monitor the loading of all trucks and reserves the right to request addition of material if trucks have not been filled to the specified load height. The Departmental Representative and the Contractors representative will agree on stockpile volumes at the end of each day's work.
 - .3 At the discretion of the Departmental Representative, a minimum of one truck per day will require weighing with the agreed upon fill level to reconcile the estimated volume with the actual weight of the truck.
 - .4 The volume of all stockpiles will be used to estimate the total volume excavated and will form the measurement for the measure of payment.

- .2 Quantities of soil will be scaled for measurement in tonnes, at the full cost to the Contractor, and backed up by certified weigh scale tickets. Volumes will be determined in metric tonnes.
- .3 De-watering of the excavation will be completed by the Contractor.
- .4 Volumes of backfill brought to the site will be scaled using a certified scale in tonnes, at full cost to the Contractor.

1.3 REFERENCES

- .1 Master Municipal Construction Documents (MMCD).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM D698-[00ae1], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
- .3 Weights and Measurements Act (R.S.C., 1985, c. W-6).

1.4 DEFINITIONS

- .1 Excavation classes: one classes of excavation will be recognized; common excavation.
 - .1 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit Excavation Designs. Excavation Design and supporting data submitted to bear stamp and signature of qualified professional Engineer registered or licensed in British Columbia, Canada.
- .3 Keep design and supporting data on site

1.6 QUALITY ASSURANCE

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.14 - Health and Safety for Contaminated Sites.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling where possible.

- .2 Transport contaminated soils and hydrocarbon impacted rock to a Departmental Representative accepted, provincially permitted/licensed facility for disposal. Do not transport soil off-Site without approval by the Departmental Representative.
- .3 The Contractor will provide the Departmental Representative a copy of all manifests and weigh scale tickets as required by the Contract.

1.8 EXISTING CONDITIONS

- .1 Review the existing Drawings, Appendices and Photographs attached.
- .2 Protect existing surface features from damage while work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.
- .3 Buried services:
 - .1 Obtain applicable "Dig Permit" from DND.
 - .2 Prior to beginning excavation work, notify Departmental Representative and applicable authorities having jurisdiction and establish location and state of use of buried utilities and structures.
 - .3 All utilities within and immediately surrounding the work area must be located prior to Work through a BC One Call and a private utility locating company to ensure all buried services are properly located. A hydrovac may be required to confirm actual location of all utilities. Completeness and accuracy of any available utility drawings are not guaranteed and the Contractor is responsible for confirming locations of all utilities. Clearly mark utility locations to prevent disturbance during Work.
 - .4 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .5 Cap off any obsolete/inactive buried services encountered in a manner approved by authorities having jurisdiction.
 - .6 Protect buried services that are required to remain undisturbed.
 - .7 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing and re-routing.
 - .8 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to accepted schedule and provide notice to affected parties.
 - .9 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
 - .10 Record location of maintained, re-routed and abandoned underground lines.
 - .11 Confirm locations of recent excavations adjacent to area of excavation.
 - .12 Where required for excavation, cut roots or branches as directed by the Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Aggregate quality: soil, hard, durable material free from organic material, clay lumps or other substances that would act in deleterious manner for use intended.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D4791.
 - .1 Greatest dimension to exceed five times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of the following:
 - .1 Natural sand;
 - .2 Manufactured sand;
 - .3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock;
 - .2 Gravel and crushed gravel composed of naturally formed particles of stone.

Part 3 Execution

3.1 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement in roadway neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.2 PREPARATION/PROTECTION

- .1 Keep excavations clean, free of standing water, and loose soil.
- .2 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.
- .3 Protect buried services that are required to remain undisturbed.

3.3 STOCKPILING

- .1 Stockpile materials rock / excavated soils in areas designated by the Departmental Representative.
 - .1 Stockpile materials in manner to prevent cross-contamination.
 - .2 Stockpile materials according to soil quality and type of contaminant.
 - .3 Stockpile granular materials in manner to prevent segregation.
 - .4 Stockpile in windrows not exceeding 2.5 m in height to allow sampling and positive drainage away from the piles.

- .5 Stockpiles are not to exceed 50 m³ in size.
- .6 Clean stockpiled materials (soil and rock) must be underlain by an impermeable material (i.e. 20 mil polyethylene) to ensure that excavated material does not come into contact with the underlying soils.
- .7 Contaminated stockpiled materials (soil and hydrocarbon impacted rock) must be underlain by a rugged, impermeable material (e.g. thick, pre-fabricated liner such as a 60 mil LLDPE liner) to minimize potential tearing and perforating from vehicle traffic and to ensure that excavated contaminated material does not come into contact with the underlying soils and that any water generated from the excavated material does not infiltrate the underlying soils.
- .8 Contaminated and inferred contaminated soil stockpiles will be covered with an impermeable cover (i.e. 6 mil polyethylene cover) when no further material will be added to them. The poly must be weighted in such a manner to prevent it from blowing off the stockpiles or allowing precipitation to infiltrate.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.4 DEWATERING

- .1 Keep excavations free of water while Work is in progress.
- .2 Protect open excavations against flooding and damage due to surface run-off.
- .3 Provide necessary treatment facilities to remove suspended solids or other materials before discharging into storm sewers or drainage areas and meet applicable regulations and bylaws.
- .4 Separate and collect light non-aqueous phase liquids (LNAPL) for off site disposal.
- .5 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of the excavation limits as necessary.

3.5 EXCAVATION

- .1 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and immediately cover roots with clean soil.
- .2 Do not mix soils and rock of different classifications.
- .3 Excavate, load, and transport 200 tonnes of petroleum hydrocarbon contaminated soils and 2,000 tonnes of hydrocarbon impacted rock. Soil and rock is to be transported to a permitted, Departmental Representative accepted, disposal facility.
- .4 Keep excavated and stockpiled materials safe distance away from edge of excavation as directed by the Departmental Representative.
- .5 Restrict vehicle operations directly adjacent to open excavation.
- .6 Do not obstruct flow of surface drainage or natural watercourses.

- .7 Obtain Departmental Representative approval of completed excavation.
- .8 Following removal of designated material, the Departmental Representative will collect confirmatory samples to ensure that all contaminated material has been removed. After the collection of confirmatory samples, the Departmental Representative will survey the sample locations. The Contractor must make clean the bottom and walls of the soil excavation area (including water and other waste material) and provide clear access for the Departmental Representative. Assist the Departmental Representative in collection of samples including provision of equipment and personnel as necessary. In the event that contamination remains, additional material may need to be removed. Any additional work must be accepted by Departmental Representative prior to the commencement of this work. The Contractor must anticipate time and equipment assisting the Departmental Representative confirmatory sample collection.
- .9 Contractors will not be paid for time associated with analytical turn around time (TAT). Analytical TAT includes 4 days for collection, shipping and tabulation of data and an additional 3 work days (Monday-Friday, excluding statutory holidays) for laboratory analysis (7 working days total). The Contractor must anticipate time pending confirmation of remediation. No standby time will be granted for waiting for confirmatory soil sample results or surveying of sample locations.
- .10 Backfill and compaction of the excavation cannot occur without clear direction from the Departmental Representative.

3.6 BACKFILLING

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 The Departmental Representative has inspected and accepted excavation extents.
 - .2 Departmental Representative receives confirmation that the backfill material meets applicable environmental standards.
 - .3 The Departmental Representative completes the survey of confirmatory samples.
- .2 Areas to be backfilled to be free from debris and water.
- .3 Contractor must not proceed with backfilling operations unless accepted by the Departmental Representative.
- .4 Stockpiled materials (soil and rock) excavated and classified as non-contaminated (below CCME Residential/Parkland quality) will be used for backfilling if deemed to be geotechnically suitable – excess material disposal will be designated by Departmental Representative. Stockpile backfill materials in areas designated by Departmental Representative. Protect backfill materials from contamination.
- .5 Placement and compaction of “Crushed Granular Sub-base” as defined by the MMCD Section 02226.
 - .1 Place backfill material in no greater than 150 mm lifts or as directed by the Departmental Representative: control moisture content as required to achieve specified density.
 - .2 Bring the “Crushed Granular Sub-base” to within 0.15 m of final grade. The top 0.15 m is to be filled with topsoil to facilitate site restoration and planting (to be done by others).

- .3 Compact each layer or material to 95% modified proctor (ASTM D698) density as verified by the Contractors Geotechnical Engineer. Results will be made available to the Departmental Representative in the field. All compaction test locations and elevations will be surveyed by the Contractor and provided to Departmental Representative immediately upon request.
- .4 Backfilled material must meet the compaction specification and will be independently tested by the Departmental Representatives Geotechnical Engineer. In the event of failed compacted test results, additional compacted and related manpower, equipment and supplies required to meet density specification will be completed at full cost of the Contractor.

3.7 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris. Correct defects as directed by the Departmental Representative.
- .2 Replace topsoil and hydro seed with a native grass mix as directed by the Departmental Representative.
- .3 Grade, place topsoil and hydro seed the existing access road with a native grass mix as directed by the Departmental Representative.
- .4 Reinstate pavements disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstate areas affected by Work as directed by the Departmental Representative.
- .6 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

3.8 AS-BUILT SURVEY

- .1 The Contractor will be required to provide an as-built survey, completed by the Contractors Surveyor, stamped and sealed by a qualified land surveyor registered in BC, that at minimum identifies the following:
 - .1 Excavation footprint and topography.
 - .2 Final Site features and topography.

END OF SECTION

APPENDIX A
Photographs

Colwood FOD North Area
CFB Esquimalt, Colwood, BC
SLR Project No.: 205.03903.00000



Photo 1: View of Site facing south west.



Photo 2: View of Site facing north east.



Remedial Specifications
COL-FOD North Area
Colwood, BC

SITE PHOTOGRAPHS

SLR Project No: 205.03903.00000



Photo 3: View of Site facing south west.



Photo 4: View of smaller trees requiring grubbing, removal and disposal, facing north west.



Remedial Specifications
COL-FOD North Area
Colwood, BC

SITE PHOTOGRAPHS

SLR Project No: 205.03903.00000



Photo 5: View of smaller trees requiring grubbing, removal and disposal, facing north west.



Photo 6: View of mature Fir and Cedar trees (red arrows) that may require removal and retained on DND property. Mature Fir trees (blue arrows) and other mature trees may require protection.



Remedial Specifications
COL-FOD North Area
Colwood, BC

SITE PHOTOGRAPHS

SLR Project No: 205.03903.00000



Photo 7: At location MW17-14, LNAPL observed in fractures at a depth of 1.4 m along the core axis (vertical projection of 1.0 mbgs). The bedrock at this location is limestone.



Photo 8: At location MW17-14, close up view of LNAPL on a fracture at a depth of 1.4 m along the core axis (vertical projection of 1.0 mbgs).



Remedial Specifications
COL-FOD North Area
Colwood, BC

SITE PHOTOGRAPHS

SLR Project No: 205.03903.00000



Photo 9: At location MW17-03, close up view of light non-aqueous phase liquid in fracture area at 7.6 m along the core axis (vertical projection of 5.4 mbgs). The bedrock at this location is limestone.



Photo 10: Light non-aqueous phase liquid and sheen on groundwater seepage adjacent to sample location GRAB-01 (red arrow).



SITE PHOTOGRAPHS

Remedial Specifications
COL-FOD North Area
Colwood, BC

SLR Project No: 205.03903.00000



Photo 11: Soil sample GRAB 01, consisting of sand from base of bedrock.



Remedial Specifications
COL-FOD North Area
Colwood, BC

SITE PHOTOGRAPHS

SLR Project No: 205.03903.00000

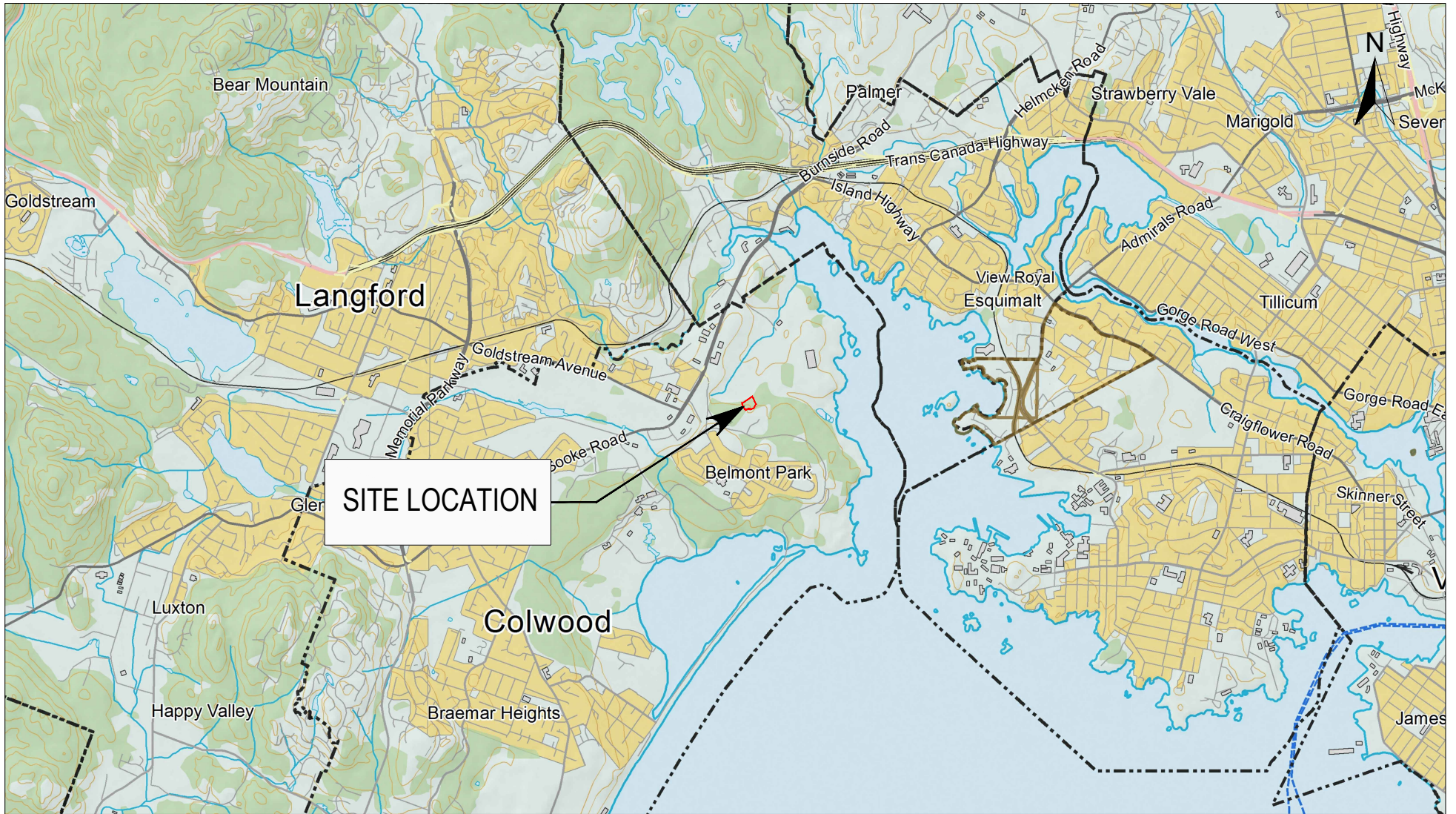
APPENDIX B
Drawings

Colwood FOD North Area
CFB Esquimalt, Colwood, BC
SLR Project No.: 205.03903.00000



Government of Canada

Gouvernement du Canada



SITE LOCATION

Cadfile name: N:\Vancouver\CAD\Project Drawings\205\205.0385\205.0385.00000\IS_205-03903-00000-A3.dwg

BORDER LAST UPDATED 2011-05-31



PROJECT: REMEDIAL SPECIFICATIONS
PROJET:

SUBJECT: **SITE LOCATION MAP**
SUJET:

DATE: 2017/03/31

APPROVED: X.X.
APPROUVÉ PAR: X.X.

SCALE: 1:50 000
ÉCHELLE:

WBS NO.:	
NO. SRT:	
PF NO.:	205.03850.00000
NO. DP:	#
DWG NO.:	X-XX-XXXX/X - 001
NO. DESSIN:	



LEGEND:

- - - PROPERTY BOUNDARY
- SITE ACCESS ROUTES
- - - APPROXIMATE LIMITS OF EXCAVATION

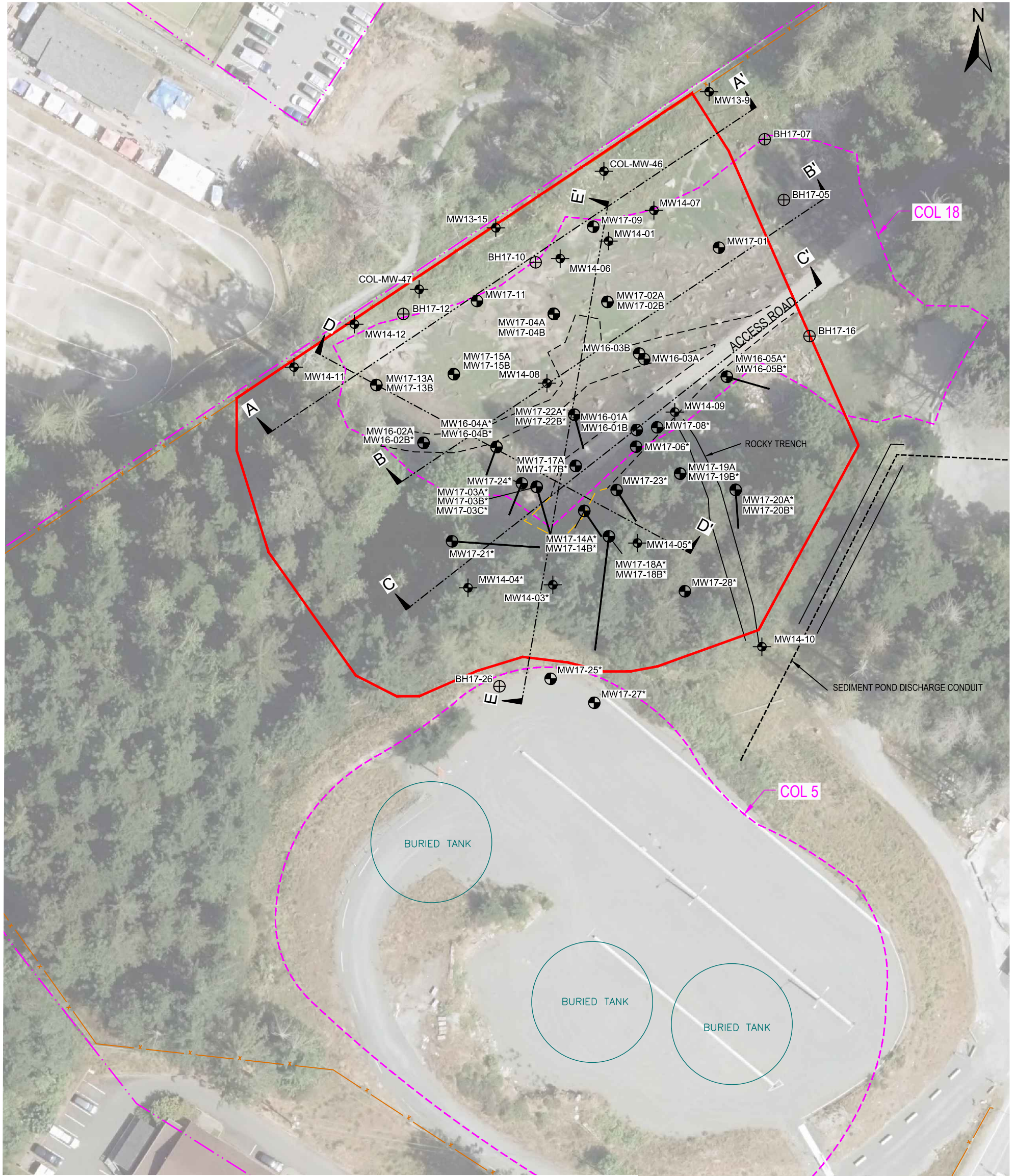
PROJET: REMEDIAL SPECIFICATIONS
 PROJECT:

SUJET: **SITE LAYOUT**
 SUBJECT:

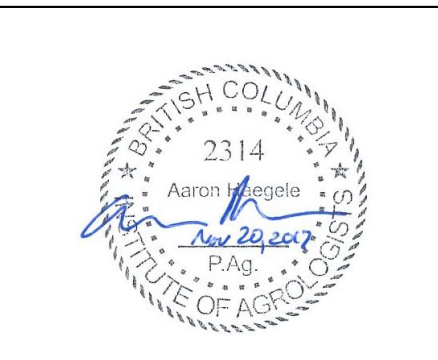
DATE: 2017/10/26



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APPROVED:	X.X.				
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NO. DESSIN:	X-XX-XXXX/X - 002				
DWG NO.:					

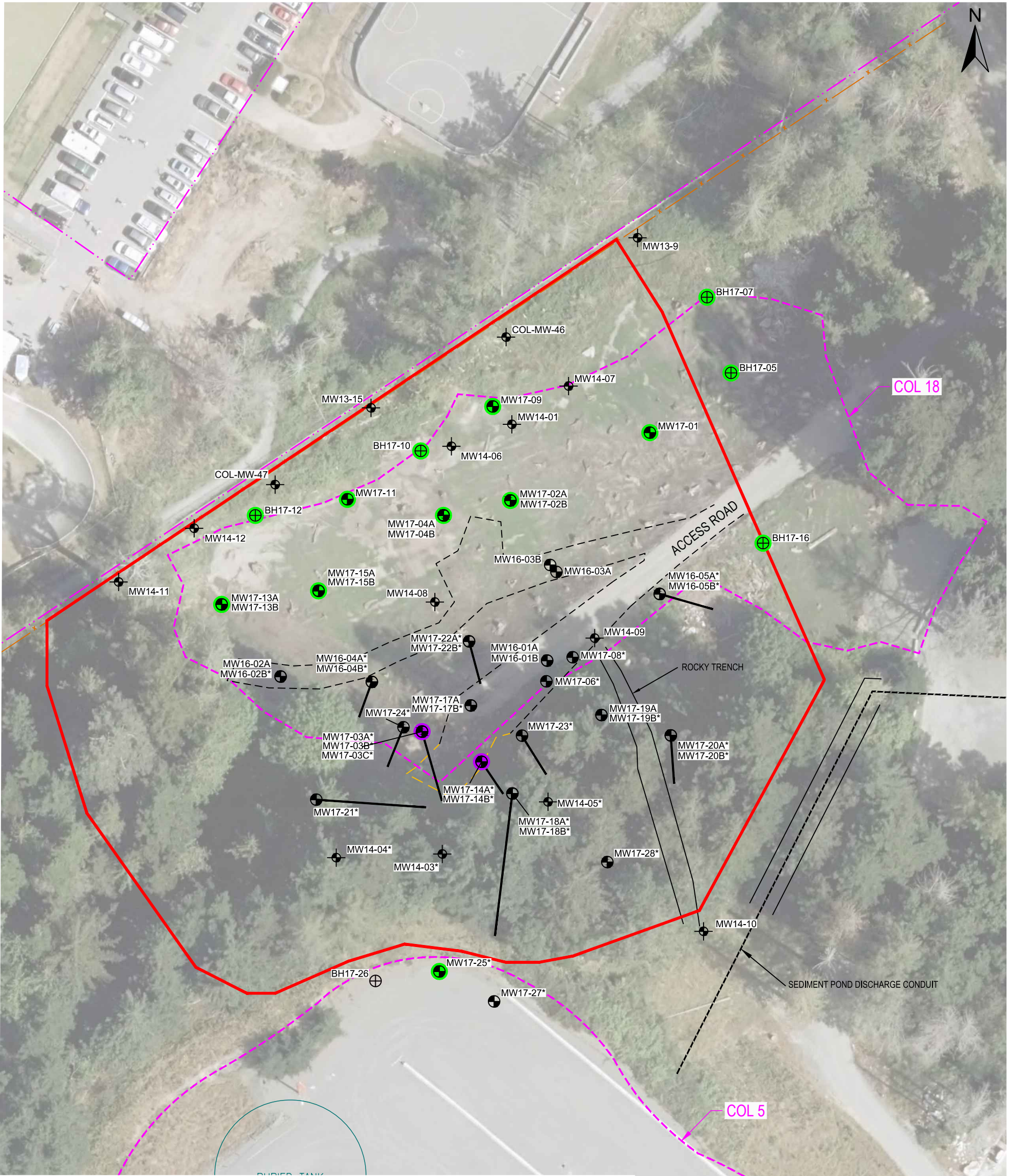


LEGEND:	
	PROPERTY BOUNDARY
	COLWOOD FORMER FOD NORTH AREA BOUNDARY
	COL BOUNDARY
	FENCE - BARBED WIRE
	BOTTOM OF BANK/ROCK FACE
	EDGE OF GRAVEL
	BOREHOLE LOCATION
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
	ANGLED MONITORING WELL
	MONITORING WELL SCREENED IN BEDROCK
	CROSS SECTION A-A' (REFER TO DRAWING 8)
	CROSS SECTION B-B' (REFER TO DRAWING 9)
	CROSS SECTION C-C' (REFER TO DRAWING 10)
	CROSS SECTION D-D' (REFER TO DRAWING 11)
	CROSS SECTION E-E' (REFER TO DRAWING 12)



PROJET: REMEDIAL SPECIFICATIONS
 PROJECT:
 SUJET: SITE PLAN WITH CROSS SECTION
 SUBJECT: REFERENCE LINES
 DATE: 2017/03/31

APPROUVÉ PAR:	X.X.
APPROVED:	X.X.
ÉCHELLE: SCALE:	1:750
NO. OTP: WBS NO.:	XXXXXXXXX
NO. DP: PF NO.:	205.03850.00000
NO. DESSIN: DWG NO.:	X-XX-XXXX/X - 003



LEGEND:	
	PROPERTY BOUNDARY
	COLWOOD FORMER FOD NORTH AREA BOUNDARY
	COL BOUNDARY
	FENCE - BARBED WIRE
	BOTTOM OF BANK/ROCK FACE
	EDGE OF GRAVEL
	BOREHOLE LOCATION
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
	ANGLED MONITORING WELL
	MONITORING WELL SCREENED IN BEDROCK
	CONCENTRATIONS LESS THAN THE APPLICABLE CCME GUIDELINES (mg/kg)
	CONCENTRATIONS GREATER THAN THE APPLICABLE CCME GUIDELINES (mg/kg)
	LOCATION WHERE NAPL WAS OBSERVED IN THE ROCK CORE



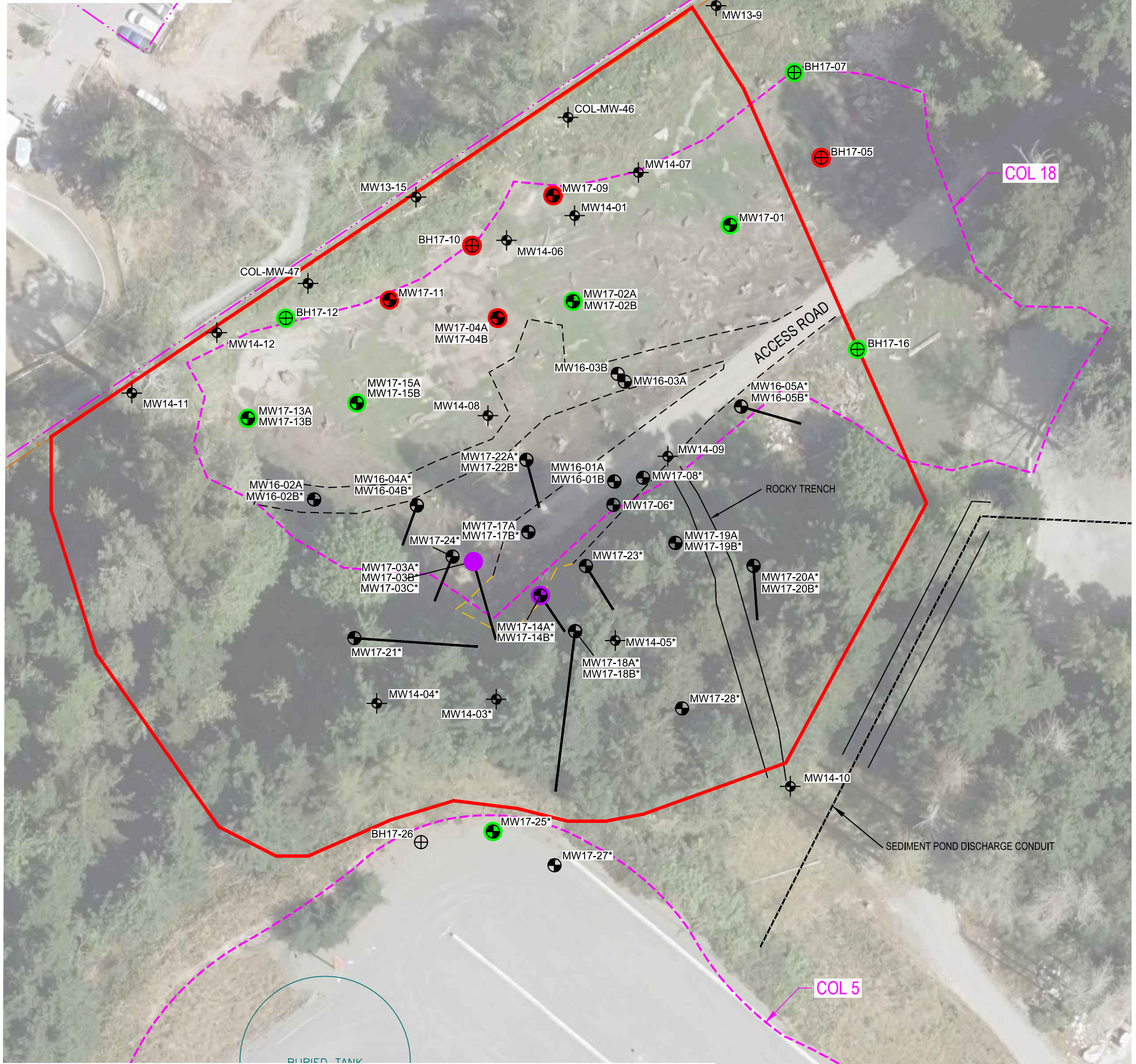
PROJET: REMEDIAL SPECIFICATIONS
 PROJECT:
 SUJET: SOIL ANALYTICAL RESULTS
 SUBJECT: -PETROLEUM HYDROCARBONS AND MTBE
 DATE: 2017/03/31

APPROUVÉ PAR:	X.X.
APPROVED:	X.X.
ÉCHELLE:	1:600
SCALE:	1:600
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NO. WBS NO.:	XXXXXXXXX
NO. DP:	205.03850.00000
PF NO:	
NO. DESSIN:	X-XX-XXXX/X - 004
DWG NO.:	

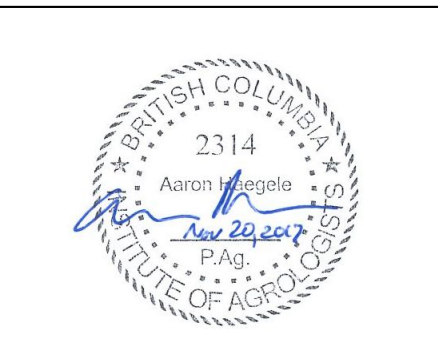


SOIL ANALYTICAL EXCEEDANCES - PAH PARAMETERS (mg/kg)			
Sample ID	Date	Depth (mbgs)	Phenanthrene
MW17-04B	24-Jan-2017	3.7 - 4.3	0.060
BH17-05A	25-Jan-2017	4.3 - 5.0	0.055
MW17-09E	25-Jan-2017	14.9 - 15.5	0.067
BH17-10A	26-Jan-2017	0.3 - 0.9	0.13
BH17-10B	26-Jan-2017	0.3 - 0.9	0.12
MW17-11C	26-Jan-2017	3.7 - 4.3	0.075
CCME ILsc			ng
CCME ILfl			0.046
CCME ILi			50
CCME ILe			ng
CSR ILt			50
CSR ILi			50
CSR ILfw			50
CSR ILdw			50

Notes:
 mbgs - metre below ground surface
 PAH - polycyclic aromatic hydrocarbons
 mg/kg - milligrams per dry kilogram
 < - less than analytical detection limit indicated
 '-' - sample not analyzed for parameter indicated
 ns - no standard listed
 ng - no guidelines listed
 CCME ILsc: CCME CSQGs for PAH, Industrial, Environmental Health guidelines, Soil Contact
 CCME ILfl: CCME CSQGs for PAH, Industrial, Environmental Health guidelines, Protection of Freshwater Life
 CCME ILi: CCME CSQGs for PAH, Industrial, Environmental Health guidelines, Interim Soil Quality Criteria (CCME 1991)
 CCME ILe: CCME CSQGs for PAH, Industrial, Environmental Health guidelines, Environmental Health
 CSR ILt: BC CSR, Schedule 4, Schedule 5 (toxicity to soil invertebrates and plants) and/or Schedule 10, Industrial
 CSR ILi: BC CSR, Schedule 4, Schedule 5 (intake of contaminated soil) and/or Schedule 10, Industrial
 CSR ILfw: BC CSR, Schedule 4, Schedule 5 (groundwater flow to surface water used by Freshwater Aquatic Life, includes mandatory site-specific factors) and/or Schedule 10, Industrial
 CSR ILdw: BC CSR, Schedule 4, Schedule 5 (groundwater used for drinking water, includes mandatory site-specific factors) and/or Schedule 10, Industrial
 Green - Less than or equal to CCME IL guidelines and/or CSR IL standards
 Red - Exceeds CCME IL guidelines
 Red - Exceeds CSR IL standards



LEGEND:	
	PROPERTY BOUNDARY
	COLWOOD FORMER FOD NORTH AREA BOUNDARY
	COL BOUNDARY
	FENCE - BARBED WIRE
	BOTTOM OF BANK/ROCK FACE
	EDGE OF GRAVEL
	BOREHOLE LOCATION
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
	ANGLED MONITORING WELL
	MONITORING WELL SCREENED IN BEDROCK
	CONCENTRATIONS LESS THAN THE APPLICABLE CCME GUIDELINES (mg/kg)
	CONCENTRATIONS GREATER THAN THE APPLICABLE CCME GUIDELINES (mg/kg)
	LOCATION WHERE NAPL WAS OBSERVED IN THE ROCK CORE



PROJET: REMEDIAL SPECIFICATIONS
 PROJECT:
 SUJET: SOIL ANALYTICAL RESULTS
 SUBJECT: -POLYCYCLIC AROMATIC HYDROCARBONS
 DATE: 2017/03/31

APPROUVÉ PAR:	X.X.
APPROVED:	X.X.
ÉCHELLE:	1:600
SCALE:	1:600
NO. OTP:	XXXXXXXXX
NO. WBS NO.:	XXXXXXXXX
NO. DP:	205.03850.00000
PF NO.:	
NO. DESSIN:	X-XX-XXXX/X - 005
DWG NO.:	

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- LEGEND:**
- PROPERTY BOUNDARY
 - COLWOOD FORMER FOD NORTH AREA BOUNDARY
 - COL BOUNDARY
 - FENCE - BARBED WIRE
 - BOTTOM OF BANK/ROCK FACE
 - EDGE OF GRAVEL
 - BOREHOLE LOCATION
 - BOREHOLE LOCATION COMPLETED AS A MONITORING WELL
 - BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
 - ANGLED MONITORING WELL
 - MONITORING WELL SCREENED IN BEDROCK
 - *
 - CONCENTRATIONS LESS THAN THE APPLICABLE CCME AFW GUIDELINES (µg/L)
 - CONCENTRATIONS GREATER THAN THE APPLICABLE CCME AFW GUIDELINES (µg/L)
 - MW17-03B* NOT SAMPLED BECAUSE OF LNAPL PRESENCE



NO.	DATE	REVISION	APPR.

SCALE | ÉCHELLE: 1:600

LOCATION | EMPLACEMENT
FORMER FOD NORTH AREA
CFB ESQUIMALT
BC

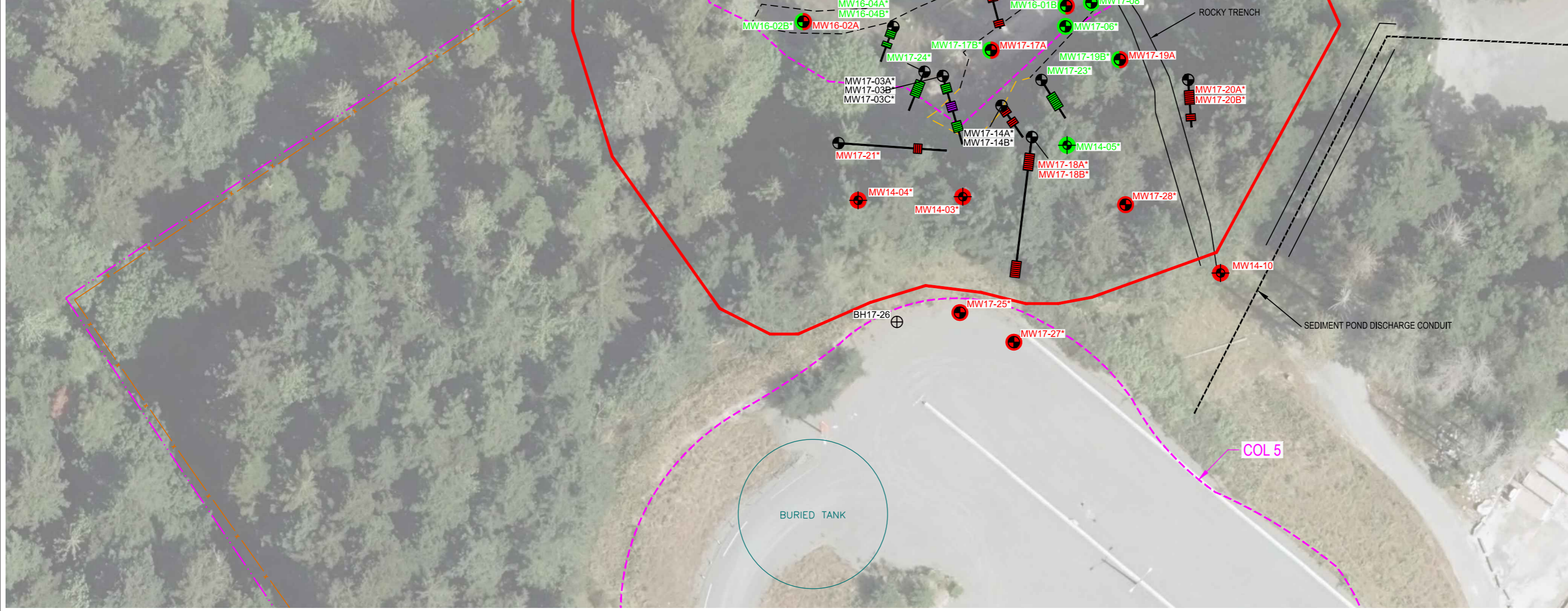
PROJECT | PROJET
REMEDIAL SPECIFICATIONS

TRADE MÉTIER	DATE
SUBJECT SUJET	2017/03/31
GROUNDWATER ANALYTICAL RESULTS - DISSOLVED METALS	
DESIGNED ETUDIÉ	DES O AGENT CONC
DRAWN DESSINÉ	PROJ MGR GEST PROJ
CHECKED VÉRIFIÉ	DES MGR GEST CONC
COORDINATION	FIRE INCENDIE

WBS NO. NO. OTP	PF NO. NO. DP
XXXXXXXX	205.03850.00000
DWG. NO. NO. DESSIN	X-XX-XXXXX-006

GROUNDWATER ANALYTICAL EXCEEDANCES - DISSOLVED METALS (µg/L)										
Sample ID	Date	Screen Depth (mbgs)	Aluminum	Arsenic	Cadmium	Copper	Iron	Selenium	Uranium	Zinc
MW14-03	14-Feb-2017	13.6 - 16.8	5.7	7.29	<0.01	0.3	241	0.68	22.2	<5
MW14-04	14-Feb-2017	12.2 - 15.2	4.7	0.47	0.064	0.47	11.6	<0.1	23.3	<5
MW14-06	14-Feb-2017	2.7 - 4.3	8.3	0.38	0.016	2.68	74.1	0.24	6.14	<5
MW14-08	14-Feb-2017	3.4 - 5.0	11.4	3.4	<0.01	<0.2	1140	<0.1	2.23	<5
MW14-09	14-Feb-2017	0.8 - 2.4	7	0.4	0.026	2.92	7.5	0.21	4.25	<5
MWA	14-Feb-2017	0.8 - 2.4	14.4	0.4	0.027	3.52	16.1	0.22	4.2	<5
MW14-10	14-Feb-2017	4.3 - 7.3	4.8	1.08	0.071	0.46	3800	<0.1	13.3	7.6
MW14-11	14-Feb-2017	0.6 - 3.7	36.6	4.79	<0.01	0.46	4270	0.18	1.72	<5
MW16-01A	14-Feb-2017	0.6 - 3.0	4.6	1.64	0.113	0.77	56.2	0.21	4.73	42.3
MW16-02A	16-Feb-2017	0.6 - 2.4	1120	0.89	0.027	8.47	1070	0.18	1.02	6.6
MW16-03A	14-Feb-2017	0.9 - 3.0	5.5	0.42	0.037	1.3	302	<0.1	3.49	9.1
MW16-05A	15-Feb-2017	4.0 - 7.0	7.3	0.61	0.038	2.9	7.3	0.46	10.6	<5
MW16-05B	15-Feb-2017	9.1 - 12.1	22.7	1.37	<0.01	1.56	1140	<0.1	2.42	<5
MW17-02A	16-Feb-2017	3.7 - 5.1	6.8	7.14	<0.01	0.22	83.4	<0.1	3.2	<5
MW17-02B	16-Feb-2017	12.2 - 13.6	8.2	1.23	<0.01	<0.2	547	0.11	5.93	<5
MW17-04B	14-Feb-2017	9.4 - 10.9	10.8	3.65	<0.01	<0.2	1230	<0.1	4.6	<5
MW17-09	14-Feb-2017	14.6 - 16.1	3.7	3.72	<0.01	<0.2	585	<0.1	7.02	<5
MW17-14A	16-Feb-2017	0.9 - 2.4	7.6	24.8	0.016	<0.2	1580	0.24	12.5	<5
MWC	16-Feb-2017	0.9 - 2.4	81.4	24.5	0.012	0.26	1650	0.18	12.4	<5
MW17-14B	16-Feb-2017	3.7 - 5.1	6.6	1.32	0.046	1.11	5.3	0.7	23.6	<5
MW17-17A	16-Feb-2017	0.9 - 3.0	13.2	1.04	<0.01	0.82	538	0.17	5.34	<5
MWD	16-Feb-2017	0.9 - 3.0	15.6	0.99	0.012	0.77	538	0.2	5.46	<5
MW17-18A	15-Feb-2017	3.0 - 6.0	4.1	2.41	<0.01	<0.2	478	0.29	12.8	<5
MW17-18B	15-Feb-2017	22.7 - 25.7	15.1	0.69	<0.01	<0.2	1550	0.14	8.63	<5
MW17-19A	15-Feb-2017	1.5 - 3.6	495	1.06	0.04	3.15	847	0.34	8.65	<5
MW17-20A	15-Feb-2017	2.4 - 5.4	6.2	0.43	0.087	3.42	6.1	0.42	3.66	<5
MW17-20B	15-Feb-2017	7.6 - 9.1	3.9	0.41	0.11	1.98	<5	0.4	3.81	<5
MW17-21	14-Feb-2017	13.7 - 15.2	6.5	1.62	0.028	3.06	9.2	1.24	29.9	<5
MW17-22A	14-Feb-2017	1.5 - 3.3	13.8	0.83	0.033	<0.2	2480	0.21	6.47	<5
MWB	14-Feb-2017	1.5 - 3.3	5.2	0.72	0.027	<0.2	2370	0.21	6.29	<5
MW17-22B	14-Feb-2017	7.6 - 9.1	8.7	0.52	0.011	<0.2	7090	0.2	6.05	<5
MW17-25	22-Mar-2017	16.6 - 18.1	6.6	0.86	0.042	0.73	108	1.38	21.4	12
MW17-27	22-Mar-2017	16.6 - 18.1	20.6	0.48	0.033	1.1	16.5	1.52	3.43	696
MW17-28	22-Mar-2017	7.2 - 8.7	<3	1.05	0.053	0.87	<5	1.13	16.5	<5
CCME AFW		5@pH<6.5 100@pH>=6.5	5	0.09		2@H>=0<120 3@H>=120<180 4@H>=180	300	1	15	30
Tier2 CLfso		ns	ns	ns		ns	ns	ns	ns	ns
Tier2 CLfw		5@pH<6.5 100@pH>=6.5	5	0.09		2@H>=0<120 3@H>=120<180 4@H>=180	300	1	15	30

Notes:
 µg/L - micrograms per litre
 mg/L - milligrams per litre
 H - Hardness in mg/L CaCO3
 < - less than analytical detection limit indicated
 "-" - sample not analyzed for parameter indicated
 ns - no standard listed
 CCME AFW: CCME Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Water, Freshwater Aquatic Life
 Tier2 CLfso: Federal Interim Groundwater Quality Guidelines, Generic Guidelines for Commercial/Industrial Land Use, Tier 2, Soil Organisms Direct Contact, Fine Grained
 Tier2 CLfw: Federal Interim Groundwater Quality Guidelines, Generic Guidelines for Commercial/Industrial Land Use, Tier 2, Freshwater Life, Fine Grained
 Green - Less than or equal to CCME AFW and/or Tier2 guidelines
 Red - Exceeds CCME AFW and/or Tier2 guidelines

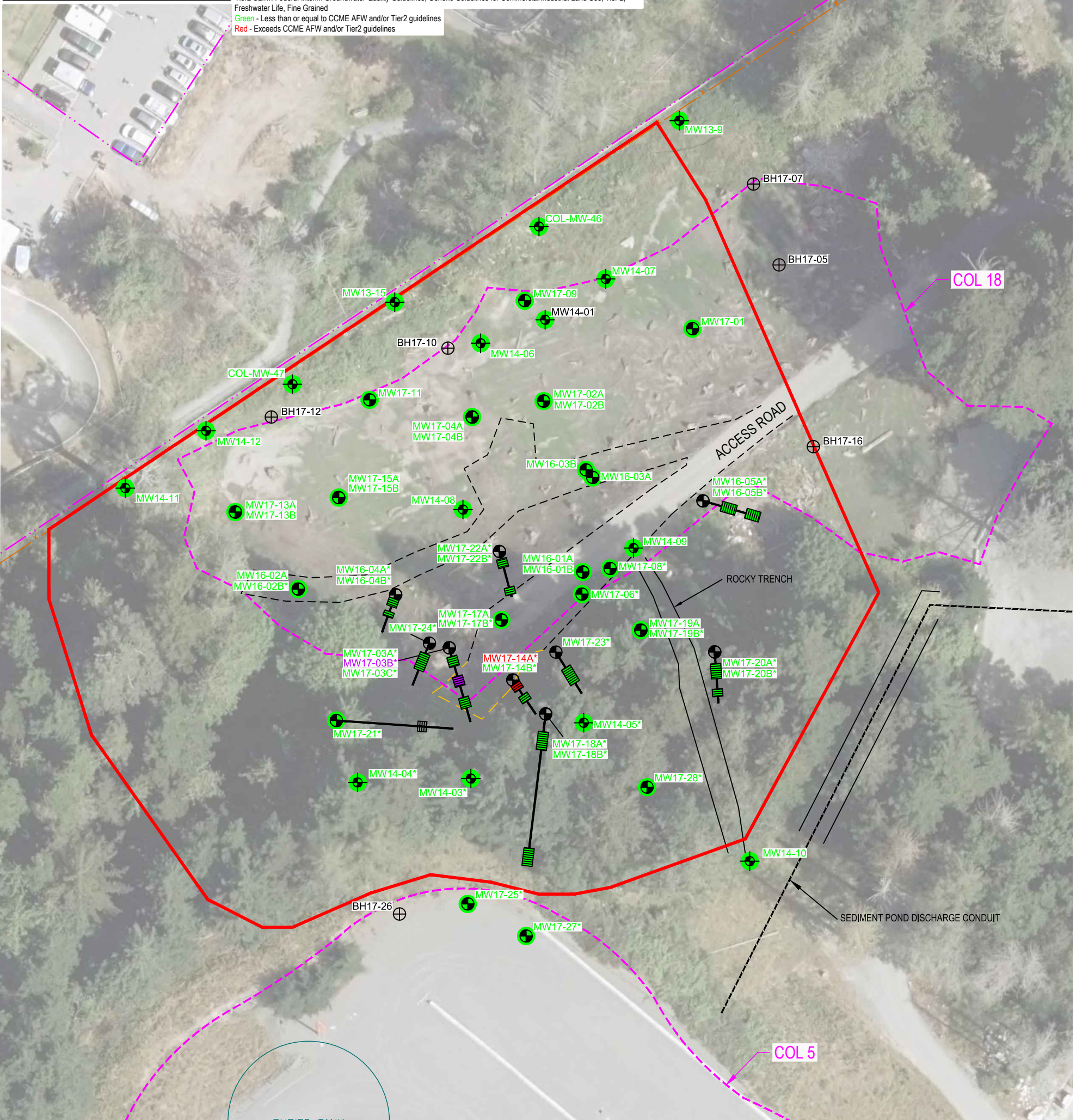




GROUNDWATER ANALYTICAL EXCEEDANCES - PETROLEUM HYDROCARBON CONSTITUENTS AND MTBE (ug/L)

Sample ID	Date	Screen Depth (mbgs)	Toluene
MW17-14A	16-Feb-2017	0.9 - 2.4	2.6
MWC			2.5
CCME AFW			2
Tier2 CLfso			240000
Tier2 CLfw			ns

Notes:
 ug/L - micrograms per litre
 mbgs - metre below ground surface
 < - less than analytical detection limit indicated
 * - sample not analyzed for parameter indicated
 F1 (C6-C10) excludes BTEX - benzene, toluene, ethylbenzene, xylene
 MTBE - methyl tertiary-butyl ether
 ns - no standard listed
 CCME AFW: CCME Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Water, Freshwater Aquatic Life
 Tier2 CLfso: Federal Interim Groundwater Quality Guidelines, Generic Guidelines for Commercial/Industrial Land Use, Tier 2, Soil Organisms Direct Contact, Fine Grained
 Tier2 CLfw: Federal Interim Groundwater Quality Guidelines, Generic Guidelines for Commercial/Industrial Land Use, Tier 2, Freshwater Life, Fine Grained
 Green - Less than or equal to CCME AFW and/or Tier2 guidelines
 Red - Exceeds CCME AFW and/or Tier2 guidelines



LEGEND:

	PROPERTY BOUNDARY		BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
	COLWOOD FORMER FOD NORTH AREA BOUNDARY		ANGLED MONITORING WELL
	COL BOUNDARY		MONITORING WELL SCREENED IN BEDROCK
	FENCE - BARBED WIRE		CONCENTRATIONS LESS THAN THE APPLICABLE CCME AFW GUIDELINES (ug/L)
	BOTTOM OF BANK/ROCK FACE		CONCENTRATIONS GREATER THAN THE APPLICABLE CCME AFW GUIDELINES (ug/L)
	EDGE OF GRAVEL		MW17-03B* NOT SAMPLED BECAUSE OF LNAPL PRESENCE DETECTED
	BOREHOLE LOCATION		
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL		

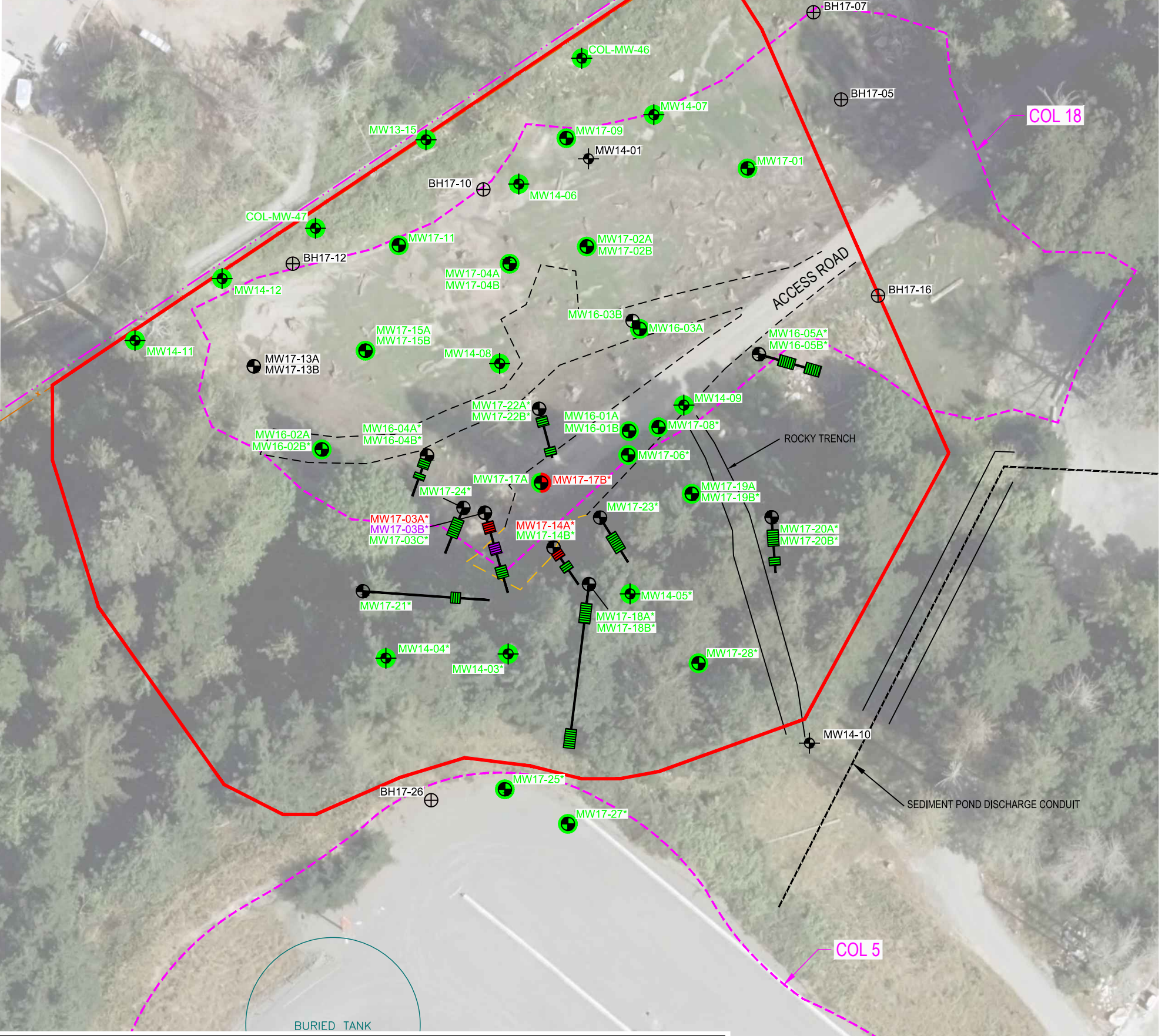
PROJET: REMEDIAL SPECIFICATIONS
 PROJECT:
 SUJET: GROUNDWATER ANALYTICAL RESULTS - PETROLEUM HYDROCARBONS AND MTBE
 SUBJECT:
 DATE: 2017/03/31

APPROUVÉ PAR:	X.X.
APPROVED:	X.X.
ÉCHELLE: SCALE:	1:600
NO. OTP: WBS NO.:	XXXXXXXXX
NO. DP: PF NO.:	205.03850.00000
NO. DESSIN: DWG NO.:	X-XX-XXXX/X - 007



GROUNDWATER ANALYTICAL EXCEEDANCES - POLYCYCLIC AROMATIC HYDROCARBONS (ug/L)							
Sample ID	Date	Screen Depth (mbgs)	Acridine	Anthracene	Naphthalene	Phenanthrene	Pyrene
MW17-03A	16-Feb-2017	1.8 - 3.9	<0.05	0.021	<0.1	<0.05	0.028
MW17-14A	16-Feb-2017	0.9 - 2.4	0.065	0.14	23	1.1	0.067
MWC			0.074	0.12	22	0.95	0.052
MW17-17B	16-Feb-2017	3.7 - 5.1	<0.05	0.02	0.87	0.13	0.032
MWE			<0.05	0.014	0.77	0.1	0.027
CCME AFW			4.4	0.012	1.1	0.4	0.025
Tier2 CLfso			ns	320	ns	ns	ns
Tier2 CLffw			0.05	0.012	1.1	0.4	0.025

Notes:
 ug/L - micrograms per litre
 PAH - polycyclic aromatic hydrocarbons
 < - less than analytical detection limit indicated
 '...' - sample not analyzed for parameter indicated
 ns - no standard listed
 CCME AFW: CCME Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Water, Freshwater Aquatic Life
 Tier2 CLfso: Federal Interim Groundwater Quality Guidelines, Generic Guidelines for Commercial/Industrial Land Use, Tier 2, Soil Organisms Direct Contact, Fine Grained
 Tier2 CLffw: Federal Interim Groundwater Quality Guidelines, Generic Guidelines for Commercial/Industrial Land Use, Tier 2, Freshwater Life, Fine Grained
 Green - Less than or equal to CCME AFW and/or Tier2 guidelines
 Red - Exceeds CCME AFW and/or Tier2 guidelines



LEGEND:	
	PROPERTY BOUNDARY
	COLWOOD FORMER FOD NORTH AREA BOUNDARY
	COL BOUNDARY
	FENCE - BARBED WIRE
	BOTTOM OF BANK/ROCK FACE
	EDGE OF GRAVEL
	BOREHOLE LOCATION
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
	ANGLED MONITORING WELL
	MONITORING WELL SCREENED IN BEDROCK
	CONCENTRATIONS LESS THAN THE APPLICABLE CCME AFW GUIDELINES (ug/L)
	CONCENTRATIONS GREATER THAN THE APPLICABLE CCME AFW GUIDELINES (ug/L)
	MW17-03B* NOT SAMPLED BECAUSE OF LNAPL PRESENCE DETECTED

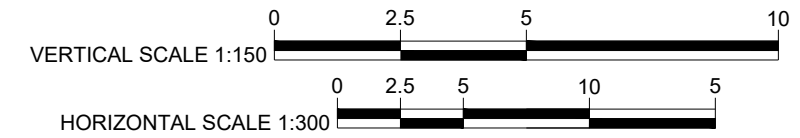
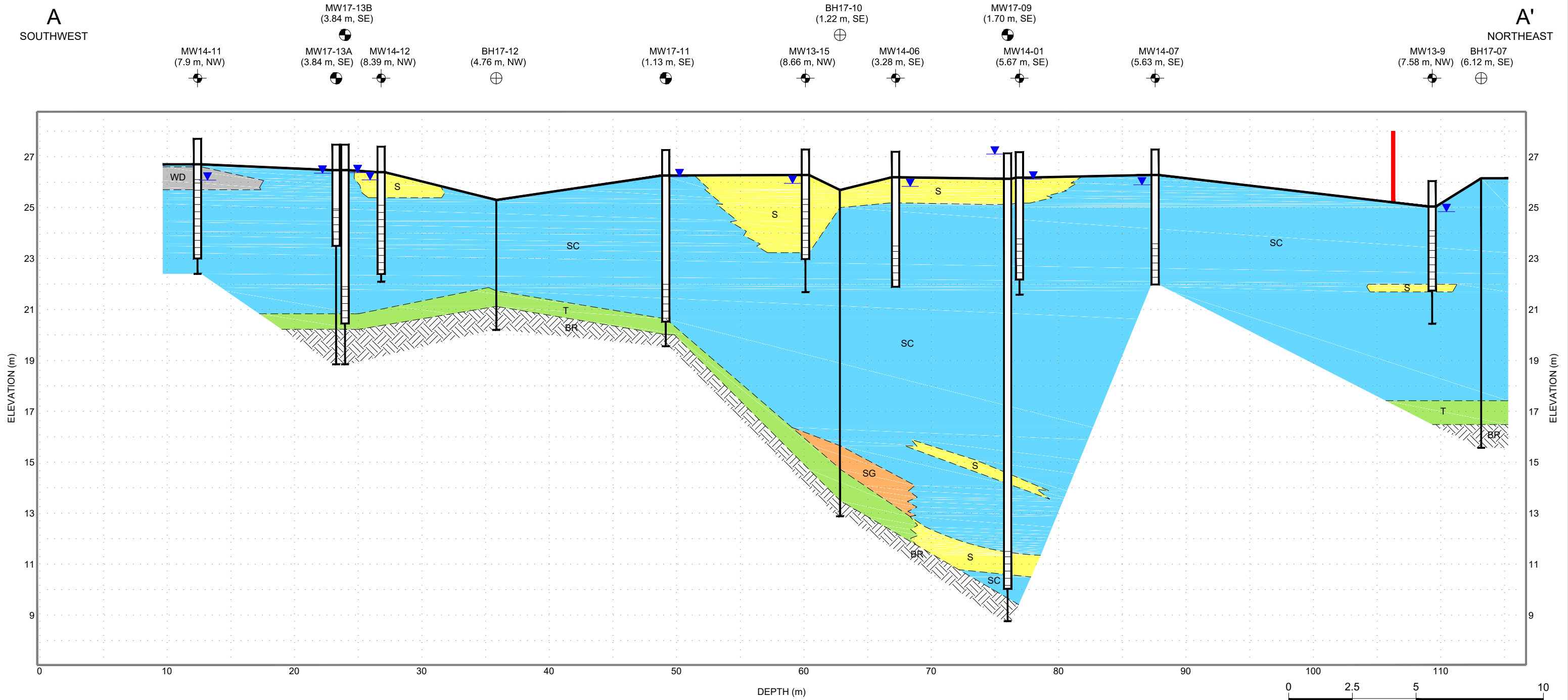


PROJET: REMEDIAL SPECIFICATIONS
 PROJECT:
 SUJET: GROUNDWATER ANALYTICAL RESULTS - POLYCYCLIC AROMATIC HYDROCARBONS
 SUBJECT:
 DATE: 2017/03/31

APPROUVÉ PAR:	X.X.
APPROVED:	X.X.
ÉCHELLE: SCALE:	1:600
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NO. DP: PF NO.:	205.03850.00000
NO. DESSIN: DWG NO.:	X-XX-XXXX/X - 008

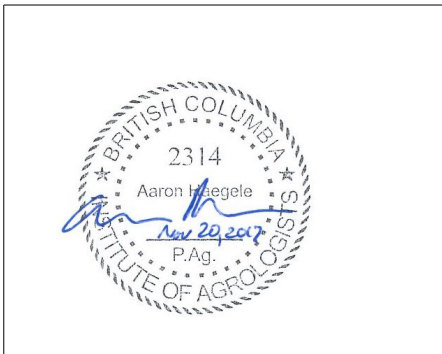
A
SOUTHWEST

A'
NORTHEAST



LEGEND:

	COLWOOD FORMER FOD NORTH AREA BOUNDARY		SANDY AND GRAVELLY SILT (TILL LIKE)
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL		SAND AND GRAVEL
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)		GROUNDWATER ELEVATION (2017-03-24)
	BEDROCK		NAPL ELEVATION (2017-03-24)
	SAND		WELL
	SILTY SAND		SCREENED INTERVAL
	SILTY CLAY		BOREHOLE
	WOOD DEBRIS		END OF HOLE



PROJECT: REMEDIAL SPECIFICATIONS
PROJET:

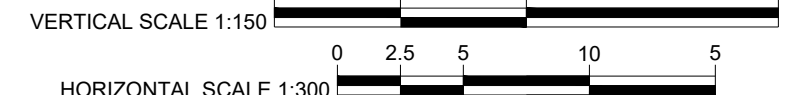
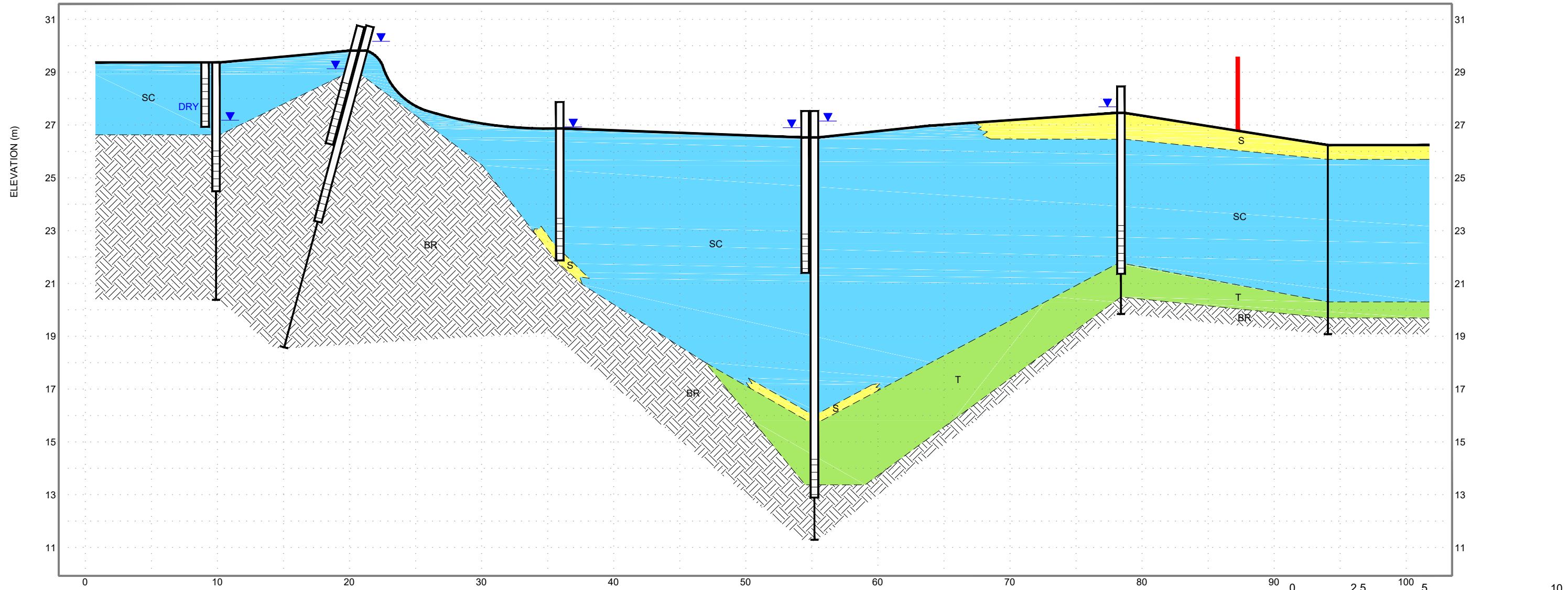
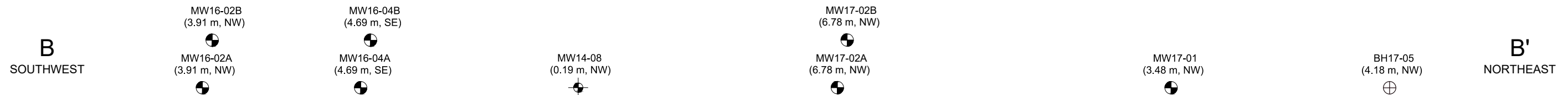
SUBJECT: CROSS SECTION A-A'
SUJET:

DATE: 2017/03/31

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SCALE:	
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NO. OTP:	
PF NO.:	205.03850.00000
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DWG NO.:	X-XX-XXXX/X - 009
NO. DESSIN:	

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BORDER LAST UPDATED 2011-11-11



LEGEND:

	COLWOOD FORMER FOD NORTH AREA BOUNDARY		SANDY AND GRAVELLY SILT (TILL LIKE)
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL		GROUNDWATER ELEVATION (2017-03-24)
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)		NAPL ELEVATION (2017-03-24)
	BEDROCK		WELL
	SAND		SCREENED INTERVAL
	SILT AND CLAY		BOREHOLE
			END OF HOLE



PROJECT: REMEDIAL SPECIFICATIONS
 PROJÉT:
 SUBJECT: CROSS SECTION B-B'
 SUJET:
 DATE: 2017/03/31

APPROVED:	
APPROUVÉ PAR:	
SCALE:	
ÉCHELLE:	
WBS NO.:	
NO. OTP:	
PF NO.:	205.03850.00000
NO. DP:	
DWG NO.:	X-XX-XXXX/X - 010
NO. DESSIN:	

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C
SOUTHWEST

MW14-04 (4.06 m, SE) MW17-21 (4.96 m, NW)

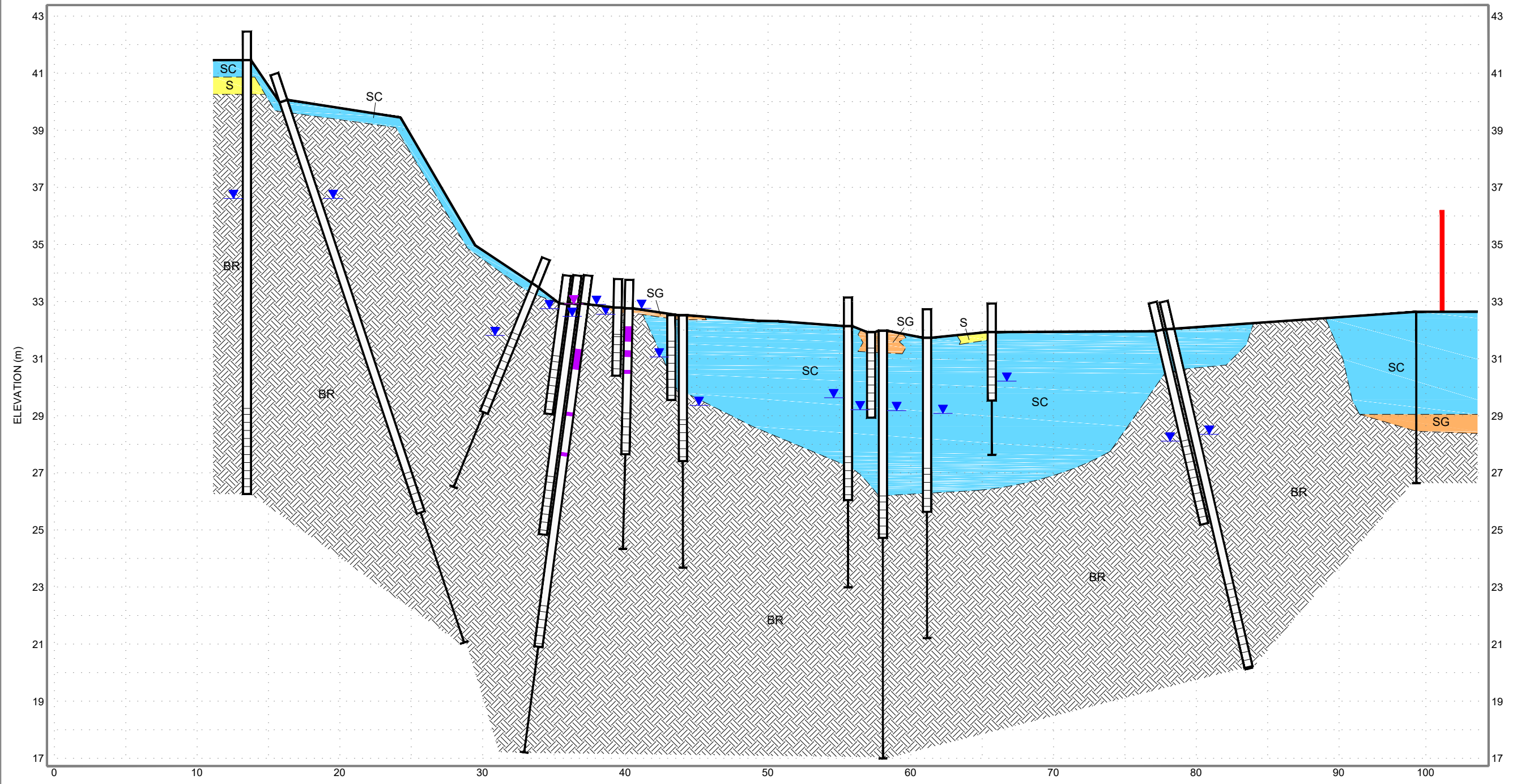
MW17-03C (3.11 m, NW) MW17-03B (3.11 m, NW) MW17-03A (3.11 m, NW)

MW17-14B (6.31 m, SE) MW17-17A (1.62 m, NW) MW17-14A (6.31 m, SE) MW17-17B (1.62 m, NW)

MW17-24 (5.43 m, NW) MW16-01B (0.23 m, SE) MW17-08 (2.28 m, SE) MW14-09 (2.06 m, SE)

MW16-01A (0.23 m, SE) MW16-05B (2.91 m, SE) MW16-05A (2.91 m, SE)

BH17-16 (6.64 m, SE) C' NORTHEAST



- LEGEND:**
- COLWOOD FORMER FOD NORTH AREA BOUNDARY
 - BOREHOLE LOCATION COMPLETED AS A MONITORING WELL
 - BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
 - BEDROCK
 - SAND
 - SILT AND CLAY
 - SAND AND GRAVEL
 - GROUNDWATER ELEVATION (2017-03-24)
 - NAPL ELEVATION (2017-03-24)
 - AREA WHERE NAPL WAS OBSERVED IN THE ROCK CORE
 - WELL
 - SCREENED INTERVAL
 - BOREHOLE
 - END OF HOLE

#	YYYYMMDD	REVISION DESCRIPTION	X.X
NO.	DATE	REVISION	APPR.

SCALE | ÉCHELLE

LOCATION | EMLACEMENT
FORMER FOD NORTH AREA
CFB ESQUIMALT
BC

PROJECT | PROJET
REMEDIAL SPECIFICATIONS

TRADE | MÉTIER
DATE
2017/03/31

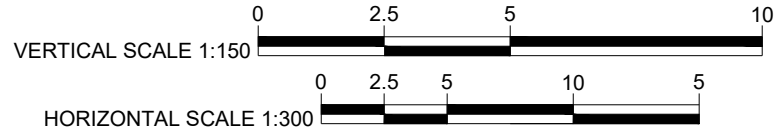
SUBJECT | SUJET
CROSS SECTION C-C'

PRODUCTION	DESIGNED ÉTUDIÉ	REVIEWED REVU	DES O AGENT CONC
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LEGEND:

- COLWOOD FORMER FOD NORTH AREA BOUNDARY
- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL
- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
- BEDROCK
- SAND AND GRAVEL
- SAND
- SILT AND CLAY
- BOULDER
- SANDY AND GRAVELLY SILT (TILL LIKE)
- WOOD DEBRIS
- GROUNDWATER ELEVATION (2017-03-24)
- NAPL ELEVATION (2017-03-24)
- AREA WHERE NAPL WAS OBSERVED IN THE ROCK CORE
- WELL
- SCREENED INTERVAL
- BOREHOLE
- END OF HOLE

#	YYYYMMDD	REVISION DESCRIPTION	X.X
NO.	DATE	REVISION	APPR.

SCALE | ÉCHELLE

LOCATION | EMPLACEMENT
**FORMER FOD NORTH AREA
CFB ESQUIMALT
BC**

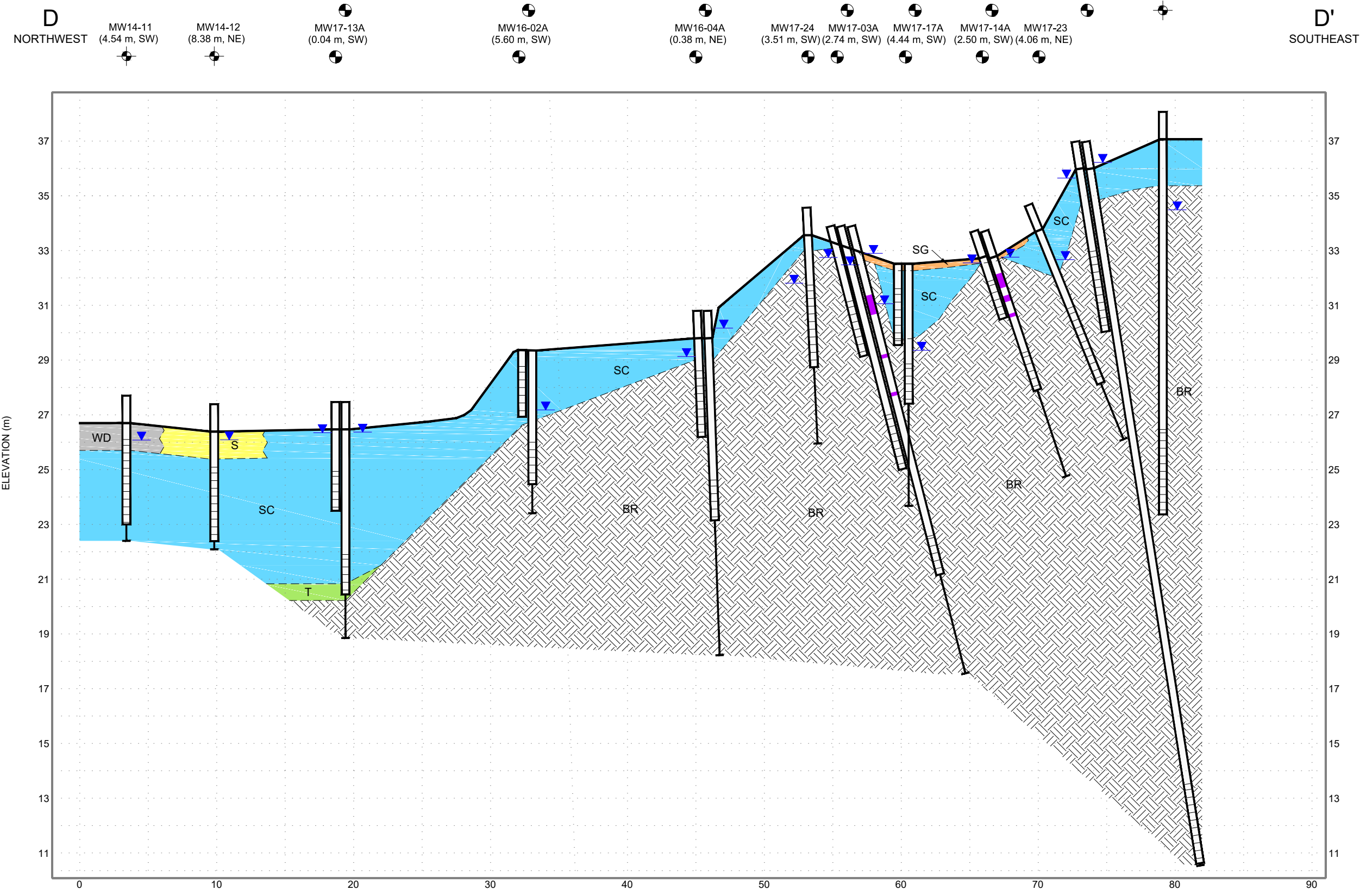
PROJECT | PROJET
REMEDIAL SPECIFICATIONS

TRADE | MÉTIER _____ DATE **2017/03/31**

SUBJECT | SUJET _____
CROSS SECTION D-D'

PRODUCTION	DESIGNED ÉTUDIÉ	REVIEWED REVU	DES O AGENT CONC
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DWG. NO. | NO. DESSIN: **X-XX-XXXXX-012**



VERTICAL SCALE 1:150

HORIZONTAL SCALE 1:300

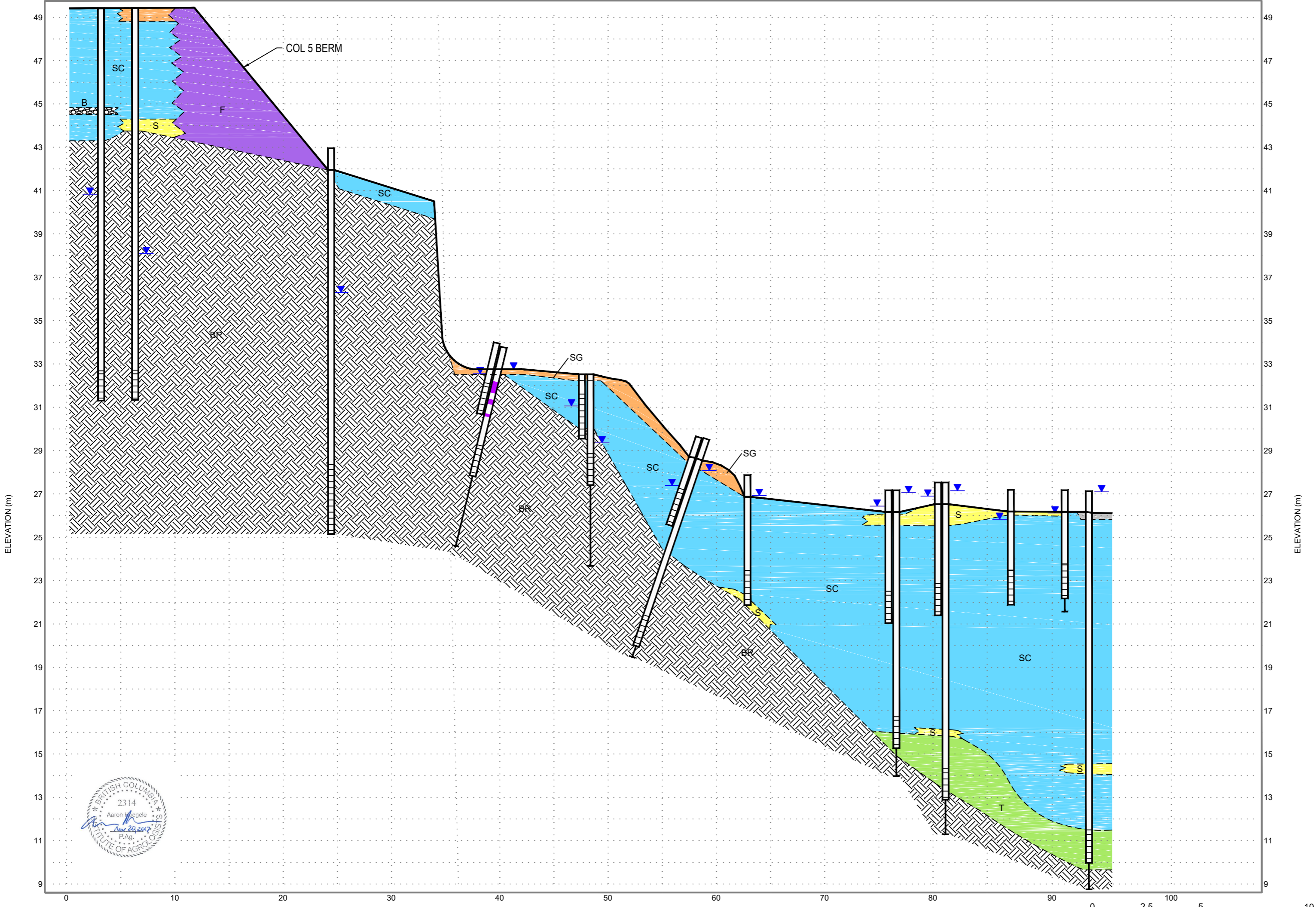


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c-d'

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E SOUTH MW17-27* (4.80 m, NW) MW17-25* (4.75 m, SE) MW14-03 (2.08 m, SE) MW17-14A (2.51 m, SE) MW17-14B (2.51 m, SE) MW17-17A (2.51 m, SE) MW17-17B (2.51 m, SE) MW17-22A (0.54 m, SE) MW17-22B (0.54 m, SE) MW14-08 (5.75 m, NW) MW17-04 (6.73 m, NW) MW17-04B (6.73 m, NW) MW17-02A (3.14 m, SE) MW17-02B (3.14 m, SE) MW14-06 (7.35 m, NW) MW17-09 (2.07 m, NW) MW14-01 (1.35 m, SE) E' NORTH



LEGEND:

- COLWOOD FORMER FOD NORTH AREA BOUNDARY
- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL
- BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (OTHERS)
- BEDROCK
- BOULDERS
- UNKNOWN FILL MATERIAL
- SAND
- SILT AND CLAY
- SANDY AND GRAVELLY SILT (TILL LIKE)
- TOPSOIL
- SAND AND GRAVEL
- GROUNDWATER ELEVATION (2017-03-24)
- NAPL ELEVATION (2017-03-24)
- AREA WHERE NAPL WAS OBSERVED IN THE ROCK CORE
- WELL
- SCREENED INTERVAL
- BOREHOLE
- END OF HOLE

NO.	DATE	REVISION	APPR.

SCALE | ÉCHELLE

LOCATION | EMPLACEMENT
**FORMER FOD NORTH AREA
 ESQUIMALT
 BC**

PROJECT | PROJET

REMEDIAL SPECIFICATIONS

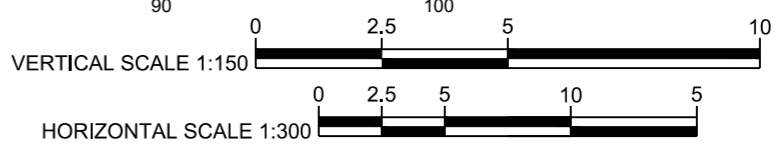
TRADE | MÉTIER DATE
 2017/03/31

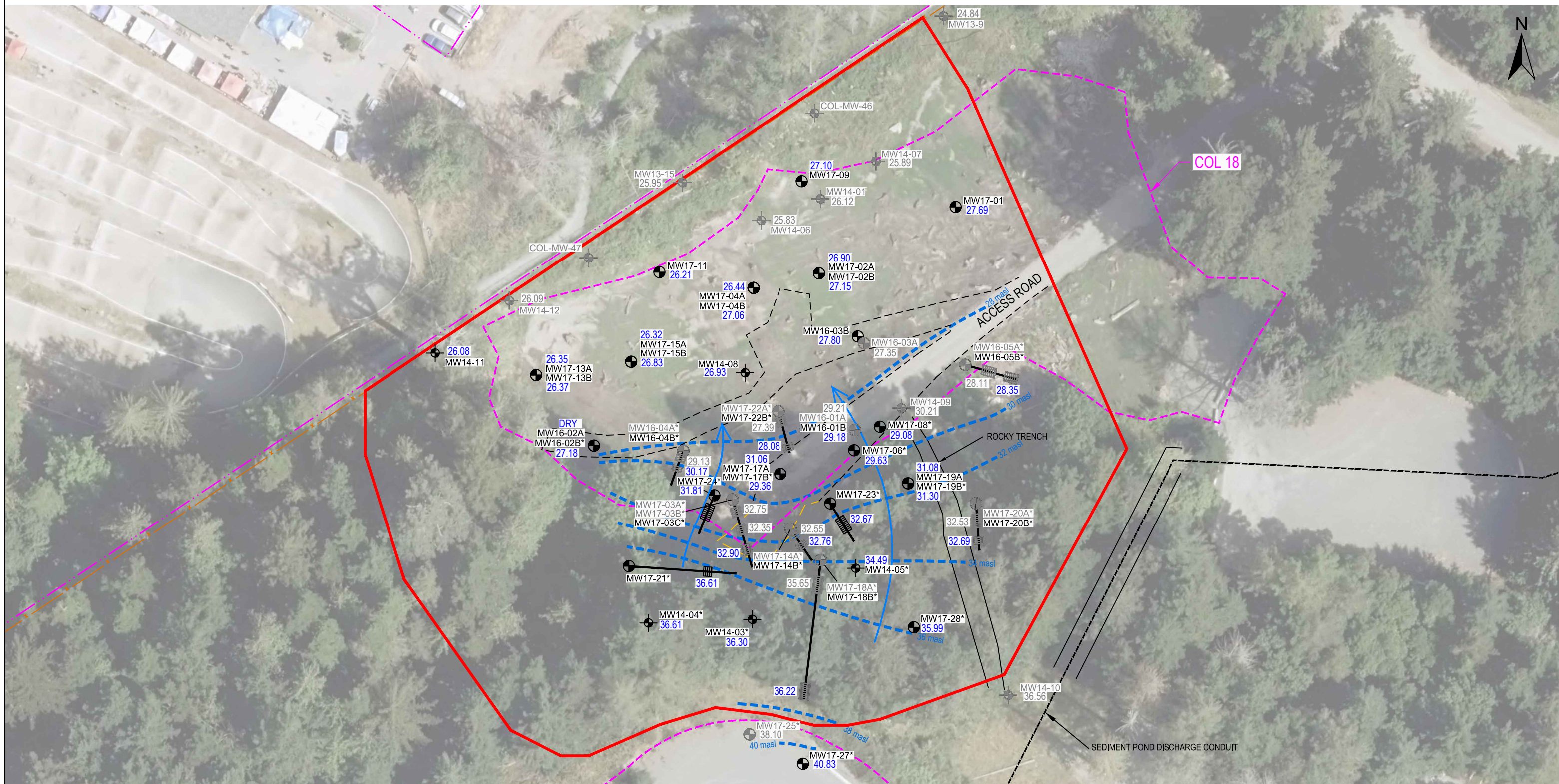
CROSS SECTION E-E'

DESIGNED ETUDIÉ	REVIEWED REVU	DES O AGENT CONC
DRAWN DESSINÉ		PROJ MGR GEST PROJ
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COORDINATION		FIRE INCENDIE

WBS NO. | NO. OTP PF NO. | NO. DP
 XXXXXXXX 205.03850.00000

DWG. NO. | NO. DESSIN X-XX-XXXXX-013





LEGEND:

	PROPERTY BOUNDARY		BOREHOLE LOCATION COMPLETED AS A MONITORING WELL (SNC LAVALIN)
	COLWOOD FORMER FOD NORTH AREA BOUNDARY		ANGLED MONITORING WELL
	COL BOUNDARY		MONITORING WELL SCREENED IN BEDROCK
	FENCE - BARBED WIRE		GROUNDWATER ELEVATION (m)
	BOTTOM OF BANK/ROCK FACE		INFERRED GROUNDWATER ELEVATION CONTOUR (INTERVAL 2.0 m)
	EDGE OF GRAVEL		INFERRED GROUNDWATER FLOW DIRECTION
	BOREHOLE LOCATION COMPLETED AS A MONITORING WELL		MONITORING WELL NOT MONITORED

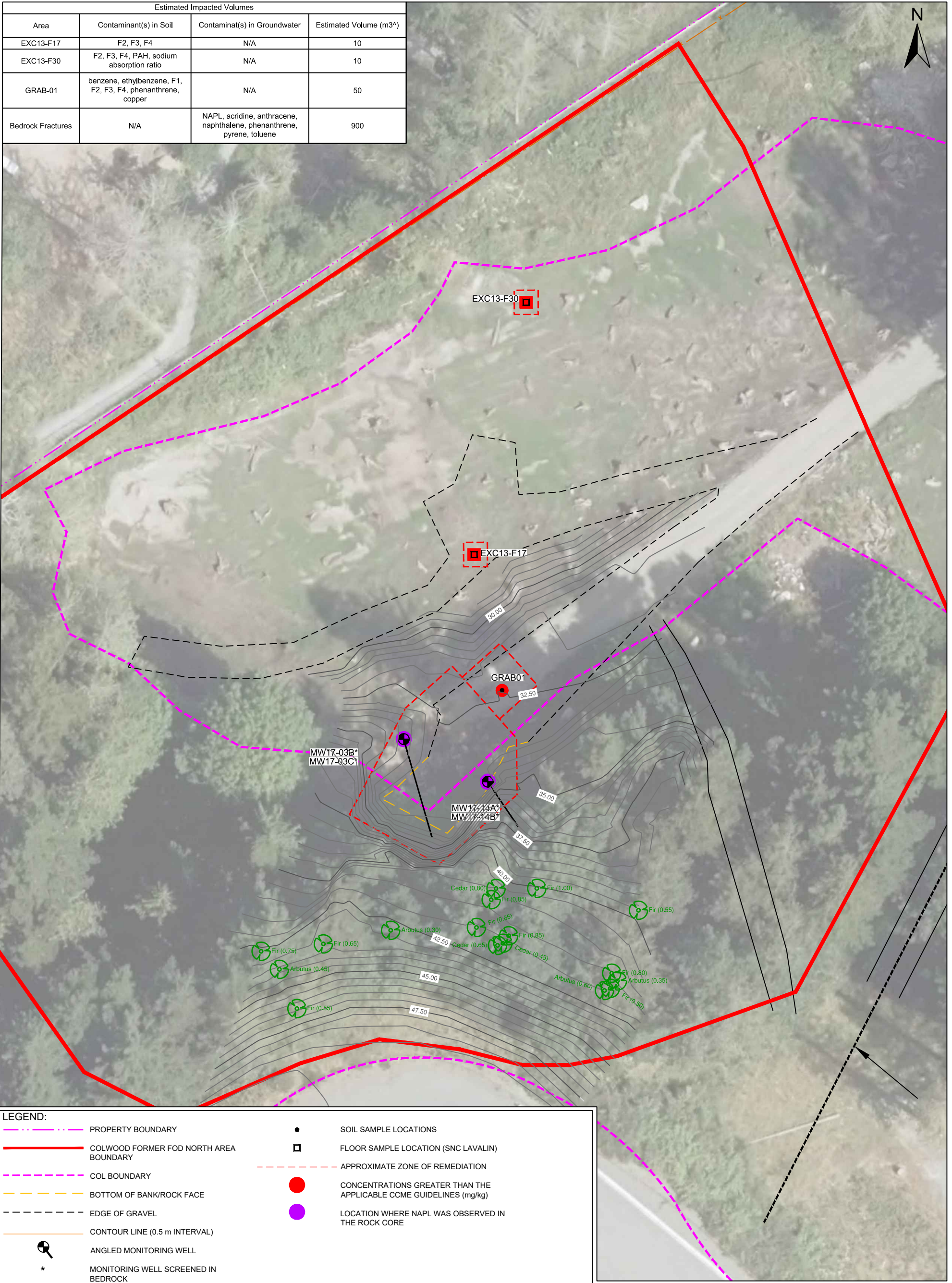


PROJECT: REMEDIAL SPECIFICATIONS
 PROJET:
 SUBJECT: **INFERRED GROUNDWATER**
 SUJET: **CONTOUR PLAN - MARCH 24, 2017**
 DATE: 2017/03/31

APPROVED:	
APPROUVÉ PAR:	
SCALE: ÉCHELLE:	1:600
WBS NO.:	XXXXXXXXX
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PF NO.:	205.03850.00000
NO. DP:	
DWG NO.:	X-XX-XXXX/X - 014
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Estimated Impacted Volumes			
Area	Contaminant(s) in Soil	Contaminant(s) in Groundwater	Estimated Volume (m ³)
EXC13-F17	F2, F3, F4	N/A	10
EXC13-F30	F2, F3, F4, PAH, sodium absorption ratio	N/A	10
GRAB-01	benzene, ethylbenzene, F1, F2, F3, F4, phenanthrene, copper	N/A	50
Bedrock Fractures	N/A	NAPL, acridine, anthracene, naphthalene, phenanthrene, pyrene, toluene	900



LEGEND:

	PROPERTY BOUNDARY		SOIL SAMPLE LOCATIONS
	COLWOOD FORMER FOD NORTH AREA BOUNDARY		FLOOR SAMPLE LOCATION (SNC LAVALIN)
	COL BOUNDARY		APPROXIMATE ZONE OF REMEDIATION
	BOTTOM OF BANK/ROCK FACE		CONCENTRATIONS GREATER THAN THE APPLICABLE CCME GUIDELINES (mg/kg)
	EDGE OF GRAVEL		LOCATION WHERE NAPL WAS OBSERVED IN THE ROCK CORE
	CONTOUR LINE (0.5 m INTERVAL)		
	ANGLED MONITORING WELL		
	MONITORING WELL SCREENED IN BEDROCK		



PROJET: REMEDIAL SPECIFICATIONS
PROJECT:

SUJET: APPROXIMATE ZONES OF
SUBJECT: REMEDIATION

DATE: 2017/03/31

APPROUVÉ PAR:	X.X.
APPROVED:	X.X.
ÉCHELLE: SCALE:	1:400
NO. OTP: WBS NO.:	XXXXXXXXX
NO. DP: PF NO.:	205.03850.00000
NO. DESSIN: DWG NO.:	X-XX-XXXX/X - 015

APPENDIX C
Geotechnical Report

Colwood FOD North Area
CFB Esquimalt, Colwood, BC
SLR Project No.: 205.03903.00000



THURBER ENGINEERING LTD.



October 27, 2017

File: 19035

SLR Consulting (Canada) Ltd.
#6 – 40 Cadillac Ave.
Victoria, BC V8Z 1T2

Attention: Aaron Haegele

DND COLWOOD FOD REMEDIATION GEOTECHNICAL BLASTING ASSESSMENT

Dear Aaron:

As outlined in our proposal dated June 13, 2017 we have carried out a geotechnical assessment of the proposed blasting to be carried out at the DND Colwood FOD site in Colwood, BC.

It is a condition of this proposal that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

1. BACKGROUND

We understand that heavy hydrocarbon contamination has penetrated fractures in the bedrock and remediation of the site requires blasting and removal of the contaminated zones of bedrock. The blasting is in a previously excavated area and rock slopes up to about 13 m will be required. The subject area is about 20 m wide x 30 m long. The area has been extensively drilled to identify the extents of contamination including rock coring.

The purpose of the project is to remove the contaminated soil and rock that remains at the site. No specific future use of the site is currently known and no regular access by personnel or the public is anticipated.

2. SCOPE OF WORK

We have completed the following scope of work:

1. Conducted an initial site visit and bedrock outcrop mapping exercise.
2. Inspected the available rock cores and test hole logs.
3. Reviewed background reports.
4. Prepared blasting recommendations and provide input into contract specifications.

3. SITE OBSERVATIONS

The subject site is a currently unused area near the edge of the Colwood Department of Defense Base. The area appears to have previously excavated rock slopes. The timing or purpose of excavated slopes is not known. Near the crest of the rock slopes, a fill embankment has been

constructed with the COL 5 parking lot at the top. We understand that decommissioned tanks containing dredgate are contained within the embankment fill.

The exposed bedrock is a slightly weathered, highly jointed limestone with existing slopes between about 60° and 76°. Stereonet 1 attached presents a two-dimensional, circular representation of a sphere with discontinuity measurements taken at the site and shows the main cut orientations. This is used for the kinematic stability analysis of the slopes. The slopes do not appear to have been blasted using presplit blasting techniques. Soil exposed at the crest of the cut appears to be thin (< 1 m), but may increase in thickness upslope.

4. RECOMMENDATIONS

Due to the presence of the fill embankment upslope, it is critical that the excavation slopes be constructed such that the fill stability is not reduced. We recommend that a minimum of 3 m of separation be left between the crest of the new cut and the toe of the embankment slope.

Typically, a minimum rock cut thickness in the range of 3 m to 5 m is required to allow controlled, production blasting. Thinner cuts would require smaller, more closely spaced holes and would be at higher risk of resulting in fly-rock and overbreak.

We recommend that the rock be cut with a backslope angle of 0.25H:1V (76°) to reduce the number of kinematically possible instabilities and reduce the likelihood of overbreak extending to the fill embankment above. Overburden cuts should be carried out at an angle of 1.5H:1V (34°). The rock slopes should be excavated by blasting using pre-split blasting techniques in maximum 8 m high lifts. Some local slope stabilization consisting of trimming, rock bolting or shotcrete may be required.

We have prepared drawings 19035-1 and -2 (attached) using the LiDAR and survey provided to us by WSP and the base of cut polygon provide by SLR. The drawings show the projected cuts up from the base of the polygon at 0.25H:1V slopes and have not estimated the thickness of overburden at the top of cut. We understand that the cut area may be partially backfilled upon completion of the remediation works. This is considered acceptable from a geotechnical perspective. Fall protection consisting of a fence or other means should be constructed around the perimeter of the excavation.

We have reviewed the generic NMS specifications for blasting and note that they do not specify performance aspects of the blasting that are more likely to result in an acceptable permanent backslope. We recommend that the specifications be updated to include requirements to complete pre-shear “smooth wall” blasting practices. We have prepared a sample rock blasting specification to be used as a guideline that will be issued separately.

The site is generally more than 100 m from nearby structures. We recommend that a maximum peak particle velocity of 25 mm/sec be used for the allowable blast vibrations at the nearest structure. The contractor should be made responsible for the blast design and for monitoring to minimize the potential for damage.

No environmental assessment of the potential for karst features in the limestone or for the effects of hydrocarbons or blasting practices has been conducted.

5. FURTHER WORK

We should be retained during construction to carry out the following inspections:

1. Inspection of the rock surface, overburden cut slope and surveyed backline hole locations prior to blasting.
2. Quality assurance blast vibration monitoring to confirm contractor's methods and procedures.
3. Inspect each lift after blasting, mucking and machine scaling to determine stabilization requirements of the exposed backslope prior to drilling the next lift.
4. Final inspection of rock slopes prior to contractor demobilization.

6. CLOSURE

We trust the above provides the information you require at this time. If you have any questions regarding this letter, please contact either of the undersigned.

Yours truly,
Thurber Engineering Ltd.
Stephen Bean, M.Eng., P.Eng.
Review Principal



Warren Wunderlick
Warren Wunderlick, B.A.Sc., P.Eng.
Geotechnical Engineer

Statement of Limitations and Conditions
Drawings



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

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5. INTERPRETATION OF THE REPORT

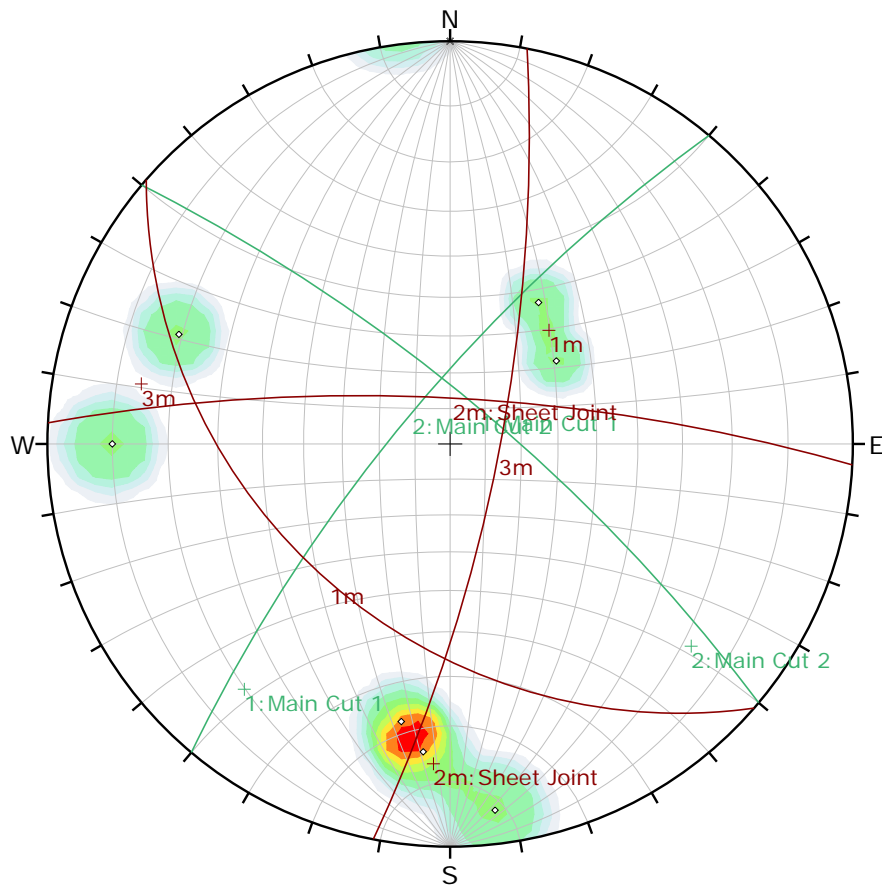
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

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Symbol	Feature
◊	Pole Vectors

Color	Density Concentrations
	0.00 - 2.80
	2.80 - 5.60
	5.60 - 8.40
	8.40 - 11.20
	11.20 - 14.00
	14.00 - 16.80
	16.80 - 19.60
	19.60 - 22.40
	22.40 - 25.20
	25.20 - 28.00

Maximum Density	27.05%
Contour Data	Pole Vectors
Contour Distribution	Fisher
Counting Circle Size	1.0%

	Color	Dip	Dip Direction	Label
User Planes				
1	■	77	40	Main Cut 1
2	■	76	310	Main Cut 2
Mean Set Planes				
1m	■	41	221	
2m	■	77	3	Sheet Joint
3m	■	76	101	

Plot Mode	Pole Vectors
Vector Count	7 (7 Entries)
Hemisphere	Lower
Projection	Equal Angle



Project

Colwood FOD

Client

SLR Consulting (Canada) Ltd.

Project Number

19035

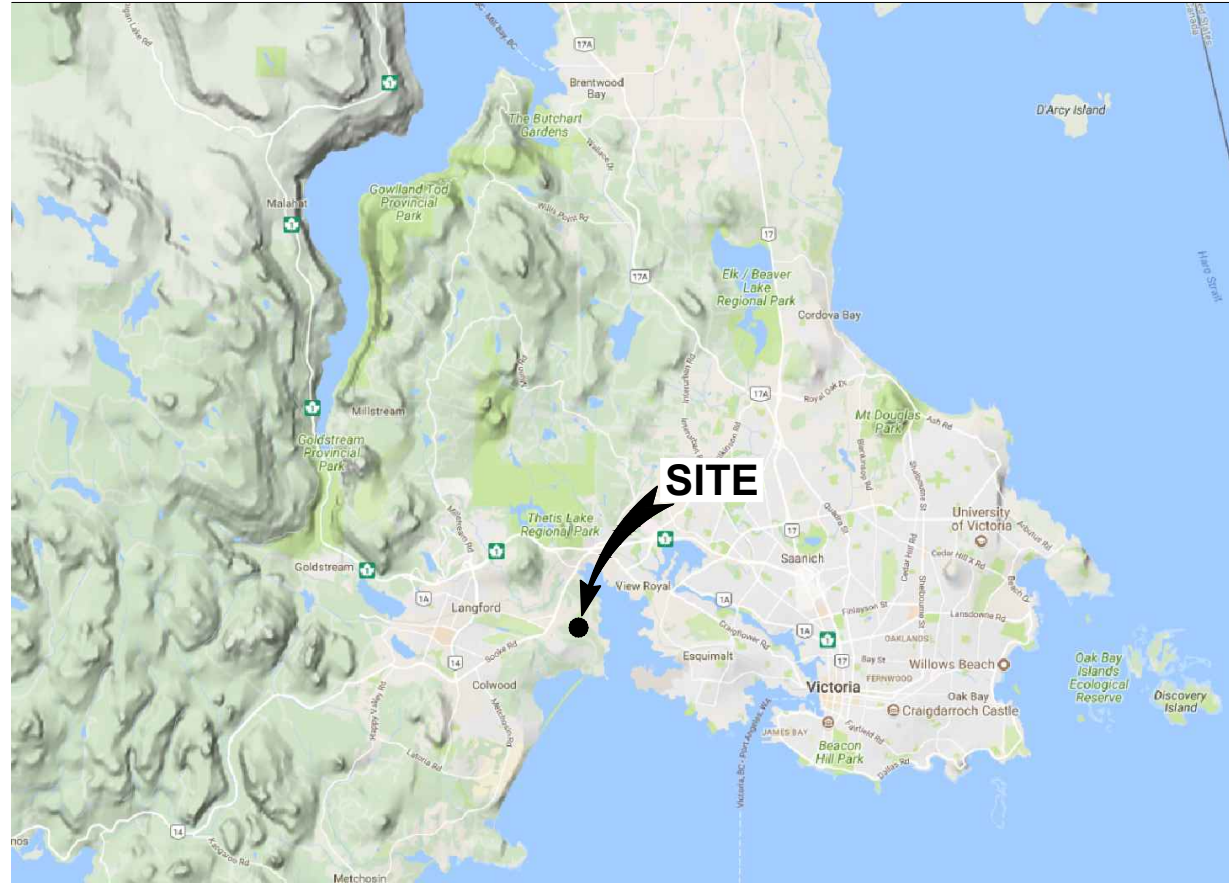
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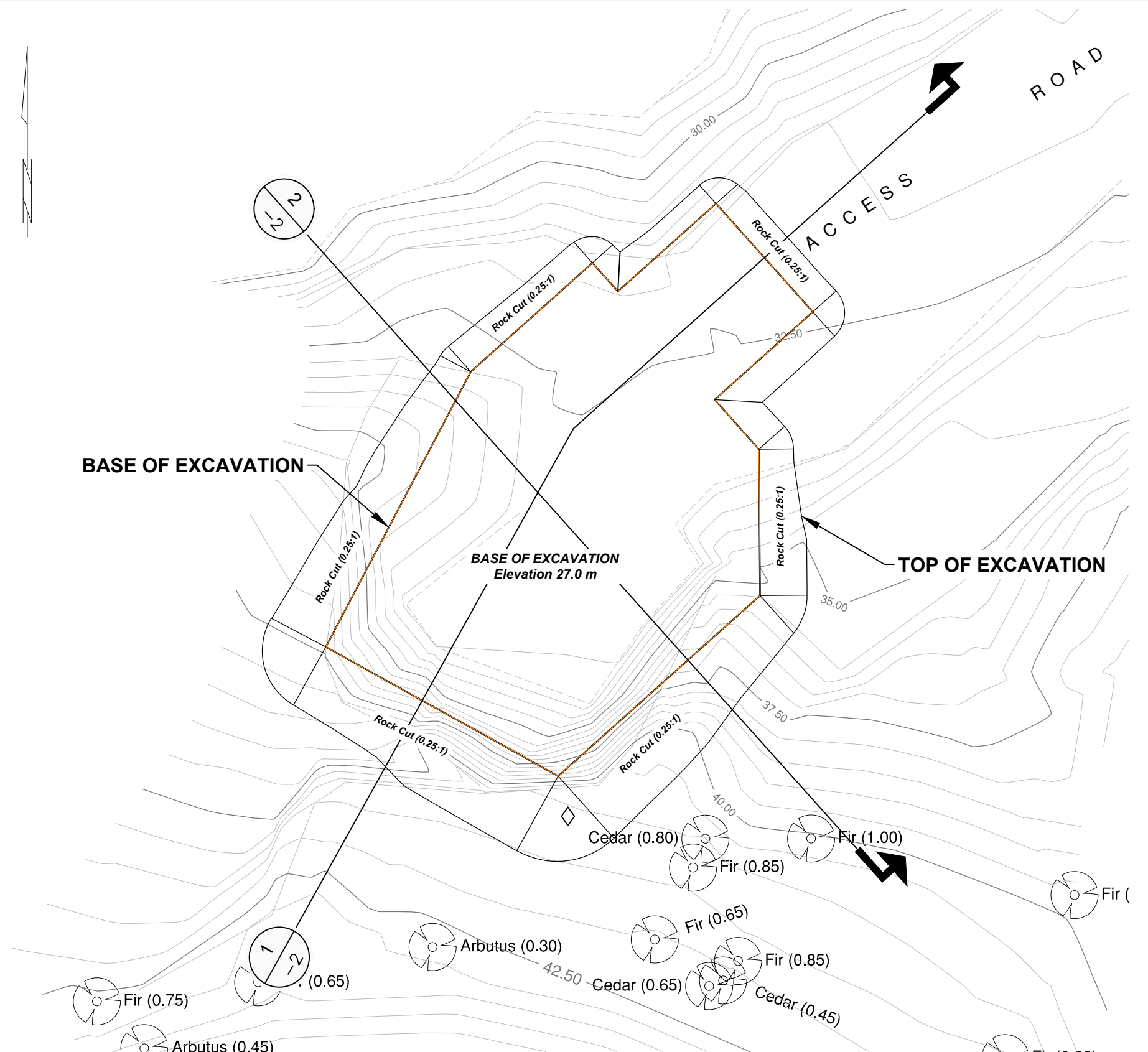


GENERAL LOCATION PLAN

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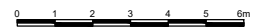
NOTES:

1. DIGITAL BASE PLAN PROVIDED BY SLR CONSULTING (CANADA) LTD.
2. GENERAL LOCATION PLAN IMAGE FROM GOOGLE EARTH.



SITE PLAN

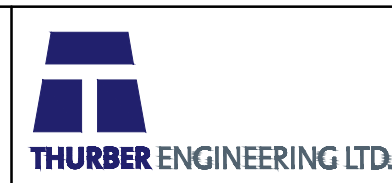
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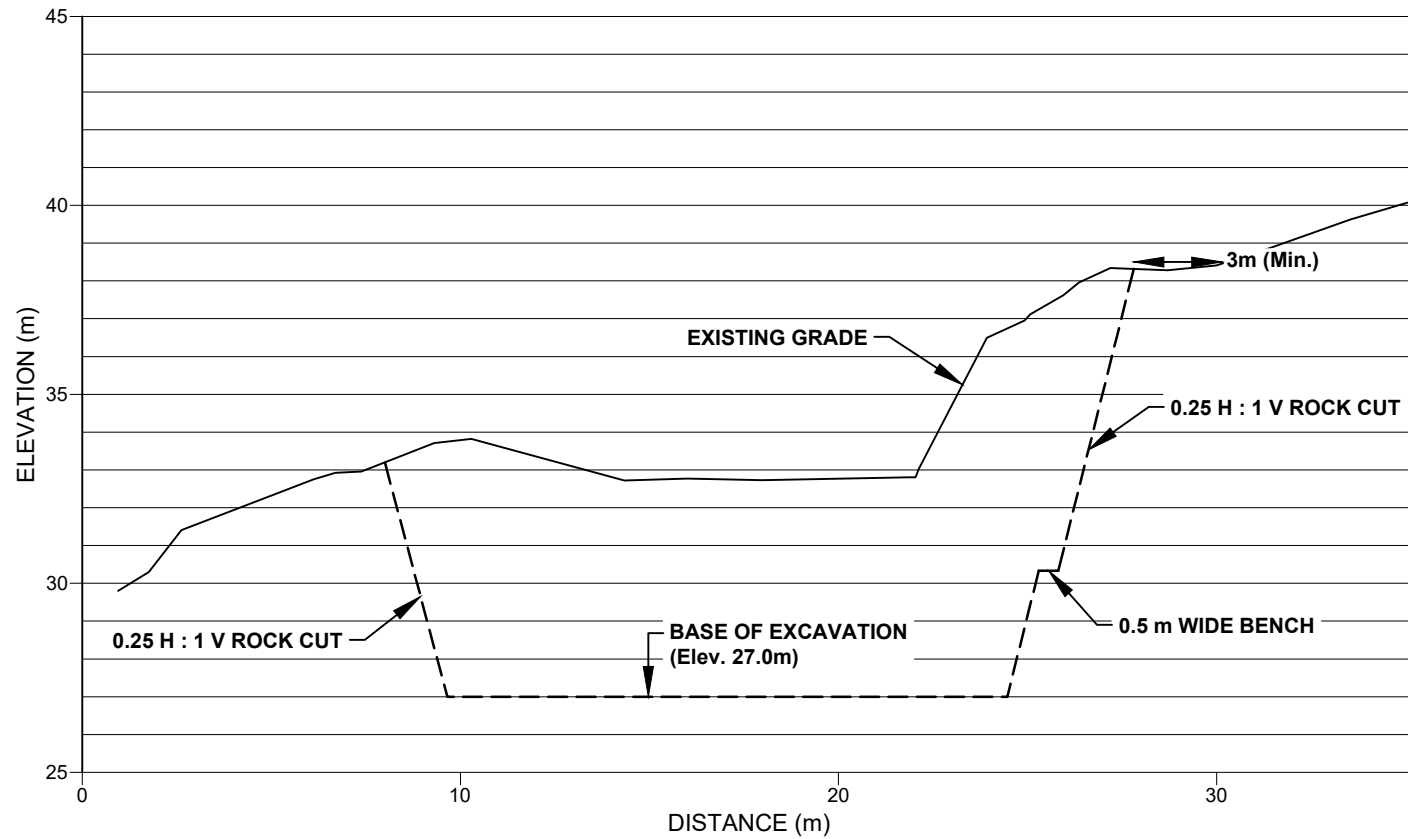
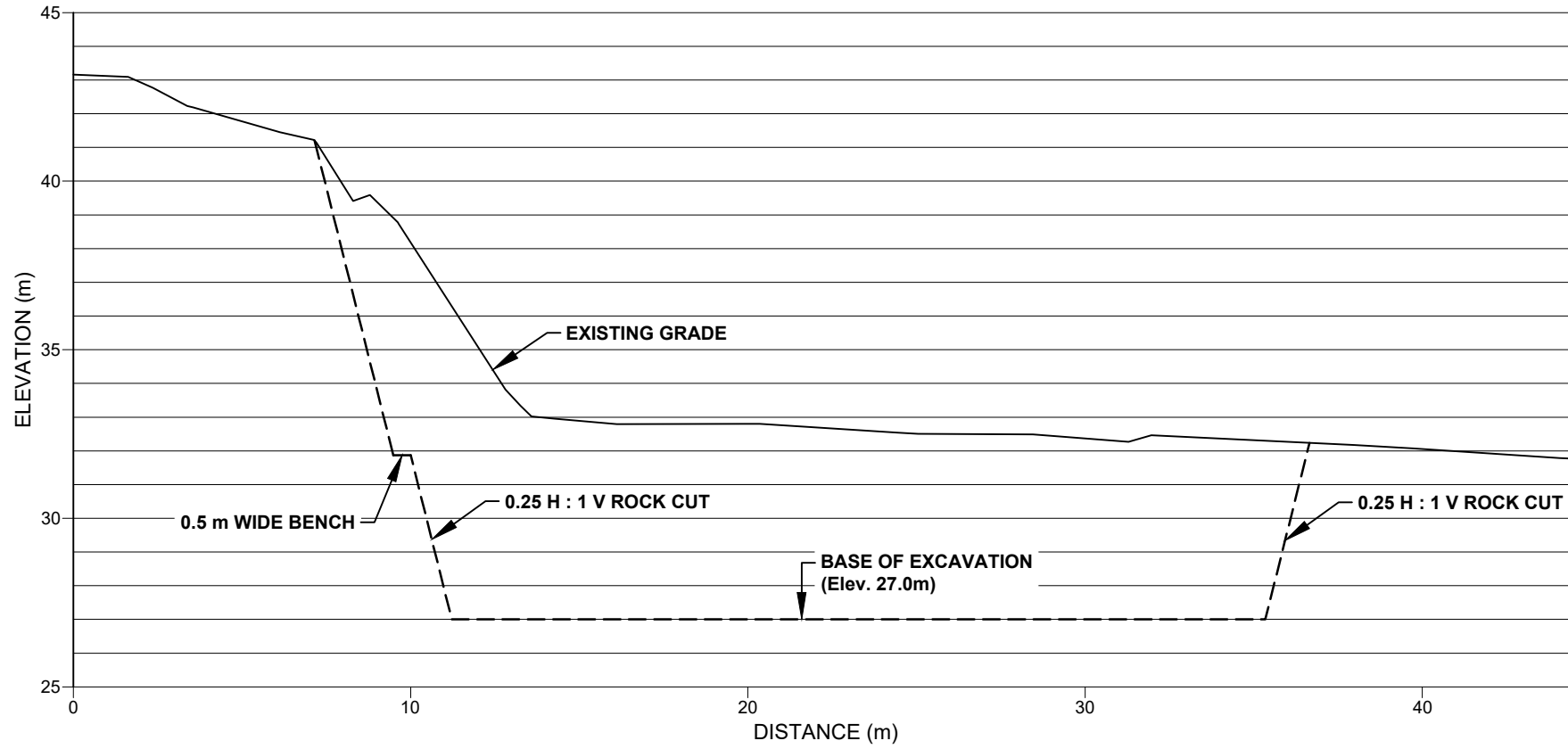
REV.No.	DATE (d/m/y)	BY	DESCRIPTION
-	MTH. ###/###	-	Revisions done

SEAL



SLR CONSULTING (CANADA) LTD.
GENERAL LOCATION PLAN & SITE PLAN
 DND COLWOOD
 FOD REMEDIATION
 COLWOOD, B.C.

DESIGNED WRW	DRAWN RRS	APPROVED
DATE OCTOBER 2, 2017	SCALE AS SHOWN	
PROJECT No. 19035 - 1	DWG. NO.	REV.

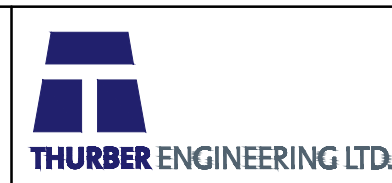


REDUCED TO HALF SIZE

SCALE 1:100

REV.No.	MTH. ####	DATE (d/m/y)	BY	DESCRIPTION
-				Revisions done

SEAL



SLR CONSULTING (CANADA) LTD.

PROFILES

DND COLWOOD
FOD REMEDIATION

COLWOOD, B.C.

DESIGNED WRW	DRAWN RRS	APPROVED
DATE OCTOBER 27, 2017	SCALE 1:100	REV.
PROJECT No. 19035 - 2	DWG. NO.	REV. -

APPENDIX D
Environmental Effects Determination Report

Colwood FOD North Area
CFB Esquimalt, Colwood, BC
SLR Project No.: 205.03903.00000

Department of National Defence (DND)

Environmental Effects Determination (EED) Report

Project: Colwood Fuel Oil Depot North Area Remediation

Prepared by: SLR Consulting (Canada) Ltd.
Date: December, 2017
Version: 2.0

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Executive Summary

The Colwood FOD North Area Site (the Site) is located northwest of Rosebank Road at CFB Esquimalt in Colwood, BC. It is bounded by the Juan de Fuca Recreation Centre to the north; the Wildplay Elements Park to the west; DND former Colwood Refuelling Facility (COL-5) to the south; and former COL-6 fuel tank area and COL-7 former fuel distribution lines, now a parking area, forest and Rosebank Road to the east. The Site also includes contractor staging and parking in the area known as COL-4 located immediately east of the proposed remediation area, as well as a temporary soil stockpile management area at the former Oily Wastewater Treatment Plant (OWWTP), located approximately 300 m northeast of the remediation area.

Potential adverse effects of the Project were identified for a variety of Valued Ecosystem Components (VECs) related to the physical, biological, social and cultural components of the environment, plus the effects of potential accidents and malfunction and the effects of the environment on the project. For each potential effect, the assessment recommended technically and economically feasible mitigation measures to avoid or minimize the potential for adverse environmental effects.

The significance of adverse environmental effects was determined taking into account the magnitude, geographic extent, duration, frequency and permanence (i.e., reversibility) of the residual adverse environmental effects. The assessment concluded that, taking into consideration the implementation of the mitigation measures, all potential adverse effects are likely to be either negligible or of minor significance.

Because the Project is not likely to cause significant adverse environmental effects, it was determined that the project **can** proceed with application of the mitigation measures specified in this report. In addition, The Contractor shall be required to prepare and submit an Environmental Protection Plan (EPP) detailing all proposed environmental protection and mitigation measures, monitoring and follow-up activities to be implemented throughout the duration of the Project. The EPP shall address the following component plans:

- Dust Management Plan;
- Noise and Vibration Management Plan;
- Blasting Plan;
- Traffic Control Plan;
- Water Management and Treatment Plan;
- Erosion and Sediment Control Plan;
- Soil Management Plan;
- Spills Prevention and Emergency Response Plan; and
- Site Restoration Plan.

The Contractor's EPP must be submitted to the Departmental Representative, for review and approval prior to the commencement of work. An accepted EPP is required prior to the commencement of any Project works or activities.

Part 1. Project Information

1.1 Title of Proposed Project

CFB Esquimalt - Colwood Fuel Oil Depot (FOD) North Area Remediation

1.2 Originating Directorate, Base, or Unit

Formation Safety and Environment
Department of National Defence
CFB Esquimalt

1.3 Location of Proposed Project

The Colwood FOD North Area Site (the Site) is located northwest of Rosebank Road at CFB Esquimalt in Colwood, BC (**Drawing 1**). It is bounded by the Juan de Fuca Recreation Centre to the north; the Wildplay Elements Park to the west; DND former Colwood Refuelling Facility (COL-5) to the south; and former COL-6 fuel tank area and COL-7 former fuel distribution lines, now a parking area, forest and Rosebank Road to the east. The approximate coordinates for the Site are:

- Latitude: 48° 26' 32.98"
- Longitude: 123° 27' 37.40"

The Site also includes contractor staging and parking in the area known as COL-4 located immediately east of the proposed remediation area. The COL-4 area has been remediated. A temporary soil stockpile management area exists at the former Oily Wastewater Treatment Plant (OWWTP), located approximately 300 m northeast of the remediation area (**Drawing 2**). The former OWWTP area has also been remediated and was recently covered with crushed rock. The remediation area (i.e., two specific zones of remediation) within the Site is shown on **Drawing 3**.

1.4 Project Summary

Remediation of the Colwood FOD North Area Site is proposed by removing a potential source of contaminants entering groundwater and adjacent properties. The contamination at the Site is associated with historic site activities and infrastructure. The project is aimed at eliminating or reducing the potential risks to humans and the environment.

The project involves the excavation of contaminated soils and bedrock (plus associated contaminated groundwater) and the off-site transport of excavated materials to the former OWWTP temporary soil stockpile management area located west of the Site. Soil stockpiles will be lined and covered to reduce the potential for contaminant transfer to surrounding areas. Characterization sampling of excavated material will be conducted to determine appropriate off-site disposal options. All contaminated soil will be disposed of off-site at a licensed facility. The Site will be backfilled and reinstated to pre-excavation conditions. The area will be hydro seeded with a native grass seed mix, and additional replanting with native species will take place at a later date.

1.5 Applicability of CEAA, 2012

This activity meets the definition of a project under Section 66 of the *CEAA, 2012* as it is a physical activity to be carried out on federal lands and is in relation to a physical work. Therefore, an EED is required under Section 67 before it can proceed.

1.6 EED Start Date

June 21, 2017

1.7 DGIEGPS EED Number

EED Number: 2017-21-100713

1.8 Provincial and Municipal Government Involvement

The project will be located entirely on DND property, and involvement of provincial or municipal governments is not required. However, the Contractor must demonstrate that soil disposal facilities comply with all provincial and municipal regulations.

1.9 Other Federal Departments

Public Works and Government Services Canada – Proponent

1.10 Contacts

1.10.1 EED Point of Contact

- a) Tracy Cornforth – Environment Officer (Tracy.Cornforth@forces.gc.ca)

1.10.2 Project OPI

- a) Cain VanCadsand (Cain.VanCadsand@forces.gc.ca)

Part 2. Environmental Effects Discussion

2.1 Description of Project Components, Project Schedule and Project Site

The Colwood Fuel Oil Depot North Area Remediation Project (the Project) will be undertaken in three (3) phases:

1. Site Preparation
2. Excavation and Remediation
3. Backfilling and Restoration

Project Phase	Physical Works and Activities	Anticipated Duration
Site Preparation	<ul style="list-style-type: none"> • Set up of site trailer, washrooms, and power supply; • Maintenance of temporary fencing around the site; • Implementation of environmental controls including erosion, dewatering, water storage, and treatment system including an in-line flow meter; • Installation of a stormwater runoff collection system to collect any runoff from the work area, and pump the runoff through the water treatment system; • Installation of a structure to contain rinsate from washing of large impacted boulders from blasting of the bedrock. 	2 Days
Excavation and Remediation	<ul style="list-style-type: none"> • Earthworks, involving the excavation of contaminated soils and blasting of bedrock over a surface area of approximately 200m² to a depth of 0.5m to 5.5m below ground surface (i.e., between 600m³ and 900m³ of contaminated material). • Temporary storage of non-contaminated bedrock materials. • Removal of contaminated product from a temporary sump using a hydro-vacuum truck. • Loading of blast rock will onto trucks and off-site transport to a licensed disposal facility. • Collection and pumped of water in the excavation into temporary tanks or a settling pond on-site for treatment prior to discharge. • Washing of large impacted boulders formed during blasting of the bedrock. The rinsate from washing of the boulders will be collected in a containment structure and disposed. • Transport of contaminated materials and impacted water collected in the hydro-vacuum truck and off-site transport to a licensed disposal facility. 	3 Weeks
Backfilling and	<ul style="list-style-type: none"> • Backfilling of excavation using either imported granular fill that meets applicable site requirements (both 	5 Days

Restoration	geotechnical and environmental), the blasted overlaying bedrock, or a combination of both. <ul style="list-style-type: none"> • Site grading to return the surface to grades that tie in with the surrounding areas. • Repairs to roadways and removal of temporary environmental controls 	
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2.2 Identification of Valued Ecosystem Components (VECs)

Table 1 identifies those Valued Ecosystem Components (VECs) that are likely affected by Project works and activities by phase. It is noteworthy that for the most part, project works and activities have the potential to affect each of the VECs to some extent, with the exception of the “Aboriginal/Traditional Activities” VEC. This is because the Site is not currently used by Aboriginal people for traditional purposes and because known areas of cultural significance (i.e., containing various cultural materials and First Nation burial sites) will be avoided in accordance with DND policy.

Table 1. Environmental Effects Matrix

PROJECT PHASE	VALUED ECOSYSTEM COMPONENTS (VEC)															
	PHYSICAL					BIOLOGICAL					SOCIAL AND CULTURAL					
	Atmosphere	Noise and Vibration	Surface Water	Groundwater	Soils and Geology	Terrain	Terrestrial Animals and Habitat	Aquatic Animals and Habitat	Vegetation	Species at Risk and Migratory Birds	Land Use and Transportation	Parks and Recreational Areas	Population	Cultural Resources	Aboriginal / Traditional Activities	Human Health and Safety
Site Preparation	X	X	X	X	X		X	X	X	X	X	X	X	X		X
Remediation	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Backfilling and Restoration	X	X	X	X	X	X	X	X	X	X	X	X	X			X

Legend: [Blank] = No Effect | [X] = Potential Significant Adverse Effect

2.3 Description of Valued Ecosystem Components

General Description

The Site is currently an unused area of DND Colwood. It is bounded by COL-18 to the north, mature forest and a gravel parking area to the east, mature forest to the south and west, followed by COL 5 to the southwest. A gravel access road intersects the Site running from northeast to southwest. Access to the Site is from Rosebank Road. Areas surrounding the site are either forested or currently used for parking and laydown areas.

2.3.1 Physical Components

Atmosphere

The climate at the project area is typical of southeastern Vancouver Island with warm, dry summers and cool, moist winters consistent with the Coastal Douglas Fir Biogeoclimatic Zone.

According to Environment Canada's Canadian Climate Normals, the average daily minimum temperatures at the Gonzales Heights weather station (11 km from the site) from 1971-2000 range from 3°C in January to 11.7°C in August, whereas the average daily maximum temperatures for that period range from 7°C in January to 20.1°C in August.

The mean annual precipitation rate at Gonzales Heights is 607.6 mm, with a mean monthly minimum of 14 mm (July) and mean monthly maximum of 108.9 mm (December).

The predominant wind direction in the adjacent Juan de Fuca Strait is easterly in winter and westerly in summer. Seasonally, winds that are greater than 55 km/hr can be expected 10 to 15 days per month in the winter and 1 to 2 days per month in the summer.

Air quality in the area is similar to that of any urbanized area in British Columbia.

Ambient Noise

There are no major sources of noise within DND Colwood or surrounding areas other than typical suburban noise from traffic, residential and commercial land uses; however, some noise is generated by marine traffic using F Jetty or the Fleet Dive Unit.

Surface Water

There are no surface water bodies present within the Site boundaries, however there are ditches and drainage pathways that may lead to surface water bodies. Dunn's Nook is located approximately 560 m to the southeast. Dunn's Nook is a small intertidal lagoon connected to Esquimalt Harbour, which is located at the base of the small gully. Surface water runoff from various areas of DND Colwood drains into Dunn's Nook.

Groundwater

Groundwater monitoring conducted in January and March 2014 indicated that groundwater was present at the Site at depths ranging from 1.578 to 1.883 metres below grade (mbg). The inferred groundwater flow direction is to the north towards the Juan de Fuca Recreation Centre

(SNC-Lavalin, 2015). Potable water for the City of Colwood is distributed through a piped distribution system sourced from the Greater Victoria Watershed (Sooke Lake).

Based on sampling of 57 groundwater wells on the Site, several contaminants of concern exceed relevant federal groundwater and/or freshwater quality guidelines. These include dissolved aluminum, arsenic, cadmium, copper, iron, selenium, uranium and/or zinc, toluene acridine, anthracene, naphthalene, phenanthrene, and/or pyrene.

Soils and Geology

According to the Surficial Materials of Canada, Geological Survey of Canada "A" Series Map 1880A, soil at the site has been identified as Glacial and Marine Deposits, Mv: Lag. This soil type includes "sand, gravel and pockets of finer sediment; thin to discontinuous sediment veneer and residual lag developed during marine submergence". It also includes areas of washed till and rock.

Observations from the 2015 DSI (SNC-Lavalin, 2015) indicate that soil upslope of the gravel road consisted of silt with trace sand and gravel overburden to a depth of 0.2 to 2.0 mbg overlying bedrock. The bedrock was typically fractured in the upper 1 m. The soil stratigraphy on or near the gravel road consisted of silt, sand and angular gravel to a maximum depth of 4.3 mbg, overlying fractured bedrock. The soil downslope of the gravel road consisted of topsoil over gravel to 0.8 mbg, which consisted of backfill from previous remediation activities, followed by native sandy silt (SNC-Lavalin, 2015).

The bedrock at the Site is generally fractured. A weathered zone was observed in the upper portion of both limestone and amphibolite bedrock to a depth of approximately 6 mbgs. In this weathered zone, the fracture density was higher and the fractures frequently exhibited iron oxidation and mineral alteration or infilling. NAPL that was identified within bedrock fractures at the Site appear to be localized in the vicinity of the rock face area.

Terrain

The Site is located at the base of a steep slope leading up to COL-5. The Site itself is also moderately sloped down to the northwest towards the gravel road that intersects the site. The area to the northwest of the gravel road slopes down towards COL-18.

2.3.2 Biological Components

Terrestrial Animals and Habitat

Large mammals that are typically found in the Coastal Douglas Fir Biogeoclimatic Zone include black tailed deer (*Odocoileus hemionus*), black bear (*Ursus americanus*) and cougar (*Puma concolor*). Smaller mammals include raccoon (*Procyon lotor*), red squirrel (*Tamiasciurus hudsonicus*), American marten (*Martes americana*) and deer mouse (*Peromyscus maniculatus*). Black bear and cougar are not typically observed at DND Colwood, as it is located within an urban area. However, black tailed deer, raccoons and squirrels are likely to be present in and around the Site.

A variety of bird species can also be found on-site and in the site vicinity. The mature trees and shrub understory surrounding the Site provide habitat for resident and migratory birds. A migratory bird sanctuary is located at Esquimalt Lagoon, approximately 1.2 km southwest of the Site. Bird species typically found at Esquimalt Lagoon include a variety of gulls, shorebirds, loons, cormorants, woodpeckers, sparrows, swans and geese, as well as Steller's Jay, Common Raven, and Red-winged blackbird (www.esquimaltlagoon.com).

Aquatic Animals and Habitat

There is no fish habitat on the Site. Fish and fish habitat exist in Dunn's Nook approximately 560 m southeast of the Site. This is an intertidal marsh area in Esquimalt harbour which had been impacted by human activity since the mid-1900s when Wilfert Road and the culverts beneath it were constructed. This original development restricted tidal flow and passage of fish and other marine life into the marsh, and caused standing water to remain during low tide events. This resulted in anoxic, low quality fish habitat that had the potential for stranding and killing fish. Nevertheless, many types of fish shelter, rear and breed among the tidal channels of these types of marshes, and in the deeper water of estuaries. Some of these include herring, salmon, cutthroat trout, stickleback, sole, flounder and surf perch.

In recent years, Public Works and Government Services Canada cleaned up a contaminated site within Dunn's Nook, improved the local habitat, and plans to transfer any surplus habitat credits to DND for application on future marine capital projects (<http://www.lookoutnewspaper.com/dunns-nook-fish-habitat-compensation-project-launched>)

Vegetation

The Site is located within the Coastal Douglas Fir Biogeoclimatic Zone. Plant species typically found in moister forest areas within this zone include Douglas-fir, western red cedar, bigleaf maple, salal, Oregon grape, sword fern and salmonberry. The majority of the Site is either cleared with a gravel roadway, or covered with smaller shrubs. Vegetation observed in the vicinity of the Site includes native species such as sword fern (*Polystichum munitum*), Oregon grape (*Mahonia nervosa*), bracken fern (*Pteridium aquilinum*), moss species, tall grasses (*Agrostis sp*), common rush (*Juncus effusus*), and non-native invasive plant species such as thistle species, scotch broom (*Cytisus scoparius*), and Himalayan blackberry (*Rubus armeniacus*). English holly (*Ilex aquifolium*), salal (*Gaultheria shallon*), rose (*Rosa sp*) and horsetail (*Equisetum sp*) have also been observed (SNC-Lavalin, 2012).

The Site is surrounded by mature tree species including Douglas-fir, western red cedar, grand fir, bigleaf maple and alder.

Species at Risk and Migratory Birds

A search of the BC Conservation Data Centre (CDC) internet mapping database (2015-07-30; map in **Appendix A**) revealed sensitive occurrences of three species in the vicinity of the site:

- **Shape ID 13834** – This occurrence is a great blue heron colony, but it has been abandoned since 2001;

- **Shape ID 55778** – This occurrence is the Douglas fir/dull Oregon grape ecosystem, which is found outside of the project area at Belmont Park, Royal Roads University and Fort Rodd Hill; and
- **Shape ID 95130** – This occurrence is the Nutall's quillwort, which is found at Yew Point and Fisgard Lighthouse, which are both located outside of the project area and will therefore not be affected by the project.

The BC CDC Species Occurrence Reports have been included in **Appendix A**.

Two masked sensitive occurrences were also identified: Shape ID 444454 and Shape ID 444286. Following up with this search, the CDC was contacted on July 31, 2015. Confirmation was provided on August 5, 2015 that none of the masked species indicated are likely to be affected by activities at the site.

The Government of Canada Species at Risk Act (SARA) Registry website provided a list of extirpated, endangered and threatened species in British Columbia, but the list cannot be narrowed down to a specific area or site.

A search for species at risk in the Capital Regional District (CRD) was conducted using the BC Species and Ecosystem Explorer online database (<http://a100.gov.bc.ca/pub/eswp/>). The list includes the status of species under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), SARA and provincially listed species. The search did not identify individual species for the project area. A copy of the list of extirpated, endangered, threatened, and special concern species that could potentially be present in the project vicinity has been included in **Appendix A**.

A DND sensitive areas maps for DND Colwood (**Appendix B**) did not show any sensitive species within the Site boundary.

2.3.3 Social and Cultural Components

Land Use and Transportation

The Site is currently zoned as "Business – Light Industrial" in the City of Colwood's Official Community Plan (2010). The Site is currently vacant. Nearby facilities include parking lots and DND buildings. No underground utilities are expected in the area. The Site can be accessed from the Island Highway via Ocean Boulevard and Rosebank Road or via Wilfert Road and Rosebank Road. The Island Highway in Colwood is proposed as a major corridor for a rapid transit network running from Victoria's Inner Harbour to the heart of Colwood.

Parks and Recreational Areas

The Juan de Fuca Recreation Centre property is located approximately 110 m to the northwest of the Site. The property features a large in-door facility housing fitness areas, swimming pool, curling rinks and meeting rooms and lounge. Outdoor facilities include a golf course, sports fields (e.g., baseball, volleyball, lawn bowling, tennis), picnic areas and playgrounds, BMX track and jogging trail.

The Wildplay Elements Park is located behind the Juan de Fuca Recreation Centre to the west of the Site. Wildplay Elements Park is an outdoor recreational facility featuring a tree-to-tree adventure course.

Population

The Site is located within the City of Colwood. Colwood has a population of just over 17,000 people in approximately 6,500 private households. The Belmont Park residential area is located approximately 370 m to the southwest of the Site. Belmont Park provides the primary military housing area (RHUs) for those posted to CFB Esquimalt. The Colwood Pacific Activity Centre, shared by the MFRC and Personnel Support Programs (PSP) is situated close to Belmont Park.

Cultural Resources

Although there are no known archaeological sites within the Site boundaries, there are five known archaeological sites in the vicinity and on the broader DND Colwood property. The nearest archaeological site is MR0360-T1 located approximately 110 metres away of the remediation site, and immediately north of the contractor parking / staging areas. This site contains shell midden, petroforms, and post contact debris scatter. Other more distant sites are:

- DcRu-C2 is located near the helicopter pad and adjacent parking lot, west of the Fire Fighter Training Area (FFTA).
- DcRu-091 is located north of Wilfert Road, between G-Jetty and the new tank farm.
- DcRu-132 is located on Col1 in the middle of the bunkers.
- DcRu-136 is located at the west end of the F-Jetty.

Millennia Research Limited (2010) found additional archaeological sites DcRu-134 near the FFTA, DcRu-1203 south of the FFTA and DcRu-1202 north of Building 55. The numerous archaeological and cultural features found at DND Colwood are shown on the DND sensitive areas maps in **Appendix B**.

2.4 Project Effects and Associated Mitigation Measures

The potential direct and indirect effects and associated mitigation measures are outlined below in **Table 2**. **Table 3** presents the effects of potential accidents and malfunction and associated mitigation measures. **Table 4** presents the effects of the environment on the project and associated mitigation measures.

Finally, the significance of adverse environmental effects was determined taking into account the magnitude, geographic extent, duration, frequency and permanence (i.e., reversibility) of the residual adverse environmental effects identified in Tables 2 to 4. **Table 5** provides the definitions for each of these significance criteria and **Table 6** provides the assessment of the significance of adverse environmental effects identified for this project.

Table 2: Potential Environmental Effects, Mitigation and Environmental Management Plan Requirements

Valued Component	Project Phase	Potential Environmental Effects	Mitigation Measures (Numbers appearing after a measure indicate the project phase to which it applies)
Atmosphere	1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration	<ul style="list-style-type: none"> Land alteration activities, such as clearing vegetation, moving soil, excavating, or placing fill, have the potential to generate dust and temporarily degrade local atmospheric conditions. Fugitive dust, PM₁₀ and PM_{2.5} emissions from these construction activities, operating vehicles and engines are relatively low. The Project's emissions of fugitive dust, PM₁₀ and PM_{2.5} may have localized and temporary effects on air quality. Dust generated may present a risk to workers or other people in the area if contaminated soil is encountered. Inhaled dust particles could cause irritation of respiratory tracts or create an exposure pathway for potentially adsorbed The Project is not expected to be a significant source of emissions of SO₂, NO_x, CO. Decommissioning and Construction works and activities are expected to produce insignificant amounts of emissions of these contaminants. The effects of these emissions on ambient concentrations of SO₂, NO₂, CO and O₃ are expected to be nominal. Any such potential effects on air quality are expected to be localized and temporary. The excavation of potentially contaminated soils and bedrock and the potential exposure of product prior to vacuuming may generate odours. Any such potential effects on air quality are expected to be localized and temporary. 	<p><u>Dust</u></p> <ul style="list-style-type: none"> A Dust Management Plan will be implemented in addition to the natural scavenging effects from precipitation. Ensure on-Site personnel have reviewed the plan, understand their roles and responsibilities, and are properly trained and equipped to implement the plan. Active dust abatement measures will be implemented if required. For example, the Contractor will be required to use good housekeeping techniques apply dust suppression measures (water) should dust levels be a concern on-site or due to a public complaint. Application of oil as a dust suppressant is prohibited. Application of other dust suppressants is not permitted without prior authorization from DND OPI (2,3). Schedule work to avoid periods of extremely dry or windy conditions (1,2,3) Speed limits will be imposed to reduce the production of road dust (1,2,3) Machinery and equipment will be in good repair and will comply with applicable emission standards. Engine and vehicle idling will be minimized and equipment will be shut off when not in use to minimize air emissions. Fuel efficient equipment and engines will be selected and used in the Project where practical (1,2,3). Monitor and manage track out of vehicles and equipment from the Site in order to reduce the potential for the dispersion of material and debris as fugitive dust. A stabilized site entrance shall be provided to minimize tracking of soils off-site (2,3) Other good housekeeping techniques to be employed are: <ul style="list-style-type: none"> Remove excess soil from equipment, machinery and vehicles Sweep haul roads and construction site daily Cover stockpiled materials Employ proper truck loading Cover stockpiles and all materials transported to and from the Site as appropriate. Cover dust-producing materials with 6 mil polyethylene sheeting (at a minimum) Monitor airborne dust conditions daily and employ additional housekeeping and dust suppression techniques as required. <p><u>Air Emissions</u></p> <ul style="list-style-type: none"> Machinery and equipment will be in good repair and will comply with applicable emission standards (1,2,3). Engine and vehicle idling will be minimized and equipment will be shut off when not in use to minimize air emissions (1,2,3) To minimize Greenhouse Gas Emission (GHGs), ultra-low sulphur fuel that meets Canadian regulatory requirements will be used in the Project where practical. All vehicles will be installed with catalytic converters to minimize NO_x emissions and meet all emission standards (1,2,3) <p><u>Odours</u></p> <ul style="list-style-type: none"> Work will proceed in a fashion that minimizes surface cover removal in areas not actively being excavated (2) Contaminated soils shall be removed from site as soon as practical. Exposed product shall be vacuumed frequently and removed from site as soon as practical (2).

<p>Noise and Vibration</p>	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Ambient noise levels will increase during the project. Noise generated during the Site Preparation and Backfilling/Restoration activities are expected to be similar to what would be caused by a typical construction project. • Noise and vibration will be generated from excavation and bedrock blasting during Remediation. The effects will be local and short term, for the duration of the project • Increased levels of noise may be disruptive to residents/personnel adjacent to the Site. • High levels of noise from equipment and demolition activities at the project site have the potential to harm hearing of on-site workers. • Increased levels of noise in the natural environment may be disruptive to terrestrial animals, including raptors and migratory/SAR birds, in the immediate area, potentially resulting in their relocation from the area 	<p><u>General Noise Control Measures</u></p> <ul style="list-style-type: none"> • To minimize the potential for excessive noise and vibration, a Noise and Vibration Management Plan will be implemented. Ensure on-Site personnel have reviewed the plan, understand their roles and responsibilities, and are properly trained and equipped to implement the plan (1,2,3). • All work will comply with WorkSafe BC Occupational Health and Safety noise regulations. On site workers will wear appropriate personal protective equipment (PPE) including hearing protection as required (1, 2, 3) • Work hours are to be limited to 7:00 AM to 5:00 PM Monday to Friday unless otherwise approved by the Departmental Representative. The Contractor shall make all attempts to operate machinery and blasting in accordance with the City of Colwood Bylaw 38 – A Bylaw to Regulate Noise within the City of Colwood. (1, 2, 3) • Minimize the duration of noisy construction activity, particularly blasting. • Reduce the distance of material, if required, being dropped or loaded into trucks to reduce the noise generated from this activity (2,3) • Post signs outlining noise management requirements on worksites which may include signage to reduce speed limits on worksites to reduce noise from trucks (1,2,3) • Inform local residents and other off-site stakeholders of Project schedule and timing of construction activities that may result in disruption to people's use and enjoyment of property. Monitor and respond to public complaints in a timely manner (2,3) • Diesel and gas powered equipment should be fitted with intake and exhaust silencers (2,3) • Avoid use of airbrakes, unnecessary idling or revving of engines (1,2,3). <p><u>Blasting Noise and Vibration Controls</u></p> <ul style="list-style-type: none"> • To minimize the potential for vibration and generation of fly-rock, a Blasting Plan will be implemented (2) • Install temporary noise barriers or sound aprons as required or appropriate and as close as possible to the blast area (2) • The area within the excavation shall be covered with suitable blasting mats, soil or other equally serviceable material to minimize noise and prevent fly-rock (2) • The Contractor shall use blasting methods designed to limit the intensity of ground vibrations originating within the excavation limits. When blasting near buildings, structures, wells, utilities or other works that may be subject to damage from blast induced ground vibrations, the ground vibrations shall be controlled using properly designed delay sequences and allowable charge weights per delay (2) • Allowable charge weights per delay shall be based on vibration levels that will not cause damage. Peak particle velocity, accelerations and frequency shall not be allowed to exceed the safe limits of the nearest structure subject to potential vibration damage (2)
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Soils and Geology	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Project works and activities (particularly vegetation removal, earthworks and stockpiling) will create exposed soils, increasing the potential for soil erosion. • Excavation could potentially result in soil erosion and ground subsidence • Land alteration activities have the potential to uncover metals, hydrocarbons, PAHs, and other Contaminants of Concern associated with historical activities. Relocation and export of these soils from the Site has the potential to contaminate adjacent soils in the export area. • Residual soil on equipment and vehicles has the potential to migrate to and contaminate off-site soils and surface waters during track out of equipment and vehicles from the Site. • The import of fill material from off-site sources that do not meet Site soil criteria has the potential to be a continued source of contamination if imported to the site. • Any soil remediation that might be undertaken at the site may result in improved soil quality in the area. • Decreased soil quality in the event of spills and/or leaks for vehicles or equipment (see Accidents and Malfunctions) 	<ul style="list-style-type: none"> • To minimize the potential for soil erosion, an Erosion and Sediment Control Plan will be implemented. All erosion and sediment control measures shall be in-place prior to the commencement of any excavation at the site. Ensure on-Site personnel have reviewed the plan, understand their roles and responsibilities, and are properly trained and equipped to implement the plan (1,2,3). • Avoid movement of machinery or equipment on areas with exposed soils (1,2,3) • Schedule work to avoid wet, windy and rainy periods that may increase erosion and sedimentation (1,2,3). • Develop and implement a Soil Management Plan to address how and where all materials will be handled, stored, stockpiled, reused, relocated or disposed of during the project. The plan should address site-specific measure to be taken if visual or olfactory observations during the remediation activities indicate that the materials may be contaminated. Ensure on-Site personnel have reviewed the plan, understand their roles and responsibilities, and are properly trained and equipped to implement the plan (1,2,3) • Stockpiled materials must be underlain by a rugged, impermeable material to minimize potential tearing and perforating from vehicle traffic and to ensure that excavated material does not come into contact with the underlying soils and that any water generated from the excavated material does not infiltrate the underlying soils. Material in the stockpile management area is to be covered with an impermeable cover nightly, during periods of work stoppage, during periods of high intensity or sustained rainfall, during periods when the stockpiled material is not being actively handled and as directed by the Departmental Representative. (2,3) • Excavation activities shall take place in stages to prevent the mixing of materials (2). • Soil must be disposed of at a provincially permitted facility that accepts soil classified as containing petroleum hydrocarbon and metals concentrations greater than the BC CSR Residential land use standards or, soil classified as containing petroleum hydrocarbon concentrations greater than the BC HWR standards. Prior to initiation transport and disposal, the contractor must submit the proposed disposal facility(ies) including a copy of their current license or permit for approval by PWGSC (2,3)
Terrain	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • The excavation will take place at the bottom of a steep slope, which may lead to issues with excavation and slope stability. These effects will be local and temporary, and will be limited to the duration of excavation and backfilling. 	<ul style="list-style-type: none"> • The contractor will employ a geotechnical engineer to ensure that the excavation is completed safely, that the correct slopes are maintained, and that the stability of the adjacent slope is not compromised. (2) • The excavation backslope shall be stabilized before any base material is placed upon the subgrade. Stabilization methods can include scaling, trimming, the application of rock bolts, shotcrete, slope mesh, drains or other stabilization techniques recommended by a Qualified Person(s) (2) • Ensure backfilling and soil compaction is conducted to avoid erosion and potential ground subsidence. Provide additional backfill where subsidence has occurred. The contractor will employ a geotechnical engineer to verify that the backfill has been adequately compacted. (3)

Surface Water	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Project works and activities (particularly vegetation removal, earthworks and stockpiling) will create exposed soils increasing the potential for soil erosion that could enter a watercourse, storm water drain, ditch or street gutter. • Exposure of potentially contaminated soils may result in elevated concentrations of hazardous compounds in storm water runoff. Surface water quality may be negatively impacted if storm water runoff is discharged prior to characterizing/testing the water to ensure it is not a deleterious substance. • Decreased storm water quality in the event of spills and leaks (see Accidents and Malfunctions) 	<ul style="list-style-type: none"> • A Water Management and Treatment Plan shall be developed and implemented prior to commencement of the work to ensure that hazardous compounds in storm water runoff are not deposited directly or indirectly into any watercourse, storm water drain, ditch or street gutter. The plan shall identify methods and procedures for management and/or discharge of waters which are directly derived from construction activities and dewatering of the site (if required). Ensure on-Site personnel have reviewed the plan, understand their roles and responsibilities, and are properly trained and equipped to implement the plan (1,2,3). • Remove excess soil from equipment, machinery, vehicles and roadways. • No vehicle washing is permitted on site. If a wheel wash is installed, contain all wash water and dispose of at a facility in accordance with Federal, Provincial and Municipal criteria applicable to the method of disposal. • A water collection, treatment, and storage system will be provided by the Contractor. The discharge location (e.g., sanitary sewer system, stormwater system, etc.) will be determined by the Departmental Representative depending on treated water quality (2, 3). • Pooled water within the excavation will be collected and directed to the on-site treatment system for settling and/or treatment prior to testing. Analytical testing results will determine the discharge/final disposal location, as directed by the Departmental Representative (2, 3). • Sediment control measures such as silt fences or sand bags must be placed in areas where there is a potential for storm water discharge into any watercourse, storm water drain, ditch or street gutter. Ensure that collected storm water is characterized and if required, treated, prior to discharge (1,2,3). • Refuel and service machinery and store fuel and other materials in such a way as to prevent any deleterious substances from entering water (1,2,3) • Ensure that materials such as blasting residues or other chemicals do not enter a watercourse, storm water drain, ditch or street gutter (2,3).
Groundwater	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Dewatering activities could have an effect on the local groundwater levels. • Any soil or groundwater remediation that might be undertaken at the site may result in improved groundwater quality. • Decreased groundwater quality in the event of spills and/or leaks for vehicles or equipment (see Accidents and Malfunctions) 	<ul style="list-style-type: none"> • Implement mitigation measures for soils and surface water listed above, and the mitigation measures listed for spills described below (1,2,3)
Vegetation	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Loss of two (2) mature trees and the potential physical damage to other individual trees retained on-site and loss of thicket vegetation and lawns • Increased potential for the introduction on noxious plants and/or non-native (invasive) species. 	<ul style="list-style-type: none"> • All equipment brought onto the Project site will be cleaned prior to arrival (1,2,3). • Avoid and minimize clearing of natural vegetation, cutting of individual trees. If tree removal is required, a Departmental Representative will be consulted (1,2). • Delineate areas and individual trees to be protected with flagging tape, temporary protective fence, hording or other suitable protection measures. Areas to be protected and/or individual trees shall be fenced off by chain link fence, plywood hoarding, board fencing or plastic fencing (1,2,3) • Develop and submit a Site Restoration Plan that describes the nature and proposed timing for site revegetation (3). At a minimum, the plan shall ensure that all areas of exposed soils not slated for construction are hydro seeded with a native grass mix following backfilling. Additional replanting with native plant species shall be undertaken to ensure that maximum areas of the site are revegetated. Consideration to be given to planting of vegetation to provide visual screening and long term noise control at neighbouring properties. Ensure on-Site personnel have reviewed the plan, understand their roles and responsibilities, and are properly trained and equipped to implement the plan (3).

<p>Terrestrial Animals and Habitat</p>	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Project works and activities and vegetation removal could be disruptive to wildlife and their movement patterns (particularly nesting activities by resident or migratory birds). • Increased potential for wildlife-vehicle interactions resulting in death or injury to animals. 	<ul style="list-style-type: none"> • Minimize the removal of terrestrial habitat to the extent possible (1,2,3) • When an animal is seen on the Project site, it should be given time to escape (2,3) • Cutting of lawns and shrubs on-site should be undertaken early in the spring so that ground-nesting bird species do not initiate nesting. Cutting should continue if needed during remediation (1,2,3) • Bird habitat shall not be removed during breeding season. The timing window is "mid-March to late August". This would address early-nesting species, as well as species that may be attempting second (or third) broods well into the summer as well as all those nesting species found in forest, open habitat present on the Site and site vicinity (2,3) • A QEP shall complete a pre-clearing survey prior to vegetation clearing to ensure no animals are within the Project area (1) • At any time during the Project, if nests containing eggs or young are discovered, work shall be stopped and the DND OPI shall be informed. Do not commence work in the vicinity of the nest until a Qualified Professional has been to the Site, assessed the feature and developed a management plan which has been approved by MARPAC FSE (1,2,3) • On site garbage will be managed as to not create attractants for wildlife (1,2,3)
<p>Aquatic Animals and Habitat</p>	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Decreased quality of fish habitat due to changes in surface water quality. 	<ul style="list-style-type: none"> • Implement mitigation measures for soils and geology, surface water and groundwater identified above (1,2,3)
<p>Species at Risk and Migratory Birds</p>	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Project works and activities could be disruptive to wildlife Species at Risk and their movement patterns 	<ul style="list-style-type: none"> • Implement mitigation measures for vegetation, wildlife and wildlife habitat effects identified above. • Project work will be conducted outside of sensitive avian nesting windows (April 1 through July 31) to ensure active nests (if present) are not disturbed. Despite the absence of known sensitive species within the project area and the anticipated project schedule, if vegetation removal is required during this time period, the area shall be assessed by a qualified environmental professional for the presence of nesting activities and appropriate mitigation measures will be implemented (1, 2, 3) • In the event that it is determined that the Project is likely to have an unavoidable adverse effect on a Species at Risk or if an individual is encountered or killed accidentally; the DND OPI will be notified who will inform competent Ministers as required. For both aquatic and terrestrial Species at Risk, the competent Minister is the Minister of Environment and Climate Change Canada. For migratory birds the competent Minister is the Minister of Environment and Climate Change Canada (1,2,3)

Land Use and Transportation	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Potential for alternate use of the Site following remediation • Increased traffic volumes and disruption to the use of local roadways • Potential damage to local roadways. 	<ul style="list-style-type: none"> • Remove construction debris, waste materials, packaging material from work site daily (1,2,3) • Ensure off-site roadways are maintained in a clean condition so that off-site tracking of soil / rock materials from the site is not evident. Complete daily street sweeping during periods of soil or bedrock transport (off-site disposal or import of backfill) or as directed by the Departmental Representative (2,3) • Develop and submit a Traffic Control Plan, that describes all traffic management measures (e.g., use of flag men, signage, routes, timing, etc.) that will be implemented to minimize traffic conflicts. Ensure on-Site personnel have reviewed the plan, understand their roles and responsibilities, and are properly trained and equipped to implement the plan (2,3). • Provide and maintain access and egress to property fronting along Rosebank Road (roads to and from site and temporary stockpile area). • Do not close any lanes of traffic without approval of the Departmental Representative. Before re-routing traffic, erect suitable signs and signalling devices (2,3). • Avoid trucks on residential streets if possible during the evening and early morning to reduce the truck noise at neighbouring residential properties (2,3). • The Contractors shall verify adequacy of existing roads and allowable load limit on these roads and shall be responsible for repair of damage to roads caused by construction operations. • The Contractor will work with the municipality and local residents to inform them of schedules and likely times of peak activity at the Project site (1,2,3).
Parks and Recreational Areas	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Disruption to use and enjoyment of adjacent parks and recreational areas. 	<ul style="list-style-type: none"> • Minimize impacts to air quality, noise and vibration, surface water and groundwater (1,2,3) • Avoid where possible stockpiling materials and staging equipment in proximity to adjacent parks and recreational areas (1,2,3). • Communicate with operators of adjacent parks and recreational areas prior to work to inform them of the Project schedule and likely activities that might result in the temporary disturbance to road access, excessive noise, vibration and dust. Operators of adjacent parks and recreational areas shall be notified by the Contractor, prior to the commencement of the blasting, as to the timing, size of blasts, types of warning and other signals (1,2,3) • The Contractor shall be responsible for any damage resulting from blasting (2).
Population	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Disruption to use and enjoyment of residential property. 	<ul style="list-style-type: none"> • Minimize impacts to air quality, noise and vibration, surface water and groundwater (1,2,3) • Avoid where possible stockpiling materials and staging equipment in proximity to residences (1,2,3) • Communicate with local residents prior to work to inform them of the Project schedule and likely activities that might result in the temporary disturbance to road access, excessive noise, vibration and dust. Local residents and occupants of local buildings shall be notified by the Contractor, prior to the commencement of the blasting, as to the timing, size of blasts, types of warning and other signals (1,2,3) • The Contractor shall be responsible for any damage resulting from blasting (2).
Cultural Resources	<ol style="list-style-type: none"> 1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration 	<ul style="list-style-type: none"> • Although no cultural resources have been identified at the Site, archaeological sites are present within the DND Colwood property. There is potential for discovery of deeply buried artefacts or accidental discovery of human remains. 	<ul style="list-style-type: none"> • Site supervisors and equipment operators involved in Project activities shall attend an Archaeological Briefing as provided by a Qualified Professional prior to any excavation work proceeding (1,2). • Stop work immediately if potential archaeological materials are discovered during project activities and immediately notify the DND OPI. The DND OPI is responsible for reporting archaeological chance finds to MARPAC FSE (2,3) • Do not disturb potential archaeological materials until a professional archaeological has been to the site, assessed the materials and developed a management plan that has been approved by DND OPI and MARPAC FSE (2,3)

<p>Human Health and Safety</p>	<p>1. Site Preparation 2. Excavation and Remediation 3. Backfilling and Restoration</p>	<p>The project may present a short-term danger to worker and public safety. These dangers include working near heavy machinery and equipment; working in or near deep, open excavations; and ingestion of soil and inhalation of dust particles that could contain elevated concentrations of metals and petroleum hydrocarbons associated with site contamination.</p> <p>The project will present longer term benefits to human and ecological health by eliminating contamination.</p> <p>Health and safety considerations may affect project schedule. Underground utilities may be present within the excavation area. Contact with utilities presents a danger to all workers at the Site.</p>	<ul style="list-style-type: none"> • The contractor will develop and implement a project-specific Health and Safety Plan (HASP). The HASP will be submitted to the Departmental Representative prior to beginning work. (1, 2, 3). At a minimum, the plan shall address relevant materials in the Department of National Defence's guidance document entitled "CFB Esquimalt – Safety & Environment for Contractors" (February, 2015). • Comply with requirements of Workplace Hazardous Materials Information System 2015 (WHMIS 2015) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code (1,2,3). • All BC Occupational Health and Safety regulations will be followed regarding worker safety. Sufficient zone boundaries will be established to ensure the construction zone is isolated from members of the public and DND personnel. WCB approved traffic control personnel will be used to direct traffic when required, such as during excavation and soil removal. (1, 2, 3) • Workers shall wear the appropriate personal protective equipment at all times during the project. Nitrile gloves must be worn when handling contaminated soil. (1, 2, 3) • All utilities must be located prior to excavation through a BC One call and a private utility location company to ensure all underground utilities are properly located. (1, 2, 3) • In the event of an emergency, the Contractor shall provide immediate access along Rosebank Road (1,2,3) • Immediately take measures to rectify unforeseen or peculiar safety related hazards that become evident during project implementation. Verbally advise the DND OPI immediately and provide a written report of the hazard or condition as soon as practical • Conduct regular safety briefings and meetings with on-site workers to encourage safe working procedures are followed.
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Table 3: Potential Effects of Accidents and Malfunctions, Mitigation and Environmental Management Plan Requirements

Accidents or Malfunctions	VCs Affected	Potential Environmental Effects	Mitigation Measures
<p>Vehicle Collision</p>	<ul style="list-style-type: none"> • Terrestrial Animals and Habitat • Land Use and Transportation 	<ul style="list-style-type: none"> • Increased potential for personal injuries to public and Project workers due to vehicle movements. 	<ul style="list-style-type: none"> • All personnel driving vehicles shall be qualified to operate those vehicles and will receive training to operate those vehicles on site (1,2,3) • Vehicles will be kept in good condition and regular checks on vehicles will be completed (1,2,3) • Provide and maintain signs, flashing warning lights and other devices required to indicate construction activities or other temporary and unusual conditions resulting from Project Work which requires road user response (1,2,3) • All personnel driving vehicles will abide to local speed limits and other traffic laws (1,2,3)

Accidents or Malfunctions	VCs Affected	Potential Environmental Effects	Mitigation Measures
Spills	<ul style="list-style-type: none"> • Soils and Geology • Surface Water • Groundwater • Vegetation 	<ul style="list-style-type: none"> • Increased potential for spills and leaks from vehicles and hazardous or potentially contaminated materials being removed from site. 	<ul style="list-style-type: none"> • The contractor will complete a Spills Contingency and Response Plan and submit it to the Departmental Representative for approval prior to commencing on-site work. The plan will outline procedures to be followed to prevent accidental spills and procedures to be followed if a spill does occur. The plan will also list all spill response equipment that will be present on-site. Ensure on-Site personnel have reviewed the plan, understand their roles and responsibilities, and are properly trained and equipped to implement the plan (1, 2, 3) • Comply with requirements of Workplace Hazardous Materials Information System 2015 (WHMIS 2015) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code. • Verbally report all spills to DND OPI immediately. If DND OPI is not available, contact the Joint Operations Centre (JOC) (363-2425, 363-5848). • In the event of a Level I spill (easily contained and cleaned up) the contractor will be required to provide Level I spill response. The Contractor will call the Departmental Representative and 911 in the event of a Level II spill (spill that cannot be easily contained or cleaned up). (1, 2, 3) • Identify high-risk locations where spills are probable and maintain spill kits, capable of handling the largest potential spill through the duration of the project, at these locations. Include an inventory of required contents at the top of the kit. Locate PPE at the top of the spill kit to ensure easy access for the spill responder. Keep spill kits closed with a safety seal affixed to indicate if the kit has been used or tampered with (1,2,3) • workers will be trained on the use of spills kits (1,2,3) • A designated fuelling area shall be established > 30 metres away from any drain, watercourse or other pathway that could lead to contamination of a watercourse and on an impervious surface and with appropriate containment and spill control (1,2,3) • Wash, refuel and service machinery and store fuel and other materials in such a way as to prevent any deleterious substances from entering water. Plan activities such that materials such as blasting residues or other chemicals do not enter a watercourse, storm water drain, ditch or street gutter (1,2,3) • Maintain spills response capability. Spill response will be a part of the safety briefing prior to start of remediation activities. All workers on-site should be aware of the spill prevention and response procedures including notification to the Province of British Columbia (1,2,3).
Blasting Accident and Fly-Rock	<ul style="list-style-type: none"> • Health and safety • Parks and Recreational Areas • Population 	<ul style="list-style-type: none"> • Blasting and excessive flyrock may cause personal injury to workers and members of the public. 	<ul style="list-style-type: none"> • The Contractor shall ensure that all persons conducting blasting operations have a valid blaster's certificate issued by the WCB or is under the direct supervision of a certificate holder (2) • Before the detonation of any blast in areas where flying rock or other debris may result in personal injury or damage to property, the area within the excavation limits shall be covered with suitable blasting mats, soil or other equally serviceable material to prevent flyrock (2).

Table 4: Effects of the Environment on the Project Mitigation and Environmental Management Plan Requirements

Environmental Condition	VCs Affected	Potential Effects on the Project	Mitigation or Contingency Measures
Severe Weather	<ul style="list-style-type: none"> • Soil • Surface Water 	<ul style="list-style-type: none"> • Increased potential for delay of activities as well as increase the potential for personnel injury from vehicle collision or lightning strikes or falling debris. • Hot temperatures in the summer could cause a health risk for personnel. • High winds and storms could affect soil erosion. 	<ul style="list-style-type: none"> • Any loose equipment will be tied down during a storm or high winds (1,2,3) • Work will stop in the event of a lightning storm or when high winds make it difficult to continue safely (1,2,3) • All vehicle drivers will be qualified to drive trucks. Sediment control measures such as silt fences or sand bags must be placed in areas where there is a potential for surface run off (1,2,3)

2.5 Environmental Protection Plans

The Contractor shall be required to prepare and submit an **Environmental Protection Plan** (EPP) detailing all proposed environmental protection and mitigation measures, monitoring and follow-up activities to be implemented throughout the duration of the Project. The Contractor's EPP must be submitted to the Departmental Representative, for review and approval prior to the commencement of work. An accepted EPP is required prior to the commencement of any Project works or activities.

An EPP is a Project-specific and site-specific document that contains a set of over-arching EPP requirements plus a set of highly specific component plans that, when implemented collectively as a management system, are intended to avoid, eliminate or reduce the severity of adverse environmental effects. The EPP should serve as a reference document for all Project personnel, so that they are aware of their responsibilities and what is expected of them concerning environmental protection. The requirements included in the EPP will apply to any person, Contractor or subcontractor involved in the Project. It is intended to be a "living" document that may require changes as the Project advances from Site Preparation through to Backfilling / Restoration.

The over-arching EPP document shall include a description of:

- The purpose and scope of the EPP;
- A Project overview;
- A construction plan and schedules;
- The roles and responsibilities of the environmental management team;
- Environmental awareness, training and competency commitments;
- General communications and record keeping commitments;
- Environmental incident reporting procedures;
- Environmental monitoring and adaptive management summary; and
- EPP review and revision procedures.

The over-arching EPP document shall also include the following information:

- Work title
- Work number
- Contract Authority contact information (if applicable)
- On-site Supervisor contact information
- Signature of individual responsible for plan

The over-arching EPP document should refer to relevant component plans and other documents at higher or lower levels in the Contractor's management system. Higher level documents may describe environmental management policies and processes. Lower level documents may describe general procedures, specific operational procedures, activity specific work-procedures and work instructions, equipment manuals, environmental protection procedures.

Where relevant, the following component plans are to be included in an EPP. Each component plan will be based on a set of Project-specific and site specific objectives. The Contractor shall ensure that on-Site personnel have reviewed the relevant plans, understand their roles and responsibilities, and are properly trained and equipped to implement the plan

Component Plan	Primary Objectives
Dust Management Plan	<ul style="list-style-type: none"> To avoid dust emissions in exceedances of regulatory standards and potential disruption to residents, businesses and other community features.
Noise and Vibration Management Plan	<ul style="list-style-type: none"> To avoid noise emissions in exceedances of regulatory standards and potential disruption to residents, businesses and other community features.
Blasting Plan	<ul style="list-style-type: none"> To minimize noise, vibration and the generation of flyrock that may result in property damage or injuries to workers of members of the public.
Traffic Control Plan	<ul style="list-style-type: none"> To minimize disruption to traffic patterns and access to property.
Water Management and Treatment Plan	<ul style="list-style-type: none"> To manage storm water runoff on the Project site to ensure that deleterious substances in storm water runoff are not deposited directly or indirectly into any watercourse, storm water drain, ditch or street gutter.
Erosion and Sediment Control Plan	<ul style="list-style-type: none"> To minimize erosion at the Project site to ensure that deleterious substances in storm water runoff are not deposited directly or indirectly into any watercourse, storm water drain, ditch or street gutter.
Soil Management Plan	<ul style="list-style-type: none"> To address how and where all materials will be handled, stored, stockpiled, reused, relocated or disposed of during the project, including the approximate values of materials to be handled.
Spills Prevention and Emergency Response Plan	<ul style="list-style-type: none"> To minimize the risk of accidents and malfunctions. To minimize risks to worker and public health and safety. To reduce disturbance and protect aquatic and terrestrial resources, including wildlife.
Site Restoration Plan	<ul style="list-style-type: none"> To undertake revegetation and landscaping to minimize long-term effects on aquatic and terrestrial resources and enhance site aesthetics To restore site aesthetics and minimize disruption to residents, businesses and community features

2.6 Significance Assessment

The significance of adverse environmental effects was determined taking into account the magnitude, geographic extent, duration, frequency and permanence (i.e., reversibility) of the residual adverse environmental effects identified in Tables 2 to 4. Table 5 provides the definitions for each of these significance criteria.

Table 5: Significance Criteria Definitions

Criterion	Low	Moderate	High
Magnitude (of the effect)	Effect is evident only at or nominally above baseline conditions.	Effect is likely to be measurable over baseline conditions; however is a less than regulatory criterion, a published guideline value, or a level that might measurably affect the quality, quantity, value or use of a Valued Component.	Effect may exceed regulatory criteria, a published guideline value, or a level that might measurably affect the quality, quantity, value or use of a Valued Component.
Geographic Extent (of the effect)	Effect is most likely to be limited to Project site.	Effect is likely to extend into areas adjacent to the Project site	Effect is likely to extend into areas beyond adjacent properties and into the local neighbourhood and site vicinity
Duration (of the effect)	Effect is most likely to be evident for the duration of the Project work	Effect is likely to be evident in the seasons after the Project work, activity or event has been completed	Effect is likely to be evident the following year or more after the Project work has been completed.
Frequency (of conditions causing the effect)	Conditions or phenomena causing the effect occur only once or are considered a one-time event.	Conditions or phenomena causing the effect may occur more than once during Project work, but are infrequent.	Conditions or phenomena causing the effect are likely to occur at regular or frequent intervals during Project work.
Permanence (of effect)	Effect is likely to be reversible over a short period of time (e.g., within several days or months) after the completion of the activity causing the effect.	Effect is likely to be reversible over an extended period of time (e.g., a growing season, following a freshet).	Effect is likely to be permanent.

After the application of these definitions, an environmental effect is assessed to be a negligible effect, a minor adverse effect or a major adverse effect, according to the following definitions:

- **Negligible Effect (Not Significant)** are those environmental effects which, after taking into consideration applicable mitigation measures have been assessed to have a “low” level of significance for all of the criteria described above.
- **Minor or Mitigable Effects (Not Significant)** are those environmental effects which, after taking into consideration mitigation measures, have been assessed to have a “low” or “moderate” level of significance for the majority of the criteria described above.
- **Major Adverse Effects (Potentially Significant)** are those environmental effects which, after taking into consideration mitigation measures, have a magnitude that may approach or exceed a legal regulatory limit and/or exhibit most of the following:
 - a) effect extends into areas beyond those adjacent to the Project site/footprint boundary;

- b) effect is evident beyond the life of the Project;
- c) conditions or phenomena causing the effect occur at regular or frequent intervals; and
- d) effect is permanent.

Taking into account the implementation of the mitigation measures identified in Tables 2 to 4, Table 6 provides an assessment of the significance of the residual adverse effect

Table 6: Assessment of Significance of Residual Adverse Effects

Valued Component	Likely Environmental Effects	Magnitude	Extent	Duration	Frequency	Permanence	Overall Significance
Atmosphere	Fugitive dust, PM ₁₀ and PM _{2.5} emissions and related effects on human health	M	L	L	L	L	Minor Effect (Not Significant)
	SO ₂ , NO _x , CO emissions from the Project's construction equipment, construction activity, vehicles and engines and related effects on human health	L	L	L	L	L	Negligible Effect (Not Significant)
	Increased odours	L	L	L	L	L	Negligible Effect (Not Significant)
Noise and Vibration	Increased ambient noise levels	M	L	L	M	L	Minor Effect (Not Significant)
	Increased noise and vibration from excavation and bedrock blasting	M	L	L	M	L	Minor Effect (Not Significant)
Soils and Geology	Increased potential for soil erosion	L	L	L	M	L	Minor Effect (Not Significant)
	Increased potential for ground subsidence	L	L	L	L	L	Negligible Effect (Not Significant)
Terrain	Increased potential for slope instability	L	L	L	L	L	Negligible Effect (Not Significant)
Surface Water	Decreased surface water quality in watercourses, storm water drains, ditches or street gutters resulting from increased erosion, exposure of potentially contaminated soils and bedrock.	L	M	M	M	L	Minor Effect (Not Significant)
Groundwater	Dewatering activities could have an effect on the local groundwater levels	L	L	L	L	L	Negligible Effect (Not Significant)
Vegetation	Loss of two (2) mature trees and the potential physical damage to other individual trees retained on-site and loss of thicket vegetation and lawns	L	L	L	L	M	Negligible Effect (Not Significant)
	Increased potential for the introduction on noxious plants and/or non-native (invasive) species	L	L	L	L	L	Negligible Effect (Not Significant)
Terrestrial Animals and Habitat	Disruption to wildlife and movement patterns (particularly nesting activities of resident and migratory birds)	M	L	L	M	L	Minor Effect (Not Significant)
	Increased potential for wildlife-vehicle interactions resulting in death or injury to animals	M	L	L	M	L	Minor Effect (Not Significant)
Aquatic Animals and Habitat	Decreased quality of fish habitat in Dunn's Nook due to changes in surface water quality	L	L	L	L	L	Negligible Effect (Not Significant)
Species at Risk and Migratory Birds	Disruption to Species at Risk and their movement patterns	M	L	L	M	L	Minor Effect (Not Significant)
Land use and Transportation	Increased traffic volumes and disruption to use of local roadways	L	H	L	H	L	Minor Effect (Not Significant)
	Potential damage to local roadways.	L	H	L	L	L	Minor Effect (Not Significant)
Parks and Recreational Areas	Disruption to use and enjoyment of adjacent parks and recreational areas	M	L	L	M	L	Minor Effect (Not Significant)
Population	Disruption to use and enjoyment of residential property	M	L	L	M	L	Minor Effect (Not Significant)
Cultural Resources	Potential for discovery of deeply buried artefacts or accidental discovery of human remains	L	L	L	L	L	Negligible Effect (Not Significant)
Human Health and Safety	Increased potential for personal injuries to workers and/or members of the public	L	L	L	M	L	Negligible Effect (Not Significant)

Effects of Accidents and Malfunctions							
Vehicle Collision	Increased potential for personal injuries to workers and members of the public and damage to property	L	M	L	M	M	Minor Effect (Not Significant)
Spills	Increased potential for spills and leaks from vehicles and hazardous or contaminated materials being removed from site	L	M	L	M	L	Minor Effect (Not Significant)
Blasting Accident and Fly-Rock	Increased potential for personal injuries to workers and members of the public and damage to property.	L	M	L	M	L	Minor Effect (Not Significant)
Effects of the Environment on the Project							
Severe Weather	<ul style="list-style-type: none"> Increased potential for delay of activities as well as increase the potential for personnel injury from vehicle collision or lightning strikes or falling debris. Hot temperatures in the summer could cause a health risk for personnel. High winds and storms could affect soil erosion. 	M	L	L	M	L	Minor Effect (Not Significant)

2.7 Public Participation

No public participation was conducted for the remediation project. The work is taking place entirely on DND property, with minimal disruption to the public. Due to the scope and scale of the project, public involvement was not deemed necessary.

2.8 Aboriginal Community Engagement

The work is taking place entirely on DND property. The project Site is not currently used by Aboriginal people for traditional activities. No significant adverse effects to lands and waters off-site are anticipated and there are no known archaeological sites within the Site boundaries. Therefore Aboriginal community engagement was not considered necessary. If archaeological resources are encountered during the project, DND will coordinate communications with the Songhees Nation and Esquimalt Nation in relation to archaeological resources.

2.9 References and Expertise from Other Federal Government Bodies

Acts, Regulations and Policies

- BC Contaminated Sites Regulation (2011);
- BC Environmental Management Act (2004);
- BC Hazardous Waste Regulation (2009);
- BC Water Protection Act (1996);
- BC Wildlife Act (1996);
- BC Workers Compensation Act (1996);
- Canada Labour Code (1985);
- CCME Canadian Soil Quality Guidelines for the Protection of Human and Environmental Health (2011);
- CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (2011);
- Canadian Environmental Assessment Act (2012);
- Canadian Environmental Protection Act (1999);
- Migratory Birds Convention Act (1994);
- Occupational Health and Safety Administration (OSHA) Occupational Health and Safety Standards; and
- Species at Risk Act (SARA) (2003).

Other References

- British Columbia Conservation Data Centre. (2015). CDC Internet Mapping Service. (<http://www.env.gov.bc.ca/atrisk/ims.htm>) [Accessed on July 30, 2015].
- British Columbia Conservation Data Centre. (2015). Personal communication with SLR. August 5, 2015.
- British Columbia Ministry of Forests. (1999). The Ecology of the Coastal Douglas-fir Zone.
- British Columbia Species and Ecosystems Explorer and Mapped Known Locations, administered by the BC Conservation Data Centre.
- Canadian Climate Normals, a service of Environment Canada.
- City of Colwood Bylaw 38 – A Bylaw to Regulate Noise within the City of Colwood.
- Department of National Defence (2015). CFB Esquimalt – Safety & Environment for Contractors.

- Millennia Research Limited (2004). An Archaeological Inventory Assessment of Lots 1, 3, and 14, CFB Esquimalt, Colwood. Prepared for Public Works and Government Services Canada and Submitted to Formation Environment, CFB Esquimalt, the Esquimalt Nation, the Songhees First Nation and the Archaeology Branch. Project #MR0401.
- SLR Consulting (Canada) Ltd. (2013). DND Environmental Assessment Form – COL-43 Remediation.
- SNC-Lavalin Inc. (2012). Environmental Assessment Screening Report, COL-18 Site Remediation.

Part 3. Environmental Effects Determination

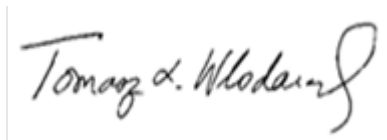
On the basis of this DND EED Report, it has been determined that the impact of this project on the environment is as follows:

- Project is not likely to cause significant adverse environmental effects. The project **can** proceed with application of the mitigation measures specified in the interaction tables in this report.
- The project is likely to cause significant adverse environmental effects that cannot be mitigated. The project **cannot** proceed without Governor in Council approval.
- Refer the project, through the chain of command and **only on the recommendation of Environmental Command and DGIEGPS**, to Governor in Council for a decision on whether the project is justified to proceed.

DND EED Report Prepared by:

Tomasz Wlodarczyk, M.E.S

Title: Principal Consultant, SLR Consulting Ltd.



01-12-2017

Signature

Date (dd-mm-yyyy)

DND EED Report Reviewed by:

Name: Aaron Haegele

Title: Senior Scientist, SLR Consulting Ltd.



01-12-2017

Signature

Date (dd-mm-yyyy)

DND EED Report Reviewed by:

Name: Tracey Comforth

Title: MARPAC Environmental Specialist Staff



Signature

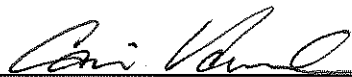
04-12-2017
Date (dd-mm-yyyy)

DND EED Report Accepted and Approved by:

The undersigned accepts the determination and recommendations of this environmental effects determination report. The undersigned also accepts the responsibility to incorporate the recommendations of the report into the project design and implementation.

Name: Cain VanCadsand

Title: Formation Environment, Project Director



Signature

06-12-2017
Date (dd-mm-yyyy)

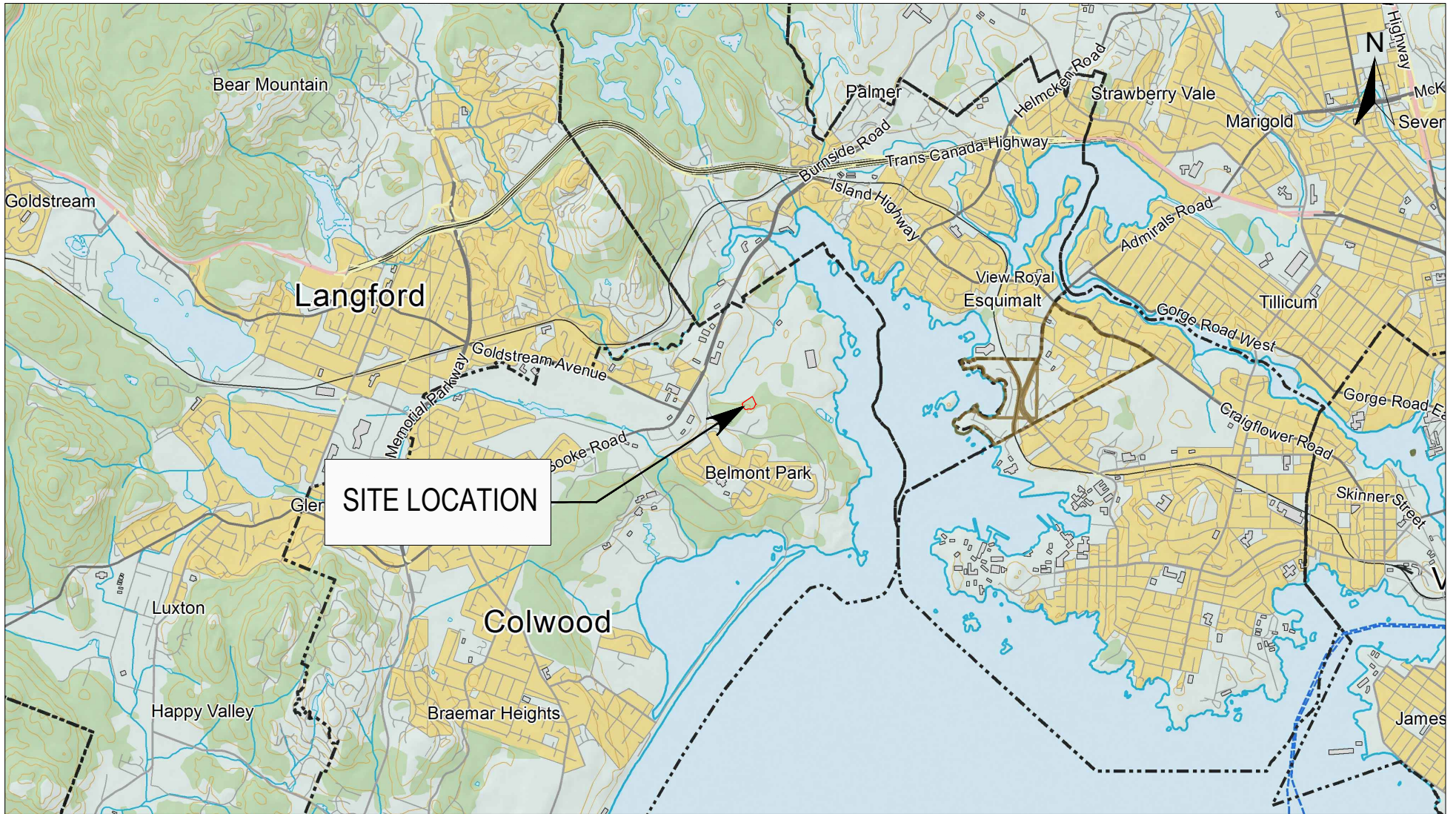
DRAWINGS

Colwood Fuel Oil Depot North Area Remediation
(DND) CFB Esquimalt Colwood property
SLR Project No.: 205.03903.00000



Government of Canada

Gouvernement du Canada



Cadfile name: N:\Vancouver\CAD\Project Drawings\205\205.03903\205.03903.00000\IS_205-03903-00000-A2.dwg

PROJECT: ENVIRONMENTAL EFFECTS DETERMINATION
 PROJET: REPORT

SUBJECT: SITE LOCATION MAP
 SUJET: SITE LOCATION MAP

DATE: 2017/10/26

APPROVED:	X.X.	
APPROUVÉ PAR:	X.X.	
SCALE:	1:50 000	
ÉCHELLE:	1:50 000	
WBS NO.:		
NO. SRT:		
PF NO.:	205.03903.00000	#
NO. DP:		
DWG NO.:		
NO. DESSIN:	X-XX-XXXX/X - 001	

BORDER LAST UPDATED 2011-05-31



LEGEND:

- - - PROPERTY BOUNDARY
- SITE ACCESS ROUTES
- - - APPROXIMATE LIMITS OF EXCAVATION

PROJET: ENVIRONMENTAL EFFECTS DETERMINATION
 PROJECT: REPORT

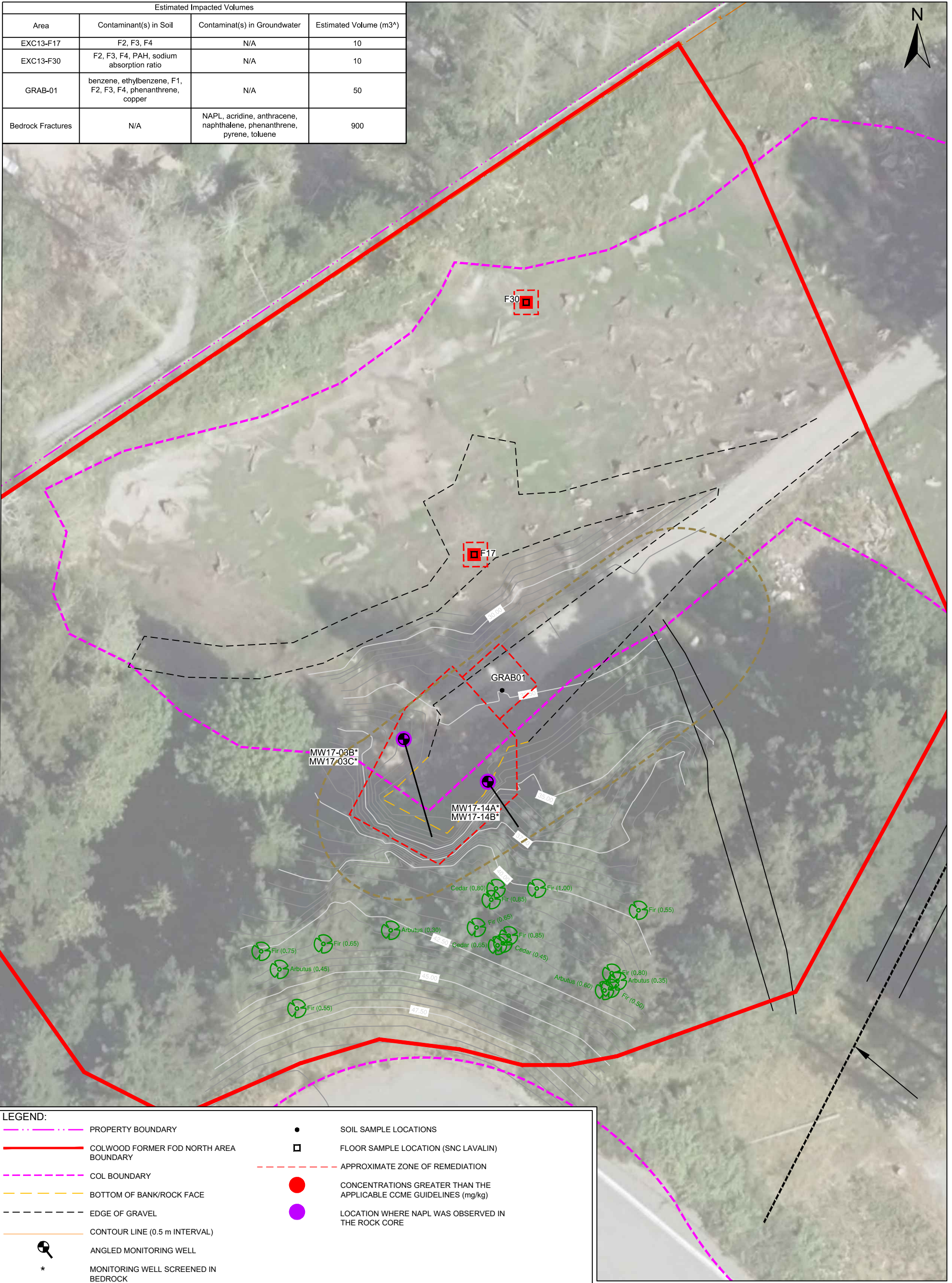
SUJET: **SITE LAYOUT**
 SUBJECT:

DATE: 2017/10/26

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APPROVED:	X.X.				
ÉCHELLE:	1:5,000				
NO. OTP:	XXXXXXXXX				
NO. DP:	205.03903.00000				
NO. DESSIN:	X-XX-XXXX/X - 002				
DWG NO.:					



Estimated Impacted Volumes			
Area	Contaminant(s) in Soil	Contaminant(s) in Groundwater	Estimated Volume (m ³)
EXC13-F17	F2, F3, F4	N/A	10
EXC13-F30	F2, F3, F4, PAH, sodium absorption ratio	N/A	10
GRAB-01	benzene, ethylbenzene, F1, F2, F3, F4, phenanthrene, copper	N/A	50
Bedrock Fractures	N/A	NAPL, acridine, anthracene, naphthalene, phenanthrene, pyrene, toluene	900



LEGEND:

	PROPERTY BOUNDARY		SOIL SAMPLE LOCATIONS
	COLWOOD FORMER FOD NORTH AREA BOUNDARY		FLOOR SAMPLE LOCATION (SNC LAVALIN)
	COL BOUNDARY		APPROXIMATE ZONE OF REMEDIATION
	BOTTOM OF BANK/ROCK FACE		CONCENTRATIONS GREATER THAN THE APPLICABLE CCME GUIDELINES (mg/kg)
	EDGE OF GRAVEL		LOCATION WHERE NAPL WAS OBSERVED IN THE ROCK CORE
	CONTOUR LINE (0.5 m INTERVAL)		
	ANGLED MONITORING WELL		
	MONITORING WELL SCREENED IN BEDROCK		

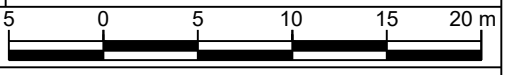
PROJET: ENVIRONMENTAL EFFECTS DETERMINATION
PROJECT: REPORT

SUJET: APPROXIMATE ZONES OF
SUBJECT: REMEDIATION

DATE: 2017/10/26

APPROUVÉ PAR: X.X.
APPROVED: X.X.

ÉCHELLE: 1:400
SCALE: 1:400



NO. OTP: XXXXXXXX
NO. WBS NO.:
NO. DP: 205.03850.00000 #
PF NO:
NO. DESSIN: X-XX-XXXX/X - 003
DWG NO.:

APPENDIX A
BC Conservation Data Centre (CDC)
Mapping and Occurrence Reports

Colwood Fuel Oil Depot North Area Remediation
(DND) CFB Esquimalt Colwood property
SLR Project No.: 205.03903.00000

CDC Occurrence Map

Legend

Species and Ecosystems at Available Occurrences - CD

FEATURE_CODE

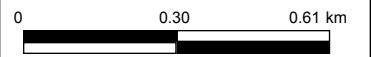
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- Animal - Invertebrate
- Plant - Vascular
- Plant - Non-vascular
- Ecological Community

Species and Ecosystems at Secured (Publicly Available)

Species and Ecosystems at Publicly Available Occurrence

FEATURE_CODE

- Animal - Vertebrate
- Animal - Invertebrate



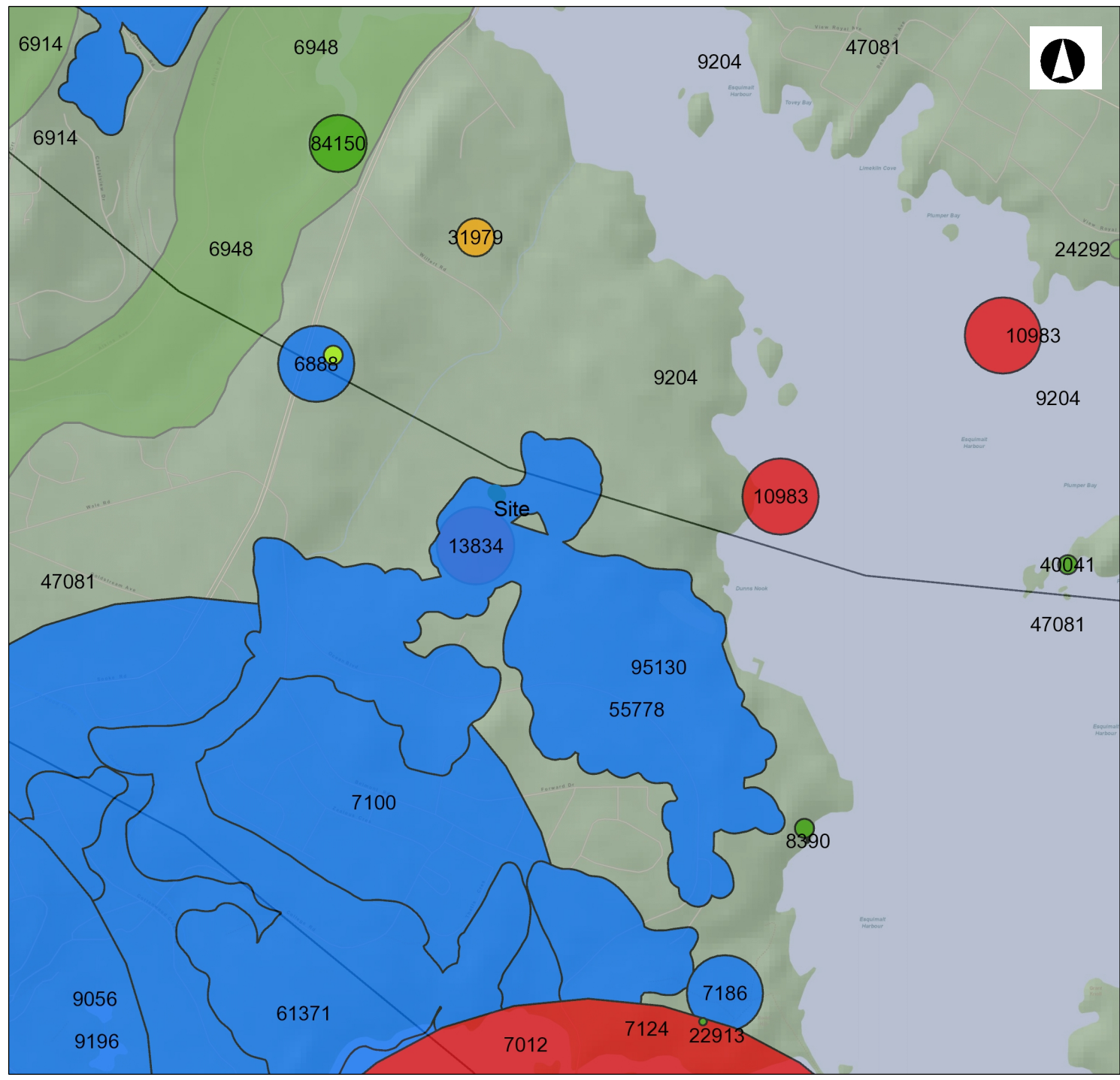
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Datum: NAD83
 Projection: NAD_1983_BC_Environment_Albers

Key Map of British Columbia





BC Conservation Data Centre: Species Occurrence Report

Shape ID: 95130

Scientific Name: Isoetes nuttallii
English Name: Nuttall's quillwort

Identifiers

Occurrence ID: 12115
Shape ID: 95130
Taxonomic Class: quillworts
Element Group: Vascular Plant

Status

Provincial Rank: S3
BC List: Blue
Global Rank: G4?
COSEWIC:
SARA Schedule:

Locators

Survey Site: YEW POINT, COLWOOD
Directions: Fort Rodd Hill, northeast of paved road, in former clearing, 500 m north from entrance to park and at Yew Point, approximately 650 m north of Fisgard Light House.

Biogeoclimatic Zone:

Ecosection: JDF;SGI

Occurrence Information

First Observation Date: 2002-04-30 **Last Observation Date:** 2002-05-07

Occurrence Data:

2002-05-07: Estimated 800-1000 plants over 300 square m area in 2 sites at Subpopulation 2 which is probably a remnant of a former natural occurrence. A flat area on shallow clay soil over bedrock that is wet in winter and spring, surrounded by young Douglas-firs. Dominant associates: Anthoxanthum odoratum and Agrostis stolonifera with Scotch broom, Danthonia californica, Hypochaeris radicata, Rumex acetosella and Holcus lanatus (H. Roemer, pers. comm. 2002). 2002-04-30: 15 plants over 0.2 square m area at Subpopulation 1. Small muddy depression in grassy rock outcrop area. Immediate associates: Triteleia hyacinthina with surrounding associates of Hordeum murinum, Poa annua and Lolium perenne; also with Camassia leichtlinii and Cerastium glomeratum. Slope of 5% and east aspect. No other habitat in vicinity (H. Roemer, pers. comm. 2002).

Area Description

General Description:

Vegetation Zone: Lowland
Min. Elevation (m): 40 **Max. Elevation (m):**
Habitat: TERRESTRIAL: Woodland Needleleaf

Occurrence Rank and Occurrence Rank Factors

Rank: AB : Excellent or good estimated viability

Rank Date: 2002-05-07

Rank Comments:

Small, healthy population in an historic artillery fort where Parks Canada has undertaken the control and removal of invasive plants that threaten sensitive species associated with Garry oak meadows and associated ecosystems.

Condition of Occurrence:

2002: Small healthy population (H. Roemer, pers. comm. 2002).

Size of Occurrence:

2002: Estimated 815-1000 plants over 300 square m area in 2 sites (H. Roemer, pers. comm. 2002).

Landscape Context:

Flat, disturbed site (H. Roemer, pers. comm. 2002).

Version

Version Date: 7/30/2014 12:00:00 AM

Version Author: Chytyk, P.

Mapping Information

Estimated Representation Accuracy: High

Estimated Representation Accuracy Comments:

Confident that full extent is represented by Occurrence: ?

Confidence Extent Definition: Uncertain whether full extent of EO is known

Additional Inventory Needed: Y

Inventory Comments: To determine full extent and viability of population.

Documentation

References:

Roemer, H. Personal communication. Botanical consultant.

Specimen:

Please visit the website http://www.env.gov.bc.ca/cdc/gis/eo_data_fields_06.htm for definitions of the data fields used in this occurrence report.

Suggested Citation:

B.C. Conservation Data Centre. 2014. Occurrence Report Summary, Shape ID: 95130, Nuttall's quillwort. B.C. Ministry of Environment. Available: <http://delivery.maps.gov.bc.ca/ess/sv/cdc>, (accessed Jul 31, 2015).



BC Conservation Data Centre: Ecosystem Occurrence Report

Shape ID: 55778

Scientific Name: Pseudotsuga menziesii / Mahonia nervosa

English Name: Douglas-fir / dull Oregon-grape

Identifiers

Occurrence ID: 8649

Shape ID: 55778

Element Group: Ecological Community

Status

Provincial Rank: S2

BC List: Red

Global Rank: G2

Locators

Survey Site: BELMONT PARK

Directions:

Biogeoclimatic Unit: CDF mm

Ecosection: SGI

Occurrence Information

First Observation Date: 1968

Last Observation Date: 2007

Occurrence Data:

This occurrence (based on Terrestrial Ecosystem Mapping) is highly variable in stand structure. The forests around the Royal Roads campus include some mature forest (44%) with patches of older veterans trees, but there are also areas of young (37%) forests and some patches of early forest regeneration (19%) established after more recent disturbance. Field observations indicate other tree species occurring within the Douglas-fir dominated stands may be western redcedar, grand fir, shore pine and arbutus depending on localized soil-moisture conditions. Red alder is common in the recently disturbed areas.

General Description:

This occurrence is located at Belmont Park and Royal Roads University and part of Fort Rodd Hill, B.C., and is located along the coastline at some areas. Other ecosystems in the area include Garry oak stands, riparian areas and wet forests.

Environmental Summary:

The terrain is covered in glaciomarine veneers, with some areas of glaciofluvial fans and hummocky and undulating bedrock.

Occurrence Rank and Occurrence Rank Factors

Rank*: CD : Fair or poor estimated viability

Note: in the case of Ecological Communities, "viability" should read as "ecological integrity".

Rank Date: 13-01-18

Rank Comments:

This small occurrence is assessed at Fair to Poor Ecological Integrity, due to the highly fragmented nature of the occurrence within a highly fragmented landscape.

Condition of Occurrence:

This occurrence has a wide diversity of forest stand development, ranging from mature forests to early forest regeneration. The occurrence includes significant areas of dense development resulting in high internal fragmentation. Infrastructure associated with the Royal Roads campus and Belmont residential area, and the historical infrastructure associated with the National Park at Fort Rodd Hill, significantly reduces the Condition assessment to Fair. Within the mature forest there are single lane roads and other disturbed areas.

Size of Occurrence:

The size of this occurrence is considered average within this fragmented landscape (180.68 ha).

Landscape Context:

This occurrence is set in a largely urban landscape, with a few remnant patches of forest and a portion of the perimeter along the coastline. Landscape Context is assessed as Poor to Fair.

Version

Version Date: 1/18/2013 12:00:00 AM

Version Author: de Groot, A. and C.M. Cadrin

Mapping Information

Estimated Representation Accuracy: Medium

Estimated Representation Accuracy Comments: The ecological community occupies 65.82% (180.68 ha) of the mapped occurrence.

Confident that full extent is represented by Occurrence: ?

Confidence extent Definition: Uncertain whether full extent of EO is known

Additional Inventory Needed: Y

Inventory Comments: Four plots listed in TEM attribute table but not found in VENUS database. VTAB Plot RO 399 was completed for Roemer (1972).

Documentation

References:

- Canadian Wildlife Service, Ministry of Environment, Lands and Parks Vancouver Island Region, and B.C. Conservation Data Centre. 1993-1996. Sensitive Ecosystems Inventory groundtruthing forms. Unpub. field forms.
- Canadian Wildlife Service, Ministry of Environment, Lands and Parks Vancouver Island Region, and B.C. Conservation Data Centre. 1993-1996. Sensitive Ecosystems Inventory site photographs. Unpub. slides and prints.
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- Madrone Environmental Services Ltd. 2008. Terrestrial Ecosystem Mapping of the Coastal Douglas-Fir Biogeoclimatic Zone. Unpublished report prepared for Integrated Land Management Bureau (ILMB), Duncan, B.C. 123pp.
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Please visit the website http://www.env.gov.bc.ca/cdc/gis/eo_data_fields_06.htm for definitions of the data fields used in this occurrence report.

Suggested Citation:

B.C. Conservation Data Centre. 2014. Occurrence Report Summary, Shape ID: 55778, Douglas-fir / dull Oregon-grape. B.C. Ministry of Environment. Available: <http://delivery.maps.gov.bc.ca/ess/sv/cdc>, (accessed Jul 31, 2015).



BC Conservation Data Centre: Species Occurrence Report

Shape ID: 13834

Scientific Name: Ardea herodias fannini
English Name: Great Blue Heron, fannini subspecies

Identifiers

Occurrence ID: 6064
Shape ID: 13834
Taxonomic Class: birds
Element Group: Vertebrate Animal

Status

Provincial Rank: S2S3B,S4N
BC List: Blue
Global Rank: G5T4
COSEWIC: SC (MAR 2008)
SARA Schedule: 1

Locators

Survey Site: COLWOOD
Directions: Canadian Forces Base, Colwood. "Located to the northeast of an oil recycling plant. The nest trees are in mature second growth conifers on a slight rise, immediately south of the fence separating the Colwood Arena playing fields" (Moul 2001).

Biogeoclimatic Zone:

Ecosection: SGI

Occurrence Information

First Observation Date: 1998 **Last Observation Date:** 2001

Occurrence Data:

This colony has been abandoned (T. Chatwin, pers. comm. 2012). .2001: 0 active nests (Moul 2002). 1998-2000: number of active nests increasing yearly from 16 to 55 (Moul 1999, 2000; Vennesland 2000).

Area Description

General Description:

Mature second growth conifers with predominantly salal understory.

Vegetation Zone:

Min. Elevation (m): **Max. Elevation (m):**

Habitat: TERRESTRIAL: Forest Needleleaf

Occurrence Rank and Occurrence Rank Factors

Rank: X : Extirpated

Rank Date: 2001-01-01

Rank Comments:

This colony has been abandoned (T. Chatwin, pers. comm. 2012). No active nests found in 2001.

Condition of Occurrence:

Size of Occurrence:

Landscape Context:

Version

Version Date: 1/24/2012 12:00:00 AM

Version Author: Gelling, L.

Mapping Information

Estimated Representation Accuracy: Medium

Estimated Representation Accuracy Comments:

Confident that full extent is represented by Occurrence: N

Confidence Extent Definition: Confident full extent of EO is NOT known

Additional Inventory Needed: N

Inventory Comments:

Documentation

References:

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Specimen:

Please visit the website http://www.env.gov.bc.ca/cdc/gis/eo_data_fields_06.htm for definitions of the data fields used in this occurrence report.

Suggested Citation:

B.C. Conservation Data Centre. 2014. Occurrence Report Summary, Shape ID: 13834, Great Blue Heron, *fannini* subspecies. B.C. Ministry of Environment. Available: <http://delivery.maps.gov.bc.ca/ess/sv/cdc>, (accessed Jul 31, 2015).

BC Species and Ecosystems Explorer Search Results

Status

Scientific Name	English Name	Provincial	BC List	COSEWIC	SARA	Global	CF Priority
<i>Abronia latifolia</i>	yellow sand-verbena	S2 (2015)	Red			G5 (1988)	1
<i>Accipiter gentilis laingi</i>	Northern Goshawk, <i>laingi</i> subspecies	S2B (2010)	Red	T (2013)	1-T (2003)	G5T2 (2008)	1
<i>Acmispon americanus</i> var. <i>americanus</i>	Spanish-clover	S3 (2015)	Blue			G5T5 (1994)	4
<i>Allium amplexens</i>	slimleaf onion	S3 (2015)	Blue			G4 (1988)	2
<i>Allium crenulatum</i>	Olympic onion	S3 (2015)	Blue			G4 (1988)	3
<i>Allium geyeri</i> var. <i>tenerum</i>	Geyer's onion	S3 (2015)	Blue			G4G5T3T5 (2002)	3
<i>Alopecurus carolinianus</i>	Carolina meadow- foxtail	S2 (2015)	Red			G5 (1986)	3
<i>Alsia californica</i>		S3 (2015)	Blue			G4 (1992)	3
<i>Anagallis minima</i>	chaffweed	S3 (2015)	Blue			G5 (1984)	2
<i>Anarta edwardsii</i>	Edwards' Beach Moth	S1 (2009)	Red	E (2009)	1-E (2011)	GNR	1
<i>Anaxyrus boreas</i>	Western Toad	S3S4 (2010)	Blue	SC (2012)	1-SC (2005)	G4 (2008)	2
<i>Aneides vagrans</i>	Wandering Salamander	S3S4 (2010)	Blue	SC (2014)		G4 (2005)	2
<i>Ardea herodias fannini</i>	Great Blue Heron, <i>fannini</i> subspecies	S2S3B,S4N (2009)	Blue	SC (2008)	1-SC (2010)	G5T4 (1997)	1
<i>Asio flammeus</i>	Short-eared Owl	S3B,S2N (2015)	Blue	SC (2008)	1-SC (2012)	G5 (2008)	2
<i>Balsamorhiza deltoidea</i>	deltoid balsamroot	S1 (2015)	Red	E (2009)	1-E (2003)	G5 (1988)	1
<i>Bartramia stricta</i>	rigid apple moss	S2 (2015)	Red	E (2009)	1-E (2003)	GU (2006)	2
<i>Bidens amplissima</i>	Vancouver Island beggarticks	S3 (2015)	Blue	SC (2001)	1-SC (2003)	G3 (1988)	1
<i>Botaurus lentiginosus</i>	American Bittern	S3B (2015)	Blue			G4 (1996)	2
<i>Botrychium simplex</i> var. <i>compositum</i>	least moonwort	S3 (2015)	Blue			G5TNR	
<i>Brachyramphus marmoratus</i>	Marbled Murrelet	S3B,S3N (2015)	Blue	T (2012)	1-T (2003)	G3 (2013)	1
<i>Brachythecium holzingeri</i>		S2S3 (2011)	Blue			GU (2000)	2
<i>Bryum violaceum</i>		S1S2 (2015)	Red			G5? (2000)	2
<i>Butorides virescens</i>	Green Heron	S3S4B (2015)	Blue			G5 (1996)	4
<i>Callitriche heterophylla</i> var. <i>heterophylla</i>	two-edged water- starwort	S2S3 (2000)	Blue			G5T5 (1998)	3
<i>Callitriche marginata</i>	winged water-starwort	S3 (2015)	Blue			G4 (1988)	1
<i>Callophrys eryphon sheltonensis</i>	Western Pine Elfin, <i>sheltonensis</i> subspecies	S3 (2013)	Blue			G5TNR	4

<i>Callophrys johnsoni</i>	Johnson's Hairstreak	S1S2 (2013)	Red			G3G4 (2004)	2
<i>Callophrys mossii mossii</i>	Moss' Elfin, <i>mossii</i> subspecies	S2S3 (2013)	Blue			G4T4 (2001)	2
<i>Camissonia contorta</i>	contorted-pod evening-primrose	S1 (2015)	Red	E (2006)	1-E (2007)	G5 (1988)	1
<i>Carex feta</i>	green-sheathed sedge	S3 (2015)	Blue			G5 (1990)	2
<i>Carex tumulicola</i>	foothill sedge	S2 (2015)	Red	E (2008)	1-E (2010)	G4 (1985)	2
<i>Carychium occidentale</i>	Western Thorn	S2S3 (2008)	Blue			G3G4 (2002)	2
<i>Castilleja levisecta</i>	golden paintbrush	S1 (2015)	Red	E (2007)	1-E (2003)	G1 (2012)	1
<i>Castilleja victoriae</i>	Victoria's owl-clover	S1 (2015)	Red	E (2010)	1-E (2012)	G1 (2007)	1
<i>Cephalanthera austiniiae</i>	phantom orchid	S2 (2015)	Red	E (2014)	1-T (2003)	G4 (1990)	2
<i>Cercyonis pegala incana</i>	Common Wood-nymph, <i>incana</i> subspecies	S2 (2013)	Red			G5T4T5 (2003)	2
<i>Chordeiles minor</i>	Common Nighthawk	S4B (2015)	Yellow	T (2007)	1-T (2010)	G5 (2009)	2
<i>Chrysemys picta</i>	Painted Turtle	S3 (2012)	No Status	E/SC (2006)	1	G5 (2005)	2
<i>Chrysemys picta</i> pop. 1	Painted Turtle - Pacific Coast Population	S2 (2012)	Red	E (2006)	1-E (2007)	G5T2 (2007)	2
<i>Clarkia purpurea</i> ssp. <i>quadrivulnera</i>	wine-cup clarkia	S2 (2015)	Red			G5T5 (1999)	1
<i>Coenonympha tullia insulana</i>	Common Ringlet, <i>insulana</i> subspecies	S1 (2013)	Red			G5T3T4 (1998)	1
<i>Contia tenuis</i>	Sharp-tailed Snake	S1S2 (2012)	Red	E (2009)	1-E (2003)	G5 (2010)	1
<i>Contopus cooperi</i>	Olive-sided Flycatcher	S3S4B (2015)	Blue	T (2007)	1-T (2010)	G4 (2008)	2
<i>Copablepharon fuscum</i>	Sand-verbena Moth	S1 (2006)	Red	E (2013)	1-E (2005)	G1G2 (2004)	2
<i>Corynorhinus townsendii</i>	Townsend's Big-eared Bat	S3S4 (2015)	Blue			G3G4 (2014)	2
<i>Crassula connata</i> var. <i>connata</i>	erect pygmyweed	S2 (2015)	Red			G5TNR	3
<i>Crumia latifolia</i>		S3 (2015)	Blue			G3 (1999)	2
<i>Cryptomastix devia</i>	Puget Oregonian	SX (2008)	Red	XT (2013)	1-XX (2005)	G3 (2005)	1
<i>Cypseloides niger</i>	Black Swift	S2S3B (2015)	Blue	E (2015)		G4 (1996)	2
<i>Danaus plexippus</i>	Monarch	S3B (2013)	Blue	SC (2010)	1-SC (2003)	G5 (2011)	2
<i>Eleocharis parvula</i>	small spike-rush	S3 (2015)	Blue			G5 (1984)	3
<i>Entosthodon fascicularis</i>	banded cord-moss	S2S3 (2015)	Blue	SC (2015)	1-SC (2006)	G4G5 (2001)	2

<i>Epargyreus clarus</i>	Silver-spotted Skipper	S3 (2013)	Blue			G5 (2009)	4
<i>Epargyreus clarus californicus</i>	Silver-spotted Skipper, <i>californicus</i> subspecies	SH (2013)	Red			G5TNR	
<i>Epilobium densiflorum</i>	dense spike-primrose	S1 (2010)	Red	E (2005)	1-E (2006)	G5 (1988)	1
<i>Epilobium torreyi</i>	brook spike-primrose	SX (2015)	Red	E (2006)	1-E (2007)	G5 (1988)	2
<i>Erynnis propertius</i>	Propertius Duskywing	S2 (2013)	Red			G5 (2009)	2
<i>Erythemis collocata</i>	Western Pondhawk	S3S4 (2015)	Blue			G5 (2000)	2
<i>Euchloe ausonides insulanus</i>	Large Marble, <i>insulanus</i> subspecies	SX (2013)	Red	XT (2010)	1-XX (2003)	G5T1 (2010)	2
<i>Eumetopias jubatus</i>	Steller Sea Lion	S3B,S4N (2013)	Blue	SC (2013)	1-SC (2005)	G3 (2011)	2
<i>Euphydryas editha taylori</i>	Edith's Checkerspot, <i>taylori</i> subspecies	S1 (2013)	Red	E (2011)	1-E (2003)	G5T1 (2008)	1
<i>Euphyes vestris</i>	Dun Skipper	S2 (2013)	Red	T (2013)	1-T (2003)	G5 (2006)	2
<i>Eurybia radulina</i>	rough-leaved aster	S2 (2015)	Red			G4G5 (1988)	2
<i>Falco peregrinus</i>	Peregrine Falcon	S3B (2015)	No Status	SC (2007)		G4 (2000)	2
<i>Falco peregrinus anatum</i>	Peregrine Falcon, <i>anatum</i> subspecies	S2?B (2010)	Red	SC (2007)	1-SC (2012)	G4T4 (2006)	2
<i>Falco peregrinus pealei</i>	Peregrine Falcon, <i>pealei</i> subspecies	S3B (2010)	Blue	SC (2007)	1-SC (2003)	G4T3 (1997)	1
<i>Festuca rubra</i> ssp. <i>mediana</i>	dwarf red fescue	S2S4 (2012)	Blue			G5TNR	
<i>Fissidens ventricosus</i>		S2S3 (2015)	Blue			GU (2000)	2
<i>Fratercula cirrhata</i>	Tufted Puffin	S2S3B,S4N (2015)	Blue			G5 (2003)	2
<i>Fraxinus latifolia</i>	Oregon ash	S1S2 (2013)	Red			G5 (1990)	1
<i>Funaria muhlenbergii</i>		S3? (2011)	Blue			G4 (1995)	2
<i>Galba vancouverensis</i>		SH (2015)	Red			GHQ (2009)	1
<i>Githopsis specularioides</i>	common bluecup	S2 (2015)	Red			G5 (1994)	2
<i>Glaucidium gnoma swarthi</i>	Northern Pygmy-Owl, <i>swarthi</i> subspecies	S3 (2009)	Blue			G4G5T3Q (1996)	1
<i>Glyceria leptostachya</i>	slender-spiked mannagrass	S3 (2015)	Blue			G3 (1991)	2
<i>Haliotis kamtschatkana</i>	Northern Abalone	S2 (2002)	Red	T (2000)	1-T (2003)	G3G4 (2010)	2
<i>Helenium autumnale</i> var. <i>grandiflorum</i>	mountain sneezeweed	S2S3 (2000)	Blue			G5T3T5 (2002)	2
<i>Hemphillia dromedarius</i>	Dromedary Jumping-slug	S2 (2008)	Red	T (2014)	1-T (2005)	G3G4 (2005)	2
<i>Hemphillia glandulosa</i>	Warty Jumping-slug	S2S3 (2008)	Blue	SC (2013)	1-SC (2005)	G3G4 (2005)	2

<i>Hesperia colorado oregonia</i>	Western Branded Skipper, <i>oregonia</i> subspecies	S1 (2013)	Red	E (2013)		G5T3T4 (2000)	2
<i>Heterocodon rariflorum</i>	heterocodon	S3 (2015)	Blue			G5 (1988)	2
<i>Hirundo rustica</i>	Barn Swallow	S3S4B (2015)	Blue	T (2011)		G5 (1996)	2
<i>Hornungia procumbens</i>	ovalpurse	S3? (2015)	Blue			G5 (1990)	4
<i>Hosackia gracilis</i>	seaside bird's foot lotus	S1 (2015)	Red	E (2010)	1-E (2003)	G4 (2005)	1
<i>Hydrophyllum tenuipes</i>	Pacific waterleaf	S2 (2015)	Red			G4G5 (1988)	2
<i>Hydroprogne caspia</i>	Caspian Tern	S3B (2015)	Blue	NAR (1999)		G5 (1996)	2
<i>Idahoa scapigera</i>	scalepod	S2S3 (2015)	Blue			G5 (1987)	2
<i>Isoetes nuttallii</i>	Nuttall's quillwort	S3 (2015)	Blue			G4? (2011)	2
<i>Jaumea carnosa</i>	fleshy jaumea	S3 (2015)	Blue			G4G5 (2000)	2
<i>Juncus kelloggii</i>	Kellogg's rush	S1 (2015)	Red	E (2003)	1-E (2005)	G3? (1990)	2
<i>Juniperus maritima</i>	seaside juniper	S3 (2008)	Blue			G3G4 (2011)	3
<i>Lathyrus littoralis</i>	silky beach pea	S2 (2015)	Red	T (2013)		G3G4 (2013)	2
<i>Limnanthes macounii</i>	Macoun's meadow-foam	S2 (2007)	Red	T (2004)	1-T (2006)	G2 (2012)	1
<i>Lomatium dissectum</i> var. <i>dissectum</i>	fern-leaved desert-parsley	S1S2 (2014)	Red			G4T4 (2003)	1
<i>Lomatium grayi</i>	Gray's desert-parsley	S1 (2015)	Red	T (2008)	1-T (2011)	G5 (1987)	2
<i>Lupinus densiflorus</i> var. <i>densiflorus</i>	dense-flowered lupine	S1 (2015)	Red	E (2005)	1-E (2006)	G5T4 (1989)	1
<i>Lupinus lepidus</i>	prairie lupine	S1 (2015)	Red	E (2009)	1-E (2003)	G5 (1989)	1
<i>Lupinus oregonus</i> var. <i>kincaidii</i>	Kincaid's lupine	SX (2015)	Red	XT (2008)	1-XX (2011)	G4T2 (2000)	1
<i>Lupinus rivularis</i>	streambank lupine	S1 (2009)	Red	E (2002)	1-E (2005)	G2G4 (2009)	1
<i>Marah oregana</i>	coast manroot	S1 (2015)	Red	E (2009)		G5 (1990)	1
<i>Meconella oregana</i>	white meconella	S1 (2015)	Red	E (2005)	1-E (2006)	G2G3 (2013)	1
<i>Megascops kennicottii</i>	Western Screech-Owl	S4 (2015)	No Status	T (2012)	1	G5 (2003)	2
<i>Megascops kennicottii kennicottii</i>	Western Screech-Owl, <i>kennicottii</i> subspecies	S3 (2009)	Blue	T (2012)	1-SC (2005)	G5T4 (2003)	1
<i>Microseris bigelovii</i>	coast microseris	S1 (2015)	Red	E (2006)	1-E (2007)	G4 (1995)	1
<i>Minuartia pusilla</i>	dwarf sandwort	S1 (2015)	Red	E (2004)	1-E (2005)	G5 (1990)	2
<i>Mirounga angustirostris</i>	Northern Elephant Seal	S1B (2014)	Red	NAR (1986)		G5 (1996)	5

<i>Monadenia fidelis</i>	Pacific Sideband	S3S4 (2008)	Blue			G4G5 (2002)	2
<i>Musculium partumeium</i>	Swamp Fingernailclam	S2S4 (2015)	Blue			G5 (2004)	1
<i>Mustela erminea anguinae</i>	Ermine, <i>anguinae</i> subspecies	S3 (2010)	Blue			G5T3 (1996)	2
<i>Myotis keenii</i>	Keen's Myotis	S3? (2015)	Blue	DD (2003)	3 (2005)	G2G3 (2012)	1
<i>Myotis lucifugus</i>	Little Brown Myotis	S4 (2015)	Yellow	E (2013)	1-E (2014)	G3 (2012)	5
<i>Navarretia intertexta</i>	needle-leaved navarretia	S2 (2015)	Red			G5TNR	2
<i>Nearctula</i> sp. 1	Threaded Vertigo	S2 (2008)	Red	SC (2010)	1-SC (2012)	G3G5 (2006)	2
<i>Nuttallanthus texanus</i>	Texas toadflax	S3 (2005)	Blue			G4G5 (1986)	4
<i>Omus audouini</i>	Audouin's Night-stalking Tiger Beetle	S2? (2015)	Red	T (2013)		G5 (2008)	1
<i>Oncorhynchus clarkii clarkii</i>	Cutthroat Trout, <i>clarkii</i> subspecies	S3S4 (2004)	Blue			G4T4 (1997)	2
<i>Oncorhynchus kisutch</i>	Coho Salmon	S4 (2000)	Yellow	E (2002)		G4 (2001)	2
<i>Ophioglossum pusillum</i>	northern adder's-tongue	S3? (2015)	Blue			G5 (2011)	3
<i>Orthocarpus bracteosus</i>	rosy owl-clover	S1 (2015)	Red	E (2004)	1-E (2005)	G3? (1998)	2
<i>Packera macounii</i>	Macoun's groundsel	S3 (2015)	Blue			G5 (1993)	2
<i>Parnassius clodius claudianus</i>	Clodius Parnassian, <i>claudianus</i> subspecies	S3S4 (2013)	Blue			G5TNR	6
<i>Patagioenas fasciata</i>	Band-tailed Pigeon	S3S4B (2015)	Blue	SC (2008)	1-SC (2011)	G4 (2000)	2
<i>Phalacrocorax auritus</i>	Double-crested Cormorant	S3S4B (2015)	Blue	NAR (1978)		G5 (1999)	2
<i>Phalacrocorax penicillatus</i>	Brandt's Cormorant	S1B,S4N (2015)	Red			G5 (1999)	1
<i>Physcomitrium pyriforme</i>		S3 (2015)	Blue			G5 (1991)	2
<i>Piperia candida</i>	white-lip rein orchid	S2 (2015)	Red			G3? (2012)	2
<i>Pituophis catenifer</i>	Gopher Snake	S2S3 (2012)	No Status		1	G5 (2005)	2
<i>Pituophis catenifer catenifer</i>	Gopher Snake, <i>catenifer</i> subspecies	SX (2012)	Red	XT (2012)	1-XX (2005)	G5T5 (1998)	6
<i>Plagiobothrys tenellus</i>	slender popcornflower	S1 (2015)	Red	T (2008)	1-T (2011)	G4G5 (1988)	1
<i>Platyhypnidium riparioides</i>		S3? (2011)	Blue			G4 (2004)	2
<i>Plebejus icarioides blackmorei</i>	Boisduval's Blue, <i>blackmorei</i> subspecies	S3 (2013)	Blue			G5T3 (2006)	3
<i>Plebejus saepiolus insulanus</i>	Greenish Blue, <i>insulanus</i> subspecies	SH (2013)	Red	E (2012)	1-E (2003)	G5TH (2003)	1

<i>Poecetes gramineus affinis</i>	Vesper Sparrow, <i>affinis</i> subspecies	S1B (2010)	Red	E (2006)	1-E (2007)	G5T3? (1996)	1
<i>Potamogeton oakesianus</i>	Oakes' pondweed	S2S3 (2015)	Blue			G4 (1988)	2
<i>Potentilla gracilis</i> var. <i>gracilis</i>	graceful cinquefoil	S2S3 (2006)	Blue			G5T5 (2012)	2
<i>Pristiloma johnsoni</i>	Broadwhorl Tightcoil	S2S3 (2008)	Blue			G3 (2013)	2
<i>Progne subis</i>	Purple Martin	S3B (2015)	Blue			G5 (1996)	3
<i>Promenetus umbilicatellus</i>	Umbilicate Sprite	S2S3 (2015)	Blue			G4 (2000)	2
<i>Prophysaon coeruleum</i>	Blue-grey Taildropper	S1 (2008)	Red	E (2006)	1-E (2007)	G3G4 (2010)	1
<i>Prophysaon vanatta</i>	Scarletback Taildropper	S3S4 (2008)	Blue			G4 (2002)	4
<i>Psilocarphus elatior</i>	tall woolly-heads	S2 (2015)	Red	E (2001)	1-E (2003)	G4Q (2001)	1
<i>Racomitrium pacificum</i>		S3 (2015)	Blue			G3 (1999)	2
<i>Rana aurora</i>	Northern Red-legged Frog	S3S4 (2010)	Blue	SC (2015)	1-SC (2005)	G4 (2008)	1
<i>Ranunculus alismifolius</i> var. <i>alismifolius</i>	water-plantain buttercup	S1 (2015)	Red	E (2009)	1-E (2003)	G5T5 (1995)	1
<i>Ranunculus californicus</i>	California buttercup	S1 (2003)	Red	E (2008)	1-E (2011)	G5 (1987)	1
<i>Ranunculus lobbii</i>	Lobb's water-buttercup	SH (2015)	Red			G4 (1991)	2
<i>Rosulabryum erythroloma</i>		S2S3 (2011)	Blue			G4? (1999)	2
<i>Rupertia physodes</i>	California-tea	S3 (2015)	Blue			G4 (1985)	2
<i>Sanicula arctopoides</i>	bear's-foot sanicle	S1 (2011)	Red	E (2001)	1-E (2003)	G5 (1990)	1
<i>Sanicula bipinnatifida</i>	purple sanicle	S2 (2015)	Red	T (2001)	1-T (2003)	G5 (1990)	2
<i>Sericocarpus rigidus</i>	white-top aster	S2 (2008)	Red	SC (2009)	1-SC (2003)	G3 (2007)	1
<i>Sidalcea hendersonii</i>	Henderson's checker-mallow	S3 (2015)	Blue			G3 (2004)	2
<i>Silene scouleri</i> ssp. <i>scouleri</i>	coastal Scouler's catchfly	S1 (2000)	Red	E (2003)	1-E (2005)	G5T3T5 (2002)	4
<i>Sorex palustris brooksi</i>	American Water Shrew, <i>brooksi</i> subspecies	S2 (2010)	Red			G5T2 (1996)	1
<i>Speyeria zerene bremnerii</i>	Zerene Fritillary, <i>bremnerii</i> subspecies	S2 (2013)	Red			G5T3T4 (1998)	2
<i>Sympetrum vicinum</i>	Autumn Meadowhawk	S3S4 (2015)	Blue			G5 (1985)	4
<i>Syntrichia laevipila</i>	twisted oak moss	S3 (2015)	Blue	SC (2014)	1-SC (2005)	GNR	2
<i>Thysanocarpus curvipes</i>	sand lacepod	S3 (2015)	Blue			G4G5 (1987)	2
<i>Tonella tenella</i>	small-flowered tonella	S1S2 (2015)	Red	E (2003)	1-E (2005)	G5 (1990)	2
<i>Tortula obtusifolia</i>		S3 (2015)	Blue			G5 (1991)	3

<i>Toxicodendron diversilobum</i>	poison oak	S3? (2015)	Blue			G5 (1999)	2
<i>Tramea lacerata</i>	Black Saddlebags	S2 (2015)	Red			G5 (1985)	2
<i>Trifolium cyathiferum</i>	cup clover	S2 (2015)	Red			G4 (1990)	2
<i>Trifolium depauperatum</i> var. <i>depauperatum</i>	poverty clover	S3 (2002)	Blue			G5T5? (2000)	4
<i>Trifolium dichotomum</i>	Macrae's clover	S2S3 (2015)	Blue			G4? (2002)	2
<i>Triglochin concinna</i>	graceful arrow-grass	S3 (2015)	Blue			G5 (1990)	3
<i>Triphysaria versicolor</i> ssp. <i>versicolor</i>	bearded owl-clover	S1 (2015)	Red	E (2011)	1-E (2003)	G5T5 (1997)	1
<i>Triteleia howellii</i>	Howell's triteleia	S1 (2005)	Red	E (2003)	1-E (2005)	G4G5T3T4Q (2003)	1
<i>Tyto alba</i>	Barn Owl	S2? (2015)	Red	T (2010)	1-SC (2003)	G5 (1996)	2
<i>Uria aalge</i>	Common Murre	S2B,S3S4N (2015)	Red			G5 (2003)	2
<i>Uropappus lindleyi</i>	Lindley's microseris	S1 (2000)	Red	E (2008)	1-E (2010)	G5 (1990)	1
<i>Vertigo andrusiana</i>	Pacific Vertigo	S2 (2008)	Red			G2G3 (2004)	1
<i>Viola howellii</i>	Howell's violet	S2 (2015)	Red			G4 (1988)	2
<i>Viola praemorsa</i> ssp. <i>praemorsa</i>	yellow montane violet	S2 (2005)	Red	E (2007)	1-E (2003)	G5T3T5 (2000)	1
<i>Wolffia columbiana</i>	Columbian water-meal	S2 (2015)	Red			G5 (1984)	2
<i>Woodwardia fimbriata</i>	giant chain fern	S3 (2015)	Blue			G5 (1994)	2
<i>Zeltnera muehlenbergii</i>	Muhlenberg's centaury	S1 (2015)	Red	E (2008)	1-E (2010)	G5? (1996)	1
<i>Zonitoides nitidus</i>	Black Gloss	S3S4 (2008)	Blue			G5 (2003)	2

Search Summary

Time Performed Tue Aug 04 15:11:28 PDT 2015

Results 178 records.

Search Criteria Search Type: Plants & Animals
AND Regional Districts: Capital (CRD) (Restricted to Red, Blue, and Legally designated species)
AND BGC Zone: CDF
Sort Order: Scientific Name Ascending

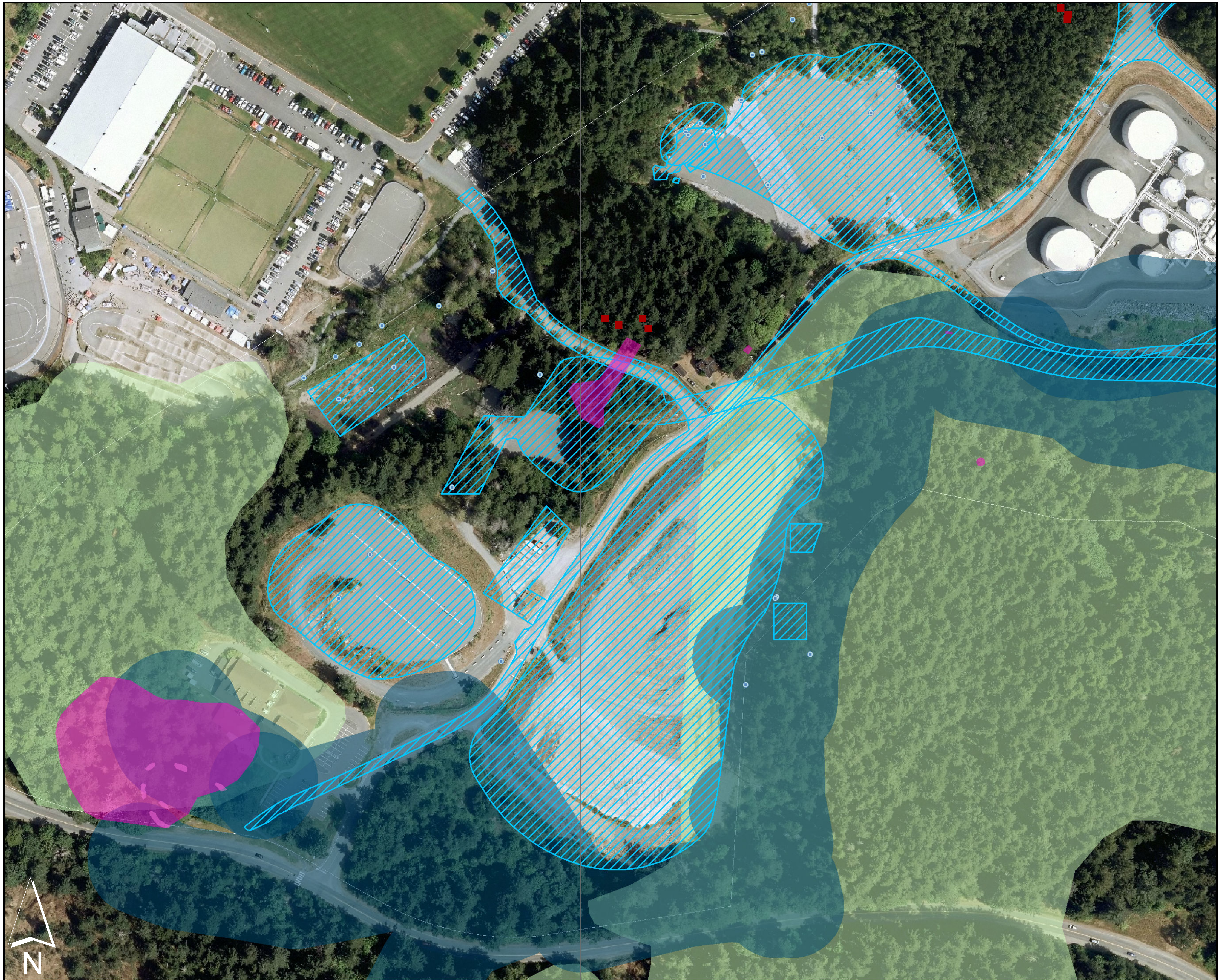
Notes 1. Citation: B.C. Conservation Data Centre. 2015. BC Species and Ecosystems Explorer. B.C. Minist. of Environ. Victoria, B.C. Available: <http://a100.gov.bc.ca/pub/eswp/> (accessed Aug 4, 2015).

2. Forest District, MoE Region, Regional District and habitat lists are restricted to species that breed in the Forest District, MoE Region, Regional District or habitat (i.e., species will not be placed on lists where they occur only as migrants).

[Modify Search](#) | [New Search](#) | [Results](#)

APPENDIX B
Sensitive Species and Areas Information

Colwood Fuel Oil Depot North Area Remediation
(DND) CFB Esquimalt Colwood property
SLR Project No.: 205.03903.00000



COLWOOD
Sensitive Areas Map Series
NOVEMBER 2017

Archaeological and Cultural Features

These layers denote identified areas of cultural significance. All projects and/or development activities occurring near these areas, or in other areas likely to be of cultural significance, should include an assessment for the potential for interference. MARPAC policy opts to avoid known archaeological areas completely where possible. If avoidance is not an option, an archaeologist is required to complete an Archaeological Impact Assessment.

- Varied Cultural Material (including, but not limited to, lithics, middens, and/or depressions). Do not disturb individual sites.
- First Nations Burial Site. Do not disturb area. Do not move or disturb rocks.

Sensitive Species Occurrences and Habitat

- This layer includes identified locations of both provincially listed and federally protected species. Formation Environment shall be contacted during the planning phase of any projects and/or development activities proposed to occur within or near these areas. Federally listed species are protected under the Species at Risk Act and by law, these areas should not be disturbed.
- This layer identifies sensitive ecosystems which are noted as fragile/fragmented. Land-use planning should consider the continued integrity of these ecosystems.

Wetland Features

- This layer includes wetland areas, including water bodies, streams, and adjacent riparian areas. All of these wetland features are protected under the Fisheries Act. This layer includes all wetland areas, including those that are intermittent (with wetted area for part of the year) and ephemeral (only wetted during and immediately after precipitation). Projects/development activities in these areas shall avoid damaging vegetation and/or causing sedimentation in the water.

Contaminated Site Features

- Active Sentry Monitoring Wells. Formation Environment shall be contacted prior to any projects and/or development activities in these areas.
- Note that additional monitoring wells, not captured in this layer, may exist on the property. Should any projects and/or development activities necessitate their destruction, appropriate decommissioning is required. Formation Environment shall be contacted prior to any groundwater well decommissioning.
- Contaminated/Risk Managed Sites. This layer includes areas of known or suspected contamination, as well as areas which have been remediated and/or are under risk management. These areas should not be disturbed. Formation Environment shall be contacted during the planning phase of any projects and/or development activities proposed to occur within or near these areas.

Soil excavation activities on all CFB Esquimalt administered lands have a potential to uncover historical contamination or archaeologically significant materials (including areas that are not marked on this map). Disturbance of any contaminated and/or archaeologically significant materials on CFB Esquimalt properties is the responsibility of the project OPI. Excavation activities occurring within all areas of CFB Esquimalt properties shall comply with FSEMS Directive #6 Contaminated and Archaeological Sites.

Produced by FORMATION ENVIRONMENT
 MARITIME FORCES PACIFIC
 DEPARTMENT OF NATIONAL DEFENCE, CANADA

2013 Colour Orthophotos
 10 cm resolution

This map was created for use by Maritime Forces Pacific. Any unauthorized use of this map is strictly prohibited.

Note that this version may not be the most current and there may be information missing and/or incorrectly represented. This map depicts the best information available at the time of printing.

COLWOOD
BRITISH COLUMBIA

Date: NOV 2017 Scale: 1:1,000

File Name: col_nr_map_nov17.mxd



COLWOOD Sensitive Areas Map Series MARCH 2014

Archaeological and Cultural Features

These layers denote identified areas of cultural significance. All projects and/or development activities occurring near these areas, or in other areas likely to be of cultural significance, should include an assessment for the potential for interference. MARPAC policy opts to avoid known archaeological areas completely where possible. If avoidance is not an option, an archaeologist is required to complete an Archaeological Impact Assessment.

- Varied Cultural Material (including, but not limited to, lithics, middens, and/or depressions). Do not disturb individual sites.
- First Nations Burial Site. Do not disturb area. Do not move or disturb rocks.

Sensitive Species Occurrences and Habitat

■ This layer includes identified locations of both provincially listed and federally protected species. Formation Environment shall be contacted during the planning phase of any projects and/or development activities proposed to occur within or near these areas. Federally listed species are protected under the Species at Risk Act and by law, these areas should not be disturbed.

■ This layer identifies sensitive ecosystems which are noted as fragile/fragmented. Land-use planning should consider the continued integrity of these ecosystems.

Wetland Features

■ This layer includes wetland areas, including water bodies, streams, and adjacent riparian areas. All of these wetland features are protected under the Fisheries Act. This layer includes all wetland areas, including those that are intermittent (with wetted area for part of the year) and ephemeral (only wetted during and immediately after precipitation). Projects/development activities in these areas shall avoid damaging vegetation and/or causing sedimentation in the water.

Contaminated Site Features

● Active Sentry Monitoring Wells. Formation Environment shall be contacted prior to any projects and/or development activities in these areas.

Note that additional monitoring wells, not captured in this layer, may exist on the property. Should any projects and/or development activities necessitate their destruction, appropriate decommissioning is required. Formation Environment shall be contacted prior to any groundwater well decommissioning.

▨ Contaminated/Risk Managed Sites. This layer includes areas of known or suspected contamination, as well as areas which have been remediated and/or are under risk management. These areas should not be disturbed. Formation Environment shall be contacted during the planning phase of any projects and/or development activities proposed to occur within or near these areas.

Soil excavation activities on all CFB Esquimalt administered lands have a potential to uncover historical contamination or archaeologically significant materials (including areas that are not marked on this map). Disturbance of any contaminated and/or archaeologically significant materials on CFB Esquimalt properties is the responsibility of the project OPI. Excavation activities occurring within all areas of CFB Esquimalt properties shall comply with FSEMS Directive E2.

Produced by FORMATION ENVIRONMENT
MARITIME FORCES PACIFIC
DEPARTMENT OF NATIONAL DEFENCE, CANADA
Information current as of March 2014

2013 Colour Orthophotos
10 cm resolution

This map was created for use by Maritime Forces Pacific.
Any unauthorized use of this map is strictly prohibited.

Note that this version may not be the most current and there may be information missing and/or incorrectly represented. This map depicts the best information available at the time of printing.

COLWOOD BRITISH COLUMBIA

Date: March 2014 Scale: 1:3,500

File Name: col_nr_map_march14.mxd

APPENDIX E
Tables

Colwood FOD North Area
CFB Esquimalt, Colwood, BC
SLR Project No.: 205.03903.00000

Table 1: CONFIRMATORY SOIL SAMPLE OBSERVATIONS

Location	Sample ID	Date	HSV L	Soil Type	Analytical Schedule
Sample at base of outlet of bedrock source area	GRAB-01	16-Feb-2016	LTDL	Silty Sand, grey, black hydrocarbon free product	metals, BETX/F1, LEPH/HEPH, F2-F4, PAHs

Table 2: SOIL CHEMISTRY RESULTS - METALS PARAMETERS (mg/kg) (page 1 of 1)

Sample ID	GRAB-01	
Date	16-Feb-2016	CCME RL
Depth (m)	---	
pH	7.33	>6<8
Aluminum	20600	ns
Antimony	0.20	20
Arsenic	9.32	12
Barium	59.3	500
Beryllium	< 0.40	4
Bismuth	< 0.10	ns
Cadmium	0.733	10
Chromium (total)	36.2	64
Cobalt	12.6	50
Copper	71.3	63
Iron	27500	ns
Lead	2.49	140
Lithium	9.0	ns
Magnesium	9900	ns
Manganese	368	ns
Mercury	< 0.050	6.6
Molybdenum	2.02	10
Nickel	32.9	45
Selenium	< 0.50	1
Silver	0.074	20
Strontium	44.3	ns
Thallium	0.075	1
Tin	0.29	50
Titanium	1840	ns
Uranium	1.33	23
Vanadium	83.2	130
Zinc	41.2	200

Notes:

m - metres

mg/kg - milligrams per dry kilogram

< - less than analytical detection limit indicated

'---' - sample not analyzed for parameter indicated

ns - no standard listed

INVERSE

Exceeds CCME RL: CCME Canadian Environmental Quality Guidelines, Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health, Residential/Parkland

Table 3: SOIL CHEMISTRY RESULTS - PETROLEUM HYDROCARBON CONSTITUENTS AND MTBE (mg/kg) (page 1 of 1)

Sample ID	GRAB-01	CCME RLcg	CCME RLfg
Date	16-Feb-2016		
Depth (m)	---		
HSVl (ppmv)	---	ns	ns
Benzene	0.093	0.03	0.0068
Ethylbenzene	1.5	0.082	0.018
Toluene	0.074	0.37	0.08
Xylenes	0.75	11	2.4
Styrene	< 0.030	ns	ns
MTBE	< 0.10	ns	ns
VPHs	210	ns	ns
EPHs (C10-19)	11700	ns	ns
EPHs (C19-32)	14000	ns	ns
LEPHs	11700	ns	ns
HEPHs	14000	ns	ns
HWOg (%)	< 0.50	ns	ns

Notes:

m - metres

mg/kg - milligrams per kilogram

HSVl (ppmv) - headspace vapour level (parts per million by volume)

< - less than analytical detection limit indicated

'---' - sample not analyzed for parameter indicated

EPH(C10-19) standard is the CSR standard for LEPH. MOE advised (June 06, 10) that EPH(C10-19) and LEPH are equivalent for screening purposes but EPH cannot be used to demonstrate legal compliance with CSR standards

EPH(C19-32) standard is the CSR standard for HEPH. MOE advised (June 06, 10) that EPH(C19-32) and HEPH are equivalent for screening purposes but EPH cannot be used to demonstrate legal compliance with CSR standards

MTBE - methyl tert-butyl ether

VPHs - volatile petroleum hydrocarbons (C6-10), excluding benzene, ethylbenzene, toluene, xylenes

EPHs - extractable petroleum hydrocarbons

LEPHs - light extractable petroleum hydrocarbons (C10-19), excluding specific polycyclic aromatic hydrocarbon parameters

HEPHs - heavy extractable petroleum hydrocarbons (C19-32), excluding specific polycyclic aromatic hydrocarbon parameters

HWOg - Hazardous Waste Oil and Grease (%)

ns - no standard listed

INVERSE
INVERSE

Table 4: SOIL CHEMISTRY RESULTS - PETROLEUM HYDROCARBON FRACTIONS (mg/kg) (page 1 of 1)

Sample ID	GRAB-01		
Date	16-Feb-2016	CCME RLphcf	CCME RLphc
Depth (m)	---		
F1 (C6-10)	240	210	30
F2 (C10-16)	8000	150	150
F3 (C16-34)	18000	1300	300
F4 (C34-50+)	5400	5600	2800
F4 (Gravimetric)	---	5600	2800

Notes:

mg/kg - milligrams per dry kilogram

m - metres

< - less than analytical detection limit indicated

'---' - sample not analyzed for parameter indicated

ns - no standard listed

INVERSE

INVERSE

Table 5: SOIL CHEMISTRY RESULTS - PAH PARAMETERS (mg/kg) (page 1 of 1)

Sample ID	GRAB-01					
Date	16-Feb-2016	CCME RLsc	CCME RLsf	CCME RLi	CCME RLe	CCME RLfi
Depth (m)	---					
Acenaphthene	< 2.8*	ns	21.5	ns	ns	0.28
Acenaphthylene	< 0.28	ns	ns	ns	ns	320
Acridine	---	ns	ns	ns	ns	ns
Anthracene	< 1.1	2.5	61.5	ns	2.5	ns
Benzo(a)anthracene	0.92	ns	6.2	1	ns	ns
Benzo(a)pyrene	0.43	20	0.6	ns	20	8800
Benzo(b)fluoranthene	---	ns	6.2	1	ns	ns
Benzo(g,h,i)perylene	0.14	ns	ns	ns	ns	ns
Benzo(k)fluoranthene	< 0.035	ns	6.2	1	ns	ns
Chrysene	2.6	ns	6.2	ns	ns	ns
Dibenz(a,h)anthracene	< 0.050	ns	ns	1	ns	ns
Fluoranthene	0.34	50	15.4	ns	50	ns
Fluorene	< 5.5*	ns	15.4	ns	ns	0.25
Indeno(1,2,3-c,d)pyrene	0.051	ns	ns	1	ns	ns
1-Methylnaphthalene	---	ns	ns	ns	ns	ns
2-Methylnaphthalene	< 0.54	ns	ns	ns	ns	ns
Naphthalene	< 0.97*	ns	8.8	ns	0.6	0.013
Phenanthrene	10	ns	43	5	ns	0.046
Pyrene	3.6	ns	7.7	10	ns	ns
Quinoline	---	ns	ns	ns	ns	ns
B(a)P TPE	0.60	ns	ns	ns	ns	ns
PAHs, Total	18	ns	ns	ns	ns	ns

Notes:

m - metres

PAH - polycyclic aromatic hydrocarbons

mg/kg - milligrams per dry kilogram

< - less than analytical detection limit indicated

* - indicates detection limits for the sample were higher than the lowest acceptable applicable standards.

'---' - sample not analyzed for parameter indicated

ns - no standard/guideline listed
Exceeds CCME RLsc: CCME Canadian Soil Quality Guidelines for PAH, Residential/Parkland, Environmental

Exceeds CCME RLsf: CCME Canadian Soil Quality Guidelines for PAH, Residential/Parkland, Environmental

Exceeds CCME RLi: CCME Canadian Soil Quality Guidelines for PAH, Residential/Parkland, Environmental

Exceeds CCME RLe: CCME Canadian Soil Quality Guidelines for PAH, Residential/Parkland, Environmental

Exceeds CCME RLfi: CCME Canadian Soil Quality Guidelines for PAH, Residential/Parkland, Environmental

Table 6: LEACHATE ANALYTICAL RESULTS - PAH PARAMETERS (ug/L) (page 1 of 1)

Sample ID	GRAB-01	HWR
Date	16-Feb-2016	
Depth (m)	---	
Acenaphthene Leachable	2.4	ns
Acenaphthylene Leachable	<0.1	ns
Acridine Leachable	<0.5	ns
Anthracene Leachable	0.38	ns
Benzo(a)anthracene Leachable	<0.1	ns
Benzo(a)pyrene Leachable	<0.1	1
Benzo(b)fluoranthene Leachable	---	ns
Benzo(b+j)fluoranthene Leachable	<0.1	ns
Benzo(g,h,i)perylene Leachable	<0.2	ns
Benzo(k)fluoranthene Leachable	<0.1	ns
Chrysene Leachable	<0.1	ns
Dibenzo(a,h)anthracene, Leachable	<0.2	ns
Fluoranthene Leachable	<0.1	ns
Fluorene Leachable	3.8	ns
Indeno(1,2,3-c,d)pyrene Leachable	<0.2	ns
1-Methylnaphthalene Leachable	---	ns
2-Methylnaphthalene Leachable	0.29	ns
Naphthalene Leachable	6.3	ns
Phenanthrene Leachable	3.2	ns
Pyrene Leachable	0.14	ns
Quinoline Leachable	<0.5	ns
Benzo(a)pyrene Equivalency	600	ns
Total PAH Leachable	16	ns
Low MW PAHs, Leachable	16	ns
High MW PAHs, Leachable	<0.2	ns
PAHs, Total	18000	ns

Notes:

m - metres

PAH - polycyclic aromatic hydrocarbons

mg/kg - milligrams per dry kilogram

< - less than analytical detection limit indicated

* - indicates detection limits for the sample were higher than the lowest acceptable applicable standards.

'---' - sample not analyzed for parameter indicated

ns - no standard/guideline listed

Exceeds CCME RLsc: CCME Canadian Soil Quality Guidelines for PAH

INVERSE

Exceeds CCME RLsf: CCME Canadian Soil Quality Guidelines for PAH,

INVERSE

Exceeds CCME RLi: CCME Canadian Soil Quality Guidelines for PAH, F

INVERSE

Exceeds CCME RLe: CCME Canadian Soil Quality Guidelines for PAH,

INVERSE

Exceeds CCME RLfl: CCME Canadian Soil Quality Guidelines for PAH,

Table 7: SOIL CHEMISTRY RESULTS - CCME PAH TPE and IACR CALCULATION (mg/kg) (page 1 of 1)

Sample ID	GRAB-01	CCME RL _{phcf}	CCME RL _{pw}	CCME RL _{sf}	CCME RL _e	CCME RL _{fi}	CCME RL
Date	16-Feb-2016						
B(a)P TPE	0.60	ns	5.3	ns	ns	ns	ns
IACR	6.6	ns	1	ns	ns	ns	ns

Notes:

mg/kg - milligrams per kilogram

< - less than analytical detection limit indicated

'---' - sample not analyzed for parameter indicated

TPE - Total Potency Equivalency (1X10⁻⁵). This is only applicable in the top 1.5m

IACR - Index of Additive Cancer Risk (for the protection of potable water)

ns - no standard listed

Exceeds CCME RL_{phcf}: CCME Canada-Wide Standards for Petroleum Hydrocarbons (PHCs) in Surface Soil, Summary of Tier 1 Levels for PHC fractions(F1-F4) for Residential Fine-grained surface soil, Most Stringent of All Exposure Pathways
 Exceeds CCME RL_{pw}: CCME Canadian Soil Quality Guidelines for PAH, Residential/Parkland, Human Health guidelines, Protection of Potable Water
 Exceeds CCME RL_{sf}: CCME Canadian Soil Quality Guidelines for PAH, Residential/Parkland, Environmental Health guidelines, Soil and Food Ingestion
 Exceeds CCME RL_e: CCME Canadian Soil Quality Guidelines for PAH, Residential/Parkland, Environmental Health guidelines, Environmental Health
 Exceeds CCME RL_{fi}: CCME Canadian Soil Quality Guidelines for PAH, Residential/Parkland, Environmental Health guidelines, Protection of Freshwater Life
 Exceeds CCME RL: CCME Canadian Environmental Quality Guidelines, Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health, Residential/Parkland

TABLE 2: Summary of Analytical Results for Hydrocarbons in Soil

Sample Location	Sample ID	Sample Date (yyyy mm dd)	Depth Interval (m)	Field Screen ^a (ppm)	Monocyclic Aromatic Hydrocarbons				Petroleum Hydrocarbon Fractions				Gross Parameters					MTBE (µg/g)
					Benzene (µg/g)	Ethyl-benzene (µg/g)	Toluene (µg/g)	Xylenes (µg/g)	F1-BTEX (µg/g)	F2 (>C10-C16) (µg/g)	F3 (>C16-C34) (µg/g)	F4 (>C34-C50) (µg/g)	VPH (C6-C10) (µg/g)	LEPH (C10-C19) (µg/g)	HEPH (C19-C32) (µg/g)	HWR Oil and Grease (%)	HWR Oil and Grease (SG) (%)	
EXC13-W9	EXC13-W9-130306	2013 03 06	0.0 - 0.1	8,250	< 0.005	0.06	< 0.02	0.63	130	34,000	130,000	45,000	-	-	-	-	-	-
EXC13-W13	EXC13-W13-130308	2013 03 08	0.0 - 0.1	20	< 0.005	< 0.01	< 0.02	< 0.04	< 10	< 10	32	13	-	-	-	-	-	-
EXC13-F17	EXC13-F17-130308	2013 03 08	0.0 - 0.1	400	< 0.0056	< 0.01	< 0.02	< 0.04	< 10	290	6,300	3,300	-	-	-	-	-	-
EXC13-F30	EXC13-F30-130321	2013 03 21	0.0 - 0.1	350	< 0.005	0.016	< 0.02	< 0.04	15	3,000	13,000	5,100	-	-	-	-	-	-
BH14-01	BH14-01-01	2014 01 09	0.5 - 0.6	65	< 0.005	< 0.01	< 0.05	< 0.05	< 10	< 10	< 10	< 10	-	-	-	-	-	-
	BH14-01-03	2014 01 09	3.5 - 3.7	150	< 0.005	< 0.01	< 0.05	< 0.05	< 10	< 10	< 10	< 10	-	-	-	-	-	-
BH14-02	BH14-02-02	2014 01 09	1.2 - 1.5	70	0.052	0.66	0.3	4.35	190	8,240	17,600	5,880	-	-	-	4.1	2.5	-
	BH14-02-03	Duplicate	1.2 - 1.5	70	0.122	1.42	0.5	8.58	330	11,300	23,200	7,710	-	-	-	5.3	3.2	-
QA/QC RPD %					81	73	50	65	54	31	28	27	-	-	-	26	25	-
	BH14-02-04	2014 01 09	2.3 - 2.6	105	-	-	-	-	-	1,810	4,300	1,440	-	-	-	-	-	-
BH14-06	BH14-06-01	2014 03 05	0.2 - 0.3	60	-	-	-	-	-	< 10	< 10	< 10	-	-	-	-	-	-
	BH14-06-05	2014 03 05	4.0 - 4.1	105	-	-	-	-	-	< 10	15	< 10	-	-	-	-	-	-
BH14-07	BH14-07-01	2014 03 05	0.3 - 0.6	80	-	-	-	-	-	< 10	37	28	-	-	-	-	-	-
	BH14-07-04	2014 03 05	2.7 - 2.9	110	-	-	-	-	-	< 10	< 10	< 10	-	-	-	-	-	-
BH14-08	BH14-08-01	2014 03 05	0.3 - 0.5	0	-	-	-	-	-	< 10	14	< 10	-	-	-	-	-	-
	BH14-08-02	Duplicate	0.3 - 0.5	-	-	-	-	-	-	< 10	76	44	-	-	-	-	-	-
QA/QC RPD %					-	-	-	-	-	*	*	*	-	-	-	-	-	-
	BH14-08-05	2014 03 05	2.7 - 2.9	60	-	-	-	-	-	< 10	21	< 10	-	-	-	-	-	-
BH14-09	BH14-09-02	2014 03 05	1.4 - 1.5	0	-	-	-	-	-	< 10	< 10	< 10	-	-	-	-	-	-
	BH14-09-03	Duplicate	1.4 - 1.5	-	-	-	-	-	-	< 10	< 10	< 10	-	-	-	-	-	-
QA/QC RPD %					-	-	-	-	-	*	*	*	-	-	-	-	-	-
	BH14-09-05	2014 03 05	3.2 - 3.4	220	< 0.005	< 0.01	< 0.05	< 0.05	< 10	< 10	< 10	< 10	-	-	-	-	-	-
BH14-10	BH14-10-07	2014 03 06	5.3 - 5.5	230	-	-	-	-	-	< 10	< 10	< 10	-	-	-	-	-	-
	BH14-10-08	Duplicate	5.3 - 5.5	-	-	-	-	-	-	< 10	< 10	< 10	-	-	-	-	-	-
QA/QC RPD %					-	-	-	-	-	*	*	*	-	-	-	-	-	-
	BH14-10-09	2014 03 06	6.9 - 7.0	105	-	-	-	-	-	< 10	< 10	< 10	-	-	-	-	-	-
Federal Guidelines/Standards																		
CCME CEQG/CWS Residential/Parkland Surface ^{b,c}					0.0068	0.018	0.08	2.4	210	150	300	2,800	n/a	n/a	n/a	n/a	n/a	n/a
CCME CEQG/CWS Residential/Parkland Subsoil ^{b,c}					0.0068	0.018	0.08	2.4	700	230	2,500	10,000	n/a	n/a	n/a	n/a	n/a	n/a
BC Standards																		
HWR Hazardous Waste (HWR)					n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	3	3	n/a

Associated AGAT files: 1486799747, 1486800002, 1486800273, 1486801284, 1486818421, 1486820071.

Associated Maxxam file: B511928.

All terms defined within the body of SNC-Lavalin's report.

< Denotes concentration less than indicated detection limit or RPD less than indicated value.

- Denotes analysis not conducted.

n/a Denotes no applicable standard.

* RPDs are not normally calculated where one or more concentrations are less than five times MDL.

BOLD Concentration greater than or equal to CCME CEQG/CWS Residential/Parkland Surface guideline/standard.

SHADOW Concentration greater than or equal to CCME CEQG/CWS Residential/Parkland Subsoil guideline/standard.

SHADED Concentration greater than HWR Hazardous Waste (HWR) standard.

^a Field screening results are measured based on a 'dry headspace' method using a combustible gas meter calibrated to a hexane standard.

^b Guideline/standard for coarse grained and fine grained soil.

^c The exposure pathway(s) used for determining the standards for this site include: tier 1 - general, direct contact, eco soil contact and management limit (whichever is most stringent).

^d Concentration has not been corrected for the presence of PAH.

^e F4 value did not return to baseline and as such F4 Gravimetric (Gravimetric Heavy Hydrocarbons) was completed and reported.

TABLE 3: Summary of Analytical Results for PAHs in Soil

Sample Location Sample ID Sample Date (yyyy mm dd) Depth Interval (m) Field Screen (ppm)	EXC13-W9	EXC13-W13	EXC13-F17	EXC13-F30	BH14-01		BH14-02			BH14-08			BH14-09	BH14-10	BH14-11	TP14-01	TP14-03	TP14-09	TP14-11	Federal Guidelines			
	EXC13-W9-130306 2013 03 06 0.0 - 0.1 8,250	EXC13-W13-130308 2013 03 08 0.0 - 0.1 20	EXC13-F17-130308 2013 03 08 0.0 - 0.1 400	EXC13-F30-130321 2013 03 21 0.0 - 0.1 350	BH14-01-01 2014 01 09 0.5 - 0.6 65	BH14-01-03 2014 01 09 3.5 - 3.7 150	BH14-02-02 2014 01 09 1.2 - 1.5 70	BH14-02-03 Duplicate 1.2 - 1.5 70	QA/QC RPD %	BH14-02-04 2014 01 09 2.3 - 2.6 105	BH14-08-01 2014 03 05 0.3 - 0.5 0	BH14-08-02 Duplicate 0.3 - 0.5 -	QA/QC RPD %	BH14-09-05 2014 03 05 3.2 - 3.4 220	BH14-10-07 2014 03 06 5.3 - 5.5 230	BH14-11-02 2014 03 06 1.7 - 1.8 195	TP14-01-04 2014 01 07 2.4 - 2.6 50	TP14-03-03 2014 01 07 2.7 - 3.0 35	TP14-09-02 2014 01 08 1.2 - 1.4 0	TP14-11-01 2014 01 08 0.5 - 0.6 0	CCME CEQG Residential/ Parkland Land Use (RL/PL)		
Parameter	Analytical Results																						
Polycyclic Aromatic Hydrocarbons																							
Naphthalene	µg/g	6.9	0.02	< 0.1 ^a	< 0.1 ^a	< 0.005	0.006	18.7	25.6	31	2.11	< 0.005	< 0.005	*	< 0.005	< 0.005	< 0.005	0.1	4	< 0.01	< 0.01	0.013	
1-Methylnaphthalene	µg/g	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	16	< 0.01	< 0.01	n/a	
2-Methylnaphthalene	µg/g	51	< 0.02	< 0.2	0.42	< 0.005	0.017	77.3	105	30	5.66	< 0.005	< 0.005	*	< 0.005	< 0.005	< 0.005	0.2	15	< 0.01	< 0.01	n/a	
Acenaphthylene	µg/g	< 0.38	< 0.005	< 0.05	< 0.18	< 0.005	< 0.005	< 0.005	< 0.005	*	< 0.005	< 0.005	< 0.005	*	< 0.005	< 0.005	< 0.005	< 0.1	< 1	< 0.01	< 0.01	320	
Acenaphthene	µg/g	< 20 ^a	0.0094	< 0.05	< 0.78 ^a	< 0.005	< 0.005	< 0.005	< 0.005	*	< 0.005	< 0.005	*	< 0.005	< 0.005	< 0.005	< 0.005	< 0.1	< 1	< 0.01	< 0.01	0.28	
Fluorene	µg/g	14	< 0.02	< 0.04	1.9	< 0.02	< 0.02	7.01	9.38	29	2.24	< 0.02	< 0.02	*	< 0.02	< 0.02	< 0.02	< 0.2	2	< 0.02	< 0.02	0.25	
Phenanthrene	µg/g	43	0.18	< 0.2 ^a	2.7	< 0.02	0.02	12.3	17.1	33	4.48	< 0.02	< 0.02	*	< 0.02	< 0.02	< 0.02	< 0.2 ^a	6	< 0.02	< 0.02	0.046	
Anthracene	µg/g	6.9	0.0049	< 0.06	0.64	< 0.004	< 0.004	< 0.004	< 0.004	*	< 0.004	< 0.004	< 0.004	*	< 0.004	< 0.004	< 0.004	< 0.2	< 2	< 0.02	< 0.02	2.5	
Fluoranthene	µg/g	7.2	0.24	< 0.2	0.63	< 0.01	< 0.01	< 0.01	< 0.01	*	< 0.01	< 0.01	< 0.01	*	< 0.01	< 0.01	< 0.01	< 0.5	< 5	< 0.05	< 0.05	15.4	
Pyrene	µg/g	34	0.18	< 0.2	2.9	< 0.01	< 0.01	4.32	5.21	19	1.2	< 0.01	< 0.01	*	< 0.01	< 0.01	< 0.01	0.7	5	< 0.02	< 0.02	7.7	
Benzo(a)anthracene	µg/g	5.2	0.036	< 0.2	0.56	< 0.03	< 0.03	0.78	1.38	56	0.23	< 0.03	< 0.03	*	< 0.03	< 0.03	< 0.03	< 0.2	< 2 ^a	< 0.02	< 0.02	1	
Chrysene	µg/g	20	0.11	< 0.2	1.8	< 0.05	< 0.05	3.4	4.12	19	0.9	< 0.05	< 0.05	*	< 0.05	< 0.05	< 0.05	< 0.5	< 5	< 0.05	< 0.05	6.2	
Benzo(b)fluoranthene	µg/g	< 1.9	0.13	< 0.2	0.22	< 0.05	< 0.05	0.26	0.33	24	0.08	< 0.05	< 0.05	*	< 0.05	< 0.05	< 0.05	0.2	< 2	< 0.02	< 0.02	6.2	
Benzo(j)fluoranthene	µg/g	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	n/a
Benzo(k)fluoranthene	µg/g	1.5	0.045	< 0.05	< 0.2	< 0.05	< 0.05	0.06	0.12	*	< 0.05	< 0.05	< 0.05	*	< 0.05	< 0.05	< 0.05	< 0.2	< 2 ^a	< 0.02	< 0.02	1	
Benzo(a)pyrene	µg/g	3.9	0.07	< 0.2	0.34	< 0.03	< 0.03	0.55	0.7	24	0.14	< 0.03	< 0.03	*	< 0.03	< 0.03	< 0.03	< 0.5	< 5 ^a	< 0.05	< 0.05	0.6	
Indeno(1,2,3-cd)pyrene	µg/g	0.88	< 0.05	< 0.5	< 0.5	< 0.05	< 0.05	0.14	< 0.05	*	< 0.05	< 0.05	< 0.05	*	< 0.05	< 0.05	< 0.05	< 0.2	< 2 ^a	< 0.02	< 0.02	1	
Dibenz(a,h)anthracene	µg/g	< 0.23	< 0.05	< 0.5	< 0.5	< 0.005	< 0.005	< 0.005	< 0.005	*	< 0.005	< 0.005	< 0.005	*	< 0.005	< 0.005	< 0.005	< 0.2	< 2 ^a	< 0.02	< 0.02	1	
Benzo(g,h,i)perylene	µg/g	1.9	< 0.05	< 0.5	< 0.5	< 0.05	< 0.05	0.25	0.26	4	0.06	< 0.05	< 0.05	*	< 0.05	< 0.05	< 0.05	< 0.5	< 5	< 0.05	< 0.05	n/a	
IACR Coarse	None	52 ^b	1.6 ^b	2.6 ^b	6.7 ^b	< 0.05	< 0.05	0.981	1.49	*	0.221	< 0.05	< 0.05	*	< 0.05	< 0.05	< 0.05	-	-	-	-	n/a	
IACR Fine	None	52 ^b	1.6 ^b	2.6 ^b	6.7 ^b	< 0.05	< 0.05	1.9	2.89	*	0.426	< 0.05	< 0.05	*	< 0.05	< 0.05	< 0.05	-	-	-	-	n/a	
B(a)P TPE	µg/g	5.1	0.12	0.4	0.72	0.027	0.027	0.713	0.9318	27	0.1881	< 0.05	< 0.05	*	< 0.05	< 0.05	< 0.05	0.405	3.95	0.0395	0.0395	5.3	

Associated AGAT files: 1486799747, 1486800002, 1486800273, 1486801284, 1486818421, 1486820071.

Associated Maxxam file: B511928.

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- Denotes analysis not conducted.

n/a Denotes no applicable standard.

* RPDs are not normally calculated where one or more concentrations are less than five times MDL.

BOLD Concentration greater than or equal to CCME CEQG Residential/Parkland Land Use (RL/PL) guideline.

^a Laboratory detection limit exceeds regulatory standard.

^b Only one IACR provided, shown in both coarse and fine rows.

TABLE 4: Summary of Analytical Results for Metals in Soil

Sample Location Sample ID Sample Date (yyyy mm dd) Depth Interval (m)	EXC13-W9	EXC13-F17	EXC13-F30	EXC13-W13	BH14-01		BH14-02			BH14-04	TP14-01		TP14-02	TP14-03		TP14-04	Federal Guidelines		
	EXC13-W9-130306 2013 03 06 0.0 - 0.1	EXC13-F17-130308 2013 03 08 0.0 - 0.1	EXC13-F30-130321 2013 03 21 0.0 - 0.1	EXC13-W13-130308 2013 03 08 0.0 - 0.1	BH14-01-01 2014 01 09 0.5 - 0.6	BH14-01-03 2014 01 09 3.5 - 3.7	BH14-02-02 2014 01 09 1.2 - 1.5	BH14-02-03 Duplicate 1.2 - 1.5	QA/QC RPD %	BH14-02-04 2014 01 09 2.3 - 2.6	BH14-04-02 2014 01 10 1.1 - 1.4	TP14-01-04 2014 01 07 2.4 - 2.6	TP14-01-05 2014 01 07 3.0 - 3.2	TP14-02-02 2014 01 07 1.1 - 1.2	TP14-03-02 2014 01 07 2.1 - 2.4	TP14-03-03 2014 01 07 2.7 - 3.0	TP14-04-02 2014 01 07 1.8 - 2.0	CCME CEQG Residential/ Parkland Land Use (RL/PL)	
Parameter	Units	Analytical Results																	
Physical Parameters																			
pH	pH	7.39	7.04	8.07	7.27	7.67	8.31	7.72	7.62	1	7.52	7.38	7.3	7.8	7.1	7.9	7.7	7.8	6 - 8
Total Metals																			
Antimony	µg/g	0.26	0.27	0.38	0.78	< 0.5	< 0.5	< 0.5	< 0.5	*	< 0.5	3.5	0.62	0.4	0.19	1.32	0.83	0.4	20
Arsenic	µg/g	9.75	8.72	16.9	18.2	4.1	3.1	9.1	12.7	33	23.4	63.3	7.8	9.4	4.2	29.1	18.2	6.4	12
Barium	µg/g	48.6	68.7	75.6	83.2	76.3	53.3	63.7	80.8	24	44.8	24.8	87.5	117	74	111	124	64.6	500
Beryllium	µg/g	< 0.4	< 0.4	< 0.4	< 0.4	< 0.5	< 0.5	< 0.5	< 0.5	*	< 0.5	< 0.5	0.34	0.46	0.3	0.48	0.44	0.37	4
Boron (Hot Water Soluble)	µg/g	-	-	-	-	< 0.5	< 0.5	1.3	1.4	*	< 0.5	< 0.5	1.4	0.3	0.8	0.4	0.7	0.1	n/a
Cadmium	µg/g	0.517	0.352	0.47	0.565	< 0.5 ^a	< 0.5 ^a	< 0.5 ^a	< 0.5 ^a	*	< 0.5 ^a	1.8	0.37	0.37	0.22	1.05	0.87	0.35	10
Chromium	µg/g	14.2	33.2	27.5	25.5	35.3	31.2	22.9	27.8	19	58.6	17.7	28	41	23	35	40	38	90 ^a
Cobalt	µg/g	7.97	11.1	12	11.3	11.6	10.4	8.9	9.7	9	26.8	22	11.2	17.5	9	21.4	20.4	15.2	50
Copper	µg/g	28.4	29.9	36.2	35.7	33.4	27.3	25.9	30.2	15	150	65.7	32.4	62	19	90.5	108	49	150 ^c
Lead	µg/g	106	39.1	69.4	21.1	3.8	3.5	25.8	26.6	3	8.4	5.1	38	6	27.7	7.4	35.8	4.3	140
Lithium	µg/g	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	n/a
Manganese	µg/g	420	247	345	833	600	452	280	372	28	604	1130	309	650	230	1860	2120	976	n/a
Mercury	µg/g	0.14	0.06	0.094	0.094	-	-	-	-	-	-	-	0.06	0.05	0.03	0.06	0.07	0.02	6.6
Molybdenum	µg/g	5.23	2.93	6.55	1.66	0.6	< 0.5	1.5	1.8	*	2.1	23.6	2.31	2.76	1.67	6.94	4.61	2.49	10
Nickel	µg/g	28.4	28.8	29.7	24.1	28.8	28.3	24.1	28.1	15	44	34.1	32.1	36.9	26.3	37.4	43.2	72.1	55 ^c
Selenium	µg/g	1.54	< 0.5	0.67	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	*	< 0.5	1.3	0.5	0.3	0.4	0.7	0.8	0.1	4 ^c
Silver	µg/g	< 0.05	0.09	0.068	0.064	< 0.5	< 0.5	< 0.5	< 0.5	*	< 0.5	< 0.5	0.07	0.09	0.07	0.13	0.15	0.05	20
Strontium	µg/g	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	n/a
Thallium	µg/g	< 0.05	0.069	0.057	0.09	< 0.5	< 0.5	< 0.5	< 0.5	*	< 0.5	< 0.5	0.08	0.06	0.06	0.15	0.12	0.08	1
Tin	µg/g	0.61	0.42	0.53	0.48	< 0.5	< 0.5	< 0.5	< 0.5	*	0.6	< 0.5	0.54	0.5	0.46	0.47	1.07	2.02	50
Uranium	µg/g	0.906	1.74	3.24	1.42	< 0.5	< 0.5	1	1.3	*	1.1	5.6	1.01	1.24	1.62	3	2.62	0.65	23
Vanadium	µg/g	51.3	71.9	65.4	61.5	71	62.2	58.9	66.9	13	169	65.3	63	94	63	86	89	73	250 ^c
Zinc	µg/g	44.9	57.9	56.4	76.6	42	43	32	39	20	63	95	46	62	42	92	93	54	200

Associated AGAT files: 1486799747, 1486800002, 1486800273, 1486801284.

Associated Maxxam file: B511928, B520014.

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< Denotes concentration less than indicated detection limit or RPD less than indicated value.

- Denotes analysis not conducted.

n/a Denotes no applicable standard.

* RPDs are not normally calculated where one or more concentrations are less than five times MDL.

NOTE: concentrations are only compared to the higher of the two guidelines for each parameter.

BOLD Concentration greater than or equal to CCME CEQG Residential/Parkland Land Use (RL/PL) guideline.

^a Regional background soil quality estimate (Protocol 4 for Contaminated Sites, Determining Background Soil Quality, MOE, 2010).

TABLE 5: Summary of Analytical Results for Salinity in Soil

Sample Location	EXC13-F17	EXC13-F30	EXC13-W13	BH14-01		BH14-02		QA/QC RPD %	BH14-06	BH14-07	BH14-08	BH14-09	BH14-10	BH14-11	BH14-12	TP14-22	TP14-23	TP14-24	Federal Guidelines	
	Sample ID	EXC13-F17-130308	EXC13-F30-130321	EXC13-W13-130308	BH14-01-01	BH14-01-03	BH14-02-02		BH14-02-03	BH14-06-01	BH14-07-01	BH14-08-01	BH14-09-05	BH14-10-07	BH14-11-02	BH14-12-03	TP14-22-01	TP14-23-02	TP14-24-01	CCME CEQG Residential/ Parkland Land Use (RL/PL)
Sample Date (yyyy mm dd)	2013 03 08	2013 03 21	2013 03 08	2014 01 09	2014 01 09	2014 01 09	Duplicate	2014 03 05	2014 03 05	2014 03 05	2014 03 05	2014 03 05	2014 03 06	2014 03 06	2014 03 06	2014 03 07	2014 03 07	2014 03 07		
Depth Interval (m)	0.0 - 0.1	0.0 - 0.1	0.0 - 0.1	0.5 - 0.6	3.5 - 3.7	1.2 - 1.5	1.2 - 1.5	0.2 - 0.3	0.3 - 0.6	0.3 - 0.5	3.2 - 3.4	5.3 - 5.5	1.7 - 1.8	3.2 - 3.5	0.8 - 0.9	1.4 - 1.5	0.2 - 0.3			
Field Screen (ppm)				65	150	70	70													
Parameter	Units	Analytical Results																		
Soil Salinity																				
Soluble pH	pH	-	-	-	-	-	-	-	7.45	7.09	6.81	6.82	7.69	7.33	7.99	7.29	6.83	6.42	n/a	
% Saturation	%	45	63.1	68.9	40	40	42	42	0	54	68	48	56	30	40	58	40	48	39	n/a
Soluble Calcium	mg/L	49.6	35.3	58.1	35	67	132	158	18	37	56	76	9	83	26	31	49	23	16	n/a
Soluble Chloride	mg/L	59.2	107	12.9	159	34	834	951	13	-	-	-	-	-	-	-	6	4	5	n/a
Soluble Magnesium	mg/L	< 5	< 5	9.1	2	12	13	12	8	7	10	6	4	9	3	4	3	2	3	n/a
Soluble Potassium	mg/L	< 20	< 20	< 20	< 2	11	7	7	*	< 2	7	< 2	< 2	7	3	5	< 2	< 2	2	n/a
Soluble Sodium	mg/L	43.8	152	6.9	144	35	530	624	16	131	95	32	15	31	39	47	13	9	18	n/a
Soluble Sulphate	mg/L	85	126	< 10	146	94	238	237	< 1	-	-	-	-	-	-	-	24	12	11	n/a
Conductivity	µS/cm	468	782	256	960	610	3,370	3,890	14	780	760	540	150	660	360	410	310	200	200	2,000
Sodium Adsorption Ratio	None	1.71	7.04	0.22	6.4	1.03	11.8	12.9	9	5.17	3.07	0.95	1.05	0.86	1.93	2.11	0.49	0.48	1.08	5
Theoretical Gypsum Req.	t/ha	-	-	-	< 0.01	< 0.01	0.99	1.49	40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	n/a
Saturated Paste Sodium	µg/g	26.7	67.6	8.9	58	14	223	262	16	-	-	-	-	-	-	-	5	4	7	n/a
Saturated Paste Chloride	µg/g	19.7	95.8	4.7	64	14	350	399	13	-	-	-	-	-	-	-	2	< 2	2	n/a
Water Soluble Calcium	µg/g	-	-	-	14	27	55	66	18	-	-	-	-	-	-	-	20	11	6	n/a
Water Soluble Magnesium	µg/g	-	-	-	< 1	5	5	5	0	-	-	-	-	-	-	-	1	1	1	n/a
Water Soluble Potassium	µg/g	-	-	-	< 2	4	3	3	*	-	-	-	-	-	-	-	< 2	< 2	< 2	n/a
Water Soluble Sulphate	µg/g	-	-	-	58	38	100	100	0	-	-	-	-	-	-	-	10	6	4	n/a
Calcium (meq/L)	meq/L	-	-	-	1.75	3.34	6.59	7.88	18	-	-	-	-	-	-	-	2.45	1.15	0.8	n/a
Magnesium (meq/L)	meq/L	-	-	-	0.16	0.99	1.07	0.99	8	-	-	-	-	-	-	-	0.25	0.16	0.25	n/a
Sodium (meq/L)	meq/L	-	-	-	6.26	1.52	23.1	27.1	16	-	-	-	-	-	-	-	0.57	0.39	0.78	n/a
Potassium (meq/L)	meq/L	-	-	-	< 0.05	0.28	0.18	0.18	*	-	-	-	-	-	-	-	< 0.05	< 0.05	0.05	n/a
Chloride (meq/L)	meq/L	-	-	-	4.48	0.96	23.5	26.8	13	-	-	-	-	-	-	-	0.17	0.11	0.14	n/a
Sulphate (meq/L)	meq/L	-	-	-	3.04	1.96	4.96	4.93	< 1	-	-	-	-	-	-	-	0.5	0.25	0.23	n/a

Associated AGAT files: 1486799747, 1486800002, 1486800273, 1486801284, 1486818421, 1486820071.

All terms defined within the body of SNC-Lavalin's report.

< Denotes concentration less than indicated detection limit or RPD less than indicated value.

- Denotes analysis not conducted.

n/a Denotes no applicable standard.

* RPDs are not normally calculated where one or more concentrations are less than five times MDL.

BOLD Concentration greater than or equal to CCME CEQG Residential/Parkland Land Use (RL/PL) guideline.

Your P.O. #: 700335941
 Your Project #: 205.03776.00000
 Site Location: COLWOOD
 AFE # client
 Work Order# client

Attention: Aaron Haegele

SLR CONSULTING (CANADA) LTD
 6-40 CADILLAC AVENUE
 VICTORIA, BC
 CANADA V8Z 1T2

Report Date: 2016/04/11
 Report #: R2155509
 Version: 7 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B615995

Received: 2016/03/03, 07:07

Sample Matrix: Hydrocarbon
 # Samples Received: 1

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Dean Stark Analysis, Mass	1	2016/03/07	N/A	PTC SOP-00088	OSRD Method 1.0
Dean Stark Analysis, Mass %	1	2016/03/07	N/A	PTC SOP-00088	OSRD Method 1.0
CCME Hydrocarbons (F2-F4 in soil) (1, 3)	1	2016/03/07	2016/03/08	AB SOP-00036 / AB SOP-00040	CCME PHC-CWS
ICP Scan - Full, Oil (D5708B)	1	N/A	2016/03/15	PTC SOP-00205	ASTM D5708B
Colour	1	2016/03/04	2016/03/11	N/A	N/A
Extrapolated Absolute Density @ 15°C	1	2016/03/11	2016/03/11	PTCSOP -00100	N/A
Density Study @ Various Temperatures	1	2016/03/11	2016/03/11	PTCSOP -00100	ASTM D5002
Viscosity (Dynamic), Brookfield	1	2016/03/04	N/A	PTC SOP-00080	N/A
Viscosity (Kinematic), ASTM D445	1	2016/03/04	N/A	ASTM D445	ASTM D445
Oil Viscosity Temperatures	1	2016/03/04	N/A	ASTM D445	ASTM D445
Sulphur Content (by EDXRF), ASTM D4294	1	2016/03/04	2016/03/11	PTC SOP-00116	ASTM D4294
Polychlorinated Biphenyls (2)	1	N/A	2016/03/09	CAL SOP-00149	EPA 8082A R1 m
RESIDUAL SOLVENT	1	2016/03/07	N/A	PTC SOP-00246	In-house

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Edmonton Environmental, 9331 - 48 St., Edmonton, AB, T6B 2R4

(2) This test was performed by Maxxam Calgary, 4000 - 19 St., Calgary, AB, T2E 6P8

(3) All CCME results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil, Validation of Performance-Based Alternative Methods September 2003. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Samantha Fregien, Project Manager

Email: SFregien@maxxam.ca

Phone# (604)639-8418

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B615995
Report Date: 2016/04/11

QUALITY ASSURANCE REPORT

SLR CONSULTING (CANADA) LTD
Client Project #: 205.03776.00000
Site Location: COLWOOD
Your P.O. #: 700335941

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8211828	NONACHLOROBIPHENYL (sur.)	2016/03/09	109	30 - 130	86	30 - 130	87	%		
8209433	Mass Bitumen								NC	N/A
8209433	Mass Solids								NC	N/A
8209433	Mass Total								NC	N/A
8209433	Mass Water								NC	N/A
8209845	F2 (C10-C16 Hydrocarbons)	2016/03/07	93	50 - 130	98	70 - 130	<10	mg/kg	NC	50
8209845	F3 (C16-C34 Hydrocarbons)	2016/03/07	90	50 - 130	96	70 - 130	<50	mg/kg	NC	50
8209845	F4 (C34-C50 Hydrocarbons)	2016/03/07	91	50 - 130	96	70 - 130	<50	mg/kg	NC	50
8211828	Aroclor 1016	2016/03/09					<1.0	mg/kg	NC	50
8211828	Aroclor 1221	2016/03/09					<1.0	mg/kg	NC	50
8211828	Aroclor 1232	2016/03/09					<1.0	mg/kg	NC	50
8211828	Aroclor 1242	2016/03/09					<1.0	mg/kg	NC	50
8211828	Aroclor 1248	2016/03/09					<1.0	mg/kg	NC	50
8211828	Aroclor 1254	2016/03/09					<1.0	mg/kg	NC	50
8211828	Aroclor 1260	2016/03/09	87	30 - 130	70	30 - 130	<1.0	mg/kg	NC	50
8211828	Aroclor 1268	2016/03/09					<1.0	mg/kg	NC	50
8211828	Total Aroclors	2016/03/09					<1.0	mg/kg	NC	50
8216763	Total Aluminum (Al)	2016/03/15					<0.05	mg/kg		
8216763	Total Antimony (Sb)	2016/03/15					<0.02	mg/kg		
8216763	Total Arsenic (As)	2016/03/15					<0.02	mg/kg		
8216763	Total Barium (Ba)	2016/03/15					<0.01	mg/kg		
8216763	Total Cadmium (Cd)	2016/03/15					<0.01	mg/kg	NC	35
8216763	Total Calcium (Ca)	2016/03/15					<0.01	mg/kg		
8216763	Total Chromium (Cr)	2016/03/15					<0.01	mg/kg	NC	35
8216763	Total Cobalt (Co)	2016/03/15					<0.01	mg/kg		
8216763	Total Copper (Cu)	2016/03/15					<0.01	mg/kg		
8216763	Total Iron (Fe)	2016/03/15					<0.01	mg/kg		
8216763	Total Lead (Pb)	2016/03/15					<0.02	mg/kg	NC	35
8216763	Total Magnesium (Mg)	2016/03/15					<0.05	mg/kg		
8216763	Total Manganese (Mn)	2016/03/15					<0.01	mg/kg		
8216763	Total Molybdenum (Mo)	2016/03/15					<0.01	mg/kg		

Maxxam Job #: B615995
Report Date: 2016/04/11

QUALITY ASSURANCE REPORT(CONT'D)

SLR CONSULTING (CANADA) LTD
Client Project #: 205.03776.00000
Site Location: COLWOOD
Your P.O. #: 700335941

QC Batch	Parameter	Date	Matrix Spike		Spiked Blank		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8216763	Total Nickel (Ni)	2016/03/15					<0.01	mg/kg		
8216763	Total Phosphorus (P)	2016/03/15					<0.04	mg/kg		
8216763	Total Potassium (K)	2016/03/15					<0.05	mg/kg		
8216763	Total Selenium (Se)	2016/03/15					<0.02	mg/kg		
8216763	Total Silicon (Si)	2016/03/15					<0.05	mg/kg		
8216763	Total Sodium (Na)	2016/03/15					<0.05	mg/kg		
8216763	Total Strontium (Sr)	2016/03/15					<0.01	mg/kg		
8216763	Total Tin (Sn)	2016/03/15					<0.02	mg/kg		
8216763	Total Titanium (Ti)	2016/03/15					<0.01	mg/kg		
8216763	Total Vanadium (V)	2016/03/15					<0.01	mg/kg		
8216763	Total Zinc (Zn)	2016/03/15					<0.01	mg/kg		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.


NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

Maxxam Job #: B615995
Report Date: 2016/04/11


SLR CONSULTING (CANADA) LTD
Client Project #: 205.03776.00000
Site Location: COLWOOD
Your P.O. #: 700335941

VALIDATION SIGNATURE PAGE

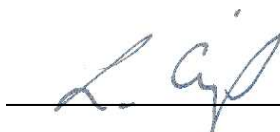
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



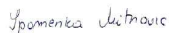
Brandon Weber, Supervisor, Water Lab



Gayle Simpson, Analyst II



Lisa Cummings, Organics Manager



Spomenka Mitrovic, Senior Analyst, PPPE, Senior Analyst, PPPE



Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

OIL ANALYSIS

MaxxID		Client ID		Meter Number		B615995:OF3019 Laboratory Number	
PUBLIC WORKS AND GOVERNMENT SERVICES							
Operator Name PRODUCT 2 - NX7457-01 TO 06				LSD N/A		Well ID MAXXAM ANALYTICS	
Well Name				Initials of Sampler PRODUCT 2 - NX7457-01 TO 06		Sampling Company GLASS BOTTLE	
Field or Area		Pool or Zone		Sample Point		Container Identity	
Test Recovery		Interval		Elevations (m)		Sample Gathering Point	
Test Type No. Multiple Recovery		From: To:		KB GRD		Well Fluid Status	
Production Rates		Gauge Pressures kPa		Temperature °C		Well Status Mode	
Water m3/d Oil m3/d Gas 1000m3/d		Source As Received		23.0		Well Status Type	
2016/01/04		2016/03/03		2016/03/15		2016/04/11	
Date Sampled Start		Date Sampled End		Date Received		Date Reported	
						2016/04/11	
						Date Reissued	
						HB2,APC,BS7,SM1,LC8,MN2,LZ3,BW6	
						Analyst	

PROPERTIES

BROWN

Colour of Clean Oil

S & W (ASTM D4007)

Water (vol%)	Sediment (vol%)	Total S & W (vol%)
--------------	-----------------	--------------------

Density of Clean Oil @ 15°C (ASTM D5002)

Relative	API	Absolute (kg/m ³)
----------	-----	-------------------------------

1.42
Total Sulphur (Mass Percent) ASTM D4294

Pour Point(°C) ASTM D97/D5853

Density of Water @ 15°C (ASTM D4052)

Relative	Absolute (kg/m ³)
----------	-------------------------------

ASTM D86 DISTILLATION

Vol % Distilled	Temp °C
IBP	
5.0	
10.0	
15.0	
20.0	
25.0	
30.0	
35.0	
40.0	
45.0	
50.0	
55.0	
60.0	
65.0	
70.0	
75.0	
80.0	
85.0	
90.0	
95.0	
100.0	
FBP	

IBP-204°C Naphtha Cut (Vol%)	204°C-274°C Kerosene Cut (Vol%)
Recoverd (Vol%)	Residue (Vol%)
Loss (Vol%)	

Temp °C	Dynamic (cP) centipoise	Kinematic (cSt) centistoke
15.0	7847	7950
20.0	4142	4209
25.0	2308	2354
30.0	1346	1377
40.0	523.1	538.6
50.0	236.2	244.8

Barometric Pressure (kPa)

** Information not supplied by Client -- data derived from LSD information Results relate only to items tested

Remarks:

All CCME results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil, Validation of Performance-Based Alternative Methods September 2003. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Sample cannot be cleaned by centrifuge.

Viscosity @ 15°C 20°C and 25°C has been calculated based on ASTM D341.

The CCME F2-F4 chromatographic peak profile is consistent with an unrefined product (e.g. condensate, crude oil). These are typically characterized by evenly distributed peaks between C10 and in some instances beyond C50, representing simple straight-chain aliphatic compounds (n-alkanes) which are most prevalent in the material. These peaks will decrease in height relative to the unresolved complex mixture (UCM or "hump") along with a general loss of the lower-weight hydrocarbons with increased weathering of the original material.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

OIL ANALYSIS

<u>MaxxID</u>		<u>Client ID</u>	<u>Meter Number</u>		<u>B615995:OF3019</u>
PUBLIC WORKS AND GOVERNMENT SERVICES					
<u>Operator Name</u>			<u>LSD</u>	<u>Well ID</u>	
PRODUCT 2 - NX7457-01 TO 06			N/A	MAXXAM ANALYTICS	
<u>Well Name</u>			<u>Initials of Sampler</u>	<u>Sampling Company</u>	
PRODUCT 2 - NX7457-01 TO 06				GLASS BOTTLE	
<u>Field or Area</u>	<u>Pool or Zone</u>	<u>Sample Point</u>		<u>Container Identity</u>	<u>Percent Full</u>
<u>Test Recovery</u>		<u>Interval</u>	<u>Elevations (m)</u>		<u>Sample Gathering Point</u>
<u>Test Type</u>	<u>No.</u>	<u>From:</u>	<u>KB</u>	<u>GRD</u>	<u>Solution Gas</u>
	<u>Multiple Recovery</u>	<u>To:</u>			<u>Well Fluid Status</u>
<u>Production Rates</u>		<u>Gauge Pressures kPa</u>		<u>Temperature °C</u>	<u>Well Status Mode</u>
<u>Water m3/d</u>	<u>Oil m3/d</u>	<u>Source</u>	<u>As Received</u>	23.0	<u>Well Status Type</u>
	<u>Gas 1000m3/d</u>				<u>Well Type</u>
<u>Date Sampled Start</u>		<u>Date Sampled End</u>	<u>Date Received</u>	<u>Date Reported</u>	<u>Date Reissued</u>
2016/01/04		2016/03/03	2016/03/15	2016/04/11	
<u>Gas or Condensate Project</u>					<u>Licence No.</u>
HB2,APC,BS7,SM1,LC8,MN2,LZ3,BW6					
<u>Analyst</u>					

NA Analysis Not Available
NR Analysis Not Requested

** Information not supplied by Client -- data derived from LSD information Results relate only to items tested

Remarks:

All CCME results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil, Validation of Performance-Based Alternative Methods September 2003. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Sample cannot be cleaned by centrifuge.

Viscosity @ 15°C 20°C and 25°C has been calculated based on ASTM D341.

The CCME F2-F4 chromatographic peak profile is consistent with an unrefined product (e.g. condensate, crude oil). These are typically characterized by evenly distributed peaks between C10 and in some instances beyond C50, representing simple straight-chain aliphatic compounds (n-alkanes) which are most prevalent in the material. These peaks will decrease in height relative to the unresolved complex mixture (UCM or "hump") along with a general loss of the lower-weight hydrocarbons with increased weathering of the original material.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

OIL ANALYSIS

<u>MaxxID</u>		<u>Client ID</u>	<u>Meter Number</u>	<u>B615995:OF3019</u>
PUBLIC WORKS AND GOVERNMENT SERVICES				
<u>Operator Name</u>		<u>LSD</u>	<u>Well ID</u>	
PRODUCT 2 - NX7457-01 TO 06		N/A	MAXXAM ANALYTICS	
<u>Well Name</u>		<u>Initials of Sampler</u>	<u>Sampling Company</u>	
PRODUCT 2 - NX7457-01 TO 06			GLASS BOTTLE	
<u>Field or Area</u>	<u>Pool or Zone</u>	<u>Sample Point</u>	<u>Container Identity</u>	<u>Percent Full</u>
<u>Test Recovery</u>		<u>Interval</u>	<u>Elevations (m)</u>	<u>Sample Gathering Point</u>
<u>Test Type</u>	<u>No.</u>	<u>From:</u>	<u>KB</u>	<u>GRD</u>
<u>Multiple Recovery</u>		<u>To:</u>		
<u>Production Rates</u>		<u>Gauge Pressures kPa</u>		<u>Well Fluid Status</u>
<u>Water m3/d</u>	<u>Oil m3/d</u>	<u>Source</u>	<u>As Received</u>	<u>Well Status Mode</u>
<u>Gas 1000m3/d</u>		<u>Temperature °C</u>		<u>Well Status Type</u>
			23.0	<u>Well Type</u>
		<u>Source</u>	<u>As Received</u>	<u>Gas or Condensate Project</u>
<u>2016/01/04</u>	<u>2016/03/03</u>	<u>2016/03/15</u>	<u>2016/04/11</u>	<u>HB2,APC,BS7,SM1,LC8,MN2,LZ3,BW6</u>
<u>Date Sampled Start</u>	<u>Date Sampled End</u>	<u>Date Received</u>	<u>Date Reported</u>	<u>Date Reissued</u>
				<u>Analyst</u>

PARAMETER DESCRIPTION	Result	Unit	Method	MDL
Monocyclic Aromatics				
Toluene	<0.005	wt%	In-house	0.005
Density Analysis				
Extrapolated Absolute Density @ 15°C	987.0	kg/m3	N/A	0.1
Absolute Density @ 40°C	968.7	kg/m3	ASTM D5002	0.1
Absolute Density @ 60 °C	954.0	kg/m3	ASTM D5002	0.1
Absolute Density @ 80°C	939.4	kg/m3	ASTM D5002	0.1
Dean Stark Analysis				
Mass Bitumen	160.35	g	OSRD Method 1.0	0.01
Mass Solids	348.62	g	OSRD Method 1.0	0.01
Mass Water	222.82	g	OSRD Method 1.0	0.01
Mass Total	742.41	g	OSRD Method 1.0	0.01
Mass % Bitumen	21.60	wt%	OSRD Method 1.0	0.01
Mass % Solids	46.96	wt%	OSRD Method 1.0	0.01
Mass % Water	30.01	wt%	OSRD Method 1.0	0.01
Mass % Recovery	98.57	wt%	OSRD Method 1.0	0.01
Total Metals by ICP				
Total Aluminum (Al)	<1	mg/kg	ASTM D5708B	1
Total Arsenic (As)	<0.3	mg/kg	ASTM D5708B	0.3
Total Barium (Ba)	<0.1	mg/kg	ASTM D5708B	0.1
Total Calcium (Ca)	<0.5	mg/kg	ASTM D5708B	0.5
Total Cadmium (Cd)	<0.1	mg/kg	ASTM D5708B	0.1
Total Cobalt (Co)	<1	mg/kg	ASTM D5708B	1
Total Chromium (Cr)	<1	mg/kg	ASTM D5708B	1
Total Copper (Cu)	<1	mg/kg	ASTM D5708B	1
Total Iron (Fe)	0.4	mg/kg	ASTM D5708B	0.1
** Information not supplied by Client -- data derived from LSD information				Results relate only to items tested

Remarks:

All CCME results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil, Validation of Performance-Based Alternative Methods September 2003. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Sample cannot be cleaned by centrifuge.

Viscosity @ 15°C 20°C and 25°C has been calculated based on ASTM D341.

The CCME F2-F4 chromatographic peak profile is consistent with an unrefined product (e.g. condensate, crude oil). These are typically characterized by evenly distributed peaks between C10 and in some instances beyond C50, representing simple straight-chain aliphatic compounds (n-alkanes) which are most prevalent in the material. These peaks will decrease in height relative to the unresolved complex mixture (UCM or "hump") along with a general loss of the lower-weight hydrocarbons with increased weathering of the original material.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

OIL ANALYSIS

B615995:OF3019

MaxxID		Client ID		Meter Number		Laboratory Number	
PUBLIC WORKS AND GOVERNMENT SERVICES							
Operator Name				LSD		Well ID	
PRODUCT 2 - NX7457-01 TO 06				N/A		MAXXAM ANALYTICS	
Well Name				Initials of Sampler		Sampling Company	
PRODUCT 2 - NX7457-01 TO 06						GLASS BOTTLE	
Field or Area		Pool or Zone		Sample Point		Container Identity	
						Percent Full	
Test Recovery							
Test Type		Interval		Elevations (m)		Sample Gathering Point	
No. Multiple Recovery		From: To:		KB GRD		Well Fluid Status	
Production Rates		Gauge Pressures kPa		Temperature °C		Well Status Mode	
Water m3/d Oil m3/d Gas 1000m3/d		Source As Received		23.0		Well Status Type	
				Source As Received		Licence No.	
2016/01/04		2016/03/03		2016/03/15		2016/04/11	
Date Sampled Start		Date Sampled End		Date Reported		Date Reissued	
						HB2,APC,BS7,SM1,LC8,MN2,LZ3,BW6	
						Analyst	

PARAMETER DESCRIPTION	Result	Unit	Method	MDL
Total Potassium (K)	<2	mg/kg	ASTM D5708B	2
Total Magnesium (Mg)	<1	mg/kg	ASTM D5708B	1
Total Manganese (Mn)	<0.1	mg/kg	ASTM D5708B	0.1
Total Molybdenum (Mo)	<0.1	mg/kg	ASTM D5708B	0.1
Total Sodium (Na)	<1	mg/kg	ASTM D5708B	1
Total Nickel (Ni)	0.8	mg/kg	ASTM D5708B	0.1
Total Phosphorus (P)	<5	mg/kg	ASTM D5708B	5
Total Lead (Pb)	<1	mg/kg	ASTM D5708B	1
Total Antimony (Sb)	<1	mg/kg	ASTM D5708B	1
Total Selenium (Se)	<0.3	mg/kg	ASTM D5708B	0.3
Total Silicon (Si)	<1	mg/kg	ASTM D5708B	1
Total Tin (Sn)	<1	mg/kg	ASTM D5708B	1
Total Strontium (Sr)	<1	mg/kg	ASTM D5708B	1
Total Titanium (Ti)	<1	mg/kg	ASTM D5708B	1
Total Vanadium (V)	<1	mg/kg	ASTM D5708B	1
Total Zinc (Zn)	<1	mg/kg	ASTM D5708B	1
Ext. Pet. Hydrocarbon				
F2 (C10-C16 Hydrocarbons)	57000	mg/kg	CCME PHC-CWS	250
F3 (C16-C34 Hydrocarbons)	120000	mg/kg	CCME PHC-CWS	1300
F4 (C34-C50 Hydrocarbons)	42000	mg/kg	CCME PHC-CWS	1300
Reached Baseline at C50	NO	mg/kg	CCME PHC-CWS	
Polychlorinated Biphenyls				
Aroclor 1016	<1.0	mg/kg	EPA 8082A R1 m	1.0
Aroclor 1221	<1.0	mg/kg	EPA 8082A R1 m	1.0
Aroclor 1232	<1.0	mg/kg	EPA 8082A R1 m	1.0
Aroclor 1242	<1.0	mg/kg	EPA 8082A R1 m	1.0
Aroclor 1248	<1.0	mg/kg	EPA 8082A R1 m	1.0
Aroclor 1254	<1.0	mg/kg	EPA 8082A R1 m	1.0

** Information not supplied by Client -- data derived from LSD information Results relate only to items tested

Remarks:

All CCME results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil, Validation of Performance-Based Alternative Methods September 2003. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Sample cannot be cleaned by centrifuge.

Viscosity @ 15°C 20°C and 25°C has been calculated based on ASTM D341.

The CCME F2-F4 chromatographic peak profile is consistent with an unrefined product (e.g. condensate, crude oil). These are typically characterized by evenly distributed peaks between C10 and in some instances beyond C50, representing simple straight-chain aliphatic compounds (n-alkanes) which are most prevalent in the material. These peaks will decrease in height relative to the unresolved complex mixture (UCM or "hump") along with a general loss of the lower-weight hydrocarbons with increased weathering of the original material.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

OIL ANALYSIS

<u>MaxxID</u> _____		<u>Client ID</u> _____		<u>Meter Number</u> _____		<u>B615995:OF3019</u>	
<u>Operator Name</u>		<u>LSD</u>		<u>Well ID</u>		<u>Laboratory Number</u>	
PUBLIC WORKS AND GOVERNMENT SERVICES		N/A		MAXXAM ANALYTICS			
<u>Well Name</u>		<u>Initials of Sampler</u>		<u>Sampling Company</u>			
PRODUCT 2 - NX7457-01 TO 06		PRODUCT 2 - NX7457-01 TO 06		GLASS BOTTLE			
<u>Field or Area</u>		<u>Pool or Zone</u>		<u>Sample Point</u>		<u>Container Identity</u> <u>Percent Full</u>	
<u>Test Recovery</u>		<u>Interval</u>		<u>Elevations (m)</u>		<u>Sample Gathering Point</u> <u>Solution Gas</u>	
<u>Test Type</u> <u>No.</u> <u>Multiple Recovery</u>		From: _____ To: _____		KB _____ GRD _____		<u>Well Fluid Status</u> <u>Well Status Mode</u>	
<u>Production Rates</u>		<u>Gauge Pressures kPa</u>		<u>Temperature °C</u>		<u>Well Status Type</u> <u>Well Type</u>	
Water m3/d Oil m3/d Gas 1000m3/d		Source _____ As Received _____		Source _____ As Received _____ 23.0		<u>Gas or Condensate Project</u> <u>Licence No.</u>	
<u>Date Sampled Start</u>		<u>Date Sampled End</u>		<u>Date Reported</u>		<u>Date Reissued</u> <u>Analyst</u>	
2016/01/04		2016/03/03		2016/03/15		2016/04/11 HB2,APC,BS7,SM1,LC8,MN2,LZ3,BW6	

PARAMETER DESCRIPTION	Result	Unit	Method	MDL
Aroclor 1260	<1.0	mg/kg	EPA 8082A R1 m	1.0
Aroclor 1268	<1.0	mg/kg	EPA 8082A R1 m	1.0
Total Aroclors	<1.0	mg/kg	EPA 8082A R1 m	1.0
** Information not supplied by Client -- data derived from LSD information Results relate only to items tested				

Remarks:

All CCME results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil, Validation of Performance-Based Alternative Methods September 2003. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Sample cannot be cleaned by centrifuge.

Viscosity @ 15°C 20°C and 25°C has been calculated based on ASTM D341.

The CCME F2-F4 chromatographic peak profile is consistent with an unrefined product (e.g. condensate, crude oil). These are typically characterized by evenly distributed peaks between C10 and in some instances beyond C50, representing simple straight-chain aliphatic compounds (n-alkanes) which are most prevalent in the material. These peaks will decrease in height relative to the unresolved complex mixture (UCM or "hump") along with a general loss of the lower-weight hydrocarbons with increased weathering of the original material.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

OIL ANALYSIS

<u>MaxxID</u>		<u>Client ID</u>		<u>Meter Number</u>		<u>B615995:OF3019</u>	
PUBLIC WORKS AND GOVERNMENT SERVICES						<u>Laboratory Number</u>	
<u>Operator Name</u>				<u>LSD</u>		<u>Well ID</u>	
PRODUCT 2 - NX7457-01 TO 06				N/A		MAXXAM ANALYTICS	
<u>Well Name</u>				<u>Initials of Sampler</u>		<u>Sampling Company</u>	
PRODUCT 2 - NX7457-01 TO 06						GLASS BOTTLE	
<u>Field or Area</u>		<u>Pool or Zone</u>		<u>Sample Point</u>		<u>Container Identity</u>	
						<u>Percent Full</u>	
<u>Test Recovery</u>				<u>Interval</u>		<u>Elevations (m)</u>	
				From: _____		KB _____ GRD _____	
Test Type No. Multiple Recovery				To: _____			
<u>Production Rates</u>				<u>Gauge Pressures kPa</u>		<u>Temperature °C</u>	
Water m3/d Oil m3/d Gas 1000m3/d				Source As Received		23.0	
						Source As Received	
<u>Date Sampled Start</u>				<u>Date Sampled End</u>		<u>Date Reported</u>	
2016/01/04				2016/03/03		2016/03/15	
<u>Date Sampled End</u>				<u>Date Received</u>		<u>Date Reissued</u>	
						2016/04/11	
						<u>Analyst</u>	
						HB2,APC,BS7,SM1,LC8,MN2,LZ3,BW6	
						<u>Gas or Condensate Project</u>	
						<u>Licence No.</u>	

PARAMETER DESCRIPTION	Result	Unit	Method	MDL
<p style="text-align: right; margin-top: 20px;">** Information not supplied by Client -- data derived from LSD information Results relate only to items tested</p>				

Remarks:

All CCME results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil, Validation of Performance-Based Alternative Methods September 2003. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Sample cannot be cleaned by centrifuge.

Viscosity @ 15°C 20°C and 25°C has been calculated based on ASTM D341.

The CCME F2-F4 chromatographic peak profile is consistent with an unrefined product (e.g. condensate, crude oil). These are typically characterized by evenly distributed peaks between C10 and in some instances beyond C50, representing simple straight-chain aliphatic compounds (n-alkanes) which are most prevalent in the material. These peaks will decrease in height relative to the unresolved complex mixture (UCM or "hump") along with a general loss of the lower-weight hydrocarbons with increased weathering of the original material.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

APPENDIX F
Borehole and Testpit Logs

Colwood FOD North Area
CFB Esquimalt, Colwood, BC
SLR Project No.: 205.03903.00000

i. ROCK TYPE

Lithology
 Colour
 Mineralogy
 Grain Size

ii. ROCK MASS**Hardness**

Weathering	R0	Extremely Weak
Hardness	R1	Very Weak
	R2	Weak
	R3	Medium Strong
	R4	Strong
	R5	Very Strong

iii. DESCRIPTION**1. Type**

1. Type	J	Joint
2. Dip	V	Vein
3. Aperture	MB	Mechanical Breakage

2. Dip

5. Infill

6. Infill Type The dip was measured using a protractor. The base of the protractor was set to collect measurements along the vertical core axis (VCA).

7. Spacing

3. Aperture

Vt	Very Tight	< 0.1 mm
Ti	Tight	0.1 - 0.25 mm
Po	Partly Open	0.25 - 0.50 mm
Op	Open	0.5 - 2.5 mm
Mw	Medium Wide	2.5 - 10 mm
Wi	Wide	10 mm
Vw	Very Wide	1 - 10 cm
Ew	Extremely Wide	0.1 - 1 m

4. & 5. Roughness / Infill

Sm	Smooth
Mr	Medium Rough
Ro	Rough
He	Healed (veins are healed)

6. Infill Type

Bi	Biotite
Ca	Calcite
Chl	Chlorite
Fe	Iron
Feld	Feldspar
Qu	Quartz
Py	Pyrite

7. Spacing

Ec	Extremely Close	< 3 cm
Vc	Very Close	3 - 10 cm
Cl	Close	10-30 cm
Mo	Moderate	30 - 60 cm
Wi	Wide	60 - 150 cm

8. Additional Notes

Symp	Sympathetic
Conj	Conjugate

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Core Log MW16-01A

Sheet 1 of 3

Supplemental Phase II Environmental Site Assessment CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

DATE(S) DRILLED:	12/6/2016 through 12/7/2016	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	31.98 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,610 E 465,890
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	14.9 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	2.04 metres below grade (12/28/2016)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0									GRAVEL, angular (road base), trace silt (increasing silt content with depth), grey, compact, dry to moist (increasing moisture with depth)			Flush-mounted roadbox Concrete Bentonite seal Silica sand	
1									SILT, trace clay, trace gravel (angular and rounded), trace sand, very hard, brown, moist				
30												25 mm 0.010 slot sched 40 PVC pipe Sample ID MW16-01A 2.1m-2.6m	
2	1	1	38										
3													
28												End cap Silica sand	
4	2	1	18										
5													

ROCK CORE: File: COLFOD (HQ3).GPJ; 3/30/2017

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Core Log MW16-01A

Sheet 2 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
26	5	3	1	90									
	6	4	2	100									
	7	5	2	105		0							
	8	6	2	80	>10	0				AMPHIBOLITE 1. J / 20° / Op / Mr / Heavy Chl / Wi AMPHIBOLITE 2. J / 110° / Op / Ro / Spotted Chl / Vc 3. J / 155° / Op / Mr / Heavy Chl / Wi / Conj. of 1 4. J / 110° / Op / Ro / Spotted Chl / Wi / Symp. of 2 (offset by 90°) 5. V / 155° / Op / He / Qu/Feld / Wi			
24	9	7	2	80	>10	0				AMPHIBOLITE 1. Rubble Zone 2. J / 130° / Op / Ro / Spotted Fe / Wi 3. J / 150° / Op-Rubble / Mr / Trace Ca / Cl-Vc / Conj. of 2 4. J / 0° / Po-Rubble / He / Qu-Bi-Ca / Wi / Symp. of 2 5. J / 170° / Po / - / Spotted Fe / Vc 6. V / 45° / Op / - / Spotted Fe / Vc / Symp. of 5 (offset by 90°)			Bentonite seal
22	10	7	2	80	>10	0				AMPHIBOLITE 1. Rubble Zone 2. J / 0° / Op-Rubble / He / Qu / Wi 3. J / 45° / Op-Rubble / Mr / Qu / Mo / Conj. of 1			
	11				>10								

ROCK CORE: File: COLFOD (HQ3).GPJ: 3/30/2017

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Core Log MW16-01A

Sheet 3 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
20	12	8	2	70	>10	0			3 1 NR				
13	13	9	3	100	>10 >10 >10	38			3 2 3 3 2 3 3	AMPHIBOLITE 1. Rubble Zone 2. J / 10° / Op-Mw / Mr / Qu / Mo / Conj. of 2 3. J / 100° / Po-Op / Ro / Heavy Fe / Mo 4. J / 100° / Po-Op / Ro / Heavy Fe / Vc-Vw / Symp. of 2 (offset by 90°) 5. J / 150° / Po-Op / Sm / Light Clay-Chl / Vc-Vw / Symp. of 2 (offset by -90°) 6. V / 50° / Om-Mw / He / Chl-Feld-Qu / Wi-Vw			
18	14	10	3	73	>10 3	43			6 6 1 2 4 3 4 3 5 NR	AMPHIBOLITE 1. Rubble Zone 2. J / 55° / Op-Rubble / Mr / Light Ca / Wi 3. J / 110° / Op / Ro / Spotted Fe-Ca / - 4. J / 140° / Op-Rubble / Ro / Heavy Fe / - 5. J / 65° / Op / Ro / Heavy Fe / Vc-Cl 6. V / 45° / He / Ro / Heavy Fe-Trace Silt / -			
16	16												
	17												

ROCK CORE: File: COLFOD (HQ3).GPJ: 3/30/2017

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Core Log MW16-01B

Sheet 1 of 3

Supplemental Phase II Environmental Site Assessment CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

DATE(S) DRILLED:	12/6/2016 through 12/7/2016	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	31.98 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,610 E 465,890
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	14.9 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	1.88 metres below grade (12/28/2016)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											GRAVEL, angular (road base), trace silt (increasing silt content with depth), grey, compact, dry to moist (increasing moisture with depth)			Flush-mounted roadbox Concrete
											SILT, trace clay, trace gravel (angular and rounded), trace sand, very hard, brown, moist			
30	2	1	1	38										Sample ID MW16-01A 2.1m-2.6m
	3													Bentonite seal
28	4	2	1	18										
	5													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-01B

Sheet 2 of 3

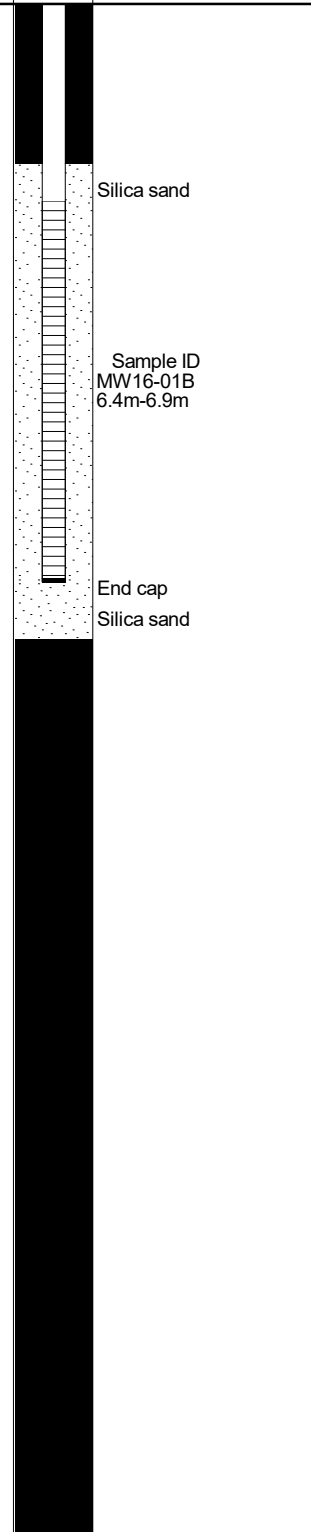
Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
26	5	3	1	90									
	6												
	7	4	2	100									
	8	5	2	105		0							
24	8	6	2	80	>10	0		1	AMPHIBOLITE 1. J / 20° / Op / Mr / Heavy Chl / Wi				
					>10			2	AMPHIBOLITE 2. J / 110° / Op / Ro / Spotted Chl / Vc				
					>10			2	3. J / 155° / Op / Mr / Heavy Chl / Wi / Conj. of 1				
					>10			3	4. J / 110° / Op / Ro / Spotted Chl / Wi / Symp. of 2 (offset by 90°)				
					>10			4	5. V / 155° / Op / He / Qu/Feld / Wi				
					>10			5					
					>10			6					
					>10			NR					
22	9				>10			1	AMPHIBOLITE 1. Rubble Zone				
					>10			2	2. J / 130° / Op / Ro / Spotted Fe / Wi				
					>10			3	3. J / 150° / Op-Rubble / Mr / Trace Ca / Cl-Vc / Conj. of 2				
					>10			6	4. J / 0° / Po-Rubble / He / Qu-Bi-Ca / Wi / Symp. of 2				
					>10			4	5. J / 170° / Po / - / Spotted Fe / Vc				
					>10			6	6. V / 45° / Op / - / Spotted Fe / Vc / Symp. of 5 (offset by 90°)				
		7	2	80	>10	0		3					
					>10			3					
					>10			2					
					>10			3					
					>10			1					
					>10			NR					
					>10			1	AMPHIBOLITE 1. Rubble Zone				
					>10			2	2. J / 0° / Op-Rubble / He / Qu / Wi				
					>10			1	3. J / 45° / Op-Rubble / Mr / Qu / Mo / Conj. of 1				
11	11				>10			2					
					>10			1					

ROCK CORE: File: COLFOD (HQ3).GPJ: 3/30/2017



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Core Log MW16-01B

Sheet 3 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
		8	2	70	>10	0			3 1 NR				Bentonite seal
20	12				>10				1 3 3 2 3 3 3	AMPHIBOLITE 1. Rubble Zone 2. J / 10° / Op-Mw / Mr / Qu / Mo / Conj. of 2 3. J / 100° / Po-Op / Ro / Heavy Fe / Mo 4. J / 100° / Po-Op / Ro / Heavy Fe / Vc-Vw / Symp. of 2 (offset by 90°) 5. J / 150° / Po-Op / Sm / Light Clay-Chl / Vc-Vw / Symp. of 2 (offset by -90°) 6. V / 50° / Om-Mw / He / Chl-Feld-Qu / Wi-Vw			
	13	9	3	100	>10	38			2 3 3 4				
					3				3 5 6				
					>10				1 2	AMPHIBOLITE 1. Rubble Zone 2. J / 55° / Op-Rubble / Mr / Light Ca / Wi 3. J / 110° / Op / Ro / Spotted Fe-Ca / - 4. J / 140° / Op-Rubble / Ro / Heavy Fe / - 5. J / 65° / Op / Ro / Heavy Fe / Vc-Cl 6. V / 45° / He / Ro / Heavy Fe-Trace Silt / -			
18	14				3				4 3				
		10	3	73	3	43			4 3 5				
									NR				
	15												
	16												
	17												

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Core Log MW16-02A

Sheet 1 of 2

Supplemental Phase II Environmental Site Assessment CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

DATE(S) DRILLED:	12/7/2016 through 12/8/2016	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	29.37 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,608 E 465,849
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	9.0 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	2.03 metres below grade (12/28/2016)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0									SILT, trace clay, trace gravel (angular and rounded), trace sand, very hard, brown, moist		Flushed-mounted roadbox Concrete		
											Bentonite seal		
											Silica sand		
1													
28													
2									Small boulder between 2.13m - 2.44m		25 mm 0.010 slot sched 40 PVC pipe		
3	1	4	99		0			1	AMPHIBOLITE Rubble				
				>10				1	AMPHIBOLITE				
				>10				2	1. J / 80° / Ti-Po / Mr / Light Fe / Cl-Mo				
				>10				1	2. J / 170° / Ti / Sm-Mr / Light Fe / Wi				
				>10				1	3. J / 100° / Po-Op / Ro / Moderate Fe / Vc-Cl				
				>10				1	4. J / 70° / Po-Op / Mr-Ro / Moderate Fe / Vc-Cl				
				>10				1	5. J / 140°-150° / Po-Op / Mr-Ro / Moderate Fe / Vc-Cl				
4	2	4	100		0			4					
				>10				5					
				>10				4					
				>10				5					
				>10				3					
				>10				1					
				>10				5	AMPHIBOLITE				
				>10				2	1. J / 140° / Op / Sm-Mr / Light Ca / Vc-Cl				
				>10				4	2. J / 70° / Op / Ro / Light Ca / Wi				
				>10				1	3. J / 140° / Op / Sm-Mr / Light Ca / Wi / symp. of #1 (offset by -90°)				
				>10				1					
				>10				2					
5				>10				2					

ROCK CORE: File: COLFOD (HQ3).GPJ; 3/30/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-02A

Sheet 2 of 2

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
24	5	3	4	100	>10	42			1	AMPHIBOLITE 1. J / 60° / Ti-Op / Sm / - / Vc-Cl 2. J / 120° / Ti-Op / Sm / - / Vc-Cl / symp. of #1 (offset by 90°) 3. J / 120° / Ti-Vt / Sm / - / Wi 4. J / 15° / Op-Mw / Sm / Ca-Clay / Wi 5. V / 15° / Op-Mw / Sm / Cl / Mo-Wi			Bentonite seal
	1												
	1												
	3												
	1												
	1												
	4												
	NR												
	1												
	2												
6	4	5	100	5	40			1					
1													
1													
1													
1													
1													
1													
2													
2													
2													
7	22	5	80	3	68			1					
1													
1													
2													
2													
3													
4													
4													
5													
5													
8	20	5	80	3	68			1					
1													
3													
3													
3													
4													
4													
4													
5													
6													
9	10			1				1					
1													
1													
1													
1													
1													
1													
1													
1													
1													
11	11							1					
1													
1													
1													
1													
1													
1													
1													
1													
1													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-02B

Sheet 1 of 2

Supplemental Phase II Environmental Site Assessment CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

DATE(S) DRILLED:	12/7/2016 through 12/8/2016	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	29.37 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,608 E 465,849
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	9.0 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	1.68 metres below grade (12/28/2016)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											SILT, trace clay, trace gravel (angular and rounded), trace sand, very hard, brown, moist			Flushed-mounted roadbox Concrete
1														
28														
2											Small boulder between 2.13m - 2.44m			▽ Bentonite seal
3		1	4	99		0			1		AMPHIBOLITE Rubble			
4					>10				1		AMPHIBOLITE 1. J / 80° / Ti-Po / Mr / Light Fe / Cl-Mo 2. J / 170° / Ti / Sm-Mr / Light Fe / Wi 3. J / 100° / Po-Op / Ro / Moderate Fe / Vc-Cl 4. J / 70° / Po-Op / Mr-Ro / Moderate Fe / Vc-Cl 5. J / 140°-150° / Po-Op / Mr-Ro / Moderate Fe / Vc-Cl			Silica sand
26		2	4	100	>10	0			4					
4					>10				5					
					>10				5					
					>10				3					
					>10				1					
					>10				5		AMPHIBOLITE 1. J / 140° / Op / Sm-Mr / Light Ca / Vc-Cl 2. J / 70° / Op / Ro / Light Ca / Wi 3. J / 140° / Op / Sm-Mr / Light Ca / Wi / symp. of #1 (offset by -90°)			51 mm 0.010 slot sched 40 PVC pipe
					>10				2					
5					>10				2					End cap

ROCK CORE: File: COLFOD (HQ3).GPJ; 3/30/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-03A

Sheet 1 of 3

Supplemental Phase II Environmental Site Assessment CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

DATE(S) DRILLED:	12/8/2016 through 12/9/2016	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	28.58 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,624 E 465,892
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	12.2 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	1.21 metres below grade (12/28/2016)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0									GRAVEL, angular (road base), trace silt (increasing silt content with depth), grey, compact, dry to moist (increasing moisture with depth)			Flush-mounted roadbox	
28									SILT, trace clay, trace gravel (angular and rounded), trace sand, very hard, brown, moist			Concrete	
1												Bentonite seal	
												Silica sand	
												▽	
												51 mm 0.010 slot sched 40 PVC pipe	
26												End cap	
												Silica sand	
3													
4													
24													
5													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-03A

Sheet 2 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
5	1	6	30										
6													
22	2	6	70										
7													
8				>10					1 2 1 1 4 2 5 3 4 2	AMPHIBOLITE 1. J / 35°-45° / Ti-Po / Mr-Ro / Light Ca / Cl 2. J / 100° / Ti-Po / Mr-Ro / Light Ca / Cl / symp. of #1 (offset by -90°) 3. J / 150° / Ti-Po / Mr-Ro / Light Ca / Cl / conj. of #1 (offset by 180°) 4. J / 165°-170° / Ti-Po / Sm-Mr / Heavy Ca-Cl / Cl 5. V / 100° / Ti-Po / He / Qu-Feld / Wi			
20	3	6	70	8	13				NR				
9													
10	4	6	100	1 3 3	33				1 2 1 1 2 1 1 1 2 4 3 3	AMPHIBOLITE 1. J / 110° / Ti-Po / Sm / Light Ca / Vc-Cl 2. J / 35° / Ti-Po / Mr-Ro / Light Ca / Cl-Mo 3. J / 150° / Ti-Po / Sm / Chl-Qu / Mo-Wi / symp. of #1 (offset by 90°) 4. V / 150° / Ti-Po / He / Light Ca / Wi			
18				1									
11				>5 3					1 3 1 1 2 2 2	AMPHIBOLITE 1. J / 40° / Ti-Po / Sm / Light Ca / Cl-Mo 2. J / 55° / Po / Sm / Light Ca / Mo 3. J / 20° / Op / Sm-Mr / Heavy Clay-Ca / Vc			

Bentonite seal

ROCK CORE: File: COLFOD (HQ3).GPJ: 3/30/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-03A

Sheet 3 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number						
		5	7	100	>10	31				1					
					>10					3	LIMESTONE (starting at 11.5m)				
	12				0					3					
					0										
16															
	13														
	14														
14															
	15														
	16														
	12														
	17														

ROCK CORE: File: COLFOD (HQ3).GPJ: 3/30/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-03B

Sheet 1 of 3

Supplemental Phase II Environmental Site Assessment CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

DATE(S) DRILLED:	12/12/2016 through 12/12/2016	AZIMUTH:	00
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	28.44 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,625 E 465,891
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	12.2 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	0.26 metres below grade (12/28/2016)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number						
0															Flush-mounted roadbox Concrete
28															
	1														
	2														
26															Slough
	3														
	4														
24															
	5														Sample ID MW16-03A 4.8m-5.0m

ROCK CORE: File: COLFOD (HQ3).GPJ; 3/30/2017

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Core Log MW16-03B

Sheet 2 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
5													
		1	6	30									
6													Bentonite seal
22													
7		2	6	70									Silica sand
													Sample ID MW16-03B 7.6m-7.9m
													51 mm 0.010 slot sched 40 PVC pipe
8									1	AMPHIBOLITE			
									2	1. J / 35°-45° / Ti-Po / Mr-Ro / Light Ca / Cl			
									1	2. J / 100° / Ti-Po / Mr-Ro / Light Ca / Cl / symp. of #1 (offset by -90°)			
									1	3. J / 150° / Ti-Po / Mr-Ro / Light Ca / Cl / conj. of #1 (offset by 180°)			
									4	4. J / 165°-170° / Ti-Po / Sm-Mr / Heavy Ca-Cl / Cl			
									5	5. V / 100° / Ti-Po / He / Qu-Feld / Wi			
20									3				End cap
		3	6	70	8	13			2				Silica sand
									NR				
9									1	AMPHIBOLITE			
									2	1. J / 110° / Ti-Po / Sm / Light Ca / Vc-Cl			
									1	2. J / 35° / Ti-Po / Mr-Ro / Light Ca / Cl-Mo			
									1	3. J / 150° / Ti-Po / Sm / Chl-Qu / Mo-Wi / symp. of #1 (offset by 90°)			
									2	4. V / 150° / Ti-Po / He / Light Ca / Wi			
									1				
									1				
10									2				
		4	6	100	3	33			1				
									1				
									1				
									3				
18									1				
									3				
									1	AMPHIBOLITE			
									2	1. J / 40° / Ti-Po / Sm / Light Ca / Cl-Mo			
									2	2. J / 55° / Po / Sm / Light Ca / Mo			
									2	3. J / 20° / Op / Sm-Mr / Heavy Clay-Ca / Vc			
11													Bentonite seal

ROCK CORE: File: COLFOD (HQ3).GPJ; 3/30/2017

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Core Log MW16-03B

Sheet 3 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number						
		5	7	100	>10	31				1					
					>10					3					
	12				0					3	LIMESTONE (starting at 11.5m)				
					0										
16															
	13														
	14														
14															
	15														
	16														
12															
	17														

ROCK CORE: File: COLFOD (HQ3).GPJ: 3/30/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-04A

Sheet 1 of 3

Supplemental Phase II Environmental Site Assessment CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

DATE(S) DRILLED:	12/9/2016 through 12/10/2016	AZIMUTH:	200
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	29.80 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,607 E 465,863
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	11.6 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	-0.36 metres below grade (12/28/2016)

Elevation, metres	ROCK CORE									Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											SILT, trace clay, trace sand, hard, brown, moist			Stick Up Monument Concrete
										1	AMPHIBOLITE 1. J / 110° / Po / Sm-Ro / Moderate Fe / Vc-Cl			Bentonite seal
1										1 2 3 4 4	AMPHIBOLITE 1. J / 110° / Po / Ro / Heavy Fe / Cl 2. J / 60° / Po / Mr / Heavy Fe / - 3. J / 160° / Po / Mr / Heavy Fe / Cl 4. J / 160° / Po / Mr / Heavy Fe / - / symp. of #3 (-90° offset) 5. J / 150° / Po / Mr / Heavy Fe / -			Silica sand
2										1 1 1 5				
										NR				
28										1	AMPHIBOLITE 1. Heavily fractured area			25 mm 0.010 slot sched 40 PVC pipe
3														
4										1 1 2	AMPHIBOLITE 1. J / 130° / Ti-Po / Sm-Mr / Heavy Fe / Mo 2. J / 130° / Ti-Po / Sm-Mr / Heavy Fe / - / conj. of #1 (180° offset) 3. J / 70° / Ti-Po / Mr-Ro / Heavy Fe / - / conj. of #4 (180° offset) 4. J / 120° / Ti-Po / Mr-Ro / Heavy Fe / -			End cap Silica sand
										3 4 4				
5														

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-04A

Sheet 2 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
26	5				1					2 4 2				
					3					1 2 2 2 2 3 2 2 4 5 6	AMPHIBOLITE 1. J / 120°-110° / Po-Op / Sm-Mr / Light Fe / - 2. J / 120°-110° / Ti-Po / Sm-Mr / Light-Moderate Fe / - / symp. of #2 (-90° offset) 3. J / 40° / Po-Op / Sm-Mr / Light-Moderate Fe / - 4. J / 170° / Po / Sm-Mr / Light Ca / Wi 5. J / 80° / Ti-Po / Sm-Mr / Light-Moderate Fe / - / conj. of #2 (180° offset) 6. J / 40° / Ti-Po / Mr / Heavy Fe / Wi			
	6	5	9	100	4	80				1 2 2 3 2 2 3 2 4 5 6				
					2					1				
	7				1					1	AMPHIBOLITE 1. J / 160° / Ti / Sm / Light Ca-Chl / Wi 2. J / 110° / Ti-Op / Sm-Mr / Heavy Ca-Chl / Cl 3. J / 30° / Ti-Op / Sm-Mr / Heavy Ca-Chl / Cl-Wi / conj. of #2 (180° offset) 4. J / 180° / Ti-Po / Sm-Ro / Heavy Chl-Clayey / Cl			
					>10					2 2 3				
		6	9	100	>10	30				4				Bentonite seal
24	8				>10					3 3 2 1				
					>10					1	AMPHIBOLITE 1. J / 180°-160° / Ti-Po / Sm / Heavy Chl-Clayey / Wi			
	9				2					1 1 1				
					2					1				
		7	9	100	0	80								
					0									
					0									
	10				0					1	AMPHIBOLITE 1. J / 145° / Ti / Sm / Light Ca / Wi 2. J / 45° / Po / Sm-Mr / Light Ca / Mo 3. J / 160° / Ti-Po / Sm-Ro / Light Ca (clayey in some locations) / Mo			
					1					2				
					3					3 3 2 1				
		8	10	100	3	83								
					3									
22	11									3				

ROCK CORE: File: COLFOD (HQ3).GPJ; 3/30/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-04A

Sheet 3 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
				>10				3					
				1									
12													
13													
20													
14													
15													
16													
18													
17													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-04B

Sheet 1 of 3

Supplemental Phase II Environmental Site Assessment CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

DATE(S) DRILLED:	12/9/2016 through 12/10/2016	AZIMUTH:	200
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	29.80 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,607 E 465,863
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	11.6 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	-0.37 metres below grade (12/28/2016)

Elevation, metres	ROCK CORE									Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number	Fracture Frequency					
0											SILT, trace clay, trace sand, hard, brown, moist			Stick Up Monument Concrete
1	1	8	60	4	0					1 1 1	AMPHIBOLITE 1. J / 110° / Po / Sm-Ro / Moderate Fe / Vc-Cl			
2	2	8	100	>10	0					1 2 2 3 4 4 3 1 1 1 5	AMPHIBOLITE 1. J / 110° / Po / Ro / Heavy Fe / Cl 2. J / 60° / Po / Mr / Heavy Fe / - 3. J / 160° / Po / Mr / Heavy Fe / Cl 4. J / 160° / Po / Mr / Heavy Fe / - / symp. of #3 (-90° offset) 5. J / 150° / Po / Mr / Heavy Fe / -			
28				>10						NR	AMPHIBOLITE 1. Heavily fractured area			Bentonite seal
3	3	8	100	>10	0									
4				>10										
4	4	8	100	4						1 1 2	AMPHIBOLITE 1. J / 130° / Ti-Po / Sm-Mr / Heavy Fe / Mo 2. J / 130° / Ti-Po / Sm-Mr / Heavy Fe / - / conj. of #1 (180° offset) 3. J / 70° / Ti-Po / Mr-Ro / Heavy Fe / - / conj. of #4 (180° offset) 4. J / 120° / Ti-Po / Mr-Ro / Heavy Fe / -			
5				5	62					3 4 4				

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-04B

Sheet 2 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
26	5				1				2	AMPHIBOLITE 1. J / 120°-110° / Po-Op / Sm-Mr / Light Fe / - 2. J / 120°-110° / Ti-Po / Sm-Mr / Light-Moderate Fe / - / symp. of #2 (-90° offset) 3. J / 40° / Po-Op / Sm-Mr / Light-Moderate Fe / - 4. J / 170° / Po / Sm-Mr / Light Ca / Wi 5. J / 80° / Ti-Po / Sm-Mr / Light-Moderate Fe / - / conj. of #2 (180° offset) 6. J / 40° / Ti-Po / Mr / Heavy Fe / Wi			Silica sand 25 mm 0.010 slot sched 40 PVC pipe End cap Silica sand
				3				2					
				2				1					
				3				2					
				4				2					
			5	9	100	80		3					
				2				2					
				1				3					
								5					
								6					
24	7				1				1	AMPHIBOLITE 1. J / 160° / Ti / Sm / Light Ca-Chl / Wi 2. J / 110° / Ti-Op / Sm-Mr / Heavy Ca-Chl / Cl 3. J / 30° / Ti-Op / Sm-Mr / Heavy Ca-Chl / Cl-Wi / conj. of #2 (180° offset) 4. J / 180° / Ti-Po / Sm-Ro / Heavy Chl-Clayey / Cl			Bentonite seal
				>10				2					
				>10				2					
				>10				3					
			6	9	100	30		4					
				>10				3					
				>10				3					
				>10				2					
								1					
								1					
22	9				2				1	AMPHIBOLITE 1. J / 180°-160° / Ti-Po / Sm / Heavy Chl-Clayey / Wi			Bentonite seal
				2				1					
				2				1					
			7	9	100	80		0					
				0				0					
				0				0					
				1				1					
				3				2					
								3					
								2					
11	10				0				1	AMPHIBOLITE 1. J / 145° / Ti / Sm / Light Ca / Wi 2. J / 45° / Po / Sm-Mr / Light Ca / Mo 3. J / 160° / Ti-Po / Sm-Ro / Light Ca (clayey in some locations) / Mo			Bentonite seal
				1				2					
				3				3					
				3				2					
			8	10	100	83		1					
				3				3					
								2					
								1					
								3					
								3					

ROCK CORE: File: COLFOD (HQ3).GPJ: 3/30/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-04B

Sheet 3 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
				>10				3					
				1									
12													
13													
20													
14													
15													
16													
18													
17													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-05A

Sheet 1 of 3

Supplemental Phase II Environmental Site Assessment CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

DATE(S) DRILLED:	12/10/2016 through 12/12/2016	AZIMUTH:	106
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	31.99 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,621 E 465,908
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	12.2 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	4.96 metres below grade (12/28/2016)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0									SILT, trace clay, trace gravel (angular and rounded) trace sand, hard, brown, moist			Stick Up Monument Concrete	
1	1	11	100										
2	2	11	95	1 0	77			1 1	LIMESTONE 1. J / 130° / Ti-Po / Mr-Ro / Light Fe / Cl-Wi 2. J / 60° / Ti / Mr-Ro / Light Fe / Wi / conj. of 1 (180° around VCA)			Bentonite seal	
3	3	11	100	2 1 0	87			1 2 1 1 1 1 1	LIMESTONE 1. J / 50° / Ti-Po / Ro / Light Fe / Vc-Cl 2. J / 130° / Ti-Po / Mr / Light Fe / Vc-VI / symp. of 1 (-90° around VCA)				
4				3 1				1 1 1	LIMESTONE 1. J / 60° / Ti-Po / Ro / Light Fe / Cl-Mc 2. J / 80° / Ti-Po / Ro / Light Fe / Wi / symp. of 1 (-90° around VCA) 3. J / 50° / Ti-Po / Mr-Ro / Light Fe / Cl / symp. of 4 (90°			Silica sand	
5				2				1					

ROCK CORE: File: COLFOD (HQ3).GPJ: 3/30/2017

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Core Log MW16-05A

Sheet 2 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
28	5				4				3	around VCA)			
	4	11	95	3	63			1	4. V / 30° / Ti-Po / Sm-Mr / Light Fe / Wi / almost vertical feature				
				2				4	5. J / 20°-120° / Po / Mr / Light Fe / Wi / undulating feature				
				2				5					
				2				1					
				2				1					
				3				NR	LIMESTONE				
				1				4	1. J / 140° / Ti-Po / Sm-Mr / Light/moderate Fe / Vc-Cl				
				2				4	2. J / 130° / Ti-Po / Sm-Mr / Light/moderate Fe / Wi / symp. of 1 (-90° around VCA)				
				2				4	3. J / 40° / Ti-Po / Mr-Ro / Moderate/heavy Fe / Wi / symp. of 4 (-90° around VCA)				
26	7	5	12	100	62			3	4. J / 20° / Ti-Po / Mr-Ro / Moderate/heavy Fe / Vc-Cl		End cap Silica sand		
				3				1					
				2				1					
				3				1					
				2				2					
				1				1	LIMESTONE				
				>10				1	1. J / 140° / Ti-Po / Mr / Light Chl-Spotted Fe / -				
				4				2	2. J / 165° / Ti-Po / Sm-Mr / Light Fe-Fine material / Vc				
				>10				3	3. J / 20° / Ti-Po / Mr / Spotted Ca / -				
				4				1	4. J / 50° / Op (Rubble) / Mr-Ro / Light Fe / -				
11	8	6	12	83	52			1	5. Rubble zone		Bentonite seal		
				4				2					
				4				3					
				1				1					
				1				4					
				2				1	LIMESTONE				
				1				1	1. J / 60°-70° / Ti-Op / Sm-Mr / Light Ca / Cl				
				2				1					
				1				1					
				0				NR					
11	10	7	12	95	65			1					
				1				1					
				2				R	LIMESTONE				
			>10					1	1. J / 60° / Ti-Po / Sm-Mr / Light Fe-Chl-Ca / Cl				
								2	2. J / 20°-60° / Ti-Po / Sm-Mr / Heavy fine material / Vc				
								3	3. Rubble zone				

ROCK CORE: File: COLFOD (HQ3).GPJ: 3/30/2017

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Core Log MW16-05A

Sheet 3 of 3

**Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC**



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
24		8	13	85	1 ----- >10	57				1 2 R 2 1 NR				
12					1 ----- 1									
13														
14														
22														
15														
16														
20	17													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-05B

Sheet 1 of 3

Supplemental Phase II Environmental Site Assessment CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

DATE(S) DRILLED:	12/10/2016 through 12/12/2016	AZIMUTH:	106
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	31.99 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,621 E 465,908
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	12.2 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	4.91 metres below grade (12/28/2016)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0										SILT, trace clay, trace gravel (angular and rounded) trace sand, hard, brown, moist			Stick Up Monument Concrete
1													
2	2	11	95	1 0 0	77		1 1			LIMESTONE 1. J / 130° / Ti-Po / Mr-Ro / Light Fe / Cl-Wi 2. J / 60° / Ti / Mr-Ro / Light Fe / Wi / conj. of 1 (180° around VCA)			
30													
3				2			2			LIMESTONE 1. J / 50° / Ti-Po / Ro / Light Fe / Vc-Cl 2. J / 130° / Ti-Po / Mr / Light Fe / Vc-VI / symp. of 1 (-90° around VCA)			
4	3	11	100	0 3 3 1	87		1 1 1 1 1 1						
5				2			1 1 1			LIMESTONE 1. J / 60° / Ti-Po / Ro / Light Fe / Cl-Mc 2. J / 80° / Ti-Po / Ro / Light Fe / Wi / symp. of 1 (-90° around VCA) 3. J / 50° / Ti-Po / Mr-Ro / Light Fe / Cl / symp. of 4 (90°			Bentonite seal

ROCK CORE: File: COLFOD (HQ3).GPJ: 3/30/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-05B

Sheet 2 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
28	5				4				3	around VCA			
		4	11	95	3	63			1	4. V / 30° / Ti-Po / Sm-Mr / Light Fe / Wi / almost vertical feature			
					2				4	5. J / 20°-120° / Po / Mr / Light Fe / Wi / undulating feature			
					2				5				
					1				1				
					2				1				
					3				NR	LIMESTONE			
					1				4	1. J / 140° / Ti-Po / Sm-Mr / Light/moderate Fe / Vc-Cl			
					2				4	2. J / 130° / Ti-Po / Sm-Mr / Light/moderate Fe / Wi / symp. of 1 (-90° around VCA)			
					1				4	3. J / 40° / Ti-Po / Mr-Ro / Moderate/heavy Fe / Wi / symp. of 4 (-90° around VCA)			
26	7	5	12	100	2	62			3	4. J / 20° / Ti-Po / Mr-Ro / Moderate/heavy Fe / Vc-Cl			
					3				1				
					2				1				
					1				1				
					>10				2	LIMESTONE			
					1				1	1. J / 140° / Ti-Po / Mr / Light Chl-Spotted Fe / -			
					4	52			1	2. J / 165° / Ti-Po / Sm-Mr / Light Fe-Fine material / Vc			
					>10				1	3. J / 20° / Ti-Po / Mr / Spotted Ca / -			
					2				4	4. J / 50° / Op (Rubble) / Mr-Ro / Light Fe / -			
					4				1	5. Rubble zone			
11	9	6	12	83	4	52			2				
					1				3				
					1				1				
					4				4				
					>10				1	LIMESTONE			
					2				1	1. J / 60°-70° / Ti-Op / Sm-Mr / Light Ca / Cl			
					1				1				
					0	65			1				
					1				NR				
					2				R	LIMESTONE			
				>10					1. J / 60° / Ti-Po / Sm-Mr / Light Fe-Chl-Ca / Cl				
									2. J / 20°-60° / Ti-Po / Sm-Mr / Heavy fine material / Vc				
									3. Rubble zone				
												Silica sand	
												25 mm 0.010 slot sched 40 PVC pipe	

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Core Log MW16-05B

Sheet 3 of 3

Supplemental Phase II Environmental Site Assessment
CFB Esquimalt, Colwood, BC



Project No. 205.03843.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
24	8	13	85	1 ----- >10	57			1 2 R 2 1 NR					
12				1 ----- 1									End cap
13													
14													
22													
15													
16													
20	17												



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-01** UTM COORDINATES
 5365645.77 N
 SURFACE ELEVATION: 27.46 m 465906.26 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
-1					Ground Surface								
0					SILT (topsoil), some sand, very soft, black, wet, some roots/rootlets								
					SAND coarse sand, some silt, very loose, grey, wet							concrete seal steel casing, stickup, plug silica sand	
1					SILT some fine-medium sand, trace clay, soft (increasing to firm), light brown with dark brown mottling, wet (decreasing to moist)								
2		MW17-01A											
3					sandy SILT medium-coarse sand, some gravel, firm-hard, light brown, moist							bentonite seal	
4					clayey SILT trace sand, soft (increasing to firm), grey, moist (increasing to wet)							silica sand	
5												50 mm 010 slot PVC pipe	
6		MW17-01B			gravelly SILT (till-like), hard, grey, wet							slotted PVC cap	
7					BEDROCK Limestone							bentonite seal	
7.6					End of borehole at 7.6 m								
					Well completion details: Screened interval from 4.6 - 6.1 m below surface								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 23, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-01** UTM COORDINATES
 SURFACE ELEVATION: 27.46 m 5365645.77 N
 465906.26 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
					Elevation at top of casing (TOC) = 28.18 m Equipment used to drill at this location: Boart Longyear 33K								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 23, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-02** UTM COORDINATES
 SURFACE ELEVATION: **26.53 m** 5365635.88 N
 465884.55 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
-1					Ground Surface								
0					SAND coarse sand, trace gravel, loose, grey, wet								26
0.5					SILT trace sand, hard, light grey, dry								27
1.5					sandy SILT fine-medium sand, trace gravel, firm, light brown, dry to moist								28
2.5					SILT some fine-medium sand, trace gravel, hard, brown, dry to moist								29
3.7					@ 3.7 m: trace clay, firm, medium plasticity, grey, moist								30
5.5					clayey SILT some sand, soft to very soft, grey, wet								31
6													32
7													33
8													34

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 24, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-02** UTM COORDINATES
 SURFACE ELEVATION: **26.53 m** 5365635.88 N
 465884.55 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
9													
10													
11													
12					SAND coarse sand, trace gravel, loose, brown, wet								
13					SILT (till-like), some sand, some rounded-subrounded gravel (increasing to gravelly), firm, moist to wet								
14		MW17-02C											
15					BEDROCK Amphibolite								
End of borehole at 15.2 m													
Well completion details for nested monitoring wells:													
MW17-02A Screened interval from 3.7 - 5.2 m below surface Elevation at top of casing (TOC) = 27.15 m													
MW17-02B Screened interval from 12.2 - 13.7 m below surface Elevation at top of casing (TOC) = 27.16 m													
Equipment used to drill at this location: Boart Longyear 33K													

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)

Notes: SONIC CORE SAMPLE

DRILL DATE: January 24, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-04** UTM COORDINATES
 SURFACE ELEVATION: **26.17 m** 5365632.89 N
 465874.13 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
-1													25
					Ground Surface								26
0					SILT (topsoil), amorphous, very soft, black, wet, some roots/rootlets								
					SAND coarse sand, loose, grey, moist to wet								
1					SILT some sand, trace gravel, firm, light brown, dry to moist, light hydrocarbon odour								27
		MW17-04A											
2													28
3													29
4					clayey SILT firm (decreasing to soft), medium plasticity, grey, moist to wet								30
		MW17-04B											
5													31
6					@ 5.8m: trace sand, very soft, wet								32
7													33
8													

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 24, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-04** UTM COORDINATES
 SURFACE ELEVATION: **26.17 m** 5365632.89 N
 465874.13 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
9													
10													
11		MW17-04C and MW17-04D			gravelly SILT (till-like), rounded-subrounded gravel, some sand, firm, grey, wet								
12					BEDROCK BEDROCK (amphibolite)								
End of borehole at 12.2 m													
Well completion details for nested monitoring wells:													
MW17-04A Screened interval from 3.7 - 5.2 m below surface Elevation at top of casing (TOC) = 26.92 m													
MW17-04B Screened interval from 9.4 - 11.0 m below surface Elevation at top of casing (TOC) = 26.96 m													
Equipment used to drill at this location: Boart Longyear 33K													

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)

Notes: SONIC CORE SAMPLE

DRILL DATE: January 24, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **BH17-05** UTM COORDINATES
 SURFACE ELEVATION: **26.70 m** 5365655.06 N
 465918.89 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				BOREHOLE COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
0					silty SAND loose, grey, wet							silica sand	
0.5					SILT trace subrounded gravel, trace fine-medium sand, soft (increasing to firm), light brown, dry to moist								
2.5		BH17-05D			sandy SILT fine-medium sand,, firm, light brown, moist								
3.5					SILT some fine-medium sand, firm to hard, light brown, moist								
4.5					clayey SILT firm (decreasing to soft), medium plasticity, grey, moist (increasing to wet)								
6.5		BH17-05C			gravelly SILT (till-like), trace sand, hard, grey, wet								
7.0					BEDROCK Limestone								
7.6					End of borehole at 7.6 m								
Equipment used to drill at this location: Boart Longyear 33K													

SLR CANADA V5.2 COLFOD (SONIC),GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 25, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **BH17-07** UTM COORDINATES
 SURFACE ELEVATION: **26.15 m** 5365666.85 N
 465915.16 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				BOREHOLE COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
0.0 - 1.0					SILT some sand, trace gravel, hard, light brown, moist							silica sand	27
1.0 - 2.0					sandy SILT trace gravel, firm, light brown, dry to moist								28
2.0 - 3.7		BH17-07A			SILT trace sand, hard, light brown, dry to moist				25				29
3.7 - 4.0					@ 3.7 m: some clay, trace sand, soft, medium plasticity, grey, moist								30
4.0 - 4.5		BH17-07B											31
4.5 - 6.4					@ 6.4m: increasing to sandy, very soft, wet								32
6.4 - 9.0												bentonite seal	33
9.0 - 9.5					gravelly SILT								34
9.5 - 9.8													35

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 25, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **BH17-07** UTM COORDINATES
 SURFACE ELEVATION: 26.15 m 5365666.85 N
 465915.16 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				BOREHOLE COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
0					(till-like) rounded-subrounded gravel, some sand, hard, grey, wet								
11		BH17-07C			BEDROCK Limestone								
11.6					End of borehole at 11.6 m								
					Equipment used to drill at this location: Boart Longyear 33K								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 25, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-09** UTM COORDINATES
 5365649.85 N
 SURFACE ELEVATION: 26.13 m 465881.8 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
-1													25
0					Ground Surface								26
0					SILT (topsoil), some clay, soft, dark brown, wet								26
0					SILT some sand, trace clay, trace angular-subrounded gravel, firm to hard, light brown, moist								27
1													27
2		MW17-09A			sandy SILT fine-medium sand, soft, light grey, moist to wet			45					28
2		MW17-09B			SILT some fine-medium sand, firm, medium plasticity, light brown, moist								29
3													29
4		MW17-09C			clayey SILT soft, medium plasticity, grey, wet								30
4													30
5													31
6													32
7													33
8													33

SLR CANADA V5.2 COLFOD (SONIC),GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)

Notes: SONIC CORE SAMPLE

DRILL DATE: January 25, 2017 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-09** UTM COORDINATES
 SURFACE ELEVATION: **26.13 m** 5365649.85 N
 465881.8 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
9													
10					sandy SILT fine-medium sand, soft, grey, wet								
11					clayey SILT soft, medium plasticity, grey, wet								silica sand
12		MW17-09D			sandy SILT fine-medium sand, soft, grey, wet								
13					clayey SILT soft, medium plasticity, grey, wet								bentonite seal
14													silica sand
15		MW17-09E			silty SAND (till-like), medium-coarse sand, some rounded-subrounded gravel, compact, grey, wet								50 mm 010 slot PVC pipe
16					sandy SILT (till-like), medium-coarse sand, firm, grey, wet								slotted PVC cap
17					BEDROCK Amphibolite								bentonite seal
					End of borehole at 17.4 m								
					Well completion details: Screened interval from 14.6 - 16.2 m below surface Elevation at top of casing (TOC) = 26.77 m								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 25, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-09** UTM COORDINATES
 SURFACE ELEVATION: **26.13 m** 5365649.85 N
 465881.8 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
					Equipment used to drill at this location: Boart Longyear 33K								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 25, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **BH17-10** UTM COORDINATES
 SURFACE ELEVATION: **25.99 m** 5364642.92 N
 465870.59 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				BOREHOLE COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
0					SAND coarse sand, loose, grey, moist								
0.5					SILT some medium-coarse sand, some gravel, soft, dark brown, moist			65					silica sand
1.2					sandy SILT coarse sand, firm to hard, grey, moist								27
1.2					@ 1.2 m: fine-medium sand, trace angular-subangular gravel, hard, light brown, dry								
2.0		BH17-10C						5					28
3.0													29
4.0		BH17-10D			SILT some sand, trace clay, firm (decreasing to soft), grey, moist (increasing to wet)								30
5.0													31
5.8					@ 5.8m: increasing clay content to some, decreasing sand content to trace								32
7.0													33
7.3					@ 7.3m: increasing clay content to clayey								34
7.5													bentonite seal

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 26, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **BH17-10** UTM COORDINATES
 SURFACE ELEVATION: **25.99 m** 5364642.92 N
 465870.59 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				BOREHOLE COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
11		BH17-10E			SAND and GRAVEL coarse sand, trace silt, compact, grey, moist								
12					sandy SILT (till-like), some rounded-subrounded gravel, firm, grey, moist to wet								
13					BEDROCK Amphibolite								
					End of borehole at 13.1 m								
					Equipment used to drill at this location: Boart Longyear 33K								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)

Notes: SONIC CORE SAMPLE

DRILL DATE: January 26, 2017 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-11** UTM COORDINATES
 5365649.11 N
 SURFACE ELEVATION: **26.26 m** 465886.89 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
-1													
0					Ground Surface								
0					sandy SILT medium-coarse sand, trace subangular gravel, firm, light brown-grey, moist							steel casing, stickup, jplug GW = 26.24 m (14-Feb-2017) concrete seal	
1	■	MW17-11A										silica sand	
2													
3	■	MW17-11B			SILT some coarse sand, some gravel, hard, light brown, dry							bentonite seal	
4	■	MW17-11C			@ 3.4 m: some sand, some clay, soft, grey, moist (increasing to wet)								
5												silica sand	
6					gravelly SILT rounded-subrounded gravel, some coarse sand, firm, grey, wet							50 mm 010 slot PVC pipe	
6					BEDROCK Amphibolite							slotted PVC cap	
6.7					End of borehole at 6.7 m							bentonite seal	
					Well completion details: Screened interval from 4.3 - 5.8 m below surface Elevation at top of casing (TOC) = 27.02 m Equipment used to drill at this location: Boart Longyear 33K								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 26, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: ■ SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **BH17-12** UTM COORDINATES
 SURFACE ELEVATION: **26.30 m** 5365632.89 N
 465844.84 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				BOREHOLE COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
0 to 2.5	■	BH17-12A			SILT some medium-coarse sand, some gravel, hard, light brown, dry (increasing to moist)							silica sand	
2.5 to 3.5	■	BH17-12B			SILT trace clay, trace sand, soft, grey, wet							bentonite seal	
3.5 to 5.1	■	BH17-12C			gravelly SILT (till-like), rounded-subrounded gravel, some coarse sand, firm, grey, wet								
5.1 to 6.1					BEDROCK Amphibolite								
End of borehole at 6.1 m													
Equipment used to drill at this location: Boart Longyear 33K													

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 26, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-13** UTM COORDINATES
 5365635.4 N
 SURFACE ELEVATION: **26.47 m** 465859.19 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
-1												steel casing, stickup, jplug	
0					Ground Surface							(14-Feb-2017 MW17-13B)	
0					SILT some fine-medium sand, hard, light brown, dry to moist							GW = 26.36 m (14-Feb-2017 MW17-13A) concrete seal	
1		MW17-13A										bentonite seal	
1.5												silica sand	
2.5												MW17-13A 25 mm 010 slot PVC pipe	
3					BOULDER Limestone							slotted PVC cap silica sand	
4		MW17-13B			SILT some medium-coarse sand, some clay, soft, grey, wet							bentonite seal	
4.5												silica sand	
5.5												MW17-13B 25 mm 010 slot PVC pipe	
6					SILT (till-like), some subrounded gravel, trace sand, firm, grey, wet							slotted PVC cap silica sand	
6.5					BEDROCK Amphibolite								
7												bentonite seal	
7.6					End of borehole at 7.6 m								
					Well completion details for nested monitoring wells:								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 27, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-13** UTM COORDINATES
 SURFACE ELEVATION: **26.47 m** 5365635.4 N
 465859.19 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
					MW17-13A Screened interval from 1.5 - 3.0 m below surface Elevation at top of casing (TOC) = 27.35 m MW17-13B Screened interval from 4.6 - 6.1 m below surface Elevation at top of casing (TOC) = 27.39 m Equipment used to drill at this location: Boart Longyear 33K								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 27, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **MW17-15** UTM COORDINATES
 SURFACE ELEVATION: **26.41 m** 5365621.15 N
 465854.68 E

SLR CONSULTING (CANADA) LTD.

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
-1													
0					Ground Surface								
0.1					SAND coarse sand, trace gravel, loose, wet								steel casing, stickup, plug GW = 26.89 m (14-Feb-2017 MW17-15B)
0.2					SILT some sand, some gravel, firm, light brown, moist								GW = 26.31 m (14-Feb-2017 MW17-15A) concrete seal
0.5													bentonite seal
1.1													silica sand
1.6													MW17-15A 25 mm 010 slot PVC pipe
2.6		MW17-15A			sandy SILT medium-coarse sand, soft, light brown, wet								slotted PVC cap silica sand
3.6													bentonite seal
4.1		MW17-15B			SILT some sand, trace clay, soft, grey, wet								silica sand
5.1													MW17-15B 25 mm 010 slot PVC pipe
5.6					gravelly SILT subrounded gravel, some medium-coarse sand, compact, grey, wet								slotted PVC cap silica sand
6.1					BEDROCK Amphibolite								bentonite seal
6.1					End of borehole at 6.1 m								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 27, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE



CLIENT: **PSPC**
 PROJECT: **Supplemental Phase II ESA**
 ADDRESS: **CFB Esquimalt, COL FOD, Victoria, BC**
 SLR JOB NO: **205.03850.00000**

BOREHOLE LOG

BOREHOLE NO: **BH17-16** UTM COORDINATES
 SURFACE ELEVATION: **32.74 m** 5365628.57 N
 465923.89 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	SPT COUNT	SOIL TYPE	SOIL DESCRIPTION	FIELD TEST DATA				BOREHOLE COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
						ORGANIC VAPOUR LEVEL (ppmv)							
						1	10	100	1000				
0.0 - 0.5				SILT	(topsoil), some sand, soft, black, wet								
0.5 - 1.0				SILT	some fine-medium sand, trace gravel, hard, light brown, dry								
1.0 - 4.0		BH17-16A											
4.0 - 4.5				SAND and GRAVEL	medium-coarse sand, subangular gravel, loose, grey, moist								
4.5 - 6.1		BH17-16B		BEDROCK	Amphibolite								
6.1 - 6.1					End of borehole at 6.1 m								
					Equipment used to drill at this location: Boart Longyear 33K								

SLR CANADA V5.2 COLFOD (SONIC).GPJ SLR_CAN V5.2.GDT 5/14/17

DRILLING METHOD: SONIC
 BOREHOLE DIAMETER: .1 m (OD)
 DRILL DATE: January 27, 2017
 LOGGED BY: RAP
 DRILLER NAME: Blue Max Drilling Inc.

Notes: SONIC CORE SAMPLE

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log BH17-26

Sheet 1 of 4

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	3/16/2017 through 3/16/2017	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	46.41 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,560 E 465,864
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	18.1 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0														
46										SAND and GRAVEL, angular gravel, some silt, loose, moist, grey-brown				
										No recovery from 0.4 m to 3.1 m			soil cuttings	
1														
2														
44														
3										SAND and GRAVEL, angular-rounded gravel, some silt, loose, moist, grey-brown				
										SILT, trace clay, olive green with brown mottling, soft-firm				
4														
42										No recovery from 4.2 m to 4.6 m				
										SAND and GRAVEL, trace silt, loose, grey, moist				
5														

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log BH17-26

Sheet 2 of 4

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
5										SILT, trace clay, occasional rounded gravel, soft-firm, brown, moist			
6										LIMESTONE (Weathered)			
7		1	A4	60	>10	0			R	LIMESTONE R. Rubble (Heavily fractured, Light Fe)			
8		2 3	A4	100	>10	43			R 1 1 2 2 1 R	LIMESTONE R. Rubble 1. J / 10°-20° / Ti-Po / Sm-Mr / Light Fe/Ca 2. J / 150°-160° / Ti-Po / Sm-Mr / Light Fe/Ca / conj. of #1 (offset of 180° VCA)			
9					>10				R	LIMESTONE R. Rubble 1. J / 110° / Po-Op / Sm / Light Fe/Ca 2. J / 160° / Op / Sm-Ro / Light Fe/Ca 3. J / 20° / Op / Sm-Ro / Light Fe/Ca 4. J / 20° / Op / Sm-Ro / Light Fe/Ca			
10		4	A4	100	2 0 3	83			2 3 4				bentonite seal
11					>10	0			1 3	LIMESTONE R. Rubble 1. J / 160° / Ti / Sm-Mr / Light Fe/Ca 2. J / 40° / Vt-Ti / Sm-Mr / Light Fe/Ca 3. J / 140° / Op / Sm-Mr / Light Fe/Ca			

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017



Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
34	5	A5	93	>10	47				2	LIMESTONE R. Rubble 1. J / 30° / Ti / Mr / Light Fe/Ca 2. J / 20°-0° / Ti / Mr / Light Fe/Ca 3. J / 30° / Ti / Mr-Ro / Light Fe/Ca				
				>10					R					
	12			>10					1					
				>10					2					
13	6	A5	100	3	17				2	LIMESTONE R. Rubble 1. J / 170° / Po-Op / Sm / Light Fe/Ca 2. J / 40° / Ti-Po / Sm / Light Fe/Ca				
				2					3					
				>10					R					
				>10					1					
32	7	A5	100	>10	0				R	LIMESTONE R. Rubble 1. J / 30° / Po / Sm / Light Fe/Ca 2. J / 30° / Po / Sm / Light Fe/Ca				
				>10										
	15			>10					1					
				3					2					
30	8	A6	100	1	82				2	LIMESTONE R. Rubble 1. J / 30° / Po / Sm / Light Fe/Ca 2. J / 30° / Po / Sm / Light Fe/Ca				
				>10					R					
	16			3					2					
				0										
17				3					2	LIMESTONE R. Rubble 1. J / 30° / Po / Sm / Light Fe/Ca 2. J / 30° / Po / Sm / Light Fe/Ca				
				0										

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log BH17-26

Sheet 4 of 4

**Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC**



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
		9	A6	92	0	87			1 2				
	18				>10								
	28				0								
	19												
	20												
	26												
	21												
	22												
	24												
	23												

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-01A

Sheet 2 of 3

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
26	5	3	1	90									
	6	4	2	100									
	7	5	2	105		0							
	8	6	2	80	>10	0			1. J / 20° / Op / Mr / Heavy Chl / Wi 2. J / 110° / Op / Ro / Spotted Chl / Vc 3. J / 155° / Op / Mr / Heavy Chl / Wi / Conj. of 1 (offset by 90°) 4. J / 110° / Op / Ro / Spotted Chl / Wi / Symp. of 2 (offset by 90°) 5. V / 155° / Op / He / Qu/Feld / Wi No recovery from 8.5 m to 8.8 m				
	9	7	2	80	>10	0			1. Rubble 2. J / 130° / Op / Ro / Spotted Fe / Wi 3. J / 150° / Op-Rubble / Mr / Trace Ca / Cl-Vc / Conj. of 2 4. J / 0° / Po-Rubble / He / Qu-Bi-Ca / Wi / Symp. of 2 5. J / 170° / Po / - / Spotted Fe / Vc 6. V / 45° / Op / - / Spotted Fe / Vc / Symp. of 5 (offset by 90°) No recovery from 10.0 m to 10.4 m			Bentonite seal	
	10	7	2	80	>10	0			1. Rubble 2. J / 0° / Op-Rubble / He / Qu / Wi 3. J / 45° / Op-Rubble / Mr / Qu / Mo / Conj. of 1 No recovery from 11.4 m to 11.9 m				
	11				>10								

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-01A

Sheet 3 of 3

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
20	12	8	2	70	>10	0			3	AMPHIBOLITE 1. Rubble 2. J / 10° / Op-Mw / Mr / Qu / Mo / Conj. of 2 3. J / 100° / Po-Op / Ro / Heavy Fe / Mo 4. J / 100° / Po-Op / Ro / Heavy Fe / Vc-Vw / Symp. of 2 (offset by 90°) 5. J / 150° / Po-Op / Sm / Light Clay-Chl / Vc-Vw / Symp. of 2 (offset by -90°) 6. V / 50° / Om-Mw / He / Chl-Feld-Qu / Wi-Vw				
								1						
	13	9	3	100	>10	38			3					
					>10				2					
18	14				3				4	AMPHIBOLITE 1. Rubble 2. J / 55° / Op-Rubble / Mr / Light Ca / Wi 3. J / 110° / Op / Ro / Spotted Fe-Ca / - 4. J / 140° / Op-Rubble / Ro / Heavy Fe / - 5. J / 65° / Op / Ro / Heavy Fe / Vc-Cl 6. V / 45° / He / Ro / Heavy Fe-Trace Silt / - No recovery from 14.5 m to end of core				
					2				5					
	15	10	3	73	3	43			4					
					3				5					
16	16													
17														

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-01B

Sheet 1 of 3

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	12/6/2016 through 12/7/2016	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	31.98 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,610 E 465,890
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	14.9 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	1.88 metres below grade (12/28/2016)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											GRAVEL, angular (road base), trace silt (increasing silt content with depth), grey, compact, dry to moist (increasing moisture with depth)			Flush-mounted roadbox Concrete
											SILT, trace clay, trace gravel (angular and rounded), trace sand, very hard, brown, moist			
30	2	1	1	38										Sample ID MW16-01A 2.1m-2.6m
	3													Bentonite seal
28	4	2	1	18										
	5													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-01B

Sheet 2 of 3

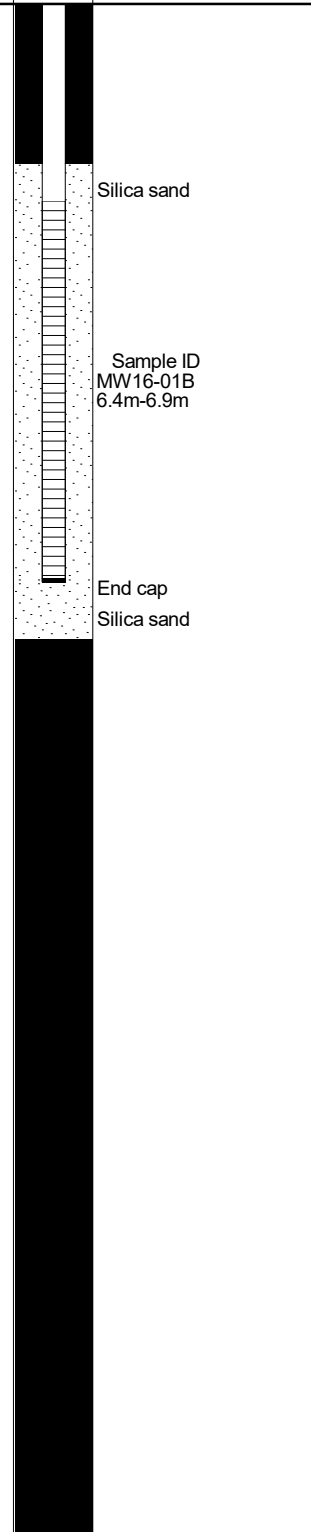
Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
26	5	3	1	90									
	6												
	7	4	2	100									
	8	5	2	105		0							
24	8	6	2	80	>10	0		1	AMPHIBOLITE 1. J / 20° / Op / Mr / Heavy Chl / Wi AMPHIBOLITE 2. J / 110° / Op / Ro / Spotted Chl / Vc 3. J / 155° / Op / Mr / Heavy Chl / Wi / Conj. of 1 4. J / 110° / Op / Ro / Spotted Chl / Wi / Symp. of 2 (offset by 90°) 5. V / 155° / Op / He / Qu/Feld / Wi No recovery from 8.5 m to 8.8 m				
	9				>10			2					
	10	7	2	80	>10	0		6	AMPHIBOLITE 1. Rubble 2. J / 130° / Op / Ro / Spotted Fe / Wi 3. J / 150° / Op-Rubble / Mr / Trace Ca / Cl-Vc / Conj. of 2 4. J / 0° / Po-Rubble / He / Qu-Bi-Ca / Wi / Symp. of 2 5. J / 170° / Po / - / Spotted Fe / Vc 6. V / 45° / Op / - / Spotted Fe / Vc / Symp. of 5 (offset by 90°) No recovery from 10.0 m to 10.4 m				
22	10				>10			4					
	11				>10			6	AMPHIBOLITE 1. Rubble 2. J / 0° / Op-Rubble / He / Qu / Wi 3. J / 45° / Op-Rubble / Mr / Qu / Mo / Conj. of 1 No recovery from 11.4 m to 11.9 m				

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017





Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade						Frac. Dwg. Number
		8	2	70	>10	0			3 1					Bentonite seal
20	12				>10				1 3 2 3 3 2 3 3	AMPHIBOLITE 1. Rubble 2. J / 10° / Op-Mw / Mr / Qu / Mo / Conj. of 2 3. J / 100° / Po-Op / Ro / Heavy Fe / Mo 4. J / 100° / Po-Op / Ro / Heavy Fe / Vc-Vw / Symp. of 2 (offset by 90°) 5. J / 150° / Po-Op / Sm / Light Clay-Chl / Vc-Vw / Symp. of 2 (offset by -90°) 6. V / 50° / Om-Mw / He / Chl-Feld-Qu / Wi-Vw				
	13	9	3	100	>10	38			2 3 3 4					
					3				3 5 6					
18	14				>10				1 2 4 3	AMPHIBOLITE 1. Rubble 2. J / 55° / Op-Rubble / Mr / Light Ca / Wi 3. J / 110° / Op / Ro / Spotted Fe-Ca / - 4. J / 140° / Op-Rubble / Ro / Heavy Fe / - 5. J / 65° / Op / Ro / Heavy Fe / Vc-Cl 6. V / 45° / He / Ro / Heavy Fe-Trace Silt / - No recovery from 14.5 m to end of core				
		10	3	73	3	43			4 3 5					
					3				4 5					
	15								NR					
	16													
	17													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-02A

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	12/7/2016 through 12/8/2016	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	29.37 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,608 E 465,849
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	9.0 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	2.03 metres below grade (12/28/2016)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											SILT, trace clay, trace gravel (angular and rounded), trace sand, very hard, brown, moist			Flushed-mounted roadbox Concrete
														Bentonite seal
														Silica sand
	1													
28														
	2										Small boulder between 2.13m - 2.44m			25 mm Ø10 slot sched 40 PVC pipe
														End cap
														Silica sand
	3	1	4	99		0			1	1	AMPHIBOLITE			
									1	1	1. Rubble			
									1	1	AMPHIBOLITE			
									2	2	1. J / 80° / Ti-Po / Mr / Light Fe / Cl-Mo			
									2	2	2. J / 170° / Ti / Sm-Mr / Light Fe / Wi			
									1	1	3. J / 100° / Po-Op / Ro / Moderate Fe / Vc-Cl			
									1	1	4. J / 70° / Po-Op / Mr-Ro / Moderate Fe / Vc-Cl			
									1	1	5. J / 140°-150° / Po-Op / Mr-Ro / Moderate Fe / Vc-Cl			
									6	6	6. Rubble			
									4	4				
	4	2	4	100		0			5	5				
									4	4				
									5	5				
									5	5				
									3	3				
									1	1				
									5	5				
									5	5				
									5	5				
									2	2	AMPHIBOLITE			
									2	2	1. J / 140° / Op / Sm-Mr / Light Ca / Vc-Cl			
									4	4	2. J / 70° / Op / Ro / Light Ca / Wi			
									1	1	3. J / 140° / Op / Sm-Mr / Light Ca / Wi / symp. of #1 (offset by -90°)			
									1	1	4. Rubble			
									2	2				
5									2	2				

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-02A

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
24	5	3	4	100	>10	42			1	AMPHIBOLITE 1. J / 60° / Ti-Op / Sm / - / Vc-Cl 2. J / 120° / Ti-Op / Sm / - / Vc-Cl / symp. of #1 (offset by 90°) 3. J / 120° / Ti-Vt / Sm / - / Wi 4. J / 15° / Op-Mw / Sm / Ca-Clay / Wi 5. V / 15° / Op-Mw / Sm / Cl / Mo-Wi No recovery from 5.6 m to 5.9 m		Bentonite seal	
	1												
	1												
	3												
	1												
	1												
	4												
	NR												
	1												
	2												
22	6	4	5	100	5	40			1				
	1												
	1												
	1												
	1												
	1												
	1												
	2												
	2												
	2												
3													
4													
5													
5													
2													
2													
1													
1													
20	8	5	5	80	4	68			1				
	2												
	3												
	1												
	3												
	3												
	3												
	8												
	3												
	3												
9													
4													
4													
5													
6													
1													
7													
11													
9	4												
11													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-02B

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	12/7/2016 through 12/8/2016	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	29.37 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,608 E 465,849
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	9.0 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	1.68 metres below grade (12/28/2016)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											SILT, trace clay, trace gravel (angular and rounded), trace sand, very hard, brown, moist			Flushed-mounted roadbox Concrete
1														
28														
2											Small boulder between 2.13m - 2.44m			▽ Bentonite seal
3		1	4	99		0			1		AMPHIBOLITE 1. Rubble			
26					>10				1		AMPHIBOLITE 1. J / 80° / Ti-Po / Mr / Light Fe / Cl-Mo 2. J / 170° / Ti / Sm-Mr / Light Fe / Wi 3. J / 100° / Po-Op / Ro / Moderate Fe / Vc-Cl 4. J / 70° / Po-Op / Mr-Ro / Moderate Fe / Vc-Cl 5. J / 140°-150° / Po-Op / Mr-Ro / Moderate Fe / Vc-Cl 6. Rubble			Silica sand
4		2	4	100	>10	0			4					
					>10				5					
					>10				5					
					>10				3					
					>10				5					
					>10				5		AMPHIBOLITE 1. J / 140° / Op / Sm-Mr / Light Ca / Vc-Cl 2. J / 70° / Op / Ro / Light Ca / Wi 3. J / 140° / Op / Sm-Mr / Light Ca / Wi / symp. of #1 (offset by -90°) 4. Rubble			25 mm 010 slot sched 40 PVC pipe
					>10				2					
5					>10				2					End cap

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-02B

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
24	5	3	4	100	>10	42			1	AMPHIBOLITE 1. J / 60° / Ti-Op / Sm / - / Vc-Cl 2. J / 120° / Ti-Op / Sm / - / Vc-Cl / symp. of #1 (offset by 90°) 3. J / 120° / Ti-Vt / Sm / - / Wi 4. J / 15° / Op-Mw / Sm / Ca-Clay / Wi 5. V / 15° / Op-Mw / Sm / Cl / Mo-Wi No recovery from 5.6 m to 5.9 m			Silica sand
	1												
	1												
	3												
	1												
	1												
	4												
	NR												
	6												
	1												
22	6	4	5	100	5	40			2	AMPHIBOLITE 1. J / 80° / Ti-Po / Mr / Light Fe / Cl-Mo 2. J / 170° / Po-Op / Sm-Mr / Light Ca / Cl / symp. of #1 (offset by -90°) 3. J / 120° / Po-Op / Sm-Mr / Light Ca / Cl 4. J / 100° / Ti-Po / Sm-Mr / Light Ca / Mo 5. J / 130°-140° / Ti-Po / Sm-Mr / - / Wi / conj. of #6 (offset by 180°) 6. J / 45° / Ti-Po / Sm-Mr / - / Wi 7. V / 140° / Ti-Po / He / Feld-Cl / Wi 8. V / 45° / Ti-Po / He / Cl / Wi 9. V / 15° / Ti-Po / He / Cl / Wi 10. V / 120° / Ti-Po / He / Cl / Wi 11. V / 160° / Ti-Po / He / Cl / Wi No recovery from			Bentonite seal
	1												
	1												
	2												
	2												
	3												
	4												
	4												
	5												
	2												
20	7	5	5	80	3	68			2				
	1												
	3												
	3												
	9												
	4												
	4												
	5												
	6												
	1												
7													
11													
9	4												

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-03A

Sheet 1 of 3

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	12/8/2016 through 12/9/2016	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	28.58 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,624 E 465,892
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	12.2 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	1.21 metres below grade (12/28/2016)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											GRAVEL, angular (road base), trace silt (increasing silt content with depth), grey, compact, dry to moist (increasing moisture with depth)			Flush-mounted roadbox
28											SILT, trace clay, trace gravel (angular and rounded), trace sand, very hard, brown, moist			Concrete
	1													Bentonite seal
														Silica sand
	2													51 mm O10 slot sched 40 PVC pipe
26														End cap
	3													Silica sand
	4													
24														
	5													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-03A

Sheet 2 of 3

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
5		1	6	30										
6														
22														
7		2	6	70										
8														
20		3	6	70	8	13			1 2 1 1 4 2 3 4 2	AMPHIBOLITE 1. J / 35°-45° / Ti-Po / Mr-Ro / Light Ca / Cl 2. J / 100° / Ti-Po / Mr-Ro / Light Ca / Cl / symp. of #1 (offset by -90°) 3. J / 150° / Ti-Po / Mr-Ro / Light Ca / Cl / conj. of #1 (offset by 180°) 4. J / 165°-170° / Ti-Po / Sm-Mr / Heavy Ca-Cl / Cl 5. V / 100° / Ti-Po / He / Qu-Feld / Wi No recovery from 8.7 m to 9.1 m				
9														
10		4	6	100	3	33			1 2 1 1 2 4 3 3	AMPHIBOLITE 1. J / 110° / Ti-Po / Sm / Light Ca / Vc-Cl 2. J / 35° / Ti-Po / Mr-Ro / Light Ca / Cl-Mo 3. J / 150° / Ti-Po / Sm / Chl-Qu / Mo-Wi / symp. of #1 (offset by 90°) 4. V / 150° / Ti-Po / He / Light Ca / Wi				
18					1				1 1 2 3					
11					3				1 2 2 2	AMPHIBOLITE 1. J / 40° / Ti-Po / Sm / Light Ca / Cl-Mo 2. J / 55° / Po / Sm / Light Ca / Mo 3. J / 20° / Op / Sm-Mr / Heavy Clay-Ca / Vc				

Bentonite seal

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-03A

Sheet 3 of 3

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
		5	7	100	>10	31				1 3 3				
					>10						LIMESTONE (starting at 11.5 m to end of core)			
	12				0									
					0									
16														
	13													
	14													
14														
	15													
	16													
12														
	17													

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Core Log MW16-03B

Sheet 1 of 3

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	12/12/2016 through 12/12/2016	AZIMUTH:	00
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	28.44 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,625 E 465,891
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	12.2 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	0.26 metres below grade (12/28/2016)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											GRAVEL, angular (road base), trace silt (increasing silt content with depth), grey, compact, dry to moist (increasing moisture with depth)			Flush-mounted roadbox Concrete
28											SILT, trace clay, trace gravel (angular and rounded), trace sand, very hard, brown, moist			
1														
2														
26														Slough
3														
4														
24														
5														Sample ID MW16-03A 4.8m-5.0m

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Core Log MW16-03B

Sheet 2 of 3

**Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC**



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
22	5	1	6	30										Bentonite seal
	6													
7	7	2	6	70										Silica sand Sample ID MW16-03B 7.6m-7.9m 25 mm 010 slot sched 40 PVC pipe
20	8													
	8				>10									
	8													
	8	3	6	70	8	13								End cap Silica sand
	9													
	10				1									
	10	4	6	100	3	33								
	10				3									
18	10				1									
	10													
	10				>5									
	11				3									Bentonite seal
	11													
	11													
	11													

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Core Log MW16-03B

Sheet 3 of 3

**Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC**



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
		5	7	100	>10	31				1 3 3				
					>10						LIMESTONE (starting at 11.5 m to end of core)			
	12				0									
					0									
16														
	13													
	14													
14														
	15													
	16													
	17													

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Core Log MW16-04A

Sheet 1 of 3

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	12/9/2016 through 12/10/2016	AZIMUTH:	200
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	29.80 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,607 E 465,863
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	11.6 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	-0.36 metres below grade (12/28/2016)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											SILT, trace clay, trace sand, hard, brown, moist			Stick Up Monument Concrete
											AMPHIBOLITE 1. J / 110° / Po / Sm-Ro / Moderate Fe / Vc-Cl			Bentonite seal
1											AMPHIBOLITE 1. J / 110° / Po / Ro / Heavy Fe / Cl 2. J / 60° / Po / Mr / Heavy Fe / - 3. J / 160° / Po / Mr / Heavy Fe / Cl 4. J / 160° / Po / Mr / Heavy Fe / - / symp. of #3 (-90° offset) 5. J / 150° / Po / Mr / Heavy Fe / - No recovery from 1.8 m to 2.4 m			Silica sand
2														
28											AMPHIBOLITE 1. Heavily fractured area			25 mm 010 slot sched 40 PVC pipe
3														
4											AMPHIBOLITE 1. J / 130° / Ti-Po / Sm-Mr / Heavy Fe / Mo 2. J / 130° / Ti-Po / Sm-Mr / Heavy Fe / - / conj. of #1 (180° offset) 3. J / 70° / Ti-Po / Mr-Ro / Heavy Fe / - / conj. of #4 (180° offset) 4. J / 120° / Ti-Po / Mr-Ro / Heavy Fe / -			End cap Silica sand
5														



Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
26	5				1				2 4 2	AMPHIBOLITE 1. J / 120°-110° / Po-Op / Sm-Mr / Light Fe / - 2. J / 120°-110° / Ti-Po / Sm-Mr / Light-Moderate Fe / - / symp. of #2 (-90° offset) 3. J / 40° / Po-Op / Sm-Mr / Light-Moderate Fe / - 4. J / 170° / Po / Sm-Mr / Light Ca / Wi 5. J / 80° / Ti-Po / Sm-Mr / Light-Moderate Fe / - / conj. of #2 (180° offset) 6. J / 40° / Ti-Po / Mr / Heavy Fe / Wi			
					3			1 2 2 3 2 4 5 6					
	6	5	9	100	80			2 3 2 4 5 6					
					4			1					
					2			1					
	7				1			1	AMPHIBOLITE 1. J / 160° / Ti / Sm / Light Ca-Chl / Wi 2. J / 110° / Ti-Op / Sm-Mr / Heavy Ca-Chl / Cl 3. J / 30° / Ti-Op / Sm-Mr / Heavy Ca-Chl / Cl-Wi / conj. of #2 (180° offset) 4. J / 180° / Ti-Po / Sm-Ro / Heavy Chl-Clayey / Cl				
					>10			2 2 3					
					>10			4					
	8	6	9	100	30			3 3 2 1					Bentonite seal
					>10			1					
					>10			1					
	9				2			1 1 1		AMPHIBOLITE 1. J / 180°-160° / Ti-Po / Sm / Heavy Chl-Clayey / Wi			
					2			1					
					0			1					
	10	7	9	100	80			1 2					
					0			1	AMPHIBOLITE 1. J / 145° / Ti / Sm / Light Ca / Wi 2. J / 45° / Po / Sm-Mr / Light Ca / Mo 3. J / 160° / Ti-Po / Sm-Ro / Light Ca (clayey in some locations) / Mo				
					0			2 3 2 1					
					0			3 2 1					
					3			3 2 1					
					3			3					
	11	8	10	100	83			3					
22	11							3					

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW16-04A

Sheet 3 of 3

**Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC**



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
				>10									
				1									
12													
13													
20													
14													
15													
16													
18													
17													

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Core Log MW16-04B

Sheet 1 of 3

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	12/9/2016 through 12/10/2016	AZIMUTH:	200
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	29.80 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,607 E 465,863
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	11.6 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	-0.37 metres below grade (12/28/2016)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0									SILT, trace clay, trace sand, hard, brown, moist			Stick Up Monument Concrete	
1	1	8	60	4	0			1 1 1	AMPHIBOLITE 1. J / 110° / Po / Sm-Ro / Moderate Fe / Vc-Cl				
2	2	8	100	>10	0			1 2 2 3 4 4 3 1 1 1 5	AMPHIBOLITE 1. J / 110° / Po / Ro / Heavy Fe / Cl 2. J / 60° / Po / Mr / Heavy Fe / - 3. J / 160° / Po / Mr / Heavy Fe / Cl 4. J / 160° / Po / Mr / Heavy Fe / - / symp. of #3 (-90° offset) 5. J / 150° / Po / Mr / Heavy Fe / - No recovery from 1.8 m to 2.4 m				
28				>10				1	AMPHIBOLITE 1. Heavily fractured area			Bentonite seal	
3	3	8	100	>10	0								
4				>10									
4				4									
4	4	8	100	5	62			1 1 2 3 4 4	AMPHIBOLITE 1. J / 130° / Ti-Po / Sm-Mr / Heavy Fe / Mo 2. J / 130° / Ti-Po / Sm-Mr / Heavy Fe / - / conj. of #1 (180° offset) 3. J / 70° / Ti-Po / Mr-Ro / Heavy Fe / - / conj. of #4 (180° offset) 4. J / 120° / Ti-Po / Mr-Ro / Heavy Fe / -				
5				6									
				5									

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017



Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
5					1				2 4 2				Silica sand
26					3				1 2 2 3 2 2 3 4 5 6	AMPHIBOLITE 1. J / 120°-110° / Po-Op / Sm-Mr / Light Fe / - 2. J / 120°-110° / Ti-Po / Sm-Mr / Light-Moderate Fe / - / symp. of #2 (-90° offset) 3. J / 40° / Po-Op / Sm-Mr / Light-Moderate Fe / - 4. J / 170° / Po / Sm-Mr / Light Ca / Wi 5. J / 80° / Ti-Po / Sm-Mr / Light-Moderate Fe / - / conj. of #2 (180° offset) 6. J / 40° / Ti-Po / Mr / Heavy Fe / Wi		25 mm 010 slot sched 40 PVC pipe	
6		5	9	100	4	80			2 3 2 4 5 6				End cap
7					2				1				Silica sand
7					1								
7					>10				1	AMPHIBOLITE 1. J / 160° / Ti / Sm / Light Ca-Chl / Wi 2. J / 110° / Ti-Op / Sm-Mr / Heavy Ca-Chl / Cl 3. J / 30° / Ti-Op / Sm-Mr / Heavy Ca-Chl / Cl-Wi / conj. of #2 (180° offset) 4. J / 180° / Ti-Po / Sm-Ro / Heavy Chl-Clayey / Cl			
8		6	9	100	>10	30			2 2 3				
8					>10				4				
24					>10				3 3 2 1				
8					>10				1				
9					2				1 1	AMPHIBOLITE 1. J / 180°-160° / Ti-Po / Sm / Heavy Chl-Clayey / Wi			
9		7	9	100	2	80			1				Bentonite seal
10					0								
10					0								
10					0				1 2	AMPHIBOLITE 1. J / 145° / Ti / Sm / Light Ca / Wi 2. J / 45° / Po / Sm-Mr / Light Ca / Mo 3. J / 160° / Ti-Po / Sm-Ro / Light Ca (clayey in some locations) / Mo			
11		8	10	100	3	83			3 2 1				
22					3				3 2 1 3				

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-04B

Sheet 3 of 3

**Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC**



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
				>10									
				1				ω					
12													
13													
20													
14													
15													
16													
18													
17													

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Core Log MW16-05A

Sheet 1 of 3

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	12/10/2016 through 12/12/2016	AZIMUTH:	106
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	31.99 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,621 E 465,908
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	12.2 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	4.96 metres below grade (12/28/2016)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0									SILT, trace clay, trace gravel (angular and rounded) trace sand, hard, brown, moist		Stick Up Monument Concrete		
1	11	100											
2	11	95	77	1				1	LIMESTONE 1. J / 130° / Ti-Po / Mr-Ro / Light Fe / Cl-Wi 2. J / 60° / Ti / Mr-Ro / Light Fe / Wi / conj. of 1 (180° around VCA) No recovery from 2.9 m to 3.0 m		Bentonite seal		
3	11	100	87	0				1 1 1 1 1 1 1 1	LIMESTONE 1. J / 50° / Ti-Po / Ro / Light Fe / Vc-Cl 2. J / 130° / Ti-Po / Mr / Light Fe / Vc-VI / symp. of 1 (-90° around VCA)				
4				3				1 1 1	LIMESTONE 1. J / 60° / Ti-Po / Ro / Light Fe / Cl-Mc 2. J / 80° / Ti-Po / Ro / Light Fe / Wi / symp. of 1 (-90° around VCA) 3. J / 50° / Ti-Po / Mr-Ro / Light Fe / Cl / symp. of 4 (90°		Silica sand		
5				2				1					

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW16-05A

Sheet 2 of 3

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
28	5				4				3 1 1 4 1 5 1 1 1	around VCA) 4. V / 30° / Ti-Po / Sm-Mr / Light Fe / Wi / almost vertical feature 5. J / 20°-120° / Po / Mr / Light Fe / Wi / undulating feature No recovery from 6.0 m to 6.1 m			25 mm Ø10 slot sched 40 PVC pipe End cap Silica sand Bentonite seal
	4	11	95		63								
	6				2				1 1				
	7				2				4 4 4 3 1 1	LIMESTONE 1. J / 140° / Ti-Po / Sm-Mr / Light/moderate Fe / Vc-Cl 2. J / 130° / Ti-Po / Sm-Mr / Light/moderate Fe / Wi / symp. of 1 (-90° around VCA) 3. J / 40° / Ti-Po / Mr-Ro / Moderate/heavy Fe / Wi / symp. of 4 (-90° around VCA) 4. J / 20° / Ti-Po / Mr-Ro / Moderate/heavy Fe / Vc-Cl			
	5	12	100		62								
	7				2				1 1 1 1 2				
	8				1				1 1 1 1	LIMESTONE 1. J / 140° / Ti-Po / Mr / Light Chl-Spotted Fe / - 2. J / 165° / Ti-Po / Sm-Mr / Light Fe-Fine material / Vc 3. J / 20° / Ti-Po / Mr / Spotted Ca / - 4. J / 50° / Op (Rubble) / Mr-Ro / Light Fe / - 5. Rubble No recovery from 9.1 m to 9.15 m			
26	6	12	83		52				2 3 1 4				
	9				>10								
	10				4				1 4				
	7	12	95		65				1 1 1	LIMESTONE 1. J / 60°-70° / Ti-Op / Sm-Mr / Light Ca / Cl No recovery from 10.6 m to 10.7 m			
	10				0				1 1 2				
	11				>10				R	LIMESTONE 1. J / 60° / Ti-Po / Sm-Mr / Light Fe-Chl-Ca / Cl 2. J / 20°-60° / Ti-Po / Sm-Mr / Heavy fine material / Vc 3. Rubble No recovery 12.0 m to 12.2 m			

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW16-05A

Sheet 3 of 3

**Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC**



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
24	8	13	85	57				1 2 2 2 1					
	12												
	13												
	14												
22	15												
	16												
20	17												

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-05B

Sheet 1 of 3

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	12/10/2016 through 12/12/2016	AZIMUTH:	106
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	31.99 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,621 E 465,908
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	12.2 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	4.91 metres below grade (12/28/2016)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0									SILT, trace clay, trace gravel (angular and rounded) trace sand, hard, brown, moist			Stick Up Monument Concrete	
1													
2	2	11	95	1 0 0	77		1 1	1	LIMESTONE 1. J / 130° / Ti-Po / Mr-Ro / Light Fe / Cl-Wi 2. J / 60° / Ti / Mr-Ro / Light Fe / Wi / conj. of 1 (180° around VCA) No recovery from 2.9 m to 3.0 m				
30													
3				2			1 1 1 1 1 1 1	2	LIMESTONE 1. J / 50° / Ti-Po / Ro / Light Fe / Vc-Cl 2. J / 130° / Ti-Po / Mr / Light Fe / Vc-VI / symp. of 1 (-90° around VCA)				
4	3	11	100	0 3 3 1	87		1 1 1	1					
5				2			1 1 1	1	LIMESTONE 1. J / 60° / Ti-Po / Ro / Light Fe / Cl-Mc 2. J / 80° / Ti-Po / Ro / Light Fe / Wi / symp. of 1 (-90° around VCA) 3. J / 50° / Ti-Po / Mr-Ro / Light Fe / Cl / symp. of 4 (90°			Bentonite seal	

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW16-05B

Sheet 2 of 3

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering						Rock Grade
28	5	4	11	95	4 3	63			3 1 1 4 1 5 1 1 1	around VCA) 4. V / 30° / Ti-Po / Sm-Mr / Light Fe / Wi / almost vertical feature 5. J / 20°-120° / Po / Mr / Light Fe / Wi / undulating feature No recovery from 6.0 m to 6.1 m			
26	6				2				4 4 4	LIMESTONE 1. J / 140° / Ti-Po / Sm-Mr / Light/moderate Fe / Vc-Cl 2. J / 130° / Ti-Po / Sm-Mr / Light/moderate Fe / Wi / symp. of 1 (-90° around VCA) 3. J / 40° / Ti-Po / Mr-Ro / Moderate/heavy Fe / Wi / symp. of 4 (-90° around VCA) 4. J / 20° / Ti-Po / Mr-Ro / Moderate/heavy Fe / Vc-Cl			
	7	5	12	100	1 2	62			3 1				
	8				3				1 1 1 1 2	LIMESTONE 1. J / 140° / Ti-Po / Mr / Light Chl-Spotted Fe / - 2. J / 165° / Ti-Po / Sm-Mr / Light Fe-Fine material / Vc 3. J / 20° / Ti-Po / Mr / Spotted Ca / - 4. J / 50° / Op (Rubble) / Mr-Ro / Light Fe / - 5. Rubble No recovery from 9.1 m to 9.15 m			
	9	6	12	83	>10 4	52			2 3 1 4				
	10				>10				1 4				
	11	7	12	95	1 0	65			1 1 1	LIMESTONE 1. J / 60°-70° / Ti-Op / Sm-Mr / Light Ca / Cl No recovery from 10.6 m to 10.7 m			Silica sand
					1 2				1 1				
					>10				1 1	LIMESTONE 1. J / 60° / Ti-Po / Sm-Mr / Light Fe-Chl-Ca / Cl 2. J / 20°-60° / Ti-Po / Sm-Mr / Heavy fine material / Vc 3. Rubble No recovery 12.0 m to 12.2 m			25 mm 010 slot sched 40 PVC pipe

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW16-05B

Sheet 3 of 3

**Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC**



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
24	8	13	85	1 ----- >10	57			1 2 2 2 1					
12				1									
				1								End cap	
13													
14													
22													
15													
16													
20	17												

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-03A

Sheet 1 of 3

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/23/2017 through 1/24/2017	AZIMUTH:	164
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	32.92 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,599 E 465,871
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	15.9 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	0.17 metres below grade (3/24/2017)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
0										AMPHIBOLITE 1. J / 20° / Po / Sm-Ro / Heavy Fe / Cl 2. J / 130° / Po / Sm-Ro / Heavy Fe / Cl			Stick Up Monument Concrete
		1	1	100	>10	46			1 2 1 2 2				
					>10					AMPHIBOLITE 1. J / 50° / Op / Sm-Mr / Heavy Fe / Wi 2. J / 0°-170° / Op / Sm-Mr / Heavy Fe / Wi 3. J / 140°-30° / Po (Rubble) / Sm-Ro / Light Fe-Heavy Silt / Wi 4. J / 60°-120° / Po / Sm-Ro / Light Fe / Vc 5. J / 120° / Po / Sm-Ro / Light Fe 6. J / 140° / Po / Sm-Ro / Light Fe			Bentonite seal
32		2	1	80	>10	35			2 4 3 3 4 4 4	No recovery from 1.8 m to 2.1 m AMPHIBOLITE			Silica sand
					>10								
2					>10					LIMESTONE R. Rubble / Black LNAPL in heavily fractured zones 1. J / 70° / Po / Sm / Light Fe 2. J / 160° / Op / Sm-Mo / Light Fe / Wi / Light PHC odour (rainbow sheen in drilling water) 3. J / 80° / Op / Sm-Mo / Light Fe / Wi / Light PHC odour (rainbow sheen in drilling water) 4. J / 160° / Po / Sm / Light Fe / Wi / Light rainbow sheen observed in fractures 5. J / 100° / Po / Sm / Light Fe / Wi-Cl / Light rainbow sheen observed in fractures 6. J / 60° / Op / Mo-Sm / Light Fe / - / Light-Moderate PHC odour 7. J / 100° / Po / Sm / Light Fe / - / Light rainbow sheen observed in fractures			25 mm 020 slot sched 40 PVC pipe
		3	1	80	>10	19			5 1 2 3 R 4 5 6 7 7				
3					>10								
					3								
										AMPHIBOLITE LIMESTONE AMPHIBOLITE LIMESTONE			
										No recovery from 3.3 m to 3.6 m LIMESTONE 1. J / 120° / Po / Sm / Light Ca / Cl-Mo / Light rainbow sheen observed in fractures 2. J / 160°-150° / Po / Sm / Light Ca / Mo 3. J / 120° / Po / Sm / - / Wi / Light rainbow sheen observed in fractures			End cap Silica sand
30		4	2	92	4	82			1 2 1 3				
					1				1				
					2				2				
					0				2				
5										No recovery from 5.1 m to 5.2 m			



Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
5				0					2 1	LIMESTONE R. Rubble 1. J / 30° / Po / Mr / Light Fe / Cl 2. J / 120° / Po-Ti / Sm-Mr / Light Fe / Cl 3. J / 160° / Po / Sm / Light Fe / - / Light rainbow sheen observed in fractures 4. J / 160° / Po / Sm-Ro / Light Fe / - / Light rainbow sheen observed in fractures			Bentonite seal
6	5	2	100	82	1				3 3 2 1 2 4 2				Silica sand
28	7			2					1 2	LIMESTONE R. Rubble / Black LNAPL in heavily fractured zone 1. J / 135° / Po / Sm-Mr / Light Ca-Cl / Vc-Cl 2. J / 20° / Ti / Sm / Light-Moderate Cl-Ca / - / symp. of #4 (offset by -90° along VCA) 3. J / 55° / Po / Sm-Mr / Light Ca-Cl / - / conj. of #1 (offset by 180° along VCA) 4. J / 20° / Ti / Sm / Light-Moderate Cl-Ca / Wi			
8	6	2	100	83	1				1 1 3 4 4				Silica sand
9	7	3	100	73	0				0 1 1 3				Bentonite seal
26	10			>10					1 2 2 2 2	LIMESTONE R. Rubble / Light rainbow sheen observed at end of run 1. J / 60°-110° / Ti / Sm-Mr / Light Ca-Cl / Wi 2. J / 160° / Po / Mr-Ro / Light Ca / Cl 3. J / 120° / Ti / Sm-Mr / Light Ca-Cl / - / symp. of #1 (offset by -90° along VCA)			
11	8	3	100	65	3				1 2 2 2 3 3 4 5	LIMESTONE 1. J / 160° / Ti / Sm / Light Ca / Wi 2. J / 40° / Ti / Sm-Mr / Light Ca / Vc 3. J / 20°-30° / Ti-Po / Sm-Ro / Light-Moderate Ca-Silt / Cl-Vc 4. J / 20°-30° / Ti-Po / Sm-Ro / Light-Moderate Ca-Silt / Wi / symp. of #3 (offset by -90° along VCA) 5. J / 0° / Op / Ro / Heavy Ca-Silt / Wi			Silica sand

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Core Log MW17-03A

Sheet 3 of 3

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
					>10								
	12	9	3	100	0	77			1 2	LIMESTONE 1. J / 110° / Ti / Sm / Light Ca-Fe / Wi 2. J / 140° / Po / Sm-Ro / Light Ca-Cl / Wi			
24					0								
	13				1				1 2 2 2 2	LIMESTONE 1. J / 10° / Ti-Po / Sm-Mr / Light Ca / Wi 2. J / 150° / Ti / Sm-Mr / Light Ca / Vc-Cl			Silica sand
	14	10	4	100	4	77			2 2 2				
	15	11	4	100	2	53			1 2 3 2 2 4 4 4	LIMESTONE 1. J / 10°-170° / Ti / Sm-Ro / Light Ca / Wi 2. J / 140° / Ti-Po / Mr / - / Vc-Cl 3. J / 130°-70° / Ti-Po / Ro / Light Ca / Wi 4. J / 30°-40° / Ti-Op (Rubble) / Ro / Light Ca / Vc-Cl			Bentonite seal
22					2								
	16				1								
	17				3								

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW17-03B

Sheet 1 of 3

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/23/2017 through 1/24/2017	AZIMUTH:	164
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	32.92 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,599 E 465,871
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	15.9 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	0.43 metres below grade (3/24/2017)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
0										AMPHIBOLITE 1. J / 20° / Po / Sm-Ro / Heavy Fe / Cl 2. J / 130° / Po / Sm-Ro / Heavy Fe / Cl			Stick Up Monument Concrete
		1	1	100	>10	46			1 2 1 2 2				
					>10								
32										AMPHIBOLITE 1. J / 50° / Op / Sm-Mr / Heavy Fe / Wi 2. J / 0°-170° / Op / Sm-Mr / Heavy Fe / Wi 3. J / 140°-30° / Po (Rubble) / Sm-Ro / Light Fe-Heavy Silt / Wi 4. J / 60°-120° / Po / Sm-Ro / Light Fe / Vc 5. J / 120° / Po / Sm-Ro / Light Fe 6. J / 140° / Po / Sm-Ro / Light Fe LIMESTONE			Bentonite seal
		2	1	80	>10	35			2 3 3 4 4 4 5	No recovery from 1.8 m to 2.1 m			Silica sand
					>10								
2										LIMESTONE R. Rubble / Black LNAPL in heavily fractured zones 1. J / 70° / Po / Sm / Light Fe 2. J / 160° / Op / Sm-Mo / Light Fe / Wi / Light PHC odour (rainbow sheen in drilling water) 3. J / 80° / Op / Sm-Mo / Light Fe / Wi / Light PHC odour (rainbow sheen in drilling water) 4. J / 160° / Po / Sm / Light Fe / Wi / Light rainbow sheen observed in fractures 5. J / 100° / Po / Sm / Light Fe / Wi-Cl / Light rainbow sheen observed in fractures 6. J / 60° / Op / Mo-Sm / Light Fe / - / Light-Moderate PHC odour 7. J / 100° / Po / Sm / Light Fe / - / Light rainbow sheen observed in fractures			
		3	1	80	>10	19			1 2 3 4 5 6 7 7				
					>10								
3													
					3								
30													
					4				1 2 1 3	No recovery from 3.3 m to 3.6 m LIMESTONE 1. J / 120° / Po / Sm / Light Ca / Cl-Mo / Light rainbow sheen observed in fractures 2. J / 160°-150° / Po / Sm / Light Ca / Mo 3. J / 120° / Po / Sm / - / Wi / Light rainbow sheen observed in fractures			Silica sand
		4	2	92	1	82			1 2 2				
					2								
					0								
5										No recovery from 5.1 m to 5.2 m			



Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
5				0					2 1	LIMESTONE R. Rubble 1. J / 30° / Po / Mr / Light Fe / Cl 2. J / 120° / Po-Ti / Sm-Mr / Light Fe / Cl 3. J / 160° / Po / Sm / Light Fe / - / Light rainbow sheen observed in fractures 4. J / 160° / Po / Sm-Ro / Light Fe / - / Light rainbow sheen observed in fractures			Bentonite seal
6	5	2	100	2 1	82				2 3 2 1 2 4 2				Silica sand
28	7			2 2					1 2	LIMESTONE R. Rubble / Black LNAPL in heavily fractured zone 1. J / 135° / Po / Sm-Mr / Light Ca-Cl / Vc-Cl 2. J / 20° / Ti / Sm / Light-Moderate Cl-Ca / - / symp. of #4 (offset by -90° along VCA) 3. J / 55° / Po / Sm-Mr / Light Ca-Cl / - / conj. of #1 (offset by 180° along VCA) 4. J / 20° / Ti / Sm / Light-Moderate Cl-Ca / Wi			25 mm 020 slot sched 40 PVC pipe
8	6	2	100	1 4 2	83				1 1 3 4 4				End cap Silica sand
9	7	3	100	0 0 1	73				1 2 3 2 2	LIMESTONE R. Rubble / Light rainbow sheen observed at end of run 1. J / 60°-110° / Ti / Sm-Mr / Light Ca-Cl / Wi 2. J / 160° / Po / Mr-Ro / Light Ca / Cl 3. J / 120° / Ti / Sm-Mr / Light Ca-Cl / - / symp. of #1 (offset by -90° along VCA)			Bentonite seal
26	10			>10 3					1 2 2 2 2	LIMESTONE 1. J / 160° / Ti / Sm / Light Ca / Wi 2. J / 40° / Ti / Sm-Mr / Light Ca / Vc 3. J / 20°-30° / Ti-Po / Sm-Ro / Light-Moderate Ca-Silt / Cl-Vc 4. J / 20°-30° / Ti-Po / Sm-Ro / Light-Moderate Ca-Silt / Wi / symp. of #3 (offset by -90° along VCA) 5. J / 0° / Op / Ro / Heavy Ca-Silt / Wi			
	8	3	100	1	65				3 3 4				Silica sand
	11			>10					5				

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Core Log MW17-03B

Sheet 3 of 3

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
					>10								
	12	9	3	100	0	77			1 2	LIMESTONE 1. J / 110° / Ti / Sm / Light Ca-Fe / Wi 2. J / 140° / Po / Sm-Ro / Light Ca-Cl / Wi			
24					0								
	13				0								
					1				1	LIMESTONE 1. J / 10° / Ti-Po / Sm-Mr / Light Ca / Wi 2. J / 150° / Ti / Sm-Mr / Light Ca / Vc-Cl			Silica sand
					4				2 2 2 2				
	14	10	4	100	1	77			2				
					2				2				
					1				2				
	15	11	4	100	2	53			1 2 3	LIMESTONE 1. J / 10°-170° / Ti / Sm-Ro / Light Ca / Wi 2. J / 140° / Ti-Po / Mr / - / Vc-Cl 3. J / 130°-70° / Ti-Po / Ro / Light Ca / Wi 4. J / 30°-40° / Ti-Op (Rubble) / Ro / Light Ca / Vc-Cl			Bentonite seal
					2				2				
					1				2				
22					3				4 4 4				
	16												
	17												

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-03C

Sheet 1 of 3

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/23/2017 through 1/24/2017	AZIMUTH:	164
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	32.92 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,599 E 465,871
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	15.9 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	0.02 metres below grade (3/24/2017)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
0										AMPHIBOLITE 1. J / 20° / Po / Sm-Ro / Heavy Fe / Cl 2. J / 130° / Po / Sm-Ro / Heavy Fe / Cl			Stick Up Monument Concrete
	1	1	100	>10	46				1 2 1 2 2				
				>10						AMPHIBOLITE 1. J / 50° / Op / Sm-Mr / Heavy Fe / Wi 2. J / 0°-170° / Op / Sm-Mr / Heavy Fe / Wi 3. J / 140°-30° / Po (Rubble) / Sm-Ro / Light Fe-Heavy Silt / Wi 4. J / 60°-120° / Po / Sm-Ro / Light Fe / Vc 5. J / 120° / Po / Sm-Ro / Light Fe 6. J / 140° / Po / Sm-Ro / Light Fe			Bentonite seal
32	2	1	80	>10	35				2 3 3 4 4 4 5	No recovery from 1.8 m to 2.1 m AMPHIBOLITE			Silica sand
				>10						LIMESTONE R. Rubble / Black LNAPL in heavily fractured zones 1. J / 70° / Po / Sm / Light Fe 2. J / 160° / Op / Sm-Mo / Light Fe / Wi / Light PHC odour (rainbow sheen in drilling water) 3. J / 80° / Op / Sm-Mo / Light Fe / Wi / Light PHC odour (rainbow sheen in drilling water) 4. J / 160° / Po / Sm / Light Fe / Wi / Light rainbow sheen observed in fractures 5. J / 100° / Po / Sm / Light Fe / Wi-Cl / Light rainbow sheen observed in fractures 6. J / 60° / Op / Mo-Sm / Light Fe / - / Light-Moderate PHC odour 7. J / 100° / Po / Sm / Light Fe / - / Light rainbow sheen observed in fractures			
	3	1	80	>10	19				1 2 3 4 5 6 7				
				>10	3					AMPHIBOLITE LIMESTONE AMPHIBOLITE LIMESTONE			
				4					1 2 1 3	No recovery from 3.3 m to 3.6 m LIMESTONE 1. J / 120° / Po / Sm / Light Ca / Cl-Mo / Light rainbow sheen observed in fractures 2. J / 160°-150° / Po / Sm / Light Ca / Mo 3. J / 120° / Po / Sm / - / Wi / Light rainbow sheen observed in fractures			Silica sand
30	4	2	92	2	82				1 2 2				
				0									
										No recovery from 5.1 m to 5.2 m			
5													



Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
5				0					2 1	LIMESTONE R. Rubble 1. J / 30° / Po / Mr / Light Fe / Cl 2. J / 120° / Po-Ti / Sm-Mr / Light Fe / Cl 3. J / 160° / Po / Sm / Light Fe / - / Light rainbow sheen observed in fractures 4. J / 160° / Po / Sm-Ro / Light Fe / - / Light rainbow sheen observed in fractures			Bentonite seal
6	5	2	100	82	1				3 3 2 1 2 4 2				Silica sand
28	7			2					1 2	LIMESTONE R. Rubble / Black LNAPL in heavily fractured zone 1. J / 135° / Po / Sm-Mr / Light Ca-Cl / Vc-Cl 2. J / 20° / Ti / Sm / Light-Moderate Cl-Ca / - / symp. of #4 (offset by -90° along VCA) 3. J / 55° / Po / Sm-Mr / Light Ca-Cl / - / conj. of #1 (offset by 180° along VCA) 4. J / 20° / Ti / Sm / Light-Moderate Cl-Ca / Wi			
8	6	2	100	83	1				1 1 3 4 4				Silica sand
9	7	3	100	73	0				0 1 1 3 2	LIMESTONE R. Rubble / Light rainbow sheen observed at end of run 1. J / 60°-110° / Ti / Sm-Mr / Light Ca-Cl / Wi 2. J / 160° / Po / Mr-Ro / Light Ca / Cl 3. J / 120° / Ti / Sm-Mr / Light Ca-Cl / - / symp. of #1 (offset by -90° along VCA)			
26	10			>10					1 2 2 2 2	LIMESTONE 1. J / 160° / Ti / Sm / Light Ca / Wi 2. J / 40° / Ti / Sm-Mr / Light Ca / Vc 3. J / 20°-30° / Ti-Po / Sm-Ro / Light-Moderate Ca-Silt / Cl-Vc 4. J / 20°-30° / Ti-Po / Sm-Ro / Light-Moderate Ca-Silt / Wi / symp. of #3 (offset by -90° along VCA) 5. J / 0° / Op / Ro / Heavy Ca-Silt / Wi			Bentonite seal
11	8	3	100	65	1				3 3 4 5				Silica sand

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-03C

Sheet 3 of 3

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
					>10								
	12	9	3	100	0	77			1 2	LIMESTONE 1. J / 110° / Ti / Sm / Light Ca-Fe / Wi 2. J / 140° / Po / Sm-Ro / Light Ca-Cl / Wi			25 mm 020 slot sched 40 PVC pipe
24					0								
	13				0								
					1				1	LIMESTONE 1. J / 10° / Ti-Po / Sm-Mr / Light Ca / Wi 2. J / 150° / Ti / Sm-Mr / Light Ca / Vc-Cl			End cap Silica sand
					4				2 2 2 2				
	14	10	4	100	1	77			2				
					2				2				
					1				2				
	15	11	4	100	2	53			1 2 3	LIMESTONE 1. J / 10°-170° / Ti / Sm-Ro / Light Ca / Wi 2. J / 140° / Ti-Po / Mr / - / Vc-Cl 3. J / 130°-70° / Ti-Po / Ro / Light Ca / Wi 4. J / 30°-40° / Ti-Op (Rubble) / Ro / Light Ca / Vc-Cl			Bentonite seal
					2				2				
					1				2				
22					3				4 4 4				
	16												
	17												

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-06

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/25/2017 through 1/25/2017	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	32.14 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,607 E 465,890
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	9.1 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	2.51 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number						
30															
	0	1	5								GRAVEL, trace silt, loose, wet. To be noted that fine soil particles were washed out while rimming the outer casing into the overburden, therefore being left with a high coarse material content.				Bentonite seal ▽
	1	2	5								SILT, trace sand, trace clay, trace (or less) gravel (i.e. pulverized), hard-very hard, low plasticity, brown, moist				
28															
	2										R. Rubble 1. J / 150° / Op (Rubble) / Mr / Heavy Fe 2. J / 180°-175° / Op (Rubble) / Sm-Ro / Heavy Fe No recovery from 5.6 m to 6.1 m				Silica sand
	3	3	5	70	>10	0									51 mm 020 slot sched 40 PVC pipe
	3				>10										
26															
	4	4	5	53	>10	0					R. Rubble 1. J / 170° / Op / Sm-Mo / Light Ca 2. J / 140° / Op / Ro / Light Ca No recovery from 6.9 m to 7.6 m				End cap Silica sand
	4				>10										

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-06

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
24	5				>10				R 1	R. Rubble 2. J / 20°-50° / Op / Sm-Ro / Light Chl/Silty 3. J / 50° / Po / Sm / Light Chl 3. J / 90° / Po / Sm / He / symp. of #1 (offset by -90° along VCA) No recovery from 9.0 m to 9.1 m			Bentonite seal
					>10			2					
		5	6	92	>10	0		3					
					>10			2					
	6				>10				1 R 1 3 R 2 R				
					>10								
22	7												
	8												
	9												
20	10												

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-08

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/25/2017 through 1/25/2017	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	31.73 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,611 E 465,894
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	10.5 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	2.65 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE									ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes			
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number	Lithology							
30	0																
	1	1	7	38													
28	2	2	7	13													
	3	3	7	20													
26	4																

SILT, trace sand, trace clay, trace gravel, low plasticity, firm, brown, moist

Bentonite seal

Silica sand

51 mm O10 slot sched 40 PVC pipe

AMPHIBOLITE
R. Rubble

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-08

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
24	5	4	7	47	>10	0			1 2 3 4 NR	AMPHIBOLITE 1. J / 170°-180° / Po (Rubble) / Sm / Light Ca 2. J / 140° / Vt / Mr / Light Ca 3. J / 110° / Po-Op / Ro / - 4. J / 40° / Ti / Mr / Light Ca / conj. of #2 (offset by 180° along VCA) No recovery from 6.7 m to 7.5 m		[Well Completion Diagram]	End cap Silica sand
		5	7	63	>10	0			1 2 NR	AMPHIBOLITE R. Rubble 1. J / 100° / Op / Sm / Light Ca/Silty 2. J / 130°-140° / Op (Rubble) / Ro / Light Ca/Silty 3. J / 15° / Op (Rubble) / Sm / Light Ca No recovery from 8.2 m to 8.7 m			
		6	7	91	>10	0			R NR	AMPHIBOLITE R. Rubble No recovery from 8.9 m to 9.0			
		7	7	70	>10	0			1 3 2 4 4 5 5 6 5 2 3 NR	AMPHIBOLITE R. Rubble 1. J / 10°-170° / Op / Ro / Light grey silt 2. J / 100° / Op / Ro-Mr / - 3. J / 80° / Op / Ro / Light grey silt / symp. of #1 (offset by 180° along VCA) 4. J / 110° / Op-Po / Sm-Ro / - 5. J / 130° / Po-Op / Sm-Ro / Light grey silt 6. J / 70° / Po-Op / Sm-Ro / - / symp. of #4 (offset by 180° along VCA) No recovery from 9.7 m to 10.5 m			
22	8											[Well Completion Diagram]	Bentonite seal
		9											
20	10												

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Core Log MW17-14A

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/27/2017 through 1/27/2017	AZIMUTH:	146
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	32.76 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,595 E 465,849
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	8.4 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	0.21 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											LIMESTONE 1. J / 90°-100° / Po / Sm-Ro / Light Fe / Light PHC odour and rainbow sheen 2. J / 50° / Po / Sm-Ro / Light Ca / Light PHC odour and rainbow sheen 3. J / 80° / Po / Sm-Ro / Light Fe / Light PHC odour / conj. of #1 (offset by 180° along VCA)			Stick Up Monument Concrete Bentonite seal
1	1	1	8	100	>10	50			R					
2	2	2	8	100	3	77				1 1 1 3 1 2 3 3 3 4 4 4	LIMESTONE 1. J / 70° / Po-Op / Sm-Mr / Light Fe / Black NAPL spots observed in this fracture feature 2. J / - / Vt / Sm / - / Black NAPL spots observed in this fracture feature 3. J / 90°-80° / Po-Op / Sm-Mr / - / symp. of #1 (offset by 90° along CVA) 4. J / 110° / Po-Op / Sm-Mr / - / Black NAPL observed in this fracture feature			Silica sand 25 mm 020 slot sched 40 PVC pipe
3	3	3	8	100	>10	77				1 2 1 1 1 1 3	LIMESTONE 1. J / 60° / Po-Op / Sm-Ro / Light Fe / Light PHC odour and rainbow sheen 2. J / 30°-180° / Po-Op / Sm-Ro / Light Fe / cong. of #1 (offset by 180° along VCA) 3. J / 70°-160° / Ti-Po / Sm-Ro / Light Fe / Black NAPL spots observed in this fracture feature 4. J / 25° / Ti / Ro / Light Fe / Light PHC staining (sheen and small NAPL globules) 5. J / 180°-0° / Op / Sm-Ro / Light Ca			End cap Silica sand Bentonite seal
4	4	4	9	100	>10	83				4 1 1 1 1 5 1 2 2 2 2 1 3	LIMESTONE R. Rubble 1. J / 60° / Op / Sm / Light Fe 2. J / 40° / Vt-Po / Sm-Mr / Light Ca 3. J / 90°-80° / Ti-Po / Sm-Mr / Light Ca			Silica sand
5	5													

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-14A

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade						Frac. Dwg. Number
28	5				3				3	LIMESTONE 1. J / 60°-110° / Po / Mr / Light Ca 2. J / 0°-20° / Ti-Po / Sm / Moderate Ca 3. J / 70° / Po-Op (Rubble) / Mr-Ro / - 4. J / 60°-110° / Po / Mr / Light Ca / cong. of #1 (offset by 180° along VCA)				
					1			3						
					4			1						
					>10			2						
	6	5	9	100	>10	70		3						
					3			4						
					2			3						
	7				1			1			LIMESTONE 1. J / 110°-130° / Ti-Po / Sm / Light Ca 2. J / 10° / Ti-Po / Sm / Light-moderate Ca			
					2			1						
					2			1						
	8	6	9	100	70			2						
					>10			1						
					>10			1						
					2			2						
					>10			1						
	9													
26	10													
	11													

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

Bentonite seal

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-14B

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/27/2017 through 1/27/2017	AZIMUTH:	146
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	32.76 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,595 E 465,849
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	8.4 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	0.00 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											LIMESTONE 1. J / 90°-100° / Po / Sm-Ro / Light Fe / Light PHC odour and rainbow sheen 2. J / 50° / Po / Sm-Ro / Light Ca / Light PHC odour and rainbow sheen 3. J / 80° / Po / Sm-Ro / Light Fe / Light PHC odour / conj. of #1 (offset by 180° along VCA)			Stick Up Monument Concrete Bentonite seal
32	1	1	8	100	>10	50		R	1		LIMESTONE 1. J / 70° / Po-Op / Sm-Mr / Light Fe / Black NAPL spots observed in this fracture feature 2. J / - / Vt / Sm / - / Black NAPL spots observed in this fracture feature 3. J / 90°-80° / Po-Op / Sm-Mr / - / symp. of #1 (offset by 90° along CVA) 4. J / 110° / Po-Op / Sm-Mr / - / Black NAPL observed in this fracture feature			Silica sand
	2	2	8	100	3	77			1 2 3 3 3 3					
	2				4				4 4					
	3	3	8	100	>10	77			1 2 1 1 1 3				Silica sand Bentonite seal	
					>10				4 1 1 1 1				Silica sand	
30	4	4	9	100	>10	83			5 1 2 2 2 1 1 3				25 mm 020 slot sched 40 PVC pipe	
	4				1				2 2 2					
					2				1 3					
	5													

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW17-17A

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/27/2017 through 1/27/2017	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	32.52 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,603 E 465,878
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	8.8 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	1.46 metres below grade (3/24/2017)

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0									GRAVEL (road base), some sand increasing with depth, loose, grey, moist			Flush-mounted roadbox	
32									SILT. Only observed return water at this location, but the return was similar to other areas where silt was observed.			Concrete	
1												Bentonite seal	
												Silica sand	
2												25 mm 010 slot sched 40 PVC pipe	
30												End cap	
3			>10					R	AMPHIBOLITE R. Rubble 1. J / 110° / Po / Sm / Heavy Fe / Rainbow sheen and a light PHC odour were noted when coring at this location 2. J / 50° / Po / Sm / Heavy Fe 3. J / 80° / Op (end of core) / Sm / Light Fe			Silica sand	
	1	10	60	0	44			2 3 R 3 1	No recovery from 3.7 m to 4.3 m			Bentonite seal	
4			>10					R 1				Silica sand	
28			>10					R 1	AMPHIBOLITE R. Rubble 1. J / 80° / Op-Po / Sm-Ro / Light Ca 2. J / 70° / Po-Op / Sm-Ro / Light Ca / symp. of #1 (offset by 90° along VCA)				
			>10					2 1 R 2					
5													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-17A

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade						Frac. Dwg. Number
	5	2	10	73	>10	39								
									No recovery from 5.4 m to 5.8 m					
									AMPHIBOLITE R. Rubble 1. J / 130° / Op / Sm-Ro / Light Ca 2. J / 35° / Op (Rubble) / Sm / Light Ca 3. J / 140°-145° / Op / Sm / Light Ca					
26	6				>10									
					>10									
					>10	0			No recovery from 6.8 m to 7.3 m					
	7	3	10	63										
									AMPHIBOLITE R. Rubble 1. J / 80° / Po (Rubble) / Ro / Light Ca 2. J / 120°-130° / Op / Mr / Light Ca/Chl					
					2									
					>10									
					2	92								
24	8	4	11	87										
					4				No recovery from 8.6 m to 8.8 m					
	9													
	10													
22	11													

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-17B

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/27/2017 through 1/27/2017	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	32.52 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,603 E 465,878
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	8.8 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	3.16 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											GRAVEL (road base), some sand increasing with depth, loose, grey, moist			Flush-mounted roadbox
32											SILT. Only observed return water at this location, but the return was similar to other areas where silt was observed.			Concrete
	1													Bentonite seal
	2													Silica sand
30														
3				>10					R	AMPHIBOLITE	1. J / 110° / Po / Sm / Heavy Fe / Rainbow sheen and a light PHC odour were noted when coring at this location			
				0					2		2. J / 50° / Po / Sm / Heavy Fe			
		1	10	60	44				3		3. J / 80° / Op (end of core) / Sm / Light Fe			
				>10					R		No recovery from 3.7 m to 4.3 m			Bentonite seal
	4								1					Silica sand
28				>10					R	AMPHIBOLITE	1. J / 80° / Op-Po / Sm-Ro / Light Ca			
				>10					2		2. J / 70° / Po-Op / Sm-Ro / Light Ca / symp. of #1 (offset by 90° along VCA)			
									1					
									R					
	5								2					25 mm 020 slot sched 40 PVC pipe

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-17B

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
5		2	10	73	>10	39			R 2 2 1 1	No recovery from 5.4 m to 5.8 m		End cap Silica sand	
6					>10				R 1 2 3 3 3 3 R	AMPHIBOLITE R. Rubble 1. J / 130° / Op / Sm-Ro / Light Ca 2. J / 35° / Op (Rubble) / Sm / Light Ca 3. J / 140°-145° / Op / Sm / Light Ca			
26		3	10	63	>10	0			R 3 3 3 R	No recovery from 6.8 m to 7.3 m			
7					>10								
8					2				1 2 R 2 2	AMPHIBOLITE R. Rubble 1. J / 80° / Po (Rubble) / Ro / Light Ca 2. J / 120°-130° / Op / Mr / Light Ca/Chl			
24		4	11	87	>10	92			R 2 2 2	No recovery from 8.6 m to 8.8 m		Bentonite seal	
9					2				1 2 2				
10					4								
22													
11													

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-18A

Sheet 1 of 5

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/28/2017 through 1/29/2017	AZIMUTH:	187
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-30 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	35.99 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,590 E 465,885
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	25.8 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	0.34 metres below grade (3/24/2017)

Elevation, metres	ROCK CORE									Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number						
0				>10							SILT, trace to some clay, trace sand, trace gravel, firm, moist, brown			Stick Up Monument Concrete ▽
1	1	12	39	>10	0				R		AMPHIBOLITE R. Rubble 1. J / 50°-60° / Ti-Op / Sm / Heavy Fe / Vc 2. J / 180°-175° / Op / Sm / Heavy Fe / Wi			
2	2	12	100	>10	23						AMPHIBOLITE 1. J / 50° / Ti-Op / Sm-Ro / Heavy Fe / Vc-Cl 2. J / 130° / Ti-Po / Sm-Ro / Heavy Fe / conj. of #1 (offset by 180° along VCA) 3. J / 60° / Ti-Po / Sm-Ro / Heavy Fe / symp. of #1 (offset by -90° along VCA) 4. J / 10° / Ti / Sm / Heavy Fe / Cl			Bentonite seal
3	3	12	100	>10	33						AMPHIBOLITE 1. J / 30°-50° / Po / Sm / Heavy Fe / Vc 2. J / 70° / Po / Sm / Heavy Fe / symp. of #1 (offset by -90° along VCA) 3. J / 80°-90° / Po-OP / Sm / Light-Heavy Fe / Vc 4. J / 90° / Po / Ro / - / symp. of #1 (offset by 90° along VCA)			Silica sand
34	4			>10							LIMESTONE 1. J / 30°-50° / Po / Sm / Heavy Fe 2. J / 70° / Po / Sm / Heavy Fe / symp. of #1 (offset by -90° along VCA) 3. J / 80°-90° / Po-OP / Sm / Light-Heavy Fe / Vc 4. J / 90° / Po / Ro / - / symp. of #1 (offset by 90° along VCA)			
5				2							LIMESTONE 1. J / 90°-100° / Po-op / Sm / Light Fe 2. J / 20° / Po / Sm / Moderate Fe/Heavy Ca / Wi 3. J / 70° / Ti / Sm / Light Fe / Vc 4. J / 130° / Op / Sm-Mr / Moderate-Heavy Fe			25 mm 020 slot sched 40 PVC pipe

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW17-18A

Sheet 2 of 5

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering						Rock Grade
32	5	4	13	87	3	38			1 3 2 2 3 4 2 3	AMPHIBOLITE			
					>10			R		No recovery from 5.7 m to 5.9 m			
		5	13	100	2	47			1 2	AMPHIBOLITE 1. J / 150° / Ti / Sm / Light Ca / Mo 2. J / 70° / Ti / Sm / Light Ca / conj. of #1 (offset by 180° along VCA)			
					6				1 3 2	3. J / 90° / Po-Op (Rubble) / Sm / Light Fe / Vc-Cl 4. J / 20° / Ti / Sm / Light Fe / Wi			
					4				3 3 3	LIMESTONE 1. J / 150° / Ti / Sm / Light Fe / Mo 2. J / 70° / Ti / Sm / Light Fe / conj. of #1 (offset by 180° along VCA)			
					>10				3 3 3 1 3 3 3				
					>10				4 3 3 2 3 1 1	LIMESTONE 1. J / 90° / Po-Op / Sm / Light Fe / Vc-Cl 2. J / 130° / Po / Sm-Ro / Light Fe / Wi 3. J / 105° / Po / Sm / Light Fe / Wi 4. J / 20° / Ti / Sm / Light Fe / Vc 5. J / 20° / Ti / Sm / Light Fe / symp. of #4 (offset by 90° along VCA)			
		6	13	100	4	50			1 1 1 1 1 1				
					>10				1 1 3 1 4				
					>10				5 2 1 1 1 1 1 1 2 3 2 2 2 1 4 3	LIMESTONE 1. J / 120° / Ti-Po / Sm / Light Fe / Wi 2. J / 90° / Ti-Po / Sm-Mr / Light Fe / Cl-Mo 3. J / 20° / Ti-Po / Ro / Light Fe / Wi 4. J / 170°-180° / Vt / Sm / Light Fe / Wi			
	7	14	100	4	62			2 3 2 2 1 4 3					
				6									
				4									
				7									
				2									
	11								1	LIMESTONE 1. J / 70° / Ti-Op / Sm / Silty / Cl 2. J / 90° / Po / Sm / Silty / Cl 3. J / 165° / Op / Sm / Light Fe / Wi			

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW17-18A

Sheet 3 of 5

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade						Frac. Dwg. Number
30	12	8	14	100	>10	88			2 2 1 3 3					
					>10									
				5										
				>10					1	LIMESTONE 1. J / 95° / Vt-Po / Sm / Silty / Vc-Mo 2. J / 75° / Ti / Sm / - / conj. of #1 (offset by 180° along VCA)				
				>10					1 2					
				>10					2					
	13		9	14	95	>10	74			1 1				
						>10				1 1				
						4					1 1	No recovery from 13.5 m to 13.6 m		
	14					5				1 1 2	LIMESTONE 1. J / 60° / Ti-Po / Sm-Mr / Light Ca-Cl / Cl 2. J / 90° / Op / Sm-Mr / - / Mo			
					>10				1 2					
10			15	92	5	92				1 1				
								>10				1 1 R 1		
15					>10				1 1 1 1					
					>10				1 1 R 1	No recovery from 15.0 m to 15.1 m			Bentonite seal	
					>10					1 1 1 1	LIMESTONE 1. J / 110°-120° / Ti-Op / Sm / Silty/Light Ca-Cl / Vc-Cl 2. J / 0° / Ti / Sm / Silty			
28	16	11	15	75	6	75			1 1 1 1					
								>10				1 1 2 1	No recovery from 16.2 m to 16.6 m	
					>10					1				
		17					>10				R 1 2 3 3	LIMESTONE 1. J / 30° / Op-Po / Sm / Light Fe-Ca/Silty / Mo 2. J / 70°-110° / Po-Ti / Sm-Ro / Light Ca 3. J / 130° / Ti-Po / Sm / Light Ca / Vc-Cl		
					>10					3 3				
					>10					1				

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW17-18A

Sheet 4 of 5

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
18	18.0	12	15	97	>10	66			3 3 3 3 3 3 3 3 3 3		[Well Completion Diagram]		
	18.1				5					No recovery from 18.0 m to 18.1 m			
	18.2				5				1 1 1 1 1	LIMESTONE 1. J / 60°-70° / Ti-Po / Sm / Light Ca / Cl			
	18.3				6				1				
	18.4				2				1				
	18.5				>10				R				
	18.6				2				1	LIMESTONE 1. J / 120° / Ti-Po / Sm / Light Ca / Vc-Mo			
	18.7				1				1 1 1 1 1				
	18.8				2				1 1 1 1 1				
	18.9				3				1 1 1 1 1				
19	19.0	13	16	100	2	90			1		[Well Completion Diagram]		
	19.1				>10				R				
	19.2				2				1				
	19.3				1				1 1 1 1 1				
	19.4				2				1 1 1 1 1				
	19.5				3				1 1 1 1 1				
	19.6				2				1 1 1 1 1	No recovery from 21.0 m to 21.2 m			
	19.7				1				1	LIMESTONE 1. J / 120° / Ti-Po (Rubble) / Sm / light Ca / Vc-Cl 2. J / 40° / Ti-Po / Sm / light Ca / conj. of #1 (offset by 180° along VCA)			
	19.8				>10				1 1 1 1 1				
	19.9				3				1 1 1 1 1				
20	20.0	14	16	88	3	85			1 1 1 1 1		[Well Completion Diagram]		
	20.1				2				1 1 1 1 1				
	20.2				1				1 1 1 1 1				
	20.3				>10				1 1 1 1 1				
	20.4				3				1 1 1 1 1				
	20.5				2				1 1 1 1 1				
	20.6				1				1 1 1 1 1				
	20.7				>10				1 1 1 1 1				
	20.8				3				1 1 1 1 1				
	20.9				2				1 1 1 1 1	No recovery from 22.6 m to 22.7 m			
21	21.0	15	16	95	3	44			2 1 1 1 1		[Well Completion Diagram]		
	21.1				4				1 1 1 1 1				
	21.2				>10				1 1 1 1 1				
	21.3				>10				1 1 1 1 1				
	21.4				3				1 1 1 1 1				
	21.5				2				1 1 1 1 1				
	21.6				1				1 1 1 1 1				
	21.7				>10				1 1 1 1 1				
	21.8				3				1 1 1 1 1				
	21.9				4				1 1 1 1 1				
22	22.0				>10				R		[Well Completion Diagram]		
	22.1				>10								
	22.2				3				1 1 1 1 1				
	22.3				2				1 1 1 1 1				
	22.4				1				1 1 1 1 1				
	22.5				>10				1 1 1 1 1				
	22.6				3				1 1 1 1 1				
	22.7				2				1 1 1 1 1				
	22.8				1				1 1 1 1 1				
	22.9				>10				1 1 1 1 1				
23	23.0				>10				R		[Well Completion Diagram]	Silica sand	
	23.1				>10								
	23.2				3				1 1 1 1 1				
	23.3				2				1 1 1 1 1				
	23.4				1				1 1 1 1 1				
	23.5				>10				1 1 1 1 1				
	23.6				3				1 1 1 1 1				
	23.7				2				1 1 1 1 1				
	23.8				1				1 1 1 1 1				
	23.9				>10				1 1 1 1 1	No recovery from 23.3 m to 24.2 m			

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW17-18A

Sheet 5 of 5

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
	24	16	17	40		25							
	25	17	17	100	>10	55			AMPHIBOLITE 1. J / 130° / Ti-Op / Sm-Mr / Light-Moderate Ca / Vc-CI 2. J / 80°-160° / Ti-Op / Sm-Mr / Light-Moderate Ca / symp. of #1 (offset by -90° along VCA) 3. J / 60° / Ti-Op / Sm-Mr / Light-Moderate Ca / conj. of #1 (offset by 180° along VCA) 4. J / 165° / Ti-Op / Sm-Mr / Light-Moderate Ca / conj. of #5 (offset by 180° along VCA) 5. J / 40°-180° / Vt-Ti / Sm / Light-Moderate Ca / CI				
	26				>10								
	27				>10								
	28				>10								
	29				>10								

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Core Log MW17-18B

Sheet 2 of 5

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering						Rock Grade
32	5	4	13	87	3	38			1 3 2 2 3 4 2 3	AMPHIBOLITE			
					>10			R		No recovery from 5.7 m to 5.9 m			
32	6	5	13	100	2	47			1 2 1 3 2 3 3 3 3 3 3	AMPHIBOLITE 1. J / 150° / Ti / Sm / Light Ca / Mo 2. J / 70° / Ti / Sm / Light Ca / conj. of #1 (offset by 180° along VCA) 3. J / 90° / Po-Op (Rubble) / Sm / Light Fe / Vc-Cl 4. J / 20° / Ti / Sm / Light Fe / Wi LIMESTONE 1. J / 150° / Ti / Sm / Light Fe / Mo 2. J / 70° / Ti / Sm / Light Fe / conj. of #1 (offset by 180° along VCA)			
	7				6 4 >10 >10								
32	8	6	13	100	2 4	50			1 2 1 1 1 1 1 1 3 3 4	LIMESTONE 1. J / 90° / Po-Op / Sm / Light Fe / Vc-Cl 2. J / 130° / Po / Sm-Ro / Light Fe / Wi 3. J / 105° / Po / Sm / Light Fe / Wi 4. J / 20° / Ti / Sm / Light Fe / Vc 5. J / 20° / Ti / Sm / Light Fe / symp. of #4 (offset by 90° along VCA)			
	9				>10 >10								
32	10	7	14	100	4	62			1 2 2 2 2 1 4 3	LIMESTONE 1. J / 120° / Ti-Po / Sm / Light Fe / Wi 2. J / 90° / Ti-Po / Sm-Mr / Light Fe / Cl-Mo 3. J / 20° / Ti-Po / Ro / Light Fe / Wi 4. J / 170°-180° / Vt / Sm / Light Fe / Wi			
	11				6 4 7 2								
									1	LIMESTONE 1. J / 70° / Ti-Op / Sm / Silty / Cl 2. J / 90° / Po / Sm / Silty / Cl 3. J / 165° / Op / Sm / Light Fe / Wi			

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017



Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
30	12	8	14	100	>10	88			2	LIMESTONE 1. J / 95° / Vt-Po / Sm / Silty / Vc-Mo 2. J / 75° / Ti / Sm / - / conj. of #1 (offset by 180° along VCA)			
					1								
					3								
					3								
					3								
	5												
	13	9	14	95	>10	74			1	No recovery from 13.5 m to 13.6 m			
					1								
					1								
					1								
1													
4													
14	10	15	92	5	92			1	LIMESTONE 1. J / 60° / Ti-Po / Sm-Mr / Light Ca-Cl / Cl 2. J / 90° / Op / Sm-Mr / - / Mo				
				1									
				2									
				1									
				1									
>10													
15	11	15	75	5	75			1	LIMESTONE 1. J / 110°-120° / Ti-Op / Sm / Silty/Light Ca-Cl / Vc-Cl 2. J / 0° / Ti / Sm / Silty				
				1									
				1									
				1									
				1									
6													
16	10	15	92	>10	92			1	No recovery from 15.0 m to 15.1 m				
				1									
				1									
				1									
				1									
>10													
17	11	15	75	>10	75			1	LIMESTONE 1. J / 30° / Op-Po / Sm / Light Fe-Ca/Silty / Mo 2. J / 70°-110° / Po-Ti / Sm-Ro / Light Ca 3. J / 130° / Ti-Po / Sm / Light Ca / Vc-Cl				
				1									
				1									
				1									
				1									
>10													
17	11	15	75	>10	75			1	No recovery from 16.2 m to 16.6 m				
				1									
				1									
				1									
				1									
>10													
17	11	15	75	>10	75			R	LIMESTONE 1. J / 30° / Op-Po / Sm / Light Fe-Ca/Silty / Mo 2. J / 70°-110° / Po-Ti / Sm-Ro / Light Ca 3. J / 130° / Ti-Po / Sm / Light Ca / Vc-Cl				
				1									
				2									
				3									
				3									
>10													
17	11	15	75	>10	75			1	LIMESTONE 1. J / 30° / Op-Po / Sm / Light Fe-Ca/Silty / Mo 2. J / 70°-110° / Po-Ti / Sm-Ro / Light Ca 3. J / 130° / Ti-Po / Sm / Light Ca / Vc-Cl				
				1									
				1									
				1									
				1									
>10													

Bentonite seal

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Core Log MW17-18B

Sheet 4 of 5

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade						Frac. Dwg. Number
18	18.0	12	15	97	>10	66			3 3 3 3 3 3 3 3 3 3					
	18.1				5					No recovery from 18.0 m to 18.1 m				
	18.2				5					LIMESTONE				
	18.3				5					1. J / 60°-70° / Ti-Po / Sm / Light Ca / Cl				
	18.4				6									
	18.5				1									
	18.6				1									
	18.7				1									
	18.8				1									
	18.9				1									
19	19.0	13	16	100	2	90			R					
	19.1				>10									
	19.2				2					LIMESTONE				
	19.3				1					1. J / 120° / Ti-Po / Sm / Light Ca / Vc-Mo				
	19.4				1									
	19.5				1									
	19.6				1									
	19.7				1									
	19.8				1									
	19.9				1									
20	20.0	14	16	88	3	85								
	20.1				2									
	20.2				1									
	20.3				2									
	20.4				1									
	20.5				1									
	20.6				1									
	20.7				1									
	20.8				1									
	20.9				1									
21	21.0				2									
	21.1				1					No recovery from 21.0 m to 21.2 m				
	21.2				1									
	21.3				1					LIMESTONE				
	21.4				1					1. J / 120° / Ti-Po (Rubble) / Sm / light Ca / Vc-Cl				
	21.5				1					2. J / 40° / Ti-Po / Sm / light Ca / conj. of #1 (offset by 180° along VCA)				
	21.6				1									
	21.7				1									
	21.8				1									
	21.9				1									
22	22.0	15	16	95	3	44								
	22.1				>10									
	22.2				2									
	22.3				1									
	22.4				1									
	22.5				1									
	22.6				1									
	22.7				1									
	22.8				1									
	22.9				1									
23	23.0				4									
	23.1				2									
	23.2				1					No recovery from 22.6 m to 22.7 m				
	23.3				1									
	23.4				1									
	23.5				1									
	23.6				1									
	23.7				1									
	23.8				1									
	23.9				1									
24	24.0				>10					AMPHIBOLITE				
	24.1				>10					1. J / 100° / Op (Rubble) / Sm / Light Ca				
24.2									2. J / 120° / Op / Sm / Light Ca / conj. of #1 (offset by 180° along VCA)					
24.3										No recovery from 23.3 m to 24.2 m				
24.4														
24.5														
24.6														
24.7														
24.8														
24.9														

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

Silica sand

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Core Log MW17-19A

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/30/2017 through 1/30/2017	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	34.28 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,602 E 465,899
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	8.9 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	3.20 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE									Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number						
0												SILT, trace clay, trace sand, trace gravel, occasional cobbles. firm, moist, brown			Stick Up Monument
34															Concrete
	1														Bentonite seal
	2														Silica sand
32															25 mm 010 slot sched 40 PVC pipe
	3														▽
	4														End cap Silica sand
30		1	18	105		0					R	AMPHIBOLITE R. Rubble			Bentonite seal
					>10						1	AMPHIBOLITE R. Rubble			Silica sand
					4						2	1. J / 140° / Ti-Op / Sm / Heavy Fe			
											4	2. J / 20° / Ti-Po / Sm / Heavy Fe			
											3	3. J / 110° / Ti-Op (Rubble) / Sm / Heavy Fe			
											3	4. J / 70° / Op (Rubble) / Sm / Heavy Fe / Symp. of 3 (offset by 180°)			
					>10						3				
5															

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-19A

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
	5	2	18	60	>10	0			3 1 1 1 1 1 R	No recovery from 5.3 m to 5.9 m			
28	6				>10				1 2 3 4 5 R	AMPHIBOLITE R. Rubble 1. J / 20°-160° / Ti-Op / Sm / Heavy Fe 2. J / 140°-150° / Ti-Op / Sm / Heavy Fe 3. J / 160°-20° / Ti-Op / Sm / Heavy Fe / Symp. of 1 (offset by 180°) 4. J / 80° / Ti-Po / Sm / Heavy Fe 5. J / 80° / Ti-Po / Sm / Heavy Fe / Conj. of 4 (offset by 90°) 6. J / 95° / Po / Sm / Light Fe-Ca			
	7	3	18	96	1	38			2 3 6 1	No recovery from 7.3 m to 7.4 m			
26	8	4	18	96	4	24			1 1 2 2 3 3 R 4 2 2 2 2 2	AMPHIBOLITE R. Rubble 1. J / 20° / Ti-Op / Sm-Ro / Light Ca/Light-Mod. Fe 2. J / 70° / Vt-Po / Sm-Ro / Light-Heavy Ca/Light Fe 3. J / 120° / Po / Sm-Ro / Light Fe-Ca 4. J / 160° / Ti / Sm / Heavy Fe / Symp. of 1 (offset by 180°)		Bentonite seal	
	9				>10				2 2 2	No recovery from 8.8 m to 8.9 m			
	10				>10								
24	11												

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-19B

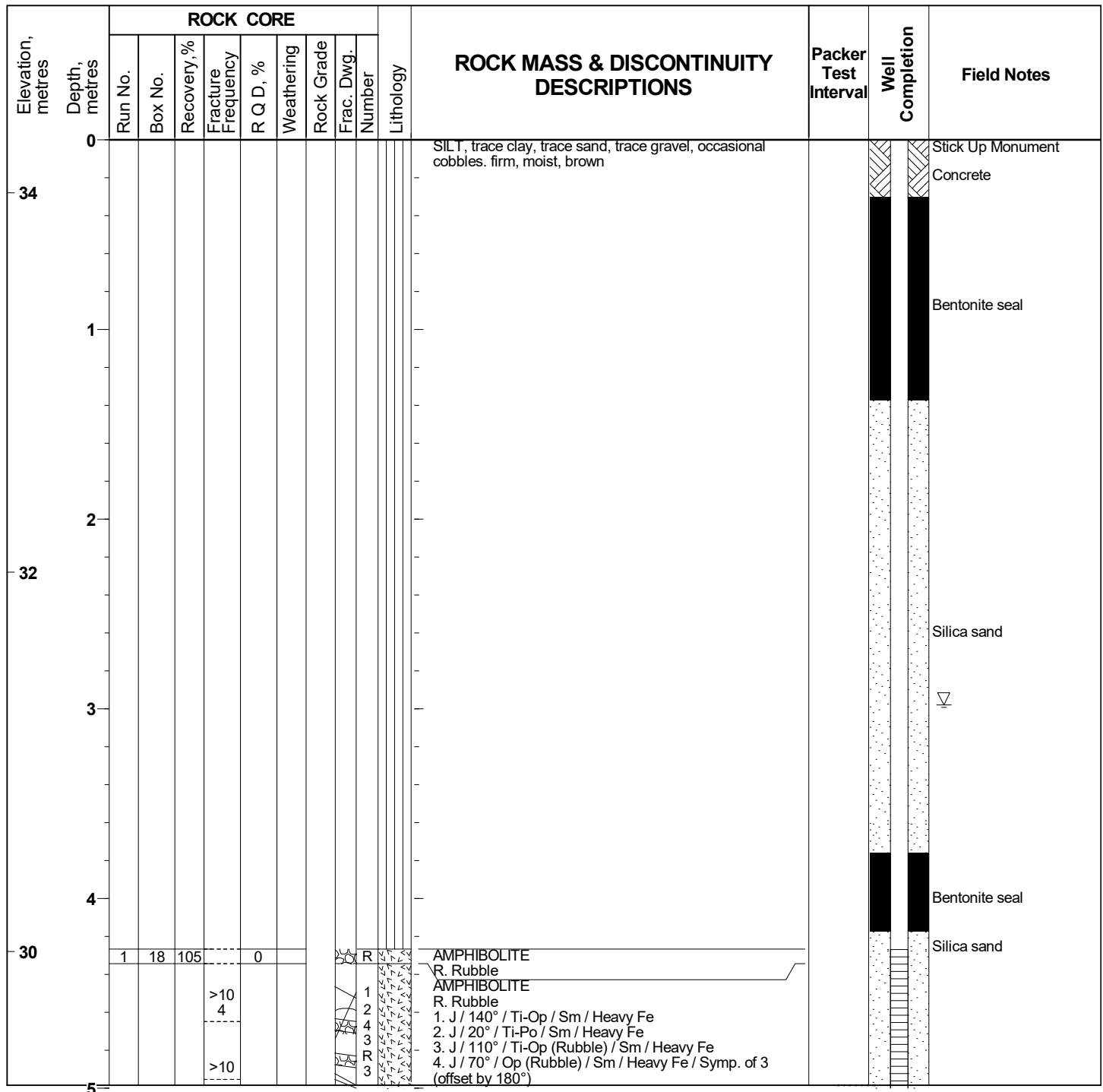
Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/30/2017 through 1/30/2017	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	34.28 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,602 E 465,899
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	8.9 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	2.98 metres below grade (3/24/2017)



THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-19B

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
	5	2	18	60	>10	0				No recovery from 5.3 m to 5.9 m			25 mm 020 slot sched 40 PVC pipe
	6				>10				1 AMPHIBOLITE 2 R. Rubble 3 1. J / 20°-160° / Ti-Op / Sm / Heavy Fe 4 2. J / 140°-150° / Ti-Op / Sm / Heavy Fe 5 3. J / 160°-20° / Ti-Op / Sm / Heavy Fe / Symp. of 1 (offset by 180°) 6 4. J / 80° / Ti-Po / Sm / Heavy Fe 7 5. J / 80° / Ti-Po / Sm / Heavy Fe / Conj. of 4 (offset by 90°) 8 6. J / 95° / Po / Sm / Light Fe-Ca			End cap Silica sand	
28	7	3	18	96	1	38				No recovery from 7.3 m to 7.4 m			
	8				4				1 AMPHIBOLITE 2 R. Rubble 3 1. J / 20° / Ti-Op / Sm-Ro / Light Ca/Light-Mod. Fe 4 2. J / 70° / Vt-Po / Sm-Ro / Light-Heavy Ca/Light Fe 5 3. J / 120° / Po / Sm-Ro / Light Fe-Ca 6 4. J / 160° / Ti / Sm / Heavy Fe / Symp. of 1 (offset by 180°)			Bentonite seal	
26	9	4	18	96	>10	24				No recovery from 8.8 m to 8.9 m			
	10				3								
	11				>10								
24													

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Core Log MW17-20A

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
32	5								1. J / 30° / Po-Op / Sm-Mr / Heavy Fe 2. J / 30° / Po-Op / Sm-Mr / Heavy Fe / Conj. of 1 (offset by -90°) 3. J / 80° / Po-Op / Sm-Mr / Heavy Fe 4. J / 70° / Po / Sm-Mr / Heavy Fe				
		3	19	97	5	19							
					>10								
					>10								
	6								No recovery from 6.2 m to 6.25 m				
					>10				AMPHIBOLITE R. Rubble 1. J / 10° / Po / Sm / Heavy Fe 2. J / 120° / Po-Op / Sm-Mr / Heavy Fe 3. J / 20°-160° / Op / Sm-Mr / Heavy Fe				
					>10								
					>10								
	7	4	20	100	>10	23							
					>10								
					>10								
					>10								
30	8								AMPHIBOLITE R. Rubble 1. J / 100° / Op / Sm / Heavy Fe 2. J / 140°-150° / Op-Po / Mr / Heavy Fe 3. J / 0° / Op / Sm / Heavy Fe 4. J / 160° / Op / Sm / Heavy Fe 5. J / 70° / Op / Sm / Heavy Fe 6. J / 120° / Op / Sm / Heavy Fe				
					>10								
					>10								
					>10								
	9												
					>10								
					>10								
					>10								
	10	6	20	100	>10	20			AMPHIBOLITE 1. J / 85° / Op-Po / Sm-Mr / Heavy Fe 2. J / 60° / Op-Po / Mr / Heavy Fe 3. J / 150° / Po-Op / Mr-Ro / Heavy Fe 4. J / 120° / Po-Op / Sm / Heavy Fe / Conj. of 3 (offset by -90°)				
					>10								
					>10								
					>10								
					>10								
28	11												

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-20B

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/30/2017 through 1/30/2017	AZIMUTH:	176
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	35.54 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,599 E 465,910
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	10.8 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	2.86 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE									Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg.	Number					
0												SILT, some cobble, trace gravel, trace sand, trace clay, firm, brown, moist		Stick Up Monument	Concrete
1														Bentonite seal	
34												AMPHIBOLITE R. Rubble 1. J / 110°-80° / Ti-Po / Sm / Heavy Fe 2. J / 140° / Ti-Po / Sm / Heavy Fe / Conj. of 1 (offset by 90°) 3. J / 155° / Ti-Po (Rubble) / Sm / Heavy Fe / Vc-Mc 4. J / 0°-50° / Po-Op / Mr / Heavy Fe			
3		1	19	100	>10 6	25									
4		2	19	100	>10 >10 >10 >10	15						AMPHIBOLITE R. Rubble 1. J / 30° / Po-Op / Sm-Mr / Heavy Fe 2. J / 80° / Po-Op / Sm / Heavy Fe 3. J / 40° / Po-Op / Sm-Mr / Heavy Fe / Conj. of 1 (offset by 90°) 4. J / 130° / Po-Op / Sm-Mr / Heavy Fe / Symp. of 1 (offset by 180°) 5. J / 0°-10° / Po-Op / Mr / Heavy Fe			Silica sand
5					>10							AMPHIBOLITE R. Rubble 1. J / 100° / Po-Op / Sm / Heavy Fe			

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-20B

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
32	5	3	19	97	5	19			1	2. J / 30° / Po-Op / Sm-Mr / Heavy Fe 3. J / 30° / Po-Op / Sm-Mr / Heavy Fe / Conj. of 1 (offset by -90°) 4. J / 80° / Po-Op / Sm-Mr / Heavy Fe 5. J / 70° / Po / Sm-Mr / Heavy Fe			
					2								
					3								
					1								
					1								
	6				>10				1	No recovery from 6.2 m to 6.25 m			
					2								
					3								
					1								
					4								
	7	4	20	100	>10	23			1	AMPHIBOLITE R. Rubble 1. J / 10° / Po / Sm / Heavy Fe 2. J / 120° / Po-Op / Sm-Mr / Heavy Fe 3. J / 20°-160° / Op / Sm-Mr / Heavy Fe			Bentonite seal
					2								
					3								
					3								
					1								
30	8	5	20	100	>10	27			1	AMPHIBOLITE R. Rubble 1. J / 100° / Op / Sm / Heavy Fe 2. J / 140°-150° / Op-Po / Mr / Heavy Fe 3. J / 0° / Op / Sm / Heavy Fe 4. J / 160° / Op / Sm / Heavy Fe 5. J / 70° / Op / Sm / Heavy Fe 6. J / 120° / Op / Sm / Heavy Fe			25 mm 020 slot sched 40 PVC pipe
					1								
					2								
					3								
					4								
	9				>10				1				End cap
					6								
					6								
					5								
					6								
10	6	20	100	>10	20			1	AMPHIBOLITE 1. J / 85° / Op-Po / Sm-Mr / Heavy Fe 2. J / 60° / Op-Po / Mr / Heavy Fe 3. J / 150° / Po-Op / Mr-Ro / Heavy Fe 4. J / 120° / Po-Op / Sm / Heavy Fe / Conj. of 3 (offset by -90°)			Silica sand	
				2									
				3									
				3									
				2									
28	11			>10				1				Bentonite seal	
				4									

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW17-21

Sheet 1 of 4

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	1/31/2017 through 2/1/2017	AZIMUTH:	94
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-30 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	40.02 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,589 E 465,854
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	20.0 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	3.41 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
40	0										SILT and BOULDER, limestone, trace gravel, trace clay, trace sand, soft/loose, some voids, brown, moist			Stick Up Monument Concrete
	1													
	2										LIMESTONE R. Rubble 1. J / 35°-45° / Ti-Po / Sm / Heavy Fe / Cl 2. J / 155° / Vt-Ti / Sm / Heavy Fe / Symp. of 1 (offset by 180°) 3. J / 70° / Ti-Po / Sm-Mr / Heavy Fe 4. J / 150° / Ti-Po / Sm / Heavy Fe / Conj. of 1 (offset by -90°)			
	3	1	20	88	>10	38					No recovery from 3.0 m to 3.2 m			
	4										LIMESTONE R. Rubble 1. J / 110° / Po / Sm-Mr / Light Fe / Cl 2. J / 130° / Op (Rubble) / Sm / Light Fe / Vc 3. J / 0° / Ti-Po / Mr-Ro / Light Fe 4. J / 80° / Ti-Po / Sm / Light Fe			
	4	2	20	78	>10	29					AMPHIBOLITE No recovery from 3.9 m to 4.1 m			
38	4										LIMESTONE 1. J / 50° / Po / Sm-Mr / Light Fe / Vc-Cl			
	5	3	20	92	3	86					No recovery from 4.6 m to 4.7 m			
					2						LIMESTONE 1. J / 40° / Vt-Po / Sm-Mr / Light Fe / Vc-Cl 2. J / 150° / Vt-Po / Sm-Mr / Light Fe / Vc-Cl / Symp. of			
	5				>10									

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017



Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
34	12	8	22	95	6	35			1	3. J / 60° / Po-Ti / Sm-Ro / Light Fe / Symp. of 1 (offset by 180°)			
					2								
					3								
	12	9	22	100	>10	0			1	No recovery from 11.65 m to 11.7 m LIMESTONE R. Rubble 1. J / 160° / Op (Rubble) / Sm-Ro / Light/Moderate Fe-Ca 2. J / 60° / Po / Sm-Ro / Light Fe-Ca			
					2								
					3								
	13	10	22	93	>10	0			1	No recovery from 12.2 m to 12.3 m LIMESTONE R. Rubble 1. J / 150°-160° / Op-Ti / Sm-Ro / Light Fe-Ca 2. J / 130° / Po / Sm-Ro / Light Fe-Ca 3. J / 120°-160° / Vt-Ti / Sm-Mr / Light Fe-Ca 4. J / 120° / Po / Sm-Mr / Light Fe-Ca / Symp. of 2 (parallel)			
					2								
					3								
	14	11	22	100	>10	25			1	No recovery from 13.3 m to 13.4 m LIMESTONE R. Rubble 1. J / 40° / Ti-Po / Sm-Mr / Light Fe-Ca / Vc-Cl			Silica sand
2													
3													
15	12	22	85	3	71			1	LIMESTONE R. Rubble 1. J / 30° / Vt-Ti / Sm / Light Ca / Vc-Cl 2. J / 70° / Po / Sm-Ro / Light Fe 3. J / 110° / Ti / Sm / Light Ca / Vc-Cl / Conj. of 1 (offset by 90°)			51 mm 020 slot sched 40 PVC pipe	
				2									
				3									
16	13	23	93	>10	93			1	No recovery from 15.1 m to 15.4 m			End cap	
				2									
				3									
17	13	23	93	>10	93			1	LIMESTONE 1. J / 35° / Ti / Sm-Mr / Light Ca / Cl 2. J / 120° / Ti / Sm-Mr / Light Ca / Cl			Silica sand	
				2									
				3									
17	13	23	93	>10	93			1	No recovery from 16.85 m to 16.9 m LIMESTONE R. Rubble 1. J / 110° / Ti-Po / Sm / Light Ca 2. J / 140° / Ti / Sm / Light Ca / Conj. of 1 (offset by 90°)				
				2									
				3									

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-21

Sheet 4 of 4

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade						Frac. Dwg. Number
	18	14	23	77	4 3	59			1 1 2 1 1 1 R 1	No recovery from 18.1 m to 18.4 m		Bentonite seal		
	19	15	23	75	1 >10	42			3 1 2 2 1 2 2 2 R 4 1	LIMESTONE R. Rubble 1. J / 130° / Ti / Sm / Moderate Ca-Cl 2. J / 30° / Ti / Sm / Heavy Ca-Cl / Conj. of 1 (offset by -90°) 3. J / 150° / Ti / Sm / Moderate Ca-Cl 4. J / 120° / Ti / Sm / Moderate Ca-Cl / Conj. of 1 (offset by 90°) No recovery from 19.6 m to end				
30	20				>10									
	21													
	22													
	23													

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-22A

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	2/2/2017 through 2/3/2017	AZIMUTH:	165
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	28.67 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,613 E 465,878
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	9.6 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	1.28 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE									ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number	Lithology				
0														
28	1												▽	
	2													
	3													
26	4													
	5													

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Core Log MW17-22A

Sheet 2 of 2

**Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC**



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
5														
6														
24														
7														
8														
9														
22														
10														
11														

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-22B

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	2/2/2017 through 2/3/2017	AZIMUTH:	165
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-45 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	28.67 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,613 E 465,878
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	9.6 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	0.59 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number						
0															
28	1														▽
	2														
	3														
26	4														
	5														

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-22B

Sheet 2 of 2

**Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC**



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
5														
6														
24														
7														
8														
9														
22														
10														
11														

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-23

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	2/3/2017 through 2/3/2017	AZIMUTH:	148
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-30 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	33.74 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,599 E 465,886
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	8.2 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	1.07 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											SILT, trace gravel, trace sand, trace clay, firm, moist, brown			Stick Up Monument Concrete
1														▽
2		1	26	79	>10	58			R	1 2	AMPHIBOLITE 1. J / 140°-150° / Ti-Po / Sm-Mr / Heavy Fe 2. J / 170°-180° / Ti-Po / Sm-Mr / Heavy Fe			Bentonite seal
3		2	26	78	>10	35				1 2 3 4 1 1 4 3 1 1 5 4 3 4 4 3	No recovery from 2.0 m to 2.1 m AMPHIBOLITE 1. J / 60° / Po / Sm / Heavy Fe 2. J / 0°-10° / Po / Sm / Heavy Fe 3. J / 90°-100° / Po / Sm / Heavy Fe 4. J / 20° / Po / Sm / Heavy Fe 5. J / 10°-0° / Po / Sm / Conj. of 2 (offset by 90°) / Heavy Fe			Silica sand
4	32	3	26	95	>10	42				1 2 2 1 2 2 1 2 3 3 1 1	AMPHIBOLITE 1. J / 50°-60° / Ti-Po / Sm / Heavy Fe 2. J / 110°-120° / Ti-Op / Sm-Mr / Heavy Fe 3. J / 110° / Ti-Op / Sm-Mr / Heavy Fe 4. J / 30° / Ti-Po / Sm / Heavy Fe			51 mm 020 slot sched 40 PVC pipe
5														

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-23

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering					
5				>10					4 2	No recovery from 5.1 m to 5.2 m		
				>10					1 2 2 3	AMPHIBOLITE 1. J / 20° / Vt-Po / Sm / Heavy Fe 2. J / 130° / Ti-Po / Sm / Heavy Fe 3. J / 100° / Ti-Po / Sm / Light-Heavy Fe		
6	4	27	97	3	50				2 3			
				4					3 2 2 2 3 2			
				5					2 2 2	No recovery from 6.6 m to 6.7 m		
				4					2 2 2	AMPHIBOLITE 1. J / 100° / Ti-Po / Sm / Light Ca-Fe 2. J / 70° / Ti-Po / Sm / Light Ca-Cl 3. J / 30° / Ti / Sm / Light Ca 4. J / 100° / Ti / Sm / Light-Heavy Ca 5. J / 10° / Ti-Po / Sm / Light Ca		
7				>10					1 2 4 3			
				>10					3			
30	5	27	100	>10	63				4 3 3 5 2			
				>10					2			
				0					2			
8				>10					2			
9												
10												
11												

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-24

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	2/4/2017 through 2/4/2017	AZIMUTH:	202
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-30 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	33.57 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,599 E 465,856
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	7.6 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	1.76 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											SILT, some cobble, trace gravel, trace sand, trace clay, firm, brown, moist			Stick Up Monument Concrete
1	1	1	28	86	>10	0			R 1 2 1 3 3 1 1	AMPHIBOLITE R. Rubble 1. J / 140° / Po-Op / Sm / Heavy Fe 2. J / 110° / Po-Op / Sm / Heavy Fe 3. J / 20°-25° / Po-Op / Sm / Heavy Fe / Symp. of 1 (offset by 180°)				
					>10						No recovery from 1.4 m to 1.5 m			
2	2	2	28	37	>10	0			R 1 1 2 2 2 2 R	AMPHIBOLITE R. Rubble 1. J / 60° / Ti-Po / Sm / Heavy Fe 2. J / 160° / Po / Sm / Heavy Fe / Symp. of 1 (offset by 180°)			▽ Bentonite seal	
					>10						No recovery from 2.4 m to 3.1 m			
3	3	3	28	97	>10	17			1 2 1 3 1 4 4	AMPHIBOLITE 1. J / 140°-120° / Ti-Po / Sm / Li-Heavy Fe 2. J / 80°-90° / Ti-Po / Sm / Li-Heavy Fe 3. J / 20°-30° / Ti-Po / Sm / Li-Heavy Fe 4. J / 160° / Ti-Po / Sm / Li-Heavy Fe				
					>10						No recovery from 3.75 m to 3.8 m			
4	4	4	28	91	>10	22			R 1 2 3	AMPHIBOLITE R. Rubble 1. J / 130° / Ti-Po / Sm / Heavy Fe 2. J / 140° / Ti-Po / Sm / Heavy Fe 3. J / 120° / Op / Sm-Mr / Heavy Fe / Symp. of 1 (offset by 180°)				
					>10						No recovery from 4.5 m to 4.6 m			
5	5	5	28	97	>10	44			1 1	AMPHIBOLITE 1. J / 0° / Ti-Po / Sm / Heavy Fe 2. J / 20° / Ti-Po / Sm / Light Fe			Silica sand	

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-24

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes		
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade						Frac. Dwg. Number	
30	5				>10					3 2 3 1 2 3 1	No recovery from 5.2 m to 5.3 m				
		6	29	97	3	68				4 3 1	AMPHIBOLITE 1. / 110°-140° / Ti / Sm / Heavy Fe 2. / 30° / Ti / Sm / Heavy Fe 3. / 70° / Po / Sm / Heavy Fe 4. / 150° / Po / Sm / Heavy Fe 5. / 120° / Op-Rubble / Sm / Heavy Fe				
		6			4					4 5	No recovery from 6.0 m to 6.1 m				
					>10					1	AMPHIBOLITE 1. / 40° / Ti / Sm / Light Fe/Ca 2. / 140° / Ti-Po / Mr-Ro / Heavy Fe 3. / 30° / Ti / Sm / Light Fe/Ca 4. / 60° / Po / Sm / Light Fe/Ca/Cl			51 mm 020 slot sched 40 PVC pipe	
		7	29	95	6	100				2 3 4					
		7			3					3 4					
					1										
					0										
		8													
		9													
	10														
	11														
28														End cap	

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Core Log MW17-25

Sheet 1 of 4

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	3/16/2017 through 3/16/2017	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	49.44 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,562 E 465,873
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	18.1 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	11.34 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											SAND and GRAVEL, trace silt, loose (increasing to hard), brown, moist			Flush-mounted roadbox Concrete
											SILT, trace-some sand, trace clay, occasional gravel, soft, wet, light brown			MW17-25A (0.6 - 1.1 mbgs)
	1										No recovery from 1.1 m to 3.0 m			
48														
	2													
	3										SILT, trace sand, trace clay, occasional rounded gravel, very hard, light brown, moist			MW17-25B (3.3 - 3.5 mbgs)
46														
	4										SILT, some gravel, trace sand, trace clay, firm, grey with black staining, light hydrocarbon odour, moist			MW17-25C (4.1 - 4.4 mbgs)
											@ 4.4 m - 4.6 m: wood waste layer, trace-some silt, occasional gravel, soft, brown, moist			
											No recovery from 4.6 m to 4.9 m			
	5										SILT, trace sand, trace clay, very soft, brown, wet			

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ: 6/5/2017



Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
5											Sand, some silt, occasional gravel, loose, brown with peat-like material, moist			
44											Weathered bedrock (limestone)			
6											Bedrock (limestone)			
7		1	A1	43	>10	0			R		LIMESTONE Heavily fractured, Light Fe/Heavy silt			
42											No recovery from 7.5 m to 8.1 m			
8		2 3 4	A1	0		0					LIMESTONE 1. J / 130° / Ti-Po / Sm-Mr / Light silt 2. J / 140° / Ti / Sm / Light Ca R. Rubble			Bentonite seal
9		5	A1	100	>10	86			R		LIMESTONE 1. J / 50° / Ti / Mr / Light silt			
40											LIMESTONE 1. J / 10° / Po / Sm-Mr / Light Ca - Moderate black mineral deposit 2. J / 180° / Op / Sm-Ro / Light Ca 3. J / 130° / Ti / Mr-Ro / Light Ca 4. / 110° / Ti / Sm / Light Ca 5. / 150° / Ti / Sm / Light Fe			
10		6	A1	100	1	100			1					
11														

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Core Log MW17-25

Sheet 3 of 4

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE							Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade						Frac. Dwg. Number
38		7	A2	100	3	60			3					
					>10				2					
	12				>10				4					
					4				1	LIMESTONE 1. J / 40° / Ti / Sm / Light Fe 2. J / 180° / Ti / Sm / Light Fe 3. J / 110° / Po / Mr / Light Fe				
					4				2					
13		8	A2	100	0	42			1					
					3				R					
36					>10					LIMESTONE 1. J / 140° / Ti / Sm-Mr / Light Ca/silt				
					0									
	14				1									
		9	A2	100	2	95			1					
					2									
	15				0					LIMESTONE 1. J / 130° / Ti-Po / Mr / Light Fe 2. J / 160° / Ti-Op (Rubble) / Sm-Mr / Light silt 3. J / 150° / Op (Rubble) / Sm-Ro / Light Ca/silt R. Rubble				
34					0									
					0									
	16	10	A3	100	2	73			1					
					2									
					>10				3					
									2					
									R					
					1					LIMESTONE 1. J / 20° / Ti / Sm / Light Fe 2. J / 30° / Ti / Sm-Mr / Light Fe/Ca R. Rubble				
17					6				1					
									2					
									2					

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

Silica sand

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Core Log MW17-25

Sheet 4 of 4

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
32	11	A3	92	3	73				1				51 mm 020 slot sched 40 PVC pipe
18									R	No recovery from 18.0 m to end			End cap
30													
20													
21													
28													
22													
23													
26													

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Core Log MW17-27

Sheet 1 of 4

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED:	3/17/2017 through 3/17/2017	AZIMUTH:	0
DRILL METHOD:	Triple Tube	HOLE INCLINATION:	-90 degrees from horizontal
DRILL EQUIPMENT:	Mobile B47 (MST 1100 Mount)	ELEVATION:	49.40 metres (Geodetic)
DRILL CONTRACTOR:	Blue Max Drilling Inc.	COORDINATE LOCATION:	N 5,365,557 E 165,873
BIT SIZE / TYPE:	HQ (96mm) / Diamond	COORDINATE DATUM:	UTM NAD83, Zone 10
LOGGED/PREPARED BY:	RP	TOTAL DRILLED DEPTH:	18.1 metres
CHECKED BY:	IM	GROUNDWATER LEVEL:	8.56 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
0											SILT, trace to some clay, trace sand, trace gravel, firm, moist, brown			Flush-mounted roadbox Concrete
											[MW17-27A, 0.5 m - 1.0 m]			
	1										No Recovery			
48											SILT, trace to some clay, trace sand, trace gravel, firm, moist, brown			
	2										SILT, trace clay, trace shell fragments throughout the core (marined sediment - dredgeate), occasional rounded gravel, soft, moist, dark brown			
											[MW17-27B/C, 2.1 m - 2.6 m]			
	3										No recovery from 2.8 m to 3.0 m			
											SILT and GRAVEL, trace sand, soft-loose, olive green-light brown, moist			
46											SILT, occasional gravel, occasional shell fragments (marine sediment), trace sand, trace clay, [MW17-27D, 3.4 m - 3.8 m]			
	4										[MW17-27E, 4.1 m - 4.6 m]			
											Boulder (limestone)			
	5										No recover from 4.9 m to 5.5 m			

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ: 6/5/2017



Elevation, metres	ROCK CORE									Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
5														
44											SILT, some gravel, occasional shell fragments (marine sediment), trace sand, trace clay,			
											SILT and GRAVEL, soft-loose, light brown, moist			
6											BEDROCK (weathered limestone)			
7											No recovery from 7.0 m to 7.5 m			
		1	A7	0		0								
42														
											LIMESTONE 1. J / 25° / Ti / Sm-Mr / Light Fe/Ca 2. J / 170° / Ti / Sm-Mr / Light Fe/Ca 3. J / 110° / Op/Rubble / Sm-Mr / Lights Fe			
				>10					2					
				>10					1					
				>10					1					
		2	A7	80	2	50			3					
				>10					1					
				>10					3					
				>10					NR					
9											LIMESTONE R. Rubble 1. J / 170° / Ti / Sm-Mr / Moderate Fe/Ca			
				>10					1					
				>10					1					
		3	A7	100	3	70			1					
				>10					1					
				>10					1					
				>10					R					
				0					1					
				0					2		LIMESTONE 1. J / 70° / Po-Op / Sm-Ro / Light Fe 2. J / 20° / Ti-Po / Sm / Light Ca			
				0					1					
				0					2					
11														
				2										

Bentonite seal





Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number					
38		4	A7	100	1	100								
	12				4						LIMESTONE 1. J / 70° / Po / Sm-Mr / Light Fe 2. J / 150° / Ti / Mr-Ro / Light Fe/Ca-Silty 3. J / 20° / Ti / Mr-Ro / Light Fe			
13		5	A8	100	0	90			1					
36					1				2					
	14				>10				2		LIMESTONE 1. J / 160° / Vt / Healed / - 2. J / 15° / Ti / Sm / Light Fe 3. J / 15° / Ti / Sm / Light Fe / symp. of #2 (offset by 90° along VCA)			
15		6	A8	100	1	62			3					
	16				2				4					
34					0				2		LIMESTONE 1. J / 50° / Po / Mr / Light Fe 2. J / 130° / Ti / Sm / Light Fe 2. J / 10° / Ti-Po / Sm-Mr / Moderate Fe			
16		7	A8	100	1	83			1					
	17				0				2		LIMESTONE 1. J / 160° / Ti / Mr / Light Fe/Ca 2. J / 10° / Ti / Sm / Light Fe-Moderate Ca			
					5				3					Silica sand
					0				1					

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Core Log MW17-27

Sheet 4 of 4

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	Depth, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes	
		Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number						
32		8	A9	100	2	95									
	18				2					2					
					>10										
30															
	19														
	20														
	21														
28															
	22														
	23														
26															

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

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Core Log MW17-28

Sheet 1 of 2

Supplemental Site Investigation and Remedial Action Plan CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

DATE(S) DRILLED: 3/18/2017 through 3/18/2017	AZIMUTH: 0
DRILL METHOD: Triple Tube	HOLE INCLINATION: -90 degrees from horizontal
DRILL EQUIPMENT: Mobile B47 (MST 1100 Mount)	ELEVATION: 40.38 metres (Geodetic)
DRILL CONTRACTOR: Blue Max Drilling Inc.	COORDINATE LOCATION: N 5,365,579 E 465,900
BIT SIZE / TYPE: HQ (96mm) / Diamond	COORDINATE DATUM: UTM NAD83, Zone 10
LOGGED/PREPARED BY: RP	TOTAL DRILLED DEPTH: 9.1 metres
CHECKED BY: IM	GROUNDWATER LEVEL: 3.47 metres below grade (3/24/2017)

Elevation, metres	Depth, metres	ROCK CORE								ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
		Run No.	Box No.	Recovery,%	Fracture Frequency	R Q D, %	Weathering	Rock Grade	Frac. Dwg. Number				
0										SILT, trace to some clay, trace sand, trace gravel, firm, moist, brown			Stick Up Monument Concrete
40													
38													
36													
5													

ROCK CORE: File: COLFOD (HQ3)_20170524.GPJ; 6/5/2017

THIS LOG IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. GEOLOGIC, STRATIGRAPHIC CONTACTS ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Core Log MW17-28

Sheet 2 of 2

Supplemental Site Investigation and Remedial Action Plan
CFB Esquimalt, Colwood, BC



Project No. 205.03850.00000

Elevation, metres	ROCK CORE								Lithology	ROCK MASS & DISCONTINUITY DESCRIPTIONS	Packer Test Interval	Well Completion	Field Notes
	Depth, metres	Run No.	Box No.	Recovery, %	Fracture Frequency	R Q D, %	Weathering	Rock Grade					
5	4	A12	100	>10	0			R		4. J / 90° / Ti-Po / Mr / Heavy Fe / symp. of #1 (offset by 90° along VCA) 5. J / 150° / Ti / Mr-Ro / Heavy Fe			
6				>10				R					
34	5	A12	100	>10	7			R	1 1 1 2 1 1 3	AMPHIBOLITE 1. J / 130° / Ti-Po / Sm / Heavy Fe 2. J / 50° / Po-Op / Sm / Heavy Fe 3. J / 85° / Po-Op / Sm-Mr / Heavy Fe 4. J / 180°-160° / Op / Sm / Heavy Fe			
7				>10				R	1 1 1 4 1 1				Silica sand
8				>10				R	1 1	AMPHIBOLITE 1. J / 30° / Ti-Po / Sm-Mr / Heavy Fe			
32	6	A12	100	3	78			R	1	LIMESTONE			51 mm O20 slot sched 40 PVC pipe
9				>5				R	1				End cap Silica sand
11				1				R	1				Bentonite seal
10				1				R					
30													